



# Assam down town University

## Curriculum and Syllabus

### Master of Science in Zoology



OUTCOME BASED EDUCATION FRAMEWORK  
CHOICE BASED CREDIT SYSTEM

Version: 2.0

**FACULTY OF SCIENCE**

July, 2022

# Preamble

Assam down town University is a premier higher educational institution which offers Bachelor, Master, and Ph.D. degree programmes across various faculties. These programmes, collectively embodies the vision and mission of the university. In keeping with the vision of evolutionary changes taking place in the educational landscape of the country, the university has restructured the course curriculum as per the guidelines of National Education Policy 2020. This document contains outline of teaching and learning framework and complete detailing of the courses. This document is a guidebook for the students to choose desired courses for completing the programme and to be eligible for the degree. This volume also includes the prescribed literature, study materials, texts, and reference books under different courses as guidance for the students to follow.

Recommended by the 22<sup>nd</sup> Board of Studies (BoS) meeting of the Faculty of Science held on dated 22/06/2022 and approved by the Emergent Academic Council (AC) meeting held on dated 30/07/2022



*Chairperson  
Board of Studies*



*Member Secretary  
Academic Council*



## ***Vision***

To become a Globally Recognized University from North Eastern Region of India, Dedicated to the Holistic Development of Students and Making Society Better

## ***Missions***

1. Creation of curricula that address the local, regional, national, and international needs of graduates, providing them with diverse and well-rounded education.
2. Build a diverse student body from various socio-economic backgrounds, provide exceptional value-based education, and foster holistic personal development, strong academic careers, and confidence.
3. Achieve high placement success by offering students skill-based, innovative education and strong industry connections.
4. Become the premier destination of young people, desirous of becoming future professional leaders through multidisciplinary learning and serving society better.
5. Create a highly inspiring intellectual environment for exceptional learners, empowering them to aspire to join internationally acclaimed institutions and contribute to global efforts in addressing critical issues, such as sustainable development, Climate mitigation and fostering a conflict-free global society.
6. To be renowned for creating new knowledge through high quality interdisciplinary research for betterment of society.
7. Become a key hub for the growth and excellence of AdtU's stakeholders including educators, researchers and innovators
8. Adapt to the evolving needs and changing realities of our students and community by incorporating national and global perspectives, while ensuring our actions are in harmony with our foundational values and objectives of serving the community.

# Programme Details

## Programme Overview

The Zoology program equips graduates for careers in industry, agriculture, and research. They develop professional, communication, and ethical skills, blending innovation and entrepreneurship for personal and national growth, while remaining responsive to societal needs and committed to lifelong learning. Graduates will identify and analyze biotechnological problems, apply multidisciplinary concepts, and achieve global competency. They gain scientific knowledge, laboratory and analytical skills, and problem-solving abilities in various fields. Proficiency in scientific tools, enhanced communication skills, adherence to professional ethics, and a research-oriented mindset are emphasized. Social and environmental responsibility, promoting sustainability, and contributing to societal development are key outcomes.

The course duration is for a period of 2 years.

### I. Specific Features of the Curriculum

- Experiential learning
- Constructivist approach to learn
- Practical and project-based learning

### II. Eligibility Criteria:

BSc in any area of life sciences with minimum of 45% marks or equivalent CGPA.

### III. Program Educational Objectives (PEOs):

**PEO1:** AdtU zoology postgraduates will be well prepared for successful careers in both government & private sectors in one or more of the following areas: ecological, conservation biology, pest, habitat, vector borne disease management and health sciences.

**PEO2:** The postgraduates will be academically prepared to become zoologists in due course and will contribute effectively to the growth and development of in broad field of ecology & life sciences.

**PEO3:** The postgraduates will engage in professional activities to enhance their stature and simultaneously contribute to the profession and society at large and be successful in higher education in zoology in apiculture, ornamental fish farming and health sciences, if pursued.

### IV. Program Specific Outcomes (PSOs):

**PSO1: Proficiency in Scientific Knowledge:** Apply the skills necessary to address challenges within the domains of zoology and open a multitude of employment opportunities in the relevant field.

**PSO2: Critical Thinking:** Able to promote a multidisciplinary approach for research exploration and collaboration with professionals across diverse disciplines.

**PSO3: Techno-Professional Competency:** Develop capability to cultivate ethical values in professionalism, emphasising integrity, responsibility, continuous learning, and skill

refinement in alignment with the latest advancements in zoological science.

#### **V. Program Outcome:**

**PO1: Disciplinary Knowledge:** Apply comprehensive knowledge of basic sciences, biostatistics, life sciences and specialization in zoological sciences for solving complex health, agricultural, taxonomical and ecological issues.

**PO2: Problem Solving:** Identify, review literature, formulate, analyse and evaluate complex zoological problems using critical thinking.

**PO3: Reasoning and Research:** Recognise the cause and effect, design hypotheses and experiments using modern tools and techniques, analyse and interpret the data to draw reasonable conclusions.

**PO4: Communication:** Communicate efficiently among stakeholders and society at large, and be able to write documents/scientific reports and deliver effective presentations.

**PO5: Values and Ethics:** Comply with human values and ethics and its strict application in the profession.

**PO6: Environmental Sustainability:** Understand the impact of the formulated solutions in socio-environmental context and redesign considering sustainable global development.

**PO7: Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO8: Lifelong Learning:** Ability to engage in independent lifelong learning in the broadest context of scientific advancement.

#### **VI. Total Credits to be Earned: 101**

#### **VII. Career Prospects:**

A post Graduate in Zoology can make one attractive to a wide variety of organisations including charities, government agencies, universities, and research centres. They can join pharmaceutical companies, fisheries and sericulture Departments, Zoological Survey of India, Entomologist, Forest Department, Wildlife Institutes and NGO's, Wildlife related Broadcasting Channels, Health Department.

# EVALUATION METHODS

The student performance shall be evaluated through In-semester (Sessional) and semester-end examinations. A weightage of 40% or as prescribed by the programme shall be added to the score of the end-semester examination.

## A. INTERNAL ASSESSMENT:

The teacher who offers the course shall be responsible for internal assessment by conducting in-semester (sessional) examination and evaluating the performance of the students pursuing that course. The components for internal assessment are illustrated in the table given below.

SN	Components/ Examinations	Marks Allotted
1.	In-Sem Exam – I (ISE-I) (Written Examination)*	30
2.	In-Sem Exam – II (ISE-II) (Written Examination)*	30
3.	Assignment	10
4.	Presentation (SP)	10
5.	Quiz	5
6.	Class Performance based score*	5

*\*are compulsory*

**Note:** Total Internal assessment should be out of 40

## INSTRUCTION

1. If a student fails to appear in the any of the component without any valid reason he/she shall be marked zero in that component. However, the course teacher at his discretion may arrange for the missed test on an alternate date for the absentee students after determining ground with genuine/valid reasons for the absent.
2. The report of evaluation of an activity towards the in-semester (sessional) component of a course shall be duly notified by the concerned course teacher within a week of completion.
3. The program coordinators should upload the in-semester marks to the ERP and forward acknowledgement of all the courses of the program to the Controller of Examinations before the start of the End-semester examination.

## B. SEMESTER END EXAMINATION:

Time table for end semester examination is published at least 25 days prior to the start of Examination.

### I. Pre-Examination:

**Eligibility Criteria for a student to appear in University Examinations:**

The student shall only be allowed to appear in a University Examination, if:

- i) He/ She is a registered student of the University;
- ii) He/ She is of good conduct and character;
- iii) He/ She has completed the prescribed Programme of study with minimum percentage of attendance as laid down in the Regulations of the Programme concerned.

Under special cases, a student may be allowed to appear for an examination without being registered in the University but the result of the said student will be kept on hold till the registration of the concerned student is completed.

## II. Admit Card:

Admit card for the examination may be downloaded through ERP where the system will generate a Unique ID Cards through online.

The University shall have the right to cancel admission for examination of any candidate on valid grounds.

## III. Pattern of Question Papers:

The question paper shall follow the principles of Bloom's Taxonomy.

Table

S.N.	Level	Questions /verbs for test
1	Remember	List, Define, tell, describe, recite, recall, identify, show who, when, where, etc.
2	Understand	Describe, explain, contrast, summarize, differentiate, discuss, etc.
3	Apply	Predict, apply, solve, illustrate, determine, examine, modify
4	Analyze	Classify, outline, categorize, analyze, diagrams, illustrate, infer, etc.
5	Evaluate	Assess, summarize, choose, evaluate, recommend, justify, compare etc.
6	Create	Design, Formulate, Modify, Develop, integrate, etc.

**Note:** No course is to be evaluated on basis of **all 6 knowledge levels**.

The format of the question paper across all the program follows a unique pattern and the total marks is 60

**Table 1: Question paper pattern for End semester examination**

Sl no	Question pattern	Total marks
1	MCQs (10 Questions)	10
2	2 Marks questions (10 Questions)	20
3	4 Marks questions (5 Questions)	20
4	10 Marks questions (1 Question)	10

#### **IV. Examination Duration:**

Each paper of 60 marks shall ordinarily be of two hours duration.

#### **V. Practical Examinations, Viva-Voce etc.:**

- i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.
- ii) Viva-Voce, Oral examinations of the Project report, Dissertation etc. shall be undertaken by a Board of Examiners constituted by the respective Dean of Program with the advice of Supervisor(s).

#### **VI. Procedure of Expulsion:**

If any candidate is found to be using any unfair-means during the examination, the invigilator may cease his/her answer sheet and report it directly to the Officer-in-Charge. The Office-in-Charge of the center may take appropriate decisions as per the rules and procedure of the examination. The Officer-in-Charge may allow the students to write the exam with new answer sheet or may expel the student from appearing the paper depending on the nature of unfair-means. In case of Computer based test, the students may be directed to write an apology letter and sign in the prescribe expulsion form. The student may not be allowed to write that examination.

#### **VII. Instruction to the Students:**

- (i) The students shall not bring to the Examination Hall, any electronic gadget used as a means of communication or record except electronic calculator, if required.
- (ii) The students shall not receive any book or printed or hand written or photo copy (Xerox) or blank-paper from any other person while he/she is in the examination-room or in laboratory or in any other place to which he/she is allowed to have access during course of examination.
- (iii) The students shall not communicate with any other candidate in the examination room or with any other person in and outside the examination-room.
- (iv) The students shall not see, read or copy anything written by any other candidate, nor shall he/she knowingly or negligently permit any other candidate to see, read or copy anything written by him/her or conveyed by him/her.



(v) The students shall not write anything on the Question Paper or in other paper or materials during the examination, or pass any kind of paper to any other candidate in the examination-room, or to any person outside the room.

(vi) The students shall not disclose his/her identity to the examiner by writing his/her name or putting any sign / symbol in any part of his answer-script.

(vii) The students shall not use any abusive language or write any objectionable remark or make any appeal to examiner by writing in any part of his answer-script.

(viii) The students shall not detach any page from the answer-script or insert any authorized or unauthorized loose sheet into it. He /she shall also not insert any other answer-script / loose sheet by removing the pins of the origin answer-scripts and re-fixing it.

(ix) The students shall not resort to any disorderly conduct inside the examination-room or misbehave with the invigilator or any other examination official.

### **VIII. Provision for an Amanuensis (writer):**

(i) A candidate may be provided with an Amanuensis (writer) to write down on dictation on his / her behalf on ground of his / her physical disability to write down by himself / herself due to accident or any other reason. The amanuensis may be provided till he / she recovers from the physical disability. The physical disability to write down by himself / herself must be supported by Medical Certificate from a competent Medical Officer.

(ii) The qualifications of the amanuensis so provided must not be equal or higher than that of the candidate. This is also to be supported by Certificate from the Faculty of Study where the Amanuensis is provided.

(iii) Such candidates are to be accommodated in a separate room under the supervision of an invigilator so that the fellow candidates are not disturbed in the process.

### **C. Credit Point:**

It is the product of grade point and number of credits for a course, thus,  $CP = GP \times CR$

#### **i. Credit:**

A unit by which the course work is measured. It determines the number of hours of instructions required per week. 'Credit' refers to the weightage given to a course, usually in terms of the number of instructional hours per week assigned to it. Credits assigned for a single course always pay attention to how many hours it would take for an average learner to complete a single course successfully.

#### **ii. Grade Point:**

Grade Point is a numerical weight allotted to each Grade Letter on a 10-point scale.

### iii. Letter Grade:

Letter Grade is an index of the performance of students in a said paper of a particular course. Grades are denoted by letters O, A+, A, B+, B, C, P, F and Abs. Student obtaining Grade F / Grade Abs shall be considered failed/ absent and, will be required to appear in the subsequent ESE. The UGC recommends a 10-point grading system with the following (Table: 1) Letter Grades:

- (i) A Letter Grade shall signify the level of qualitative/quantitative academic achievement of a student in a Course, while the Grade Point shall indicate the numerical weight of the Letter Grade on a 10-point scale.
- (ii) There shall be 08 (eight) Letter Grades bearing specific Grade Points as listed in Table 1, where the Letter Grades 'O' to 'P' shall indicate successful completion of a course.
- (iii) Apart from the 08 (eight) regular Letter Grades listed in Table 1, there shall be 03 (three) additional Letter Grades, which shall be awarded if a Course is withdrawn or spanned over the next Semester or remains incomplete as stated in Table 2.

**Table 2: Letter Grades and Grade Points**

<b>Letter Grade</b>	<b>Grade Points</b>	<b>Description</b>
O	10	Outstanding
A+	9	Excellent
A	8	Very Good
B+	7	Good
B	6	Above Average
C	5	Average
P	4	Pass
F	0	Fail
Abs	0	Absent
UFM	0	Unfair Means

### iv. Grade Point Average:

#### a. SGPA (Semester Grade Point Average)

The SGPA of a student in a Semester shall be the weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered in that

Semester, irrespective of whether he/she could or could not complete the Courses. More specifically, the calculation of SGPA shall take into account the Courses graded with Letter Grades ‘O’ to ‘F’ as given in Table 1.

$$SGPA = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i} \quad (1.1)$$

The SGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.1) up to two decimal places, where n is the total number of Credit Courses registered by the student in that Semester,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  registered Course and  $C_i$  is the Credit (weight) of that Course.

**b. CGPA (Cumulative Grade Point Average)**

(i) The CGPA of a student in a Semester of a Programme shall be the accumulated weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered and successfully completed so far starting from the enrollment in the Programme. In other words, taking into account all the Courses graded with ‘O’ to ‘P’ as given in Table 1.1, generally the CGPA of a student shall be calculated starting from the first Semester of his/her enrolled Programme, while the CGPA of a lateral-entry student shall be calculated starting from the Semester of his/her enrollment.

(ii) The CGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.2) up to two decimal places, where N is the total number of Credit Courses registered and successfully completed so far by the student,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  completed Course and  $C_i$  is the Credit (weight) of that Course.

$$CGPA = \frac{\sum_{i=1}^N C_i G_i}{\sum_{i=1}^N C_i} \quad (1.2)$$

(iii) The CGPA shall be convertible into equivalent percentage of marks using Equation Conversion of CGPA to percentage marks: = CGPA\*10

**D. Post-Examination**

**i. Transcript or Grade Card or Certificate:**

A marking certificate shall be issued to all the registered students after every Semester. The Semester mark sheet will display the course details (code, title, number of credits, grade secured) along with total credit earned in that Semester.

## **ii. Grievance Readdress Mechanism:**

Students with any dissatisfaction or grievance regarding the marks awarded in any of the Papers / Courses may appeal to the Controller of Examinations for remedial action such as Re-evaluation within 10 days of the declaration of result.

- (i) A student has options to appeal for re-evaluation of his /her answer script to the Controller of Examination.
- (ii) Application for re-evaluation / re-scrutiny of answer scripts shall be made in the definite proforma available with the Examination Office through the head of the respective departments within 10 days of declaration of the results of the respective examinations.
- (iii) The Controller of Examination may appoint an examiner for re-evaluation and will consider and recognize the evaluation done by a University appointed examiner.
- (iv) There shall be no provision for re-evaluation of the Practical Papers, Project Work, and Dissertation etc. However, the students fail in practical examination or viva voce and wish to appear again may apply to be evaluated can do so with the next schedule.
- (v) After screening the application for re-evaluation, the CoE may send the answer scripts of the student to the examiners appointed by the CoE with the approval of Vice Chancellor.
- (vi) The marks/grades achieved by the students after the re-evaluation shall be final and binding.
- (vii) Fresh Marks – sheets / Grade Card shall be issued only if the candidate secures pass marks / passing grade in the re-evaluated paper.
- (viii) Revaluation of answer scripts shall be deemed to be an additional facility provided to the students with a view to improving upon their results at the preceding examination result for any reason whatsoever shall not confer any right upon them for admission to next higher class which matters always be regulated in accordance with the relevant rules or regulations framed by the University.
- (ix) If as a result of revaluation of the candidate attracts the provision of condonation of deficiency, the same may be applied to his/her only for fresh attempt.

# INSTRUCTION TO TEACHERS AND STUDENTS

## (Teaching and Learning Methods)

In all the courses the teacher has to select topics for teacher-method which should not be less than 20 percent. The approach will be direct classroom teaching through a series of lectures delivering concepts using ITC facilities, white or blackboard. Notes may also be circulated to the students; however, the students are to be involved in the preparation of the notes. The teacher will be responsible for selecting the best note for circulation. The teacher-centric methodology has recently fallen out of favour because this strategy for teaching is seen to favour passive students.

### **1. Student- centric / Constructivist Approach:**

The topics of the courses may be selected at the start of the class and assigned one topic to each of the students for studying by themselves, prepare presentations, notes, etc., and present at respective class time after consultation and discussion with the course teachers. The teacher facilitates the learning of the students by guiding and providing input and explaining concepts. 60 percent of the course contents may be selected for this purpose. To avoid behaviour problems, teachers must lay a lot of groundwork in student-centric classrooms. Typically, it involves instilling a sense of responsibility in students. In addition, students must learn internal motivation.

**a. Project-Based Learning:** The teacher may select 5 percent of topics for the purpose and may conduct visits to the laboratory for experiments or field surveys. The selection of the topic may be done considering the available facility for the purpose. However, in the final semester of each of the programme the student has to undergo project-based learning at least 4 months duration. This approach will help the student to think critically, evaluate, analyze, make decisions, collaborate, and more.

**b. Inquiry-Based Learning:** The teacher/ students are supposed to list at least five questions in each contact hour and student solve these question or search for answer which becomes the home work for the students “question-driven” learning approach. The teacher may look for the correctness of the solution or the best possible answer and discuss in the successive class. This will help in the preparation for various competitive examination and develop a habit for search for solutions.

**c. Flipped Classroom:** About 10 percent of the course content has to be completed by this method. In this approach the students are asked to watch video or lecture prepared by the teacher or any video available (relevant to the course). A set of questions may be given to the students for searching answers by the students. The idea is that students should have more time in-classroom focusing on achieving these higher levels of thinking and learning. The Flipped classroom is also an acronym. The letters FLIP represent the four pillars included in this type of learning: Flexible environment, Learning culture shift, Intentional content, and Professional educator. As you can see, the second pillar refers to a culture shift from the traditional approach where students are more passive to an approach where students are active participants. As a result, this approach is also a student- centric teaching method.

**d. Cooperative Learning:** The remaining five percent has to be completed by cooperative learning approach. In this approach, the students are allotted problems. During library hours the students along with the teacher visit the library and search for probable solutions for the assigned problem. The same has to be done in groups so that the students discuss among themselves for the appropriate answers. Essentially, cooperative learning believes that social interactions can improve learning. In addition, the approach recreates real-world work situations in which collaboration and cooperation are required.

**The percentage categorization for the completion of a theory course**

Teacher-centric or Direct Classroom Teaching: Delivery by series of lectures	20%
Student-centric Approach, Students present and deliver lectures in the presence of teacher and supervised by teacher	60%
Students visit fields or perform experiments or teachers perform demonstration	05%
Flipped Classroom approach	10%
Cooperative learning approach	05%

**Inquiry-based approach has to be followed in all of the classes**

The teacher has to distribute the topics to be considered for teaching by the above-mentioned approaches and prepare a lesson plan for execution and maintain a file.

## Curriculum Framework

### Breakdown of Credits

Sl. No	Category	Total number of Credits
1	University Core (UC)	13
2	University Elective (UE)	12
3	Program Core (PC)	72
4	Program Elective (PE)	0
5	Faculty Elective (FE)	4
<b>Total number of credit</b>		<b>101</b>

### Breakdown by categories of courses

Sl no	Category	Credits	%
1	Science	92	91.08%
2	Engineering	1	1%
3	Humanities and Management	8	7.92%
<b>Total</b>		<b>101</b>	<b>100%</b>

### SEMESTER WISE COURSE DISTRIBUTION

Semester I	S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
					L	T	P	S	R	O		IA*	SEE*	PE*	
1.	22MSZO111R	Taxonomy and Basic Entomology	PC	3	0	2	0	0	0	4	40	60	100	200	
2	22MSZO112R	Biochemistry and Bioinstrumentation	PC	3	0	2	0	0	0	4	40	60	100	200	
3	22MSZO113R	Genetics	PC	3	0	2	0	0	0	4	40	60	100	200	
4	22MSZO114R	Cell Biology	PC	3	0	2	0	0	0	4	40	60	100	200	

	5	22MSZO115R	Mini Research (Review of literature-R1)	UC	0	0	0	4	8	0	2	-	-	100	100
	6	22MSCE111R	MOOCS-I	FE	0	0	0	0	0	0	2	0	100	-	100
	7	22UMFS111R	Fundamental of Statistics	UC	2	0	2	0	0	0	3	40	60	100	200
	8	22UMPD111R	Effective English	UE	0	0	4	0	0	0	2	-	-	100	100
	<b>Total</b>				<b>14</b>	<b>0</b>	<b>14</b>	<b>4</b>	<b>8</b>	<b>0</b>	<b>25</b>	<b>200</b>	<b>400</b>	<b>700</b>	<b>1400</b>
<b>Semester II</b>	<b>S. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Course Category</b>	<b>Engagement</b>							<b>Maximum Marks for</b>			
					<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O</b>	<b>C</b>	<b>IA*</b>	<b>SEE*</b>	<b>PE*</b>	<b>Total</b>
	1.	22MSZO121R	Endocrinology and Immunology	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22MSZO122R	Molecular Biology, Genomics and Genetic Engineering	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22MSZO123R	Evolution and Ecology	PC	3	0	2	0	0	0	4	40	60	100	200
	4	22MSZO124R	Apiculture (Techno Professional Skill-I)	PC	0	0	4	0	0	0	2	0	0	100	100
	5	22MSZO125R	Mini Research (Research gap analysis-R2)	UC	0	0	0	4	16	0	3	-	-	100	100
	6	22MSCE121R	MOOCS-CE II	FE	0	0	0	0	0	0	2	0	100	-	100
	7	-	Generic Elective	UE	2	0	0	0	0	0	2	40	60	-	100
	8	22UMRM121R	Research methodology and Statistical Analysis	UC	1	0	0	4	0	0	2	40	60	100	200
	9	22UUHV101R	Universal Human Values (UHV) + Professional Ethics	UC	1	0	2	4	0	0	2	40	60	100	200
	10	22UMPD121R	Communication Mastery	UE	0	0	4	0	0	0	2	0	0	100	100
11	22UCDL103R	Computational Systems and Digital World	UE	0	0	2	0	0	0	1	0	0	100	100	
	<b>Total</b>				<b>13</b>	<b>0</b>	<b>18</b>	<b>12</b>	<b>16</b>	<b>0</b>	<b>28</b>	<b>240</b>	<b>460</b>	<b>900</b>	<b>1600</b>
<b>Semester III</b>	<b>S. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Course Category</b>	<b>Engagement</b>							<b>Maximum Marks for</b>			
					<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O</b>	<b>C</b>	<b>IA*</b>	<b>SEE*</b>	<b>PE*</b>	<b>Total</b>
	1.	22MSCE211R	MOOCS-CE III	FE	0	0	0	0	0	0	2	0	100	-	100
2	22MSCE212R	MOOCS-CE IV	FE	0	0	0	0	0	0	2	0	100	-	100	
3	22MSZO211R	Ornamental Fish Farming (Techno Professional Skill-	PC	0	0	4	0	0	0	2	0	0	100	100	



		II)													
4	-	Generic Elective	<b>UE</b>	0	0	0	0	0	0	2	40	60	-	100	
5	22MSZO215R	Mini Research (Survey/experiments)-R3	<b>UC</b>	0	0	6	4	0	0	4	-	-	-	100	
6	22UMRE211R	Research Ethics	<b>UC</b>	1	0	0	0	0	0	1	-	-	100	100	
7	22UMPD211R	Corporate Proficiency	<b>UE</b>	0	0	4	0	0	0	2	-	-	100	100	
8	22MSZO216R	Animal Physiology	<b>DSE</b>	3	0	2	0	0	0	4	40	60	100	200	
9	22MSZO217R	Developmental Biology	<b>DSE</b>	3	0	2	0	0	0	4	40	60	100	200	
10	22MSZO218R	Aquaculture	<b>DSE</b>	3	0	2	0	0	0	4	40	60	100	200	
11	22MSZO219R	Animal Diversity	<b>DSE</b>	3	0	2	0	0	0	4	40	60	100	200	
<b>Total</b>				<b>13</b>	<b>0</b>	<b>22</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>31</b>	<b>200</b>	<b>500</b>	<b>700</b>	<b>1500</b>	

S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1	22MSZO221R	Research/data analysis/documentation- R4	<b>PE</b>	0	0	20	8	4	0	12	0	0	100	100
2	22MSZO222R	Entomology I (Insect biology, Ecology and Pest management)	<b>PE</b>	2	0	0	0	0	0	2	40	60	0	100
3	22MSZO223R	Entomology II (Insect Physiology and Toxicology)	<b>PE</b>	3	0	2	0	0	0	4	40	60	100	200
4	22MSZO222R	Fish Biology and Fisheries I (Fish physiology and Fish culture)	<b>PE</b>	2	0	0	0	0	0	2	40	60	0	100
5	22MSZO223R	Fish Biology and Fisheries II (Fish reproductive biology, endocrinology and fish genetics)	<b>PE</b>	3	0	2	0	0	0	4	40	60	100	200
6	22MSZO222R	Molecular Cell Biology I	<b>PE</b>	2	0	0	0	0	0	2	40	60	0	100
7	22MSZO223R	Molecular Cell Biology II	<b>PE</b>	3	0	2	0	0	0	4	40	60	100	200
<b>Total</b>				<b>5</b>	<b>0</b>	<b>22</b>	<b>8</b>	<b>4</b>	<b>0</b>	<b>18</b>	<b>80</b>	<b>120</b>	<b>200</b>	<b>400</b>

**\*IA: Internal Assessment, SEE: Semester End Examination, PE: Practical Examination**

SEMESTER – I									
Course Title	TAXONOMY AND BASIC ENTOMOLOGY								
Course code	22MSZO111R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To impart the knowledge of taxonomy and schools of biological classification. 2. To provide the knowledge of application of zoology in insect pest management. 3. To provide skill on insect-based industries for the benefit of mankind.								
CO1	Discuss the history and concept of taxonomy and its classification.								
CO2	Identify various approaches of taxonomy and its importance								
CO3	Describe the collection, identification and preservation process of animal								
CO4	Identify insect pests and vectors responsible for diseases.								
CO5	Determine the commercial value of insects and plan for rearing insects.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Definition and basic Concepts of taxonomy: History of classification and its importance Aims and objective of taxonomy Scope of taxonomy	7	Students will acquire knowledge regarding the history and concept of taxonomy					1,2	
II	Different approaches in Taxonomy and its importance:  Morphological, Embryological, Molecular, Ecological and Behavioural approach	10	Students will be able to apply knowledge on application of different approaches to be adopted in taxonomy for different group of organisms					1,2	
III	Nature and Characteristics of Taxonomic procedures:  Taxonomic procedures: collection, preservation and process of identification of biological species  Taxonomic keys: Different kinds of taxonomic keys, their merits and demerits  International Code of Zoological Nomenclature (ICZN), its operative principles; History of rules of Zoological nomenclature  Interpretation and application of important rules  Formation of scientific names of different taxa. Regulations governing this code and	10	Students will gain knowledge on Different collection and preservation procedures and use of keys for species identification. Students will acquire knowledge on Principles and rules of nomenclature commission.					1,2	

	code of ethics			
<b>IV</b>	Introduction to Applied Entomology: Economic importance of insects (honey bee, silkworm, lac insect). Insect pests, vectors of diseases: Mosquito, fly The role of insects in ecosystem as environmental indicator.	<b>8</b>	The course aims to provide students with an introduction of the application and economic importance of entomology	1,2
<b>V</b>	Commercial importance of insects and their culture: Honey bee and silk worm (life cycle, by product and commercial method of farming)  Role of insects in pest management - Brief about chemical and biological control of insect pest  Insects in the service of forensic science (role of insect in solving crime)	<b>10</b>	Students will know about the economic value of insect rearing and different methods of rearing the insects and also regarding different methods of controlling insect pests	1,2
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Identification and classification of important organisms from different phylum of animal kingdom.</li> <li>• Collection, identification and preservation of insects.</li> <li>• Permanent slide preparation of mouthparts of mosquito, cockroach, butterfly and honeybee.</li> <li>• Study of various types of social insects (honeybee/ants) and their nests.</li> <li>• Mounting of legs, antennae and wings (at least of two types).</li> <li>• Dissection of sting apparatus in honey bee.</li> </ul>	<b>30</b>	Students will be able to identify, classify, and preserve key animals, prepare insect mouthpart slides, study social insects and their nests, mount insect parts, and dissect a honeybee's sting apparatus.	1,2,3,4

### TEXT BOOKS:

- T1. Insect pest management by Dent D R, (latest edition). Westville Publishing House: Delhi  
T2. An ecological and social approach to biological control, Eilenberg J, (latest edition). Springer.  
T3. Theory and Practice of Animal Taxonomy and Biodiversity by Kapoor V C 8Ed. Oxford and IBH publishing.  
T4. The insects: structure and functions by R. F. Chapman (5<sup>th</sup> Edition). Cambridge University Press.  
T5. Handbook of entomology by T. V Prasad, (4th Edition). New Vishal Publications.

### REFERENCE BOOKS:

- R1. Principles of Animal Taxonomy by G. G. Simpson, (latest edition). Scientific publisher Animal Taxonomy by H. E. Goto (latest Edition). Arnold

R2. International Code of Zoological Nomenclature official publication

R4. A Text Book of Fundamental and Applied Entomology by M.S. Ali, S.V.S. Raju and M. Raghuraman Tanweer Alam, (latest edition). Kalyani publisher

R5. Introduction to general and applied entomology (Scientific Pub.: India) by Awasthi V B (latest Edition). Scientific publishers journal Dept.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Discuss the history and concept of taxonomy and its classification.	<b>1, 5, 6</b>
<b>2</b>	Identify various approaches of taxonomy and its importance	<b>1, 3</b>
<b>3</b>	Describe the collection, identification and preservation process of animal	<b>1, 6, 8</b>
<b>4</b>	Identify insect pests and vectors responsible for diseases.	<b>1, 6, 8</b>
<b>5</b>	Determine the commercial value of insects and plan for rearing insects.	<b>1, 8</b>

SEMESTER – I									
Course Title	BIOCHEMISTRY AND BIOINSTRUMENTATION								
Course code	22MSZO112R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	<ul style="list-style-type: none"> <li>• To understand the fundamentals of structure, composition and function of biomolecules. To develop knowledge and identify the chemical logic of bioenergetics and metabolic pathways.</li> <li>• To impart knowledge of principles and applications of analytical instruments in life sciences.</li> <li>• To analyse biological samples for purification and characterisation of Proteins and Nucleic Acids</li> </ul>								
CO1	Describe the concepts of carbohydrates, lipids, nucleic acids, vitamins and minerals.								
CO2	Explain concept of Bioenergetics including thermodynamics and enzymology.								
CO3	Discuss the principles and operation of instruments for detecting biomolecules.								
CO4	Explain the principles and application of separation and characterisation of biomolecules from biological samples.								
CO5	Identify chromatography techniques to separate molecules.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Concept of biomolecules (composition, structure and functions): <ul style="list-style-type: none"> <li>• Carbohydrates</li> <li>• Lipids</li> <li>• Nucleic acids</li> <li>• vitamins and minerals.</li> <li>• Special focus on conformation of proteins (level of protein organization and Ramachandran plot), domains, motif and folds.</li> </ul>	7	Students will learn about biomolecules, their unique structural characteristics and functions.					1,2	
II	<b>Bioenergetics:</b> <ul style="list-style-type: none"> <li>• Concept of thermodynamics (entropy, enthalpy and free energy)</li> <li>• Reaction kinetics: Substrate phosphorylation and oxidative phosphorylation, coupled reaction, group transfer and biological energy transducer).</li> </ul> Enzymology/Enzymes: Definition and structural organization of enzyme, classification, mechanism of enzyme action and factors affecting enzyme activity. Salient features of active site.	10	They will gain knowledge in Basics of metabolism (Bioenergetics and thermodynamics) Also, they will get to know about enzymes and their kinetics					1,2	

	<ul style="list-style-type: none"> <li>Enzyme regulation and role of inhibitors.</li> </ul>			
III	<p><b>Metabolism of biomolecules:</b></p> <ul style="list-style-type: none"> <li>Carbohydrate metabolism- Glycolysis and its regulation, Gluconeogenesis, Glycogenolysis TCA cycle, Pentose phosphate pathway</li> <li>Lipid metabolism: oxidation of fatty acid and biosynthesis of fatty synthesis. Heme synthesis and degradation.</li> <li>Amino acid metabolism- Transamination, deamination and urea cycle.</li> <li>Nucleotide metabolism - Biosynthesis of purines and pyrimidines by de novo and salvage pathways, inhibitors of nucleotide synthesis, degradation of purines and pyrimidines.</li> </ul>	10	They will be gaining knowledge about carbohydrate metabolism. Also, they will get to know lipid, protein and nucleic acid metabolism.	1,2
IV	<p><b>Gel Electrophoresis:</b></p> <ul style="list-style-type: none"> <li>Introduction, principle, types, application. PCR: Introduction, types and application.</li> <li>Blotting technique: Southern blot, Western Blot and Northern blot,</li> </ul> <p><b>Microscopy:</b></p> <ul style="list-style-type: none"> <li>Introduction, types (light field microscope, dark field microscope, phase contrast microscope, fluorescence microscope, AFM and Electron microscope), and application.</li> </ul> <p><b>Centrifugation:</b></p> <ul style="list-style-type: none"> <li>Introduction, principle, types of centrifuge and rotors, application of density gradient and analytical centrifugation</li> </ul> <p><b>Radioactive tracer technology:</b> Principle, measurement and applications in biology</p>	8	<p>Students will understand the Techniques to measure, study And observe Biomolecules like Proteins, DNA, RNA etc.</p> <p>Students will learn Microscopic technique applied to understand cellular ultrastructure and function of genes and proteins.</p> <p>Students will apply the knowledge of radioactive tracer molecule to track down biochemical metabolism and gene expression</p>	1,2
V	<p><b>Chromatography:</b></p> <p>Introduction, Principle, Classification, Column Chromatography; Adsorption column chromatography; operational technique, elution procedure, application,</p> <p>Partition chromatography. Thin layer chromatography: Introduction, Principle, technique, application and HPTLC. Rf value. Gas Chromatography</p> <p>Ion exchange chromatography: Ion</p>	10	<p>Students will learn the principle and applications of Chromatography in protein purification, MW determination</p> <p>Students will understand the principle and application of Spectroscopic technique to Gauge conformation and Concentration of biomolecules</p> <p>Students will be able to separate biomolecules from complex mixtures.</p>	1,2

	<p>exchange resins, mechanisms, procedure, applications. High Performance liquid chromatography: Introduction, instrumentation, application, advantages. Gel Chromatography: Introduction, Technique, instrumentation, application</p> <p><b>Spectroscopic techniques:</b> Infra-red Spectrophotometry: Introduction, Instrumentation, application.</p> <p>NMR: Introduction, Principle, Instrumentation, Spin- Spin coupling, application.</p> <p>Mass Spectrometry: Introduction, Principle, Instrumentation, application, UV- Visible spectroscopy, Atomic absorption spectroscopy.</p>			
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Estimation of protein by Lowry's/ Bradford method.</li> <li>• Estimation of Glucose by Anthrone method.</li> <li>• Estimation of RNA/ DNA.</li> <li>• Achromic point of salivary amylase</li> <li>• Qualitative analysis of protein, carbohydrate and amino acid</li> </ul>	<b>30</b>	Students will be able to estimate proteins, glucose, RNA/DNA, and analyze the achromic point of salivary amylase, as well as perform qualitative analysis of proteins, carbohydrates, and amino acids.	1,2,3,4

### TEXT BOOKS:

- T1. "Lehninger Principles of Biochemistry" by David L Nelson and Michael M Cox  
T2. "Biochemistry" by U Satyanaryana and U Chakrapani  
T3. Principles of Biochemical Techniques, 5<sup>th</sup> edition, Wilson and Walker. Cambridge University Press.  
T4. Modern Biochemistry Laboratory Techniques. 3<sup>rd</sup> edition. Rodney Boyer. Tata McGraw Hill.

### REFERENCE BOOKS:

- R1. "Haper's Illustrated Biochemistry" by Robert Murray, Daryl K Granner et al.  
R2. "Biochemistry" by Lubert Stryer, Jeremy M Berg, et al.  
R3. "Biochemistry" by David E Metzler.  
R4. Lehninger's Principles of Biochemistry. 4<sup>th</sup> edition. Nelson and Cox. Prentice Hall.  
R5. Biochemistry, 4<sup>th</sup> edition. Voet and Voet. Tata McGraw Hill.

### OTHER LEARNING RESOURCES:

1. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=MNhNzp1RQIU+6LM40KjY1Q>.
2. Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
3. ERP LMS-PRAN
- 4.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe the concepts of carbohydrates, lipids, nucleic acids, vitamins and minerals.	<b>1</b>
<b>2</b>	Explain concept of Bioenergetics including thermodynamics and enzymology.	<b>1</b>
<b>3</b>	Discuss the principles and operation of instruments for detecting biomolecules.	<b>1, 8</b>
<b>4</b>	Explain the principles and application of separation and characterisation of biomolecules from biological samples.	<b>1, 8</b>
<b>5</b>	Identify chromatography techniques to separate molecules.	<b>1, 8</b>



SEMESTER – I									
Course Title	GENETICS								
Course code	22MSZO113R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	<p>1. To introduce learner to the science of heredity, from its basic principles to the most recent advances in the field.</p> <p>2. To impart knowledge on genetic alterations in human genome, classical and molecular genetics.</p> <p>3. To impart knowledge on classical and molecular genetics.</p>								
CO1	Describe chromatin, chromosomes, heterochromatin and euchromatin.								
CO2	Explain mechanisms of sex determination, dosage compensation in human, <i>Drosophila</i> , and <i>C. Elegans</i> , discuss on structural and numerical aberrations of chromosomes.								
CO3	Apply karyotyping and pedigree method for identification of inheritance patterns in genetic disorders, use logarithm of the odds scores for linkage testing in specific disease contexts.								
CO4	Evaluate polygenic inheritance, heritability through Quantitative Trait Locus mapping, linkage maps, and tetrad analysis, explain Human Genome Project and Mapping.								
CO5	Discuss lac and tryptophan operon concept of gene regulation, in prokaryotes, gene regulation in eukaryotes, explain restrictive enzymes and their role in recombinant DNA techniques.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<p>Chromosome: Eukaryotic structure of chromatin and chromosome, heterochromatin, euchromatin</p> <p>Extension of Mendel's principles: Codominance, incomplete dominance, gene interactions, penetrance and expressivity, epistasis, pleiotropy, genomic imprinting, linkage and crossing over, sex linkage, sex limited and sex influenced characters.</p>	7	Learners would be able to Understand basic concepts of chromatin and gene interaction				1,2		
II	<p>Mechanisms of sex determination and Dosage Compensation: Human, <i>Drosophila</i> and <i>C. elegans</i></p> <p>Structural and numerical aberrations of chromosomes: Deletion, duplication, inversion, translocation and ploidy</p>	10	The learners will become aware of the sex determination in human and <i>Drosophila</i> . It will also be able to distinguish between structural and numerical				1,2		

			aberrations of chromosomes and learn the cause of human syndrome	
<b>III</b>	Human Genetics: Karyotypes, pedigree analysis, LOD score for linkage testing, Chronic myeloid leukemia, Burkett's lymphoma and retinoblastoma.	<b>10</b>	Learners will be able to understand inherited genetics and diseases associated to gene alteration	1,2
<b>IV</b>	Quantitative inheritance: Polygenic inheritance, heritability, QTL mapping.  Gene mapping methods: Linkage maps, tetrad analysis, Basic idea of Human Genome Project and Mapping.	<b>8</b>	Learners would be able to understand basic concepts of quantitative inheritance, methods of gene mapping and information of human genes	1,2
<b>V</b>	Regulation of Gene Expression: Regulation of gene activity in lac and Btrp operons of E. coli.; General introduction to gene regulation in Eukaryotes at transcriptional and posttranscriptional levels  Genetic Engineering: Restrictive enzymes - Recombinant DNA techniques. Applications of Recombinant DNA technology.	<b>10</b>	Students will learn how genes were regulated in prokaryotes and eukaryotes. It will also assist them in understanding genetic engineering and biotechnology	1,2
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Study of divisional stages in Mitosis using onion root tip.</li> <li>• Study of divisional stages in Meiosis using permanent slides of grasshopper's testes.</li> <li>• Preparation and mapping of polyethene chromosomes from salivary gland of Chironomus/Drosophila larvae.</li> <li>• Preparation of human karyotypes: normal male and female: analysis of common human chromosomal aberrations from the pictures provided.</li> <li>• To solve some genetic problems based on pedigree analysis.</li> <li>• To solve some genetic problems based on gene interaction.</li> </ul>	<b>30</b>	Students will be able to study mitosis and meiosis stages, prepare and map polytene chromosomes, create human karyotypes, analyze chromosomal aberrations, and solve genetic problems based on pedigree and gene interaction.	1,2, 3,4

### TEXT BOOKS:

T1. Principles of Genetics by Snustad and Simmons (7<sup>th</sup> Edition) John Wiley and Sons, USA.

T2. Modern Genetic Analysis: Integrating Genes and Genomes by Griffiths, J.F., Gilbert, M., Lewontin, C. and Miller ( 2<sup>nd</sup> Edition) W. H. Freeman and Company, New York, USA.

T3. Genetics by J. Russell (3<sup>rd</sup> Edition) Benjamin-Cummings Publishing Company, San Francisco, California, USA.

T4. Molecular Biology of the Gene by Watson. J.D. Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M.1987. W.A. (4<sup>th</sup> Edition) Benjamin/Cummings Co., New York.

T5. Recombinant DNA: Genes and Genomics – a short course by Watson et al., (3<sup>rd</sup> Edition) W. H. Freeman and Company, New York, USA.

### REFERENCE BOOKS:

R1. Principles of Gene Manipulation and Genomics, Primrose by S. B. and Twyman, R.M., (7<sup>th</sup> Edition), Blackwell Publishing, West Sussex, UK.

R2. Concepts of genetics by William S Klung (Latest Edition), Benjamin-Cummings Publishing Company

R3. Genetics by BD Singh (Latest Edition), Kalyani Publishers

R4. Genetics: Analysis of gene and genetics by Harti and Ruvolu (8<sup>th</sup> Edition), Laxmi Publications.

R5. Principles of genetics by Tamarin (Latest Edition), McGraw Hill Education.

### OTHER LEARNING RESOURCES:

<https://nptel.ac.in/courses/102/104/102104052/>

Human gene: [https://swayam.gov.in/nd2\\_cec20\\_bt17/preview](https://swayam.gov.in/nd2_cec20_bt17/preview)

Tissue engineering: [https://swayam.gov.in/nd1\\_noc19\\_bt33/preview](https://swayam.gov.in/nd1_noc19_bt33/preview)

Genetic Engineering: Theory and Application:

[https://swayam.gov.in/nd1noc19\\_bt15/preview](https://swayam.gov.in/nd1noc19_bt15/preview). O5. Related Online Contents

[MOOC, SWAYAM, NPTEL, Websites etc.]

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe chromatin, chromosomes, heterochromatin and euchromatin.	1, 3
2	Explain mechanisms of sex determination, dosage compensation in human, <i>Drosophila</i> , and <i>C. Elegans</i> , discuss on structural and numerical aberrations of chromosomes.	1, 3
3	Apply karyotyping and pedigree method for identification of inheritance patterns in genetic disorders, use logarithm of the odds scores for linkage testing in specific disease contexts.	1, 3, 8
4	Evaluate polygenic inheritance, heritability through Quantitative Trait Locus mapping, linkage maps, and tetrad analysis, explain Human Genome Project and Mapping.	1, 3, 8
5	Discuss lac and tryptophan operon concept of gene regulation, in prokaryotes, gene regulation in eukaryotes, explain restrictive enzymes and their role in recombinant DNA techniques.	1, 3

SEMESTER – I									
Course Title	CELL BIOLOGY								
Course code	22MSZO114R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	<p>1. To make students understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles</p> <p>2. To define how the cellular components are used to generate and utilize energy in cells.</p> <p>3. Familiarize the cellular components underlying mitotic cell division.</p>								
CO1	Explain membrane structure and its functioning.								
CO2	Describe structural organization of cell and their roles.								
CO3	Illustrate different cell cycle processes.								
CO4	Discuss mechanism of cell to cell communications.								
CO5	Illustrate functions of cells and resulting diseases because their improper functioning.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Membrane Structure and Function: (Structure of a model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes)	7	Knowledge of structure of cell membrane and function				1,2		
II	Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure and function of cytoskeleton and its role in motility)	10	To learn the basic structural organisation of intracellular organelles				1,2		
III	Cell Division and Cell Cycle (Mitosis and Meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle)	10	To understand the basics of how a cell divides and its importance in cell cycle				1,2		
IV	Cell signaling: (Ligands and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling pathways in plants, bacterial chemotaxis and quorum sensing) neurotransmission and its regulation	8	To know about the communications and signalling mechanisms in cells				1,2		

<b>V</b>	Cellular communication: (Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins)	<b>10</b>	Knowledge on Basic regulatory mechanisms of cell communications	1,2
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Microscopic observation and comparison between prokaryotic and eukaryotic cell.</li> <li>• Isolation of mitochondria and staining.</li> <li>• Counting of RBC and WBC in human blood.</li> <li>• Extraction of membrane lipids and observation of lipid bilayer formation.</li> </ul> Squash preparation. sub-cellular fractionation - separation of macromolecules.	<b>30</b>	Students will be able to compare prokaryotic and eukaryotic cells, isolate and stain mitochondria, count RBCs and WBCs, extract membrane lipids, and perform squash preparation and sub-cellular fractionation.	1,2,3,4

### TEXT BOOKS:

- T1. The Cell: A Molecular Approach (7th Edition): Geoffrey M Cooper, Robert E Hausman, Sinauer Publication
- T2. Essential Cell Biology (5th Edition) , Alberts, Hopkin, Johnson, Morgan, Raff, Roberts, Walter: W.W.Nortopn & Company
- T3. Cell biology by CB Power (Latest Edition), Himalaya Publishing House.
- T4. Cell biology (cytology, biomolecules and molecular biology), V. K. Agarwal and Dr. P.S. Verma Lewin B. et al. (2007). Cells. Jones and Bartlett Publishers

### REFERENCE BOOKS:

- R1. Molecular Biology of the Cell (6th Edition)
- R2. Advanced practical zoology, Dr. P.S. Verma and P. C. Srivastava
- R3. Sharma, V. K. (1991). Techniques in Microscopy and Cell Biology. Tata-McGraw Hill.
- R4. Pollard T.D. and Earnshaw W.C. (2007). Cell Biology. Elsevier.
- R5. Lodish H, Berk A, Lawrence S, et al., Molecular Cell Biology, Freeman WH & Co. New York.

### OTHER LEARNING RESOURCES:

<https://www.cellbio.com/education.html>

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

<https://www.genome.gov/genetics-glossary/Cell-Membrane>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain membrane structure and its functioning.	<b>1, 3</b>
<b>2</b>	Describe structural organization of cell and their roles.	<b>1, 3</b>
<b>3</b>	Illustrate different cell cycle processes.	<b>1, 3</b>
<b>4</b>	Discuss mechanism of cell to cell communications.	<b>1, 3</b>
<b>5</b>	Illustrate functions of cells and resulting diseases because their improper functioning.	<b>1, 3</b>

SEMESTER – I									
Course Title	MINI RESEARCH (REVIEW OF LITERATURE- R1)								
Course code	22MSZO115R	Total credits: 2 Total hours: 30P	L	T	P	S	R	O/F	C
			0	0	2	4	6	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. students will become familiar with and learn to identify the most relevant textbooks, reviews, papers and journals for their research topics. 2. Students will also learn how to critically read and assess research papers and reviews. 3. Students will gain knowledge on selection of specific journal and submission for publications.								
CO1	Use of database and libraries for original research, books and other article.								
CO2	Summarize different types of reviews in the form of analytical and descriptive review.								
CO3	Identify relevant topic for continuing research and methods of collection including filtering of information.								
CO4	Analyse the demonstrations and findings made by previous authors and comprehend them.								
CO5	Write a review explaining the prospects of study chosen.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Introduction, comprehension on research search engines, selection of topics	5	Describe, illustrate and explain cell organization and functions, microscopy and structural differences.					1,2	
II	Tools for reference citation, different methods for writing citation and references.	5	Describe, illustrate and explain membrane structure, function; cell organization and the proteins involved in transportation.					1,2	
III	Introduction to structure of review and specific features of review	10	Describe, illustrate and explain chromosomal structure and types.					1,2	
IV	Plagiarism, ethical issues in writing the review	5	Describe, illustrate and explain the mechanism of cell to cell communication					1,2	
V	Mapping and selection of journal of specific knowledge of discipline and submission for publications	5	Describe, illustrate and explain the cell cycle and division in general and in some specific cell types					1,2	

### TEXT BOOKS:

T1. **Conducting Research Literature Reviews** by Arlene Fink ISBN: 1412971896 Call Number: Q180.55.M4 F56 2010

T2. **Writing Literature Reviews-4th Ed** by Jose L. Galvan ISBN: 1884585868 Call Number: H62.G35 2009

T3. **Approaches to Social Research** by Royce A. Singleton; Bruce C. Straits ISBN: 9780195147940 Publication Date: 2004-08-12

**REFERENCE BOOKS:**

R1. Literature Reviews from the Writing Center, The University of North Carolina at Chapel Hill

R2. Social Work Literature Review Guidelines from OWL Purdue Online Writing Lab

R3. Article available through PubMed Central® (PMC), "a free archive of biomedical and life sciences journal literature at the U.S. National Institutes of Health's National Library of Medicine (NIH/NLM)."

R4.Khan, K.S., Kunz, R., Kleijnen, J., & Antes, G. (2003). Five steps to conducting a systematic review. *Journal of the Royal Society of Medicine*, 96 (3), 118-121.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Use of database and libraries for original research, books and other article.	<b>1, 2, 3</b>
<b>2</b>	Summarize different types of reviews in the form of analytical and descriptive review.	<b>1, 3</b>
<b>3</b>	Identify relevant topic for continuing research and methods of collection including filtering of information.	<b>1, 2, 3</b>
<b>4</b>	Analyse the demonstrations and findings made by previous authors and comprehend them.	<b>1, 5</b>
<b>5</b>	Write a review explaining the prospects of study chosen.	<b>1, 5, 8</b>



SEMESTER – I									
Course Title	FUNDAMENTAL OF STATISTICS								
Course code	22UMFS111R	Total credits: 3 Total hours: 30T+30P	L	T	P	S	R	O/F	C
			2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. Help to understand the role of statistics in data analysis, decision-making, and scientific research 2. Introduce students to descriptive statistics, including measures of central tendency (mean, median, mode) and measures of dispersion (range, variance, standard deviation). 3. Teach students how to summarize and present data effectively using tables, charts, and graphs								
CO1	Describe statistical population and sample, compile, classify and characterize data including scale of measurement.								
CO2	Compile and present univariate data in tabular and graphical form and explain the descriptive statistics.								
CO3	Compile and present bivariate data and explain it by various bivariate analysis, including the predictions/ forecasting.								
CO4	Compute probability including events and distributions (normal, binomial, Poisson).								
CO5	Explain the methods of hypothesis testing, parametric and non-parametric and use them to evaluate specific cases.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio.	5	Describe, illustrate and explain cell organization and functions, microscopy and structural differences.					1,2	
II	Presentation: tabular and graphical, including histogram and ogives. Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, skewness and kurtosis	5	Describe, illustrate and explain membrane structure, function; cell organization and the proteins involved in transportation.					1,2	
III	Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, fitting of polynomials and exponential curves.	5	Describe, illustrate and explain chromosomal structure and types.					1,2	
IV	Random experiment: trial, sample point and sample space, event, Operations of Events, concepts of mutually exclusive	8	Describe, illustrate and explain the mechanism of cell to cell communication					1,2	

	and exhaustive events. Definition of probability: classical and relative frequency approach. Discrete probability space, Properties of probability, Independence of events, Conditional probability, total and compound probability rules, Normal probability Distribution, Binomial probability Distribution, Poisson Probability Distribution, Bayes' theorem and its applications.			
<b>V</b>	Testing of hypothesis, parametric test: t-test, z-test, chi-square test. Non-Parametric test: One sample Kolmogorov test, Wilcoxon Signed test, Mann-Whitney Test, Kruskal Wallis test	<b>7</b>	Describe, illustrate and explain the cell cycle and division in general and in some specific cell types	1,2
<b>Practical</b>	<p>1. Introduction to R - A programming language and environment for data analysis and graphics. Syntax of R expressions: Vectors and assignment, vector arithmetic, generating regular sequence, logical vector, character vectors, Index vectors; selecting and modifying subsets of data set</p> <p>2. Data objects: Basic data objects, matrices, partition of matrices, arrays, lists, creating and using these objects; Functions- Elementary functions and summary functions, applying functions to subsets of data. Data frames: The benefits of data frames, creating data frames, combining data frames, Adding new classes of variables to data frames; Data frame attributes.</p> <p>3. Importing data files: import.data function, read.table function; Exporting data: export.data function, cat, write, and write.table functions, function, formatting output - options, and format functions; Exporting graphs -export.graph function. Graphics in R: creating graphs using plot function, box plot, histogram, line plot, stem and leaf plot, pie chart, bar chart, multiple plot layout, plot titles, formatting plot axes; Visualizing the multivariate data: Scatter plot, Q-Q plot, P-P plot.</p>	<b>30</b>	Describe, illustrate and explain and apply staining techniques and carry out microscopic examination.	1,2,3,4

	4. Performing data analysis tasks: Reading data with scan function, Exploring data using graphical tools, computing descriptive statistics, one sample tests, two sample tests, Goodness of fit tests.			
	5. Parametric test and Non-Parametric test			

**Text books:**

T1: Methods in Biostatistics by K S Negi , ISBN:9789374735053,4th Edition, Year:2023, AITBS Publishers, INDIA

**Reference books**

- R1. "Introduction to the Practice of Statistics" by David S. Moore, George P. McCabe, and Bruce A. Craig  
R2. "Statistics" by David Freedman, Robert Pisani, and Roger Purves

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe statistical population and sample, compile, classify and characterize data including scale of measurement.	<b>1, 2</b>
<b>2</b>	Compile and present univariate data in tabular and graphical form and explain the descriptive statistics.	<b>1, 2, 3</b>
<b>3</b>	Compile and present bivariate data and explain it by various bivariate analysis, including the predictions/ forecasting.	<b>1, 2</b>
<b>4</b>	Compute probability including events and distributions (normal, binomial, Poisson).	<b>1, 2</b>
<b>5</b>	Explain the methods of hypothesis testing, parametric and non-parametric and use them to evaluate specific cases.	<b>1, 2, 3, 8</b>

Course Title	EFFECTIVE ENGLISH (Communicative English & Soft Skills)									
Course code	22UMPD111R	Total credits: 2	L	T	P	S	R	O/F	C	
			0	0	4	0	0	0	2	
Pre-requisite	Nil	Co-requisite	Nil							
Programmes	MASTER OF SCIENCE IN ZOOLOGY									
Semester	Fall/I Semester of First Year of the Programme									
Course objectives	1. To introduce the types of sentences and their significance. 2. To strengthen the students' vocabulary to enhance their speaking and writing skills. 3. To familiarize the students with the importance of dress codes in various organizations. 4. To introduce the 3P's (Planning, prioritizing & performing) of Time Management. 5. To give insight into English pronunciation and into central concepts in phonetics.									
CO1	This course will enable students to analysis and identify the different types of sentences.									
CO2	Learners will be able to integrate the skills of reading and speaking in professional communication.									
CO3	Dress code Etiquette sessions will boost their confidence and morals.									
CO4	Students will learn about the effective and efficient utilization of time.									
CO5	Introduction to Phonetics and its importance will improve the learners 'pronunciation									
MODULES	<b>Module 1- Grammar</b> Interchange of Interrogative and Assertive Sentences, Exclamatory and Assertive Sentences, Types of Tenses, Common Errors, Synonyms, Antonyms, Homonyms <b>Module 2- Reading Skills</b> Techniques of Effective Reading, Gathering ideas and information from a text The SQ3R Technique Interpret the text <b>Module 3-Listening Skills</b> What is listening?, The Process of Listening, Factors that adversely affect Listening, Difference between Listening and Hearing, Purpose and Importance of Effective Listening, How to Improve Listening Process, <b>Module 4- Conflict Management</b> Definition, Type of Conflict Management, Effects of Conflict Management, Methods to deal with Conflicts (Negative) <b>Module 5- Time-Management Skills</b> Introduction To Time Management, Purpose And Importance of Time Management, Basic Tips to Maintain Time. <b>Activity: Problem solving activity:</b> A situation will be given to the students and they will have to tell us how to handle the situation or solve the problem.									

**Text books:**

- T1: Wren,P.C and Martin,H. 1995. High School English Grammar and Composition, S Chand Publishing.  
 T2: English Grammar in Use, Raymond Murphy 4th edition, CUP.  
 T3: Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

**Reference books:**

- R1; English Vocabulary in Use (Advanced), Michael McCarthy and Felicity, CUP.  
 R2: Effective Communication and Soft Skills, Nitin Bhatnagar, Pearsons.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	This course will enable students to analysis and identify the different types of sentences.	<b>1</b>
<b>2</b>	Learners will be able to integrate the skills of reading and speaking in professional communication.	<b>1, 2</b>
<b>3</b>	Dress code Etiquette sessions will boost their confidence and morals.	<b>1, 8</b>
<b>4</b>	Students will learn about the effective and efficient utilization of time.	<b>1, 8</b>
<b>5</b>	Introduction to Phonetics and its importance will improve the learners' pronunciation	<b>1, 8</b>

SEMESTER – II									
Course Title	ENDOCRINOLOGY AND IMMUNOLOGY								
Course code	22MSZO121R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. Understand the functions and importance of endocrine glands and hormone actions. 2. Explore invertebrate endocrine systems for applications like pest control. 3. Learn about immunology, including immune system cells, immunities, immunogens, and immunoglobulins.								
CO1	Identify various endocrine glands and their functions including biosynthesis and classification of hormones.								
CO2	Describe endocrine, hypothalamus and their functions including invertebrate hormones.								
CO3	Explain the types of immunity including functions of immune cells.								
CO4	Describe immunogens, properties, structure and functions including factors affecting antigenicity.								
CO5	Identify various immunoglobulins, their processing, presenting, activation and differentiation.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Endocrine glands, their hormones and classification; Biosynthesis, storage and mechanism of action of protein and steroid hormones.	7	To gain basic knowledge and understanding of endocrine glands and hormones				1,2		
II	<b>Endocrine hypothalamus</b> <ul style="list-style-type: none"> <li>• Pituitary, Thyroid,</li> <li>• Parathyroid,</li> <li>• Pancreas,</li> <li>• Adrenal Glands: Structure, secretions and functions of each gland.</li> <li>• Invertebrate hormones and their functions.</li> </ul>	10	To understand the nature of y different glands and how their secretions regulate and control the metabolism, growth and other functions of the body.				1,2		
III	<b>Types of immunity:</b> Innate and acquired immunity; passive and active immunity; <ul style="list-style-type: none"> <li>• Humoral and cell- mediated immunity.</li> <li>• Organs of immune system: Primary and Secondary lymphoid organs.</li> <li>• Brief account on immune cells: types and production.</li> </ul>	10	Understand the complex system of immunity which helps in fighting pathogens and toxins etc to keep the body healthy				1,2		
IV	<b>Immunogens (Antigens)</b> <ul style="list-style-type: none"> <li>• General properties, Structure and function, Factors affecting antigenicity</li> <li>• Epitopes and Haptens</li> <li>• Adjuvants</li> </ul>	8	To understand and analyse the knowledge gained on nature of immunogens.  How vaccines are produced by knowing the antigenicity factors				1,2		
V	<b>Immunoglobulins (antibodies)</b> <ul style="list-style-type: none"> <li>• General Properties- Structure and</li> </ul>	10	To understand the importance of antibodies in immune response, the functions of major immune cells and how the activation of				1,2		

	<p>functions</p> <ul style="list-style-type: none"> <li>• Different classes of immunoglobulins (IgA, IgD, IgE, IgG and IgM)</li> <li>• Antigen-antibody interactions: Primary and secondary immune responses</li> <li>• Major Histocompatibility Complex (MHC), antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors.</li> </ul>		<p>these cells is done. Studying about how scientist created vaccine against Covid 19 virus</p>	
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Histology of various endocrine glands of vertebrates.</li> <li>• Study of various endocrine glands using models and charts and computer software.</li> <li>• Study of thyroxine and iodine solution in amphibian metamorphosis.</li> <li>• Estimation of urea and uric acid.</li> <li>• Blood glucose – Oral Glucose Tolerance Test.</li> <li>• Study of different types of cells in the blood of human beings.</li> <li>• Hemagglutination assay for ABO blood groups.</li> <li>• Total Leucocyte count.</li> <li>• Differential Leucocyte Count.</li> <li>• 3D structural organization of various antibodies using bioinformatics and online resources.</li> </ul>	<b>30</b>	<p>Students will study endocrine glands, analyze amphibian metamorphosis, estimate urea, uric acid, and glucose levels, perform blood cell analysis and hemagglutination assays, and explore antibody structures using bioinformatics.</p>	1,2,3,4

### TEXT BOOKS:

- T1: Endocrinology by Hadley Mac E and John Levine(sixth edition) Pears  
T2: Textbook of Endocrinology,2009,Sonali Publications, New Delhi  
T3: Williams Textbook of Endocrinology,14th edition 2019, Elsevier publications Company, Philadelphia George Griffin, Endocrinology,2015, Star pearls publishing, USA  
T4: DeGroot's Endocrinology,8th edition 2 volume set, Elsevier  
T5: Elements of Immunology: F .H. Khan Pearson Education

### REFERENCE BOOKS:

- R1: Vertebrate Endocrinology by O Davis, O Norris (6<sup>th</sup> Edition). Elsevier Science Publishing Co Inc.  
R2: Williams Text book of Endocrinology (14<sup>th</sup> Edition). Elsevier.  
R3: An introduction to Comparative. Endocrinology by Barrington, E.E.W (Latest Edition). Clarendon Press  
R4. Kuby Immunology (8<sup>th</sup> Edition) W.F.Freeman, U.S.A.  
R5. Fundamentals of Immunology by W. Paul (7<sup>th</sup> Edition). Wolters Kluwer | Lippincott Williams and Wilkins.

## OTHER LEARNING RESOURCES:

Endocrinology: <https://www.classcentral.com/course/swayam-endocrinology-19855>

Immunology : <https://www.classcentral.com/course/swayam-immunology-14117>

Immunology : [https://swayam.gov.in/nd2\\_cec20\\_bt05/preview](https://swayam.gov.in/nd2_cec20_bt05/preview)

Fundamentals of Immunology:

<https://www.classcentral.com/course/immunologyfundamentalsimmunitybcells-12724>

Monoclonal Antibodies :

<https://www.coursera.org/lecture/immunologyfundamentalsimmunitybcells/monoclonalantibodies-KxBvo>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Identify various endocrine glands and their functions including biosynthesis and classification of hormones.	<b>1</b>
<b>2</b>	Describe endocrine, hypothalamus and their functions including invertebrate hormones.	<b>1, 2</b>
<b>3</b>	Explain the types of immunity including functions of immune cells.	<b>1, 2</b>
<b>4</b>	Describe immunogens, properties, structure and functions including factors affecting antigenicity.	<b>1</b>
<b>5</b>	Identify various immunoglobulins, their processing, presenting, activation and differentiation.	<b>1, 2</b>



SEMESTER – II									
Course Title	MOLECULAR BIOLOGY, GENOMICS AND GENETIC ENGINEERING								
Course code	22MSZO122R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To teach in depth about genome and its arrangement in eukaryotes and microbes. 2. To teach the central dogma of life (replication, transcription, translation and post transcriptional modifications) with the best possible teaching tools (explanation/power point presentation/seminar/assignment) and with utmost attention. 3. Important topics like mutation, DNA damage and repair are explained.								
CO1	Discuss genomics, genome, proteome and transcriptome.								
CO2	Explain the central dogma including genome expression.								
CO3	Illustrate genome sequencing, chromosome painting and genome mapping.								
CO4	Explain DNA mutation and repair mechanisms.								
CO5	Describe genetic engineering.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	Introduction to genomics, definitions of genome, proteome and the transcriptome		7	Introductory knowledge and refreshing the existing understanding				1,2	
II	The central dogma: transcription, translation, replication, post-transcriptional modification role of DNA binding proteins in genome expression, nucleosome modifications and genome expression, histone modification, acetylation		10	Sequencing techniques in detail followed by linkage mapping				1,2	
III	Mapping of genomes, basics of genome sequencing, shotgun sequencing, Euchromatin and heterochromatin, chromosome painting.		10	Explain why a map is an important aid to genome sequencing				1,2	
IV	Accessing the genome: chromosome painting, nucleosome modifications and genome expression, histone, chromosome painting, nucleosome modifications and genome expression, histone modification, acetylation, Mutations and DNA repair		8	Genome organisation is discussed in detail with various post translational events along with regulatory mechanisms				1,2	
V	Introduction to genetic engineering, Different DNA manipulating enzymes, methods for isolating DNA, vectors for bacteria, plant and animals, expression vectors, DNA libraries, application of genetic engineering		10	Knowledge on DNA manipulation using recombinant DNA technology				1,2	

<b>Practical</b>	<ul style="list-style-type: none"> <li>• Isolation of genomic DNA.</li> <li>• Isolation of plasmid DNA.</li> <li>• Polymerase chain reaction.</li> <li>• Endonuclease digestion of DNA and analysis of DNA fragments by agarose electrophoresis.</li> </ul>	<b>30</b>	Students will be able to isolate genomic and plasmid DNA, perform PCR, and analyze DNA fragments using endonuclease digestion and agarose electrophoresis.	1,2,3,4
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### TEXT BOOKS:

T1: The Molecular Biology of the Gene by J. D. Watson et al. (1987) Benjamin Cummings.

T2: Cell and Molecular Biology, Lohar (Prakash S), 1st Edition, Mjp Publishers

T3: Cell and Molecular Biology: Concepts and Experiments. Carp Gerald, 1996. John Wiley & Sons Publishers.

T4: Lodish H, Berk A, Lawrence S, et al., Molecular Cell Biology, Freeman WH & Co. New York.

T5: De Robertis EDP and De Robertis EMF, Cell and Molecular Biology Saunders College, Philadelphia Dowben RM, Cell Biology, Harper and Row Publ. London.

### REFERENCE BOOKS:

R1: The Molecular Biology of the Cell by Alberts et al. (1991).

R2: Gene V by B. Lewin (1994) Oxford University Press, Oxford.

R3: Molecular cell biology by Lodish et al. (1995) Scientific American press.

R4: Alberts B, Johnson A, Lewis J, et al. Molecular Biology of the Cell, Taylor & Francis Group, New York, USA.

R5: Gerald Karpgen, 1999. *Cell and Molecular Biology*, Concepts & Epts. Sec. edn. John Wiley & Sons, Inc., New York.

### OTHER LEARNING RESOURCES:

<https://in.coursera.org/courses?query=molecular%20biology>

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Discuss genomics, genome, proteome and transcriptome.	1
2	Explain the central dogma including genome expression.	1, 2
3	Illustrate genome sequencing, chromosome painting and genome mapping.	1, 2
4	Explain DNA mutation and repair mechanisms.	1, 2
5	Describe genetic engineering.	1

SEMESTER – II									
Course Title	EVOLUTION AND ECOLOGY								
Course code	22MSZO123R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To sensitize the candidates with various aspects on evolutionary biology, various theories related to evolution, patterns of behaviour and biological communications. 2. To provide basic and advanced information on population and community ecology and the immensely fascinating world of biodiversity and wildlife. 3. To give advanced information on conservation biology.								
CO1	Explain the theories of evolution.								
CO2	Describe population genetics and phenomenon, mechanism, laws associated with it.								
CO3	Explain population and community ecology.								
CO4	Discuss the working mechanisms of an ecosystem.								
CO5	Describe biodiversity, conservation and management including case studies of Indian origin								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Darwinism</b> <ul style="list-style-type: none"> <li>• Concepts of variation,</li> <li>• Adaptation, struggle, fitness and natural selection</li> </ul> <b>Mendelism</b> <ul style="list-style-type: none"> <li>• Spontaneity of mutations</li> <li>• The evolutionary synthesis.</li> <li>• Concepts of neutral evolution, molecular divergence and molecular clocks</li> </ul>	7	Students will understand the theories of evolution				1,2		
II	<b>Population genetics</b> <ul style="list-style-type: none"> <li>• Populations</li> <li>• Gene pool, Gene frequency</li> <li>• Hardy-Weinberg Law</li> <li>• Concepts and rate of change in gene frequency through natural selection</li> <li>• Migration and random genetic drift</li> <li>• Adaptive radiation</li> <li>• Isolating mechanisms</li> </ul> Speciation, Allopatricity and Sympatricity <ul style="list-style-type: none"> <li>• Convergent evolution</li> <li>• Sexual selection</li> <li>• Co-evolution</li> <li>• Altruism and evolution- Group selection</li> <li>• Kin selection</li> <li>• Reciprocal altruism</li> <li>• Biological clocks</li> <li>• Development of behavior</li> <li>• Social communication</li> </ul>	10	Students will acquire knowledge on population genetics and various behaviour shown by organisms				1,2		

	<ul style="list-style-type: none"> <li>• Social dominance</li> <li>• Use of space and territoriality</li> </ul>			
<b>III</b>	<p><b>Population ecology</b></p> <ul style="list-style-type: none"> <li>• Characteristics and size of a population</li> <li>• Growth curves and regulation of Population</li> <li>• r and K selection</li> </ul> <p><b>Community ecology</b></p> <ul style="list-style-type: none"> <li>• Nature of communities</li> <li>• Structure and attributes of communities</li> <li>• Edge effect and ecotones.</li> <li>• Ecological succession (causes and examples)</li> <li>• Stability and Climax community Predation</li> <li>• Model of prey predator dynamics</li> </ul> <p>Predators and their role in nature</p>	<b>10</b>	Students will gain knowledge on population and community ecology and ecological developmental processes	1,2
<b>IV</b>	<p><b>Ecosystem Ecology</b></p> <ul style="list-style-type: none"> <li>• Ecosystem structure and ecosystem function</li> <li>• Energy flow</li> <li>• Mineral cycling (C, N, P)</li> <li>• Primary production and decomposition</li> <li>• Structure and function of some Indian ecosystems, terrestrial (forest) and aquatic (fresh water, marine)</li> </ul>	<b>8</b>	Students will gain knowledge about the structures and function of ecosystem	1,2
<b>V</b>	<p><b>Conservation Biology</b></p> <ul style="list-style-type: none"> <li>• Major drivers of biodiversity change</li> <li>• Principles of conservation</li> <li>• Major approaches to management</li> <li>• Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves)</li> </ul>	<b>10</b>	Students will gain knowledge on various conservation strategies and process adopted of conservation of biodiversity	1,2
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Web based tools for sequence searches and homology screening.</li> <li>• Prediction and validation of protein structure using homology modelling.</li> <li>• Introduction to bioinformatics: FASTA, BLAST databases.</li> <li>• Analysis of water samples for various physico-chemical parameters-pH, free CO<sub>2</sub>, dissolved oxygen, hardness.</li> <li>• Estimation of primary productivity</li> </ul>	<b>30</b>	Students will use bioinformatics tools for sequence analysis, predict protein structures, analyze water quality, estimate primary productivity, quantify planktons, assess local biodiversity, and visit conservation areas.	1,2, 3,4

	<p>using dark and light bottles.</p> <ul style="list-style-type: none"> <li>• Quantitative estimation of planktons.</li> <li>• Assessment of invertebrate and vertebrate diversity in your locality (e.g. campus).</li> <li>• Visit to National parks, Wildlife sanctuaries and biosphere reserves of India.</li> </ul>			
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**TEXT BOOKS:**

- T1: Behaviour, development and Evolution by Patrick Batesson (Latest Edition). Open book publishers.
- T2: Biodiversity by Wilson, E.O (Latest Edition). Academic Press, Washington.
- T3: The Biology of Biodiversity by Kato (Latest Edition). M. Springer.
- T4: Wildlife in India by V.B. Saharia Natraj Publishers (Latest Edition) Dehradun.
- T5: The Wildlife of India by E.P. Gee (Latest Edition). Harper Collins India.
- T6: Environmental Biology- K.C. Agrawal (Latest Edition). Agro Botanical Publishers
- T7: Ecology and Environment- P.D (Latest Edition). Sharma Rastogi Publications.
- T8: Ecology by Krebs, C. J. (6<sup>th</sup> Edition). Benjamin Cummings.
- T9: Fundamentals of Ecology by Odum, E.P (5<sup>th</sup> Edition). Cengage Learning India
- T10: Ecology and field biology by Smith and Smith (6<sup>th</sup> Edition). Benjamin- Cummings.

**REFERENCE BOOKS:**

- R1: Genetics and Origin of Species by Dobzhansky, (Latest Edition). Columbia University press
- R2: Evolution by Dobzhansky, Th. F.J.Ayala, I.L. Stebbins and J.M. valentine (Latest Edition). Surjeet Publication, Delhi.
- R3: Species Evolution-The role of chromosomal Change by King, M. (Latest Edition). The Cambridge University Press, Cambridge.
- R4: Evolution and genetics by Merrel, D. J. (Latest Edition). Holt, Rinchart and Winston, Inc.
- R5: Animal Behaviour by M. P. Arora (Latest Edition). Himalaya Pub.House-New Delhi.
- R6: Organic Evolution (Evolutionary Biology) by Veer Bala Rastogi (13<sup>th</sup> Edition). Medtech
- R7: Animal Behaviour by Dustin R. Rubenstein (Eleventh Edition). Sinauer Associates Inc.
- R8: Evolution and behaviour by Workman Lance (Latest Edition). Taylor and Francis Ltd.

R9: Ecological Concepts by Cherrett (Latest Edition) Blackwell Science Oxford, U.K.

**OTHER LEARNING RESOURCES:**

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the theories of evolution.	<b>1</b>
<b>2</b>	Describe population genetics and phenomenon, mechanism, laws associated with it.	<b>1, 2</b>
<b>3</b>	Explain population and community ecology.	<b>1, 2, 8</b>
<b>4</b>	Discuss the working mechanisms of an ecosystem.	<b>1, 8</b>
<b>5</b>	Describe biodiversity, conservation and management including case studies of Indian origin	<b>1, 8</b>

SEMESTER – II									
Course Title	APICULTURE (TECHNO PROPESSIONAL SKILL - I)								
Course code	22MSZO124R	Total credits: 2	L	T	P	S	R	O/F	C
			0	0	4	0	0	0	2
		Total hours:30							
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	<ol style="list-style-type: none"> <li>1. Provide knowledge of apiculture, including honey bee species, history, importance, and beekeeping equipment.</li> <li>2. Teach practical skills in managing and maintaining honey bee colonies, honey production, and queen rearing.</li> <li>3. Enable identification and control of honey bee enemies and diseases.</li> </ol>								
CO1	Explain historical evolution of apiculture, identify species of honeybees, and use of different equipments for bee rearing.								
CO2	Demonstrate bee colony handling techniques maintaining apiary records.								
CO3	Analyse and implement seasonal management strategies for honey bee colonies.								
CO4	Plan honey production and exhibit queen rearing for sustainable honey production.								
CO5	Identify enemies and diseases of honey bees and control them.								
Unit-No.	Content		Contact Hour	Learning Outcome					KL
I	<ul style="list-style-type: none"> <li>• Introduction to apiculture: importance and history</li> <li>• Different species of honey bees</li> <li>• Bee keeping equipment</li> </ul>		5	Students will be able to understand the importance and history of apiculture, identify different species of honey bees, and demonstrate knowledge of essential beekeeping equipment.					1,2
II	<ul style="list-style-type: none"> <li>• Handling of a honey bee colony and maintenance of apiary record</li> <li>• Collection and preservation of bee pasture</li> </ul>		10	Students will be able to handle a honey bee colony, maintain accurate apiary records, and effectively collect and preserve bee pasture.					1,2
III	<ul style="list-style-type: none"> <li>• Seasonal management of honey bee colonies</li> <li>• Miscellaneous management (dividing, uniting, queen management, supplementary feeding, shifting bee colonies, robbing, absconding)</li> </ul>		5	Students will be able to manage honey bee colonies seasonally and perform tasks like dividing, uniting, queen management, supplementary feeding, and addressing robbing and absconding.					1,2
IV	<ul style="list-style-type: none"> <li>• Manipulations for honey production</li> <li>• Economics of beekeeping</li> <li>• Queen rearing</li> </ul>		5	Students will be able to perform honey production techniques, understand the economics of beekeeping, and conduct queen rearing.					1,2
V	<ul style="list-style-type: none"> <li>• Familiarization with enemies of honey bees and their control</li> <li>• Familiarization with diseases of honey bees and their control</li> </ul>		5	Students will be able to identify and control enemies and diseases of honey bees.					1,2

### TEXT BOOKS

T1: Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.

T2: Sardar Singh, Beekeeping in India. ICAR, New Delhi.

T3: Principles of Insect Physiology by V.B. Wigglesworth, 1972, Springer

T4: Fundamentals of Entomology by Richard J. Elzinga, 2003, Pearson

T5: Hand book of Economic Entomology for South India by Ayyar, T.V.R, 1992, Narendra Publishing House, New Delhi

### REFERENCE BOOKS

R1: Bisht D.S., Apiculture, ICAR Publication.

R2: Entomophagous Insect by Curtis Paul Clausen, 2010, McGraw-Hill book Company

R3: Insect and hygiene by Busvine, J.R. 1951, Published by Methuen & Co, London

R4: The Insects Structure and Function by R.F. Chapman, 2012, Cambridge University Press.

R5: Principles of Insect Physiology by V.B. Wigglesworth, 1972, Springer

### OTHER LEARNING RESOURCES:

ERP notes

Online study materials

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain historical evolution of apiculture, identify species of honeybees, and use of different equipments for bee rearing.	1, 6, 8
2	Demonstrate bee colony handling techniques maintaining apiary records.	1, 6, 8
3	Analyse and implement seasonal management strategies for honey bee colonies.	1, 6, 7, 8
4	Plan honey production and exhibit queen rearing for sustainable honey production.	1, 6, 7, 8
5	Identify enemies and diseases of honey bees and control them.	1, 6, 8



SEMESTER – II									
Course Title	MINI-RESEARCH (RESEARCH GAP ANALYSIS - R2)								
Course code	22MSZO125R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30P	0	0	0	4	6	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	<ol style="list-style-type: none"> <li>1. Develop and implement strategies to identify and address gaps in the current literature, moving towards an ideal future state.</li> <li>2. Critically assess current research to identify gaps and evaluate potential solutions to bridge these gaps.</li> <li>3. Formulate and execute action plans to meet identified research gaps, with guidance and supervision.</li> </ol>								
CO1	Create and implement a plan to bridge the gap								
CO2	Find the gap and evaluate solutions.								
CO3	Identify the ideal future state/action plan								
CO4	To analyse the current state/work of research								
CO5	To implement the strategies to meet the research gap under supervision.								
Unit-No.	Content	Contact Hour	Learning Outcome						KL
I	What is literature review.	7	Identify literary techniques and creative uses of language in literary texts. Adapt their texts to particular audiences and purposes.						1,2
II	How to Begin the literature Review	10	Adapt their texts to particular audiences and purposes.						1,2
III	How to write main body of literature review	10	The students will learn about the importance of ethical consideration in research writing						1,2
IV	How to write conclusion of literature Review	8	The students will be able to select one of the major key concepts and variables from the chosen research topic.						1,2
V	How to analyze gap in literature review.	10	The students will get practical exposure in writing research papers in proper APA format and styles.						1,2

### TEXT BOOKS:

T1. Multiple Stressors: Literature Review and Gap Analysis (WERF Research Report Series) by S.M. Swanson.

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Create and implement a plan to bridge the gap	1, 2, 3
2	Find the gap and evaluate solutions.	2, 3
3	Identify the ideal future state/action plan	2, 3
4	To analyse the current state/work of research	2, 3
5	To implement the strategies to meet the research gap under supervision.	2, 3, 8

SEMESTER – II									
Course Title	WILDLIFE CONSERVATION AND MANAGEMENT (GENERIC ELECTIVE)								
Course code	22MSZO126R	Total credits: 2 Total hours: 30T	L	T	P	S	R	O/F	C
			2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To impart the knowledge on importance of wildlife, ethics and management tactics for wildlife conservation. 2. To provide the information regarding different conservation programme adopted in India for the conservation of wildlife. 3. To Employ habitat management techniques and understand the Wildlife Protection Act and conservation principles through case studies.								
CO1	Describe the strategies and programmes adopted for conservation of wildlife.								
CO2	Explain the ethics and management tactics for wildlife conservation.								
CO3	Discuss the approaches of habitat management and their significance.								
CO4	Discuss the Wildlife Protection Act and projects.								
CO5	Describe the conservation programme adopted in India for conservation of wildlife.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Wildlife Importance and Conservation</b> <ul style="list-style-type: none"> <li>• Definition and importance of wildlife</li> <li>• Causes of depletion</li> <li>• Important National Parks, Wildlife sanctuaries and biosphere reserves of India</li> </ul>	5	Students will understand the importance of wildlife and the need of their conservation					1,2	
II	<b>Environmental Ethics and Management</b> <ul style="list-style-type: none"> <li>• Conservation and management of Wildlife</li> <li>• In-situ conservation and ex-situ conservation</li> </ul> <b>Innovative Methods in Wildlife</b> <ul style="list-style-type: none"> <li>• Camera Trap</li> <li>• Conservation Drones</li> <li>• Remote Sensing</li> <li>• Radio Telemetry</li> <li>• GIS</li> <li>• GPS</li> <li>• Mobile App</li> <li>• Capturing and marking techniques</li> <li>• Trapping</li> <li>• Darting</li> <li>• tagging and banding</li> <li>• Scat analysis</li> <li>• Sign surveys</li> </ul>	10	Students will be able to know ethics and management tactics for wildlife conservation					1,2	

<b>III</b>	<b>Habitat Management</b> <ul style="list-style-type: none"> <li>• Fire as management tool in grassland management.</li> <li>• Habitat management techniques</li> <li>• Weed eradication</li> <li>• Water hole management</li> <li>• RAMSAR and Bonn Convention</li> </ul>	<b>5</b>	Students will know regarding various approaches of habitat management and its significance	1,2
<b>IV</b>	<b>Wild life Protection Act and Projects</b> <ul style="list-style-type: none"> <li>• Wildlife Protection Act (1972) and its detailed structure</li> <li>• Recent amendments in WPA 1972 and their role in Wildlife protection and Conservation</li> </ul>	<b>5</b>	Students will have basic idea on WPA, 1972 and its implementation	1,2
<b>V</b>	<b>Conservation Biology</b> <ul style="list-style-type: none"> <li>• Principles of conservation</li> <li>• Major approaches to management</li> <li>• Indian case studies on conservation/ management strategy (Project Tiger, Biosphere reserves)</li> </ul>	<b>5</b>	Students will have understanding on different conservation programme adopted in India for the conservation of wildlife	1,2

### **TEXT BOOKS:**

T1: An Introduction to Conservation Biology, Anna A. Sher and Richard B. Primack 2019. Oxford University press.

T2: Indian Wildlife Protection Act 1972. Anon. 2004. Natraj Publishers, Dehra Dun. 104p.

T3: Fundamentals of Wildlife Management. Gopal, R. 1992. Justice Home. Allahabad. 668p.

T4: Conservation Biology for All. Navjot S. Sodhi and Paul R. Ehrlich 2010 Oxford University press.

T5: Conserving earth's biodiversity. Wilson, E. O., and D. Perlman. 2000. Island Press, Washington, D.C.

### **REFERENCE BOOKS:**

R1: Principles of Conservation Biology. Meffe, G. K. and C. R. Carroll 1994. Sinauer Associates, USA

R2: Ecological Methods for Field and Laboratory Investigations. Michael, P. 1984. Tata Mc Graw Hill Publishing Company Limited, New Delhi. 404 p.

R3: Conservation Biology: Voices from the Tropics. Peter H. Raven, Navjot S. Sodhi, Luke Gibson, 2013. Willey Online library.

R4: Fundamentals of Ecology. Odum, E.P. 1996. Natraj Publishers, Dehra Dun 574p. 19. Primack, R. B. 2006. Essentials of Conservation Biology, Sinauer Associates, USA.

R5: Wildlife Ecology and Management. Robinson W.L. and Eric G. Bolen (1984). Millen Publishing Co. New York.

### **OTHER LEARNING RESOURCES:**

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe the strategies and programmes adopted for conservation of wildlife.	1, 6
<b>2</b>	Explain the ethics and management tactics for wildlife conservation.	1, 5, 6
<b>3</b>	Discuss the approaches of habitat management and their significance.	1, 6, 8
<b>4</b>	Discuss the Wildlife Protection Act and projects.	1, 3
<b>5</b>	Describe the conservation programme adopted in India for conservation of wildlife.	1, 8

SEMESTER – II									
Course Title	RESEARCH METHODOLOGY AND STATISTICAL ANALYSIS								
Course code	22UMRM121R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours:15T+60S	2	0	0	4	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	<p>1. The course aims to enhances the students’ a broad understanding of research methodology, including theory of science and qualitative and quantitative methods in research.</p> <p>2. The course seeks to enhance the students’ skills for developing critical thinking through research literature review in different domain. Consequently it aims to develop skills for preparation of a research proposal for a master’ thesis project/Mini research.</p> <p>3. To develop Students competency in planning, conducting, evaluating and presenting a research project.</p>								
CO1	Explain research methodology, evaluate significance of research and identify research problems.								
CO2	Explain research design, sampling design and design experiment for research.								
CO3	Collection and representation of data and interpret the data with descriptive statistics.								
CO4	Explain to write report, article, reviews etc.								
CO5	Explain intellectual property right and related rights								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Research Methodology- An Introduction- meaning and objectives of research, motivation in research, types and significance of research, criteria of good research. Defining the Research Problems- definition of research problem, necessity of defining research problem	7	Knowledge on fundamental concepts of research methodology, including the meaning and objectives of research				1,2		
II	Research Design- meaning and need of research design, features of a good design, different research designs, Sampling Design- steps in sampling design, Sample Size determination, criteria for selecting a sampling design, different types of sampling design, Experimental Design, Principles of Design of Experiment, One – way ANOVA, Two- Way ANOVA, CRD, RBD, LSD, 22, 23 Factorial Design	10	Able to understand and apply the fundamental principles of research design, including the meaning and necessity of research design				1,2		
III	Types of data, sources of data collection, tools of data collection, Nominal, ordinal, interval and ratio – Attitude scale construction and measurement, rating scales, semantic differential (SD), Use of scale in statistical analysis, Schedules for interviews preparation and standardization, development of survey instruments and item analysis for the questionnaire	10	A good knowledge on different types of data and identify various sources and tools for data collection				1,2		

<b>IV</b>	Planning and organizing research report, Format of research report, Different steps of writing report, lay out of the research report , How to organize thesis/Dissertation, mechanics of writing research report, standard methods of quoting- presenting the result, written and oral reports, Uses of abstract, format of research report, presentation of statistics - tabular and graphic references and uses of references, Bibliography and presentation of bibliography	<b>8</b>	Able to organize and write a comprehensive research report	1,2
<b>V</b>	Intellectual property right (IPR), Introduction and the need for IPR, IPR in India and worldwide, Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge and Geographical Indications, Patentable and non-patentable, patenting life, Filing of a patent application, The different layers of the international patent system, Case studies on Basmati rice, Turmeric, and Neem patents	<b>10</b>	Knowledge on importance of Intellectual Property Rights (IPR) both in India and globally	1,2
<b>Practical</b>	<b>Laboratory using R Software:</b> 1. Analysis of One way ANOVA; 2. Analysis of Two way ANOVA; 3. Analysis of CRD 4. Analysis of RBD 5. Analysis of 22 and 23 Factorial Experiment 6. Simulation-I using R (Bernoulli, Binomial, Poisson and Geometric distribution.). 7. Simulation-II using R (Exponential and Normal distribution). 8. Simple random Sampling 9. Stratified Random Sampling	<b>30</b>	Knowledge on various statistical experiments and simulations using R	1,2, 3,4

#### Text books

**T1:** Methods in Biostatistics by K S Negi , ISBN:9789374735053,4th Edition, Year:2023, AITBS Publishers, INDIA

#### Reference books

R1. Johnson & Christensen. (2004). Educational Research: Quantitative, qualitative and mixes approaches, 2nd Ed. Boston: Allyn & Bacon.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain research methodology, evaluate significance of research and identify research problems.	<b>1, 2, 3</b>
<b>2</b>	Explain research design, sampling design and design experiment for research.	<b>2, 3</b>
<b>3</b>	Collection and representation of data and interpret the data with descriptive statistics.	<b>2, 3</b>
<b>4</b>	Explain to write report, article, reviews etc.	<b>2, 3, 4</b>
<b>5</b>	Explain intellectual property right and related rights	<b>1, 8</b>

COURSE TITLE		UNIVERSAL HUMAN VALUES (UHV) + PROFESSIONAL ETHICS							
Course code	22MSCE121R	Total credits: 2	L	T	P	S	R	O/f	C
		Total hours:15T+30P	1	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Zoology								
Semester	Winter/II semester of First year of the programme								
Course objectives	<ol style="list-style-type: none"> <li>To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings</li> <li>To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way</li> <li>To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature</li> </ol>								
CO1	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.								
CO2	It is free from any dogma or value prescriptions.								
CO3	It is a process of self-investigation and self-exploration, and not of giving sermons.								
CO4	Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.								
CO5	This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.								
Unit	Content								
I	<ul style="list-style-type: none"> <li>Understanding the need, basic guidelines, content and process for Value Education</li> <li>Self Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self exploration</li> <li>Continuous Happiness and Prosperity- A look at basic Human Aspirations</li> <li>Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority</li> <li>Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario</li> <li>Method to fulfil the above human aspirations: understanding and living in harmony at various levels.</li> </ul>								
II	<ul style="list-style-type: none"> <li>Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’</li> <li>Understanding the needs of Self (‘I’) and ‘Body’ - <i>Sukh</i> and <i>Suvidha</i></li> <li>Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)</li> <li>Understanding the characteristics and activities of ‘I’ and harmony in ‘I’</li> <li>Understanding the harmony of I with the Body: <i>Sanyam</i> and <i>Swasthya</i>; correct appraisal of Physical needs, meaning of Prosperity in detail</li> <li>Programs to ensure <i>Sanyam</i> and <i>Swasthya</i>-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>								



<p style="text-align: center;"><b>III</b></p>	<ul style="list-style-type: none"> <li>• Understanding Harmony in the family – the basic unit of human interaction</li> <li>• Understanding values in human-human relationship; meaning of Nyaya and program for its fulfilment to ensure Ubhay-tripti;</li> <li>• Trust (Vishwas) and Respect (Samman) as the foundational values of relationship</li> <li>• Understanding the meaning of Vishwas; Difference between intention and competence</li> <li>• Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship</li> <li>• Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals</li> <li>• Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha )- from family to world family!-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>
<p style="text-align: center;"><b>IV</b></p>	<ul style="list-style-type: none"> <li>• Understanding the harmony in the Nature</li> <li>• Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature</li> <li>• Understanding Existence as Co-existence (<i>Sah-astitva</i>) of mutually interacting units in all-pervasive space</li> <li>• Holistic perception of harmony at all levels of existence-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>
<p style="text-align: center;"><b>V</b></p>	<ul style="list-style-type: none"> <li>• Natural acceptance of human values</li> <li>• Definitiveness of Ethical Human Conduct</li> <li>• Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order</li> <li>• Competence in professional ethics: <ul style="list-style-type: none"> <li>➤ Ability to utilize the professional competence for augmenting universal human order</li> <li>➤ Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems,</li> <li>➤ Ability to identify and develop appropriate technologies and management patterns for above production systems.</li> </ul> </li> <li>• Case studies of typical holistic technologies, management models and production systems</li> <li>• Strategy for transition from the present state to Universal Human Order: <ul style="list-style-type: none"> <li>➤ At the level of individual: as socially and ecologically responsible engineers, technologists and managers</li> <li>➤ At the level of society: as mutually enriching institutions and organizations</li> </ul> </li> </ul>
<p><b>Guidelines and Content for Practice Sessions</b></p>	<p>UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education</p> <p>PS 1: Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? How do you differentiate between right and wrong? What have been your achievements and shortcomings in your life? Observe and analyze them.</p> <p>Expected outcome: the students start exploring themselves; get comfortable to each other and to the teacher and start finding the need and relevance for the course.</p>

PS 2: Now-a-days, there is a lot of voice about many techno-genic maladies such as energy and natural resource depletion, environmental pollution, global warming, ozone depletion, deforestation, soil degradation, etc. – all these seem to be man-made problems threatening the survival of life on Earth – What is the root cause of these maladies & what is the way out in your opinion?

On the other hand, there is rapidly growing danger because of nuclear proliferation, armsrace, terrorism, criminalization of politics, large scale corruption, scams, breakdown of relationships, generation gap, depression & suicidal attempts, etc – what do you think, is the root cause of these threats to human happiness and peace – what could be the way out in your opinion?

Expected outcome: the students start finding that technical education without study of human values can generate more problems than solutions. They also start feeling that lack of understanding of human values is the root cause of all problems and the sustained solution could emerge only through understanding of human values and value based living. Any solution brought out through fear, temptation or dogma will not be sustainable.

PS 3:

1. Observe that each one of us has Natural Acceptance, based on which one can verify right or not right for him. Verify this in case of

i) What is Naturally Acceptable to you in relationship- Feeling of respect or disrespect?

ii) What is Naturally Acceptable to you – to nurture or to exploit others? Is your living the same as your natural acceptance or different?

2. Out of the three basic requirements for fulfillment of your aspirations- right understanding, relationship and physical facilities, observe how the problems in your family are related to each. Also observe how much time & effort you devote for each in your daily routine.

Expected outcome:

1. The students are able to see that verification on the basis of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity; it will only develop assumptions.

2. The students are able to see that their practice in living is not in harmony with their natural acceptance most of the time, and all they need to do is to refer to their natural acceptance to remove this disharmony.

3. The students are able to see that lack of right understanding leading to lack of relationship is the major cause of problems in their family and not the lack of physical facilities in most of the cases, while they have given higher priority to earning of physical facilities in their life ignoring relationships and not being aware that right understanding is the most important requirement for any human being.

UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!

PS 4: List down all your desires. Observe whether the desire is related to Self (I) or Body. If it appears to be related to both, see which part of it is related to Self (I) and which part is related to Body.

Expected outcome: the students are able to see that they can enlist their desires and the desires are not vague. Also they are able to relate their desires to 'I' and 'Body' distinctly. If any desire appears related to both, they are able to see that the feeling is related to I while the physical facility is related to the body. They are also able to see that 'I' and 'Body' are two realities, and most of their desires are related to 'I' and not body, while their efforts are mostly centered on the fulfillment of the needs of the body

assuming that it will meet the needs of 'I' too.

PS 5:

1. a. Observe that any physical facility you use, follows the given sequence with time : Necessary & tasteful → unnecessary & tasteful → unnecessary & tasteless → intolerable  
b. In contrast, observe that any feeling in you is either naturally acceptable or not acceptable at all. If naturally acceptable, you want it continuously and if not acceptable, you do not want it any moment!

2. List down all your activities. Observe whether the activity is of 'I' or of Body or with the participation of both 'I' and Body.

3. Observe the activities within 'I'. Identify the object of your attention for different moments (over a period of say 5 to 10 minutes) and draw a line diagram connecting these points. Try to observe the link between any two nodes.

Expected outcome:

1. The students are able to see that all physical facilities they use are required for a limited time in a limited quantity. Also they are able to see that in case of feelings, they want continuity of the naturally acceptable feelings and they do not want feelings which are not naturally acceptable even for a single moment.

2. The students are able to see that activities like understanding, desire, thought and selection are the activities of 'I' only, the activities like breathing, palpitation of different parts of the body are fully the activities of the body with the acceptance of 'I' while the activities they do with their sense organs like hearing through ears, seeing through eyes, sensing through touch, tasting through tongue and smelling through nose or the activities they do with their work organs like hands, legs etc. are such activities that require the participation of both 'I' and body.

3. The students become aware of their activities of 'I' and start finding their focus of attention at different moments. Also they are able to see that most of their desires are coming from outside (through preconditioning or sensation) and are not based on their natural acceptance.

PS 6:

1. Chalk out programs to ensure that you are responsible to your body- for the nurturing, protection and right utilisation of the body.

2. Find out the plants and shrubs growing in and around your campus. Find out their use for curing different diseases.

Expected outcome: The students are able to list down activities related to proper upkeep of the body and practice them in their daily routine. They are also able to appreciate the plants wildly growing in and around the campus which can be beneficial in curing different diseases.

UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

PS 7: Form small groups in the class and in that group initiate dialogue and ask the eight questions related to trust. The eight questions are:

1a. Do I want to make myself happy? 2a. Do I want to make the other happy?

3a. Does the other want to make him happy? 4a. Does the other want to make me happy?

What is the answer?

Intention (Natural Acceptance)

1b. Am I able to make myself always happy? 2b. Am I able to make the other always happy?

3b. Is the other able to make him always happy? 4b. Is the other able to make me always happy?

What is the answer?

Competence

Let each student answer the questions for himself and everyone else. Discuss the difference between intention and competence. Observe whether you evaluate your intention & competence as well as the others' intention & competence.

Expected outcome: The students are able to see that the first four questions are related to our Natural Acceptance i.e. Intention and the next four to our Competence. They are able to note that the intention is always correct, only competence is lacking! We generally evaluate ourselves on the basis of our intention and others on the basis of their competence! We seldom look at our competence and others' intention as a result we conclude that I am a good person and other is a bad person.

PS 8:

1. Observe on how many occasions you are respecting your related ones (by doing the right evaluation) and on how many occasions you are disrespecting by way of under-evaluation, over-evaluation or otherwise evaluation.

2. Also observe whether your feeling of respect is based on treating the other as yourself or on differentiations based on body, physical facilities or beliefs.

Expected outcome: The students are able to see that respect is right evaluation, and only right evaluation leads to fulfillment in relationship. Many present problems in the society are an outcome of differentiation (lack of understanding of respect), like gender biasness, generation gap, caste conflicts, class struggle, dominations through power play, communal violence, clash of isms, and so on so forth. All these problems can be solved by realizing that the other is like me as he has the same natural acceptance, potential and program to ensure a happy and prosperous life for him and for others though he may have different body, physical facilities or beliefs.

PS 9:

1. Write a note in the form of story, poem, skit, essay, narration, dialogue to educate a child. Evaluate it in a group.

2. Develop three chapters to introduce 'social science- its need, scope and content' in the primary education of children

Expected outcome: The students are able to use their creativity for educating children. The students are able to see that they can play a role in providing value education for children. They are able to put in simple words the issues that are essential to understand for children and comprehensible to them. The students are able to develop an outline of holistic model for social science and compare it with the existing model.

UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

PS 10: List down units (things) around you. Classify them in four orders. Observe and explain the mutual fulfillment of each unit with other orders.

Expected outcome: The students are able to differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them. They are also able to see that human beings are not fulfilling to other orders today and need to take appropriate steps to ensure right participation (in terms of nurturing, protection and right utilization) in the nature.

	<p>PS 11:</p> <ol style="list-style-type: none"> <li>1. Make a chart for the whole existence. List down different courses of studies and relate them to different units or levels in the existence.</li> <li>2. Choose any one subject being taught today. Evaluate it and suggest suitable modifications to make it appropriate and holistic.</li> </ol> <p>Expected outcome: The students feel confident that they can understand the whole existence; nothing is a mystery in this existence. They are also able to see the interconnectedness in the nature, and point out how different courses of study relate to the different units and levels. Also they are able to make out how these courses can be made appropriate and holistic.</p> <p>UNIT 5: Implications of the above Holistic Understanding of Harmony at all Levels of Existence</p> <p>PS 12: Choose any two current problems of different kind in the society and suggest how they can be solved on the basis of natural acceptance of human values. Suggest steps you will take in present conditions.</p> <p>Expected outcome: The students are able to present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.</p> <p>PS 13:</p> <ol style="list-style-type: none"> <li>1. Suggest ways in which you can use your knowledge of Technology/Engineering/Management for universal human order, from your family to the world family.</li> <li>2. Suggest one format of humanistic constitution at the level of nation from your side.</li> </ol> <p>Expected outcome: The students are able to grasp the right utilization of their knowledge in their streams of Technology/Engineering/ Management to ensure mutually enriching and recyclable productions systems.</p> <p>PS 14: The course is going to be over now. Evaluate your state before and after the course in terms of</p> <ol style="list-style-type: none"> <li>a. Thought</li> <li>b. Behavior and</li> <li>c. Workd. Realization</li> </ol> <p>Do you have any plan to participate in the transition of the society after graduating from the institute? Write a brief note on it.</p> <p>Expected outcome: The students are able to sincerely evaluate the course and share with their friends. They are also able to suggest measures to make the course more effective and relevant. They are also able to make use of their understanding in the course for a happy and prosperous society.</p>
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### **Text book**

T1: R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and Professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

### **Reference**

**R1:** B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

**R2:** PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.

**R3:** Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986,1991

### **Other Learning Resources**

Value Education websites, <http://uhv.ac.in>, <http://www.uptu.ac.in>

Story of Stuff, <http://www.storyofstuff.com>

Al Gore, An Inconvenient Truth, Paramount Classics, USA  
 Charlie Chaplin, Modern Times, United Artists, USA  
 IIT Delhi, Modern Technology – the Untold Story

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.	<b>2</b>
<b>2</b>	It is free from any dogma or value prescriptions.	<b>2</b>
<b>3</b>	It is a process of self-investigation and self-exploration, and not of giving sermons.	<b>1</b>
<b>4</b>	Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.	<b>0</b>
<b>5</b>	This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.	<b>0</b>

<b>COURSE TITLE</b>	<b>COMMUNICATION MASTERY (Communicative English &amp; Soft Skills)</b>								
<b>Course code</b>	<b>22UMPD121R</b>	<b>Total credits: 2</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/f</b>	<b>C</b>
			<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Pre-requisite</b>	<b>22UMPD111R</b> <b>Effective English</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>programme</b>	<b>Master of Science in Biotechnology</b>								
<b>Semester</b>	<b>Spring/II semester of First year of the programme</b>								
<b>Course objectives</b>	<ol style="list-style-type: none"> <li>To familiarize students with the transformation of sentences and the appropriate use of prepositions.</li> <li>To enhance the writing skills in different areas including CV and cover letter writing.</li> <li>To convey meaning by reinforcing, substituting for, or contradicting verbal communication.</li> <li>Productivity and performance boosting activities for professional goal achievement.</li> </ol>								
<b>CO1</b>	<b>Explain prepositions, tag questions, and idioms correctly.</b>								
<b>CO2</b>	<b>Discuss and analyze different sentence types and voices.</b>								
<b>CO3</b>	<b>Explain effective paragraphs, precis, and professional documents.</b>								
<b>CO4</b>	<b>Describe SWOT analysis, goal setting, and personal hygiene principles.</b>								
<b>CO5</b>	<b>Illustrate non-verbal communication and body language concepts.</b>								
<b>Unit</b>	<b>Content</b>								
<b>Module 1- Grammar</b>	<ol style="list-style-type: none"> <li>Use of Prepositions</li> <li>Tag questions</li> <li>Idioms, Phrases and Clauses</li> <li>Simple, complex, compound sentences</li> </ol>								
<b>Module 2- Grammar</b>	<ol style="list-style-type: none"> <li>Active and Passive Voice</li> <li>Direct and Indirect Speech</li> </ol>								
<b>Module 3- Writing Skills</b>	<ol style="list-style-type: none"> <li>The Basics of Writing; avoid ambiguity and vagueness</li> <li>Paragraph Writing</li> <li>Precis Writing</li> <li>Letter Writing</li> <li>Resume, CV and Cover Letter</li> </ol>								
<b>Module 4- Self-Management Skills</b>	<ol style="list-style-type: none"> <li>SWOT Analysis</li> <li>Self-Regulation- Goal Setting</li> <li>Personal Hygiene</li> </ol>								
<b>Module 5- Non- Verbal Communication- Sciences of Body Language</b>	<ol style="list-style-type: none"> <li>What is Non-Verbal Communication &amp; Body Language,</li> <li>Elements of Communication,</li> <li>Types of Body Language,</li> <li>Importance and Impact of Body Language,</li> <li>Types of Communication through Body Language,</li> <li>Introduction to Haptic, Introduction to Kinesics</li> <li>Introduction to Proxemics,</li> <li>Body Language Do's and Don'ts, Doubt Clearing Session.</li> </ol>								
<b>Module 6- Group Discussion (Theory)</b>	<ol style="list-style-type: none"> <li>Importance,</li> <li>Planning, Elements, and Skills assessed;</li> <li>Effectively disagreeing,</li> </ol>								

**Text book**

T1: Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

T2: McDowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition).

**Reference books**

R1: Communication Skills Training: A Practical Guide to Improving Your Social Intelligence, Presentation and Social Speaking, Ian Tuhovsky, 2019

R2: A Textbook for AECC English Communication: Interface, Dr. Kironmoy Chetia and Pranami Bania Breez Mohan Hazarika, January 2019.

**Other Learning Resources:**

<https://youtu.be/x60GHpQ8gJk>

[https://youtu.be/Ke\\_oSN-BCaY](https://youtu.be/Ke_oSN-BCaY)

<https://youtu.be/TDPDtrLxT-c>

<https://www.classcentral.com/report/toefl-preparation/>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain prepositions, tag questions, and idioms correctly.	<b>1, 2, 4, 8</b>
<b>2</b>	Discuss and analyze different sentence types and voices.	<b>1, 2, 4, 8</b>
<b>3</b>	Explain effective paragraphs, precis, and professional documents.	<b>1, 2, 4, 8</b>
<b>4</b>	Describe SWOT analysis, goal setting, and personal hygiene principles.	<b>1, 2, 4, 8</b>
<b>5</b>	Illustrate non-verbal communication and body language concepts.	<b>1, 2, 4, 8</b>



Course Title	Computational System and Digital Literacy								
Course code	22UCDL103R	Total credits: 1 Total hours:30	L	T	P	S	R	O/f	C
			0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Biotechnology								
Semester	Spring/II semester of First year of the programme								
Course objectives	1. Students will be able to understand the fundamentals of computer systems and Internet search along with advanced features of MS-Office. 2. Students will be able to learn data management, statistical analysis and visualization. 3. Students will be able to use social media and e-commerce portals, Digital Payment systems, and other utility software.								
CO1	Explain <b>computer systems and Internet search fundamentals.</b>								
CO2	Describe <b>data analysis and visualization problems with MS Office.</b>								
CO3	Illustrate <b>social media and e-commerce sites efficiently and ethically.</b>								
CO4	Discuss <b>about utility software for research and information management.</b>								
CO5	Explain <b>software tools for research and data management.</b>								
Unit-No.	Content								
I	<b>Fundamentals of Computer Systems, Office Automation and Internet Search</b> i. Components of a Computer and their functions. ii. Office Automation using MS-Word, MS-Excel, and MS-PowerPoint. iii. Data management, Statistical Data Analysis and Data Visualization with MS-Excel. iv. Use of Functions, Graphs & Charts in MS-Excel.								
II	<b>Internet &amp; Cyber World</b> i. Introduction to Computer Networks, Internet and World Wide Web, Websites and Web portals. ii. Creation and use of Email Accounts. iii. Web browsing, Web Searching, Different aspects of Web Searching- Search Keywords, conditions and combinations. iv. Study of different Search Engines like Google, Microsoft Bing, Yahoo, Yandex, DuckDuckGo, Ask.Com etc. v. Cyber Crimes, Cyber Laws and IT Act 2000,India.								
III	<b>Introduction to Social Media and E-Commerce</b> i. Relevance of Social Media in present scenario. Posting different types of contents in Social Media. ii. Creating accounts and using some popular Social media portals and Apps like WhatsApp, Facebook, etc. Social Media Etiquettes &Crimes. iii. Definition of E-Commerce; E-Commerce versus traditional Commerce. iv. Case studies of popular E-Commerce portals like Amazon. v. E-commerce Etiquettes &Crimes.								
IV	<b>Digital Payments and Digital Transactions</b> i. Introduction to Digital Payment Systems. ii. Creating accounts and using Digital Payment Systems like Credit Cards, Debit Cards, Netbanking, UPI. Digital payments Etiquettes &Crimes.								

<b>V</b>	<p style="text-align: center;"><b>Basic Accounting and Utility Software</b></p> <p>i. Introduction to Basic accounting concepts, Introduction to an Accounting Software like GnuCash or Tally.</p> <p>ii. Introduction to Technical Document writing using LaTeX.</p> <p>iii. Introduction to Data Visualization software – Sigma, Google Charts, Tableau</p>
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**Text books**

T1: Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems & Applications. 3rd ed. New Delhi: BPB Publications.

T2: Goel, A, 2010. Computer Fundamentals, Pearson India.

**Reference books**

R1: Balaguruswamy, E. 2009 Fundamentals of Computers, Tata McGraw-Hill Education.

R2: Balaguruswamy, 2014. E. Fund Of Comp & Programming (Updated Ed Sem. I, Au) Tata McGraw-Hill Education.

R3: Lawson, C. 2022. Introduction to Social Media, Oklahoma State University.

**Other learning resources:**

<https://www.w3schools.com>

<https://edu.gcfglobal.org>

<https://www.tutorialspoint.com>

<https://www.javatpoint.com>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain computer systems and Internet search fundamentals.	<b>1</b>
<b>2</b>	Describe data analysis and visualization problems with MS Office.	<b>1, 2</b>
<b>3</b>	Illustrate social media and e-commerce sites efficiently and ethically.	<b>1, 2, 5</b>
<b>4</b>	Discuss about utility software for research and information management.	<b>1, 2, 3</b>
<b>5</b>	Explain software tools for research and data management.	<b>1, 3</b>

SEMESTER – III									
Course Title	ORNAMENTAL FISH FARMING (TPS-II)								
Course code	22MSZO213R	TOTAL CREDITS: 2	L	T	P	S	R	O/F	C
		TOTAL HOURS: 60P	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To inculcate importance of ornamental fish farming in relation with entrepreneurship development. 2. To give students knowledge about ornamental fish rearing to make them self-sustainable. 3. To teach techniques of construction of glass aquarium and its maintenance.								
CO1	Identify ornamental fish and aquarium plants.								
CO2	Design setting up of aquaria and apply knowledge on farming for its maintenance.								
CO3	Demonstrate rearing of indigenous ornamental fish and estimate physico chemical characteristics of aquarium water.								
CO4	Analyse physico-chemical characteristics of aquarium water, design and construct biological filter for culturing plankton.								
CO5	Analyze ornamental fish farms through field visits.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Ornamental fishes and plants</b> <ul style="list-style-type: none"> <li>• Identification of common ornamental fishes.</li> <li>• Identification of common aquarium plants.</li> </ul>	7	Students will be able to identify common Ornamental Fishes and common aquarium plants				1,2		
II	<b>Designing and setting up of aquarium</b> <ul style="list-style-type: none"> <li>• Aquarium designing and equipments.</li> </ul> Setting up and maintenance of fresh water aquaria.	10	Students will be able to design and maintain aquaria				1,2		
III	<b>Rearing and physico-chemical parameters of aquarium water</b> <ul style="list-style-type: none"> <li>• Rearing of indigenous ornamental fish in aquarium.</li> </ul> Estimation of physico-chemical characteristics of aquarium water.	10	Students will be able to rear Indigenous ornamental fish in Aquarium and able to do estimation of Physico-chemical characteristics of Aquarium water				1,2		
IV	<b>Biological filter and plankton culture</b> <ul style="list-style-type: none"> <li>• Preparation of biological filter for removal of ammonia from aquarium.</li> </ul>	8	Students will be able to Construct biological filter and develop plankton culture				1,2		

	• Culture of planktons.			
<b>V</b>	<b>Field study</b> Visit to ornamental fish farm.	<b>10</b>	It will help the students to get broad knowledge in ornamental fish farming	1,2

**TEXT BOOKS:**

- T1: Ornamental fish farming by B. Andrews. (Latest Edition) Kindle Edition.  
T2: Textbook of aquaculture by B. Ahilan, N. Felix and R. Santhanan (Latest Edition) Daya Publishing House.  
T3: Aquarium Fish: A definite guide to identifying and keeping fresh water and marine species by M. Bailey and G. Sandford (Latest Edition)

**REFERENCE BOOKS:**

- R1: The freshwater fishes of the Indian region by Jayaram, K.C. 1999. New Delhi: Narendra Publishing House. 551 pp.  
R2: Fishes of northeast India by Vishwanath, W., W.S. Lakra and U.K. Sarkar. 2007. Lucknow: National Bureau of Fish Genetic Resources. 264 pp.  
R3: A textbook of Fish Biology and Fisheries by S.S. Khanna and H. R. Singh (3<sup>rd</sup> Edition). Narendra Publishing House, Delhi.  
R4: Handbook of the freshwater fishes of India by Beaven C R (Latest Edition) Narendra Publishing House.  
R5: Fish and Fisheries of India by Jhingran V. G. (4<sup>th</sup> Edition). Hindustan Publishing Corporation  
R6: Ichthyology by Lagler et al. (2<sup>nd</sup> edition). Wiley Publication.  
R7: Fish and Fisheries by Pandey (Latest Edition). Rastogi Publications.  
R8: Fishes by Chandy, M. (1<sup>st</sup> Edition). National Book Trust, India.

**OTHER LEARNING RESOURCES:**

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Identify ornamental fish and aquarium plants.	<b>1</b>
<b>2</b>	Design setting up of aquaria and apply knowledge on farming for its maintenance.	<b>1, 8</b>
<b>3</b>	Demonstrate rearing of indigenous ornamental fish and estimate physico chemical characteristics of aquarium water.	<b>1, 8</b>
<b>4</b>	Analyse physico-chemical characteristics of aquarium water, design and construct biological filter for culturing plankton.	<b>1, 8</b>
<b>5</b>	Analyze ornamental fish farms through field visits.	<b>1, 7</b>

COURSE TITLE	RESEARCH ETHICS								
COURSE CODE	22UMRE214R	TOTAL CREDITS:1	L	T	P	S	R	O/F	C
		TOTAL HOURS:60	0	0	0	4	0	0	1
PRE-REQUISITE	NA	CO-REQUISITE	NA						
PROGRAMME	MSc. Zoology								
SEMESTER	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	1. Grasp moral theories, research regulation, and ethical principles in research. 2. Identify and address scientific misconduct and maintain research integrity. 3. Learn about publication ethics, open access, and research metrics.								
CO1	Describe and apply research ethics theories and methods.								
CO2	Explain research ethics issues such as responsibility, vetting, and misconduct.								
CO3	Illustrate <b>arguments and results in ethical research inquiries.</b>								
CO4	Identify and apply procedures for sampling, data collection, and reporting.								
CO5	Apply ethical principles to research design and evaluation								
Unit no	Content								
I	<b>ETHICS:</b> Introduction to the course and each other; an introduction to moral theory. Ethics: definition, moral philosophy, nature of moral judgements and reactions. Research regulation; self – regulation; research ethics. Honesty, candor, compromise and integrity. Data ownership and stewardship; conflicts of interest; collaboration. Human and Non-Human subjects. Research and researchers in society.								
II	<b>SCIENTIFIC CONDUCT-</b> Ethics with respect to science and research. Intellectual honesty and research integrity. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP). Redundant publications: duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data								
III	<b>PUBLICATION ETHICS-</b> Publication ethics: definition, introduction and importance. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types. Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals.								
IV	<b>OPEN ACCESS PUBLISHING-</b> Open access publications and initiatives. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies. Software tool to identify predatory publications developed by SPPU. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.								
V	<b>PUBLICATION MISCONDUCT</b> Group Discussions; Subject specific ethical issues, FFP, authorship. Conflicts of interest. Complaints and appeals: examples and fraud from India and abroad. Software tools; Use of plagiarism software like Turnitin, Urkund and other open source software tools. <b>DATABASES AND RESEARCH METRICS</b> –Databases: Indexing databases. Citation databases: Web of Science, Scopus, etc. Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score. Metrics: h-index, g index, I 10 index, altmetrics.								

### Text Books

T1: Bird, A(2006).Philosophy of Science.Routledge.

T2: MacIntyre, Alasdair (1967) A Short History of Ethics.London.

T3:Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance(2019)

**Reference Books**

R1: National Academy of Science, National Academy of Engineering and Institute of Medicine (2009). R2: On Being a Scientist: A Guide of Responsible Conduct in Research: Third Edition, National academicsPress

R3: George R, (2011). Sociological Theory, Rawat Publication, New Delhi, India. GeorgeR, (2019).

R3: Post Modern Social Theory, Rawat Publication, New Delhi, India.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe and apply research ethics theories and methods.	<b>1, 3, 5</b>
<b>2</b>	Explain research ethics issues such as responsibility, vetting, and misconduct.	<b>1, 3, 5</b>
<b>3</b>	Illustrate arguments and results in ethical research inquiries.	<b>1, 3, 5</b>
<b>4</b>	Identify and apply procedures for sampling, data collection, and reporting.	<b>1, 3, 5</b>
<b>5</b>	Apply ethical principles to research design and evaluation	<b>1, 3, 5</b>

COURSE TITLE	CORPORATE PROFICIENCY								
COURSE CODE	22UMPD211R	Total credits: 2 Total hours: 30	L	T	P	S	R	O/F	C
			0	0	4	0	0	0	2
PRE-REQUISITE	22UMPD121R Communication Mastery	CO-REQUISITE	NA						
PROGRAMMES	MSc. Biotechnology								
SEMESTER	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	<ol style="list-style-type: none"> <li>To acquaint students with the various tools of an effective presentation.</li> <li>To acquire the speaking skill instruct, influence, engage, educate, or appease the listeners.</li> <li>To increase proficiency, present ability and quality of resume and provide guidance for self- promotion and self-evaluation in social media.</li> <li>To prepare and train the students for the campus drives &amp; walking interviews.</li> </ol>								
CO1	Able to speak with greater control and charisma in front of others.								
CO3	Discuss the positive impact in their thought process and problem-solving skills.								
CO3	Illustrate with all the necessary tools and skill sets to prepare professional resume.								
CO4	Discuss the highlights and assess themselves in social media.								
CO5	Explain the impart in them techniques to solve critical problems in an interview, develop strategies to crack interviews, improve their communication skills, boost their confidence								
Unit no	Content								
I	<b>Module 1- Presentation Skills</b> i. Introduction ii. Essential characteristics of a good presentation iii. Preparation of a good presentation								
II	<b>Module 2- Public Skills</b> i. Fear of Public Speaking, ii. Understanding and Overcoming Fear of Public Speaking, iii. Confidence and Control, iv. Physiology and Stress - Control/Process, v. Tips for Presentations and Public Speaking, vi. Tips for Using Visual Aids in Presentations, vii. Process for Preparing and Creating Presentations, viii. Delivering Presentations Successfully, ix. Doubt Clearing and Summary of Main Points								
III	<b>Module 3- Practical session on Resume, Curriculum Vitae, Writing cover letter &amp; LinkedIn Profile</b> i. Preparation, submission & screening of Resume. ii. Practical session on cover letter screening session iii. Creating a profile on LinkedIn iv. How to utilize it <b>Module 4- Leadership &amp; Management Skills</b> i. Concepts of Leadership, ii. Leadership Styles, iii. Manager VS Leader, iv. How to be an Effective Leader, v. Mock/ Practice Session, vi. Doubt Clearing Session.								
IV	<b>Module 5- Research Paper – Writing Skills</b>								

	i. How to write a research paper ii. Key point in Research Work  <b>Module 6- Interview Skills &amp; Dress code Ethics</b> i. Types of the interview- telephonic, virtual & face to face ii. Online interview, personal interview, iii. Panel interview, iv. Group interview, v. JAM session, vi. Types of interview questions-traditional/common interview questions, vii. Case interview questions, viii. General Strategies for answering questions, ix. Marketing your skills and experiences, x. Preparation before the interview, xi. How to dress up for an interview, xii. How to maintain eye contact and positive body language, xiii. How to be presentable, xiv. Interview dos and don'ts, xv. Introduction to Dress Code Ethics, xvi. Purpose and Importance xvii. How to Make „FIRSTIMPRESSION“ xviii. What to Wear During Interviews or Any Other Formal Meetings – Male &Female
<b>V</b>	<b>Module 7- Mock Interview</b> i. Practical Mock Interview, ii. Feedback- Receiving Feedback, iii. Giving Feedback, iv. Advantages of Effective Feedback, v. How to deal with negative feedback.

#### Text Books

- T1.Barrett,Grant.2016.Perfect English Grammar: The Indispensible Guide to Excellent Writing and Speaking, Zephyros Press.  
 T2.McDowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition).

#### Reference Books

- Garg. Manoj Kr. (2018)English Communication: Theory and Practice  
 Other Learning Resources: <https://brightlinkprep.com/10-best-toefl-prep-books/>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Able to speak with greater control and charisma in front of others.	<b>1, 4, 8</b>
<b>2</b>	Discuss the positive impact in their thought process and problem-solving skills.	<b>1, 4, 8</b>
<b>3</b>	Illustrate with all the necessary tools and skill sets to prepare professional resume.	<b>1, 4, 8</b>
<b>4</b>	Discuss the highlights and assess themselves in social media.	<b>1, 4, 8</b>
<b>5</b>	Explain the impart in them techniques to solve critical problems in an interview, develop strategies to crack interviews, improve their communication skills, boost their confidence	<b>1, 4, 8</b>



SEMESTER – III									
Course Title	ANIMAL PHYSIOLOGY								
Course code	22MSZO216R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	<ul style="list-style-type: none"> <li>To provide knowledge of animal body system to reveal physiological homologies, pattern of physiological adaptation to various environments.</li> <li>To introduce various principles that underlies higher level integrative bodily functions.</li> <li>To provide a comprehensive knowledge of functional physiological pathways common to all animals ranging from molecular, biochemical, cellular processes.</li> </ul>								
CO1	Explain the concepts of gas exchange in lungs and different types of respiratory pigments in humans and animals.								
CO2	Describe the function of heart as a pump and connecting tissues.								
CO3	Describe human response to different stimulus and ability of brain in understanding, storing information and controlling body.								
CO4	Illustrate the mechanism of breaking down of complex foods, assimilation and elimination of the nitrogenous wastes								
CO5	Discuss sensory organs (ear and eye) and the perception prepared by the brain.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Respiratory physiology</b> <ul style="list-style-type: none"> <li>Respiratory pigments: Haemoglobin, hemocyanin, erythrocrurin-chlorocruorin and haemerythrin</li> <li>Pulmonary circulation: Gaseous exchange through membranes and tissues: Fick's Law, structure of respiratory membrane, diffusion and perfusion</li> <li>Oxygen and carbon dioxide transport</li> <li>Oxygen dissociation curve and Bohr effect</li> <li>Chemical and neural regulation of respiration (briefly) <ul style="list-style-type: none"> <li>Aviation, space and deep-sea diving physiology</li> </ul> </li> </ul>	7	To understand the concepts of gas exchange in the lungs and different types of respiratory pigments in humans and animals.				1,2		
II	<b>Cardiovascular physiology</b> <ul style="list-style-type: none"> <li>Composition of blood, Hemostasis, Haemopoiesis, Lymphatic system and Lymph</li> <li>Circulation of blood in different</li> </ul>	10	To understand the function of heart as a pump and the blood and lymph as connecting tissues to carry gases and nutrients to and from the tissues and heart				1,2		

	animals (briefly), Origin and conduction of the cardiac impulse			
<b>III</b>	<b>Nerve and muscle physiology</b> <ul style="list-style-type: none"> <li>• Sensory parts: Sensory receptors, Motor Parts: Effectors</li> <li>• Processing of information, Storage of information</li> </ul> Synaptic transmission, neurotransmitters	<b>10</b>	To understand and analyze the ways in which we perceive the world around us and our response to stimuli along with the knowledge of how the brain stores and understands the information gathered to control our entire body.	1,2
<b>IV</b>	<b>Gastrointestinal and Renal physiology</b> <ul style="list-style-type: none"> <li>• Digestion, absorption and assimilation; Energy balance and BMR: Definitions;</li> <li>• Patterns of nitrogenous excretion in different animals; Counter- current exchanger in the kidney;</li> <li>• Regulation of urine formation; Acid base balance (blood and kidney); Homeostasis</li> </ul>	<b>8</b>	To understand the breaking down of complex foods into nutrients that are necessary for our body, assimilation and elimination of the nitrogenous wastes produced as a result of breakdown and utilization in the body.	1,2
<b>V</b>	<b>Special Senses</b> <ul style="list-style-type: none"> <li>• Vision: The retina structure and photochemistry of vision and function of the visual cortex</li> <li>• Hearing: The organ of Corti: structure and function, auditory nervous pathways and function of the cerebral cortex in hearing, Bioluminescence</li> </ul>	<b>10</b>	To understand that the eye and ear function as sensory organs and the visual and audio perception is done by the brain	1,2
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Estimation of free amino acid using ninhydrin reagent.</li> <li>• Blood glucose test.</li> <li>• Measurement of lung volume by spirometry.</li> <li>• Erythrocyte Sedimentation Rate (ESR).</li> <li>• Dissection to show the striated muscle structure of an invertebrate and vertebrate.</li> <li>• Dissection of a sample of goat spinal cord to demonstrate the structure of neurons.</li> </ul>	<b>30</b>	Students will be able to estimate free amino acids, perform blood glucose tests, measure lung volume with spirometry, determine ESR, and dissect specimens to study muscle structure and neuron anatomy.	1,2, 3,4

**TEXT BOOKS:**

T1: Essentials of Animal Physiology by S. C. Rastogi (Latest Edition) Publisher New Age Internationals.

T2: Textbook of Medical Physiology by Guyton and Hall (Latest Edition). Elsevier.

T3: Animal Physiology Edn.5 Part II, Verma (P.S) Etc, Aul. H Ed.Nch (James) Himalaya, 2000.  
 T4: Chordate Zoology and Animal Physiology, Jordan(El); Verma(P.S), S Chand and Company, 1993.  
 T5: Introduction to Animal Physiology, Kay(Ian), Bios Scientific Publishers, 1998.

### REFERENCE BOOKS:

R1: Eckert Animal Physiology: Mechanisms and Adaptations by Eckert and Randal (4<sup>th</sup> Edition). W. H. Freeman.  
 R2: Animal Physiology by Hill, Wyse and Anderson (3<sup>rd</sup> Edition). Sinauer Associates, Inc. Publishers • Sunderland, Massachusetts  
 R3: Essentials of Medical Physiology by K. Sembulingam and Prema Sembulingam (7<sup>th</sup> Edition). Jaypee Brothers Medical Pub  
 R4: Physiology by Linda S. Costanzo (7<sup>th</sup> Edition.). Wolters Kluwer  
 R5: Animal physiology: mechanism and adaptations by Eckert R. and Randal D (2<sup>nd</sup> Edition) CBS publishers and Distributor, New Delhi  
 General and Comparative physiology by Hoar W. S.(Latest Edition). Prentice Hall of India Pvt. Ltd.  
 R6: Animal physiology: Adaptation and Environment by Schmidt-Neilsen (Latest Edition), Cambridge Press.  
 R7: Comparative animal Physiology by Prosser C. L. (Latest Edition) Saunders, Philadelphia, USA

### OTHER LEARNING RESOURCES:

Animal Physiology : [https://swayam.gov.in/nd1\\_noc20\\_bt42/preview](https://swayam.gov.in/nd1_noc20_bt42/preview)  
 Physiology and Biochemistry: [https://swayam.gov.in/nd2\\_cec20\\_bt19/preview](https://swayam.gov.in/nd2_cec20_bt19/preview)  
 Animal Physiology : <https://www.classcentral.com/course/swayam-animal-physiology-12894>  
 Respiration in the Human Body: <https://www.classcentral.com/course/edx-respiration-in-thehuman-body-3050>  
 Introduction to Brain & Behaviour : [https://swayam.gov.in/nd1\\_noc20\\_hs33/preview](https://swayam.gov.in/nd1_noc20_hs33/preview)  
 Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]  
<https://www.ncbi.nlm.nih.gov/books/NBK459327/>  
<https://hearinghealthfoundation.org/how-hearing-works>  
<https://www.ncbi.nlm.nih.gov/books/NBK50780>

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain the concepts of gas exchange in lungs and different types of respiratory pigments in humans and animals.	1, 3
2	Describe the function of heart as a pump and connecting tissues.	1, 3
3	Describe human response to different stimulus and ability of brain in understanding, storing information and controlling body.	1, 3
4	Illustrate the mechanism of breaking down of complex foods, assimilation and elimination of the nitrogenous wastes	1, 3
5	Discuss sensory organs (ear and eye) and the perception prepared by the brain.	1, 3

SEMESTER – III									
Course Title	DEVELOPMENTAL BIOLOGY								
Course code	22MSZO217R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To comprehend key developmental processes and genetic mechanisms, including potency, differentiation, stem cells, and transgenics. 2. To analyse morphogenesis and cell adhesion in various organisms, and study types of regeneration. 3. To examine developmental stages in frogs, chicks, fish, and Drosophila, and understand programmed cell death processes.								
CO1	Explain the basic terminology of animal development, pre and post fertilization events and morphogenesis.								
CO2	Describe the gene regulations in axis and pattern formation in drosophila, amphibia and chick.								
CO3	Explain the process of organ formation (organogenesis).								
CO4	Explain the mechanism for regeneration of organs.								
CO5	Describe metamorphosis and types of cell death.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Modern concepts of development</b> <ul style="list-style-type: none"> <li>• Potency</li> <li>• Commitment</li> <li>• Specification</li> <li>• Induction</li> <li>• Competence</li> <li>• Determination</li> <li>• Differentiation</li> <li>• Cell fate and cell lineages</li> <li>• Stem cells</li> <li>• Genomic equivalence</li> <li>• cytoplasmic determinants</li> <li>• Imprinting</li> <li>• Mutant</li> </ul> Transgenics in analysis of development. <b>Fertilization</b> <ul style="list-style-type: none"> <li>• Pre and post fertilization events,</li> <li>• Activation of eggs</li> <li>• Gamete fusion</li> <li>• Prevention of phylogeny.</li> </ul> <b>Morphogenesis and cell adhesion</b> <ul style="list-style-type: none"> <li>• The thermodynamic model of cell</li> </ul>	7	Students will understand the modern concepts of development, including key processes like cell differentiation, stem cell function, genomic equivalence, and cytoplasmic determinants and explore the application of transgenics in developmental analysis and comprehend the mechanisms underpinning cell fate and lineage specification.				1,2		

	<p>interaction</p> <ul style="list-style-type: none"> <li>• Concept of morphogen gradients and morphogenetic fields</li> <li>• Cell adhesion molecules.</li> </ul>			
<b>II</b>	<p><b>Morphogenesis in organism</b></p> <ul style="list-style-type: none"> <li>• Cell aggregation and differentiation in Dictyostelium,</li> <li>• Axis and pattern formation in Drosophila: Maternal effect genes, gap genes, pair rule genes, segment polarity genes, homeotic genes and hox genes in development.</li> <li>• Axis and pattern formation in amphibian and chick.</li> </ul>	<b>10</b>	Students will understand the mechanisms of morphogenesis, including cell aggregation in Dictyostelium and axis and pattern formation in Drosophila, amphibians, and chicks, emphasizing the roles of key developmental genes.	1,2
<b>III</b>	<p><b>Organogenesis in animals</b></p> <ul style="list-style-type: none"> <li>• Vulva formation in <i>Caenorhabditis elegans</i></li> <li>• Eye lens induction</li> <li>• Limb development</li> </ul>	<b>10</b>	Students will understand the processes of organogenesis in animals, focusing on vulva formation in <i>Caenorhabditis elegans</i> , eye lens induction, and limb development.	1,2
<b>IV</b>	<p><b>Regeneration</b></p> <ul style="list-style-type: none"> <li>• Epimorphic regeneration of Salamander limbs</li> <li>• Morphallactic regeneration in hydra</li> <li>• Compensatory regeneration in Mammalian liver</li> </ul>	<b>8</b>	Students will understand various types of regeneration, including salamander limb epimorphic regeneration, hydra morphallactic regeneration, and mammalian liver compensatory regeneration.	1,2
<b>V</b>	<p><b>Post embryonic development</b></p> <ul style="list-style-type: none"> <li>• Larva formation</li> <li>• Metamorphosis</li> <li>• Chromosomal sex determination in mammals</li> </ul> <p><b>Programmed cell death</b></p> <ul style="list-style-type: none"> <li>• Apoptosis</li> <li>• Autophagy</li> <li>• Necrosis</li> </ul>	<b>10</b>	Students will understand post-embryonic development processes such as larva formation, metamorphosis, and chromosomal sex determination in mammals.	1,2
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole.</li> <li>• Study of whole mounts of developmental stages of chick through permanent slides/model/charts.</li> <li>• Preparation of whole mount of chick embryo of 13-18, 24-33, 36-48</li> </ul>	<b>30</b>	Students will develop practical skills in identifying and analyzing the developmental stages of various organisms, including frogs, chicks, fish, and <i>Drosophila melanogaster</i> , as well as understanding regeneration in tadpole tails and different egg types in invertebrates and vertebrates.	1,2, 3,4

	<p>and 48-72 hours and identification of the developmental stages.</p> <ul style="list-style-type: none"> <li>• Study of different types of invertebrate and vertebrate eggs from permanent slides/model/charts.</li> <li>• Study of developmental stages of fish from egg to hatching.</li> <li>• Study of regeneration in the tail of tadpoles.</li> <li>• Study of life cycle of <i>Drosophila melanogaster</i>.</li> </ul>			
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### TEXT BOOKS:

T1: Developmental Biology by Scott F, Gilbert (8<sup>th</sup> Ed.) NCBI Book self.

### REFERENCE BOOKS:

R1: Human Embryology and Developmental Biology by Bruce, M. Carlson (6<sup>th</sup> Edition). Elsevier.

R2: Principles of Development by Lewis Wolpert, Cheryll Tickle and Alfonso Martinez Arias (5<sup>th</sup> Edition). Oxford University Press.

R3: Developmental Biology by Michael J F Barresi and Scott F, Gilbert (12<sup>th</sup> Edition). Oxford University Press.

R4: Vertebrates Comparative Anatomy, Function and Evolution by Kardong, K.V. (IV • Edition). McGraw-Hill Higher Education.

R5: Comparative Anatomy of the Vertebrates by Kent, G.C. and Carr R.K. (IX • Edition). The McGraw-Hill Companies.

R6: Analysis of Vertebrate Structure by Hilderbrand, M and Gaslow G.E.(6<sup>th</sup> Edition). John Wiley and Sons.

R7: Biology of Vertebrates by Walter, H.E. and Sayles, L.P. (Latest Edition) Khosla Publishing House.

R8: Developmental Biology by Carol A. Erickson, Leon W. Browder, William R. Jeffery. (3<sup>rd</sup> Edition), Saunders College Publishing, Philadelphia.

R9: Principles of Development 5e Hardcover by Lewis Wolpert (5<sup>th</sup> Edition), Oxford University Press.

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain the basic terminology of animal development, pre and post fertilization events and morphogenesis.	1, 3
2	Describe the gene regulations in axis and pattern formation in drosophila, amphibia and chick.	1, 3
3	Explain the process of organ formation (organogenesis).	1, 3
4	Explain the mechanism for regeneration of organs.	1, 3
5	Describe metamorphosis and types of cell death.	1, 3

SEMESTER – III									
Course Title	AQUACULTURE								
Course code	22MSZO218R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	<ol style="list-style-type: none"> <li>To learn about freshwater and marine ecosystems, including their zonation and habitat classifications.</li> <li>To gain knowledge of various aquaculture methods, site selection, and species suitability for optimal production.</li> <li>To apply pre- and post-stocking management techniques, including water quality assessment and food efficiency metrics, to ensure successful aquaculture operations.</li> </ol>								
CO1	Explain concepts of different aquatic ecosystems.								
CO2	Describe types of aquaculture methods.								
CO3	Assess sites and identify species for aquaculture.								
CO4	Analyze pre stocking procedure and management.								
CO5	Analyze post stocking procedure and management.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Aquatic Ecosystems:</b> <ul style="list-style-type: none"> <li>Freshwater ecosystems - Lotic and Lentic ecosystems;</li> </ul> Marine ecosystems - oceans and seas, zonation of the seas - rocky, sandy and muddy shores; classification of marine habitat - pelagic, benthic, neritic, oceanic, littoral and abyssal.	7	Students will learn different aquatic systems				1,2		
II	<b>Aquaculture systems and methods:</b> <ul style="list-style-type: none"> <li>Scope and definition; origins and growth of aquaculture; biological and technological basis;</li> <li>Traditional, extensive, semi-intensive and intensive culture; monoculture, polyculture, composite culture, mixed culture, monosex culture; cage culture, pen culture, raft culture, sewage – fed fish culture.</li> </ul>	10	Students will learn different types of aquaculture methods				1,2		
III	<b>Selection of Sites and species for aquaculture:</b> <ul style="list-style-type: none"> <li>Survey and location of suitable site – topography; soil characteristics; water source; hydrometeorological data.</li> </ul>	10	It will help the students for site selection and selection of species for aquaculture				1,2		

	<ul style="list-style-type: none"> <li>Biological characteristics of aquaculture species; economic and market considerations; seed resources, collection and transportation</li> </ul>			
<b>IV</b>	<p><b>Pre Stocking Management:</b></p> <ul style="list-style-type: none"> <li>Sun drying, ploughing / tilling, desilting, liming and fertilization, eradication of weed fishes.</li> <li>Stocking: Acclimatization of seed and release; species combinations; stocking density; ratio.</li> </ul>	<b>8</b>	It will help the students to learn about prestocking processes	1,2
<b>V</b>	<p><b>Post Stocking Management:</b></p> <ul style="list-style-type: none"> <li>Water and soil quality parameters required for optimum production, control of aquatic weeds and aquatic insects, algal blooms;</li> <li>Specific food consumption, food conversion ratio (FCR), protein efficiency ratio, true net protein utilization, apparent net protein utilization, biological value of protein.</li> </ul>	<b>10</b>	It will help the students to get the knowledge Regarding different post stocking management	1,2
<b>Practical</b>	<ul style="list-style-type: none"> <li>Determination of water temperature, pH, salinity, turbidity.</li> <li>Analysis of total alkalinity of water.</li> <li>Determination of total hardness of water.</li> <li>Estimation of dissolved oxygen, BOD of water.</li> <li>Estimation of phosphates and CO<sub>2</sub>.</li> <li>Dissection of pituitary gland of fish.</li> <li>Estimation of primary productivity using dark and light bottle.</li> </ul>	<b>30</b>	Students will develop skills in assessing water quality by determining key parameters such as temperature, pH, salinity, turbidity, etc. as well as conducting primary productivity measurements and fish pituitary gland dissection.	1,2,3,4

#### TEXT BOOKS:

T1: Jhingran V.G. 1991. Fish and Fisheries of India. Hindustan Publ. Corporation, India

T2: Pillay TVR. 1990. Aquaculture- Principles and Practices. Fishing News Books Ltd.,

T3: Blackwell Rath RK. 2000. Freshwater Aquaculture. Scientific Publ.

T4: Landau M. 1992. Introduction to Aquaculture. John Wiley & Sons.

T5: A textbook of Fish Biology and Fisheries. S.S. Khanna and H. R. Singh. (3<sup>rd</sup>

Edition) Narendra PublishingHouse, Delhi.



**REFERENCE BOOKS:**

- R1: Huet J. 1986. A text Book of Fish Culture. Fishing News Books Ltd.
- R2: Mathew Landau. 1995. Introduction to Aquaculture. Daya Publishing House, New Delhi
- R3: Jhingran, V. G. 1982. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi.
- R4: Chakrabarti, N. M. 1998. Biology, Culture and Production of Indian Major Carps. Narendra Publishing House, New Delhi.
- R5: General and Applied Ichthyology by Gupta S.K., Gupta P.C. (Latest Edition). S Chand and Company
- R6: Handbook of the freshwater fishes of India by Beaven C R. (Latest Edition). Narendra Publishing House.

**OTHER LEARNING RESOURCES:**

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain concepts of different aquatic ecosystems.	<b>1, 3</b>
<b>2</b>	Describe types of aquaculture methods.	<b>1, 3</b>
<b>3</b>	Assess sites and identify species for aquaculture.	<b>1, 3</b>
<b>4</b>	Analyze pre stocking procedure and management.	<b>1, 3, 8</b>
<b>5</b>	Analyze post stocking procedure and management.	<b>1, 3, 8</b>

SEMESTER – III									
Course Title	ANIMAL DIVERSITY								
Course code	22MSZO219R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To understand concepts of biodiversity, global hotspots, and classifications of the Animal Kingdom. 2. To study animal diversity in India, including endemic species, protected areas, and adaptations in various ecosystems. 3. To learn principles of wildlife conservation, human-wildlife conflict resolution, and wildlife protection laws.								
<b>CO1</b>	Describe animal kingdom and animal diversity.								
<b>CO2</b>	Explain animal diversity in Indian context.								
<b>CO3</b>	Describe salient features and composition of life forms.								
<b>CO4</b>	Analyse adaptations in animal diversity.								
<b>CO5</b>	Describe the conservation programs adopted in India for conservation of wildlife.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
<b>I</b>	<b>Introduction to animal diversity:</b> <ul style="list-style-type: none"> <li>Biodiversity: Concept of biological diversity;</li> <li>Global biodiversity hotspots; RAMSAR convention and RAMSAR sites.</li> <li>Outline of Animal Kingdom Classification with examples.</li> </ul>	<b>7</b>	Students will understand the importance biological diversity					1,2	
<b>II</b>	<b>Animal diversity in India:</b> <ul style="list-style-type: none"> <li>General profile of faunal resources, endemic and threatened species.</li> <li>Protected areas: Biosphere reserve, national parks and sanctuaries</li> </ul>	<b>10</b>	Students will be able to know overall faunal profile of India, concept of protected areas.					1,2	
<b>III</b>	<b>Salient features and composition of life forms:</b> <ul style="list-style-type: none"> <li>Salient features and composition of life forms in terrestrial, desert and cavernicolous ecosystem</li> <li>Salient features and composition of life forms in freshwater, estuarine and marine ecosystem</li> </ul>	<b>10</b>	Students will know regarding salient features and composition of life forms.					1,2	
<b>IV</b>	<b>Adaptations in animal diversity:</b> <ul style="list-style-type: none"> <li>Terrestrial, desert and aquatic adaptation</li> <li>Animal diversity and human health:</li> </ul>	<b>8</b>	Students will have basic idea on adaptive capabilities of animal diversity.					1,2	

	<p>Important pathogenic life forms</p> <ul style="list-style-type: none"> <li>• Animal diversity and human society: Ethnozoology and Zootherapeutic</li> </ul>			
<b>V</b>	<p><b>Conservation and management of wildlife:</b></p> <ul style="list-style-type: none"> <li>• Principles of conservation, biodiversity management approaches</li> <li>• Human wildlife conflict; Peoples participation in managing protected areas</li> <li>• Wildlife health and disease</li> <li>• Wildlife trade and laws: Wildlife Protection Act, 1972</li> <li>• Red Data Book; Measure to control poaching and wildlife trade</li> </ul>	<b>10</b>	Students will have understanding on different conservation programme adopted in India for the conservation of animal diversity.	1,2
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Study of invertebrate museum specimen (two specimen from each phylum).</li> <li>• Study of invertebrate museum specimen (two specimen from each phylum).</li> <li>• Mounting of different types of scales of fish.</li> <li>• Mounting of mouthparts of insects.</li> <li>• Study of various types of social insects (honeybee/ants) and their nests.</li> </ul>	<b>30</b>	Students will gain practical experience in identifying and studying invertebrate specimens, mounting fish scales and insect mouthparts, and examining social insects and their nests.	1,2,3,4

**TEXT BOOKS:**

T1: Anna A. Sher and Richard B. Primack 2019. An Introduction to Conservation Biology, Oxford University press.

T2: Anon. 2004. Indian Wildlife Protection Act 1972. Natraj Publishers, Dehra Dun. 104p.

T3: Gopal, R. 1992. Fundamentals of Wildlife Management. Justice Home. Allahabad. 668p.

T4: Navjot S. Sodhi and Paul R. Ehrlich 2010. Conservation Biology for All. Oxford University press.

T5: Wilson, E. O., and D. Perlman. 2000. Conserving earth's biodiversity. Island Press, Washington, D.C.

## REFERENCE BOOKS:

- R1: Meffe, G. K. and C. R. Carroll 1994. Principles of Conservation Biology, Sinauer Associates, USA
- R2: Michael, P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata Mc Graw Hill Publishing Company Limited, New Delhi. 404 p.
- R3: Peter H. Raven, Navjot S. Sodhi, Luke Gibson, 2013. Conservation Biology: Voices from the Tropics, Willey Online library.
- R4: Odum, E.P. 1996. Fundamentals of Ecology. Natraj Publishers, Dehra Dun 574p. 19. Primack, R. B. 2006. Essentials of Conservation Biology, Sinauer Associates, USA.
- R5: Soule, M. E. 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.

## OTHER LEARNING RESOURCES:

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe animal kingdom and animal diversity.	<b>1,3</b>
<b>2</b>	Explain animal diversity in Indian context.	<b>1, 3</b>
<b>3</b>	Describe salient features and composition of life forms.	<b>1, 3</b>
<b>4</b>	Analyse adaptations in animal diversity.	<b>1, 3</b>
<b>5</b>	Describe the conservation programs adopted in India for conservation of wildlife.	<b>1, 3, 8</b>

<b>SEMESTER – IV</b>									
<b>Course Title</b>	<b>RESEARCH/DATA ANALYSIS/DOCUMENTATION-R4</b>								
<b>Course code</b>	<b>22MSZO221R</b>	<b>Total credits: 12</b> <b>Total hours:</b> <b>45T+30P</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
			<b>0</b>	<b>0</b>	<b>20</b>	<b>8</b>	<b>4</b>	<b>0</b>	<b>12</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>MASTER OF SCIENCE IN ZOOLOGY</b>								
<b>Semester</b>	<b>Fall/ I semester of first year of the programme</b>								
<b>Course Objectives (Minimum 3)</b>	<p>To demonstrate critical thinking by developing methods to test hypotheses, analyzing and interpreting results, and discussing their findings.</p> <p>To show technical competency and ethical laboratory conduct in their experiments.</p> <p>To synthesize scientific literature with their experiments and effectively communicate their findings to a scientific audience.</p>								
<b>CO1</b>	Students should demonstrate critical thinking skills through establishing methods to test a hypothesis;								
<b>CO2</b>	Students can analyse and interpret results and discuss findings.								
<b>CO3</b>	Students should demonstrate technical competency and ethical laboratory conduct.								
<b>CO4</b>	Students should be able to synthesize scientific literature to their experiments.								
<b>CO5</b>	Students can effectively communicate their finding to a scientific audience.								

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Students should demonstrate critical thinking skills through establishing methods to test a hypothesis;	<b>1, 2, 3</b>
<b>2</b>	Students can analyse and interpret results and discuss findings.	<b>1, 2, 3</b>
<b>3</b>	Students should demonstrate technical competency and ethical laboratory conduct.	<b>1, 2, 3</b>
<b>4</b>	Students should be able to synthesize scientific literature to their experiments.	<b>1, 2, 3</b>
<b>5</b>	Students can effectively communicate their finding to a scientific audience.	<b>1, 2, 3</b>

SEMESTER – IV									
Course Title	ENTOMOLOGY I (INSECT BIOLOGY, ECOLOGY AND PEST MANAGEMENT)								
Course code	22MSZO222R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	<ol style="list-style-type: none"> <li>To understand the structure and function of insect body parts and sensory organs.</li> <li>To explore various insect pest control methods and biotechnological approaches.</li> <li>To analyze the ecological roles, medical significance, defense mechanisms, and behavioral adaptations of insects.</li> </ol>								
CO1	Explain Class Insecta and describe morphology of insects.								
CO2	Illustrate and plan pest management approaches.								
CO3	Describe role of insects in an ecosystem.								
CO4	Describe the diseases caused by insects and their control measures.								
CO5	Explain defense mechanism of insects.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>General morphology of insects and function:</b> <ul style="list-style-type: none"> <li>Structure of insect head, thorax and abdomen, insect integument,</li> <li>Type of mouthparts, antennae, legs and their modifications &amp; function,</li> <li>Wings, wing structure, venations and wing coupling,</li> <li>Insect eye: structure &amp; function,</li> <li>Receptor organs in insects (Chemo receptors, mechanoreceptors and Photoreceptors,</li> <li>Sound and light producing organs in insects.</li> </ul>	7	Students will acquire knowledge Regarding morphology of different appendages of insects					1,2	
II	<b>Insect pest control and management:</b> <ul style="list-style-type: none"> <li>Primary control measures</li> <li>Hormonal and Pheromonal control</li> <li>Biological control</li> <li>Plant resistance to insects</li> <li>Biotechnological approach in pest management.</li> </ul>	10	Students will able to know different methods of pest manmanagement					1,2	

<p><b>III</b></p>	<p><b>Major Ecological Role of Insects:</b></p> <ul style="list-style-type: none"> <li>• Insects as herbivores</li> <li>• Insect as pollinators</li> <li>• Aquatic insects</li> <li>• Insects as parasites and predators</li> <li>• Role of insects in forensic sciences</li> <li>• Insect biotic potential and environmental resistance</li> <li>• Insect as human food.</li> </ul>	<p><b>10</b></p>	<p>Students will know regarding different role of insects in an ecosystem</p>	<p>1,2</p>
<p><b>IV</b></p>	<p><b>Insects of medical Importance:</b></p> <ul style="list-style-type: none"> <li>• Life cycle, Mode of transmission and epidemiology of major vector borne diseases such as Malaria, yellow fever, kalazar, typhus, plague, filiarisis.</li> </ul>	<p><b>8</b></p>	<p>Students will have basic idea on various diseases that are caused by insects and their control measures</p>	<p>1,2</p>
<p><b>V</b></p>	<p><b>Defense Mechanism in Insects:</b></p> <ul style="list-style-type: none"> <li>• Behavioural and structural defense,</li> <li>• Chemical defense,</li> <li>• Coloration defense</li> <li>• Mimicry.</li> </ul> <p>Adaptation of insects in terrestrial and aquatic environment</p> <p><b>Insect Behavior:</b></p> <ul style="list-style-type: none"> <li>• Chemotropism, thigmotropism, hydrotropism, rheotropism, anemotropism, phototropism, thermotropism, geotropism, instinct</li> </ul> <p><b>Protective behaviour:</b> mimicry. Crypsis, warning coloration. Behavioural defence, chemical defence. Breeding behaviour.</p> <p><b>Insect associations:</b> Passive insect association, active associations, estivating aggregation, protective aggregation, swarming aggregation, sleeping aggregation, dissociation, social aggregations</p>	<p><b>10</b></p>	<p>Students will have understanding on different behavioural mechanism in insects</p>	<p>1,2</p>

### TEXT BOOKS:

T1: The Insects: Structure and Function. AUTHOR: R. F. Chapman, EDITORS: Stephen J. Simpson, University of Sydney Angela E. Douglas, Cornell University, New York. Cambridge University Press.

T2: Modern Entomology by D.B. Tembhare. Himalayan Publishing House.

### REFERENCE BOOKS:

R1: IMMS' general text book of entomology by Richard's and Davies (Latest Edition) Chapman and Hall, UK.

R2: Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F.M (6<sup>th</sup> Edition). Saunders College Publication, USA.

R3: Principles of Insect Morphology, Snodgrass, R. E. (Latest Edition). Cornell Univ. Press, USA.

R4: The Insect Societies, Wilson, E. O. (Latest Edition). Harvard Univ. Press, UK.

R5: Daly and Doyen's Introduction to Insect Biology and Diversity. Whitfield, J. B. and A. H. Purcell III. (3<sup>rd</sup> Edition). Oxford University Press, Oxford, UK.

R5: Wigglesworth, V.B. (1976). Insect and the life of Man. London Chapman and Hall.

R6: Entomology and Pest Management by Pedigo, L.P. and Rics, M.E. (6<sup>th</sup> Edition). PHI Learning Private Limited.

R7: Pests of Stored Grains and their Management by Bhargava, M.C. and Kumawat, K.C. (Latest Edition). New India Publishing Agency.

R8: Insect Pests of Stored Grains and Grains Products: Identification, Habits and Methods of Control by Cotton, R.T. (Latest Edition). Biotech Books, Delhi.

R9: Fundamentals of Agriculture Entomology by Haldhar and Deshwal. (Latest Edition) New Vishal Publication.

### OTHER LEARNING RESOURCES:

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain Class Insecta and describe morphology of insects.	1, 6
2	Illustrate and plan pest management approaches.	1, 6, 8
3	Describe role of insects in an ecosystem.	1, 6
4	Describe the diseases caused by insects and their control measures.	1, 6, 8
5	Explain defense mechanism of insects.	1, 3



SEMESTER – IV									
Course Title	ENTOMOLOGY II (INSECT PHYSIOLOGY AND TOXICOLOGY)								
Course code	22MSZO223R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To learn about the structure and function of insect organ systems and hormones. 2. To understand social structures and communication methods in insects. 3. To examine pesticide effects, including toxicity, and identify key insecticides.								
CO1	Describe the endocrine system and their influence on physiology of insects.								
CO2	Explain physiological system of insects.								
CO3	Describe insect's communication and its significance.								
CO4	Describe the toxicity of pesticides and their effects on insects.								
CO5	Identify pesticides and explain their mode of action in controlling insects.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Insect Physiology:</b> Digestive system, Respiratory system, Circulatory system, Nervous System, Reproductive system, Excretory system.	7	Students will acquire knowledge regarding the endocrine system and their influence on physiology of insects.					1,2	
II	<b>Endocrine system:</b> Insect hormones- with reference to metamorphosis and reproduction.	10	Students will able to know about Different physiological system of insects.					1,2	
III	<b>Social insects and communication:</b> Social Insects, Social organization, Caste differentiation, Honey bees, Termites and ants as social insects <b>Insect communication:</b> Chemical communication, Audio and tactile communication, Visual communication, Luminescent insects	10	Students will acquire knowledge on insect communication and its significance.					1,2	
IV	<b>Toxicology of pesticides:</b> LD50 and LC50, Dose-response relationship, Carcinogenic, Mutagenic and Teratogenic effects; Method of testing chemicals on insect and evaluation of toxicity.	8	Students will have basic idea on toxicology of pesticides and their effect on insects.					1,2	
V	<b>Group characteristics and function of pesticides:</b> Organochlorines, Organophosphorus insecticides, Carbamates, Pyrethroids, other plant origin bio-insecticides, neonicotinoids and nitrogenous insecticides; fumigants; IGRs, attractants, repellents and anti-feedants. Properties of few individual insecticides i.e. DDT, HCH (BHC), Lindane, Endosulfan, Parathion, Malathion, Carbaryl, Cypermethrin etc.	10	Students will have understanding on different group of pesticides and their mode of action.					1,2	

<p><b>Practical</b></p>	<ul style="list-style-type: none"> <li>• Identification and classification of important organisms from different phylum of animal kingdom.</li> <li>• Collection, identification and preservation of insects.</li> <li>• Permanent slide preparation of mouthparts of mosquito, cockroach, butterfly and honeybee.</li> <li>• Study of various types of social insects (honeybee/ants) and their nests.</li> <li>• Mounting of legs, antennae and wings (at least of two types).</li> <li>• Dissection and display of sting apparatus in honey bee.</li> <li>• Dissection and display of male and female reproductive system of insects.</li> <li>• Dissection and display of nervous system of cockroach.</li> <li>• Dissection and display of digestive system of cockroach.</li> <li>• Dissection and display of Salivary gland of cockroach/ honey bee.</li> <li>• Dissection and display of Corpora cardiaca of cockroach.</li> <li>• Dissection and display of bacterial chamber of termite.</li> </ul>	<p style="text-align: center;"><b>30</b></p>	<p>Students will develop skills in identifying, classifying, and dissecting insects, and preparing permanent slides to study their anatomy and specialized structures.</p>	<p style="text-align: center;">1,2, 3,4</p>
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**TEXT BOOKS:**

T1: The Insects: Structure and Function. AUTHOR: R. F. Chapman, EDITORS: Stephen J. Simpson, University of Sydney Angela E. Douglas, Cornell University, New York. Cambridge University Press.

T2: Modern Entomology by D.B. Tembhare. Himalayan Publishing House.

**REFERENCE BOOKS:**

R1: The Principles of Insect Physiology by Wigglesworth, Vincent B. (7<sup>th</sup> Edition). Chapman and Hall Ltd. USA.

R2: Physiological system in Insects by Klowden, M. J. (3<sup>rd</sup> Edition). Academic Press, USA.

R3: The Insects, An outline of Entomology by Gullan, P. J., and Cranston, P. S. (5<sup>th</sup> Edition). Wiley Blackwell, UK.

R4: Insect Physiology and Biochemistry, Nation, J. L. (4<sup>th</sup> Edition). CRC Press, USA.

- R5: Social Insects (Vol-III) by Hermann, H.R. (Latest Edition). Academic Press, London.  
 R6: Toxicology and Risk Assessment: A Comprehensive Introduction by Greim H., and Snyder, R. (2<sup>nd</sup> Edition), John Wiley and Sons, UK.  
 R7: The Complete Book of pesticide management by Whitford, F. (Latest Edition).  
 R8: Wiley Interscience, John Wiley and Sons, UK.  
 R9: Pesticide Application Methods by Matthews, G, A. (4<sup>th</sup> Edition) Blackwell Science, London  
 R10: Insecticide Biochemistry and Physiology, Wilkinson, C. F. (Latest Edition). Plenum Press

**OTHER LEARNING RESOURCES:**

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe the endocrine system and their influence on physiology of insects.	<b>1, 3</b>
<b>2</b>	Explain physiological system of insects.	<b>1, 3</b>
<b>3</b>	Describe insect's communication and its significance.	<b>1, 3</b>
<b>4</b>	Describe the toxicity of pesticides and their effects on insects.	<b>1, 3, 8</b>
<b>5</b>	Identify pesticides and explain their mode of action in controlling insects.	<b>1, 3, 8</b>

SEMESTER – IV									
Course Title	<b>FISH BIOLOGY AND FISHERIES I (Fish physiology and Fish culture)</b>								
Course code	22MSZO222R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To learn about fish classification, skeletal structure, and organ systems. 2. To analyse fish feeding habits, digestive systems, and disease management. 3. To understand ornamental fish culture, fish farming practices, and fisheries management.								
CO1	Classify fish into appropriate groups based on their key characteristics.								
CO2	Describe respiration and excretion of fish.								
CO3	Discuss food and feeding habit of fishes and the digestive system of fishes								
CO4	Explain types of fish diseases, their symptoms and control.								
CO5	Identify ornamental fishes of North East India and describe fish farming, fishing gears and crafts.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Fish classification and skeletal system</b> <ul style="list-style-type: none"> <li>General characters and classifications, major fish groups (extant and extinct).</li> <li>Epidermis, Exoskeleton, Skeletal system</li> <li>Cardio vascular system of fishes.</li> </ul>	7	Students will learn general characteristics of fish along with classification of major fish groups					1,2	
II	<b>Respiratory and excretory system of fish</b> <ul style="list-style-type: none"> <li>Structure and function of gills, air breathing organs</li> <li>Swim bladder and its modifications</li> <li>Weberian ossicles and its function</li> <li>Excretion: kidney, structure and function</li> <li>Osmoregulation in fresh water and marine teleost.</li> </ul>	10	Students will learn respiration and excretion in fishes					1,2	
III	<b>Food and feeding habit of fishes</b> <ul style="list-style-type: none"> <li>Food and feeding habit of fishes. Digestive system</li> <li>Alimentary canal and its modifications</li> <li>Modifications of the Teeth</li> <li>Gut content analysis: Index of</li> </ul>	10	Students will learn feeding habit and digestion of fish					1,2	

	fullness, Ponderal index, and Gastro-somatic index.			
<b>IV</b>	<b>Fish diseases Disease</b> <ul style="list-style-type: none"> <li>• Disease definition, Disease problems.</li> <li>• Types of Diseases: viral, bacterial, fungal, protozoan etc.</li> <li>• Symptoms and control measures, Immunoassay, Biochemical assay, Serological techniques, vaccines.</li> </ul>	<b>8</b>	Students will learn different types of fish diseases and their control measures	1,2
<b>V</b>	<b>Fish culture</b> <ul style="list-style-type: none"> <li>• Ornamental fish, culture of ornamental fishes, Ornamental fishes of northeast India.</li> <li>• Fish farming: Integrated and composite fish culture</li> <li>• Fishing gears and Crafts. Preservation and processing of fishes.</li> <li>• Fisheries cooperative and their role in fish production and marketing.</li> </ul>	<b>10</b>	Students will learn fisheries management	1,2

#### **TEXT BOOKS:**

T1: A textbook of Fish Biology and Fisheries by S.S. Khanna and H. R. Singh (3<sup>rd</sup> Edition). Narendra PublishingHouse, Delhi.

T2: The freshwater fishes of the Indian region by Jayaram, K.C. 1999. New Delhi: Narendra Publishing House. 551 pp.

#### **REFERENCE BOOKS:**

R1: Handbook of the freshwater fishes of India by Beaven C R (Latest Edition) Narendra Publishing House.

R2: Fishery by-products technology by Brody (Latest Edition) AVI, Westport.

R3: Fish and Fisheries of India by Jhingran V. G. (4<sup>th</sup> Edition). Hindustan Publishing Corporation.

R4: Ichthyology by Lagler et al. (2<sup>nd</sup> edition). Wiley Publication.

R5: Fish and Fisheries by Pandey (Latest Edition). Rastogi Publications.

R6: Fishes by Chandy, M. (1<sup>st</sup> Edition). National Book Trust, India.

R7: Inland fishes of the India and adjacent countries by Talwar, P.K. and A.G. Jhingran. 1991. Volume 1 and 2. New Delhi: Oxford and IBH Publishing Co.

R8: Fishes of northeast India by Vishwanath, W., W.S. Lakra and U.K. Sarkar. 2007. Lucknow: NationalBureau of Fish Genetic Resources. 264 pp.

#### **OTHER LEARNING RESOURCES:**

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Classify fish into appropriate groups based on their key characteristics.	<b>1, 3</b>
<b>2</b>	Describe respiration and excretion of fish.	<b>1, 3</b>
<b>3</b>	Discuss food and feeding habit of fishes and the digestive system of fishes	<b>1, 3, 6</b>
<b>4</b>	Explain types of fish diseases, their symptoms and control.	<b>1, 6</b>
<b>5</b>	Identify ornamental fishes of North East India and describe fish farming, fishing gears and crafts.	<b>1, 6, 8</b>

SEMESTER – IV									
Course Title	FISH BIOLOGY AND FISHERIES II (Fish reproductive biology, endocrinology and fish genetics)								
Course code	22MSZO223R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To understand olfactory and taste systems, fish migration types, and factors influencing migration. 2. To Learn about fish reproduction, hormonal control, and endocrine glands. 3. Investigate fish adaptations, sexual dimorphism, and use bioinformatics for genetic and diversity studies.								
CO1	Explain concepts of sensory organs, pattern, and mechanism of fish migration.								
CO2	Describe the reproductive organs of fish.								
CO3	Explain Endocrine system in fishes.								
CO4	Compare the modifications of hill stream and deep sea fishes.								
CO5	Explain fish genetics and apply bioinformatics methods for managing data and retrieving meaningful information in connection to fishes.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Chemoreceptors and migration</b> <ul style="list-style-type: none"> <li>Structure of olfactory system, morphology of peripheral olfactory organ, cellular composition of olfactory epithelium, olfactory bulb and central projections. Structure and functions of taste buds.</li> <li>Migration in fishes: Types Anadromous, Catadromous, Amphidromous, factors responsible for migration (Intrinsic and environmental), periodicity of migration. Role of hormones in migration, Orientation and Navigation during migration.</li> </ul>		7	Students will learn Sensory organs and Migration of fish				1,2	
II	<b>Reproductive system of fish</b> <ul style="list-style-type: none"> <li>Structure of male reproductive system. Stages of maturation. Mechanism of spermatogenesis and its hormonal control. Gonado-somatic index, Modified Gonado-somatic index and Dobriyal index.</li> <li>Structure of female reproductive system. Stages of maturation. Oogenesis, egg development, hormonal control of oogenesis.</li> </ul>		10	Students will learn Reproductive Biology of fishes				1,2	

<b>III</b>	<b>Endocrine system</b> <ul style="list-style-type: none"> <li>• Structure, hormones and functions of pituitary gland in fishes. Structure, hormones and functions of other endocrine glands.</li> <li>• Structure of Hypothalamo-hypophysial system in fishes. Neurohormones and their functions.</li> </ul>	<b>10</b>	Students will acquire knowledge on Endocrine system in fishes	1,2
<b>IV</b>	<b>Adaptation in fishes</b> <ul style="list-style-type: none"> <li>• Adaptation in Hill Stream Fishes</li> <li>• Adaptations in deep sea fishes</li> <li>• Sexual dimorphism, mating and Parental care. Lateral line system in fishes.</li> <li>• Larvivorous and exotic fishes.</li> </ul>	<b>8</b>	Students will learn Modifications of hill stream and deep sea in fishes	1,2
<b>V</b>	<b>Genetics and bioinformatics</b> <ul style="list-style-type: none"> <li>• Genetics, Biotechnology and Aquaculture.</li> <li>• Introduction to Bioinformatics: FASTA, BLAST, Databases</li> <li>• Application of Bioinformatics in Fishery, Barcoding, Genetic diversity and phylogenetics</li> </ul>	<b>10</b>	It will help the students to get the knowledge Fish Genetics and Bioinformatics	1,2
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Identification of important indigenous and exotic fishes of NE India representing all fish groups.</li> <li>• Biological analysis of fish samples for gut contents (GASI), maturity stages (Gonado-somatic index (GSI), hepato-somatic index (HIS)).</li> <li>• Determination of length-weight and length-length relationships.</li> <li>• Determination of Condition Factor (CF), Absolute and Relative fecundity.</li> <li>• Identification of fishing gears.</li> <li>• Analysis of water samples for various physico-chemical parameters – pH, Free CO<sub>2</sub>, Dissolved Oxygen, Hardness.</li> <li>• Histological study of the fish gonads for stages of maturity study.</li> <li>• Identification of important fish parasites (external and internal).</li> <li>• Fish osteology: Alizarin preparation of fish skeleton.</li> <li>• DNA extraction from fish tissues, gel electrophoresis.</li> <li>• Analysis of gene sequences from databases for phylogenetic and genetic diversity study.</li> </ul>	<b>30</b>	Students will accurately identify and analyze indigenous and exotic fish species, assess their biological parameters, and utilize molecular techniques to study genetic diversity and fish physiology.	1,2, 3,4



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**TEXT BOOKS:**

T1: A Text Book of Fish, Fisheries and Technology by Biswas K P. (2<sup>nd</sup> Edition)

Narendra Publishing House.

T2: A textbook of Fish Biology and Fisheries. S.S. Khanna and H. R. Singh. (3<sup>rd</sup>

Edition) Narendra Publishing House, Delhi.

**REFERENCE BOOKS:**

R1: Handbook of fish biology and fisheries by (Volume I and II) by Hart P. and Reynold J. D (Latest Edition). Blackwell publishing U.S.A.

R2: Fish Endocrinology by Matty A. J. (Latest Edition). Croom Helm Ltd., Australia.

R3: Fishes: An introduction to ichthyology by Moyle P.B. and Cech J. J. Jr (5<sup>th</sup> Edition).

Prentice Hall, New Jersey, U.S.A.

R4: General and Applied Ichthyology by Gupta S.K., Gupta P.C. (Latest Edition). S Chand and Company

R5: Handbook of the freshwater fishes of India by Beaven C R. (Latest Edition).

Narendra Publishing House.

R6: Biology of Fishes, Bone, Q. and Moore, R. (3<sup>rd</sup> Edition) Talyor and Francis Group.

R7: The Physiology of Fishes, Evans, D. H. and Claiborne, J. D. (5<sup>th</sup> Edition) CRC Press.

R8: The Senses of Fish: Adaptations for the Reception of Natural Stimuli. von der Emde, R., Mogdans, J. and Kapoor, B. G., (Latest Edition) Narosa Publishing House, New Delhi, India, 2004.

**OTHER LEARNING RESOURCES:**

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain concepts of sensory organs, pattern, and mechanism of fish migration.	<b>1, 3</b>
<b>2</b>	Describe the reproductive organs of fish.	<b>1</b>
<b>3</b>	Explain Endocrine system in fishes.	<b>1</b>
<b>4</b>	Compare the modifications of hill stream and deep sea fishes.	<b>1, 6</b>
<b>5</b>	Explain fish genetics and apply bioinformatics methods for managing data and retrieving meaningful information in connection to fishes.	<b>1, 6, 8</b>

SEMESTER – IV									
Course Title	MOLECULAR CELL BIOLOGY I								
Course code	22MSZO222R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To gain insight into the mechanisms of mitosis and meiosis, the steps of the cell cycle, and its regulatory processes. 2. To learn about gene expression regulation at transcription and translation levels, and the role of chromatin in gene expression and silencing. 3. To study cellular communication principles, cell adhesion, gap junctions, and the biology of cancer including cell transformation, tumor viruses, and cell cycle regulation in cancer.								
CO1	Describe mitosis, meiosis and eukaryotic cell cycle.								
CO2	Explain the processes of gene regulation in prokaryotic and eukaryotic cells.								
CO3	Describe the molecular basis of cellular processes and the mechanisms that govern cell proliferation and cell death.								
CO4	Explain cell-cell adhesion and the extracellular matrix in the evolution of multicellular organisms.								
CO5	Describe cell progression and death.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Cell division and cell cycle</b> <ul style="list-style-type: none"> <li>Mitosis and meiosis, their regulation</li> <li>Steps in cell cycle</li> </ul> Control of cell cycle	7	Students would be able to understand how cell undergoes division and regulation				1,2		
II	<b>Gene Expression</b> <ul style="list-style-type: none"> <li>Control of gene expression at Transcription and translation levels</li> <li>Regulation of phages, viruses, prokaryotic and eukaryotic gene expression</li> <li>Role of chromatin in regulating gene expression and gene silencing</li> </ul>	10	The learners will become be able to draw parallels between gene expression in prokaryotic and eukaryotic				1,2		
III	<b>Cellular Communication</b> <ul style="list-style-type: none"> <li>General principles of cellular communication</li> <li>Cell adhesion and roles of different adhesion molecules</li> <li>Gap junctions, extra cellular matrix, integrins, neurotransmission and its regulation.</li> </ul>	10	Students will be able to understand inherited genetics and diseases associated to gene alteration				1,2		
IV	<b>Biology of Cancer</b> <ul style="list-style-type: none"> <li>Normal and cancer cells,</li> <li>Cell transformation</li> <li>DNA and tumour viruses</li> <li>Chromosomal basis of human cancer</li> </ul>	8	Students would learn the importance of cell-cell adhesion and the extracellular matrix in the evolution of multicellular organisms.				1,2		

	<ul style="list-style-type: none"> <li>Regulation of cell cycle in cancer progression</li> </ul>			
V	<b>Cell Proliferation and Death</b> <ul style="list-style-type: none"> <li>Factors for cell proliferation</li> <li>Different types of cell death (apoptosis, necrosis and autophagy)</li> </ul>	10	Students would learn how cell undergoes progression and death	1,2

### TEXT BOOKS:

T1: Cell and Molecular Biology, Lohar (Prakash S), 1st Edition, Mjp Publishers.

T2: Cell Biology, De Robertis (Edp) & Others, 5<sup>th</sup> Edition.

T3: Cell Biology, Genetics, Evolution and Ecology, Edn.3 Part Ii Verma (P.S), Aul. H) Ed. Nch (James); Agarwal (V.K.).

T4: Cell and Molecular Biology: Concepts and Experiments. Carp Gerald, 1996. John Wiley & Sons Publishers.

T5: Concept of Cell Biology, Verma (P S); Agarwal (V K), S. Chand & Co Publishers.

### REFERENCE BOOKS:

R1: Cell Biology, Power (C.B), 3<sup>rd</sup> Edition, Himalaya Publishers.

R2: Cell Biology, Gupta (M L); Jangir (M L), 1<sup>st</sup> Edition.

R3: Cell Biology, Rastogi (S C), 1<sup>st</sup> Edition, New Age International Limited Publishers.

R4: A Textbook of Cell Biology, Shukla (R M), 1<sup>st</sup> Edition, Dominant Publishers.

R5: Cytogenetics, Swanson (Carl. P) Etc. Prentice Hall Publishers.

### OTHER LEARNING RESOURCES:

Molecular Cell Biology: <https://nptel.ac.in/courses/102/106/102106025/>

Cell Biology: <https://nptel.ac.in/courses/102/103/102103012/>

Molecular Cell Biology: <https://nptel.ac.in/courses/102/106/102106025/>

Molecular Biology: [https://swayam.gov.in/nd2\\_cec20\\_ma13/preview](https://swayam.gov.in/nd2_cec20_ma13/preview)

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe mitosis, meiosis and eukaryotic cell cycle.	1, 3
2	Explain the processes of gene regulation in prokaryotic and eukaryotic cells.	1, 3
3	Describe the molecular basis of cellular processes and the mechanisms that govern cell proliferation and cell death.	1, 3
4	Explain cell-cell adhesion and the extracellular matrix in the evolution of multicellular organisms.	1, 3
5	Describe cell progression and death.	1, 3

SEMESTER – IV									
Course Title	MOLECULAR CELL BIOLOGY II								
Course code	22MSZO223R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	MASTER OF SCIENCE IN ZOOLOGY								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To proficiently use site-directed mutagenesis, DNA microarrays, and PCR for genetic analysis. 2. To comprehend cancer genetics, including oncogenes and tumor suppressor genes, and key signaling pathways. 3. To master cell culture methods and explore advanced therapies like gene therapy and targeted drug delivery.								
CO1	Explain processes at the molecular level for understanding functions of a eukaryotic cell.								
CO2	Outline the molecular mechanisms of cell signalling pathways.								
CO3	Apply techniques and methods in cell/tissues culture and drug delivery.								
CO4	Describe the techniques used in molecular biology.								
CO5	Explain cell culture techniques and cancer therapies and immunomodulation.								
Unit-No.	Content		Contact Hour	Learning Outcome					KL
I	<b>Molecular mutagenesis</b> <ul style="list-style-type: none"> <li>• Site directed mutagenesis</li> <li>• Sequence tagged sites</li> <li>• DNA microarrays Chromosome painting</li> </ul>		7	Students would be able to understand basic concepts DNA interaction with chemical agents					1,2
II	<b>Cancer genetics</b> <ul style="list-style-type: none"> <li>• Progenitor cells</li> <li>• Oncogenes</li> <li>• Tumour suppressor genes and their role in cancer</li> <li>• Genes for apoptosis</li> <li>• Intrinsic and extrinsic pathways</li> </ul>		10	To study DNA interaction with chemical agents, cancer therapies and immunomodulation.					1,2
III	<b>Cell signaling pathways</b> <ul style="list-style-type: none"> <li>• GPCR signalling</li> <li>• MAPkinse</li> <li>• Receptor tyrosine kinase (RTK)</li> <li>• JAK-STAT</li> <li>• Ras</li> <li>• NO pathways</li> </ul>		10	Students will be familiar with the molecular pathways					1,2
IV	<b>Techniques in molecular biology</b> <ul style="list-style-type: none"> <li>• c-DNA library</li> <li>• Gene expression analysis (PCR, RT-PCR and DNA microarray), RFLP, RAPD, AFLP, SSCP, SNP. DNA Fingerprinting</li> </ul>		8	Students will be familiar with scientific competencies that will allow them to investigate the molecular mechanisms important for the structure and function of the living cells through modern techniques.					1,2
V	<b>Methods of cell and tissue culture</b>		10	Students will learn animal cell culture techniques and cancer					1,2

	<ul style="list-style-type: none"> <li>• Monolayer and Suspension culture,</li> <li>• Co-culture,</li> <li>• Cell freezing</li> <li>• Biology and applications of stem cells</li> </ul> <p><b>Recent trends in therapy</b></p> <ul style="list-style-type: none"> <li>• Biomolecules as diagnostic markers and therapeutic agents</li> <li>• Gene technology</li> <li>• Gene therapy</li> <li>• Drug delivery and targeting</li> </ul>		therapies and immunomodulation.	
<b>Practical</b>	<ul style="list-style-type: none"> <li>• Isolation of DNA from goat spleen</li> <li>• Estimation of DNA (diphenyl method)</li> <li>• Estimation of RNA (Orcinol method)</li> <li>• UV absorption spectra of native and denatured DNA</li> <li>• Agarose gel Electrophoresis of DNA</li> <li>• DNA amplification by PCR</li> <li>• Isolation and analysis of proteins</li> <li>• Gel Documentation</li> </ul>	<b>30</b>	Students will effectively isolate and analyse DNA and proteins using techniques like UV spectroscopy, gel electrophoresis, and PCR.	1,2,3,4

#### TEXT BOOKS:

1. Cell and Molecular Biology, Lohar (Prakash S), 1st Edition, Mjp Publishers.
2. Cell Biology, De Robertis (Edp) & Others, 5<sup>th</sup> Edition.
3. Cell Biology, Genetics, Evolution and Ecology, Edn.3 Part Ii Verma (P.S), Aul. H) Ed. Nch (James); Agarwal (V.K.).
4. Cell and Molecular Biology: Concepts and Experiments. Carp Gerald, 1996. John Wiley & Sons Publishers.
5. Concept of Cell Biology, Verma (P S); Agarwal (V K), S. Chand & Co Publishers.

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2. Cell Biology, Gupta (M L); Jangir (M L), 1<sup>st</sup> Edition.
3. Cell Biology, Rastogi (S C), 1<sup>st</sup> Edition, New Age International Limited Publishers.
4. A Textbook of Cell Biology, Shukla (R M), 1<sup>st</sup> Edition, Dominant Publishers.
5. Cytogenetics, Swanson (Carl. P) Etc. Prentice Hall Publishers.

#### OTHER LEARNING RESOURCES:

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. NOC: Cell Culture Technologies: <https://nptel.ac.in/courses/102/104/102104059/>
2. Molecular Cell Biology: <https://nptel.ac.in/courses/102/106/102106025/>
3. Cell Biology: <https://nptel.ac.in/courses/102/103/102103012/>
4. Molecular Cell Biology: <https://nptel.ac.in/courses/102/106/102106025/>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain processes at the molecular level for understanding functions of a eukaryotic cell.	<b>1, 3</b>
<b>2</b>	Outline the molecular mechanisms of cell signalling pathways.	<b>1, 3</b>
<b>3</b>	Apply techniques and methods in cell/tissues culture and drug delivery.	<b>1, 3</b>
<b>4</b>	Describe the techniques used in molecular biology.	<b>1, 3, 8</b>
<b>5</b>	Explain cell culture techniques and cancer therapies and immunomodulation.	<b>1, 3, 8</b>





# Assam down town University

## Curriculum and Syllabus

### Master of Science in Microbiology



OUTCOME BASED EDUCATION FRAMEWORK  
CHOICE BASED CREDIT SYSTEM

Version: 2.0

**FACULTY OF SCIENCE**

July, 2022



# Preamble

Assam down town University is a premier higher educational institution which offers Bachelor, Master, and Ph.D. degree programmes across various faculties. These programmes, collectively embodies the vision and mission of the university. In keeping with the vision of evolutionary changes taking place in the educational landscape of the country, the university has restructured the course curriculum as per the guidelines of National Education Policy 2020. This document contains outline of teaching and learning framework and complete detailing of the courses. This document is a guidebook for the students to choose desired courses for completing the programme and to be eligible for the degree. This volume also includes the prescribed literature, study materials, texts, and reference books under different courses as guidance for the students to follow.

Recommended by the 22<sup>nd</sup> Board of Studies (BoS) meeting of the Faculty of Science held on dated 22/06/2022 and approved by the Emergent Academic Council (AC) meeting held on dated 30/07/2022



*Chairperson  
Board of Studies*



*Member Secretary  
Academic Council*



## ***Vision***

To become a Globally Recognized University from North Eastern Region of India, Dedicated to the Holistic Development of Students and Making Society Better

## ***Missions***

1. Creation of curricula that address the local, regional, national, and international needs of graduates, providing them with diverse and well-rounded education.
2. Build a diverse student body from various socio-economic backgrounds, provide exceptional value-based education, and foster holistic personal development, strong academic careers, and confidence.
3. Achieve high placement success by offering students skill-based, innovative education and strong industry connections.
4. Become the premier destination of young people, desirous of becoming future professional leaders through multidisciplinary learning and serving society better.
5. Create a highly inspiring intellectual environment for exceptional learners, empowering them to aspire to join internationally acclaimed institutions and contribute to global efforts in addressing critical issues, such as sustainable development, Climate mitigation and fostering a conflict-free global society.
6. To be renowned for creating new knowledge through high quality interdisciplinary research for betterment of society.
7. Become a key hub for the growth and excellence of AdtU's stakeholders including educators, researchers and innovators
8. Adapt to the evolving needs and changing realities of our students and community by incorporating national and global perspectives, while ensuring our actions are in harmony with our foundational values and objectives of serving the community.

## Programme Details

### Programme Overview

Master of Science in Microbiology is a 2-year postgraduate programme which deals with more detailed and advanced study of the microorganisms, including microbial cellular processes, their harmful and beneficial aspects, microbes for human welfare, molecular details of microbial cells and develops knowledge and understanding for applying it for societal benefits which may include sectors such as healthcare, agriculture, soil and environment, food processing, pharmaceutical etc. The objective of this programme is to produce intellectual and proficient microbiologists by enhancing the abilities and skills of students for application of microbiology theories and expertise in the live problems faced by the industry.

### I. Specific Features of the Curriculum

The Master of Microbiology curriculum features core courses in microbial physiology, genetics, molecular biology, and biotechnology, with electives in medical, environmental, and industrial microbiology. It emphasizes hands-on laboratory skills and bioinformatics, and includes a substantial research thesis project along with seminars, workshops, and industry or clinical internships. The program incorporates interdisciplinary approaches, regulatory and ethical training, and develops essential soft skills such as scientific communication and project management. Additionally, it offers global perspectives on health issues and international standards, preparing graduates for diverse careers in research, industry, and healthcare.

The curriculum provides skill enhancement and value-added courses along with the core papers.

### II. Eligibility Criteria:

Minimum 45% B.Sc. in (Microbiology/Biotechnology/Biochemistry/Life Science/Botany/Zoology/Agriculture/Veterinary), MBBS/Human Genetics etc. 5% relaxation for SC/ST, EWS, and Specially abled candidates.

### III. Program Educational Objectives (PEOs):

**PEO 1:** Graduates will be prepared for successful careers in broader aspects of Microbiology in both government and private sectors as microbiologists, QA/QC officers, food analysts, public health officers, food microbiologists, food product developers, food inspectors and allied areas.

**PEO 2:** Graduates will cultivate adept problem-solving skills, fostering innovative research ideas with a sense of social responsibility.

**PEO 3:** Graduates will be skilled professionals in microbiology aiding in the holistic development of knowledge creation contributing to the sustainability and progress of science and society at large.

**PEO 4:** Graduates will be successful in higher education and research in the field of microbiology and interdisciplinary fields if pursued

#### **IV. Program Specific Outcomes (PSOs):**

**PSO1 Experiential Learning and Applied Knowledge:** Exhibit an in-depth understanding of the concept of life science specifically in the field of Microbiology and apply the skills and proficiency to address challenges within the domains enabling employment opportunities in the relevant field.

**PSO2 Innovation and Entrepreneurship:** Demonstrate scientific temperament and ability to promote a multidisciplinary approach for research exploration and collaboration with professionals across diverse disciplines contributing to innovation and entrepreneurship.

**PSO3 Global certification:** Post-graduates gain global recognition through online courses offered by prestigious universities worldwide.

#### **V. Program Outcome:**

**PO1: Comprehensive Knowledge:** Apply comprehensive knowledge of microbial sciences, biochemistry, immunology, biostatistics, molecular and computational biology, ecological principles and microbiological processes to solve biological problems.

**PO2: Problem-Solving:** Identify, formulate, review the literature and evaluate complex biological issues using critical thinking for designing sustainable solutions.

**PO3: Modern Techniques Usage:** Apply standardized protocols, modern analytical techniques, and appropriate tools to execute experiments and conduct rigorous analyses.

**PO4: Investigation and Research:** Leverage research-based knowledge and research methods to design experiments, analyze and interpret data, and synthesize information to draw valid conclusions.

**PO5: Communication:** Communicate proficiently among peers and diverse communities through effective documentation, reports, presentations, talks etc.

**PO6: Professional Ethics:** Integrate professional values and ethics to demonstrate ethical decision-making in the workplace.

**PO7: Leadership and Teamwork:** Contribute effectively as an individual, and as a member within multidisciplinary teams, demonstrating strong leadership abilities in diverse settings.

**PO8: Environment and Sustainability:** Exhibit a sense of environmental responsibility to develop sustainable solutions that prioritize preserving the ecosystem.

**PO9: Lifelong Learning:** Ability to engage in independent and lifelong learning in the broadest context of technological advancement.

#### **VI. Total Credits to be Earned: 98**

## **VII. Career Prospects:**

Upon completing the program, graduates can pursue careers in various fields, including roles as research scholars in R&D laboratories, microbiologists in hospital laboratories, and health officers. They are also well-prepared for positions in food processing industries as microbiologists and quality control officers. Additionally, opportunities abound in the beverage and pharmaceutical industries, as well as in various biotechnological sectors. Graduates can also explore careers in environmental microbiology, bioinformatics, regulatory affairs, and academic or industrial research.

## EVALUATION METHODS

The student performance shall be evaluated through In-semester (Sessional) and semester-end examinations. A weightage of 40% or as prescribed by the programme shall be added to the score of the end-semester examination.

### A. INTERNAL ASSESSMENT:

The teacher who offers the course shall be responsible for internal assessment by conducting in-semester (sessional) examination and evaluating the performance of the students pursuing that course. The components for internal assessment are illustrated in the table given below.

SN	Components/ Examinations	Marks Allotted
1.	In-Sem Exam – I (ISE-I) (Written Examination)*	30
2.	In-Sem Exam – II (ISE-II) (Written Examination)*	30
3.	Assignment	10
4.	Presentation (SP)	10
5.	Quiz	5
6.	Class Performance based score*	5

*\*are compulsory*

**Note:** Total Internal assessment should be out of 40

### INSTRUCTION

1. If a student fails to appear in the any of the component without any valid reason he/she shall be marked zero in that component. However, the course teacher at his discretion may arrange for the missed test on an alternate date for the absentee students after determining ground with genuine/valid reasons for the absent.
2. The report of evaluation of an activity towards the in-semester (sessional) component of a course shall be duly notified by the concerned course teacher within a week of completion.
3. The program coordinators should upload the in-semester marks to the ERP and forward acknowledgement of all the courses of the program to the Controller of Examinations before the start of the End-semester examination.

### B. SEMESTER END EXAMINATION:

Time table for end semester examination is published at least 25 days prior to the start of Examination.

#### I. Pre-Examination:

##### **Eligibility Criteria for a student to appear in University Examinations:**

The student shall only be allowed to appear in a University Examination, if:

- i) He/ She is a registered student of the University;
- ii) He/ She is of good conduct and character;

iii) He/ She has completed the prescribed Programme of study with minimum percentage of attendance as laid down in the Regulations of the Programme concerned.

Under special cases, a student may be allowed to appear for an examination without being registered in the University but the result of the said student will be kept on hold till the registration of the concerned student is completed.

## II. Admit Card:

Admit card for the examination may be downloaded through ERP where the system will generate a Unique ID Cards through online.

The University shall have the right to cancel admission for examination of any candidate on valid grounds.

## III. Pattern of Question Papers:

The question paper shall follow the principles of Bloom's Taxonomy.

Table

S. N.	Level	Questions /verbs for test
1	Remember	List, Define, tell, describe, recite, recall, identify, show who, when, where, etc.
2	Understand	Describe, explain, contrast, summarize, differentiate, discuss, etc.
3	Apply	Predict, apply, solve, illustrate, determine, examine, modify
4	Analyze	Classify, outline, categorize, analyze, diagrams, illustrate, infer, etc.
5	Evaluate	Assess, summarize, choose, evaluate, recommend, justify, compare etc.
6	Create	Design, Formulate, Modify, Develop, integrate, etc.

**Note:** No course is to be evaluated on basis of **all 6 knowledge levels**.

The format of the question paper across all the program follow a unique pattern and the total marks is 60

**Table 1: Question paper pattern for End semester examination**

Sl no	Question pattern	Total marks
1	MCQs (10 Questions)	10
2	2 Marks questions (10 Questions)	20
3	4 Marks questions (5 Questions)	20
4	10 Marks questions (1 Question)	10

#### **IV. Examination Duration:**

Each paper of 60 marks shall ordinarily be of two hours duration.

#### **V. Practical Examinations, Viva-Voce etc.:**

- i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.
- ii) Viva-Voce, Oral examinations of the Project report, Dissertation etc. shall be undertaken by a Board of Examiners constituted by the respective Dean of Program with the advice of Supervisor(s).

#### **VI. Procedure of Expulsion:**

If any candidate is found to be using any unfair-means during the examination, the invigilator may cease his/her answer sheet and report it directly to the Officer-in-Charge. The Office-in-Charge of the center may take appropriate decisions as per the rules and procedure of the examination. The Officer-in-Charge may allow the students to write the exam with new answer sheet or may expel the student from appearing the paper depending on the nature of unfair-means. In case of Computer based test, the students may be directed to write an apology letter and sign in the prescribe expulsion form. The student may not be allowed to write that examination.

#### **VII. Instruction to the Students:**

- (i) The students shall not bring to the Examination Hall, any electronic gadget used as a means of communication or record except electronic calculator, if required.
- (ii) The students shall not receive any book or printed or hand written or photo copy (Xerox) or blank-paper from any other person while he/she is in the examination-room or in laboratory or in any other place to which he/she is allowed to have access during course of examination.
- (iii) The students shall not communicate with any other candidate in the examination room or with any other person in and outside the examination-room.
- (iv) The students shall not see, read or copy anything written by any other candidate, nor shall he/she knowingly or negligently permit any other candidate to see, read or copy anything written by him/her or conveyed by him/her.
- (v) The students shall not write anything on the Question Paper or in other paper or materials during the examination, or pass any kind of paper to any other candidate in the examination-room, or to any person outside the room.
- (vi) The students shall not disclose his/her identity to the examiner by writing his/her name or putting any sign / symbol in any part of his answer-script.
- (vii) The students shall not use any abusive language or write any objectionable remark or make any appeal to examiner by writing in any part of his answer-script.
- (viii) The students shall not detach any page from the answer-script or insert any authorized or unauthorized loose sheet into it. He /she shall also not insert any other answer-script / loose sheet by removing the pins of the origin answer-scripts and re-fixing it.



- (ix) The students shall not resort to any disorderly conduct inside the examination-room or misbehave with the invigilator or any other examination official.

**VIII. Provision for an Amanuensis (writer):**

- (i) A candidate may be provided with an Amanuensis (writer) to write down on dictation on his / her behalf on ground of his / her physical disability to write down by himself / herself due to accident or any other reason. The amanuensis may be provided till he / she recovers from the physical disability. The physical disability to write down by himself / herself must be supported by Medical Certificate from a competent Medical Officer.
- (ii) The qualifications of the amanuensis so provided must not be equal or higher than that of the candidate. This is also to be supported by Certificate from the Faculty of Study where the Amanuensis is provided.
- (iii) Such candidates are to be accommodated in a separate room under the supervision of an invigilator so that the fellow candidates are not disturbed in the process.

**C. Credit Point:**

It is the product of grade point and number of credits for a course, thus,  $CP = GP \times CR$

**i. Credit:**

A unit by which the course work is measured. It determines the number of hours of instructions required per week. 'Credit' refers to the weightage given to a course, usually in terms of the number of instructional hours per week assigned to it. Credits assigned for a single course always pay attention to how many hours it would take for an average learner to complete a single course successfully.

**ii. Grade Point:**

Grade Point is a numerical weight allotted to each Grade Letter on a 10-point scale.

**iii. Letter Grade:**

Letter Grade is an index of the performance of students in a said paper of a particular course. Grades are denoted by letters O, A+, A, B+, B, C, P, F and Abs. Student obtaining Grade F / Grade Abs shall be considered failed/ absent and, will be required to appear in the subsequent ESE. The UGC recommends a 10-point grading system with the following (Table: 1) Letter Grades:

- (i) A Letter Grade shall signify the level of qualitative/quantitative academic achievement of a student in a Course, while the Grade Point shall indicate the numerical weight of the Letter Grade on a 10-point scale.
- (ii) There shall be 08 (eight) Letter Grades bearing specific Grade Points as listed in Table 1, where the Letter Grades 'O' to 'P' shall indicate successful completion of a course.
- (iii) Apart from the 08 (eight) regular Letter Grades listed in Table 1, there shall be 03 (three) additional Letter Grades, which shall be awarded if a Course is withdrawn or spanned over the next Semester or remains incomplete as stated in Table 2.

**Table 2: Letter Grades and Grade Points**

Letter Grade	Grade Points	Description
O	10	Outstanding

A+	9	Excellent
A	8	Very Good
B+	7	Good
B	6	Above Average
C	5	Average
P	4	Pass
F	0	Fail
Abs	0	Absent
UFM	0	Unfair Means

#### iv. Grade Point Average:

##### a. SGPA (Semester Grade Point Average)

The SGPA of a student in a Semester shall be the weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered in that Semester, irrespective of whether he/she could or could not complete the Courses. More specifically, the calculation of SGPA shall take into account the Courses graded with Letter Grades ‘O’ to ‘F’ as given in Table 1.

$$SGPA = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i} \quad (1.1)$$

The SGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.1) up to two decimal places, where n is the total number of Credit Courses registered by the student in that Semester,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  registered Course and  $C_i$  is the Credit (weight) of that Course.

##### b. CGPA (Cumulative Grade Point Average)

- (i) The CGPA of a student in a Semester of a Programme shall be the accumulated weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered and successfully completed so far starting from the enrollment in the Programme. In other words, taking into account all the Courses graded with ‘O’ to ‘P’ as given in Table 1.1, generally the CGPA of a student shall be calculated starting from the first Semester of his/her enrolled Programme, while the CGPA of a lateral-entry student shall be calculated starting from the Semester of his/her enrollment.
- (ii) The CGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.2) up to two decimal places, where N is the total number of Credit Courses registered and successfully completed so far by the student,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  completed Course and  $C_i$  is the Credit (weight) of that Course.

$$CGPA = \frac{\sum_{i=1}^N C_i G_i}{\sum_{i=1}^N C_i} \quad (1.2)$$

- (iii) The CGPA shall be convertible into equivalent percentage of marks using Equation Conversion of CGPA to percentage marks: = CGPA\*10

#### **D. Post-Examination**

##### **i. Transcript or Grade Card or Certificate:**

A marking certificate shall be issued to all the registered students after every Semester. The Semester mark sheet will display the course details (code, title, number of credits, grade secured) along with total credit earned in that Semester.

##### **ii. Grievance Readdress Mechanism:**

Students with any dissatisfaction or grievance regarding the marks awarded in any of the Papers / Courses may appeal to the Controller of Examinations for remedial action such as Re-evaluation within 10 days of the declaration of result.

- (i) A student has options to appeal for re-evaluation of his /her answer script to the Controller of Examination.
- (ii) Application for re-evaluation / re-scrutiny of answer scripts shall be made in the definite proforma available with the Examination Office through the head of the respective departments within 10 days of declaration of the results of the respective examinations.
- (iii) The Controller of Examination may appoint an examiner for re-evaluation and will consider and recognize the evaluation done by a University appointed examiner.
- (iv) There shall be no provision for re-evaluation of the Practical Papers, Project Work, and Dissertation etc. However, the students fail in practical examination or viva voce and wish to appear again may apply to be evaluated can do so with the next schedule.
- (v) After screening the application for re-evaluation, the CoE may send the answer scripts of the student to the examiners appointed by the CoE with the approval of Vice Chancellor.
- (vi) The marks/grades achieved by the students after the re-evaluation shall be final and binding.
- (vii) Fresh Marks – sheets / Grade Card shall be issued only if the candidate secures pass marks / passing grade in the re-evaluated paper.
- (viii) Revaluation of answer scripts shall be deemed to be an additional facility provided to the students with a view to improving upon their results at the preceding examination result for any reason whatsoever shall not confer any right upon them for admission to next higher class which matters always be regulated in accordance with the relevant rules or regulations framed by the University.
- (ix) If as a result of revaluation of the candidate attracts the provision of condonation of deficiency, the same may be applied to his/her only for fresh attempt.

# INSTRUCTION TO TEACHERS AND STUDENTS

## (Teaching and Learning Methods)

In all the courses the teacher has to select topics for teacher-method which should not be less than 20 percent. The approach will be direct classroom teaching through a series of lectures delivering concepts using ITC facilities, white or blackboard. Notes may also be circulated to the students; however, the students are to be involved in the preparation of the notes. The teacher will be responsible for selecting the best note for circulation. The teacher-centric methodology has recently fallen out of favour because this strategy for teaching is seen to favour passive students.

### 1. Student- centric / Constructivist Approach:

The topics of the courses may be selected at the start of the class and assigned one topic to each of the students for studying by themselves, prepare presentations, notes, etc., and present at respective class time after consultation and discussion with the course teachers. The teacher facilitates the learning of the students by guiding and providing input and explaining concepts. 60 percent of the course contents may be selected for this purpose. To avoid behaviour problems, teachers must lay a lot of groundwork in student-centric classrooms. Typically, it involves instilling a sense of responsibility in students. In addition, students must learn internal motivation.

**a. Project-Based Learning:** The teacher may select 5 percent of topics for the purpose and may conduct visits to the laboratory for experiments or field surveys. The selection of the topic may be done considering the available facility for the purpose. However, in the final semester of each of the programme the student has to undergo project-based learning at least 4 months duration. This approach will help the student to think critically, evaluate, analyze, make decisions, collaborate, and more.

**b. Inquiry-Based Learning:** The teacher/ students are supposed to list at least five questions in each contact hour and student solve these question or search for answer which becomes the home work for the students “question-driven” learning approach. The teacher may look for the correctness of the solution or the best possible answer and discuss in the successive class. This will help in the preparation for various competitive examination and develop a habit for search for solutions.

**c. Flipped Classroom:** About 10 percent of the course content has to be completed by this method. In this approach the students are asked to watch video or lecture prepared by the teacher or any video available (relevant to the course). A set of questions may be given to the students for searching answers by the students. The idea is that students should have more time in-classroom focusing on achieving these higher levels of thinking and learning. The Flipped classroom is also an acronym. The letters FLIP represent the four pillars included in this type of learning: Flexible environment, Learning culture shift, Intentional content, and Professional educator. As you can see, the second pillar refers to a culture shift from the traditional approach where students are more passive to an approach where students are active participants. As a result, this approach is also a student- centric teaching method.

**d. Cooperative Learning:** The remaining five percent has to be completed by cooperative learning approach. In this approach, the students are allotted problems. During library hours the students along

with the teacher visit the library and search for probable solutions for the assigned problem. The same has to be done in groups so that the students discuss among themselves for the appropriate answers. Essentially, cooperative learning believes that social interactions can improve learning. In addition, the approach recreates real-world work situations in which collaboration and cooperation are required.

### **The percentage categorization for the completion of a theory course**

Teacher-centric or Direct Classroom Teaching: Delivery by series of lectures	20%
Student-centric Approach, Students present and deliver lectures in the presence of teacher and supervised by teacher	60%
Students visit fields or perform experiments or teachers perform demonstration	05%
Flipped Classroom approach	10%
Cooperative learning approach	05%

### **Inquiry-based approach has to be followed in all of the classes**

The teacher has to distribute the topics to be considered for teaching by the above-mentioned approaches and prepare a lesson plan for execution and maintain a file.

**Curriculum Framework**  
**Breakdown of Credits (for 2022-23 Syllabus)**

<b>Sl. No</b>	<b>Category</b>	<b>Total number of Credits</b>
1	University Core(UC)	17
2	University Elective (UE)	12
3	Program Core(PC)	31
4	Program Elective (PE)	30
5	Faculty Elective (FE)	8
<b>Total number of credit</b>		<b>98</b>

**Breakdown by categories of courses**

<b>Sl no</b>	<b>Category</b>	<b>Credits</b>	<b>%</b>
1	Science	96	97.95%
2	Engineering	1	1.02%
3	Commerce and Management	1	1.02%
<b>Total</b>		<b>98</b>	<b>100%</b>

**PCI, INC, AICTE regulated programs shall have to follow the regulating body**

## SEMESTER WISE COURSE DISTRIBUTION

S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			
				L	T	P	S	R	O		IA*	SEE*	PE*	Total
1.	22MSMB111R	Introduction to Microbiology & Microbial Diversity	PC	3	0	2	0	0	0	4	40	60	100	200
2.	22MSMB112R	Microbial Genetics and Physiology	PC	3	0	2	0	0	0	4	40	60	100	200
3.	22MSMB113R	Biochemistry	PC	3	0	2	0	0	0	4	40	60	100	200
4.	22MSMB114R	Bioinstrumentation	PC	3	0	2	0	0	0	4	40	60	100	200
5.	22MSCE111R	MOOCS –I	FE	0	0	0	4	0	0	2	0	100		100
6.	22UMFS111R	Fundamental of Statistics	UC	2	0	2	0	0	0	3	40	60	100	200
7.	22MSMB115R	Mini Research - R1	UC	0	0	0	4	8	0	2	0	0	100	100
8.	22UMPD111R	PDP: Effective English	UE	0	0	4	0	0	0	2	0	0	100	100
<b>Total</b>										<b>25</b>				<b>1300</b>

S. No.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			
				L	T	P	S	R	O		IA*	SEE*	PE*	Total
1.	22MSMB121R	Immunology	PC	3	0	2	0	0	0	4	40	60	100	200
2.	22MSMB122R	Molecular Biology, Genomics and Genetic Engineering	PC	3	0	2	0	0	0	4	40	60	100	200
3.	22MSMB123R	Bioinformatics	PC	2	0	2	0	0	0	3	40	60	100	200

4.	22MSMB124R	Mushroom Cultivation : Techno-Professional Skill 1	PC	0	0	4	0	0	0	2	0	0	100	100
5.	2MSMB125R	Generic Elective: Public health and Hygiene	UE	2	0	0	0	0	0	2	40	60	0	100
6.	22MSCE121R	MOOCS -II	FE	0	0	0	0	0	0	2	0	100	0	100
7.	22UMRM121R	Research Methodology and Statistical Analysis	UC	1	0	0	4	0	0	2	40	60	0	100
8.	22MSMB126R	Mini Research 2 (Research gap Analysis-R2)	UC	0	0	0	4	12		3	0	0	100	100
9.	22UHV101R	Universal Human Values and Professional Ethics	UC	1	0	2	0	0	0	2	40	60	100	200
10.	22UMPD121R	PDP: Communication Mastery	UE	0	0	4	0	0	0	2	0	0	100	100
11.	22UCBL103R	Computational system and digital world	UE	0	0	2	0	0	0	1	0	0	100	100
<b>Total</b>										<b>27</b>				<b>1500</b>

S. No.	Course Code	Course Title	Course Category	Engagement							Maximum Marks for			
				L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
1.	22MSMB211R	Biofertilizer Production: (Techno-Professional Skill-II)	PC	0	0	4	0	0	0	2	0	0	100	100
2.	22MSMB212R	Generic Elective - Public health and Hygiene	UE	2	0	0	0	0	0	2	40	60	0	100
3.	22MSCE211R	MOOCS-III	FE	0	0	0	0	0	0	2	0	100	0	100



4.	22MSCE212R	MOOCS-IV	<b>FE</b>	0	0	0	0	0	0	2	0	100	0	100
5.	22UMRE214R	Research Ethics	<b>UC</b>	0	0	2	0	0	0	1	0	0	100	100
6.	22MSMB213R	Mini Research – (Survey/Experiments - R3)	<b>UC</b>	0	0	6	4	0	0	4			100	100
7.	22UMPD211R	PDP: Corporate Proficiency	<b>UE</b>	0	0	4	0	0	0	2	0	0	100	100
8.	22UUFL202R	Personal Financial Planning	<b>UE</b>	0	0	2	0	0	0	1	0	0	100	100
<b>Discipline specific Elective (Any three subjects to be selected)</b>														
9.	22MSMB214R	Medical Microbiology	<b>PE</b>	3	0	2	0	0	0	4	40	60	100	200
10.	22MSMB215R	Microbial Ecology and Environmental Microbiology	<b>PE</b>	3	0	2	0	0	0	4	40	60	100	200
11.	22MSMB216R	Soil and Agricultural Microbiology	<b>PE</b>	3	0	2	0	0	0	4	40	60	100	200
12.	22MSMB217R	Clinical and Diagnostic Microbiology	<b>PE</b>	3	0	2	0	0	0	4	40	60	100	200
13.	22MSMB218R	Organic Farming	<b>PE</b>	3	0	2	0	0	0	4	40	60	100	200
<b>Total</b>										<b>28</b>				<b>1400</b>

S	S. N.	Course Code	Course Title	Course Category	Engagement							Maximum Marks for			
					L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
	1.	22MSMB221R	Research/ Data analysis/ documentation -R4	<b>PE</b>	0	0	20	4	6	0	12	0	0	200	200
<b>Discipline specific Elective (Any two subjects to be selected)</b>															
	2.	22MSMB222R	Industrial Microbiology and Fermentation	<b>PE</b>	2	0	2	0	0	0	3	40	60	100	200

		Technology												
3.	22MSMB223R	Food and Dairy Microbiology	<b>PE</b>	2	0	2	0	0	0	3	40	60	100	200
4.	22MSMB224R	Pharmaceutical Microbiology	<b>PE</b>	2	0	2	0	0	0	3	40	60	100	200
5.	22MSMB225R	Marine Microbiology	<b>PE</b>	2	0	2	0	0	0	3	40	60	100	200

	<b>Total</b>									<b>18</b>				<b>600</b>
	<b>Total for all four Semesters</b>									<b>98</b>				<b>4800</b>

**\*IA: Internal Assessment, SEE: Semester End Examination,  
PE: Practical Examination**

SEMESTER – I									
Course Title	Introduction to Microbiology & Microbial Diversity								
Course code	22MSMB111R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To familiarize the students with those concepts those are basic to prokaryotic and eukaryotic cells. 2. To emphasize on distribution, morphology and physiology of microorganisms in addition to skills in aseptic procedures, isolation and identification. 3. To study the structure, function, diversity of microorganisms in different habitats, ecosystem, and microbial associations, microbial interactions								
CO1	Describe the fundamentals of microbiology including historical perspectives, classification of microorganisms, microscopy, and structure of prokaryotic cell organelles.								
CO2	Demonstrate different sterilization techniques, application of microbial culture media, and staining techniques								
CO3	Explore microbial diversity in different habitats including extreme environments and space.								
CO4	Apply the microorganisms for Bioleaching, bioremediation, and biodeterioration.								
CO5	Explain microbial indicators of wastewater, microbial interactions, and biogeochemical cycles.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	History of microbiology: Theory of spontaneous generation, germ theory of disease, Contribution of Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Alexander Fleming; The Three Kingdom Concept, The Five Kingdom concept and the three domain concept. Microscopy: Principle of microscopy, Prokaryotic cell, Bacterial cell wall, plasma membrane, capsule, outer membrane, cytoplasm, fimbriae, pilli, flagella, endospore, ribosome, inclusion bodies	8	Summarize the historical events in the development of microbiology and the role of key contributors. Explain the principle and functioning of microscopes. Describe the structure and function of prokaryotic cell components.					1 2 3	
II	Sterilization technique, Microbial Culture & Media: Physical and chemical methods of sterilization; Staining technique: Simple staining, Differential staining, Structural Staining, Aerobic and anaerobic culture. Concept of mixed culture and pure culture. Techniques of pure culture isolation, Enrichment culture techniques, Preservation, and maintenance of pure culture. Definition of media, types of media, uses of different types of media, basal media, differential media, selective media, transport media. Cultural & Un-culturable microbes: Culture-dependent approaches for diversity study and their limitations, Exploration of Un-culturable bacteria: Culture independent molecular methods for identifying unculturable bacteria, metagenome concept	10	Apply appropriate sterilization methods for various microbial cultures and equipment. Explain the principles and applications of different staining techniques. Understand the concept of mixed cultures and pure cultures and be able to isolate pure culture. Define media and describe the different types. Explore culture dependent and culture independent methods for study of microorganisms.					1 2 3 4	

III	<b>Environmental microbiology&amp; Diversity:</b> <b>Concept of microbial ecology,</b> Diversity of microbes in terrestrial (agricultural and desert soil), aquatic (fresh water and marine water) and animal (cattle, termite and human being), <b>Microbes in extreme environments –</b> thermophiles, psychrophiles, barophiles, acidophiles, alkaliphiles and halophiles, organic solvent and radiation tolerant, and their potential applications. Microbiology of air and space.	10	Explain the concept of microbial ecology and the interactions between microorganisms and their environments. Identify and describe the diversity of microbes. Describe the characteristics and adaptations of extremophiles. Explain the presence and significance of microorganisms in the air and space.	1 2 3 4 5
IV	Bioremediation – copper, gold and uranium, Microbial degradation of xenobiotics – petroleum, oil spills, biomagnifications. Bioremediation- in-situ and ex-situ, Biodeterioration- paper, textile, wood, metal, Corrosion: – methods of protection	10	Discuss the microbial mechanisms involved in bioremediation. Describe the microbial processes involved in the degradation of xenobiotics. Understand the concept of biomagnification and its environmental implications. Differentiate in-situ and ex-situ bioremediation techniques. Explain the microbial causes of biodeterioration. Understand the microbial role in corrosion and methods for its prevention.	2 3 5
V	<b>Wastewater treatment,</b> Bacterial indicators – DO, BOD, COD, water purification; <b>Microbial interaction:</b> Competition, ammensalism, parasitism, mutualism, commensalism, synergism, Biogeochemical cycles – Carbon, Nitrogen, Phosphorus	7	Explain the stages of wastewater treatment. Understand the importance and function of bacterial indicators such as DO, BOD, and COD. Identify and explain different types of microbial interactions. Explain the roles of microbes in the Biogeochemical Cycles.	1 2 3 4 5
Practical	<ol style="list-style-type: none"> <li>Study of effective Sterilization by physical and chemical method</li> <li>Preparation of bacterial smear and staining (Simple, Grams, negative and acid fast)</li> <li>Preparation of culture media, Measurement of pH</li> <li>Isolation of pure culture – serial dilution, Pour plate Technique, spread plate technique, types</li> <li>of streaking.</li> <li>Fungal staining: KOH Mounting, LPCB</li> <li>Isolation of air microbes by gravity settle method</li> <li>Study of Biochemical test: IMViC, Starch hydrolysis test, catalase test, Oxidase test</li> </ol>	30	Proficiency in various biochemical tests, isolation and staining techniques for bacterial and fungal identification.	1 2 3 4 5 6

	9. Bacteriological examination of water			
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**TEXTBOOKS:**

- T1. Gerard J. Totoro, Berdell R. Funke, Christine L. Case (2008). Microbiology: An Introduction. 8<sup>th</sup> Edition, 2004, Publisher. Pearson, Benjamin Cummings,
- T2. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company
- T3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology.
- T4. Ananthanarayanan R. and C.K. Jayaram Panicker. Text of Microbiology. Twelfth Edition, 2022. Orient Longman.
- T5. Jennifer C. Stearns, Michael G. Surette, Julie Kaiser (2019). Microbiology. J Wiley & Sons

**REFERENCE BOOKS:**

- R1. Dr. R.C. Dubey & Dr. D. K. Maheshwari. (2012). Third Revised Edition. Practical Microbiology. S. Chand and Company Ltd.
- R2. Mette Prætorius Ibba & Katherine Elasky (2018). Basic and Practical Microbiology Lab Manual Practical. Cognella, Incorporated.
- R3. C.P. Baweja. (2012) 4<sup>th</sup> Edition. Textbook of Microbiology. Arya Publishers
- R4. Subhash Chandra Parija. (2019). Second Edition. Textbook of Practical Microbiology. Ahuja Book Company Pvt. Limited
- R5. Joanne Willey, Kathleen Sandman, Dorothy Wood. (2020). 11<sup>th</sup> Edition. McGraw-Hill Professional

**OTHER LEARNING RESOURCES:**

1. <https://www.edx.org/learn/microbiology>
2. <https://www.futurelearn.com/courses/introduction-to-microbiology>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe the fundamentals of microbiology including historical perspectives, classification of microorganisms, microscopy, and structure of prokaryotic cell organelles.	1, 3, 9
2	Demonstrate different sterilization techniques, application of microbial culture media, and staining techniques	1, 3, 4, 7
3	Explore microbial diversity in different habitats including extreme environments and space.	1, 2, 3, 4, 8, 9
4	Apply the microorganisms for Bioleaching, bioremediation,	1, 2, 3, 8

	and biodeterioration.	
<b>5</b>	Explain microbial indicators of wastewater, microbial interactions, and biogeochemical cycles.	<b>1, 3, 4, 8</b>

SEMESTER – I									
Course Title	Microbial Genetics and Physiology								
Course code	22MSMB112R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	<p>1. To teach the biological processes that ensures a balance between stability and variability of genetic material.</p> <p>2. To discuss the application of the knowledge of microbial genetics and genetic engineering techniques in order to produce strains applicable in biotechnology.</p> <p>3. To study the structure, function, energy metabolism, growth and regulatory mechanisms of microorganisms.</p>								
CO1	Discuss the historical prospect and overview of DNA, its structure, types, and replication and gene transfer mechanisms.								
CO2	Describe plasmids, bacteriophage life cycles, DNA mutation, damage, and repair, including detection techniques like the Ames test and replica plating. Describe genetic code, RNA types, and structure; its role in protein synthesis.								
CO3	Analyze the mechanism of transcription and translation, associated enzymes and factors, and the regulation of gene expression.								
CO4	Explain bacterial and fungal growth kinetics and cell cycle.								
CO5	Explore microbial response to environmental challenges								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<p>Developments in genetics: Discovery of DNA, primary, secondary, tertiary and quaternary structures of DNA, Watson and Crick model of dsDNA, the law of DNA consistency, and C value paradox. Detailed structure of DNA, A DNA, B DNA, Z DNA, Genome organization of prokaryotes and eukaryotes, enzymes in DNA replication – detailed mechanism of semi-conservative replication, rolling circle method and bidirectional method of replication. Recombination: reciprocal and non-reciprocal, mechanisms of recombination, Holliday model. Transposons: Classes of transposable elements, nomenclature of transposable elements, Insertion sequences, mechanism of transposition.</p> <p>Effects of transposition in bacteria. Genetic requirements for transposition. Gene transfer mechanisms: bacterial transformation, conjugation, transduction –generalized, specialized and abortive, sexduction, mapping of recombination, Molecular mechanism of gene transfer by conjugation – genes and proteins involved.</p>	12	<p>Knowledge of DNA structure, replication, and types.</p> <p>Knowledge on recombination and transposons</p>						
II	<p>Plasmid: definition and types – F, R, Col, Vir, Ti, Plasmid, plasmid incompatibility. Ti plasmid transfer system and its application in creating</p>	12	<p>Knowledge on Plasmid and its types, Bacteriophages and their life cycle</p> <p>Knowledge on mutation and Genetic</p>						

	<p>transgenics.</p> <p>Bacteriophages – Lytic development cycle using phages T4 and T7 as models. Lysogenic phage – lambda and P1, M13 and phi X 174, Genetic analysis of phages –complementation and recombination tests with phages.</p> <p>Mutation – spontaneous and induced, mutagenic agents, replica plating, Ame’s test. DNA damage and repair: factors affecting DNA bases, identification and molecular characterization of repair enzymes in photoreactivation, excision, recombination and SOS pathways.</p> <p>Importance and uses of mutation analysis. Genetic code – their nature, codon, anticodon, Wobble’s hypothesis. Structural features of RNA (rRNA, m RNA and tRNA),polycistronic and monocistronic mRNA.</p>		code	
<b>III</b>	<p>Prokaryotic Transcription and Translation: Organisation of transcriptional units and regulation of gene expression, Mechanism of transcription in prokaryotes – structure and function of RNA polymerase, (DNA foot printing), termination and anti termination – N protein and nut sites in DNA binding proteins, enhancer sequences and control of transcription, ribonucleoprotein, direction of protein synthesis, RNA template, direction with experimental proof, t RnA as adaptor, ribosomes and their organization in prokaryotes, polycistronic m RNA in bacteria, initiation of translation in bacteria, small subunits, accessory factors, SD sequence in bacteria, initiator tRNA, elongation of translation, translocation and termination mechanisms</p>	<b>10</b>	Knowledge on prokaryotic transcription and translation and associated factors	
<b>IV</b>	<p>Cell Growth and Nutrition: Nutrient requirements, growth factors, nutritional categories, physical factors affecting growth.</p> <p>Bacterial Growth: Bacterial growth curve, growth kinetics, batch, continuous and synchronized culture.</p> <p>Cell cycle in microbes and generation time, fungal growth patterns</p>	<b>7</b>	Knowledge on bacterial growth patterns and nutrient requirements	
<b>V</b>	<p>Physiological Adaptationsand signalling: Quorum sensing, Heat-Shock responses, Chaperones proteins, pH homeostasis,osmotic homeostasis.</p>	<b>4</b>	Knowledge on cell signalling by microbes	
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Gel casting and gel loading</li> <li>2. Isolation of DNA (plasmidDNA, Chromosomal DNA,Fungal DNA)</li> <li>3. Agarose Gel Electrophoresis</li> <li>4. Preparation of competentcell Transformation (Blue-whitescreening, Antibiotics resistance screening)</li> </ol>	<b>30</b>	Proficiency in DNA isolation and separation, preparation of competent cell, transformation experiment and screening	



**TEXTBOOKS:**

- T1. Microbial genetics by Maloy et al. 1994, Jones and Bartlett Publishers  
 T2. Modern Microbial Genetics. 1991 by Streips and Yasbin. Niley Ltd.  
 T3. Microbial genetics by Stanly R. Maloy, John E. Cronan and David Freifelder.

**REFERENCE BOOKS:**

- R1. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology.  
 R2. Molecular Biology of the Gene 4th edition by J D Watson, N H Hopkins, Roberts, Steitz and Weiner. 1987. The Benjamin Cummings Publication Co. Inc California.  
 R3. Gene VII by Lewin Oxford University Press. 2000  
 R4. Molecular Genetics of Bacteria by J W Dale, 1994, John Wiley and Sons

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Discuss the historical prospect and overview of DNA, its structure, types, and replication and gene transfer mechanisms.	<b>1, 9</b>
<b>2</b>	Describe plasmids, bacteriophage life cycles, DNA mutation, damage, and repair, including detection techniques like the Ames test and replica plating. Describe genetic code, RNA types, and structure; its role in protein synthesis.	<b>1, 3, 4, 9</b>
<b>3</b>	Analyze the mechanism of transcription and translation, associated enzymes and factors, and the regulation of gene expression.	<b>1, 3, 4, 6, 9</b>
<b>4</b>	Explain bacterial and fungal growth kinetics and cell cycle.	<b>1, 2, 3, 4, 9</b>
<b>5</b>	Explore microbial response to environmental challenges	<b>1, 2, 3, 4, 8, 9</b>

SEMESTER – I									
Course title	Biochemistry								
Course code	23MSMB113R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Microbiology								
Semester	Fall/I Semester of First Year of the Program								
Course objectives:	1. To study the structure of biomolecules, such as proteins, nucleic acids, carbohydrates and lipids 2. To know the functions and interactions of biomolecules, which will provide the knowledge of the structure of cells and the various functions performed by them which are associated with life? 3. To study the metabolic pathways of biomolecules like carbohydrate, amino acids etc.								
CO1	Improve the concept of chemical interactions and molecular organization of micro and macromolecules								
CO2	Understand the composition, structure and function of the biomolecules								
CO3	Enhance the understanding on metabolism and physiology of cell.								
CO4	Analyse the concepts of secondary metabolites for human benefits.								
CO5	Prepare the base for understanding courses such as molecular biology and cellular functioning at molecular level.								
Unit-No.	Content	CH	Learning Outcome					KL	
I	<b>Concept of biomolecules (composition, structure and functions):</b> Carbohydrates, Proteins, Lipids, Nucleic acids, Vitamins and Minerals.	10	Knowledge on the concept of biomolecules, differentiating the various biomolecules with thorough understanding on their types and functions					1,2	
II	<b>Bioenergetics:</b> Concept of thermodynamics (entropy, enthalpy and free energy), reaction kinetics: Substrate phosphorylation and oxidative phosphorylation, <b>Enzymology:</b> Principle of catalysis, enzyme and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, Importance of enzymes in diagnosis and therapy.	10	Demonstrate the fundamental knowledge of bioenergetics and enzyme and its kinetics for understanding of metabolism and learning its applications in clinical and therapeutics.					1,2	
III	<b>Metabolism of biomolecules:</b> <b>Carbohydrate metabolism:</b> Glycolysis and its regulation, Gluconeogenesis, Glycogenolysis TCA cycle, Pentose phosphate pathway, glyoxalate pathway. <b>Lipid metabolism:</b> oxidation of saturated and unsaturated fatty acid, odd chain fatty acid, regulation of fatty acid metabolism.	10	Build knowledge of the biochemical pathways of synthesis and degradation of the carbohydrate and lipids with its regulatory concept					1,2	
IV	<b>Amino acid metabolism:</b> Transamination, Deamination and its types, urea cycle <b>Nucleotide metabolism:</b> biosynthesis and degradation of purines and pyrimidines	8	Understand the amino acid and nucleotide synthesis and degradation with its biochemical and regulatory concept					1,2,3	
V	<b>Heme Metabolism and Photosynthesis and Secondary metabolites:</b> Heme synthesis and degradation, Photosynthesis: Structure of chloroplast, light reaction and dark reaction, Brief concept on the secondary metabolites (Flavonoids, terpenoids, phenolic acids and alkaloids)	7	Learn the synthesis and breakdown of heme, gain knowledge on the mechanism of photosynthesis and apply the concept of secondary metabolites for mankind.					1,2,3, 4	

<b>Practical</b>	Buffers: Preparation of acetate buffer, citrate buffer, tris buffer, phosphate buffer; Estimation of protein by Lowry's/Bradford method. Estimation of reducing sugar by DNS method. Estimation of RNA by orcinol method. Estimation of DNA by diphenyl amine method, Extraction and estimation of chlorophyll. Determination of total activity of amylase. Determination of total activity of protease, Qualitative analysis for protein, carbohydrate and its types, amino acid.	<b>30</b>	To apply the practical knowledge of biochemistry in various fields	1,2,3, 4
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#### TEXTBOOKS:

T1. U Satyanarayana. Biochemistry. 13th edition. Elsevier Health Sciences;2017.

#### REFERENCE BOOKS:

R1. David L. Nelson, Michael Cox. Lehninger Principles of Biochemistry. 7th Edition. WH Freeman; 2017.

R2. Rodwell et al. Harper's Illustrated Biochemistry. 29th edition. McGraw Hill; 2012.

R3. Voet and Voet. Biochemistry. 3rd edition. John Wiley & Sons, 2004.

#### OTHER LEARNING RESOURCES:

1. <https://pubmed.ncbi.nlm.nih.gov/34809432/>

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Improve the concept of chemical interactions and molecular organization of micro and macromolecules	1,3
2	Understand the composition, structure and function of the biomolecules	1, 4
3	Enhance the understanding on metabolism and physiology of cell.	1,3,4
4	Analyse the concepts of secondary metabolites for human benefits.	1, 2, 7
5	Prepare the base for understanding courses such as molecular biology and cellular functioning at molecular level.	1, 9.

SEMESTER – I									
Course Title	Bioinstrumentation								
Course code	23MSMB114R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To impart knowledge about the working of different Biomedical Instruments. 2. Basic working principle of different instruments. 3. Working principle of chromatography, centrifugation								
CO1	Discuss Chromatography techniques including history, classification, principles, operation, analysis and application.								
CO2	Define Centrifugation techniques, classification, principles, operation and its application.								
CO3	Explain and investigate Electrophoresis, its categorization, underlying principle, operational methods, pH meter functionality, dialysis, and blotting methodologies.								
CO4	Discuss radioisotope dating principles, including detection, measurement, isotopes, radiation, units and decay.								
CO5	Develop the comprehensive understanding of principles, and practical application skills in various spectroscopic methods for scientific analysis.								
Unit-No.	Content	CH	Learning Outcome				KL		
I	<b>Chromatography:</b> History; Classification; Types, principles, operation, application & analysis (Paper, Column, Adsorption column, Partition, Thin layer, Ion exchange, quantitative Ion exchange, and Gel Chromatography):	10	Able to describe, illustrate and explain the chromatography and their applications				1,2		
II	<b>Centrifugation:</b> Types; Application; Principle; rotors; density gradient & analytical centrifugation.	5	Able to describe, illustrate and explain the centrifuge				1,2		
III	<b>Gel Electrophoresis:</b> Application; Types; Principle; pH meter (Principle); Dialysis, <b>Blotting technique:</b> Southern, Western, & Northern blot	8	Able to describe, illustrate and explain the electrophoresis				1,2		
IV	<b>Radio- isotope dating technique:</b> Introduction, nature, detection & measurement of radioactivity, radioisotopes & radiation, units, radioactive decay.	7	Able to describe, illustrate and explain the radio isotopes.				1,2		
V	<b>Spectroscopic techniques:</b> Introduction, Principle and application of spectroscopy	10	Able to describe, illustrate and explain the spectroscope				1,2		
Practical	Operation of molecules from given sample by 1. Paper chromatography 2. Column chromatography 3. Thin layer chromatography 4. Separation of DNA and protein molecules by gel electrophoresis	30	Able to use various instruments for analysis				1,2, 3,4		

#### TEXT BOOKS:

T1. Upadhyay. Biophysical chemistry: principle and technique. 12th edition. Himalaya Publishing House Pvt. Ltd; 2017.

#### REFERENCE BOOKS:

R1. Kakkar. Atomic and Molecular Spectroscopy. 1st edition. Cambridge English; 2017.

R2. Evans. Handbook of Chromatography. 2nd Edition, Willford Press; 2019.

R3. Holme and Peck. Analytical biochemistry. 3rd edition. Longman, 1983.

**OTHER LEARNING RESOURCES:**

1. <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/chromatography>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Discuss Chromatography techniques including history, classification, principles, operation, analysis and application.	<b>1, 3, 4</b>
<b>2</b>	Define Centrifugation techniques, classification, principles, operation and its application.	<b>1, 3</b>
<b>3</b>	Explain and investigate Electrophoresis, its categorization, underlying principle, operational methods, pH meter functionality, dialysis, and blotting methodologies.	<b>1, 3, 4</b>
<b>4</b>	Discuss radioisotope dating principles, including detection, measurement, isotopes, radiation, units and decay.	<b>1, 3, 4</b>
<b>5</b>	Develop the comprehensive understanding of principles, and practical application skills in various spectroscopic methods for scientific analysis.	<b>1, 3, 4</b>

SEMESTER – I									
Course Title	Fundamental of Statistics								
Course code	23UMFS111R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 30T+30P	2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Fall/I Semester of First Year of the Programme								
Course objectives	1. Help to understand the role of statistics in data analysis, decision-making, and scientific research 2. Introduce students to descriptive statistics, including measures of central tendency (mean, median, mode) and measures of dispersion (range, variance, standard deviation). 3. Teach students how to summarize and present data effectively using tables, charts, and graphs								
CO1	Improve understanding of Descriptive Statistics and Demography.								
CO2	Develop knowledge to understand the Probability theory, Distribution, and sampling methods.								
CO3	Develop knowledge to understand the methods for hypothesis testing and Biological data analysis.								
CO4	Develop knowledge to understand the principles of various statistical analyses of data.								
CO5	Develop knowledge on R language for data analysis								
Unit-No.	Content	CH	Learning Outcome				KL		
I	<b>Statistical Methods:</b> Definition and scope of Statistics concepts of statistical population and sample. Data quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio.	5	Foundational Understanding of Statistical Concepts				1,2		
II	<b>Presentation:</b> tabular and graphical, including histogram and ogives. Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, skewness and kurtosis.	5	Proficiency in Data Presentation and Analysis				1,2		
III	<b>Bivariate data:</b> Definition, scatter diagram, simple partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, fitting of polynomials and exponential curves.	5	Knowledge on Analyzing Bivariate Data and Relationships				1,2		
IV	<b>Random experiment:</b> trial, sample point and sample space, event, Operations of Events, concepts of mutually exclusive and exhaustive events. Definition of probability: classical and relative frequency approach. Discrete probability space, Properties of probability. Independence of events, Conditional probability, total and compound probability rules, Normal probability Distribution, Binomial probability Distribution, Poisson Probability Distribution, Bayes' theorem and its applications.	8	Understanding of Probability and Distributions				1,2		
V	<b>Testing of hypothesis,</b> parametric test: t-test, z-test, chi square test. Non-Parametric test: One sample Kolmogorov test, wilcoxon Signed test, Mann-Whitney Test, Kruskal walis test.	7	Application of Hypothesis Testing and Statistical Tests				1,2		
<b>Practical</b>	1.Introduction to R - A programming language and environment for data analysis and graphics. Syntax of R expressions: Vectors and assignment, vector arithmetic generating regular sequence, logical vector, character vectors, Index vectors; selecting and modifying subsets of dataset 2.Data objects: Basic data objects, matrices, partition of matrices, arrays, lists, creating and using these objects	30	A brief knowledge on using R for data analysis and visualization				1,2,3,4		

	<p>Functions- Elementary functions and summary functions applying functions to subsets of data. Data frames: The benefits of data frames, creating data frames, combining data frames, Adding new classes of variables to data frames; Data frame attributes.</p> <p>3.Importing data files: import. data function, read. table function; Exporting data: export. data function, cat, write and write. table functions, function, formatting output options, and format functions; Exporting graphs -export graph function. Graphics in R: creating graphs using plot function, box plot, histogram, line plot, steam and leaf plot, pie chart, bar chart, multiple plot layout, plot titles formatting plot axes; Visualizing the multivariate data Scatter plot, Q-Q plot, P-plot.</p> <p>4.Performing data analysis tasks: Reading data with scan function, exploring data using graphical tools, computing descriptive statistics, one sample tests, two sample tests Goodness of fit tests.</p> <p>5.Parametric test and Non-Parametric test</p>			
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**Textbooks:**

T1. Methods in Biostatistics by K S Negi, ISBN:9789374735053,4th Edition, Year:2023, AITBS Publishers, INDIA

**Reference books**

R1. "Introduction to the Practice of Statistics" by David S. Moore, George P. McCabe, and Bruce A. Craig  
R2. "Statistics" by David Freedman, Robert Pisani, and Roger Purves

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Improve understanding of Descriptive Statistics and Demography.	<b>1, 4</b>
<b>2</b>	Develop knowledge to understand the Probability theory, Distribution, and sampling methods.	<b>1, 4</b>
<b>3</b>	Develop knowledge to understand the methods for hypothesis testing and Biological data analysis.	<b>1, 4</b>
<b>4</b>	Develop knowledge to understand the principles of various statistical analyses of data.	<b>1, 4</b>
<b>5</b>	Develop knowledge on R language for data analysis	<b>1, 4, 9</b>

SEMESTER – I									
Course Title	MINI RESEARCH (REVIEW OF LITERATURE-R1)								
Course code	22MSMB115R	Total credits: 2 Total hours: 120(S+R)	L	T	P	S	R	O/F	C
			0	0	0	4	6	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Fall/I Semester of First Year of the Programme								
Course objectives	To develop students scientific writing skill								
CO1	Employ databases and library resources to gather original research, books, and articles effectively								
CO2	Summarize and differentiate between various types of reviews, specifically analytical and descriptive reviews.								
CO3	Identify research topics and employ appropriate methods for collecting and filtering information.								
CO4	Critically analyze the demonstrations and findings of previous authors to comprehend their contributions and insights.								
CO5	Compose a detailed review that explains the prospects and future directions of the chosen study.								

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Employ databases and library resources to gather original research, books, and articles effectively	1, 2, 3, 4
2	Summarize and differentiate between various types of reviews, specifically analytical and descriptive reviews.	1, 2, 3, 4
3	Identify research topics and employ appropriate methods for collecting and filtering information.	1, 2, 3, 4
4	Critically analyze the demonstrations and findings of previous authors to comprehend their contributions and insights.	1, 2, 3, 4
5	Compose a detailed review that explains the prospects and future directions of the chosen study.	1, 2, 3, 4,6



SEMESTER – I									
Course Title	EFFECTIVE ENGLISH (Communicative English & Soft Skills)								
Course code	22UMPD111R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 60P	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Fall/I Semester of First Year of the Programme								
Course objectives	1. To introduce the types of sentences and their significance. 2. To strengthen the students' vocabulary to enhance their speaking and writing skills. 3. To familiarize the students with the importance of dress codes in various organizations. 4. To introduce the 3P's (Planning, prioritizing & performing) of Time Management. 5. To give insight into English pronunciation and into central concepts in phonetics.								
CO1	Analyse and identify the different types of sentences.								
CO2	Able to integrate the skills of reading and speaking in professional communication.								
CO3	Illustrate code Etiquette sessions will boost their confidence and morals.								
CO4	Describe about the effective and efficient utilization of time.								
CO5	Explain the concept of Phonetics and its importance will improve the learners 'pronunciation								
MODULES	<b>Module 1- Grammar</b> Interchange of Interrogative and Assertive Sentences, Exclamatory and Assertive Sentences, Types of Tenses, Common Errors, Synonyms, Antonyms, Homonyms <b>Module 2- Reading Skills</b> Techniques of Effective Reading, Gathering ideas and information from a text The SQ3R Technique Interpret the text <b>Module 3-Listening Skills</b> What is listening?, The Process of Listening, Factors that adversely affect Listening, Difference between Listening and Hearing, Purpose and Importance of Effective Listening, How to Improve Listening Process, <b>Module 4- Conflict Management</b> Definition, Type of Conflict Management, Effects of Conflict Management, Methods to deal with Conflicts (Negative) <b>Module 5- Time-Management Skills</b> Introduction To Time Management, Purpose And Importance of Time Management, Basic Tips to Maintain Time. <b>Activity: Problem solving activity:</b> A situation will be given to the students and they will have to tell us how to handle the situation or solve the problem.								

#### TEXTBOOKS:

- T1. Wren, P.C and Martin, H. 1995. High School English Grammar and Composition, S Chand Publishing.  
 T2. English Grammar in Use, Raymond Murphy 4th edition, CUP.  
 T3. Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

#### REFERENCE BOOKS:

- R1. English Vocabulary in Use (Advanced), Michael McCarthy and Felicity, CUP.  
 R2. Effective Communication and Soft Skills, Nitin Bhatnagar, Pearsons.

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Analyse and identify the different types of sentences.	1, 5
2	Able to integrate the skills of reading and speaking in professional	1, 5, 9

	communication.	
<b>3</b>	Illustrate code Etiquette sessions will boost their confidence and morals.	<b>5, 6, 9</b>
<b>4</b>	Describe about the effective and efficient utilization of time.	<b>5, 9</b>
<b>5</b>	Explain the concept of Phonetics and its importance will improve the learners 'pronunciation	<b>1, 5, 9</b>

SEMESTER – II									
Course Title	Immunology								
Course code	22MSMB121R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Microbiology								
Semester	Spring/II Semester of First Year of the Programme								
Course objectives	1. To make students understand the Immune system and its components, immune response, antigen, antibody, immunity, Hypersensitivity, Autoimmunity etc. 2. To make students learn various immunological diagnostic techniques								
CO1	Describe the immune system and its components and their mode of action in defense mechanisms.								
CO2	Outline antigen and antibody structure, types, and properties including the processes of monoclonal and polyclonal antibody production								
CO3	Apply the knowledge of different immunological diagnostics tests, their principle, and interpretations aiding in the detection of the underlying cause of the diseases.								
CO4	Interpret transplantation and cancer immunology findings and their role in research.								
CO5	Discuss immunological disorders like autoimmunity and hypersensitivity, their prevention strategies, and management								
Unit-No.	Content		CH	Learning Outcome				KL	
<b>I</b>	<b>Introduction to immunology</b> – Definition, history, scope of immunology. Overview of the immune system-cells and organs of the immune system. Immune response- Humoral and cell mediated immune response. Immunity- types of immunity- Innate and acquired immunity, APC.		<b>7</b>	Knowledge of Immune system, Immunity, immune response				1,2	
<b>II</b>	<b>Antigens</b> – General features, haptens, adjuvants, epitopes. <b>Antibody</b> – Structure, types, antibody mediated effector functions – opsonisation, antibody activated complement, ADCC, isotypes, allotypes, idiotypes, <b>Antibody production and purification</b> – production of monoclonal antibodies, immunotoxins, abzymes, extraction of antibodies. Expression of immunoglobulin genes- antibody diversity, class switching of Immunoglobulins		<b>10</b>	Knowledge on antigens and their properties and antibodies and their types along with their production and purification process				1,2	
<b>III</b>	<b>Antigen-antibody interaction</b> – principle and application – RIA, ELISA, Western blotting, Immunofluorescence, Complement system – classical and alternative pathway, functions		<b>10</b>	Theoretical and practical knowledge on principle and process of different immunological diagnostic tests				1,2	
<b>IV</b>	<b>HLA</b> – Theories of antibody formation, HLA typing, MHC, T cell receptors, Transplantation immunology – Graft rejection, immune suppressive therapy, immune tolerance, clinical transplantation Immune effectors – Cytokines, IL and functions, cell mediated cytotoxicity, NK cells, TNF, Interferons, Inflammation, leukocyte activation, and migration		<b>8</b>	Knowledge on transplantation immunology and immune effectors.				1,2	
<b>V</b>	Hypersensitivity and types, Autoimmunity, Cancer and immune system – tumor antigen, tumor evasion and immunotherapy of cancer, AIDS – primary and secondary		<b>10</b>	Knowledge on Hypersensitivity, Autoimmunity, cancer immunology, immunodeficiency				1,2	

	immunodeficiency. Vaccines and its types		and vaccines	
<b>Practical</b>	Precipitation Reaction: i. Double Diffusion Reaction ii. Single Diffusion Reaction iii. Ouchterlony immunodiffusion iv. Immunoelctrodiffusion Agglutination Reaction: (Qualitative and quantitative) WIDAL, ASO, VDRL, RPR, CRP Blood grouping and Rh typing, ELISA	<b>30</b>	Able to operate ELISA, RIA	1,2,3,4

### TEXTBOOKS

T1. Punt et al. Kuby Immunology 18th Edition. W H Freeman & Co (Sd); 2018.

### REFERENCE BOOKS

- R1. Abbas. Cellular and Molecular Immunology. 10th edition. Elsevier; 2021.  
 R2. Martin et al. Roitt's Essential Immunology (Essentials). 13th edition. Wiley-Blackwell, 2017.  
 R3. Westwood. Practical Immunology. 4th edition. Wiley-Blackwell; 2002.

### OTHER LEARNING RESOURCES:

1. <https://pubmed.ncbi.nlm.nih.gov/28830733/>

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe the immune system and its components and their mode of action in defense mechanisms.	1, 2, 9
2	Outline antigen and antibody structure, types, and properties including the processes of monoclonal and polyclonal antibody production	1, 3, 4
3	Apply the knowledge of different immunological diagnostics tests, their principle, and interpretations aiding in the detection of the underlying cause of the diseases.	1, 2, 3, 4
4	Interpret transplantation and cancer immunology findings and their role in research.	1, 2, 4
5	Discuss immunological disorders like autoimmunity and hypersensitivity, their prevention strategies, and management.	1, 2, 3, 4

SEMESTER – II									
Course Title	Molecular Biology, Genomics And Genetic Engineering								
Course code	22MSMB122R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Microbiology								
Semester	Spring/II Semester of First Year of the Programme								
Course objectives	1. To teach in depth about genome and its arrangement in eukaryotes and microbes. 2. To teach the central dogma of life (replication, transcription, translation and post transcriptional modifications) with the best possible teaching tools (explanation/power point presentation/seminar/assignment) and with utmost attention. 3. Important topics like mutation, DNA damage and repair are explained.								
CO1	Explain the fundamental of genomics concepts such as genome, DNA structure, RNA, proteins and the central dogma.								
CO2	Explain the methods for mapping genomes, describe markers, linkage analysis with different types of organisms, physical mapping, and basics of genome sequencing, shotgun sequencing.								
CO3	Compare prokaryotic and eukaryotic genomes, including the presence of extra chromosomal DNA and examine the vital function of DNA binding proteins in gene expression and regulation.								
CO4	Illustrate the dynamics of genome access, encompassing aspects such as euchromatin, heterochromatin, chromosome painting, nucleosome modifications, histone acetylation, DNA modifications, DNA methylation-induced gene silencing, and gene regulation in both prokaryotes and eukaryotes.								
CO5	Discuss the mutation causes, types of DNA mutation and DNA repair mechanisms, crucial for maintaining genetic stability and impacting human health.								
Unit-No.	Content	CH	Learning Outcome				KL		
I	Introduction to genomics, definitions of genome, DNA structure and composition, RNA and the transcriptome, proteins and the proteome, the central dogma	7	Introductory knowledge and refreshing the existing understanding				1,2		
II	Mapping of genomes, markers for genetic mapping, the basis to genetic mapping, linkage analysis with different types of organisms, physical mapping, basics of genome sequencing, shotgun sequencing	10	Sequencing techniques in detail followed by linkage mapping				1,2		
III	Genomes of prokaryotes and eukaryotes, extra chromosomal DNA, role of DNA binding proteins in genome expression: methods for studying DNA binding proteins and their attachment sites, special features of DNA binding proteins, interaction between DNA and its binding proteins	10	Knowledge on DNA replication in prokaryotes and eukaryotes with special emphasis on the proteins and enzymes involved				1,2		
IV	Accessing the genome: euchromatin and heterochromatin, chromosome painting, nucleosome modifications and genome expression, histone modification, acetylation, DNA modifications and genome expression, gene silencing by DNA methylation, gene regulation in prokaryotes and eukaryotes	8	Genome organisation is discussed in detail with various post translational events along with regulatory mechanisms				1,2		
V	Introduction to genetic engineering, Different DNA manipulating enzymes, methods for isolating DNA, vectors for bacteria, plant and animals, expression vectors, DNA libraries, application of genetic engineering.	10	Understand genetic engineering techniques, use vectors, evaluate expression vectors, and propose innovative applications.				1,2		
Practical	Isolation of genomic DNA., Isolation of plasmid DNA, Polymerase chain reaction, Endonuclease digestion of DNA and analysis of DNA fragments	30	Knowledge on extraction of DNA and plasmid from biological samples followed by				1,2, 3,4		

	by agarose electrophoresis.		their in vitro amplification and studying RFLP profile	
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### Textbooks

T1. Watson et al. The Molecular Biology of the Gene. 7th edition. Pearson Publication; 2013.

### Reference books

R1. Alberts et al. The Molecular Biology of the Cell. 7th Edition. WW Norton & Co, 2022.

R2. Rastogi. Cell and Molecular Biology. 4th edition. New Age International Private Limited; 2020.

R3. Som. Practical Manual of Molecular Biology. 1st edition. KAAV Publications, 2018.

### Other learning resources

1. <https://pubmed.ncbi.nlm.nih.gov/28830733/>

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain the fundamental of genomics concepts such as genome, DNA structure, RNA, proteins and the central dogma.	1, 9
2	Explain the methods for mapping genomes, describe markers, linkage analysis with different types of organisms, physical mapping, and basics of genome sequencing, shotgun sequencing.	1, 2, 3, 4, 6, 9
3	Compare prokaryotic and eukaryotic genomes, including the presence of extra chromosomal DNA and examine the vital function of DNA binding proteins in gene expression and regulation.	1, 2, 3, 4, 6, 9
4	Illustrate the dynamics of genome access, encompassing aspects such as euchromatin, heterochromatin, chromosome painting, nucleosome modifications, histone acetylation, DNA modifications, DNA methylation-induced gene silencing, and gene regulation in both prokaryotes and eukaryotes.	1, 4, 9
5	Discuss the mutation causes, types of DNA mutation and DNA repair mechanisms, crucial for maintaining genetic stability and impacting human health.	1, 2, 7, 9

SEMESTER – II									
Course Title	Bioinformatics								
Course code	22MSMB123R	Total credits: 3 Total hours: 30T+30P	L	T	P	S	R	O/F	C
			2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Microbiology								
Semester	Spring/II Semester of First Year of the Programme								
Course objectives	1. To search and retrieve biological information from different biological databases. 2. Knowledge on computational database management system and its application in Biology 3. A basic idea on the structural biology using computer.								
CO1	A basic concept on Bioinformatics and its significance in the field of biological data analysis								
CO2	Knowledge on database management system and its application in Biology								
CO3	A good knowledge on sequence submission tools as well as biological search engines								
CO4	Knowledge on sequence alignment and analysis.								
CO5	Learn the concept of computer aided drug designing								
Unit-No.	Content	CH	Learning Outcome				KL		
<b>I</b>	Introduction to Bioinformatics, Scope and Applications of Bioinformatics, Introduction to various molecular data and databases, Importance of Computers/IT in the field of Biology. Flatfile formats. Biological Database and its Types - General Introduction of Biological Databases: Nucleotide sequence databases (NCBI, DDBJ, and EMBL). Protein sequence databases (SWISS-PROT, PIR, GenPept), Specialized Genome databases: (SGD, TIGR etc). Structure databases (CATH, SCOP, and PDB, NDB, MMDB)	<b>7</b>	Knowledge on bioinformatics and its relation with molecular biology and its application.				1,2		
<b>II</b>	Database Management System: Basic Concept of DBMS, Concepts of Entities, Attribute, Keys, Relationship. Three level architecture of a DBMS, Structure of a DBMS, Advantages & Disadvantages of a DBMS. File Based System, Traditional System, DBMS types Hierarchical, Network, Relational Data Model etc	<b>6</b>	Formation of a database and its application in biology				1,2		
<b>III</b>	Bioinformatics Database search engines: Text-based search engines (Entrez, DBGET /LinkDB). Sequence similarity based search engines (BLAST and FASTA). Motif-based search engines (ScanProsite and eMOTIF). Structure similarity based search engines (Combinatorial Extension, VAST and DALI). Proteomics tools: - ExPASy server, EMBOSS.	<b>7</b>	Knowledge on different bioinformatics search engines and their applications in retrieving data				1,2		
<b>IV</b>	Pairwise sequence alignments: Sequence similarity, identity, and homology. Global and local alignment, BLAST and PSI-Blast, Application of Blast tool, Multiple sequence alignments and Application of multiple sequence alignment.	<b>5</b>	A good knowledge on sequence alignment and its application				1,2		
<b>V</b>	Computer assisted drug design- concept, methods and practical approaches, various computational methods applied to design the drugs, CADD software demonstration. Protein homology modelling	<b>5</b>	A brief knowledge on drug designing through computer as well as protein 3D modelling				1,2		
<b>Practical</b>	Data retrieval from different biological database Sequence alignment through BLAST Protein homology modeling Phylogenetic Analysis through MEGA software Demonstration of Drug designing	<b>30</b>	Knowledge on different biological databases and sequence alignment tool.				1,2, 3,4		

### TEXTBOOKS

1. Harisha S. Fundamental of Bioinformatics. 3rd edition. Dreamtech Press, 2019.

### REFERENCE BOOKS

1. Sharma T. R. Genome Analysis and Bioinformatics: A Practical Approach (English) (Paperback). 1st edition. Dreamtech Press; 2019.
2. Orengo C.A. et al. Bioinformatics: Genes, proteins and computers. 1st edition. Taylor & Francis, 2002.
3. Kanguane P., Mathura V. Bioinformatics: A Concept-Based Introduction. 1st edition. Springer-Verlag New York Inc. 2009.

### OTHER LEARNING RESOURCES

1. <https://pubmed.ncbi.nlm.nih.gov/28830733/>

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	A basic concept on Bioinformatics and its significance in the field of biological data analysis	1, 4, 9
2	Knowledge on database management system and its application in Biology	1, 4, 5
3	A good knowledge on sequence submission tools as well as biological search engines	1, 4, 5
4	Knowledge on sequence alignment and analysis.	1, 4
5	Learn the concept of computer aided drug designing	1, 3, 4



SEMESTER – II									
Course Title	Mushroom Cultivation: Techno-Professional								
Course code		Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 58	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	<ol style="list-style-type: none"> <li>To create awareness about the Mushroom among the people.</li> <li>To strengthen the promotion of mushroom cultivation by establishing a well-equipped laboratory and offices.</li> <li>To know and explore the cultivation in Assam</li> </ol>								
CO1	Explain different classes of mushrooms.								
CO2	Describe the reproduction and growth of mushrooms.								
CO3	Explain mushroom spawn production								
CO4	Discuss the methods of cultivation of mushroom								
CO5	Apply the techniques for the utilization of mushrooms spent								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Introduction: Background of mushroom (common feature, types and uses, edible mushroom, non-edible and poisonous mushroom common features on poisonous mushroom, uses of mushroom, important of mushroom, biological efficiency of mushroom)	12	Understand the key characteristics, types, and uses of mushrooms, including the distinction between edible and poisonous varieties, and their biological efficiency.				1,2,3,4		
II	Biology of mushroom (reproduction, growth and nutrition), Oyster and Button mushrooms, Mushroom structure designed and maintenance	12	Grasp the biology, reproduction, and growth of mushrooms, focusing on Oyster and Button mushrooms, and understand their structural design and maintenance.				1,2,3		
III	Laboratory techniques for production of mushroom spawn (seed)	12	Understand and apply the fundamental principles of mushroom spawn production				1, 2, 3		
IV	Methods for cultivation and harvesting of mushroom	12	Understand and apply various techniques for mushroom cultivation.				1, 2, 3		
V	Utilization of mushroom spent(waste).	10	Understand the environmental and economic benefits of utilizing spent mushroom substrate.				1, 2, 3, 4		

#### TEXTBOOKS:

- T1. Mushroom Cultivation Technology by [Joy Sarkar, Krishnendu Acharya, Anirban Roy](#).  
 Publisher: Techno World
- T2. Handbook of Mushrooms 4th Edition by Bahl N, Oxford &Ibh Publishing

#### REFERENCE BOOKS:

- R1. Mushroom Cultivation by Parveen Garg, Publisher: B.R. Publishing Corporation, ISBN:9788193031421
- R2. Mushrooms: A Manual for Cultivation by S. Biswas, M. Datta, S. V. Ngachan, PHI Learning.

## OTHER LEARNING RESOURCES

1. <https://www.nhb.gov.in/pdf/Cultivation.pdf>

## RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain different classes of mushrooms.	<b>1</b>
<b>2</b>	Describe the reproduction and growth of mushrooms.	<b>1</b>
<b>3</b>	Explain mushroom spawn production	<b>1, 3, 4</b>
<b>4</b>	Discuss the methods of cultivation of mushroom	<b>1, 3</b>
<b>5</b>	Apply the techniques for the utilization of mushrooms spent	<b>1, 2, 3, 4</b>

SEMESTER-III									
Course Title	Generic Elective - Public Health And Hygiene								
Course code	22MSMB125R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30	2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To understand the concepts, significance and relevance of public health and hygiene. 2. To understand the health hazards as associated with public health and hygiene.								
CO1	Explain the concepts of public health, evaluate India's health systems and policies, and assess the impact of nutrition, environment, and mental health on public well-being								
CO2	Analyze environmental health hazards, assess pollution impacts, and understand the importance of hygiene, waste management, and food safety.								
CO3	Describe key hygiene concepts across personal, medical, food, and industrial settings.								
CO4	Identify and understand the causes, prevention, and control measures of lifestyle-related non-communicable and communicable diseases.								
CO5	Analyze social health issues in India and evaluate the role of health education and programs in promoting deaddiction and eco-friendly practices.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	INTRODUCTION Concept of Public Health Goals and Objectives of Public health and Hygiene, Public health system in India and in the rest of world HEALTH ASPECTS Introduction to National Health Policy - National Rural Health Mission (NRHM) and National Urban Health Mission (NUHM) Nutrition and health, Environmental health- sanitation, air, water pollution, Mental health	7	Knowledge about the Concepts, Goals, and Objectives of Public Health and Hygiene. NRHU and NUHM				1, 2		
II	ENVIRONMENT AND HEALTH HAZARDS : Environmental degradation and Pollution: Sources, Impacts of wastes and treatment methods Environment & Health Relation Assessment - Concept, Steps and application, Personal and mental hygiene, Health destroying habits and addictions Need of Water Purification Adulteration of Food Undesirable Changes in Air, Radiation effects, e- waste, Solid waste and Excreta disposal	5	Knowledge on Environmental Pollution, degradation, Hygiene and Food adulteration				1, 2, 3		
III	HYGIENE CONCEPTS Personal Hygiene Medical Hygiene Food Hygiene Industrial Hygiene	5	Knowledge on hygiene (personal, Medical, food and industrial)				1, 2		
IV	LIFE STYLE RELATED NON-COMMUNICABLE DISEASES Hypertension Coronary Heart Diseases Stroke Diabetes Mellitus Obesity COMMUNICABLE DISEASES AND THEIR CONTROL MEASURES: Air Borne Disease : Tuberculosis, Influenza Food and water Borne Disease : Amoebiasis, Jaundice Vector Borne Disease : Malaria, Dengue Contact Disease : Venereal disease and AIDS	8	Theoretical and practical knowledge on communicable and non-communicable diseases				1, 2, 3		

<b>V</b>	<b>SOCIAL HEALTH PROBLEMS AND HEALTH EDUCATION IN INDIA:</b> Smoking, Alcoholism, Drug Dependence and Their Deaddiction. Eco-Friendly Environmental Practices, Effects of drug abuse, WHO programmes Government and voluntary Organizations – vaccination and awareness programme, First Aid	<b>5</b>	Knowledge on Indian Health Education and Social health problems	1, 2, 3
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**TEXTBOOKS:**

- T1. Introduction to Public Health, Raymond L. Goldstein, Karen Goldstein, David G. Graham, 2011, Springer publishing company
- T2. Introduction To Community Health Nursing, Kasturi Sundar Rao, 4th edition, Bi Publications Pvt Ltd
- T3. Concepts of Epidemiology, Raj S Bhopal, 2002, Oxford University press
- T4. A Treatise on Hygiene And Public Health, Birendra Nath Ghosh, 9th edition, Calcutta Scientific Publishing Co
- T5. An Introduction to Public Health, Caryl Thomas, 1949, John Wright and Sons Ltd.,

**REFERENCE BOOKS:**

- R1. Park and Park, 1995: Text book of preventive and social medicine – Banarsidas Bhanot Publ. Jodhpur- India
- R2. Verma, S. 1998: Medical zoology, Rastogi Publ.- Meerut- India
- R3. Jatin V. Modi and Renjith S. Chawan. Essentials of Public Health and Sanitation –Part I- IV
- R4. Murray, C. J. L. and A.D. Lopez. (1996). The Global Burden Of Disease. World Health Organization.
- R5. Park, J.E. and Park, K. Textbook of Community Health for Nurses.

**OTHER LEARNING RESOURCES:**

- 1. <https://www.cdcfoundation.org/what-public-health>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the concepts of public health, evaluate India's health systems and policies, and assess the impact of nutrition, environment, and mental health on public well-being	<b>1, 2, 4, 7</b>
<b>2</b>	Analyze environmental health hazards, assess pollution impacts, and understand the importance of hygiene, waste management, and food safety.	<b>1, 2, 4, 7, 8</b>
<b>3</b>	Describe key hygiene concepts across personal, medical, food, and industrial settings.	<b>1, 5, 7</b>
<b>4</b>	Identify and understand the causes, prevention, and control measures of lifestyle-related non-communicable and communicable diseases.	<b>1, 2, 4, 5, 7</b>
<b>5</b>	Analyze social health issues in India and evaluate the role of health education and programs in promoting deaddiction and eco-friendly practices.	<b>1, 2, 4, 7</b>

SEMESTER-II									
COURSE TITLE	Research Methodology and Statistical Analysis								
Course code	22UMRM121R	Total credits: 2	L	T	P	S	R	O/f	C
		Total hours:15T+60S	1	0	0	4	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
programme	Master of Science in Microbiology								
Semester	Spring/II semester of First year of the programme								
Course objectives	<ol style="list-style-type: none"> <li>1. The course aims to enhances the students' a broad understanding of research methodology, including theory of science and qualitative and quantitative methods in research.</li> <li>2. The course seeks to enhance the students' skills for developing critical thinking through research literature review in different domain. Consequently, it aims to develop skills for preparation of a research proposal for a master' thesis project/Mini research.</li> <li>3. To develop Students competency in planning, conducting, evaluating and presenting a research project.</li> </ol>								
CO1	Students will have basic knowledge of Research methods.								
CO2	Students will gain the knowledge of Research Methodology.								
CO3	Students will be able to gain the Skill questionnaire development.								
CO4	Students will be able to acquire the knowledge of basic Report/dissertation Procedure.								
CO5	Knowledge on different IPR rights								
Unit no	Content		CH	Learning Outcome				KL	
I	Research Methodology- An Introduction- meaning and objectives of research, motivation in research, types and significance of research, criteria of good research. Defining the Research Problems- definition of research problem, necessity of defining research problem		2	Knowledge on fundamental concepts of research methodology, including the meaning and objectives of research				1,2	
II	Research Design- meaning and need of research design, features of a good design, different research designs, Sampling Design- steps in sampling design, Sample Size determination, criteria for selecting a sampling design, different types of sampling design, Experimental Design, Principles of Design of Experiment, One – way ANOVA, Two- Way ANOVA, CRD, RBD, LSD, 22, 23 Factorial Design		4	Able to understand and apply the fundamental principles of research design, including the meaning and necessity of research design				1,2	
III	Types of data, sources of data collection, tools of data collection, Nominal, ordinal, interval and ratio – Attitude scale construction and measurement, rating scales, semantic differential (SD), Use of scale in statistical analysis, Schedules for interviews preparation and standardization, development of survey instruments and item analysis for the questionnaire		3	A good knowledge on different types of data and identify various sources and tools for data collection				1,2	
IV	Planning and organizing research report, Format of research report, Different steps of writing report, lay out of the research report , How to organize thesis/Dissertation, mechanics of writing		3	Able to organize and write a comprehensive research report				1,2	

	research report, standard methods of quoting-presenting the result, written and oral reports, Uses of abstract, format of research report, presentation of statistics - tabular and graphic references and uses of references, Bibliography and presentation of bibliography			
<b>V</b>	Intellectual property right (IPR), Introduction and the need for IPR, IPR in India and worldwide, Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge and Geographical Indications, Patentable and non-patentable, patenting life, Filing of a patent application, The different layers of the international patent system, Case studies on Basmati rice, Turmeric, and Neem patents	3	Knowledge on importance of Intellectual Property Rights (IPR) both in India and globally	1,2
<b>Practical</b>	Laboratory using R Software: 1 Analysis of One way ANOVA; 2 Analysis of Two way ANOVA; 3 Analysis of CRD 4 Analysis of RBD 5 Analysis of 22 and 23 Factorial Experiment 6 Simulation-I using R (Bernoulli, Binomial, Poisson and Geometric distribution). 7 Simulation-II using R (Exponential and Normal distribution). 8 Simple random Sampling 9 Stratified Random Sampling	60	Knowledge on various statistical experiments and simulations using R	1,2,3,4

### TEXTBOOKS

T1: Methods in Biostatistics by K S Negi, ISBN:9789374735053,4th Edition, Year:2023, AITBS Publishers, INDIA

### REFERENCE BOOKS

R1. Johnson & Christensen. (2004). Educational Research: Quantitative, qualitative and mixed approaches, 2nd Ed. Boston: Allyn & Bacon.

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Students will have basic knowledge of Research methods.	2, 4, 9
2	Students will gain the knowledge of Research Methodology.	2, 4, 9
3	Students will be able to gain the Skill questionnaire development.	2, 4, 5
4	Students will be able to acquire the knowledge of basic Report/dissertation Procedure.	4, 5
5	Knowledge on different IPR rights	6, 7

SEMESTER – II									
Course Title	MINI RESEARCH 2 (RESEARCH GAP ANALYSIS)								
Course code	22MSMB126R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 192 (S+R)	0	0	0	4	12	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Fall/I Semester of First Year of the Programme								
Course objectives	1. To enable Students to comprehend various research methodologies and their applications in identifying research gaps. 2. To develop the ability to critically analyze existing literature and identify areas where further research is needed. 3. To enable students to formulate research questions or hypotheses based on identified gaps in the literature.								
CO1	Analyze existing literature								
CO2	Identify research gap								
CO3	Formulate research questions								
CO4	Formulate research objectives								
CO5	Prepare research synopsis								

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Analyze existing literature	1, 2, 4
2	Identify research gap	1, 2, 4
3	Formulate research questions	1, 2, 4, 9
4	Formulate research objectives	1, 2, 4, 9
5	Prepare research synopsis	1, 2, 4

SEMESTER-II									
COURSE TITLE	UNIVERSAL HUMAN VALUES (UHV) + PROFESSIONAL ETHICS								
Course code	22UUHV101R	Total credits: 2	L	T	P	S	R	O/f	C
		Total hours:15T+30P	1	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Winter/II semester of First year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings</li> <li>To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way</li> <li>To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature</li> </ol>								
CO1	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.								
CO2	It is free from any dogma or value prescriptions.								
CO3	It is a process of self-investigation and self-exploration, and not of giving sermons.								
CO4	Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.								
CO5	This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.								
Unit	Content								
I	<ul style="list-style-type: none"> <li>Understanding the need, basic guidelines, content and process for Value Education</li> <li>Self Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self exploration</li> <li>Continuous Happiness and Prosperity- A look at basic Human Aspirations</li> <li>Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority</li> <li>Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario</li> <li>Method to fulfil the above human aspirations: understanding and living in harmony at various levels.</li> </ul>								
II	<ul style="list-style-type: none"> <li>Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’</li> <li>Understanding the needs of Self (‘I’) and ‘Body’ - <i>Sukh</i> and <i>Suvidha</i></li> <li>Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)</li> <li>Understanding the characteristics and activities of ‘I’ and harmony in ‘I’</li> <li>Understanding the harmony of I with the Body: <i>Sanyam</i> and <i>Swasthya</i>; correct appraisal of Physical needs, meaning of Prosperity in detail</li> <li>Programs to ensure <i>Sanyam</i> and <i>Swasthya</i>-Practice Exercises and Case</li> </ul>								



	Studies will be taken up in Practice Sessions.
<b>III</b>	<ul style="list-style-type: none"> <li>• Understanding Harmony in the family – the basic unit of human interaction</li> <li>• Understanding values in human-human relationship; meaning of Nyaya and program for its fulfilment to ensure Ubhay-tripti;</li> <li>• Trust (Vishwas) and Respect (Samman) as the foundational values of relationship</li> <li>• Understanding the meaning of Vishwas; Difference between intention and competence</li> <li>• Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship</li> <li>• Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals</li> <li>• Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha )- from family to world family!-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>
<b>IV</b>	<ul style="list-style-type: none"> <li>• Understanding the harmony in the Nature</li> <li>• Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature</li> <li>• Understanding Existence as Co-existence (<i>Sah-astitva</i>) of mutually interacting units in all-pervasive space</li> <li>• Holistic perception of harmony at all levels of existence-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>
<b>V</b>	<ul style="list-style-type: none"> <li>• Natural acceptance of human values</li> <li>• Definitiveness of Ethical Human Conduct</li> <li>• Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order</li> <li>• Competence in professional ethics: <ul style="list-style-type: none"> <li>➤ Ability to utilize the professional competence for augmenting universal human order</li> <li>➤ Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems,</li> <li>➤ Ability to identify and develop appropriate technologies and management patterns for above production systems.</li> </ul> </li> <li>• Case studies of typical holistic technologies, management models and production systems</li> <li>• Strategy for transition from the present state to Universal Human Order: <ul style="list-style-type: none"> <li>➤ At the level of individual: as socially and ecologically responsible engineers, technologists and managers</li> <li>➤ At the level of society: as mutually enriching institutions and organizations</li> </ul> </li> </ul>
<b>Guidelines and Content for Practice Sessions</b>	<p>UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education</p> <p>PS 1: Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? How do you differentiate between right and wrong? What have been your achievements and shortcomings in your life? Observe and analyze them.</p>

Expected outcome: the students start exploring themselves; get comfortable to each other and to the teacher and start finding the need and relevance for the course.

PS 2: Now-a-days, there is a lot of voice about many techno-genic maladies such as energy and natural resource depletion, environmental pollution, global warming, ozone depletion, deforestation, soil degradation, etc. – all these seem to be man-made problems threatening the survival of life on Earth – What is the root cause of these maladies & what is the way out in your opinion?

On the other hand, there is rapidly growing danger because of nuclear proliferation, armsrace, terrorism, criminalization of politics, large scale corruption, scams, breakdown of relationships, generation gap, depression & suicidal attempts, etc – what do you think, is the root cause of these threats to human happiness and peace – what could be the way out in your opinion?

Expected outcome: the students start finding that technical education without study of human values can generate more problems than solutions. They also start feeling that lack of understanding of human values is the root cause of all problems and the sustained solution could emerge only through understanding of human values and value based living. Any solution brought out through fear, temptation or dogma will not be sustainable.

PS 3:

1. Observe that each one of us has Natural Acceptance, based on which one can verify right or not right for him. Verify this in case of

i) What is Naturally Acceptable to you in relationship- Feeling of respect or disrespect?

ii) What is Naturally Acceptable to you – to nurture or to exploit others? Is your living the same as your natural acceptance or different?

2. Out of the three basic requirements for fulfillment of your aspirations- right understanding, relationship and physical facilities, observe how the problems in your family are related to each. Also observe how much time & effort you devote for each in your daily routine.

Expected outcome:

1. The students are able to see that verification on the basis of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity; it will only develop assumptions.

2. The students are able to see that their practice in living is not in harmony with their natural acceptance most of the time, and all they need to do is to refer to their natural acceptance to remove this disharmony.

3. The students are able to see that lack of right understanding leading to lack of relationship is the major cause of problems in their family and not the lack of physical facilities in most of the cases, while they have given higher priority to earning of physical facilities in their life ignoring relationships and not being aware that right understanding is the most important requirement for any human being.

UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!

PS 4: List down all your desires. Observe whether the desire is related to Self (I) or Body. If it appears to be related to both, see which part of it is related to Self (I) and which part is related to Body.

Expected outcome: the students are able to see that they can enlist their desires and the desires are not vague. Also they are able to relate their desires to 'I' and 'Body' distinctly. If any desire appears related to both, they are able to see that the feeling is

related to I while the physical facility is related to the body. They are also able to see that 'I' and 'Body' are two realities, and most of their desires are related to 'I' and not body, while their efforts are mostly centered on the fulfillment of the needs of the body assuming that it will meet the needs of 'I' too.

PS 5:

1. a. Observe that any physical facility you use, follows the given sequence with time : Necessary & tasteful → unnecessary & tasteful → unnecessary & tasteless → intolerable

b. In contrast, observe that any feeling in you is either naturally acceptable or not acceptable at all. If naturally acceptable, you want it continuously and if not acceptable, you do not want it any moment!

2. List down all your activities. Observe whether the activity is of 'I' or of Body or with the participation of both 'I' and Body.

3. Observe the activities within 'I'. Identify the object of your attention for different moments (over a period of say 5 to 10 minutes) and draw a line diagram connecting these points. Try to observe the link between any two nodes.

Expected outcome:

1. The students are able to see that all physical facilities they use are required for a limited time in a limited quantity. Also they are able to see that in case of feelings, they want continuity of the naturally acceptable feelings and they do not want feelings which are not naturally acceptable even for a single moment.

2. the students are able to see that activities like understanding, desire, thought and selection are the activities of 'I' only, the activities like breathing, palpitation of different parts of the body are fully the activities of the body with the acceptance of 'I' while the activities they do with their sense organs like hearing through ears, seeing through eyes, sensing through touch, tasting through tongue and smelling through nose or the activities they do with their work organs like hands, legs etc. are such activities that require the participation of both 'I' and body.

3. The students become aware of their activities of 'I' and start finding their focus of attention at different moments. Also they are able to see that most of their desires are coming from outside (through preconditioning or sensation) and are not based on their natural acceptance.

PS 6:

1. Chalk out programs to ensure that you are responsible to your body- for the nurturing, protection and right utilisation of the body.

2. Find out the plants and shrubs growing in and around your campus. Find out their use for curing different diseases.

Expected outcome: The students are able to list down activities related to proper upkeep of the body and practice them in their daily routine. They are also able to appreciate the plants wildly growing in and around the campus which can be beneficial in curing different diseases.

UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

PS 7: Form small groups in the class and in that group initiate dialogue and ask the eight questions related to trust. The eight questions are:

1a. Do I want to make myself happy? 2a. Do I want to make the other happy?

3a. Does the other want to make him happy? 4a. Does the other want to make me happy?

What is the answer?

Intention (Natural Acceptance)

1b. Am I able to make myself always happy? 2b. Am I able to make the other always happy?

3b. Is the other able to make him always happy? 4b. Is the other able to make me always happy?

What is the answer?

Competence

Let each student answer the questions for himself and everyone else. Discuss the difference between intention and competence. Observe whether you evaluate your intention & competence as well as the others' intention & competence.

Expected outcome: The students are able to see that the first four questions are related to our Natural Acceptance i.e. Intention and the next four to our Competence. They are able to note that the intention is always correct, only competence is lacking! We generally evaluate ourselves on the basis of our intention and others on the basis of their competence! We seldom look at our competence and others' intention as a result we conclude that I am a good person and other is a bad person.

PS 8:

1. Observe on how many occasions you are respecting your related ones (by doing the right evaluation) and on how many occasions you are disrespecting by way of under-evaluation, over-evaluation or otherwise evaluation.

2. Also observe whether your feeling of respect is based on treating the other as yourself or on differentiations based on body, physical facilities or beliefs.

Expected outcome: The students are able to see that respect is right evaluation, and only right evaluation leads to fulfillment in relationship. Many present problems in the society are an outcome of differentiation (lack of understanding of respect), like gender biasness, generation gap, caste conflicts, class struggle, dominations through power play, communal violence, clash of isms, and so on so forth. All these problems can be solved by realizing that the other is like me as he has the same natural acceptance, potential and program to ensure a happy and prosperous life for him and for others though he may have different body, physical facilities or beliefs.

PS 9:

1. Write a note in the form of story, poem, skit, essay, narration, dialogue to educate a child. Evaluate it in a group.

2. Develop three chapters to introduce 'social science- its need, scope and content' in the primary education of children

Expected outcome: The students are able to use their creativity for educating children. The students are able to see that they can play a role in providing value education for children. They are able to put in simple words the issues that are essential to understand for children and comprehensible to them. The students are able to develop an outline of holistic model for social science and compare it with the existing model.

UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

PS 10: List down units (things) around you. Classify them in four orders. Observe and explain the mutual fulfillment of each unit with other orders.

Expected outcome: The students are able to differentiate between the characteristics and

	<p>activities of different orders and study the mutual fulfillment among them. They are also able to see that human beings are not fulfilling to other orders today and need to take appropriate steps to ensure right participation (in terms of nurturing, protection and right utilization) in the nature.</p> <p>PS 11:</p> <ol style="list-style-type: none"> <li>1. Make a chart for the whole existence. List down different courses of studies and relate them to different units or levels in the existence.</li> <li>2. Choose any one subject being taught today. Evaluate it and suggest suitable modifications to make it appropriate and holistic.</li> </ol> <p>Expected outcome: The students feel confident that they can understand the whole existence; nothing is a mystery in this existence. They are also able to see the interconnectedness in the nature, and point out how different courses of study relate to the different units and levels. Also they are able to make out how these courses can be made appropriate and holistic.</p> <p>UNIT 5: Implications of the above Holistic Understanding of Harmony at all Levels of Existence</p> <p>PS 12: Choose any two current problems of different kind in the society and suggest how they can be solved on the basis of natural acceptance of human values. Suggest steps you will take in present conditions.</p> <p>Expected outcome: The students are able to present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.</p> <p>PS 13:</p> <ol style="list-style-type: none"> <li>1. Suggest ways in which you can use your knowledge of Technology/Engineering/Management for universal human order, from your family to the world family.</li> <li>2. Suggest one format of humanistic constitution at the level of nation from your side.</li> </ol> <p>Expected outcome: The students are able to grasp the right utilization of their knowledge in their streams of Technology/Engineering/ Management to ensure mutually enriching and recyclable productions systems.</p> <p>PS 14: The course is going to be over now. Evaluate your state before and after the course in terms of</p> <ol style="list-style-type: none"> <li>a. Thought</li> <li>b. Behavior and</li> <li>c. Workd. Realization</li> </ol> <p>Do you have any plan to participate in the transition of the society after graduating from theinstitute? Write a brief note on it.</p> <p>Expected outcome: The students are able to sincerely evaluate the course and share with their friends. They are also able to suggest measures to make the course more effective and relevant. They are also able to make use of their understanding in the course for a happy and prosperous society.</p>
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### **TEXTBOOKS**

T1. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

### **REFERENCE**

- R1. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
- R2. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.

3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986,1991

### OTHER LEARNING RESOURCES

1. Value Education websites, <http://uhv.ac.in>, <http://www.uptu.ac.in>
2. Story of Stuff, <http://www.storyofstuff.com>
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story

### RELATIONSHIP BETWEEN COURE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.	<b>1, 2, 3, 4, 7</b>
<b>2</b>	It is free from any dogma or value prescriptions.	<b>1, 3, 4</b>
<b>3</b>	It is a process of self-investigation and self-exploration, and not of giving sermons.	<b>1, 2, 3</b>
<b>4</b>	Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.	<b>1, 3, 5</b>
<b>5</b>	This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.	<b>3, 8</b>

SEMESTER-II									
COURSE TITLE	COMMUNICATION MASTERY (Communicative English & Soft Skills)								
Course code	22UMPD121R	Total credits: 2	L	T	P	S	R	O/f	C
			0	0	4	0	0	0	2
Pre-requisite	22UMPD111R Effective English	Co-requisite	Nil						
programme	Master of Science in Microbiology								
Semester	Spring/II semester of First year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To familiarize students with the transformation of sentences and the appropriate use of prepositions.</li> <li>To enhance the writing skills in different areas including CV and cover letter writing.</li> <li>To convey meaning by reinforcing, substituting for, or contradicting verbal communication.</li> <li>Productivity and performance boosting activities for professional goal achievement.</li> </ol>								
CO1	Explain prepositions, tag questions, and idioms correctly.								
CO2	Discuss and analyze different sentence types and voices.								
CO3	Explain effective paragraphs, precis, and professional documents.								
CO4	Describe SWOT analysis, goal setting, and personal hygiene principles.								
CO5	Illustrate non-verbal communication and body language concepts.								
Unit	Content								
Module 1- Grammar	<ol style="list-style-type: none"> <li>Use of Prepositions</li> <li>Tag questions</li> <li>Idioms, Phrases and Clauses</li> <li>Simple, complex, compound sentences</li> </ol>								
Module 2- Grammar	<ol style="list-style-type: none"> <li>Active and Passive Voice</li> <li>Direct and Indirect Speech</li> </ol>								
Module 3- Writing Skills	<ol style="list-style-type: none"> <li>The Basics of Writing; avoid ambiguity and vagueness</li> <li>Paragraph Writing</li> <li>Precis Writing</li> <li>Letter Writing</li> <li>Resume, CV and Cover Letter</li> </ol>								
Module 4- Self-Management Skills	<ol style="list-style-type: none"> <li>SWOT Analysis</li> <li>Self-Regulation- Goal Setting</li> <li>Personal Hygiene</li> </ol>								
Module 5- Non- Verbal Communication- Sciences of Body Language	<ol style="list-style-type: none"> <li>What is Non-Verbal Communication &amp; Body Language,</li> <li>Elements of Communication,</li> <li>Types of Body Language,</li> <li>Importance and Impact of Body Language,</li> <li>Types of Communication through Body Language,</li> <li>Introduction to Haptic, Introduction to Kinesics</li> <li>Introduction to Proxemics,</li> <li>Body Language Do's and Don'ts, Doubt Clearing Session.</li> </ol>								
Module 6- Group Discussion	<ol style="list-style-type: none"> <li>Importance,</li> <li>Planning, Elements, and Skills assessed;</li> </ol>								

<b>(Theory)</b>	III. Effectively disagreeing, IV. Initiating, Summarizing and Attaining the Objective
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**TEXTBOOKS**

- T1. Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.  
 T2. McDowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition).

**REFERENCE BOOKS**

- R1. Communication Skills Training: A Practical Guide to Improving Your Social Intelligence, Presentation and Social Speaking, Ian Tuhovsky, 2019  
 R2. A Textbook for AECC English Communication: Interface, Dr. Kironmoy Chetia and Pranami Bania Breez Mohan Hazarika, January 2019.

**OTHER LEARNING RESOURCES:**

1. <https://youtu.be/x60GHpQ8gJk>
2. [https://youtu.be/Ke\\_oSN-BCaY](https://youtu.be/Ke_oSN-BCaY)
3. <https://youtu.be/TDPDtrLxT-c>
4. <https://www.classcentral.com/report/toefl-preparation/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain prepositions, tag questions, and idioms correctly.	<b>5</b>
<b>2</b>	Discuss and analyze different sentence types and voices.	<b>2, 5</b>
<b>3</b>	Explain effective paragraphs, precis, and professional documents.	<b>3, 5</b>
<b>4</b>	Describe SWOT analysis, goal setting, and personal hygiene principles.	<b>5</b>
<b>5</b>	Illustrate non-verbal communication and body language concepts.	<b>5</b>



SEMESTER-II									
Course Title	<b>Computational System and Digital Literacy</b>								
Course code	<b>22UUDLI103R</b>	Total credits: 1	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/f</b>	<b>C</b>
		Total hours:30	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
Pre-requisite	<b>Nil</b>	Co-requisite	<b>Nil</b>						
Programme	<b>Master of Science in Microbiology</b>								
Semester	<b>Spring/II semester of First year of the programme</b>								
Course Objectives	1. Students will be able to understand the fundamentals of computer systems and Internet search along with advanced features of MS-Office. 2. Students will be able to learn data management, statistical analysis and visualization. 3. Students will be able to use social media and e-commerce portals, Digital Payment systems, and other utility software.								
CO1	Explain computer systems and Internet search fundamentals.								
CO2	Describe data analysis and visualization problems with MS Office.								
CO3	Illustrate social media and e-commerce sites efficiently and ethically.								
CO4	Discuss about utility software for research and information management.								
CO5	Explain software tools for research and data management.								
Unit-No.	Content								
I	<b>Fundamentals of Computer Systems, Office Automation and Internet Search</b> i. Components of a Computer and their functions. ii. Office Automation using MS-Word, MS-Excel, and MS-PowerPoint. iii. Data management, Statistical Data Analysis and Data Visualization with MS-Excel. iv. Use of Functions, Graphs & Charts in MS-Excel.								
II	<b>Internet &amp; Cyber World</b> i. Introduction to Computer Networks, Internet and World Wide Web, Websites and Web portals. ii. Creation and use of Email Accounts. iii. Web browsing, Web Searching, Different aspects of Web Searching- Search Keywords, conditions and combinations. iv. Study of different Search Engines like Google, Microsoft Bing, Yahoo, Yandex, DuckDuckGo, Ask.Com etc. v. Cyber Crimes, Cyber Laws and IT Act 2000,India.								
III	<b>Introduction to Social Media and E-Commerce</b> i. Relevance of Social Media in present scenario. Posting different types of contents in Social Media. ii. Creating accounts and using some popular Social media portals and Apps like WhatsApp, Facebook, etc. Social Media Etiquettes &Crimes. iii. Definition of E-Commerce; E-Commerce versus traditional Commerce. iv. Case studies of popular E-Commerce portals like Amazon. v. E-commerce Etiquettes &Crimes.								
IV	<b>Digital Payments and Digital Transactions</b> i. Introduction to Digital Payment Systems. ii. Creating accounts and using Digital Payment Systems like Credit Cards, Debit Cards, Netbanking, UPI.								

	Digital payments Etiquettes & Crimes.
<b>V</b>	<p><b>Basic Accounting and Utility Software</b></p> <ul style="list-style-type: none"> <li>i. Introduction to Basic accounting concepts, Introduction to an Accounting Software like GnuCash or Tally.</li> <li>ii. Introduction to Technical Document writing using LaTeX.</li> <li>iii. Introduction to Data Visualization software – Sigma, Google Charts, Tableau</li> </ul>

### TEXTBOOKS

- T1: Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems & Applications. 3rd ed. New Delhi: BPB Publications.
- T2: Goel, A, 2010. Computer Fundamentals, Pearson India.

### REFERENCE BOOKS

- R1: Balaguruswamy, E. 2009 Fundamentals of Computers, Tata McGraw-Hill Education.
- R2: Balaguruswamy, 2014. E. Fund Of Comp & Programming (Updated Ed Sem. I, Au) Tata McGraw-Hill Education.
- R3: Lawson, C. 2022. Introduction to Social Media, Oklahoma State University.

### OTHER LEARNING RESOURCES:

1. <https://www.w3schools.com>
2. <https://edu.gcfglobal.org>
3. <https://www.tutorialspoint.com>
4. <https://www.javatpoint.com>

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain computer systems and Internet search fundamentals.	1
2	Describe data analysis and visualization problems with MS Office.	1, 3
3	Illustrate social media and e-commerce sites efficiently and ethically.	5
4	Discuss about utility software for research and information management.	2, 5
5	Explain software tools for research and data management.	2, 5

SEMESTER-III									
COURSE TITLE		Techno-Professional Skills II (Biofertilizer production)							
COURSE CODE	22MSMB211R	TOTAL CREDITS: 2	L	T	P	S	R	O/F	C
		TOTAL HOURS: 60P	0	0	4	0	0	0	2
PRE-REQUISITE	General Microbiology, Biochemistry	CO-REQUISITE	NA						
PROGRAMME	Master of Science in Microbiology								
SEMESTER	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	1. Appreciate the agronomic importance of beneficial micro-organisms 2. Formulate, produce and apply Biofertilizers in a pilot scale								
CO1	Explain the Importance of biofertilizers in plant development.								
CO2	Describe mass cultivation and inoculation.								
CO3	Explain the importance of Azolla as a biofertilizers.								
CO4	Describe the importance of phosphate in biofertilizers.								
CO5	Apply the knowledge on the use of Fungi and Mycorrhiza.								
Unit no	Content				CH	Learning outcome			KL
I	Biofertilizers - Introduction, scope. A general account of plant growth promoters and regulators – Cyanobacterial Biofertilizer: Algalization – mass cultivation of cyanobacterial biofertilizers				10	Importance of biofertilizers in plant development			1,2
II	Nitrogen fixing Bacteria: Isolation, characterization, identification, mass cultivation and inoculation method of Rhizobium and Azospirillum. Mechanism of nitrogen fixation (free-living and symbiotic) - Biochemistry and molecular basis of nitrogen fixation.				10	Knowledge about mass cultivation and inoculation.			1,2
III	Azolla – Structure and Morphology – Mass cultivation method and Application. Economic and Ecological importance of Azolla.				10	Importance of Azolla			1,2
IV	Phosphate solubilizing Bacteria: Isolation, characterization, identification, mass cultivation and inoculation method of Phosphobacteria. Biochemistry of Phosphate solubilization and mobilization. Carrier based inoculum production methods and Field application References				10	Importance of phosphate in biofertilizers			1,2
V	Mycorrhizal fungi as biofertilizers - Introduction, scope. A general account of Ecto, Endo and Arbuscular mycorrhizae (AM). Isolation and method of inoculation of Arbuscular mycorrhizae (AM), Legume - AM interactions				10	Importance of Fungi, Mycorrhiza			1,2

## TEXTBOOKS

T1: A text book of microbiology, second reprint. S. Chand and Company Ltd., New Delhi. Ann Larkin Hansen , 2010.

#### REFERENCE BOOKS

R1. Kannaiyan, S. 2002 Biotechnology of Biofertilizers. Narosa publishing house, New Delhi. Dubey, R.C. 2001.

R2. Dubey, R. C. 2008. A Textbook of Biotechnology. S. Chand & Co., New Delhi.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the Importance of biofertilizers in plant development.	<b>1, 2, 9</b>
<b>2</b>	Describe mass cultivation and inoculation.	<b>1, 2, 3</b>
<b>3</b>	Explain the importance of Azolla as a biofertilizers.	<b>1, 2, 9</b>
<b>4</b>	Describe the importance of phosphate in biofertilizers.	<b>1, 2, 9</b>
<b>5</b>	Apply the knowledge on the use of Fungi and Mycorrhiza.	<b>1, 9</b>

SEMESTER-III									
Course Title	Generic Elective - Public Health And Hygiene								
Course code	22MSMB212R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30	2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	3. To understand the concepts, significance and relevance of public health and hygiene. 4. To understand the health hazards as associated with public health and hygiene.								
CO1	Explain the concepts of public health, evaluate India's health systems and policies, and assess the impact of nutrition, environment, and mental health on public well-being								
CO2	Analyze environmental health hazards, assess pollution impacts, and understand the importance of hygiene, waste management, and food safety.								
CO3	Describe key hygiene concepts across personal, medical, food, and industrial settings.								
CO4	Identify and understand the causes, prevention, and control measures of lifestyle-related non-communicable and communicable diseases.								
CO5	Analyze social health issues in India and evaluate the role of health education and programs in promoting deaddiction and eco-friendly practices.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	INTRODUCTION Concept of Public Health Goals and Objectives of Public health and Hygiene, Public health system in India and in the rest of world HEALTH ASPECTS Introduction to National Health Policy - National Rural Health Mission (NRHM) and National Urban Health Mission (NUHM) Nutrition and health, Environmental health- sanitation, air, water pollution, Mental health	7	Knowledge about the Concepts, Goals, and Objectives of Public Health and Hygiene. NRHU and NUHM	1, 2					
II	ENVIRONMENT AND HEALTH HAZARDS : Environmental degradation and Pollution: Sources, Impacts of wastes and treatment methods Environment & Health Relation Assessment - Concept, Steps and application, Personal and mental hygiene, Health destroying habits and addictions Need of Water Purification Adulteration of Food Undesirable Changes in Air, Radiation effects, e- waste, Solid waste and Excreta disposal	5	Knowledge on Environmental Pollution, degradation, Hygiene and Food adulteration	1, 2, 3					
III	HYGIENE CONCEPTS Personal Hygiene Medical Hygiene Food Hygiene Industrial Hygiene	5	Knowledge on hygiene (personal, Medical, food and industrial)	1, 2					
IV	LIFE STYLE RELATED NON-COMMUNICABLE DISEASES Hypertension Coronary Heart Diseases Stroke Diabetes Mellitus Obesity COMMUNICABLE DISEASES AND THEIR CONTROL MEASURES: Air Borne Disease : Tuberculosis, Influenza Food and water Borne Disease : Amoebiasis, Jaundice Vector Borne Disease : Malaria, Dengue Contact Disease : Venereal disease and AIDS	8	Theoretical and practical knowledge on communicable and non-communicable diseases	1, 2, 3					
V	SOCIAL HEALTH PROBLEMS AND HEALTH EDUCATION IN INDIA:	5	Knowledge on Indian Health Education and Social health problems	1, 2, 3					

Smoking, Alcoholism, Drug Dependence and Their Deaddiction. Eco-Friendly Environmental Practices, Effects of drug abuse, WHO programmes Government and voluntary Organizations – vaccination and awareness programme, First Aid			
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### TEXT BOOKS:

- T1.Introduction to Public Health, Raymond L. Goldsteen, Karen Goldsteen, David G. Graham, 2011, Springer publishing company  
T2.Introduction To Community Health Nursing, Kasturi Sundar Rao, 4th edition, Bi PublicationsPvt Ltd  
T3.Concepts of Epidemiology, Raj S Bhopal, 2002, Oxford University press  
T4.A Treatise n Hygiene And Public Health, Birendra Nath Ghosh, 9th edition, CalcuttaScientific Publishing Co  
T5.An Introduction to Public Health, Caryl Thomas, 1949, John Wright and Sons Ltd.,

### REFERENCE BOOKS:

- R1.Park and Park, 1995: Text book of preventive and social medicine – Banarsidas Bhanot Publ. jodhpur- India  
R2.Verma, S. 1998: Medical zoology, Rastogi Publ.- Meerut- India  
R3.Jatin V. Modi and Renjith S. Chawan. Essentials of Public Health and Sanitation –Part I- IV  
R4.Murray, C. J. L. and A.D. Lopez. (1996). The Global Burden Of Disease. World Health Organization.  
R5.Park, J.E. and Park, K. Textbook of Community Health for Nurses.

### OTHER LEARNING RESOURCES:

1. <https://www.cdcfoundation.org/what-public-health>

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain the concepts of public health, evaluate India's health systems and policies, and assess the impact of nutrition, environment, and mental health on public well-being	1, 2, 4, 7
2	Analyze environmental health hazards, assess pollution impacts, and understand the importance of hygiene, waste management, and food safety.	1, 2, 4, 7, 8
3	Describe key hygiene concepts across personal, medical, food, and industrial settings.	1, 5, 7
4	Identify and understand the causes, prevention, and control measures of lifestyle-related non-communicable and communicable diseases.	1, 2, 4, 5, 7
5	Analyze social health issues in India and evaluate the role of health education and programs in promoting deaddiction and eco-friendly practices.	1, 2, 4, 7

SEMESTER-III									
COURSE TITLE	Research Ethics								
COURSE CODE	22UMRE211R	TOTAL CREDITS:1	L	T	P	S	R	O/F	C
		TOTAL HOURS:60	0	0	0	4	0	0	1
PRE-REQUISITE	NA	CO-REQUISITE	NA						
PROGRAMME	Master of Science in Microbiology								
SEMESTER	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	This course aims to lay a foundation for empirical research and make students aware of relevant guidelines, policies, and codes relating to ethical research, as well as to provide, via a study of ethical theories, concepts.								
CO1	Describe and apply research ethics theories and methods.								
CO2	Explain research ethics issues such as responsibility, vetting, and misconduct.								
CO3	Illustrate arguments and results in ethical research inquiries.								
CO4	Identify and apply procedures for sampling, data collection, and reporting.								
CO5	Apply ethical principles to research design and evaluation								
Unit no	Content								
I	<b>ETHICS:</b> Introduction to the course and each other; an introduction to moral theory. Ethics: definition, moral philosophy, nature of moral judgements and reactions. Research regulation; self – regulation; research ethics. Honesty, candor, compromise and integrity. Data ownership and stewardship; conflicts of interest; collaboration. Human and Non-Human subjects. Research and researchers in society.								
II	<b>SCIENTIFIC CONDUCT-</b> Ethics with respect to science and research. Intellectual honesty and research integrity. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP). Redundant publications: duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data								
III	<b>PUBLICATION ETHICS-</b> Publication ethics: definition, introduction and importance. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types. Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals.								
IV	<b>OPEN ACCESS PUBLISHING-</b> Open access publications and initiatives. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies. Software tool to identify predatory publications developed by SPPU. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.								
V	<b>PUBLICATION MISCONDUCT</b> Group Discussions; Subject specific ethical issues, FFP, authorship. Conflicts of interest. Complaints and appeals: examples and fraud from India and abroad. Software tools; Use of plagiarism software like Turnitin, Urkund and other open source software tools. <b>DATABASES AND RESEARCH METRICS</b> –Databases: Indexing databases. Citation databases: Web of Science, Scopus, etc. Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score. Metrics: h-index, g index, I 10 index, altmetrics.								

#### TEXT BOOKS

- T1.Bird, A(2006).Philosophy of Science.Routledge.  
T2.MacIntyre, Alasdair (1967) A Short History of Ethics.London.

T3. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance(2019)

**REFERENCE BOOKS**

R1.National Academy of Science, National Academy of Engineering and Institute of Medicine (2009). On Being a Scientist: A Guide of Responsible Conduct in Research: Third Edition, National academicsPress

R2.George R, (2011). Sociological Theory, Rawat Publication, New Delhi, India.

R3.GeorgeR,(2019).PostModernSocialTheory,RawatPublication,NewDelhi,India.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe and apply research ethics theories and methods.	<b>6</b>
<b>2</b>	Explain research ethics issues such as responsibility, vetting, and misconduct.	<b>6</b>
<b>3</b>	Illustrate arguments and results in ethical research inquiries.	<b>5, 6</b>
<b>4</b>	Identify and apply procedures for sampling, data collection, and reporting.	<b>2, 3, 4</b>
<b>5</b>	Apply ethical principles to research design and evaluation	<b>4, 9</b>



<b>SEMESTER - III</b>									
<b>Course Title</b>	<b>MINI RESEARCH (SURVEY/EXPERIMENTS-R3)</b>								
<b>Course code</b>	<b>22MSMB213R</b>	<b>Total credits: 2</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
		<b>Total hours: 120 (P+S)</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programmes</b>	<b>Master of Science in Biotechnology</b>								
<b>Semester</b>	<b>Spring/II Semester of First Year of the Programme</b>								
<b>Course objectives</b>	1. To learn the principles of designing effective surveys, including question formulation and sampling techniques. 2. To gain hands-on experience in designing and conducting research experiments to test hypotheses								
<b>CO1</b>	Formulate research methodology								
<b>CO2</b>	Prepare research tool(s)								
<b>CO3</b>	Apply the knowledge of sampling methods in sample collection.								
<b>CO4</b>	Design experiment using scientific method								
<b>CO5</b>	Investigate the research Problem								

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Formulate research methodology	<b>1, 2, 4, 6, 7</b>
<b>2</b>	Prepare research tool(s)	<b>1, 3, 4</b>
<b>3</b>	Apply the knowledge of sampling methods in sample collection.	<b>1, 2, 3, 4</b>
<b>4</b>	Design experiment using scientific method	<b>1, 2, 3, 4, 6</b>
<b>5</b>	Investigate the research Problem	<b>1, 2, 3, 4, 7, 9</b>

SEMESTER-III									
COURSE TITLE	CORPORATE PROFICIENCY								
COURSE CODE	22UMPD211R	TOTAL CREDITS:	L	T	P	S	R	O/F	C
		TOTAL HOURS:	0	0	4	0	0	0	2
PRE-REQUISITE	22UMPD121R Communication Mastery	CO-REQUISITE	NA						
PROGRAMMES	Master of Science in Microbiology								
SEMESTER	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	<ol style="list-style-type: none"> <li>To acquaint students with the various tools of an effective presentation.</li> <li>To acquire the speaking skill instruct, influence, engage, educate, or appease the listeners.</li> <li>To increase proficiency, present ability and quality of resume and provide guidance for self- promotion and self-evaluation in social media.</li> <li>To prepare and train the students for the campus drives &amp; walking interviews.</li> </ol>								
CO1	Able to speak with greater control and charisma in front of others.								
CO3	Discuss the positive impact in their thought process and problem-solving skills.								
CO3	Illustrate with all the necessary tools and skill sets to prepare professional resume.								
CO4	Discuss the highlights and assess themselves in social media.								
CO5	Explain the impart in them techniques to solve critical problems in an interview, develop strategies to crack interviews, improve their communication skills, boost their confidence								
Unit no	Content								
I	<b>Module 1- Presentation Skills</b> i. Introduction ii. Essential characteristics of a good presentation iii. Preparation of a good presentation								
II	<b>Module 2- Public Skills</b> i. Fear of Public Speaking, ii. Understanding and Overcoming Fear of Public Speaking, iii. Confidence and Control, iv. Physiology and Stress - Control/Process, v. Tips for Presentations and Public Speaking, vi. Tips for Using Visual Aids in Presentations, vii. Process for Preparing and Creating Presentations, viii. Delivering Presentations Successfully, ix. Doubt Clearing and Summary of Main Points								
III	<b>Module 3- Practical session on Resume, Curriculum Vitae, Writing cover letter &amp; LinkedIn Profile</b> i. Preparation, submission & screening of Resume. ii. Practical session on cover letter screening session iii. Creating a profile on LinkedIn iv. How to utilize it <b>Module 4- Leadership &amp; Management Skills</b> i. Concepts of Leadership, ii. Leadership Styles, iii. Manager VS Leader, iv. How to be an Effective Leader, v. Mock/ Practice Session, vi. Doubt Clearing Session.								

<b>IV</b>	<p><b>Module 5- Research Paper – Writing Skills</b></p> <p>i. How to write a research paper ii. Key point in Research Work</p> <p><b>Module 6- Interview Skills &amp; Dress code Ethics</b></p> <p>i. Types of the interview- telephonic, virtual &amp; face to face ii. Online interview, personal interview, iii. Panel interview, iv. Group interview, v. JAM session, vi. Types of interview questions-traditional/common interview questions, vii. Case interview questions, viii. General Strategies for answering questions, ix. Marketing your skills and experiences, x. Preparation before the interview, xi. How to dress up for an interview, xii. How to maintain eye contact and positive body language, xiii. How to be presentable, xiv. Interview dos and don'ts, xv. Introduction to Dress Code Ethics, xvi. Purpose and Importance xvii. How to Make „FIRSTIMPRESSION“ xviii. What to Wear During Interviews or Any Other Formal Meetings – Male &amp;Female</p>
<b>V</b>	<p><b>Module 7- Mock Interview</b></p> <p>i. Practical Mock Interview, ii. Feedback- Receiving Feedback, iii. Giving Feedback, iv. Advantages of Effective Feedback, v. How to deal with negative feedback.</p>

### TEXT BOOKS

- T1.Barrett,Grant.2016.Perfect English Grammar: The Indispensible Guide to Excellent Writing and Speaking, Zephyros Press.  
T2.McDowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition).

### REFERENCE BOOKS

- R1.Garg. Manoj Kr. (2018) English Communication: Theory and Practice

### OTHER LEARNING RESOURCES:

1. <https://brightlinkprep.com/10-best-toefl-prep-books/>

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Able to speak with greater control and charisma in front of others.	5
2	Discuss the positive impact in their thought process and problem-solving skills.	2
3	Illustrate with all the necessary tools and skill sets to prepare professional resume.	5

<b>4</b>	Discuss the highlights and assess themselves in social media.	<b>5</b>
<b>5</b>	Explain the impart in them techniques to solve critical problems in an interview, develop strategies to crack interviews, improve their communication skills, boost their confidence	<b>5, 6, 8</b>

SEMESTER-III									
COURSE TITLE	PERSONAL FINANCIAL PLANNING								
COURSE CODE	22UUF202R	TOTAL CREDITS:1	L	T	P	S	R	O /F	C
		TOTAL HOURS:30P	0	0	2	0	0	0	1
PRE-REQUISITE	22UUF201R Introduction to Financial Budgeting And Planning	CO-REQUISITE	NIL						
PROGRAMMES	Master of Science in Microbiology								
SEMESTER	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	1. The course would offer an inclusive approach to understand the relevant concepts of money, borrowing, lending, taxes and their application to financial planning. 2. Assess the personal financial planning process, the life cycle of financial plans, and methods of goal achievement. 3. Formulate a budget, record-keeping system, and tax planning strategy based on current financial goals.								
CO1	Explain the cash management and buying plan for homes or automobiles.								
CO2	Discuss a diversified investment portfolio for different objectives.								
CO3	Compare mutual funds, ETFs, and real estate investment options.								
CO4	Develop a financial plan for retirement and estate protection.								
CO5	Describe financial products and strategies for long-term goals								
Unit no	Content								
I	<b>Unit 1- Fundamentals of Financial Planning –</b> i. Functions of money; ii. Inflation- Meaning, causes, how it can be controlled; iii. process official planning , iv. Time value of money-simple and compound interest; v. Net Present Value and Future value, vi. Power of Compounding; vii. Doubling period and Rule of 72.								
II	<b>Unit 2- Income Tax Planning–</b> i. Meaning of Income, ii. Direct & Indirect Taxes, Taxable Income, various heads of Income for tax Calculation, iii. Non-taxable Income, iv. Tax evasion and tax avoidance, v. GST, Tax Planning Strategies.								
III	<b>Unit 3- Entrepreneurial planning –</b> i. Meaning of Entrepreneurship, prerequisites for becoming an entrepreneur, ii. Entrepreneurship Support Systems in India, iii. Institutional support systems for entrepreneurs, iv. Financial support systems for entrepreneurs; v. Venture Capital, Business Angels,								

	vi. Assistant of Government, vii. Commercial Bank Loans and Overdraft.
<b>IV</b>	<b>Unit 4-Planning for investing in securities market –</b> i. Investment avenues offered by Securities Markets,. Primary Market and Secondary Market, ii. Stock market- meaning, features, functions of NSE,BSE DEMAT trading account, iii. Security repository, stock brokers, Operational aspects of securities markets: placement of orders, contract note, pay-in and pay-out, trading and settlement cycle, iv. Various risks involved in investing in securities markets; Role of Financial Intermediaries; Stock indices. v. Mutual Funds- meaning concept, definition, types, importance and drawbacks of mutual funds, mutual funds in India, investing in mutual funds, vi. Systematic Investment Plan (SIP) and its advantages.
<b>V</b>	<b>Unit 5- Planning for debts and Retirement</b> i. Consumer credit - Introduction to consumer credit; choosing a source of credit, the cost of credit alternatives, ii. Consumer Legal Protection; iii. Housing Decision: Factors and Finance; Vehicle Decisions. iv. Retirement planning - Meaning of cost of living; retirement need analysis; development of retirement plan, various retirement schemes, v. Estate Planning; Pension and Medicare Planning; Wills.

**TEXT BOOKS:**

- T1. Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems &The Million-Dollar Financial Advisor: Powerful Lessons and Proven Strategies from Top Producers by David J. Mullen Jr
- T2. Personal Finance and Planning by Dr. Rajni
- T3. Peaceful Personal Finance: A Short Read on the Basics of Personal Finance and Planning Kindle Edition by Hema Singh
- T4. Be Your Own Financial Advisor: Financial Planning, Investment Options, Risk Management, Tax Management, Succession Planning Kindle Edition y Sushil Bali
- T5. The Dumb Things Smart People Do with Their Money: Thirteen Ways to Right Your Financial Wrongs Kindle Edition y Jill Schlesinger

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the cash management and buying plan for homes or automobiles.	<b>5</b>
<b>2</b>	Discuss a diversified investment portfolio for different objectives.	<b>9</b>
<b>3</b>	Compare mutual funds, ETFs, and real estate investment options.	<b>2, 5, 9</b>
<b>4</b>	Develop a financial plan for retirement and estate protection.	<b>9</b>
<b>5</b>	Describe financial products and strategies for long-term goals	<b>5</b>

SEMESTER-III									
Course Title	Medical Microbiology								
Course code	22MSMB214R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 46T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Fall/ III semester of first year of the programme								
Course Objectives	<p>1. To familiarize the students about the different diseases caused by bacteria &amp; viruses, fungi and parasites and prevention and control measures of the diseases</p> <p>2. To teach different diagnostic tests to identify the causative organisms</p>								
CO1	Explain the normal flora of the human body, virulence factors of pathogens, epidemiology of infection, and host-pathogen interaction.								
CO2	Describe the general characteristics, biochemical traits, virulence factors, pathogenicity, clinical manifestations, laboratory diagnosis, prophylaxis, and treatment of various pathogenic bacteria.								
CO3	Describe the general properties, antigenicity, pathogenicity, laboratory diagnosis, treatment, and prophylaxis of various viruses.								
CO4	Characterise fungi with respect to epidemiology, pathogenesis, clinical features, laboratory diagnosis, and treatment of various fungal infections								
CO5	Summarize different types of parasites, their life cycle, pathogenesis and diagnosis.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<p><b>Normal flora</b> - Skin, mouth, upper respiratory tract, intestinal tract, urogenital tract, eye. Transient flora.</p> <p>Infection process and Virulence factors of pathogenic bacteria –toxins, enzymes, capsular polysaccharides. Host pathogen interaction.</p>	6	<p>Understand the normal flora of different body sites.</p> <p>Learn the infection process and virulence factors of pathogenic bacteria.</p> <p>Explore host-pathogen interactions.</p>					1 2 3	
II	<p>General characteristics, biochemical characteristics, virulence factors, pathogenicity, clinical manifestations, lab diagnosis, prophylaxis and treatment of Staphylococcus aureus, Streptococcus, Corynebacterium diphtheria, Bacillus, Clostridium, Vibrio cholera, E. coli, Salmonella spp, Shigella spp, Pseudomonas, Mycobacterium spp, Spirochaete, Mycoplasma, Rickettsiae, Chlamydiae, Listeria, Campylobacter, Helicobacter.</p>	10	<p>Understand the general characteristics, biochemical traits, virulence factors of bacterial pathogens.</p> <p>Analyze the pathogenicity, clinical manifestations, lab diagnosis, prophylaxis, and treatment of bacterial pathogens.</p> <p>Apply the knowledge for disease prevention and management</p>					1 2 3 4	
III	<p>General properties, antigenicity, pathogenicity, laboratory diagnosis, treatment and prophylaxis of – Adenoviruses, Herpes viruses, Pox viruses, Hepatitis viruses, Oncogenic viruses, Polioviruses, Reoviruses, rotaviruses, arboviruses (togavirus and flavivirus, encephalitis, yellow fever, dengue). Influenza viruses, Mumps, Measles,</p>	10	<p>Analyze and evaluate the general properties, antigenicity, pathogenicity, laboratory diagnosis, treatment, and prophylaxis of various viruses.</p> <p>Examine emerging and re-emerging viral diseases, including Ebola, SARS, Corona,</p>					1 2 3 4 5	

	Rubella, Rabies virus, HIV, Emerging and reemerging viral diseases- Ebola, SARS, Corona, Chikungunya.		Chikungunya, and assess their impact on public health and control measures.	
<b>IV</b>	<p>Mycology, immunity, epidemiology, pathogenesis, clinical features, laboratory diagnosis and treatment of: Superficial cutaneous</p> <p>Mycoses- Dermatophytoses, Tinea nigra, Malassezia infection, Piedra</p> <p>Subcutaneous Mycoses - Mycetoma, Sporotrichosis, lobomycosis.</p> <p>Systemic Mycoses - Histoplasmosis, Blastomycosis, Coccidioidomycosis, paracoccidioidomycosis</p> <p>Opportunistic Mycoses -Candidiasis, Cryptococcosis, Aspergillosis, Zygomycosis</p> <p>Fungal toxins - Aflatoxins- Definition, major types of aflatoxins, symptoms and pathogenesis</p>	<b>10</b>	<p>Understand and Evaluate the mycology, immunity, epidemiology, pathogenesis, clinical features, laboratory diagnosis, and treatment of various mycoses.</p> <p>Understand fungal toxins, including aflatoxins—its definition, major types, symptoms, and pathogenesis.</p>	1 2 3 4 5
<b>V</b>	<p>Protozoology - Introduction to protozoa, Amoebae – Entamoeba histolytica, Flagellates- Giardialamblia, Leishmania donovani. Sporozoa - Malarial parasites, Toxoplasma gondii, Blastocystishominis.</p> <p>Helminthology - Cestodes ortapeworms- Taenia saginata, Tinea solium,, Trematodes or flukes- Fasciola hepatica, Fasciolopsis buski. Nematodes- Ascaris lumbricoides, Wuchereria bancrofti.</p>	<b>10</b>	<p>Gain knowledge on the fundamental concepts of protozoology and helminthology</p> <p>Understand the classification, biology, and medical significance of various protozoa and helminths.</p>	1 2 3 4 5
<b>Practical</b>	<ol style="list-style-type: none"> <li>Study of different Biochemical tests – Indole, methyl red, voges proskeaur, citrate, Catalase, coagulase, oxidase, Mannitol motility test, hydrogen sulfideproduction, urease test, gelatin liquefaction test, fermentation of carbohydrates, triple sugar iron test, casein hydrolysis test.</li> <li>Antibiotic sensitivity by Kirby-Bauer method</li> <li>Antibiotic sensitivity by broth dilution method</li> <li>Staining technique – Gram’s, Acid fast, Capsular, Endospore, Flagellar, Metachromatic granular staining</li> <li>Isolation of normal flora from skin, nail scrapings, nose, throat, oral cavity</li> <li>and ear</li> <li>Fungal mounting by lacto phenol cotton blue and KOH</li> </ol>		<p>Perform and interpret various biochemical tests,</p> <p>Assess antibiotic sensitivity using the Kirby-Bauer method and broth dilution method.</p> <p>Apply and analyze different staining techniques</p> <p>Isolate and identify normal flora from skin, nail scrapings, nose, throat, oral cavity, and ear samples.</p> <p>Use lacto phenol cotton blue and KOH for fungal mounting and identification</p> <p>Perform Leishman and Giemsa staining</p>	1 2 3 4 5 6



	8. Leishman staining, Giemsa staining			
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**TEXT BOOKS:**

- T1. Medical Microbiology by David Green Wood Richard Slack & John Peutherer. Churchill Livingstone Company.  
 T2. Medical Microbiology by Jawetz, Melnick, Geo R. Brookes McGraw-Hill Company.  
 T3. Medical Microbiology by Anantanarayan & Panekar, Orient Longman Limited.  
 T4. Textbook Virology by Rhodes & Van Royen  
 T5. Practical Microbiology by C.P. Baweja

**REFERENCE BOOKS:**

- R1. Bacterial Diseases by Wilson & Topley. Medical Microbiology by Cruickshank- Vol.I & Vol.II.  
 R2. General Virology by Luria & Parnel Virology by Dimmock.

**OTHER LEARNING RESOURCES:**

1. <https://microbenotes.com/>
2. <https://www.youtube.com/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain the normal flora of the human body, virulence factors of pathogens, epidemiology of infection, and host-pathogen interaction.	1, 2, 4
2	Describe the general characteristics, biochemical traits, virulence factors, pathogenicity, clinical manifestations, laboratory diagnosis, prophylaxis, and treatment of various pathogenic bacteria.	1, 2, 3, 4, 9
3	Describe the general properties, antigenicity, pathogenicity, laboratory diagnosis, treatment, and prophylaxis of various viruses.	1, 2, 3, 4, 9
4	Characterise fungi with respect to epidemiology, pathogenesis, clinical features, laboratory diagnosis, and treatment of various fungal infections	1, 2, 3, 4, 9
5	Summarize different types of parasites, their life cycle, pathogenesis, and diagnosis.	1, 2, 3, 4, 9

SEMESTER-III									
Course Title	Microbial Ecology and Environmental Microbiology								
Course code	22MSMB215R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Fall/ III semester of first year of the programme								
Course Objectives	1. To understand the role of microorganisms as agents of environmental change. 2. To recognize microorganisms as indicators of alteration of an ecosystem. 3. To understand microbial processes aimed to solve environmental problems.								
CO1	Discuss various ecosystems and inhabiting microbial diversity with special reference to ecological niches, limiting factors, ecological pyramid, energy flow, trophic levels, etc.								
CO2	Asses the microbial diversity in aquatic ecosystems, wastewater treatment techniques, and microbial water quality.								
CO3	Establish the role of microorganisms in soil fertility with reference to biological nitrogen fixation through leguminous plants and genes involved in nitrogen fixation.								
CO4	Describe microbial Bioremediation and their role in the degradation of environmental pollutants.								
CO5	Illustrate microbial interactions and various biogeochemical cycles								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
<b>I</b>	<p><b>Microbial Ecology:</b> Interaction between abiotic and biotic factors in an ecosystem, ecological niche, limiting factor, concept of community, fluctuation and succession. Ecological pyramid, energy flow, food chain, foodwebs and their dynamism, stability and complexity of ecosystem. Interactions Between microbes and organisms at other trophic levels: commensalism, mutualism, parasitism and predation with examples</p> <p><b>Diversity of microbes:</b> Microbial communities in terrestrial (agricultural and desert soil), aquatic (fresh water and marine water) and animal (cattle, termite and human being), in extreme environments – thermophiles, psychrophiles, barophiles, acidophiles, alkaliphiles and halophiles, Role of decomposers, Microbiology of air, enumeration of air microflora.</p>	<b>15</b>	Analyze microbial ecology by understanding interactions between abiotic and biotic factors in ecosystems, ecological niches, limiting factors, community concepts, fluctuation, and succession. Explore ecological pyramids, energy flow, food chains, food webs, and ecosystem dynamics, stability, and complexity. Examine microbial interactions at various trophic levels. Study the role of decomposers, air microbiology, and the enumeration of air microflora.					1 2 3 4	
<b>II</b>	<p><b>Aquatic Microbiology:</b> The aquatic environment – major environmental conditions influencing microflora. Distribution of microorganisms in the aquatic environments - freshwater environment, estuaries and marine environment. Microbiology of drinking water, water pollution, purification of water for human consumption. Assessment of microbial status in water and waste water. Wastewater characteristics,</p>	<b>10</b>	Understand the impact of major environmental conditions on microflora in aquatic environments. Explore the distribution of microorganisms in freshwater, estuaries, and marine environments. Study the microbiology of drinking water, including water pollution and purification					1 2 3 4 5	

	Effluent treatment processes (like trickling filter, activated sludge, oxidative pond, anaerobic digestion and chemical disinfection), Bacterial indicators – DO, BOD, COD, water purification		methods for human consumption. Assess the microbial status in water and wastewater. Understand wastewater treatment process. Evaluate bacterial indicators such as Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD) in water purification.	
<b>III</b>	<b>Soil Microbiology:</b> Soil microbes and soil fertility, Nitrogen fixation: Biochemistry of Nitrogen fixation - mechanism of nitrogenase - hydrogenase - Assay of nitrogen fixation - physiology of legume root nodule, leghemoglobin - Synthesis, Genes involved in nitrogen fixation	<b>7</b>	Understand the role of soil microbes in soil fertility and nitrogen fixation. Learn the biochemistry and mechanisms of nitrogenase and hydrogenase, assay methods for nitrogen fixation, and the physiology and genetics of legume root nodules and leghaemoglobin.	1 2 3 4 5
<b>IV</b>	<b>Bioremediation</b> – Factors affecting the bioremediation process, Bioremediation of toxic waste sites; Bioremediation practices and technologies; Bioleaching of copper, gold, uranium Role of microbes; Microbial degradation of environmental pollutants - industrial solvents, pesticides, petroleum hydrocarbons, xenobiotics; Biodeterioration – paper, textile, wood, metal, Corrosion – methods of protection Biomagnification	<b>8</b>	Understand bioremediation. Study the bioremediation of toxic waste sites and the role of microbes in bioleaching copper, gold, and uranium. Learn about microbial degradation of environmental pollutants. Explore biodeterioration of materials like paper, textile, wood, and metal, methods for corrosion protection, and the concept of biomagnification.	1 2 3 4 5
<b>V</b>	<b>Microbial interaction:</b> Competition, ammensalism, parasitism, mutualism, commensalism, synergism, Biogeochemical cycles – Carbon, Nitrogen, Phosphorus, Sulfur.	<b>5</b>	Understand microbial interactions. Explore the roles of microbes in biogeochemical cycles of carbon, nitrogen, phosphorus, and sulfur.	1 2 3 4 5
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Isolation of air microbes by gravity settle method</li> <li>2. Measurement of Ph</li> <li>3. Measurement of temperature</li> <li>4. Measurement of acidity and alkalinity</li> <li>5. Determination of DO</li> <li>6. Determination of BOD</li> <li>7. Determination of COD</li> <li>8. Preparation of biofilms</li> <li>9. Bacteriological examination of</li> </ol>	<b>30</b>	<p>Proficiency in various environmental microbiological experiments.</p> <p>Determine DO, BOD, COD</p> <p>Learn techniques for preparing biofilms.</p> <p>Conduct bacteriological examination of water.</p> <p>Isolate microorganisms from soil</p>	1 2 3 4 5 6

	water 10. Isolation of microorganisms from soil and their application		and explore their applications.	
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**TEXT BOOKS:**

- T1. Environmental Microbiology by Eugene L Madsen
- T2. Environmental Microbiology, Blackwell Synergy, Blackwell publishing
- T3. Environmental Microbiology by P D Sharma, Alpha Science publishing
- T4. Environmental Microbiology by Alan and Malcolm

**REFERENCE BOOKS:**

- R1. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company
- R2. Prescott, Harley and Klein's Microbiology.
- R3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Discuss various ecosystems and inhabiting microbial diversity with special reference to ecological niches, limiting factors, ecological pyramid, energy flow, trophic levels, etc.	1, 2, 4, 8
2	Asses the microbial diversity in aquatic ecosystems, wastewater treatment techniques, and microbial water quality.	1, 2, 3, 4, 8
3	Establish the role of microorganisms in soil fertility with reference to biological nitrogen fixation through leguminous plants and genes involved in nitrogen fixation.	1, 2, 4, 8, 9
4	Describe microbial Bioremediation and their role in the degradation of environmental pollutants.	1, 2, 4, 8, 9
5	Illustrate microbial interactions and various biogeochemical cycles	1, 2, 4, 8

SEMESTER-III									
Course Title	Soil and Agricultural Microbiology								
Course code	22MSMB216R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Fall/ III semester of first year of the programme								
Course Objectives	<p>1. To familiarize the students about the different types of soil and soil profile.</p> <p>2. To teach about the different types of microorganisms found in soil and their application in improvement of soil fertility</p>								
CO1	Describe soil profiles and dynamics of positive and negative interactions between microbes and plants.								
CO2	Explain the nitrogen cycle, the role of genes and enzymes in nitrogen metabolism								
CO3	Discuss the principles and applications of biofertilizers, biopesticides, and plant gene modification.								
CO4	Analyze host-parasite interactions, and the role of R and r genes in disease development in plants.								
CO5	Identify post-harvest diseases to implement effective control measures.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Soil profile, types of microorganisms found in soil and plant surfaces Microbe plant interaction –positive interaction and types, Negative interaction and types, role of siderophores	7	Understand the soil profile and identify the types of microorganisms found in soil and plant surfaces. Explore microbe-plant interactions. Study the role of siderophores in these interactions.					1 2 3 4	
II	Nitrogen cycle, Symbiotic and Non symbiotic Nitrogen Fixation, Nitrogenase enzyme and nif genes	7	Comprehend the nitrogen cycle, focusing on symbiotic and non-symbiotic nitrogen fixation. Understand the role of the nitrogenase enzyme and the function of nif genes in these processes.					1 2 3 4	
III	<b>Biofertilizers</b> –types (free living soil microbes fixing N <sub>2</sub> (Azotobacter, Azospirillum), Rhizobium, Azorhizobium, Bradyrhizobiumin symbiotic association with leguminous plants. Free living cyanobacteria-Nostoc, Anabaena. Associative cyanobacteria (symbionts)- Anabaena azollae, Azollaas Biofertilizer ) <b>Biopesticides</b> and types (Bacteria- <i>Bacillus thuringiensis</i> , Bt based commercial products, <i>Beauveria bassiana</i> , <i>Trichoderma</i> , Baculoviruses for insect pest control -Nuclear polyhedrosis virus) Plant	15	Understand the types and functions of biofertilizers Learn about biopesticides Explore plant transformation techniques, focusing on the importance of Ti plasmid and Agrobacterium-mediated gene transfer.					1 2 3 4 5	

	transformation- Ti plasmid and its importance, Agrobacterium mediated gene transfer			
<b>IV</b>	<b>Host parasite interaction</b> , production of phytoalexins, involvement of elicitors, role of R and r genes in disease development Plant disease –bacterial –blight of rice, citrus canker, viral –TMV, Banana bunchy top, fungal –wilt, downy mildew, powdery mildew, smut and rusts, mycoplasmal – sandal spike, grassy shoot of sugarcane	<b>8</b>	Understand host-parasite interactions, including the production of phytoalexins and the involvement of elicitors. Explore the role of R (resistance) and r (susceptibility) genes in disease development. Study plant diseases caused by various pathogens	1 2 3 4
<b>V</b>	Post harvest disease and control measures	<b>8</b>	Identify post-harvest diseases and their control measures, focusing on strategies to prevent and manage diseases affecting harvested crops and produce.	1 2 3 4
<b>Practical</b>	1. Isolation of nitrogen fixing bacteria from legume root nodules 2. Study of Rhizosphere and Phyllosphere 3. Isolation of Phosphorus solubilizing microorganisms 4. Observation of Anabaena from Azolla plants 5. Microscopic observations of root colonization by VAM fungi	<b>30</b>	Isolate nitrogen-fixing bacteria from legume root nodules. Isolate phosphorus-solubilizing microorganisms. Study the rhizosphere and phyllosphere environments. Observe Anabaena from Azolla plants. Observe root colonization by VAM (Vesicular-Arbuscular Mycorrhizal) fungi.	1 2 3 4 5 6

#### TEXTBOOKS:

- T1. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.  
T2. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi

#### REFERENCE BOOKS:

- R1. Microbiology – Michael J. Pelczar, JR. E.C.S. Chan Noel K. Krieg, Vth Edition (2005), Publisher – TATA McGraw Hill.  
R2. Plant Diseases – R.S. Singh, IXth Edition, Oxford and IBH (N. Delhi)

#### OTHER LEARNING RESOURCES:

1. [http://www.jnkvv.org/PDF/02042020180252Yogranjan\\_Lecture%20notes\\_Agricultural%20Microbiology.pdf](http://www.jnkvv.org/PDF/02042020180252Yogranjan_Lecture%20notes_Agricultural%20Microbiology.pdf)

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe soil profiles and dynamics of positive and negative interactions between microbes and plants.	<b>1, 2, 4</b>
<b>2</b>	Expalin the nitrogen cycle, the role of genes and enzymes in nitrogen metabolism	<b>1, 2, 3, 4</b>
<b>3</b>	Discuss the principles and applications of biofertilizers, biopesticides, and plant gene modification.	<b>1, 2, 3, 4, 9</b>
<b>4</b>	Analyze host-parasite interactions, and the role of R and r genes in disease development in plants.	<b>1, 2, 3, 4, 9</b>
<b>5</b>	Identify post-harvest diseases to implement effective control measures.	<b>1, 2, 4, 8</b>

SEMESTER-III									
Course Title	<b>Clinical and Diagnostic Microbiology</b>								
Course code	22MSMB217R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Fall/ III semester of first year of the programme								
Course Objectives	1. To teach the importance of a microbiologist in diagnosis of microbial diseases. 2. To make students proficient in isolation and characterization of infectious organisms. 3. To analyse the nature of the agent, Study the sensitivity pattern to drugs.								
CO1	Apply the skills of handling clinical specimens, isolating and identifying microorganisms from clinical samples.								
CO2	Perform different immunological techniques using immunodiagnostic tools in clinical microbiology								
CO3	Describe the concept of vaccine and its effectiveness and safety concern								
CO4	Apply the advanced diagnostic tools and techniques for disease diagnosis								
CO5	Illustrate the concept of antimicrobial chemotherapy, mode of action, and sensitivity pattern.								
Unit- No.	Content		Contact Hour	Learning Outcome					KL
<b>I</b>	<b>Introduction to clinical Microbiology:</b> Role of Microbiologist in Diagnostic laboratory, General concepts for specimen collection, handling, transportation, processing, specimen work up, Laboratory safety and infection control. Scientific and Laboratory basis for Clinical/Diagnostic Microbiology: Microscopic examination of infectious diseases, Growth and biochemical characteristics, Rapid methods of identification		<b>10</b>	Understand the role of a microbiologist in a diagnostic laboratory and key concepts related to specimen collection, handling, transportation, processing, and work-up. Learn about laboratory safety and infection control. Gain insights into the scientific and laboratory basis of clinical microbiology, including microscopic examination of infectious diseases, growth and biochemical characteristics, and rapid methods of identification.					1 2 3
<b>II</b>	<b>Immunotechniques and Immunodiagnosis:</b> Antigens and Antibody reactions in vitro; Agglutination, complement fixation, ELISA, Western Blotting Immunodiffusion, Immunoelectrophoresis, Immunofluorescence, Immunoprecipitation, Radioimmunoassay, and serotyping.		<b>7</b>	Understand and apply various immunotechniques and immunodiagnostic methods					1 2 3 4
<b>III</b>	<b>Vaccines and Vaccination:</b> Vaccines – definition, types, Antigens used as Vaccines, effectiveness of vaccines, Vaccine safety, current vaccines, adjuvants, active immunization and passive immunization.		<b>8</b>	Understand vaccines and vaccination by exploring types, antigens used, effectiveness, safety, current vaccines, adjuvants, and the differences					1 2 3 4 5



			between active and passive immunization.	
<b>IV</b>	<b>Recent Diagnostic tools and techniques:</b> Principle, working and application of a) Autoanalyser b) Biosensor glucometer /labon chip/microfluidics c) Diagnostickits-ELISA, Western Blot d)Enzymes in Disease diagnosis andtherapy: Lactate dehydrogenase, Aspartate aminotransferase, Alkaline phosphatase, Creatine kinase, Acid phosphotase, Cholinesterase	<b>10</b>	Understand recent diagnostic tools and techniques, including auto analyzers, biosensors (glucometers, lab-on-a-chip, microfluidics), diagnostic kits (ELISA, Western Blot), and the role of enzymes (lactate dehydrogenase, aspartate aminotransferase, alkaline phosphatase, creatine kinase, acid phosphatase, cholinesterase) in disease diagnosis and therapy.	1 2 3 4 5
<b>V</b>	<b>Antimicrobial Chemotherapy:</b> Development of chemotherapy;General characteristics of drugs and their testing; Mechanism of action. Antibacterial drugs; antifungaldrugs, antiviral and antiprotozoan drugs; antibiotic sensitivity testing, MIC, Drug resistance; mechanism of drug resistance; multi drug resistance.	<b>10</b>	Understand antimicrobial chemotherapy by exploring their mechanisms of action, and the specifics of antibacterial, antifungal, antiviral, and antiprotozoan drugs, including antibiotic sensitivity testing, MIC, and mechanisms of drug resistance, including multi-drug resistance.	1 2 3 4 5
<b>Practical</b>	1. Study of sample collection procedure, Storage protocol, Processing. 2. Isolation of pathogen from clinical sample and its antibiogram 3. Serological test, 4. Handling and working of rapid diagnostic kits. 5. Study of nature of antibioticsactions. Detection and analysis of antibiotic resistance	<b>30</b>	Learn sample collection, storage, and processing procedures. Isolate pathogens from clinical samples and perform antibiograms, conduct serological tests. Handle rapid diagnostic kits. Study the nature of antibiotic actions, and analyze antibiotic resistance.	1 2 3 4 5 6

#### TEXTBOOKS

- T1. Medical Microbiology by Anantanarayan & Panikar Orient Longman Limited.  
T2. Medical Parasitology by Arora and Arora, CBS Publishers & Distributors.

#### REFERENCE

- R1. Medical Microbiology by David Green Wood Richard slack & John Peuthrer. Churchill Livingston Company.

R2. Parasitology by K. P. Chattergy Medical Microbiology by Jawetz, Melnick, Geo R. Brokes McGraw-Hill Company.

R3. Medical Mycology by Jagedeese Chander

R4. Medical Microbiology by Jawetz

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Apply the skills of handling clinical specimens, isolating and identifying microorganisms from clinical samples.	<b>1, 3, 4, 6, 7</b>
<b>2</b>	Perform different immunological techniques using immunodiagnostic tools in clinical microbiology	<b>1, 3, 4, 6, 7</b>
<b>3</b>	Describe the concept of vaccine and its effectiveness and safety concern	<b>1, 3, 4, 6</b>
<b>4</b>	Apply the advanced diagnostic tools and techniques for disease diagnosis	<b>1, 3, 4, 6, 7</b>
<b>5</b>	Illustrate the concept of antimicrobial chemotherapy, mode of action, and sensitivity pattern.	<b>1, 3, 4, 6, 7, 9</b>

SEMESTER-III									
Course Title	Organic Farming								
Course code	22MSMB218R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Fall/ III semester of first year of the programme								
Course Objectives	1. Introduction to Concept of Organic cultivation 2. To discuss the Organic Farming System (OFS), its importance and benefits. 3. To discuss the methods associated with organic farming – mulching, crop rotation, tillage, bio-fertilizer etc								
CO1	Explain organic Farming, its principles, scope and benefits for the health and society.								
CO2	Illustrate the relation between organic farming and natural processes such as nutrient cycles, soil preparation and choice of crop varieties, planting material and seed treatment.								
CO3	Discuss crop protection methods, analyse scenarios, propose strategies and evaluate effectiveness, preparing to innovate in pest and weed management.								
CO4	Explain the organic production of rice, zinger, turmeric, banana and vegetables.								
CO5	Describe the concept of soil less farming system.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Introduction to Organic Farming(OF); Development of OF; Principles and Types of OF; Biodynamic Farming; Need and Benefits of OF; Conventional Farming (CF) Vs(OF); Scope of OF.	5	Understand organic farming by exploring its development, principles, and types, including biodynamic farming, its benefits and needs, and comparing conventional farming (CF) with OF, along with the scope of organic farming.					1 2	
II	OF System; Soil and Soil tillage, Choice of crop/ varieties, Propagation –Seed, planting material and seed treatments, Crop rotation, Intercropping, Water Management, Green Manuring, Mulching, Composting, Vermicomposting, Organic Manure, Biofertilizer	8	Understand the organic farming system by exploring soil and tillage practices, crop selection and propagation, crop rotation, intercropping, water management, and techniques such as green manuring, mulching, composting, vermicomposting, organic manure, and biofertilizers.					1 2 3 4 5	
III	Cultural and Mechanical method of crop protection, Biopesticides and Botanical Pesticides, Bio- control agents, Weed Management	9	Understand and apply crop protection methods, including cultural and mechanical approaches, biopesticides, botanical pesticides, bio-control agents, and weed management techniques.					1 2 3 4	
IV	Organic crop production of Rice, Zinger, Turmeric, Banana and Vegetables	17	Learn organic crop production practices for rice, ginger, turmeric, banana, and vegetables.					1 2 3	

V	Concept on modern organic farming methods – Hydroponics, Aquaponics, Hydroponics	6	Explore modern organic farming methods, including hydroponics, aquaponics, and vertical farming.	1 2 3 4 5
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### TEXT BOOKS:

T1. The Market Gardener – A successful Grower’s Handbook for Small- Scale OF (2014), Jean-Martin Fortier

T2. Profitable OF (2004), Jon Newton

T3. Organic Farming for Sustainable Agriculture (2016) Dilip Nandwani (eds)

### REFERENCE BOOKS:

R1. Organic Farming: Concepts and Principles (2011) G. K. Veeresh and G.K. Veerash

R2. Organic Farming: New Advances Towards Sustainable Agriculture Systems (2019). C. Sarath Chandran, Sabu Thomas. M.R. Unni

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain organic Farming, its principles, scope and benefits for the health and society.	1, 4, 9
2	Illustrate the relation between organic farming and natural processes such as nutrient cycles, soil preparation and choice of crop varieties, planting material and seed treatment.	1, 2, 3, 8, 9
3	Discuss crop protection methods, analyse scenarios, propose strategies and evaluate effectiveness, preparing to innovate in pest and weed management.	1, 2, 3, 4
4	Explain the organic production of rice, zinger, turmeric, banana and vegetables.	1, 4
5	Describe the concept of soil less farming system.	1, 2, 3, 4, 8, 9

<b>SEMESTER - IV</b>									
<b>Course Title</b>	<b>MINI RESEARCH - IV (RESEARCH DATA ANALYSIS AND DOCUMENTATION-R4)</b>								
<b>Course code</b>	<b>22MSMB221R</b>	<b>Total credits: 12</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
		<b>Total hours: 360</b>	<b>0</b>	<b>0</b>	<b>20</b>	<b>4</b>	<b>6</b>	<b>0</b>	<b>12</b>
	<b>(P+S+R)</b>								
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programmes</b>	<b>Master of Science in Biotechnology</b>								
<b>Semester</b>	<b>Spring/II Semester of First Year of the Programme</b>								
<b>Course objectives</b>	1. To enable students to apply experimental methods to solve a given scientific task. 2. To be able to analyse research data 3. To be able to compile and document research data.								
<b>CO1</b>	Learn to tabulate research data								
<b>CO2</b>	Analyze research outcomes								
<b>CO3</b>	Corelate with exiting literature								
<b>CO4</b>	Prepare an effective dissertation report								
<b>CO5</b>	Able to communicate research outcome								

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Learn to tabulate research data	<b>1, 2, 3, 4, 6, 7, 9</b>
<b>2</b>	Analyze research outcomes	<b>1, 2, 3, 4, 6, 7, 9</b>
<b>3</b>	Corelate with exiting literature	<b>3, 4, 6, 7, 9</b>
<b>4</b>	Prepare an effective dissertation report	<b>1, 2, 3, 5, 6, 7, 9</b>
<b>5</b>	Able to communicate research outcome	<b>5, 6, 9</b>

SEMESTER-IV									
Course Title	Industrial Microbiology and Fermentation								
Course code	22MSMB222R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 33T+30P	2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Spring/IV Semester of second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To familiarize the students with the concept of fermentation processes &amp; the use of different microorganisms in industries.</li> <li>To teach the students about the different industrial products produced by microorganisms.</li> </ol>								
CO1	Explain the principles of diverse bioreactors and their advantages								
CO2	Illustrate different microbial strain improvement strategies and the development of novel applications.								
CO3	Illustrate various fermentation products and the underlying biotechnological principles involved.								
CO4	Describe various downstream processes and their storage and packaging techniques.								
CO5	Explore the potential of using microbes to produce metabolites in industrial settings.								
Unit-No.	Content		Contact Hour	Learning Outcome					KL
I	<b>General Principles of Fermentation:</b> Bioreactors: Bioreactor types, immobilized bioreactors, types of fermentation. Fermentation kinetics and Monod's Model:- Growth kinetics and Monod's Model, Substrate accelerated death, specific growth rate, stringent response, Ntr and Pho system, growth limiting substrate, maintenance energy, growth yield and product formation. Process optimization: factors of optimization, rheology of fermentation fluid, oxygenation, and oxygen transfer kinetics.		8	Understand various types of bioreactors and their applications.  Comprehend growth kinetics and the principles of Monod's Model.  Identify key factors influencing the optimization of fermentation processes.					1 2 3 4 5
II	<b>Microbial strain improvement</b> Isolation, selection and improvement of microbial cultures: Screening and isolation of microorganisms, primary and secondary metabolites, enrichment, specific screening for the desired product. Strain improvement for the selected organism:		6	Learn techniques for screening and isolating microorganisms from various environments.  Understand the production and importance of primary and secondary metabolites.  Learn techniques to improve microbial strains for increased yield and efficiency of desired products.					1 2 3 4 5

<b>III</b>	<b>Industrial Fermentation Products</b> Biofuels:- Ethanol, Hydrogen, Methane Antibiotics:- $\beta$ -lactumantibiotics (Synthetic penicillin), Streptomycin,Cephalosporin. Biopreservative: Lactobacillus sakei. Biopolymers:-Xanthan, Polyhydroxyalkanoates. Thermostable enzymes:- Proteases. Biosurfactants: acomparative account.	<b>8</b>	Understand the process of fermentative production of biofuels, antibiotics, bio preservatives, biopolymer, enzymes, biosurfactants from microbial sources.	1 2 3 4 5
<b>IV</b>	<b>Downstream Processing and scaleup:</b> Downstream processes: types of processing units and systems,Storage and packaging methods.Scale up: criteria involved in scale up, Productivity, power requirements, Basic control theory	<b>4</b>	Understand different types of processing units and systems used in downstream processing.  Analyze factors affecting productivity and power requirements during scale-up.	1 2 3 4 5
<b>V</b>	<b>Food and Healthcare products:</b> SCP, various types and processes, SCO Aminoacids:-Lysine, Glutamicacid. Vitamins:-riboflavin, Vit.B12. Fattyacids (Palmetate, oleate). Organic acids Production of Fuels: Ethanol,Methanol Mushroom Cultivation and Wine production	<b>7</b>	Understand the various types of SCP and SCO, and the processes involved in their production.  Gain knowledge on the biosynthesis and industrial production of vitamins, amino acids, organic acids, wine, fatty acids, biofuels.  Understand the techniques and processes involved in mushroom cultivation.	1 2 3 4 5
<b>Practical</b>	1. Yoghurt production 2. Yeast Fermentation 3. Wine preparation 4. Vinegar production 5. Single cell Protein and Single Cell Oil 6. Citric acid estimation 7. Lactic acid estimation	<b>30</b>	Perform fermentative production of yoghurt, wine, vinegar, SCO, SCP  Estimate Citric acid and lactic acid produces through fermentation	1 2 3 4 5

**TEXTBOOKS:**

T1.Stanbury P.F., A. Whitaker, S.j. Hall, Principles of Fermentation Technology  
Publisher:Butterworth-Heinemann

T2.Shuler M.L. and F. Kargi: Bioprocess Engineering Basic Concepts by Publisher PrenticeHall

**REFERENCE BOOKS:**

R1.Prescott and Dunn's Industrial Microbiology, Publisher: Gerald Reed: Books

R2.W. Crueger and A. Crueger: Biotechnology. A textbook of Industrial Microbiology, Publisher: Sinauer Associates.

**OTHER LEARNING RESOURCES:**

1. <https://microbenotes.com/>

2. [www.youtube.com](http://www.youtube.com)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the principles of diverse bioreactors and their advantages	<b>1, 3</b>
<b>2</b>	Illustrate different microbial strain improvement strategies and the development of novel applications.	<b>1, 2, 3, 4, 9</b>
<b>3</b>	Illustrate various fermentation products and the underlying biotechnological principles involved.	<b>1, 2, 3, 4, 9</b>
<b>4</b>	Describe various downstream processes and their storage and packaging techniques.	<b>1, 2, 3, 4, 9</b>
<b>5</b>	Explore the potential of using microbes to produce metabolites in industrial settings.	<b>1, 2, 3, 4, 8, 9</b>



SEMESTER-IV									
Course Title	Food and Dairy Microbiology								
Course code	22MSMB223R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 32T+30P	2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Spring/IV Semester of second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. The course provides students with both a knowledge of general scientific methods and contents of the food microbiology field and specific professional skills</li> <li>2. The course provides an integrated overview of the field of food microbiology covering issues of food safety, food preservation and food production.</li> <li>3. The course provides insights concerning aspects of microbial ecophysiology, determination and control of food microorganisms, and the distribution of spoilage and pathogen microorganisms in plant- and animal-based food.</li> </ol>								
CO1	Describe the significance of microorganisms in food and their relation to spoilage								
CO2	Apply the principles and techniques employed in the preservation of foods.								
CO3	Analyze the role of microbes in food production, and explore the concept of probiotics and prebiotics								
CO4	Characterize different food-borne illnesses and associated microorganisms.								
CO5	Demonstrate safety measures and control programs in food production								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Food &amp; Microorganisms-</b> food as a substrate for microorganisms, important microorganisms in food microbiology, general principles underlying food spoilage <b>Food Contamination-</b> contamination, preservation, and spoilage of cereal products/ vegetables & fruits/ meat & meat products/ milk & milk products/ canned products	7	Understand the role of food as a substrate for microorganisms, identify key microorganisms in food microbiology, learn the principles of food spoilage, and gain knowledge on contamination, preservation, and spoilage prevention methods for various food products					1 2 3 4 5	
II	<b>Principles of Food Preservation-</b> asepsis, removal, anaerobic condition, preservation by high temperature/ low temperature/ drying/ food additives/ radiation	5	Apply the principles of food preservation, including asepsis, removal of contaminants, creation of anaerobic conditions, and methods such as high temperature, low temperature, drying, use of food additives, and radiation.					1 2 3 4 5	
III	<b>Foods &amp; Enzymes Produced by Microorganisms-</b> productions of cultures, food fermentation, foods & enzymes from	8	Understand and apply the process of food fermentation learn about probiotics and					1 2 3 4	

	microorganisms <b>Probiotics &amp; Prebiotics</b> - functions, types, acidophilus milks, yogurt, butter milk, solid formulas		prebiotics, their functions, types, and applications in products such as acidophilus milk, yogurt, buttermilk, and solid formulas.	5
<b>IV</b>	<b>Foods in Relation to Disease</b> - bacterial food borne illnesses, non- bacterial food poisoning/infections/intoxication, food borne disease outbreaks	<b>5</b>	Corelate food borne disease and their causative agents and factors contributing to food poisoning	1 2 3 4 5
<b>V</b>	<b>Food Sanitation, Control &amp; Inspection</b> -sterilization, microbiology in food sanitation, enforcement & control agencies- national/ international/ federal/ state/ private, Microbiological criteria for food	<b>7</b>	Understand the principles of food sanitation, including sterilization and the role of microbiology, and become familiar with the enforcement and control agencies at national, international, federal, state, and private levels, as well as the microbiological criteria for food safety.	1 2 3 4 5
<b>Practical</b>	1. MBRT of milk samples and their standard plate count. 2. Isolation of food-borne bacteria and fungi from food products. 3. Most Probable Number Analysis 4. Microbiological examination of canned foods 5. Isolation of spoilage bacteria from fruits and vegetables. 6. Adulterant test – formalin and starch test 7. Effect of temperature on the spoilage of food products. 8. Production of fermented food and their microbial examination	<b>30</b>	Assess milk quality, isolate food borne microorganisms. Estimate MPN Perform microbial examination of food. Perform adulterant test Able to produce fermented food	1 2 3 4 5

#### TEXTBOOKS:

T1.Frazier W.C. and Westhoff D.C. (2008) Food Microbiology, 4<sup>th</sup> Edn. Tata McGraw Hill PublishingCo.,New Delhi.

T2.Bamforth C.W. (2005) Food, Fermentation and Microorganisms, Blackwell Science

#### REFERENCE BOOKS:

R1.Doyle M.P. and Buchanan R.L. (Ed.) (2013) Food Microbiology: Fundamentals and Frontiers, 4<sup>th</sup> Edn.ASM press.

R2.Jay J.M., Loessner M.J. and Golden D.A. (2005) Modern Food Microbiology, 7<sup>th</sup> Edn. Springer Publishers

R3.Robinson R.K. (2002) Dairy Microbiology: Milk and Milk Products, 3<sup>rd</sup> Edn. Wiley Publishers.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe the significance of microorganisms in food and their relation to spoilage	<b>1, 4</b>
<b>2</b>	Apply the principles and techniques employed in the preservation of foods.	<b>1, 2, 4</b>
<b>3</b>	Analyze the role of microbes in food production, and explore the concept of probiotics and prebiotics	<b>1, 2, 3, 4</b>
<b>4</b>	Characterize different food-borne illnesses and associated microorganisms.	<b>1, 2, 4, 9</b>
<b>5</b>	Demonstrate safety measures and control programs in food production	<b>1, 2, 4, 9</b>

SEMESTER-IV									
Course Title	Pharmaceutical Microbiology								
Course code	22MSMB224R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 32T+30P	2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Spring/IV Semester of second year of the programme								
Course Objectives	1. To teach the basic definition of pharmacology and kinetics of drugs in human. 2. To understand the mechanism of action of antibiotics and the mode of spoilage of pharmaceutical products 3. To incorporate in depth knowledge of techniques, processes and strategies in order to avoid any potentially costly and life-threatening failures and consequences.								
CO1	Explain pharmacology and pharmacokinetics.								
CO2	Describe the mode of action of antimicrobial agents, pathogenicity, and resistance to antibiotics.								
CO3	Explore microbial pharmaceutical products, and their spoilage.								
CO4	Execute Good manufacturing practices, quality assurance, and quality control.								
CO5	Apply different physical and chemical sterilization techniques to ensure sterility in the pharmaceutical industry.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Introduction to pharmacology:</b> Definitions, sources, terminology used, classification, Pharmacodynamics – Actions, Therapeutic, Adverse, toxic <b>Pharmacokinetics</b> – absorption, distribution, metabolism, interaction, excretion, Routes of drug administration, Storage of various drugs	7	Gain a foundational understanding of pharmacology, including definitions, sources, terminology, classification, pharmacodynamics (actions, therapeutic, adverse, toxic effects), pharmacokinetics (absorption, distribution, metabolism, interaction, excretion), routes of drug administration, and drug storage methods						
II	<b>Mechanism of action of antibiotics:</b> Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis). Bacterial resistance to antibiotics. Mode of action of bacterial killing by quinolones. Bacterial resistance to quinolones.	5	Understand the mechanisms of action of antibiotic. Comprehend bacterial resistance to antibiotics and quinolones						
III	<b>Microbial production and Spoilage of pharmaceutical Products:</b> Microbial contamination and spoilage of pharmaceutical products (sterile injectibles, non injectibles, ophthalmic preparations and implants) and their sterilization. Manufacturing procedures and in process control of pharmaceuticals. Other pharmaceuticals produced by	7	Understand microbial contamination and spoilage of pharmaceutical products Learn manufacturing procedures and in-process control of pharmaceuticals; Gain knowledge on pharmaceuticals produced by						

	microbial fermentations (streptokinase, streptodornase). New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines. Vaccine clinical trials.		microbial fermentations Explore new vaccine technologies Understand the process of vaccine clinical trials.	
<b>IV</b>	<b>Principles and applications of GMP in pharmaceuticals and cosmetics:</b> Principles – Applications and Definitions, The concept of Quality, The regulatory factors QC, QA and GMP, Quality assurance beyond Good Manufacturing Practices (GMP), ISO, Sanitary practices in cosmetic manufacturing	<b>6</b>	Understand the principles, applications, and definitions related to quality in pharmaceutical and cosmetic manufacturing; Grasp the concept of quality and the regulatory factors involved, including Quality Control (QC), Quality Assurance (QA), and Good Manufacturing Practices (GMP); Explore quality assurance practices beyond GMP, learn about ISO standards. Understand sanitary practices in cosmetic manufacturing.	
<b>V</b>	<b>Sterilization and sterility assurance:</b> Sterilization control and sterility testing (heat sterilization, D value, z value, survival curve, Radiation, gaseous and filter sterilization) Chemical and biological indicators. Design and layout of sterile product manufacturing unit. (Designing of Microbiology laboratory).	<b>7</b>	Understand sterilization control and sterility testing methods, Learn about chemical and biological indicators used in sterility testing; Comprehend the design and layout of sterile product manufacturing units, including the design principles for microbiology laboratories.	
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Antimicrobial assay of antibiotics - determine MIC</li> <li>2. Sampling of pharmaceuticals for microbial contamination and load (syrops, suspensions, creams and ointments, ophthalmic preparations).</li> <li>3. Determination of antimicrobial activity of a chemical compound (Phenol, resorcinol, thymol, formaldehyde) to that of phenol under Standardized experimental conditions.</li> <li>4. Determination of D value, Z value for heat sterilization in pharmaceuticals.</li> <li>5. Sampling of pharmaceuticals for microbial contamination and load (syrops, suspensions, creams and</li> </ol>	<b>30</b>	<p>Determine the Minimum Inhibitory Concentration (MIC) of antibiotics through antimicrobial assays.</p> <p>Perform microbial contamination and load testing of pharmaceuticals, including syrops, suspensions, creams, ointments, and ophthalmic preparations.</p> <p>Evaluate and compare the antimicrobial activity of chemical compounds (e.g., phenol, resorcinol, thymol, formaldehyde) against phenol under standardized experimental conditions.</p>	<p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p>

	ointments, ophthalmic preparations).		Measure D value and Z value for heat sterilization in pharmaceutical products to ensure effective sterilization.	
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**TEXT BOOKS:**

- T1.Pharmaceutical Microbiology by Hugo & Russell, Blackwell Science Publication, 6<sup>th</sup> Edition  
T2.Pharmaceutical Microbiology: Essentials for Quality Assurance and Quality Control by Tim Sandle, Woodhead Publishing.

**REFERENCE BOOKS:**

- R1.Pharmacology by Harvey and Champe, Wolters Kluwer Publication, 4<sup>th</sup> Edition  
R2. Principles of Pharmacology, Armstrong, Wolters Kluwer Publication  
R3.Basic and Clinical Pharmacology, by Katzung, McGraw Hill, 10<sup>th</sup> edition  
R4.Pharmacology, Principles and Practice, Bachmann, Hecker, Messer, AP Publication  
R5.Analytical Microbiology –Edt by Frederick Kavanagh Volume I & II. Academic Press New York.  
R6.Quinolone antimicrobial agents – Edt. by David C. Hooper, John S.Wolfson .ASM Washington DC.  
R7.Quality control in the Pharmaceutical Industry - Edt. by Murray S.Cooper Vol.2.Academic Press New York.

**OTHER LEARNING RESOURCES:**

- 1.[https://www.carewellpharma.in/B Pharmacy/Notes/3rd Sem/Microbiology/Unit 1/](https://www.carewellpharma.in/B_Pharmacy/Notes/3rd_Sem/Microbiology/Unit_1/)  
[www.youtube.com](http://www.youtube.com)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain pharmacology and pharmacokinetics.	1
2	Describe the mode of action of antimicrobial agents, pathogenicity, and resistance to antibiotics.	1, 2, 4
3	Explore microbial pharmaceutical products, and their spoilage.	1, 2, 3, 4, 9
4	Execute Good manufacturing practices, quality assurance, and quality control.	1, 6, 7, 9
5	Apply different physical and chemical sterilization techniques to ensure sterility in the pharmaceutical industry.	1, 3

SEMESTER-IV									
Course Title	Marine Microbiology								
Course code	22MSMB225R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 32T+30P	2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Microbiology								
Semester	Spring/IV Semester of second year of the programme								
Course Objectives	1. To develop the knowledge about the biology of marine microbes and their distribution. 2. To understand the role of marine microorganisms. 3. To explore potential of marine microorganisms.								
CO1	Describe the distribution and significance of marine cyanobacteria and actinomycetes.								
CO2	Explain the marine eukaryotic microbial cell structure and functions.								
CO3	Discuss the role of marine microorganisms in ocean acidification and sedimentation.								
CO4	Characterize marine viruses and virus-like particles.								
CO5	Explore the role of marine microorganisms in the production of various bioactive compounds								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Occurrence and distribution, structure and biology, ecological role and significance of marine cyanobacteria, marine actinomycetes	5	Understand the occurrence, distribution, structure, biology, ecological role, and significance of marine cyanobacteria and marine actinomycetes					1 2 3	
II	Marine eukaryotic microbes: Introduction to the protists and fungi Overview of eukaryotic cell structure and Function Nanoplanktonic flagellates, Dinoflagellates, Bioluminescence and biological clocks Ciliates, Diatoms.	7	Gain an introduction to marine eukaryotic microbes Understand eukaryotic cell structure and function; Explore nanoplanktonic flagellates, dinoflagellates, bioluminescence, biological clocks, ciliates, and diatoms.					1 2 3 4	
III	Role of microorganisms in ocean acidification, Marine microbes as a major component of the Plankton, Microbes play a key role in the formation of sediments	7	Understand the role of microorganisms in ocean acidification, Recognize marine microbes as a major component of plankton, Explore how microbes contribute to the formation of sediments.					1 2 3 4 5	
IV	Marine virus: The nature of marine viruses, Viruses infecting prokaryotes, Enumerating viruses and virus-like particles, Morphology of marine viruses.	6	Understand the nature of marine viruses, including those infecting prokaryotes; Learn methods for enumerating viruses and virus-like particles; and explore the morphology of marine viruses.					1 3 4	
V	Exploring potentials of marine microorganisms, Bioactive Marine Natural	7	Explore the potential of marine microorganisms, including the					1 2	

	Products, Bioactive compounds, biofilms.		discovery and applications of bioactive marine natural products, bioactive compounds, and the role of marine microorganisms in biofilm formation.	3 4 5
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Sampling techniques in marine microbiology</li> <li>2. Estimation of bacterial population from marine samples</li> <li>3. Isolation of marine actinobacteria</li> <li>4. Enumeration of total heterotrophic bacteria in sea water</li> <li>5. Hydrolytic enzyme profiling of the marine isolates.</li> </ol>	<b>30</b>	Master sampling techniques for marine microbiological studies. Accurately estimate bacterial populations from marine samples. Isolate and identify marine actinobacteria. Enumerate total heterotrophic bacteria in seawater samples. Perform hydrolytic enzyme profiling of marine bacterial isolates.	1 2 3 4 5 6

**TEXT BOOKS:**

- T1.Munn, C.B., 2019. Marine microbiology: ecology & applications. CRC Press.3rd edtn
- T2.Gasol, J.M. and Kirchman, D.L. eds., 2018. Microbial ecology of the oceans. John Wiley & Sons. 3rd edtn
- T3.Stal, L.J. and Cretoiu, M.S., 2016. The marine microbiome. Springer International: Switzerland.
- T4.Kim, S.K. ed., 2015. Springer handbook of marine biotechnology. Springer.

**REFERENCE BOOKS**

- R1.Mckane, L. and J.Kandel, 1996. Microbiology, Essentials and Applications. McGraw Hill Inc., New York, 843 pp
- R2.Austin B. and D.A. Austin, 1996 Bacterial Fish Pathogens- Diseases of Farmed and Wild Fish, Springer Praxis Publishing, 457 pp.
- R3.Stickney, B.R., 2000. Encyclopedia of Aquaculture. John Wiley & Sons, Inc, US. 1063pp.
- R4.Munn, C.B. 2004. Microbial ecology: ecology and applications. BIOS Sci., Pub., US., 282pp. 7. Kirchman, D.L., 2008. Microbial ecology of the oceans John Wiley & sons US 593pp.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe the distribution and significance of marine	<b>1, 4</b>



	cyanobacteria and actinomycetes.	
<b>2</b>	Explain the marine eukaryotic microbial cell structure and functions.	<b>1, 3, 4</b>
<b>3</b>	Discuss the role of marine microorganisms in ocean acidification and sedimentation.	<b>1, 3, 4</b>
<b>4</b>	Characterize marine viruses and virus-like particles.	<b>1</b>
<b>5</b>	Explore the role of marine microorganisms in the production of various bioactive compounds	<b>1, 2, 3, 4, 8, 9</b>



# Assam down town University

## Curriculum and Syllabus

### Master of Science in Food Nutrition and Dietetics



OUTCOME BASED EDUCATION FRAMEWORK  
CHOICE BASED CREDIT SYSTEM

Version: 2.0

**FACULTY OF SCIENCE**

July, 2022

# Preamble

Assam down town University is a premier higher educational institution which offers Bachelor, Master, and Ph.D. degree programmes across various faculties. These programmes, collectively embodies the vision and mission of the university. In keeping with the vision of evolutionary changes taking place in the educational landscape of the country, the university has restructured the course curriculum as per the guidelines of National Education Policy 2020. This document contains outline of teaching and learning framework and complete detailing of the courses. This document is a guidebook for the students to choose desired courses for completing the programme and to be eligible for the degree. This volume also includes the prescribed literature, study materials, texts, and reference books under different courses as guidance for the students to follow.

Recommended by the 22<sup>nd</sup> Board of Studies (BoS) meeting of the Faculty of Science held on dated 22/06/2022 and approved by the Emergent Academic Council (AC) meeting held on dated 30/07/2022



*Chairperson  
Board of Studies*



*Member Secretary  
Academic Council*



## ***Vision***

To become a Globally Recognized University from North Eastern Region of India, Dedicated to the Holistic Development of Students and Making Society Better

## ***Missions***

1. Creation of curricula that address the local, regional, national, and international needs of graduates, providing them with diverse and well-rounded education.
2. Build a diverse student body from various socio-economic backgrounds, provide exceptional value-based education, and foster holistic personal development, strong academic careers, and confidence.
3. Achieve high placement success by offering students skill-based, innovative education and strong industry connections.
4. Become the premier destination of young people, desirous of becoming future professional leaders through multidisciplinary learning and serving society better.
5. Create a highly inspiring intellectual environment for exceptional learners, empowering them to aspire to join internationally acclaimed institutions and contribute to global efforts in addressing critical issues, such as sustainable development, Climate mitigation and fostering a conflict-free global society.
6. To be renowned for creating new knowledge through high quality interdisciplinary research for betterment of society.
7. Become a key hub for the growth and excellence of AdtU's stakeholders including educators, researchers and innovators
8. Adapt to the evolving needs and changing realities of our students and community by incorporating national and global perspectives, while ensuring our actions are in harmony with our foundational values and objectives of serving the community.

# Programme Details

## Programme Overview

M Sc. FND offers a wide range of courses covering various basic and applied areas of nutritional sciences. The student develops an aptitude and scientific temperament to apply the technical skills in various important areas of Nutrition and Food such as Food Science , Nutritional biochemistry, Food Microbiology, Clinical Nutrition, Food Technology and Food Science. The course also offers various techno specific skills, universal ethics and elective courses considering overall development and employability scopes in research, industry and teaching sectors. The course duration is for a period of 2 years.

### I. Specific Features of the Curriculum

- Experiential learning
- Constructivist approach to learn
- Practical and project-based learning

### II. Eligibility Criteria:

BSc in FND with minimum of 45% marks or equivalent CGPA.

### III. Program Educational Objectives (PEOs):

**PEO1** AdtU Food Nutrition and Dietetics post graduates will be equipped to pursue lucrative careers as food analysts, public health nutritionists, food microbiologists, food product developers, food inspectors, and other related fields in both public and private sectors.

**PEO2** Post graduates in Food Nutrition and Dietetics will have the academic preparation to work as certified dietitians or diet counselors, assessing nutritional status and promoting health.

**PEO3** Food Nutrition and Dietetics post graduates from AdtU will actively engage in professional efforts to uplift their status in the field of higher education/research in specialized or multidisciplinary fields while also positively impacting society and the profession. If they choose to continue further education

### IV. Program Specific Outcomes (PSOs):

**PSO1 Global Proficiency:** Manifest global proficiency in the profession with self-paced skill development and continuous learning.

**PSO2 Research and outreach:** Encourage the pursuit of problem-solving through research, collaborate with national and international organizations that specialize in nutrition and

related multi-disciplinary subjects, and raise public awareness through outreach and extension.

**PSO3 Entrepreneurship:** Empower competency to construct a profitable business as an entrepreneur to pursue careers in domain and multidisciplinary fields to establish a successful venture.

#### **V. Program Outcome:**

**PO1.** Nutritional Knowledge: Apply comprehensive knowledge of food science, nutrition, dietetics, allied aspects of biological sciences, and nutrition specialization to solving complex human nutritional issues.

**PO2.** Problem Analysis: Identify and analyse complex nutritional problems reaching substantial conclusions using life science fundamentals and nutrition using critical thinking.

**PO3.** Reasoning and Research: Apply multidisciplinary knowledge and research methods including review of literature, hypotheses formulation, experimental design and analysis using modern tools and analytical techniques to provide valid conclusions.

**PO4.** Communication: Communicate effectively the information and nutritional intervention with individuals, peers, and society at large; prepare documents/ scientific reports and deliver presentations efficiently.

**PO5.** Professional Ethics: Comply with moral values, professional ethics, and their strict application in the professional practice.

**PO6.** Eco-Friendly Approach: Understand the impact of the formulated nutritional solutions in a socioeconomic context with eco-friendly approaches.

**PO7.** Teamwork and Leadership: Function effectively as an individual, and as a member or leader in multidisciplinary teams.

**PO8.** Lifelong Learning: Ability to engage in independent lifelong learning in the broadest context of scientific and technological advancement.

#### **VI. Total Credits to be Earned: 94**

#### **VII. Career Prospects:**

M.Sc. in Food Nutrition and Dietetics offers a range of dynamic career opportunities. Graduates can work in research and development, hospitals, and food processing industries. Roles include nutritionist, quality control analysts, and clinical researchers. Opportunities also exist in academia and education, where graduates can contribute to scientific knowledge and train future professionals.

## EVALUATION METHODS

The student performance shall be evaluated through In-semester (Sessional) and semester-end examinations. A weightage of 40% or as prescribed by the programme shall be added to the score of the end-semester examination.

### A. INTERNAL ASSESSMENT:

The teacher who offers the course shall be responsible for internal assessment by conducting in-semester (sessional) examination and evaluating the performance of the students pursuing that course. The components for internal assessment are illustrated in the table given below.

SN	Components/ Examinations	Marks Allotted
1.	In-Sem Exam – I (ISE-I) (Written Examination)*	30
2.	In-Sem Exam – II (ISE-II) (Written Examination)*	30
3.	Assignment	10
4.	Presentation (SP)	10
5.	Quiz	5
6.	Class Performance based score*	5

*\*are compulsory*

Note: Total Internal assessment should be out of 40

### INSTRUCTION

1. If a student fails to appear in the any of the component without any valid reason he/she shall be marked zero in that component. However, the course teacher at his discretion may arrange for the missed test on an alternate date for the absentee students after determining ground with genuine/valid reasons for the absent.
2. The report of evaluation of an activity towards the in-semester (sessional) component of a course shall be duly notified by the concerned course teacher within a week of completion.

3. The program coordinators should upload the in-semester marks to the ERP and forward acknowledgement of all the courses of the program to the Controller of Examinations before the start of the End-semester examination.

## **B. SEMESTER END EXAMINATION:**

Time table for end semester examination is published at least 25 days prior to the start of Examination.

### **I. Pre-Examination:**

#### **Eligibility Criteria for a student to appear in University Examinations:**

The student shall only be allowed to appear in a University Examination, if:

- i) He/ She is a registered student of the University;
- ii) He/ She is of good conduct and character;
- iii) He/ She has completed the prescribed Programme of study with minimum percentage of attendance as laid down in the Regulations of the Programme concerned.

Under special cases, a student may be allowed to appear for an examination without being registered in the University but the result of the said student will be kept on hold till the registration of the concerned student is completed.

### **II. Admit Card:**

Admit card for the examination may be downloaded through ERP where the system will generate a Unique ID Cards through online.

The University shall have the right to cancel admission for examination of any candidate on valid grounds.

### **III. Pattern of Question Papers:**

The question paper shall follow the principles of Bloom's Taxonomy.

<b>S. N.</b>	<b>Level</b>	<b>Questions /verbs for test</b>
1	Remember	List, Define, tell, describe, recite, recall, identify, show who, when, where, etc.
2	Understand	Describe, explain, contrast, summarize, differentiate, discuss, etc.
3	Apply	Predict, apply, solve, illustrate, determine, examine, modify
4	Analyze	Classify, outline, categorize, analyze, diagrams, illustrate, infer,



		etc.
5	Evaluate	Assess, summarize, choose, evaluate, recommend, justify, compare etc.
6	Create	Design, Formulate, Modify, Develop, integrate, etc.

**Note:** No course is to be evaluated on basis of **all 6 knowledge levels**.

The format of the question paper across all the program follow a unique pattern and the total marks is 60

**Table 1: Question paper pattern for End semester examination**

<b>Sl no</b>	<b>Question pattern</b>	<b>Total marks</b>
1	MCQs (10 Questions)	10
2	2 Marks questions (10 Questions)	20
3	4 Marks questions (5 Questions)	20
4	10 Marks questions (1 Question)	10

#### **IV. Examination Duration:**

Each paper of 60 marks shall ordinarily be of two hours duration.

#### **V. Practical Examinations, Viva-Voce etc.:**

- i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.
- ii) Viva-Voce, Oral examinations of the Project report, Dissertation etc. shall be undertaken by a Board of Examiners constituted by the respective Dean of Program with the advice of Supervisor(s).

#### **VI. Procedure of Expulsion:**

If any candidate is found to be using any unfair-means during the examination, the invigilator may cease his/her answer sheet and report it directly to the Officer-in-Charge.

The Office-in-Charge of the center may take appropriate decisions as per the rules and procedure of the examination. The Officer-in-Charge may allow the students to write the exam with new answer sheet or may expel the student from appearing the paper depending on the nature of unfair-means. In case of Computer based test, the students may be directed to write an apology letter and sign in the prescribe expulsion form. The student may not be allowed to write that examination.

## **VII. Instruction to the Students:**

- (i) The students shall not bring to the Examination Hall, any electronic gadget used as a means of communication or record except electronic calculator, if required.
- (ii) The students shall not receive any book or printed or hand written or photo copy (Xerox) or blank-paper from any other person while he/she is in the examination-room or in laboratory or in any other place to which he/she is allowed to have access during course of examination.
- (iii) The students shall not communicate with any other candidate in the examination room or with any other person in and outside the examination-room.
- (iv) The students shall not see, read or copy anything written by any other candidate, nor shall he/she knowingly or negligently permit any other candidate to see, read or copy anything written by him/her or conveyed by him/her.
- (v) The students shall not write anything on the Question Paper or in other paper or materials during the examination, or pass any kind of paper to any other candidate in the examination-room, or to any person outside the room.
- (vi) The students shall not disclose his/her identity to the examiner by writing his/her name or putting any sign / symbol in any part of his answer-script.
- (vii) The students shall not use any abusive language or write any objectionable remark or make any appeal to examiner by writing in any part of his answer-script.
- (viii) The students shall not detach any page from the answer-script or insert any authorized or unauthorized loose sheet into it. He /she shall also not insert any other answer-script / loose sheet by removing the pins of the origin answer-scripts and re-fixing it.
- (ix) The students shall not resort to any disorderly conduct inside the examination-room or misbehave with the invigilator or any other examination official.

## **VIII. Provision for an Amanuensis (writer):**

- (i) A candidate may be provided with an Amanuensis (writer) to write down on dictation on his / her behalf on ground of his / her physical disability to write down by himself / herself due to accident or any other reason. The amanuensis may be provided till he / she recovers from the physical disability. The physical disability to write down by himself / herself must be supported by Medical Certificate from a competent Medical Officer.
- (ii) The qualifications of the amanuensis so provided must not be equal or higher than that of the candidate. This is also to be supported by Certificate from the Faculty of Study where the Amanuensis is provided.
- (iii) Such candidates are to be accommodated in a separate room under the supervision of an invigilator so that the fellow candidates are not disturbed in the process.

### **C. Credit Point:**

It is the product of grade point and number of credits for a course, thus,  $CP = GP \times CR$

#### **i. Credit:**

A unit by which the course work is measured. It determines the number of hours of instructions required per week. 'Credit' refers to the weightage given to a course, usually in terms of the number of instructional hours per week assigned to it. Credits assigned for a single course always pay attention to how many hours it would take for an average learner to complete a single course successfully.

#### **ii. Grade Point:**

Grade Point is a numerical weight allotted to each Grade Letter on a 10-point scale.

#### **iii. Letter Grade:**

Letter Grade is an index of the performance of students in a said paper of a particular course. Grades are denoted by letters O, A+, A, B+, B, C, P, F and Abs. Student obtaining Grade F / Grade Abs shall be considered failed/ absent and, will be required to appear in the subsequent ESE. The UGC recommends a 10-point grading system with the following (Table: 1) Letter Grades:

- (i) A Letter Grade shall signify the level of qualitative/quantitative academic achievement of a student in a Course, while the Grade Point shall indicate the numerical weight of the Letter Grade on a 10-point scale.
- (ii) There shall be 08 (eight) Letter Grades bearing specific Grade Points as listed in Table 1, where the Letter Grades ‘O’ to ‘P’ shall indicate successful completion of a course.
- (iii) Apart from the 08 (eight) regular Letter Grades listed in Table 1, there shall be 03 (three) additional Letter Grades, which shall be awarded if a Course is withdrawn or spanned over the next Semester or remains incomplete as stated in Table 2.

**Table 2: Letter Grades and Grade Points**

Letter Grade	Grade Points	Description
O	10	Outstanding
A+	9	Excellent
A	8	Very Good
B+	7	Good
B	6	Above Average
C	5	Average
P	4	Pass
F	0	Fail
Abs	0	Absent
UFM	0	Unfair Means

**iv. Grade Point Average:**

**a. SGPA (Semester Grade Point Average)**

The SGPA of a student in a Semester shall be the weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered in that Semester, irrespective of whether he/she could or could not complete the Courses. More specifically, the calculation of SGPA shall take into account the

Courses graded with Letter Grades ‘O’ to ‘F’ as given in Table 1.

$$SGPA = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i} \quad (1.1)$$

The SGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.1) up to two decimal places, where n is the total number of Credit Courses registered by the student in that Semester,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  registered Course and  $C_i$  is the Credit (weight) of that Course.

### **b. CGPA (Cumulative Grade Point Average)**

(i) The CGPA of a student in a Semester of a Programme shall be the accumulated weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered and successfully completed so far starting from the enrollment in the Programme. In other words, taking into account all the Courses graded with ‘O’ to ‘P’ as given in Table 1.1, generally the CGPA of a student shall be calculated starting from the first Semester of his/her enrolled Programme, while the CGPA of a lateral-entry student shall be calculated starting from the Semester of his/her enrollment.

(ii) The CGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.2) up to two decimal places, where N is the total number of Credit Courses registered and successfully completed so far by the student,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  completed Course and  $C_i$  is the Credit (weight) of that Course.

$$CGPA = \frac{\sum_{i=1}^N C_i G_i}{\sum_{i=1}^N C_i} \quad (1.2)$$

(iii) The CGPA shall be convertible into equivalent percentage of marks using Equation Conversion of CGPA to percentage marks: = CGPA\*10

## **D. Post-Examination**

### **i. Transcript or Grade Card or Certificate:**

A marking certificate shall be issued to all the registered students after every Semester. The Semester mark sheet will display the course details (code, title, number of credits, grade secured) along with total credit earned in that Semester.

### **ii. Grievance Readdress Mechanism:**

Students with any dissatisfaction or grievance regarding the marks awarded in any of the Papers / Courses may appeal to the Controller of Examinations for remedial action such as Re-evaluation within 10 days of the declaration of result.

- (i) A student has options to appeal for re-evaluation of his /her answer script to the Controller of Examination.
- (ii) Application for re-evaluation / re-scrutiny of answer scripts shall be made in the definite proforma available with the Examination Office through the head of the respective departments within 10 days of declaration of the results of the respective examinations.
- (iii) The Controller of Examination may appoint an examiner for re-evaluation and will consider and recognize the evaluation done by a University appointed examiner.
- (iv) There shall be no provision for re-evaluation of the Practical Papers, Project Work, and Dissertation etc. However, the students fail in practical examination or viva voce and wish to appear again may apply to be evaluated can do so with the next schedule.
- (v) After screening the application for re-evaluation, the CoE may send the answer scripts of the student to the examiners appointed by the CoE with the approval of Vice Chancellor.
- (vi) The marks/grades achieved by the students after the re-evaluation shall be final and binding.

- (vii) Fresh Marks – sheets / Grade Card shall be issued only if the candidate secures pass marks / passing grade in the re-evaluated paper.
- (viii) Revaluation of answer scripts shall be deemed to be an additional facility provided to the students with a view to improving upon their results at the preceding examination result for any reason whatsoever shall not confer any right upon them for admission to next higher class which matters always be regulated in accordance with the relevant rules or regulations framed by the University.
- (ix) If as a result of revaluation of the candidate attracts the provision of condonation of deficiency, the same may be applied to his/her only for fresh attempt.

# INSTRUCTION TO TEACHERS AND STUDENTS

## (Teaching and Learning Methods)

In all the courses the teacher has to select topics for teacher-method which should not be less than 20 percent. The approach will be direct classroom teaching through a series of lectures delivering concepts using ITC facilities, white or blackboard. Notes may also be circulated to the students; however, the students are to be involved in the preparation of the notes. The teacher will be responsible for selecting the best note for circulation. The teacher-centric methodology has recently fallen out of favour because this strategy for teaching is seen to favour passive students.

### **1. Student- centric / Constructivist Approach:**

The topics of the courses may be selected at the start of the class and assigned one topic to each of the students for studying by themselves, prepare presentations, notes, etc., and present at respective class time after consultation and discussion with the course teachers. The teacher facilitates the learning of the students by guiding and providing input and explaining concepts. 60 percent of the course contents may be selected for this purpose. To avoid behaviour problems, teachers must lay a lot of groundwork in student-centric classrooms. Typically, it involves instilling a sense of responsibility in students. In addition, students must learn internal motivation.

**a. Project-Based Learning:** The teacher may select 5 percent of topics for the purpose and may conduct visits to the laboratory for experiments or field surveys. The selection of the topic may be done considering the available facility for the purpose. However, in the final semester of each of the programme the student has to undergo project-based learning at least 4 months duration. This approach will help the student to think critically, evaluate, analyze, make decisions, collaborate, and more.

**b. Inquiry-Based Learning:** The teacher/ students are supposed to list at least five questions in each contact hour and student solve these question or search for answer which becomes the home work for the students “question-driven” learning approach. The teacher may look for the correctness of the solution or the best possible answer and



discuss in the successive class. This will help in the preparation for various competitive examination and develop a habit for search for solutions.

**c. Flipped Classroom:** About 10 percent of the course content has to be completed by this method. In this approach the students are asked to watch video or lecture prepared by the teacher or any video available (relevant to the course). A set of questions may be given to the students for searching answers by the students. The idea is that students should have more time in-classroom focusing on achieving these higher levels of thinking and learning. The Flipped classroom is also an acronym. The letters FLIP represent the four pillars included in this type of learning: Flexible environment, Learning culture shift, Intentional content, and Professional educator. As you can see, the second pillar refers to a culture shift from the traditional approach where students are more passive to an approach where students are active participants. As a result, this approach is also a student- centric teaching method.

**d. Cooperative Learning:** The remaining five percent has to be completed by cooperative learning approach. In this approach, the students are allotted problems. During library hours the students along with the teacher visit the library and search for probable solutions for the assigned problem. The same has to be done in groups so that the students discuss among themselves for the appropriate answers. Essentially, cooperative learning believes that social interactions can improve learning. In addition, the approach recreates real-world work situations in which collaboration and cooperation are required.

### **The percentage categorization for the completion of a theory course**

Teacher-centric or Direct Classroom Teaching: Delivery by series of lectures	20%
Student-centric Approach, Students present and deliver lectures in the presence of teacher and supervised by teacher	60%
Students visit fields or perform experiments or teachers perform demonstration	05%
Flipped Classroom approach	10%
Cooperative learning approach	05%

**Inquiry-based approach has to be followed in all of the classes**

The teacher has to distribute the topics to be considered for teaching by the above-mentioned approaches and prepare a lesson plan for execution and maintain a file.

## Curriculum Framework

### Breakdown of Credits

Sl. No	Category	Total number of Credits
1	University Core (UC)	13
2	University Elective (UE)	12
3	Program Core (PC)	52
4	Program Elective (PE)	8
5	Faculty Elective (FE)	9
<b>Total number of credit</b>		<b>94</b>

### Breakdown by categories of Courses

Sl no	Category	Credits	%
1	Science	86	92%
2	Engineering	1	1%
3	Humanities and Management	7	7%
<b>Total</b>		<b>94</b>	<b>100%</b>

## SEMESTER WISE COURSE DISTRIBUTION

Semester I	S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
					L	T	P	S	R	O		IA*	SEE*	PE*	
	1.	22MSFD111R	Macronutrients	PC	3	0	0	0	0	0	3	40	60	0	100
	2	22MSFD112R	Human Physiology	PC	3	0	0	0	0	0	3	40	60	0	100
	3	22MSFD113R	Nutritional Biochemistry I	PC	3	0	0	0	0	0	3	40	60	0	100
	4	22MSFD114R	Advance Food Science	PC	3	0	2	0	0	0	3+1	40	60	100	200
	5	22MSCE111R	MOOCS-CE I	FE	0	0	4	0	0	0	2	0	0	100	100
	6	22UMFS111R	Fundamental of Statistics	UC	2	0	2	0	0	0	3	40	60	100	200
	7	22MSFD115R	Mini Research(R1)	UC	0	0	0	4	8	0	2	0	0	0	100
	8	22UMPD111R	Effective English	UE	0	0	4	0	0	0	2	0	0	0	100
	<b>Total</b>										<b>22</b>				
Semester II	S. No.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
					L	T	P	S	R	O		IA*	SEE*	PE*	
	1.	22MSFD121R	Micronutrients	PC	3	0	0	0	0	0	3	40	60	0	100
	2	22MSFD122R	Nutritional Biochemistry II	PC	3	0	2	0	0	0	3+1	40	60	100	200
	3	22MSFD123R	Public Nutrition	PC	3	0	2	0	0	0	3+1	40	60	100	200
	4	22MSFD124R	Food Microbiology and Food Safety	PC	3	0	0	0	0	0	3	40	60	0	100
	5	22MSFD125R	Packaging Technology	PC	0	0	2	0	0	0	1	0	0	100	100
	6	22UMPD121R	Communication Mastery	UE	0	0	4	0	0	0	2	0	0	0	100
	7	22MSFD126R	Generic electric	UE	2	0	0	0	0	0	2	40	60	0	100
	8	22UUHV101R	Universal human Values	UC	0	0	0	4	0	0	1	0	0	0	100
	9	22UMRM121R	Research Methodology and Statistical Analysis	UC	1	0	0	4	0	0	2	40	60	0	200
	10	22MSCE121R	Moocs-CE II	FE	0	4	0	0	0	0	2	0	0	0	100
	11	22MSFD127R	Mini Research(R2)	PC	0	0	0	4	16	0	3	0	0	0	100
	12	22UUDL1103R	Computational System and Digital Literacy	UE	0	0	2	0	0	0	4	0	0	0	100
	<b>Total</b>										<b>27</b>				<b>1000</b>

S. No.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1.	22UMPD211R	Corporate Proficiency	UE	0	0	4	0	0	0	2	0	0	0	100
2	22MSFD211R	Advance Nutrition	PC	2	0	0	0	0	0	2	40	60	0	100
3	22MSFD212R	Product Development and Marketing	PC	0	0	2	0	0	0	1	40	60	0	100
4	22MSFDCE211R	MOOCS-III	FE	0	0	4	0	0	0	2	0	100	0	100
5	22MSFDCE212R	MOOCS-IV	FE	0	0	4	0	0	0	2	0	100	0	100
6	22UMRE211R	Research Ethics	UC	1	0	0	0	0	0	1	0	0	0	100
7	22MSFD213R	Mini Research (Survey/Experiments -R3)	PC	0	0	6	4	0	0	4	0	0	100	100
8	22MSFD214R	Generic elective	UE	2	0	0	0	0	0	2	40	60	0	50
9	22UUFL202R	Personal Financial Planning	UC	0	0	2	0	0	0	1	0	0	100	100
<b>Group I</b>														
10	22MSFD215R	Applied Nutrition I	PE	3	0	2	0	0	0	3+1	40	60	100	200
11	22MSFD216R	Clinical Nutrition I	PE	3	0	2	0	0	0	3+1	40	60	100	200
<b>Group II</b>														
	22MSFD217R	Applied Nutrition II	PE	3	0	2	0	0	0	3+1	40	60	100	200
	22MSFD218R	Clinical Nutrition II	PE	3	0	2	0	0	0	3+1	40	60	100	200
<b>Total</b>										<b>24</b>				

S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1.	22MSFD221R	Internship	PC	0	0	0	24	0	0	6	0	0	100	100
2	22MSFD222R	Research/Data Analysis/Documentation-R4	PC	0	0	20	4	6	0	12	40	60	0	100
3	22MSFDCE221R	MOOCS-V	FE	3	0	0	0	0	0	3	40	60	0	100
<b>Total</b>										<b>21</b>				

SEMESTER – I									
Course Title	MACRONUTRIENT								
Course code	22MSFD121R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 45T	3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. To introduce the students to the basics of nutrition. 2. To study the basic food groups, cooking methods in details. 3. To learn the new concept of nutrients								
CO1	Acquire knowledge on different macronutrient.								
CO2	Learn about different macronutrient deficiency and the related causes								
CO3	Understand the program and policies in connection to food and health								
CO4	Understand body composition and recommended dietary allowances for different age groups								
CO5	Gain knowledge on the sources of different nutrients.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Introduction to Nutrition Science</b> - Definitions, history, and nutrition research in India. Methods of determining human nutrient needs and Description of basic terms and concepts in relation to human nutritional requirements. <b>Guidelines and Recommendations</b> - Recommended Dietary Allowances, factors affecting RDA, methods used to derive RDA, determination of RDA for different nutrients, requirements and allowances. <b>Body Composition</b> - Significance of body composition and changes through the life cycle. Methods for assessing body composition (both classical and recent) and their applications. Energy - Components of energy requirements: BMR, RMR, thermic effect of feeding, physical activity. Factors affecting energy requirements, methods of Measuring energy expenditure.	10	Learn about Understand body composition and recommended dietary allowances for different age groups changes through the life cycle.				1,2		
II	Estimating energy requirements of individuals and groups. Regulation of energy metabolism and body weight: Control of food intake – role of leptin and other hormones	7	Estimating energy requirements of individuals and groups.				1,2		
III	<b>Carbohydrates</b> - Review of nutritional significance of carbohydrates and changing trends in dietary intake of different types of	10	Understand nutritional significance of carbohydrates				1,2		

	carbohydrates and their implications. <b>Dietary fibre:</b> Types, sources, role and mechanism of action. Resistant starch, fructo-oligosaccharides, other oligosaccharides: Chemical composition and physiological significance. Glycemic Index and glycemic load. Deficiency and excess of carbohydrates, its relation to human health.			
<b>IV</b>	<b>Proteins</b> – Metabolism of Protein, overview of role of muscle, liver and G.I. tract in protein metabolism, Nutritional requirements. <b>Amino acid</b> – Essential and Non-essential of amino acids, therapeutic applications of specific amino acids, Peptides of physiological significance. Proteins and Applied Aspects: Protein Quality.	<b>9</b>	Understand nutritional significance of Protein	1,2
<b>V</b>	<b>Lipids</b> – Metabolism of fat, Nutritional significance of fatty acids – SFA, MUFA, PUFA: functions and deficiency. Role of n-3 and n-6 fatty acids. Prostaglandins and trans Fatty	<b>9</b>	Understand nutritional significance of Lipid	1,2

#### TEXT BOOKS:

T1: Shils, M.E. ;Olson, J.; Shike, M. and Roos, C. (1998): Modern Nutrition in Health and Disease. 9th edition. Williams and Williams. A Beverly Co. London.

#### REFERENCE BOOKS:

R1: Annual Reviews of Nutrition. Annual Review Inc, California, USA.

R2: Bodwell, C.E. and Erdman, J.W. (1988) Nutrient Interactions. Marcel Dekker Inc. NewYork

R3: Sumathi, R., Mudambi, Rajagopal, M.V. (1997) Fundamentals of Foods and Nutrition, New Age International (P) Ltd, Publishers, Third edition.

R4: Bamji, M. S.,(2009)Textbook of Human Nutrition, Oxford, IBH Publishing (P) Ltd,2009.

#### OTHER LEARNING RESOURCES:

SWAYAM, Coursera, Research articles

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
<b>1</b>	Acquire knowledge on different macronutrient.	<b>1,2</b>

<b>2</b>	Learn about different macronutrient deficiency and the related causes	<b>1,2,4</b>
<b>3</b>	Understand the program and policies in connection to food and health	<b>1,2,4</b>
<b>4</b>	Understand body composition and recommended dietary allowances for different age groups	<b>1,2</b>
<b>5</b>	Gain knowledge on the sources of different nutrients.	<b>1,2</b>

<b>SEMESTER – I</b>									
<b>Course Title</b>	<b>HUMAN PHYSIOLOGY</b>								
<b>Course code</b>	22MSFD112R	<b>Total credits: 3</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>



		<b>Total hours: 45T</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Master of Science in Food Nutrition and Dietetics</b>								
<b>Semester</b>	<b>Fall/ I semester of first year of the programme</b>								
<b>Course Objectives (Minimum 3)</b>	1. To introduce the students the basics of human physiology. 2. To understand how the various physiological function of different parts of the body and there metabolism.								
<b>CO1</b>	Understand the basics of human physiology								
<b>CO2</b>	Understand the functioning of the various parts of the body and the nutrient uptake from the food								
<b>CO3</b>	Provide knowledge on the rheological properties, its measurement and its application to food								
<b>CO4</b>	Gain knowledge on general organization, structure and properties of all the systems in our body								
<b>CO5</b>	Understand and apply the knowledge of exercise on health								
<b>Unit-No.</b>	<b>Content</b>	<b>Contact Hour</b>	<b>Learning Outcome</b>					<b>KL</b>	
<b>I</b>	<b>General Physiology:</b> Organization of human body, cell structure and organelle, Tissues and functions.	<b>6</b>	Understand basic organization of human body					1,2	
<b>II</b>	<b>Blood:</b> Blood volume and body fluids, Composition and functions of blood, Structure and formation and function of RBC, WBC and platelets, Haemoglobin, Plasma, blood coagulation, Blood groups	<b>7</b>	Learn about structure, composition and functions of blood					1,2	
<b>III</b>	<b>Digestive System:</b> General introduction, organizational plan of digestive system, Movement of G.I. Tract and functions of various components, Composition, functions and regulation of salivary, gastric, pancreatic, intestinal and biliary secretion, Functions of liver, gall bladder and pancreas, Digestion and Absorption of carbohydrate, protein and fat.	<b>10</b>	Learn about Digestive System					1,2	
<b>IV</b>	<b>Respiratory System:</b> General organization, Mechanics of respiration, Regulation of respiration, Gaseous exchange in lunge and tissues, Pulmonary ventilation, volumes and capacities, Effect of exercise on respiration, hypoxia.	<b>10</b>	Learn about Respiratory System					1,2	
<b>V</b>	<b>Cardiovascular system:</b> General organization, structure and properties of cardiac muscles, Cardiac output, cardiac cycle, conducting system of heart, Heart sounds, regulation of H.R., pulse, blood pressure and its regulation, Systemic circulation, pulmonary circulation and coronary circulation, ECG, cardio respiratory Changes during exercise.	<b>12</b>	Learn about Cardiovascular System					1,2	

**TEXT BOOKS:**

**T1: Meyer B J, Meij H S and Meyer AC.**, Human Physiology, AITBS Publishers and Distributors

**T2: Wilson, K. J. W and Waugh, A.** (1996): Rossand Wilson, Anatomy and Physiology in Health and Illness, 8<sup>th</sup> Edition, Churchill Livingstone

**REFERENCE BOOKS:**

**R1: Ranganathan,T.S.**(2004): A Textbook of Human Anatomy, Chand and Co. N.Delhi.

**R2: Jain, A.K.**, Textbook of Physiology, Vol.I and II, Avichal Publishing Co., New Delhi.

**R3: Chatterjee C.C.** (1987): Human Physiology, Vol.I and II, Medical Allied Agency, Calcutta

**OTHER LEARNING RESOURCES:**

SWAYAM, Coursera, Research articles

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the basics of human physiology	<b>1,2</b>
<b>2</b>	Understand the functioning of the various parts of the body and the nutrient uptake from the food	<b>1,2</b>
<b>3</b>	Provide knowledge on the rheological properties, its measurement and its application to food	<b>1,2</b>
<b>4</b>	Gain knowledge on general organization, structure and properties of all the systems in our body	<b>1,2</b>
<b>5</b>	Understand and apply the knowledge of exercise on health	<b>1,2</b>

<b>SEMESTER – I</b>									
<b>Course Title</b>	<b>NUTRITIONAL BIOCHEMISTRY-I</b>								
<b>Course code</b>	<b>22MSFD113R</b>	<b>Total credits: 4</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
		<b>Total hours: 45T</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Master of Science in Food Nutrition and Dietetics</b>								
<b>Semester</b>	<b>Fall/ I semester of first year of the programme</b>								

<b>Course Objectives (Minimum 3)</b>	1.To review about the different biochemical metabolism reaction of the body. 2.To understand how this metabolism takes place in correlation with the nutrients of the			
<b>CO1</b>	Understand the basics metabolic reaction of the body.			
<b>CO2</b>	Give a clear picture of the biochemical Parameters of the body in normal and disease condition.			
<b>CO3</b>	Understand the concept of solutions of solid in liquid and liquid in liquid and the properties related to the concentration of solute.			
<b>CO4</b>	Learn about different pathways involved in nutrient metabolism			
<b>CO5</b>	Learn about fluid and electrolyte balance			
<b>Unit- No.</b>	<b>Content</b>	<b>Contact Hour</b>	<b>Learning Outcome</b>	<b>KL</b>
<b>I</b>	<b>Carbohydrates-</b> Definition, classification. Structure (linear) of Monosaccharide- Glucose, fructose and galactose; Disaccharides- Maltose, lactose and sucrose; Polysaccharides- Starch and glycogen. Metabolism- Glycolytic pathway, electron transport chain and oxidative phosphorylation. Metabolism of carbohydrates: glycolysis and tricarboxylic Acid (TCA) cycle, HMP shunt.	<b>9</b>	Learn about Metabolism of carbohydrates	1,2
<b>II</b>	<b>Protein-</b> Definition, classification, structure, physical properties, chemical properties and utilization. Metabolism of proteins:- Transamination, deamination, decarboxylation, urea cycle. Enzymes and co-enzymes- Definition, types, classification and factors affecting velocity of enzyme catalyzed reactions. diagnostic value of serum enzymes - Creatinine kinase, Alkaline phosphatase, Acid phosphatase, LDH, SGOT, SGPT, Amylase, Lipase, Carbonic anhydrase etc.	<b>10</b>	Learn about Metabolism of protein	1,2
<b>III</b>	<b>Lipids-</b> Definition, classification and properties. Metabolism- Oxidation and biosynthesis of fatty acids. Ketone bodies, ketogenesis and ketosis.	<b>7</b>	Learn about Metabolism of lipid	1,2
<b>IV</b>	<b>Acid – base balance-</b> Acid-base balance in normal health, definition of buffers, principles of buffers, major sources of acid produced in the body, physiological buffer system and role of different buffer systems. <b>Fluid and electrolyte balance-</b> Distribution of fluids in the body, ECF, ICF, Water metabolism, Dehydration Maintenance in normal health.	<b>10</b>	Learn about acid base balance and Fluid and electrolyte balance	1,2
<b>V</b>	<b>Hormones -</b> Classification, general mode of action, hormones of Pituitary, Thyroid, Parathyroid, Adrenals, Reproductive Glands, Pancreas, hormonal disorders, counter regulatory hormones.	<b>9</b>	Learn about general function of hormones	1,2

**TEXT BOOKS:**

T1: **Deb.A. C.**, Fundamental of Biochemistry, New Central Book Agency (P) Ltd, reprint 2004

**REFERENCE BOOKS:**

R1: **Pattabiraman. T. N.** Concise text Book of Bio-Chemistry, 2<sup>nd</sup> edition, All India Publishers and Distributors, Regd., 1998.

R2: **Ambika Shanmugam**, Fundamentals of biochemistry for Medical students, Karthik Printers, 7<sup>th</sup> edition, 1992.

**OTHER LEARNING RESOURCES:**

SWAYAM, Coursera, Research articles

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the basics metabolic reaction of the body.	<b>1,2,</b>
<b>2</b>	Give a clear picture of the biochemical Parameters of the body in normal and disease condition.	<b>1,2</b>
<b>3</b>	Understand the concept of solutions of solid in liquid and liquid in liquid and the properties related to the concentration of solute.	<b>1,2,3</b>
<b>4</b>	Learn about different pathways involved in nutrient metabolism	<b>1</b>
<b>5</b>	Learn about fluid and electrolyte balance	<b>1,2</b>

<b>SEMESTER – I</b>									
<b>Course Title</b>	<b>ADVANCE FOOD SCIENCE</b>								
<b>Course code</b>	<b>22MSFD114R</b>	<b>Total credits: 4</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
		<b>Total hours: 45T+30P</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Master of Science in Food Nutrition and Dietetics</b>								
<b>Semester</b>	<b>Fall/ I semester of first year of the programme</b>								
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To study different food group and their component</li> <li>To study physical and chemical properties of food</li> </ol>								

<b>(Minimum 3)</b>				
<b>CO1</b>	Introduce student to advance food science and function of different kinds of foods, its composition and classification			
<b>CO2</b>	Apply the knowledge of toxic components in legumes and other food items			
<b>CO3</b>	Understand and apply the knowledge of food nutrient by selecting foods from different food groups in planning of diet.			
<b>CO4</b>	Gain home scale processing and storage skills to retain nutrients			
<b>CO5</b>	Develop culinary skills to satisfy sensory and nutrient needs			
<b>Unit- No.</b>	<b>Content</b>	<b>Contact Hour</b>	<b>Learning Outcome</b>	<b>KL</b>
<b>I</b>	Cereals chemistry: Structure, composition, nutritive value of cereals, storage and care, breakfast cereals, Characteristics of starch, use in variety of preparations Pulse chemistry: Chemical composition, Selection and variety, use in variety of preparation, nutritional aspects and cost, effect of cooking & storage on nutritive value of pulses. Toxic constituents of pulses, Lathyrism.	<b>10</b>	To learn about structure, composition and nutritive value of cereals and pulses	1,2
<b>II</b>	Milk & Milk Products: Composition & nutritive value, physical properties and effect of heat, nutritional importance. Milk Processing, Milk products, Substitutes, Role of milk in cookery.	<b>7</b>	To learn about composition and nutritive value of milk	1,2
<b>III</b>	Poultry & Fish: Composition & nutritive value, selection and storage, indication of freshness Meat: Sources of edible meat, composition & nutritive value, selection of meat, postmortem changes, changes on cooking, storage, factors effecting tenderness of meat. Egg- Structure, composition, nutritive value, tasting of freshness in eggs, uses of egg in food preparation, storage of egg Baking - Types of bake products & its nutritive value	<b>10</b>	To learn about types, composition and nutritive value of Poultry & Fish	1,2
<b>IV</b>	Vegetables & Fruits- Classification, composition & nutritive value, importance in human nutrition, storage, cooking of vegetables, changes in vegetables and fruits on cooking, effects of heat, acids & alkali. Phytonutrients in fruits and vegetables Spices and Condiments: Types, uses in Indian recipe Beverages: Coffee, tea, and cocoa, processing composition and preparation	<b>10</b>	To learn about types, composition and nutritive value of vegetables and fruits	1,2
<b>V</b>	Nuts & oilseeds, Nutritive value of commonly used nuts & oil seeds in our diet, Fats & Oils- Nutritive values, types of fats & oils, role of fat in cookery.	<b>8</b>	To learn about types, composition and nutritive value of Nuts & oilseeds	1,2

	Sugar and Related Products: Nutritive value, Properties, characteristics & uses, sugar cookery, Form of sugar and liquid sweetness, Caramelization, Hydrolysis, Crystallization.			
<b>VI</b>	<ol style="list-style-type: none"> <li>1. Standardization of Cereal and pulses recipe and determine the nutritive value</li> <li>2. Standardization of egg, meat and product recipe and determine the nutritive value</li> <li>3. Standardization of vegetables, spices and fats and oil recipe and determine the nutritive value</li> <li>4. Market survey on different types of cereals and pulse(s)</li> <li>5. Market survey on different types of meat and milk products</li> </ol>	<b>45</b>	To apply theoretical knowledge	1,2, 3,4

### TEXT BOOKS:

T1: **Norman N. Potter and Joseph H. Hotchkiss**, Food Science, CBS publishers and distributors, Fifth edition, 2000

### REFERENCE BOOKS:

R1: **Manay Shakunthala, Nand Shadaksharaswamy M.** Foods facts and Principles, New Age International (P) Ltd Publishers, Reprint 2005.

R2: **Srilakshmi B.** Food Science, New Age International (P) Ltd Publishers, Third edition, 2005.

### OTHER LEARNING RESOURCES:

SWAYAM, Coursera, Research articles

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Introduce student to advance food science and function of different kinds of foods, its composition and classification	<b>1,2</b>
<b>2</b>	Apply the knowledge of toxic components in legumes and other food items	<b>1,2</b>
<b>3</b>	Understand and apply the knowledge of food nutrient by selecting foods from different food groups in planning of diet.	<b>1,2,4</b>
<b>4</b>	Gain home scale processing and storage skills to retain nutrients	<b>1,2</b>
<b>5</b>	Develop culinary skills to satisfy sensory and nutrient needs	<b>1,2,7</b>

**SEMESTER – I**

<b>SEMESTER – I</b>									
<b>Course Title</b>	<b>FUNDAMENTAL OF STATISTICS</b>								
<b>Course code</b>	<b>22MSFD121R</b>	<b>Total credits: 3</b> <b>Total hours: 45T</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
			<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Master of Science in Food Nutrition and Dietetics</b>								
<b>Semester</b>	<b>Fall/ I semester of first year of the programme</b>								
<b>Course Objectives (Minimum 3)</b>	<ol style="list-style-type: none"><li>1. Help to understand the role of statistics in data analysis, decision-making, and scientific research</li><li>2. Introduce students to descriptive statistics, including measures of central tendency (mean,</li></ol>								

	median, mode) and measures of dispersion (range, variance, standard deviation). 3. Teach students how to summarize and present data effectively using tables, charts, and graphs			
<b>CO1</b>	1. Improve understanding of Descriptive Statistics and Demography.			
<b>CO2</b>	2. Develop knowledge to understand the Probability theory, Distribution, and sampling methods.			
<b>CO3</b>	3. Develop knowledge to understand the methods for hypothesis testing and biological data analysis.			
<b>CO4</b>	4. Develop knowledge to understand the principles of various statistical analyses of data.			
<b>CO5</b>	5. Develop knowledge on R language for data analysis			
<b>Unit-No.</b>	<b>Content</b>	<b>Contact Hour</b>	<b>Learning Outcome</b>	<b>KL</b>
<b>I</b>	Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio.	5	Foundational Understanding of Statistical Concepts	1,2
<b>II</b>	Presentation: tabular and graphical, including histogram and ogives. Measures of Central Tendency: mathematical and positional. Measures  Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, skewness and kurtosis	5	Proficiency in Data Presentation and Analysis	1,2
<b>III</b>	Bivariate data: Definition scatter diagram, simple, partial and multiple correlation (3 variable only), rank correlation, simple linear regression, fitting of polynomials and exponential curves	5	Knowledge on Analyzing Bivariate Data and Relationships	1,2
<b>IV</b>	Random experiment: trial, sample point and sample space, event, Operations of Events, concepts of mutually exclusive and exhaustive events. Definition of probability: classical and relative frequency approach. Discrete probability space, Properties of probability, Independence of events, Conditional probability, total and compound  Probability rules, Normal probability Distribution, Binomial probability Distribution, Poisson Probability Distribution, Bayes' theorem and its applications.	8	Understanding of Probability and Distributions	1,2



<b>V</b>	Testing of hypothesis, parametric test: t-test, z-test, chi-square test. Non-Parametric test: One sample Kolmogorov test, wilcoxon Signed test, Mann-Whitney Test, Kruskalwalistest	7	Application of Hypothesis Testing and Statistical Tests	1,2
<b>VI</b>	<p>1. Introduction to R - A programming language and environment for data analysis and graphics. Syntax of R expressions: Vectors and assignment, vector arithmetic, generating regular sequence, logical vector, character vectors, Index vectors; selecting and modifying subsets of data set</p> <p>2. Data objects: Basic data objects, matrices, partition of matrices, arrays, lists, creating and using these objects; Functions-Elementary functions and summary functions, applying functions to subsets of data. Data frames: The benefits of data frames, creating data frames, combining data frames, Adding new classes of variables to data frames; Data frame attributes. matrices, partition of matrices, arrays, lists, creating and using these objects; Functions-Elementary functions and summary functions, applying functions to subsets of data. Data frames: The benefits of data frames, creating data frames, combining data frames, Adding new classes of variables to data frames; Data frame attributes.</p> <p>3. Importing data files: import. Data function, read. Table function; Exporting data: export. data function, cat, write, and write. table functions, function, formatting output - options, and format functions; Exporting graphs -export. graph function. Graphics in R:creating graphs using plot function, box plot, histogram, line plot, steam and leaf plot, pie chart, bar chart, multiple plot layout, plot titles, formatting plot axes; Visualizing the multi variate data: Scatterplot, Q-Qplot,P-Pplot.</p> <p>4. Performing data analysis tasks: Reading data with scan function, Exploring data using graphical tools, computing descriptive statistics, one sample tests, two sample tests, Goodness of fit tests.</p>	30	A brief knowledge on using R for data analysis and visualization	1,2, 3,4

	5.Parametric test and Non-Parametric test			
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**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Improve understanding of Descriptive Statistics and Demography.	<b>1, 3, 4</b>
<b>2</b>	Develop knowledge to understand the Probability theory, Distribution, and sampling methods.	<b>1, 4</b>
<b>3</b>	Develop knowledge to understand the methods for hypothesis testing and Biological data analysis.	<b>1, 4</b>
<b>4</b>	Develop knowledge to understand the principles of various statistical analyses of data.	<b>1, 4</b>
<b>5</b>	Develop knowledge on R language for data analysis	<b>1, 4, 9</b>

Mapping Table Missing

<b>SEMESTER – I</b>									
<b>Course Title</b>	<b>EFFECTIVE ENGLISH (Communicative English &amp; Soft Skills)</b>								
<b>Course code</b>	<b>22UMPD111R</b>	<b>Total credits: 2</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
		<b>Total hours: 30T</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Master of Science in Food Nutrition and Dietetics</b>								
<b>Semester</b>	<b>Fall/ I semester of first year of the programme</b>								
<b>Course Objectives</b>	1. To introduce the types of sentences and their significance.								

<b>(Minimum 3)</b>	<ol style="list-style-type: none"> <li>2. To strengthen the students' vocabulary to enhance their speaking and writing skills.</li> <li>3. To familiarize the students with the importance of dress codes in various organizations.</li> <li>4. To introduce the 3P's (Planning, prioritizing &amp; performing) of Time Management.</li> <li>5. To give insight into English pronunciation and into central concepts in phonetics.</li> </ol>
<b>CO1</b>	This course will enable students to analysis and identify the different types of sentences.
<b>CO2</b>	Learners will be able to integrate the skills of reading and speaking in professional communication.
<b>CO3</b>	Dress code Etiquette sessions will boosts their confidence and morals.
<b>CO4</b>	Students will earn about the effective and efficient utilization of time.
<b>CO5</b>	Introduction to Phonetics and its importance will improve the learners' pronunciation
<b>Modules</b>	<p>Module 1- Grammar</p> <ol style="list-style-type: none"> <li>i. Interchange of Interrogative and Assertive Sentences, Exclamatory and Assertive Sentences</li> <li>ii. Types of Tenses</li> <li>iii. Common Errors</li> <li>iv. Synonyms</li> <li>v. Antonyms</li> <li>vi. Homonyms</li> </ol> <p>Module 2- Reading Skills</p> <ol style="list-style-type: none"> <li>i. Techniques of Effective Reading</li> <li>ii. Gathering ideas and information from a text The SQ3R Technique Interpret the text</li> </ol> <p>Module 3-Listening Skills</p> <ol style="list-style-type: none"> <li>i. What is listening?</li> <li>ii. The Process of Listening</li> <li>iii. Factors that adversely affect Listening</li> <li>iv. Difference between Listening and Hearing,</li> <li>v. Purpose and Importance of Effective Listening</li> <li>vi. How to Improve Listening Process,</li> </ol> <p>Module 4- Conflict Management</p> <ol style="list-style-type: none"> <li>i. Definition</li> <li>ii. Type of Conflict Management</li> <li>iii. Effects of Conflict Management</li> <li>iv. Methods to deal with Conflicts (Negative)</li> </ol> <p>Module 5- Time-Management Skills</p> <ol style="list-style-type: none"> <li>i. Introduction To Time Management,</li> <li>ii. Purpose And Importance of Time Management,</li> <li>iii. Basic Tips to Maintain Time.</li> </ol> <p>Activity: Problem solving activity: A situation will be given to the students and they will have to tell us how to handle the situation or solve the problem.</p>
<b>II</b>	<p><b>Module1-Grammar</b></p> <ol style="list-style-type: none"> <li>I. Interchange of Interrogative and Assertive Sentences, Exclamatory and Assertive Sentences</li> <li>II. Types of Tenses       <ol style="list-style-type: none"> <li>III. Common Errors</li> <li>IV. Synonyms</li> <li>V. Antonyms</li> <li>VI. Homonyms</li> </ol> </li> </ol> <p><b>Module 2- Reading Skills</b></p> <ol style="list-style-type: none"> <li>i. Techniques of Effective Reading</li> </ol>

	<p>Gathering ideas and information from a text The SQ3R Technique Interpret the text</p> <p><b>Module 3 – Listening Skills</b></p> <ol style="list-style-type: none"> <li>i. What is listening?</li> <li>ii. The Process of Listening</li> <li>iii. Factors that adversely affect Listening</li> <li>iv. Difference between Listening and Hearing,</li> <li>v. Purpose and Importance of Effective Listening</li> <li>vi. How to Improve Listening Process,</li> </ol> <p><b>Module 4- Conflict Management</b></p> <ol style="list-style-type: none"> <li>i. Definition</li> <li>ii. Type of Conflict Management</li> <li>iii. Effects of Conflict Management</li> <li>iv. Methods to deal with Conflicts (Negative)</li> </ol> <p><b>Module 5- Time-Management Skills</b></p> <ol style="list-style-type: none"> <li>i. Introduction To Time Management,</li> <li>ii. Purpose And Importance of Time Management,</li> <li>iii. Basic Tips to Maintain Time.</li> </ol> <p>Activity: Problem solving activity: A situation will be given to the students and they will have to tell us how to handle the situation or solve the problem.</p>
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**TEXT BOOKS:**

T1: Wren,P.C and Martin,H.1995. *High School English Grammar and Composition*, SChand Publishing.

T2: *English Grammar in Use*, Raymond Murphy 4thedition, CUP.

T3: Barrett, Grant. 2016. *Perfect English Grammar: The Indispensible Guide to Excellent Writing and Speaking*, Zephyros Press.

**REFERENCE BOOKS:**

R1: English Vocabulary in Use (Advanced), Michael McCarthy and Felicity, CUP.

R2: Effective Communication and Soft Skills, Nitin Bhatnagar, Pearsons.

**OTHER LEARNING RESOURCES:**

<https://www.classcentral.com/report/toefl-preparation/>

<https://brightlinkprep.com/10-best-toefl-prep-books/>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Analyse and identify the different types of sentences.	<b>1, 4</b>
<b>2</b>	Able to integrate the skills of reading and speaking in professional communication.	<b>1, 4, 7</b>

<b>3</b>	Illustrate code Etiquette sessions will boost their confidence and morals.	<b>4,7,8</b>
<b>4</b>	Describe about the effective and efficient utilization of time.	<b>4,7</b>
<b>5</b>	Explain the concept of Phonetics and its importance will improve the learners 'pronunciation	<b>1, 4,7</b>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>SEMESTER – I</b>									
<b>Course Title</b>	<b>MINI RESEACH (R1)</b>								
<b>Course code</b>	<b>22MSFD115R</b>	<b>Total credits:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
		<b>Total hours:</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
		<b>45T+30P</b>							
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Master of Science in Food Nutrition and Dietetics</b>								
<b>Semester</b>	<b>Fall/ I semester of first year of the programme</b>								

<b>Course Objectives (Minimum 3)</b>	1. Appreciate and understand the importance of importance of various research writing and review. 2. Applying the techniques and skill for writing Abstract, short communications.	
<b>CO1</b>	Develop competence in writing and abstracting skill	
<b>CO2</b>	Learn to write literature and review	
<b>CO3</b>	Develop competence in Project proposal	
<b>CO4</b>	Acquired the knowledge to conduct scientific project	
<b>CO5</b>	Analyze the significant aspect of scientific project	
<b>Unit- No.</b>	<b>Content</b>	<b>KL</b>
<b>I</b>	Introduction, Comprehension on research search engines, Selection of Topic	1,2
<b>II</b>	Tools for reference citation, Different methods for writing citation and references, Introduction to structure of Review and specific features of review, Plagiarism, ethnical issue in writing there view, Mapping and selection of Journal of specific knowledge of discipline and submission for publication.	1,2

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Develop competence in writing and abstracting skill	1,2
2	Learn to write literature and review	1,2
3	Develop competence in Project proposal	1,2
4	Acquired the knowledge to conduct scientific project	1,2,3
5	Analyze the significant aspect of scientific project	1,2,3

SEMESTER – II									
Course Title	MICRONUTRIENT								
Course code	22MSFD121R	Total credits: 3 Total hours: 45T+30P	L 3	T 0	P 0	S 0	R 0	O/F 0	C 3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								

Semester	Spring/ II semester of first year of the Programme			
<b>Course Objectives (Minimum 3)</b>	1. To review the importance of micronutrients and its major metabolic rate 2. To study about the requirements and importance of different micronutrients in different stages of life			
<b>CO1</b>	Acquire knowledge on different micronutrient.			
<b>CO2</b>	Learn about different micronutrient deficiency and the related causes			
<b>CO3</b>	Understand the program and policies in connection to food and health			
<b>CO4</b>	Understand interaction with other nutrients			
<b>CO5</b>	Acquire knowledge on water and electrolyte balance			
Unit- No.	Content	Contact Hour	Learning Outcome	KL
<b>I</b>	<b>Fat Soluble Vitamins(A, D, E and K)</b>  Historical background, Food sources, Metabolism and functions Interaction with other nutrients, Requirements, Deficiency and toxicity.	<b>10</b>	To learn about Fat Soluble Vitamins	1,2
<b>II</b>	<b>Water Soluble Vitamins (B complex and C)</b>  Historical background, Food sources, Metabolism and functions Interaction with other nutrients, Requirements, Deficiency and toxicity.	<b>10</b>	To learn about water Soluble Vitamins	1,2
<b>III</b>	<b>Macro Mineral</b> (a. Calcium and Phosphorus b. Magnesium c. Sodium, d. Potassium, e. Chloride)  Historical background, Food sources, Metabolism and functions, Interaction with other nutrients, Requirements, Deficiency and toxicity.	<b>10</b>	To learn about macro minerals	1,2
<b>IV</b>	<b>Micro Mineral</b> (a. Iron b. Copper c. Manganese d. Iodine e. Fluoride f:Zinc g. Selenium h. Cobalt i. Chromium j Molybdneum)  Historical background, Food sources, Metabolism and functions, Interaction with other nutrients, Requirements, Deficiency and toxicity	<b>7</b>	To learn about micro minerals	1,2
<b>V</b>	<b>Water and Electrolyte Balance</b> -Distribution of body water, ECF/ICF, functions, different electrolytes-their functions, thirst mechanism, water/electrolyte balance, water-Imbalance	<b>8</b>	To learn about water and electrolyte	1,2

### TEXT BOOKS:

**T1: Sumathi R. Mudambi, Rajagopal, M.V.,** Fundamentals of Foods and Nutrition, New Age International (P) Ltd, Publishers, Third edition, 1997.

### REFERENCEBOOK

- R1: Indian Council of Medical Research. Recommended Dietary Intakes for Indians –Latest Recommendations.
- R2: Indian Council of Medical Research. Nutritive Value of Indian Foods -Latest Publication.
- R3: Annual Reviews of Nutrition. Annual Review Inc, California, USA.
- R4: Krause's Food & the Nutrition Care Process (Krause's Food & Nutrition Therapy) Hardcover – Illustrated, 7 July2016.
- R5: **Srilakshmi, B.** Nutrition Science, New Age International (P) Ltd, Publishers,2004.
- R6: **Bamji, M.S.**,Textbook of Human Nutrition, Oxford, IBH Publishing (P) Ltd, 2009.
- R7: WHO Technical Reports series.
- R8:Indian Council of Medical Research. Recommended Dietary Intakes for Indians-Latest Recommendations.

**OTHERLEARNINGRESOURCES:**

SWAYAM, Coursera, Research articles

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Acquire knowledge on different micronutrient.	1,2
2	Learn about different micronutrient deficiency and the related causes	1,2
3	Understand the program and policies in connection to food and health	1,2
4	Understand interaction with other nutrients	1,2
5	Acquire knowledge on water and electrolyte balance	1,2

Mapping Table Missing

SEMESTER – II									
Course Title	NUTRITIONAL BIOCHEMISTRY-II								
Course code	22MSFD122R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Spring/ II semester of first year of the Programme								
Course Objectives (Minimum)	1. To review about the different biochemical metabolism reaction of the body. 2. To understand how this metabolism takes place in co-relation with the nutrients of the food								



3)				
<b>CO1</b>	Understand the basics metabolic reaction of the body.			
<b>CO2</b>	Give them a clear picture of the biochemical Parameters of the body in normal and disease condition			
<b>CO3</b>	Understand biochemistry behind chromosomal disorders			
<b>CO4</b>	Gain knowledge of biochemical alteration in deficiency disorders			
<b>CO5</b>	Understand biochemical aspects of some vital components			
<b>Unit- No.</b>	<b>Content</b>	<b>Contact Hour</b>	<b>Learning Outcome</b>	<b>KL</b>
<b>I</b>	<b>Introduction- DNA, RNA, Genetics Biochemistry behind chromosomal disorders:</b> Down syndrome, Triple-X syndrome, Turner syndrome, trisomy18, trisomy13	<b>10</b>	Learn about Biochemistry behind chromosomal disorders	1,2
<b>II</b>	<b>Free radicals and reactive oxygen species:</b> types, and disease, sources, markers of oxidative stress  <b>Antioxidants:</b> types and sources, antioxidant defense system, combating free radicals and reactive oxygen species	<b>8</b>	Learn about Free radicals and reactive oxygen species	1,2
<b>III</b>	<b>Enzymes and coenzymes:</b> types, functions, active sites, factors affecting, kinetics and inhibition, use in investigation, role of coenzymes	<b>10</b>	Learn about types and function of Enzymes and coenzymes	1,2
<b>IV</b>	<b>Biochemical alteration in deficiency disorders:</b> PCM/ VADD/ Anaemia, IDD, Rickets, osteomalacia, beri-beri, pellagra, scurvy	<b>7</b>	Learn about Biochemical alteration in deficiency disorders	1,2
<b>V</b>	<b>Biochemical aspects of some vital components:</b> Fiber, cholesterol, prostaglandins, lipoproteins, Omega-3 fa, Hb, glycosylated Hb, immunoglobulins, elastin, collagen, myosin, keratin	<b>10</b>	Learn about Biochemical aspects of some vital components	1,2
<b>VI</b>	1. Qualitative Tests for Carbohydrate 2. Qualitative Tests of proteins 3. Qualitative test for Lipid 4. Qualitative determination of sugar 5. To study the general properties of the enzyme urease and Achromatic time of salivary amylase	<b>40</b>	Plan and carry out experiments	1,2, 3,4

### TEXT BOOKS:

**T1:** Deb. A.C., Fundamental of Biochemistry, New central book agency (P) Ltd, reprint2004.

### REFERENCEBOOK

**R1:** Pattabiraman. T. N. Concise text Book of Bio-Chemistry, 2<sup>nd</sup> edition, All India

Publishers and Distributors, Regd., 1998.

R2: **Ambika Shanmugam**, Fundamentals of biochemistry for Medical students, Karthik printers, 7th edition, 1992

**OTHER LEARNING RESOURCES:**

SWAYAM, Coursera, Research articles

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
S N	Course Outcome (CO)	Mapped Program Outcome
1	Understand the basics metabolic reaction of the body.	1,2
2	Give them a clear picture of the biochemical Parameters of the body in normal and disease condition	1,2
3	Understand biochemistry behind chromosomal disorders	1,2
4	Gain knowledge of biochemical alteration in deficiency disorders	1,2
5	Understand biochemical aspects of some vital components	1,2

SEMESTER – II									
Course Title	PUBLIC HEALTH NUTRITION								
Course code	22MSFD123R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Spring/ II semester of first year of the Programme								
Course Objectives (Minimum 3)	<ol style="list-style-type: none"> <li>To study about different aspect of nutrition and health.</li> <li>To study about the importance of child and maternal health.</li> </ol>								
CO1	Understand the different aspects of community health.								

<b>CO2</b>	Give them a clear picture of importance of health programs polices related to maternal and child health			
<b>CO3</b>	Apply the knowledge of nutrition science to human health across the life span.			
<b>CO4</b>	Comprehend the knowledge on nutritional problems and complications on community level			
<b>CO5</b>	Learn about nutritional programmes running in global as well as in India			
<b>Unit- No.</b>	<b>Content</b>	<b>Contact Hour</b>	<b>Learning Outcome</b>	<b>KL</b>
<b>I</b>	<p><b>Nutrition and health:</b> Nutrition as health indicator, nutrition related problems in global as well as in India- deficiency disorders</p> <p><b>Malnutrition:</b> Causes, effects of malnutrition. Prevalence, epidemiology. Hidden hunger, Vitamin deficiency- A, B1, B2, Niacin, C, D - prevalence, programmes to combat, Nutritional Anaemia, IDD and fluorosis- Prevalence, causes, symptoms and programmes to control.</p> <p>IMR, MMR, Mortality, morbidity rate, birth rate, sex ratio and poverty level. Health care delivery - PHC, School Health services and their role in preventing communicable diseases.</p>	<b>1 0</b>	Learn about Nutrition as health indicator and malnutrition	1,2
<b>II</b>	<p><b>Maternal and child health:</b> Nutritional care in childhood, premature baby , LBW, Programmes of immunization, Nutritional requirements in pregnancy lactation, Impact of diet on outcome of pregnancy, MCH</p> <p><b>Nutrition in emergencies:</b> Infant feeding, safety and hygienic measures, nutrient supplements.</p>	<b>8</b>	Learn about Nutrition care in Pregnancy and lactation	1,2
<b>III</b>	<p><b>Assessment of nutritional status in the community:</b> Assessment, clinical symptoms of deficiency disorder.</p> <p><b>Nutrition education:</b> Merits, planning, evaluation and conduct, educational techniques, aids, communication media, impact of mass media, young child feeding practices</p>	<b>1 0</b>	Learn about nutritional assessment	1,2
<b>IV</b>	<p><b>Nutrition and national development, national nutritional policy:</b> Aim, objectives, guidelines and thrust areas.PDS - Public distribution system, Agricultural planning - New strategies.</p>	<b>7</b>	Have an insight on Nutrition and national development, national nutritional policy	1,2
<b>V</b>	<p><b>Nutrition intervention programmes:</b> Objectives, operation of feeding programmes. ICDS.</p> <p><b>National organizations</b> - ICMR, NIN, NNMB, ICAR, CFTRI, NIPCCD, NHM, FSSAI.</p> <p><b>International organizations-FAO,</b></p>	<b>1 0</b>	Have an insight on Nutrition intervention programmes	1,2

	WHO, UNICEF, UNESCO, World Bank.			
<b>VI</b>	<ol style="list-style-type: none"> <li>1. Conduct socio-economic survey</li> <li>2. Conduct diet survey</li> <li>3. Conduct clinical examination: Planning, conducting and Evaluating</li> <li>4. Nutrition Education Programme</li> <li>5. Impact of Government health programmes</li> </ol>	<b>4</b> <b>0</b>	Interpret and apply nutrition	1,2, 3,4

### TEXT BOOKS:

T1: **B. Srilakshmi**, Nutrition Science NewAge International (CP) Ltd, New Delhi, 2002.

### REFERENCEBOOK

R1: **Mahtab, S. Bamji, N. Pralhadrao, Vinodini Reddy**, Textbook of Human Nutrition, Oxford and IBIT Publishing co Pvt. Ltd, New Delhi, reprint 1999.

R2: **Shukla, P. K.**, Nutritional problems of India, 1982.

### OTHERLEARNINGRESOURCES:

SWAYAM, Coursera, Research articles

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the different aspects of community health.	<b>1,2</b>
<b>2</b>	Give them a clear picture of importance of health programs polices related to maternal and child health	<b>1,2</b>
<b>3</b>	Apply the knowledge of nutrition science to human health across the life span.	<b>1,2</b>
<b>4</b>	Comprehend the knowledge on nutritional problems and complications on community level	<b>1,2,3</b>
<b>5</b>	Learn about nutritional programmes running in global as well as in India	<b>1,2</b>

<b>SEMESTER – II</b>									
<b>Course Title</b>	<b>FOOD MICROBIOLOGY AND FOOD SAFETY</b>								
<b>Course code</b>	<b>22MSFD124R</b>	<b>Total credits: 3</b> <b>Total hours: 45T</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
			<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Master of Science in Food Nutrition and Dietetics</b>								
<b>Semester</b>	<b>Spring/ II semester of first year of the Programme</b>								
<b>Course Objectives (Minimum 3)</b>	<ol style="list-style-type: none"> <li>1. To study about different microbiological aspects of the food.</li> <li>2. To understand the positive and negative reaction of the microbes on food and human health.</li> </ol>								
<b>CO1</b>	Understand the different principles of food safety.								
<b>CO2</b>	Give them a clear picture of role in food preservation and food spoilages.								

<b>CO3</b>	Apply the knowledge of microbiology on food product development			
<b>CO4</b>	Know about principles of Food Preservation by using different methods			
<b>CO5</b>	Acquire knowledge on food safety enforcement and control agencies			
<b>Unit- No.</b>	<b>Content</b>	<b>Contact Hour</b>	<b>Learning Outcome</b>	<b>KL</b>
<b>I</b>	<b>Food and Microorganisms-</b> food as a substrate for microorganisms, important microorganisms in food microbiology, general principles underlying food spoilage.  <b>Food Contamination-</b> contamination, preservation and spoilage of cereal products/ vegetables and fruits/ meat and meat products/ milk and milk products/ canned products	<b>10</b>	Learn about Food and Microorganisms	1,2
<b>II</b>	<b>Principles of Food Preservation-</b> asepsis, removal, anaerobic condition, preservation by high temperature/ low temperature/ drying/ food additives/ radiation	<b>8</b>	Learn about Principles of Food Preservation	1,2
<b>III</b>	<b>Foods and Enzymes Produced by Microorganisms-</b> productions of cultures, food fermentation, foods and enzymes from microorganisms	<b>10</b>	Learn about Foods and Enzymes Produced by Microorganisms	1,2
<b>IV</b>	<b>Food toxicity-</b> bacterial food borne illnesses, non-bacterial food poisoning/ infections/ intoxication, food borne disease outbreaks	<b>7</b>	Learn about Food toxicity	1,2
<b>V</b>	<b>Food Sanitation, control and Inspection-</b> sterilization, microbiology in food sanitation, enforcement and control agencies- national/ international/ federal/ state/ private, microbiological criteria for food	<b>10</b>	Learn about Food Sanitation, control and Inspection	1,2, 3

### TEXT BOOKS:

**T1: Frazier, W.C,** Food Microbiology, McGraw Hill Publications, New York, 4th Edition, 1998.

### REFERENCEBOOK

- R1: Doyle, M.P., Diez-Gonzalez, F., & Hill, C. (Eds.). (2020). *Food microbiology: fundamentals and frontiers*. John Wiley & Sons.  
R2: Fields, M. L. (1979). *Fundamentals of food microbiology*. AVI Publishing Co. Inc.  
R3: Matthews, K. R., Kniel, K. E., & Montville, T. J. (2017). *Food microbiology: an introduction*. John Wiley & Sons.

### OTHER LEARNING RESOURCES:

SWAYAM, Coursera, Research articles

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand the different principles of food safety.	1,2,3,8
2	Give them a clear picture of role in food preservation and food spoilages.	1,2,3,8
3	Apply the knowledge of microbiology on food product development	1,2,3,8
4	Know about principles of Food Preservation by using different methods	1,2,3,8
5	Acquire knowledge on food safety enforcement and control agencies	1,2,3,8

SEMESTER – II									
Course Title	BASIC OF NUTRITION								
Course code	22MSFD126R	Total credits: 2 Total hours: 30T	L	T	P	S	R	O/F	C
			2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Spring/ II semester of first year of the Programme								
Course Objectives (Minimum 3)	1. To introduce the students the basics of nutrition, importance of food. 2. To understand the functions, sources of nutrients. 3. To study about the requirements and importance of different macro and micronutrient in different stage of life								
CO1	Understand the basic terms related to nutrition and its correlation with human health.								
CO2	Understand the functioning of macronutrients in details.								
CO3	Comprehend the knowledge on nutritional problems and complications								
CO4	Acquire knowledge on micronutrients in details								

CO5		Assess and compare diet and nutritional requirements relative to age, developmental and disease status		
Unit- No.	Content	Contact Hour	Learning Outcome	KL
I	<b>Food, nutrition and health:</b> Basic definitions, function of food, classification of food according to function and nutritive value, physiological, psychological and social function of food.  <b>Recommended dietary allowances:</b> Definition, biological value, bioavailability, Minimal and optimal Nutritional Requirements, Formulation of RDA and Dietary Guidelines- Reference Man and Reference women, factors affecting RDA.	10	To understand basics of nutrition	
II	<b>Carbohydrates:</b> Definition, classification and function. glycemic index, dietary fiber and its importance, RDA, sources, metabolic disorder associated with carbohydrate.  <b>Protein:</b> Definition, classification and function, sources, disorders due to deficiency or excess.	10	To understand basics of carbohydrate and protein	
III	<b>Fat:</b> Definition, classification and functions, RDA, sources, disorders due to deficiency or excess, dietary fat and coronary heart disease.	8	To understand basics of fat	
IV	<b>Vitamins and minerals:</b> Physiological role, requirements, sources, deficiency and excess (Fat soluble and water soluble) <b>Water:</b> Distribution of water in the body, function of water, requirements and human water balance system	7	To understand basics of vitamin and mineral	
V	<b>Nutrition for Life Cycle:</b> Infancy, toddlers, childhood, adulthood-pregnancy and lactation, geriatric nutrition	10	To understand nutrition in different stages	

### TEXT BOOKS:

**T1: Sumathi R. Mudambi, Rajagopal, M.V.,** Fundamentals of Foods and Nutrition, NewAge International (P) Ltd, Publishers, Third edition, 1997.

**T2: Srilakshmi, B.** Nutrition Science, NewAge International (P) Ltd, Publishers, 2004.

### REFERENCEBOOK

**R1: Srilakshmi. B.,** Dietetics, Wiley Eastern Ltd., New Delhi, 2003.

**R2: Robinson C.H., Lawer M.R., Chenoweth. W.C., and Garwich A.E.,** Normal and therapeutic nutrition, McMillan Publishers Co., New York, XVII Edition, 1986.



**OTHER LEARNING RESOURCES:**

SWAYAM, Coursera, Research articles

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand the basic terms related to nutrition and its correlation with human health.	1,2
2	Understand the functioning of macronutrients in details.	1,2
3	Comprehend the knowledge on nutritional problems and complications	1,2
4	Acquire knowledge on micronutrients in details	1,2
5	Assess and compare diet and nutritional requirements relative to age, developmental and disease status	1,2

SEMESTER – II									
Course Title	TECHNIQUES OF PACKAGING								
Course code	22MSFD125R	Total credits: 1 Total hours: 0T+4P	L	T	P	S	R	O/F	C
			0	0	0	2	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Spring/ II semester of first year of the Programme								
Course Objectives (Minimum 3)	1. To provide comprehensive overview of the scientific and technical aspects of food packaging 2. To develop comprehensive understanding of different packaging tests								
CO1	To provide comprehensive overview of the scientific and technical aspects of food packaging.								
CO2	Understand packaging machinery, systems, testing and regulations of packaging.								
CO3	Learn effect of various environmental factors on the stability of food Comprehend the knowledge on nutritional problems and complications								
CO4	Develop comprehensive understanding of different packaging tests								
CO5	Acquire knowledge on importance of selective packaging related to food products.								
Unit- No.	Content		Contact Hour	Learning Outcome			KL		

<b>I</b>	<b>Introduction:</b> Importance, definition and function of food packaging, Need of food packaging Role of packaging in extending shelflife of foods.	<b>3</b>	Learn basics of packaging	1,2, 3,4
<b>II</b>	Types of packaging materials, Glass (construction of jars and bottles, optical, thermal and mechanical properties of glass), Metal (types of base metal sheets, construction of metal cans, lacquering), Plastics- substituted olefins, tetrafluro ethylene, PET, polyamides, polyesters.	<b>3</b>	Learn types of packaging	1,2, 3,4
<b>III</b>	Food packaging systems, product characteristics and package requirements. Introduction of food packaging system. Different forms of packaging. Rigid, semi-rigid, flexible forms of packaging.	<b>3</b>	Learn about food packaging systems	1,2, 3,4
<b>IV</b>	Different packaging system for-Dehydrated foods, Frozen foods, Dairy products, Fresh fruits, Vegetables, Meat, Poultry, Sea foods.	<b>3</b>	Learn about packaging system for different food	1,2, 3,4
<b>V</b>	Package accessories and advances in Packaging technology-Introduction, Active packaging, Modified atmosphere packaging, Aseptic packaging, Packages for microwave ovens, Biodegradable plastics, Edible gums, Coatings.	<b>3</b>	Learn about packaging system for different food	1,2, 3,4

### TEXT BOOKS:

**T1:** Gordon L. Robertson, Food Packaging: Principles and Practice, Third Edition, 2013.  
**T2:** Gordon L. Robertson, Food Packaging and Shelf Life: A Practical Guide, 2010.

### REFERENCEBOOK

**R1:** Ruben Hernandez, Susan E. M Selke, John Culter, John D. Culter, Plastics Packaging: Properties, Processing, Applications, and Regulations, 2000.

**R2:** Walter Soroka, Fundamentals of Packaging Technology-Fourth Edition,

### OTHER LEARNING RESOURCES:

SWAYAM, Coursera, Research articles

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>
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SN	Course Outcome (CO)	Mapped Program Outcome
1	To provide comprehensive overview of the scientific and technical aspects of food packaging.	1,2,6,7
2	Understand packaging machinery, systems, testing and regulations of packaging.	1,2,6,7
3	Learn effect of various environmental factors on the stability of food. Comprehend the knowledge on nutritional problems and complications.	1,2,6,7
4	Develop comprehensive understanding of different packaging tests.	1,2,6,7
5	Acquire knowledge on importance of selective packaging related to food products.	1,2,6,7

Semester II									
COURSE TITLE	COMMUNICATION MASTERY (Communicative English & Soft Skills)								
Course code	22UMPD121R	Total credits: 2	L	T	P	S	R	O/f	C
			0	0	4	0	0	0	2
Total hours: 60P									
Pre-requisite	22UMPD111R Effective English	Co-requisite	Nil						
programme	Master of Science in Food Nutrition and Dietetics								
Semester	Spring/II semester of First year of the programme								
Course objectives	<ol style="list-style-type: none"> <li>To familiarize students with the transformation of sentences and the appropriate use of prepositions.</li> <li>To enhance the writing skills in different areas including CV and cover letter writing.</li> <li>To convey meaning by reinforcing, substituting for, or contradicting verbal communication.</li> <li>Productivity and performance boosting activities for professional goal achievement.</li> </ol>								
CO1	Explain prepositions, tag questions, and idioms correctly.								
CO2	Discuss and analyze different sentence types and voices.								
CO3	Explain effective paragraphs, precis, and professional documents.								
CO4	Describe SWOT analysis, goal setting, and personal hygiene principles.								
CO5	Illustrate non-verbal communication and body language concepts.								
Unit	Content								
Module 1- Grammar	<ol style="list-style-type: none"> <li>Use of Prepositions</li> <li>Tag questions</li> <li>Idioms, Phrases and Clauses</li> <li>Simple, complex, compound sentences</li> </ol>								

<b>Module 2- Grammar</b>	I. Active and Passive Voice II. Direct and Indirect Speech
<b>Module 3- Writing Skills</b>	I. The Basics of Writing; avoid ambiguity and vagueness II. Paragraph Writing III. Precis Writing IV. Letter Writing V. Resume, CV and Cover Letter
<b>Module 4- Self-Management Skills</b>	I. SWOT Analysis II. Self-Regulation- Goal Setting III. Personal Hygiene
<b>Module 5- Non- Verbal Communication- Sciences of Body Language</b>	I. What is Non-Verbal Communication & Body Language, II. Elements of Communication, III. Types of Body Language, IV. Importance and Impact of Body Language, V. Types of Communication through Body Language, VI. Introduction to Haptic, Introduction to Kinesics VII. Introduction to Proxemics, VIII. Body Language Do's and Don'ts, Doubt Clearing Session.
<b>Module 6- Group Discussion (Theory)</b>	I. Importance, II. Planning, Elements, and Skills assessed; III. Effectively disagreeing, IV. Initiating, Summarizing and Attaining the Objective

### TEXT BOOKS:

**T1:** Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

**T2:** McDowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition).

### REFERENCE BOOK:

**R1:** Communication Skills Training: A Practical Guide to Improving Your Social Intelligence, Presentation and Social Speaking, Ian Tuhovsky, 2019

**R2:** A Textbook for AECC English Communication: Interface, Dr. Kironmoy Chetia and Pranami Bania Breez Mohan Hazarika, January 2019

### OTHER LEARNING RESOURCES:

1. <https://youtu.be/x60GHpQ8gJk>
2. [https://youtu.be/Ke\\_oSN-BCaY](https://youtu.be/Ke_oSN-BCaY)
3. <https://youtu.be/TDPDtrLxT-c>

4. <https://www.classcentral.com/report/toefl-preparation/>

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Practice of grammar will polish their writing skills.	4,2,8
2	It will enhance their communication and interpretative skills.	4,2,8
3	Introduction to behavioural skills, thoughts, and emotions will enable them to behave in a conscious and productive way.	2,4,5
4	It will have a positive impact in their thought process and problem-solving skills.	2,4,5

COURSE TITLE									
<b>UNIVERSAL HUMAN VALUES (UHV) + PROFESSIONAL ETHICS</b>									
Course code	22UUHV101R	Total credits: 2	L	T	P	S	R	O/f	C
		Total hours:15T+30P	1	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Winter/II semester of First year of the Programme								
Course objectives	<ol style="list-style-type: none"> <li>To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings</li> <li>To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way</li> <li>To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature</li> </ol>								
CO1	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.								
CO2	It is free from any dogma or value prescriptions.								
CO3	It is a process of self-investigation and self-exploration, and not of giving sermons.								
CO4	Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.								
CO5	This process of self-exploration takes the form of a dialogue between the teacher and the								

	students to begin with, and then to continue within the student leading to continuous self-evolution.
<b>Unit</b>	<b>Content</b>
<b>I</b>	<ul style="list-style-type: none"> <li>• Understanding the need, basic guidelines, content and process for Value Education</li> <li>• Self Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self exploration</li> <li>• Continuous Happiness and Prosperity- A look at basic Human Aspirations</li> <li>• Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority</li> <li>• Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario</li> <li>• Method to fulfil the above human aspirations: understanding and living in harmony at various levels.</li> </ul>
<b>II</b>	<ul style="list-style-type: none"> <li>• Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’</li> <li>• Understanding the needs of Self (‘I’) and ‘Body’ - <i>Sukh</i> and <i>Suvidha</i></li> <li>• Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)</li> <li>• Understanding the characteristics and activities of ‘I’ and harmony in ‘I’</li> <li>• Understanding the harmony of I with the Body: <i>Sanyam</i> and <i>Swasthya</i>; correct appraisal of Physical needs, meaning of Prosperity in detail</li> <li>• Programs to ensure <i>Sanyam</i> and <i>Swasthya</i>-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>
<b>III</b>	<ul style="list-style-type: none"> <li>• Understanding Harmony in the family – the basic unit of human interaction</li> <li>• Understanding values in human-human relationship; meaning of Nyaya and program for its fulfilment to ensure Ubhay-tripti;</li> <li>• Trust (Vishwas) and Respect (Samman) as the foundational values of relationship</li> <li>• Understanding the meaning of Vishwas; Difference between intention and competence</li> <li>• Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship</li> <li>• Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals</li> <li>• Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha )- from family to world family!-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>
<b>IV</b>	<ul style="list-style-type: none"> <li>• Understanding the harmony in the Nature</li> <li>• Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature</li> </ul>

	<ul style="list-style-type: none"> <li>• Understanding Existence as Co-existence (<i>Sah-astitva</i>) of mutually interacting units in all-pervasive space</li> <li>• Holistic perception of harmony at all levels of existence-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>
V	<ul style="list-style-type: none"> <li>• Natural acceptance of human values</li> <li>• Definitiveness of Ethical Human Conduct</li> <li>• Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order</li> <li>• Competence in professional ethics: <ul style="list-style-type: none"> <li>➤ Ability to utilize the professional competence for augmenting universal human order</li> <li>➤ Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems,</li> <li>➤ Ability to identify and develop appropriate technologies and management patterns for above production systems.</li> </ul> </li> <li>• Case studies of typical holistic technologies, management models and production systems</li> <li>• Strategy for transition from the present state to Universal Human Order: <ul style="list-style-type: none"> <li>➤ At the level of individual: as socially and ecologically responsible engineers, technologists and managers</li> <li>➤ At the level of society: as mutually enriching institutions and organizations</li> </ul> </li> </ul>
<b>Guidelines and Content for Practice Sessions</b>	<p>UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education</p> <p>PS 1: Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? How do you differentiate between right and wrong? What have been your achievements and shortcomings in your life? Observe and analyze them. Expected outcome: the students start exploring themselves; get comfortable to each other and to the teacher and start finding the need and relevance for the course.</p> <p>PS 2: Now-a-days, there is a lot of voice about many techno-genic maladies such as energy and natural resource depletion, environmental pollution, global warming, ozone depletion, deforestation, soil degradation, etc. – all these seem to be man-made problems threatening the survival of life on Earth – What is the root cause of these maladies &amp; what is the way out in your opinion? On the other hand, there is rapidly growing danger because of nuclear proliferation, arms race, terrorism, criminalization of politics, large scale corruption, scams, breakdown of relationships, generation gap, depression &amp; suicidal attempts, etc – what do you think, is the root cause of these threats to human happiness and peace – what could be the way out in your opinion? Expected outcome: the students start finding that technical education without study of human values can generate more problems than solutions. They also start feeling that lack of understanding of human values is the root cause of all problems and the sustained solution could emerge only through understanding of human values and value based living. Any solution brought out through fear, temptation or dogma will not be sustainable.</p> <p>PS 3:</p>

1. Observe that each one of us has Natural Acceptance, based on which one can verify right or not right for him. Verify this in case of

- i) What is Naturally Acceptable to you in relationship- Feeling of respect or disrespect?
- ii) What is Naturally Acceptable to you – to nurture or to exploit others? Is your living the same as your natural acceptance or different?

2. Out of the three basic requirements for fulfillment of your aspirations- right understanding, relationship and physical facilities, observe how the problems in your family are related to each. Also observe how much time & effort you devote for each in your daily routine.

Expected outcome:

1. The students are able to see that verification on the basis of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity; it will only develop assumptions.
2. The students are able to see that their practice in living is not in harmony with their natural acceptance most of the time, and all they need to do is to refer to their natural acceptance to remove this disharmony.
3. The students are able to see that lack of right understanding leading to lack of relationship is the major cause of problems in their family and not the lack of physical facilities in most of the cases, while they have given higher priority to earning of physical facilities in their life ignoring relationships and not being aware that right understanding is the most important requirement for any human being.

UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!

PS 4: List down all your desires. Observe whether the desire is related to Self (I) or Body. If it appears to be related to both, see which part of it is related to Self (I) and which part is related to Body.

Expected outcome: the students are able to see that they can enlist their desires and the desires are not vague. Also they are able to relate their desires to 'I' and 'Body' distinctly. If any desire appears related to both, they are able to see that the feeling is related to I while the physical facility is related to the body. They are also able to see that 'I' and 'Body' are two realities, and most of their desires are related to 'I' and not body, while their efforts are mostly centered on the fulfillment of the needs of the body assuming that it will meet the needs of 'I' too.

PS 5:

1.
  - a. Observe that any physical facility you use, follows the given sequence with time : Necessary & tasteful → unnecessary & tasteful → unnecessary & tasteless → intolerable
  - b. In contrast, observe that any feeling in you is either naturally acceptable or not acceptable at all. If naturally acceptable, you want it continuously and if not acceptable, you do not want it any moment!
2. List down all your activities. Observe whether the activity is of 'I' or of Body or with the participation of both 'I' and Body.
3. Observe the activities within 'I'. Identify the object of your attention for different moments (over a period of say 5 to 10 minutes) and draw a line diagram



connecting these points. Try to observe the link between any two nodes.

Expected outcome:

1. The students are able to see that all physical facilities they use are required for a limited time in a limited quantity. Also they are able to see that in case of feelings, they want continuity of the naturally acceptable feelings and they do not want feelings which are not naturally acceptable even for a single moment.

2. the students are able to see that activities like understanding, desire, thought and selection are the activities of 'I' only, the activities like breathing, palpitation of different parts of the body are fully the activities of the body with the acceptance of 'I' while the activities they do with their sense organs like hearing through ears, seeing through eyes, sensing through touch, tasting through tongue and smelling through nose or the activities they do with their work organs like hands, legs etc. are such activities that require the participation of both 'I' and body.

3. The students become aware of their activities of 'I' and start finding their focus of attention at different moments. Also they are able to see that most of their desires are coming from outside (through preconditioning or sensation) and are not based on their natural acceptance.

PS 6:

1. Chalk out programs to ensure that you are responsible to your body- for the nurturing, protection and right utilisation of the body.

2. Find out the plants and shrubs growing in and around your campus. Find out their use for curing different diseases.

Expected outcome: The students are able to list down activities related to proper upkeep of the body and practice them in their daily routine. They are also able to appreciate the plants wildly growing in and around the campus which can be beneficial in curing different diseases.

UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

PS 7: Form small groups in the class and in that group initiate dialogue and ask the eight questions related to trust. The eight questions are:

1a. Do I want to make myself happy? 2a. Do I want to make the other happy?

3a. Does the other want to make him happy? 4a. Does the other want to make me happy?

What is the answer?

Intention (Natural Acceptance)

1b. Am I able to make myself always happy? 2b. Am I able to make the other always happy?

3b. Is the other able to make him always happy? 4b. Is the other able to make me always happy?

What is the answer?

Competence

Let each student answer the questions for himself and everyone else. Discuss the difference between intention and competence. Observe whether you evaluate your intention & competence as well as the others' intention & competence.

Expected outcome: The students are able to see that the first four questions are related to

our Natural Acceptance i.e. Intention and the next four to our Competence. They are able to note that the intention is always correct, only competence is lacking! We generally evaluate ourselves on the basis of our intention and others on the basis of their competence! We seldom look at our competence and others' intention as a result we conclude that I am a good person and other is a bad person.

PS 8:

1. Observe on how many occasions you are respecting your related ones (by doing the right evaluation) and on how many occasions you are disrespecting by way of under-evaluation, over-evaluation or otherwise evaluation.

2. Also observe whether your feeling of respect is based on treating the other as yourself or on differentiations based on body, physical facilities or beliefs.

Expected outcome: The students are able to see that respect is right evaluation, and only right evaluation leads to fulfillment in relationship. Many present problems in the society are an outcome of differentiation (lack of understanding of respect), like gender biasness, generation gap, caste conflicts, class struggle, dominations through power play, communal violence, clash of isms, and so on so forth. All these problems can be solved by realizing that the other is like me as he has the same natural acceptance, potential and program to ensure a happy and prosperous life for him and for others though he may have different body, physical facilities or beliefs.

PS 9:

1. Write a note in the form of story, poem, skit, essay, narration, dialogue to educate a child. Evaluate it in a group.

2. Develop three chapters to introduce 'social science- its need, scope and content' in the primary education of children

Expected outcome: The students are able to use their creativity for educating children. The students are able to see that they can play a role in providing value education for children. They are able to put in simple words the issues that are essential to understand for children and comprehensible to them. The students are able to develop an outline of holistic model for social science and compare it with the existing model.

UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

PS 10: List down units (things) around you. Classify them in four orders. Observe and explain the mutual fulfillment of each unit with other orders.

Expected outcome: The students are able to differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them. They are also able to see that human beings are not fulfilling to other orders today and need to take appropriate steps to ensure right participation (in terms of nurturing, protection and right utilization) in the nature.

PS 11:

1. Make a chart for the whole existence. List down different courses of studies and relate them to different units or levels in the existence.

2. Choose any one subject being taught today. Evaluate it and suggest suitable modifications to make it appropriate and holistic.

Expected outcome: The students feel confident that they can understand the whole existence; nothing is a mystery in this existence. They are also able to see the

	<p>interconnectedness in the nature, and point out how different courses of study relate to the different units and levels. Also they are able to make out how these courses can be made appropriate and holistic.</p> <p>UNIT 5: Implications of the above Holistic Understanding of Harmony at all Levels of Existence</p> <p>PS 12: Choose any two current problems of different kind in the society and suggest how they can be solved on the basis of natural acceptance of human values. Suggest steps you will take in present conditions.</p> <p>Expected outcome: The students are able to present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.</p> <p>PS 13:</p> <ol style="list-style-type: none"> <li>1. Suggest ways in which you can use your knowledge of Technology/Engineering/Management for universal human order, from your family to the world family.</li> <li>2. Suggest one format of humanistic constitution at the level of nation from your side.</li> </ol> <p>Expected outcome: The students are able to grasp the right utilization of their knowledge in their streams of Technology/Engineering/ Management to ensure mutually enriching and recyclable productions systems.</p> <p>PS 14: The course is going to be over now. Evaluate your state before and after the course in terms of</p> <ol style="list-style-type: none"> <li>a. Thought</li> <li>b. Behavior and</li> <li>c. Workd. Realization</li> </ol> <p>Do you have any plan to participate in the transition of the society after graduating from theinstitute? Write a brief note on it.</p> <p>Expected outcome: The students are able to sincerely evaluate the course and share with their friends. They are also able to suggest measures to make the course more effective and relevant. They are also able to make use of their understanding in the course for a happy and prosperous society.</p>
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### TEXT BOOKS:

**T1:** R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

### REFERENCEBOOK

1. ucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986,1991
4. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III,1972, limits to Growth, Club of Rome's Report, Universe Books.
6. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagaraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.

8. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, Human Values, New Age International Publishers

**OTHER LEARNING RESOURCES:**

1. Value Education websites, <http://uhv.ac.in>, <http://www.uptu.ac.in>
2. Story of Stuff, <http://www.storyofstuff.com>
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.	5,6,7,8
2	It is free from any dogma or value prescriptions.	5,6,7,8
3	It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it, based on their Natural Acceptance and subsequent Experiential Validation.	5,6,7,8
4	This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.	5,6,7,8
5	This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.	5,6,7,8

COURSE TITLE	Research Methodology and Statistical Analysis								
Course code	22UMRM121R	Total credits: 2	L	T	P	S	R	O/f	C
		Total hours: 15T+60S	1	0	0	4	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
programme	Master of Science in Food Nutrition and Dietetics								
Semester	Spring/II semester of First year of the programme								
Course objectives	<ol style="list-style-type: none"> <li>1. The course aims to enhance the students' a broad understanding of research methodology, including theory of science and qualitative and quantitative methods in research.</li> <li>2. The course seeks to enhance the students' skills for developing critical thinking through research literature review in different domain. Consequently, it aims to develop skills for preparation of a research proposal for a master's thesis</li> </ol>								

	project/Mini research. 3. To develop Students competency in planning, conducting, evaluating and presenting a research project.			
<b>CO1</b>	Students will have basic knowledge of Research methods.			
<b>CO2</b>	Students will gain the knowledge of Research Methodology.			
<b>CO3</b>	Students will be able to gain the Skill questionnaire development.			
<b>CO4</b>	Students will be able to acquire the knowledge of basic Report/dissertation Procedure.			
<b>CO5</b>	Knowledge on different IPR rights			
<b>Unit no</b>	<b>Content</b>	<b>CH</b>	<b>Learning Outcome</b>	<b>KL</b>
<b>I</b>	Research Methodology- An Introduction-meaning and objectives of research, motivation in research, types and significance of research, criteria of good research. Defining the Research Problems- definition of research problem, necessity of defining research problem	2	Knowledge on fundamental concepts of research methodology, including the meaning and objectives of research	1,2
<b>II</b>	Research Design- meaning and need of research design, features of a good design, different research designs, Sampling Design- steps in sampling design, Sample Size determination, criteria for selecting a sampling design, different types of sampling design, Experimental Design, Principles of Design of Experiment, One – way ANOVA, Two- Way ANOVA, CRD, RBD, LSD, 22, 23 Factorial Design	4	Able to understand and apply the fundamental principles of research design, including the meaning and necessity of research design	1,2
<b>III</b>	Types of data, sources of data collection, tools of data collection, Nominal, ordinal, interval and ratio – Attitude scale construction and measurement, rating scales, semantic differential (SD), Use of scale in statistical analysis, Schedules for interviews preparation and standardization, development of survey instruments and item analysis for the questionnaire	3	A good knowledge on different types of data and identify various sources and tools for data collection	1,2
<b>IV</b>	Planning and organizing research report, Format of research report, Different steps of writing report, lay out of the research report , How to organize thesis/Dissertation, mechanics of writing research report, standard methods of quoting- presenting the result, written and oral reports, Uses of abstract, format of research report, presentation of statistics - tabular and graphic references and uses of	3	Able to organize and write a comprehensive research report	1,2

	references, Bibliography and presentation of bibliography			
<b>V</b>	Intellectual property right (IPR), Introduction and the need for IPR, IPR in India and worldwide, Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge and Geographical Indications, Patentable and non-patentable, patenting life, Filing of a patent application, The different layers of the international patent system, Case studies on Basmati rice, Turmeric, and Neem patents	3	Knowledge on importance of Intellectual Property Rights (IPR) both in India and globally	1,2
<b>Practical</b>	Laboratory using R Software: 1 Analysis of One way ANOVA; 2 Analysis of Two way ANOVA; 3 Analysis of CRD 4 Analysis of RBD 5 Analysis of 22 and 23 Factorial Experiment 6 Simulation-I using R (Bernoulli, Binomial, Poisson and Geometric distribution.). 7 Simulation-II using R (Exponential and Normal distribution). 8 Simple random Sampling 9 Stratified Random Sampling	60	Knowledge on various statistical experiments and simulations using R	1,2,3,4

## REFERENCEBOOK

- R1: Boyle JS. Styles of ethnography. In: JM Morse, editor. Critical issues in qualitative research methods.
- R2: Thousand Oaks, CA: Sage, 1994:159–85.
- R3: Coughlan M., Cronin P. and Ryan F. (2007). Step-by-step guide to critiquing research. Part 1: quantitative research. British journal of Nursing 16 (11).
- R4: Creswell, JW. (1998). Qualitative Inquiry and Research Design Choosing Among Five Traditions.
- R5: Thousand Oaks, CA: Sage Publications.
- R6: Crotty, M. (1998). The Foundations of social research: Meaning and perspective in the research process. London: Sage.
- R7: Denzin, NK. (1978). Sociological Methods. New York: McGraw-Hill.
- R8: Hanson WE, JW Creswell, VL Plano Clark, KS Petska and JD Creswell. Mixed Methods Research
- R9: Designs in Counseling Psychology. Journal of Counseling Psychology, 2005, Vol. 52, No. 2, 224–
- R10: 235 [http://www.preciousheart.net/chaplaincy/Auditor\\_Manual/13casesd.pdf](http://www.preciousheart.net/chaplaincy/Auditor_Manual/13casesd.pdf)
- R11: 7 Johnson & Christensen. (2004). Educational Research: Quantitative, qualitative and mixes approaches, 2nd Ed. Boston: Allyn & Bacon

## RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Students will have basic knowledge of Research methods.	2,3
2	Students will gain the knowledge of Research Methodology.	2,3
3	Students will be able to gain the Skill questionnaire development. Students will be able to acquire the knowledge of basic Report/dissertation Procedure.	2,3

Course Title	Computational System and Digital Literacy								
Course code	22UUDLI103R	Total credits: 1	L	T	P	S	R	O/f	C
		Total hours:30	0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Spring/II semester of First year of the programme								
Course objectives	1. Students will be able to understand the fundamentals of computer systems and Internet search along with advanced features of MS-Office. 2. Students will be able to learn data management, statistical analysis, and visualization. 3. Students will be able to use social media and e-commerce portals, Digital Payment systems, and other utility software.								
CO1	Explain computer systems and Internet search fundamentals.								
CO2	Describe data analysis and visualization problems with MS Office.								
CO3	Illustrate social media and e-commerce sites efficiently and ethically.								
CO4	Discuss about utility software for research and information management.								
CO5	Explain software tools for research and data management.								

Unit-No.	Content
<b>I</b>	<b>Fundamentals of Computer Systems, Office Automation and Internet Search</b> i. Components of a Computer and their functions. ii. Office Automation using MS-Word, MS-Excel, and MS-PowerPoint. iii. Data management, Statistical Data Analysis and Data Visualization with MS-Excel. iv. Use of Functions, Graphs & Charts in MS-Excel.
<b>II</b>	<b>Internet &amp; Cyber World</b> i. Introduction to Computer Networks, Internet and World Wide Web, Websites and Web portals. ii. Creation and use of Email Accounts. iii. Web browsing, Web Searching, Different aspects of Web Searching- Search Keywords, conditions, and combinations.

	iv. Study of different Search Engines like Google, Microsoft Bing, Yahoo, Yandex, DuckDuckGo, Ask.Com etc. v. Cyber Crimes, Cyber Laws and IT Act 2000, India.
<b>III</b>	<b>Introduction to Social Media and E-Commerce</b> i. Relevance of Social Media in present scenario. Posting different types of contents in Social Media. ii. Creating accounts and using some popular Social media portals and Apps like WhatsApp, Facebook, etc. Social Media Etiquettes & Crimes. iii. Definition of E-Commerce; E-Commerce versus traditional Commerce. iv. Case studies of popular E-Commerce portals like Amazon. v. E-commerce Etiquettes & Crimes.
<b>IV</b>	<b>Digital Payments and Digital Transactions</b> i. Introduction to Digital Payment Systems. ii. Creating accounts and using Digital Payment Systems like Credit Cards, Debit Cards, Netbanking, UPI. Digital payments Etiquettes & Crimes.
<b>V</b>	<b>Basic Accounting and Utility Software</b> i. Introduction to Basic accounting concepts, Introduction to an Accounting Software like GnuCash or Tally. ii. Introduction to Technical Document writing using LaTeX. iii. Introduction to Data Visualization software – Sigma, Google Charts, Tableau

**TEXT BOOK :**

T1: Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems & Applications. 3rd ed. New Delhi: BPB Publications.

T2: Goel, A, 2010. Computer Fundamentals, Pearson India.

**REFERENCE BOOK:**

R1: Balaguruswamy, E. 2009 Fundamentals of Computers, Tata McGraw-Hill Education.

R2: Balaguruswamy, 2014. E. Fund Of Comp & Programming (Updated Ed Sem. I, Au) Tata McGraw-Hill Education.

R3: Lawson, C. 2022. Introduction to Social Media, Oklahoma State University process. London: Sage.

**OTHER LEARNING RESOURCES:**

1. <https://www.w3schools.com>
2. <https://edu.gcfglobal.org>
3. <https://www.tutorialspoint.com>
4. <https://www.javatpoint.com>

Latest updates available in WWW.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Students will understand Computer Systems and Internet	2,3



	search.	
2	Students will be able to solve data analysis, management and visualization issues using MS-Office products.	2,3
3	Students will be able to efficiently and ethically use social media and e-commerce sites.	2,3

COURSE TITLE		PERSONAL FINANCIAL PLANNING							
COURSE CODE	22UUFL202R	TOTAL CREDITS:1	L	T	P	S	R	O/F	C
		TOTAL HOURS:30P	0	0	2	0	0	0	1
PRE-REQUISITE	22UUFL201R Introduction to Financial Budgeting And Planning	CO-REQUISITE	NIL						
PROGRAMMES	Master of Science in Food Nutrition and Dietetics								
SEMESTER	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	1. The course would offer an inclusive approach to understand the relevant concepts of money, borrowing, lending, taxes and their application to financial planning. 2. Assess the personal financial planning process, the life cycle of financial plans, and methods of goal achievement. 3. Formulate a budget, record-keeping system, and tax planning strategy based on current financial goals.								
CO1	Explain the cash management and buying plan for homes or automobiles.								
CO2	Discuss a diversified investment portfolio for different objectives.								
CO3	Compare mutual funds, ETFs, and real estate investment options.								
CO4	Develop a financial plan for retirement and estate protection.								
CO5	Describe financial products and strategies for long-term goals								
Unit no	Content								
I	<b>Unit 1- Fundamentals of Financial Planning –</b> i. Functions of money; ii. Inflation- Meaning, causes, how it can be controlled; iii. process official planning, iv. Time value of money-simple and compound interest; v. Net Present Value and Future value, vi. Power of Compounding; vii. Doubling period and Rule of 72.								
II	<b>Unit 2- Income Tax Planning–</b> i. Meaning of Income, ii. Direct & Indirect Taxes, Taxable Income, various heads of Income for tax Calculation, iii. Non-taxable Income,								

	<p>iv. Tax evasion and tax avoidance, v. GST, Tax Planning Strategies.</p>
<b>III</b>	<p><b>Unit 3- Entrepreneurial planning –</b> i. Meaning of Entrepreneurship, prerequisites for becoming an entrepreneur, ii. Entrepreneurship Support Systems in India, iii. Institutional support systems for entrepreneurs, iv. Financial support systems for entrepreneurs; v. Venture Capital, Business Angels, vi. Assistant of Government, vii. Commercial Bank Loans and Overdraft.</p>
<b>IV</b>	<p><b>Unit 4-Planning for investing in securities market –</b> i. Investment avenues offered by Securities Markets,. Primary Market and Secondary Market, ii. Stock market- meaning, features, functions of NSE,BSE DEMAT trading account, iii. Security repository, stock brokers, Operational aspects of securities markets: placement of orders, contract note, pay-in and pay-out, trading and settlement cycle, iv. Various risks involved in investing in securities markets; Role of Financial Intermediaries; Stock indices. v. Mutual Funds- meaning concept, definition, types, importance and drawbacks of mutual funds, mutual funds in India, investing in mutual funds, vi. Systematic Investment Plan (SIP) and its advantages.</p>
<b>V</b>	<p><b>Unit 5- Planning for debts and Retirement</b> i. Consumer credit - Introduction to consumer credit; choosing a source of credit, the cost of credit alternatives, ii. Consumer Legal Protection; iii. Housing Decision: Factors and Finance; Vehicle Decisions. iv. Retirement planning - Meaning of cost of living; retirement need analysis; development of retirement plan, various retirement schemes, v. Estate Planning; Pension and Medicare Planning; Wills.</p>

**Text Books:**

1. Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems &The Million-Dollar Financial Advisor: Powerful Lessons and Proven Strategies from Top Producers by David J. Mullen Jr
2. Personal Finance and Planning by Dr. Rajni
3. Peaceful Personal Finance: A Short Read on the Basics of Personal Finance and Planning Kindle Edition by Hema Singh
4. Be Your Own Financial Advisor: Financial Planning, Investment Options, Risk Management, Tax Management, Succession Planning Kindle Edition y Sushil Bali
5. The Dumb Things Smart People Do with Their Money: Thirteen Ways to Right Your Financial Wrongs Kindle Edition y Jill Schlesinger

**CO PO Mapping**

SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain the cash management and buying plan for homes or automobiles.	5
2	Discuss a diversified investment portfolio for different objectives.	9
3	Compare mutual funds, ETFs, and real estate investment options.	2, 5, 9
4	Develop a financial plan for retirement and estate protection.	9
5	Describe financial products and strategies for long-term goals	5

SEMESTER – III									
Course Title	CLINICAL NUTRITION I								
Course code	22UMRM121R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	1. To study about different aspect of diet modification and adaptations. 2. To study about the different nutrient modification at different disease state.								
CO1	Understand the different aspect of food nutrients and its affect in health and wellbeing								
CO2	Learn and apply different aspect of diet modification and adaptations in diseases state								
CO3	Acquired knowledge on planning of different hospital diet								
CO4	Apply the importance of therapeutic diet in diseases condition								
CO5	Evaluate the significance in the modifications of diet in different feeding methods.								
Unit- No.	Content		Contact Hour	Learning Outcome					KL
I	Introduction to clinical therapy- Introduction, Role of dietician in health care. Patient Care and Counselling.		5	Role of dietician					1,2
II	<b>Adaptation of therapeutic diets:</b> Introduction to therapeutic diets, Types of dietary adaptation for therapeutic needs,  Normal nutrition- a base of therapeutic diet, Diet prescription and constructing therapeutic diets  <b>Routine Hospital Diets:</b> Normal or general diets, Liquid diets, soft diets.  <b>Mode of Feeding:</b> Oral feeding, tube or enteral feeding, Peripheral vein feeding, Total parenteral nutrition.		10	Learning of hospital diet, different , mode of feeding					1,2

<b>III</b>	<p><b>Nutritional management in infections and fever:</b> Typhoid, Pneumonia and Tuberculosis</p> <p><b>Nutritional care in weight management:</b> Introduction, underweight, overweight and obesity, PCOS.</p>	<b>10</b>	Different types of diet for infections, weight management	1,2
<b>IV</b>	<p><b>Nutritional management in cardiovascular diseases:</b> Dyslipidemia, Atherosclerosis, Hypertension, Myocardial Infarction, Angina Pectoris, Chronic Heart Failure, Rheumatic heart disease, Stroke.</p> <p><b>Nutritional management in diabetes mellitus and gout</b></p>	<b>10</b>	Diet modifications for CVD, Diabetes.	1,2
<b>V</b>	<p><b>Nutritional management in gastrointestinal diseases:</b> Diarrhoea, Constipation, Gastritis, Peptic Ulcer, Gall bladder and biliary disorders, pancreatitis.</p> <p><b>Malabsorption Syndrome-</b> Celiac disease, Steatorrhoea, Lactose Intolerance, Tropical spruce, Crohns disease, Irritable bowel disease.</p>	<b>10</b>	Therapeutic diet for gastrointestinal diseases	
<b>VI (Practical)</b>	<p>1. Planning, preparations and calculations of nutritive value of: Routine hospital diet: Liquid diet: Clear liquid, Full fluid, Semisolid diet, Soft diet</p> <p>2. Planning, preparations and calculations of nutritive value of: Feeds: Nasogastric (NG) feeds and Jejunostomy (JJ) feed</p> <p>3. Planning, preparations and calculations of nutritive value of: Cardiovascular diseases: Hyperlipidemia and Hypertension</p> <p>4. Planning, preparations and calculations of nutritive value of: Gastrointestinal tract: Diarrhoea and Constipation</p> <p>5. Planning, preparations and calculations of nutritive value of: Gastrointestinal tract: Peptic ulcer and gastritis</p> <p>6. Planning, preparations and calculations of nutritive value of: Gastrointestinal tract: Celiac disease and Crohn's disease</p> <p>7. Planning, preparations and calculations of nutritive value of: Gastrointestinal tract: Diabetes mellitus</p> <p>8. Planning, preparations and calculations of nutritive value of: Gastrointestinal tract: Gout</p>	<b>16</b>	Learn different types of hospital diet, Feeding method, diet for CVD, Gastrointestinal disorder, peptic ulcer, Celiac disease and Crohn's disease, diabetes mellitus, gout	1,2

**TEXT BOOKS:**

**T1: Joshi, S. A., Nutrition and Dietetics**, Tata McGraw Hill Publications, NewDelhi, 2004.

**T2: Srilakshmi B.**, Dietetics, NewAge International (P) limited Publications, 2004

**REFERENCE BOOKS:**

**R1: Raymond, J. L., & Morrow, K.** (2020). Krause and mahan's food and the nutrition care. Elsevier Health Science

**R2: Antia F.P., & P.Abraham.** (2002). Clinical Dietetics and Nutrition.

**R3: Shils, M. E., Olson, J. A., Shike, M. and Ross, A. C.** (1999): Modern Nutrition in Health and Disease, 9th Edition, Williams and Wilkins

**R4: Escott-Stump, S.** (1998): Nutrition and Diagnosis Related Care, 4<sup>th</sup> Edition, Williams and Wilkins.

**R5: Garrow, J. S., James, W.P.T.**

**OTHER LEARNING RESOURCES:**

Courseera, swayam

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the different aspect of food nutrients and its affect in health and wellbeing	<b>1,2</b>
<b>2</b>	Learn and apply different aspect of diet modification and adaptations in diseases state	<b>1,2</b>
<b>3</b>	Acquired knowledge on planning of different hospital diet	<b>1,2</b>
<b>4</b>	Apply the importance of therapeutic diet in diseases condition	<b>1,2</b>
<b>5</b>	Evaluate the significance in the modifications of diet in different feeding methods.	<b>1,2</b>

SEMESTER – III									
Course Title	APPLIED NUTRITION I								
Course code	22MSFD215R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives (Minimum 3)	1. To study about different aspect of Food Science and processing. 2. To study about the application of principles of food science in product development.								
CO1	Understand the different application of food science in food production and packaging								
CO2	Give them a clear picture of recent trends and advancement in food science and technology.								
CO3	Learn different food standard and regulations governed by Indian govt								
CO4	Develop nutrients dense food products								
CO5	Analyze different techniques and skill for detecting food adulteration.								
Unit- No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Role of macronutrients:</b> Role of fiber in lipid metabolism, colon function, blood glucose level and G.I tract functions – Disadvantages of Dietary fiber, Role of saturated fat, cholesterol, lipoprotein and Triglycerides and EFA in the diet		5	Role of dietician					
II	<b>Standards for foods:</b> Milk and milk products, Fruits and vegetables, Beverages and Fleshy foods.		10	Learning of hospital diet, different ,ode of feeding					
III	<b>Food regulations-Standards and quality control :</b> Principles of quality control- Raw material process  Control and product inspections.  <b>Food laws and consumerism:</b> Definition, Consumer protection, Consumer Education, Legal modes of protection and Machinery		10	Different types of diet for infections, weight management					

	for redressal of consumer grievances.			
<b>IV</b>	<b>Product development:</b> Designing new product-types and drawing force, Need for product development, stages of product development, Success in product development, Consumer research, Role of sensory evaluation in consumer product acceptance.	<b>10</b>	Diet modifications for CVD, Diabetes.	
<b>V</b>	<b>Food adulteration and hygiene:</b> Definition, Common adulterants in different foods, Methods of detecting adulterated foods, Food Sensitivity	<b>10</b>	Therapeutic diet for gastrointestinal diseases	
<b>VI (Practical)</b>	<ol style="list-style-type: none"> <li>1. Introduction to different equipments used in food processing industries</li> <li>2. Evaluation of proximate composition- moisture</li> <li>3. Evaluation of proximate composition- protein</li> <li>4. Evaluation of proximate composition- total ash</li> <li>5. Evaluation of proximate composition-fats</li> <li>6. Evaluation of proximate composition-Fiber</li> <li>7. Introduction to sensory analysis and uses of sensory tests: Establishing sensory panels, Recognition tests for 4 basic tastes, odour and aroma., Analytical tests:(i)Difference, (ii)Ranking, (iii)Descriptive, (iv)Scoring and (v) Rating</li> <li>8. Standardization and storage studies of developed food products and using different packaging properties.</li> </ol>	<b>16</b>	Knowledge of different equipment, Learn the analysis process of proximate composition, Sensory evaluation, Storage studies by packaging materials	

### TEXT BOOKS:

T1: Norman N. Potter and Joseph H. Hotchkiss, Food Science, CBS publishers and distributors, Fifth edition, 2000

### REFERENC EBOOKS:

R1: Manay, S. and Shadaksharaswami, M., Foods: Facts and Principles, NewAge Publishers, 2004

R2: B. Srilakshmi, Food science, NewAge Publishers, 2002

### OTHERLEARNINGRESOURCES:

Courseera, swayam

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>
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<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the different application of food science in food production and packaging .	<b>1,2</b>
<b>2</b>	Give them a clear picture of recent trends and advancement in food science and technology.	<b>1,2</b>
<b>3</b>	Learn different food standard and regulations governed by Indian govt	<b>1,2</b>
<b>4</b>	Develop nutrients dense food products	<b>1,2</b>
<b>5</b>	Analyze different techniques and skill for detecting food adulteration.	<b>1,2</b>



SEMESTER – III									
Course Title	CLINICAL NUTRITION II								
Course code	22MSFD218R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives (Minimum 3)	1. To review about the different biochemical metabolism reaction of the body. 2. To understand how this metabolism takes place in correlation with the nutrients of the food								
CO1	Understand the different aspect of food nutrients and interactions.								
CO2	Understand and apply different aspect of diet modification and adaptations in metabolic and systemic diseases state								
CO3	Analyse and understand different diet for inborn error metabolism								
CO4	Acquired knowledge on the planning diet for different conditions								
CO5	Apply therapeutic diet for extreme nutrient required patients.								
Unit- No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Nutrient and drug interaction:</b> Effect of Nutrition on Drug, Drug Effects on Nutritional Status, Drug and Drug Interaction		5	Learn the importance of Nutrient and drug interaction				1,2	
II	<b>Nutritional management in cancer, Aids, hematological disorders and burns</b>		10	Learn different types of diet for AIDS				1,2	
III	<b>Nutritional management in hepatic disorders:</b> Viral Hepatitis, Liver Cirrhosis, Hepatic encephalopathy or Hepatic coma  <b>Nutritional management in pulmonary disorders:</b> Asthma, COPD, Bronchitis, Pneumonia		10	Learn different types of diet modification for liver and pulmonary diseases.				1,2	
IV	<b>Nutritional management in renal diseases:</b> Acute and Chronic renal diseases, Nephrotic Syndrome, Renal calculi, ESRD, Renal Transplantation		10	Learn different types of diet modification for renal diseases				1,2	
V	<b>Nutritional management in neurological and mental disorders:</b> Eating disorders, Alzheimer's disease, Parkinson's		10	Learn different Types of diet modification for neurological disorders				1,2	

	disease, Nutritional and holistic care for neurological and mental disorder. <b>Inborn Errors of Metabolism</b>			
<b>VI (Practical)</b>	<ol style="list-style-type: none"> <li>1. Planning, preparation and calculation of nutritive value of hepatic disorders: Viral Hepatitis, Liver Cirrhosis</li> <li>2. Planning, preparation and calculation of nutritive value of hepatic disorders: Hepatic encephalopathy or hepatic coma</li> <li>3. Planning, preparation and calculation of nutritive value of pulmonary disorders: Asthma, COPD, Bronchitis, Pneumonia</li> <li>4. Planning, preparation and calculation of nutritive value of renal disorders: Nephrotic syndrome, Dialysis</li> <li>5. Planning, preparation and calculation of nutritive value of renal disorders: Renal calculi and Renal Transplantation</li> <li>6. Planning, preparation and calculation of nutritive value of cancer</li> <li>7. Planning, preparation and calculation of nutritive value of AIDS</li> <li>8. Planning, preparation and calculation of nutritive value of anemia, burns</li> </ol>	<b>16</b>	Learn diet modifications of liver disorders, Learn diet modifications of Nephrotic disorder	1,2

### TEXT BOOKS:

T1: **Srilakshmi.B.**, Dietetics, New Age International (P) Ltd, Publishers, 2014

T2: **Mahan, L.K. and Escott-Stump, S. (2000)**: Krause's Food Nutrition and Diet Therapy, 10th Edition, W.B. Saunders Ltd.

### REFERENCE BOOKS:

R1: **Srilakshmi.B.**, Dietetics, New Age International (P) Ltd, Publishers, 2014

R2: **Robinson C. H., Lawer M. R., Chenoweth.WIC., and Garwich A. E.**, Normal and therapeutic nutrition, McMillan Publishers Co., Newyork, XVII Edition, 1986.

R3: **Mahan, L.K. and Escott-Stump, S. (2000)**: Krause's Food Nutrition and Diet Therapy, 10th Edition, W.B. Saunders Ltd.

R4: **Escott-Stump,S.(1998)**: Nutrition and Diagnosis Related Care, 4<sup>th</sup> Edition, Williams and Wilkins

R5: **Raymond,J.L.,& Morrow, K.** (2020). Krause and mahan's food and the nutrition care. Elsevier Health Science

R6: **Antia F.P., & P. Abraham.** (2002). Clinical Dietetics and Nutrition.

### OTHERLEARNINGRESOURCES:

Courseera, swayam

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the different aspect of food nutrients and interactions.	<b>1,2,3</b>
<b>2</b>	Understand and apply different aspect of diet modification and adaptations in metabolic and systemic diseases state	<b>1,2,3</b>
<b>3</b>	Analyse and understand different diet for inborn error metabolism	<b>1,2,3</b>
<b>4</b>	Acquired knowledge on the planning diet for different conditions	<b>1,2,3</b>
<b>5</b>	Apply therapeutic diet for extreme nutrient required patients.	<b>1,2,3</b>

SEMESTER – III									
Course Title	APPLIED NUTRITION II								
Course code	22MSFD217R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives (Minimum 3)	1. To study a different aspect of food standards and safety. 2. To study the different regulatory bodies of food safety and production.								
CO1	Understand the different applications of food science in food production and packaging.								
CO2	Give them a clear picture of regulatory bodies of food science and technology.								
CO3	Understand the recent trends of health foods.								
CO4	Acquired knowledge on different packaging material.								
CO5	Evaluate the significance of recent food trends								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Introduction:</b> Aim and Objectives of Food Science and Technology <b>Constituents of Food:</b> Chemical, Physical and Nutritional Alterations Occurring in Foods During Processing and Storage <b>Enzymes of importance in food processing:</b> Carbohydrates, Proteases, lipases, Oxidoreductases, Hydrolases.		5	Learn different Constituents of foods					
II	<b>Introduction to advanced technologies used in food processing:</b> Agglomeration, agitation, air classification, Membrane technology (reverse osmosis and ultra Filtration), high pressure, surface heat exchanger, ohmic resistance heating, super critical extraction. <b>Pre and Primary Processing:</b> Some Basic Concepts <b>Fermentation, Semi Processed Foods, Instant Foods</b>		10	Learn technologies used in food processing					
III	<b>Quality Evaluation of Food:</b> Requirement for conducting sensory tests, Types of tests, limitation of sensory evaluation. Objective methods of evaluation of food.		10	Learn different types of quality evaluation of food					
IV	<b>Food Trends:</b> Changing food trends and consumer behavior in, Purchasing foods, LifeStyle changes: economic, socio-cultural, Psychological influences and marketing influences.		10	Learn different Food Trends					

<b>V</b>	<b>Food Packaging:</b> Food packaging-Principles in the development of safe and protective packing, Packaging materials (metals, glass, paper and plastics) use of packaging in extending shelf life of unprocessed foods (modified atmosphere packaging, Biodegradable Plastics). <b>Food Safety:</b> Food Toxins, Food Standards	<b>10</b>	Learn different types of food packaging	
<b>VI (Practical)</b>	1. Introduction to different equipment in processing and preservation 2. <b>Preservation by heat treatment:</b> Sterilization, 3. <b>Preservation by heat treatment</b> :Blanching 4. <b>Preservation by cold treatment</b> :Refrigeration 5. <b>Preservation by cold treatment:</b> Freezer, deep freezing 6. <b>Different methods of drying:</b> Mechanical drying 7. <b>Different methods of drying</b> :Sun drying 8. <b>Preparation of extruded products</b>	<b>16</b>	Learning the equipment of processing and preservation, Techniques of heat treatment, Techniques of cold treatment, Techniques of dry treatment, Techniques of extruded products	

#### TEXTBOOKS:

- T1: **Norman N. Potter and Joseph H. Hotchkiss** (1999) Food Science, Springer  
T2: **G. Subbulakshmi and Shobha U Udipi** (2006) Food Processing and Preservation. New age publishers; First edition (1 January 2006)

#### REFERENCEBOOKS:

- R1: **Norman N. Potter and Joseph H. Hotchkiss** (1999) Food Science, Springer  
R2: **Fields, M. L.**(1979). *Fundamentals of food microbiology*. AVI Publishing Co.Inc.  
R3: **Matthews, K.R.,Kniel, K.E., & Montville,T.J.** (2017). *Food microbiology:an introduction*. John Wiley & Sons.

#### OTHERLEARNINGRESOURCES:

Courseera, swayam

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand the different applications of food science in food production and packaging.	1,2
2	Give them a clear picture of regulatory bodies of food science and	1,2

	technology.	
3	Understand the recent trends of health foods.	1,2
4	Acquired knowledge on different packaging material.	1,2
5	Evaluate the significance of recent food trends	1,2

SEMESTER – III									
Course Title	CORPORATE PROFICIENCY (Communicative English & SoftSkills)								
Course code	22UMPD211R	Total credits: 2 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1.To acquaint students with the various tools of an effective presentation. 2.To acquire the speaking skill instruct, influence, engage, educate, or appease the listeners. 3.To increase proficiency, presentability and quality of resume and provide guidance for self-promotion and self-evaluation in social media. 4.To prepare and train the students for the campus drives & walking interviews.								
CO1	It will prepare the learners to speak with greater control and charisma in front of others.								
CO2	It will have a positive impact in their thought process and problem-solving skills.								
CO3	It will arm the students with all the necessary tools and skill sets to prepare professional resume. They will learn to highlight and assess themselves in social media.								
CO4	It will impart in them techniques to solve critical problems in an interview, develop strategies to crack interviews, improve their communication skills, boost their confidence								
CO5	It will prepare the learners to speak with greater control and charisma in front of others.								
Unit-No.	Content								
I	<b>Module1-Presentation Skills</b> i. Introduction ii. Essential characteristics of a good presentation iii. Preparation of a good presentation								
II	<b>Module2-PublicSkills</b> i. Fear of Public Speaking, ii. Understanding and Overcoming Fear of Public Speaking, iii. Confidence and Control, iv. Physiology and Stress - Control/Process, v. Tips for Presentations and Public Speaking, vi. Tips for Using Visual Aids in Presentations, vii. Process for Preparing and Creating Presentations, viii. Delivering Presentations Successfully, Doubt Clearing and Summary of Main Points								
III	<b>Module 3-Practical session on Resume, Curriculum Vitae, Writing cover letter &amp; LinkedIn Profile</b> i. Preparation, submission & screening of Resume. ii. Practical session on cover letter screening session iii. Creating a profile on LinkedIn How to utilize it								
IV	<b>Module 4-Leadership &amp; Management Skills</b>								

	<ol style="list-style-type: none"> <li>i. Concepts of Leadership,</li> <li>ii. Leadership Styles,</li> <li>iii. Manager VS Leader,</li> <li>iv. How to be an Effective Leader,</li> <li>v. Mock/Practice Session,</li> <li>vi. Doubt Clearing Session.</li> </ol>
<b>V</b>	<p><b>Module 5-Research Paper–Writing Skills</b></p> <ol style="list-style-type: none"> <li>i. How to write a research paper</li> </ol> <p style="text-align: center;">Key point in Research Work</p>
<b>VI (Practical)</b>	<p><b>Module 6- Interview Skills &amp; Dresscode Ethics</b></p> <ol style="list-style-type: none"> <li>i. Types of the interview-telephonic, virtual &amp; face to face</li> <li>ii. Online interview, personal interview,</li> <li>iii. Panel interview,</li> <li>iv. Group interview,</li> <li>v. JAM session,</li> <li>vi. Types of interview questions-traditional/common interview questions,</li> <li>vii. Case interview questions,</li> <li>viii. General Strategies for answering questions,</li> <li>ix. Marketing your skills and experiences,</li> <li>x. Preparation before the interview,</li> <li>xi. How to dress up for an interview,</li> <li>xii. How to maintain eye contact and positive body language,</li> <li>xiii. How to be presentable,</li> <li>xiv. Interview dos and don'ts,</li> <li>xv. Introduction to Dress Code Ethics,</li> <li>xvi. Purpose and Importance</li> <li>xvii. How to Make 'FIRST IMPRESSION'</li> </ol> <p style="text-align: center;">What to Wear During Interviews or Any Other Formal Meetings–Male &amp; Female</p>
<b>VII</b>	<p><b>Module 7- Mock Interview</b></p> <ol style="list-style-type: none"> <li>i. Practical Mock Interview,</li> <li>ii. Feedback-Receiving Feedback,</li> <li>iii. Giving Feedback,</li> <li>iv. Advantages of Effective Feedback,</li> <li>v. How to deal with negative feedback.</li> </ol>

### TEXTBOOKS:

T1: Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

T2: McDowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition)

### REFERENCEBOOKS:

R1: Garg. Manoj Kr. (2018) *English Communication: Theory and Practice*

### OTHERLEARNINGRESOURCES:

- <https://brightlinkprep.com/10-best-toefl-prep-books/>
- <https://files.eric.ed.gov/fulltext/EJ1132742.pdf>

## RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	It will have a positive impact in their thought process and problem-solving skills.	
2	It will arm the students with all the necessary tools and skill sets to prepare professional resume. They will learn to highlight and assess themselves in social media.	
3	It will impart in them techniques to solve critical problems in an interview, develop strategies to crack interviews, improve their communication skills, boost their confidence	
4	It will prepare the learners to speak with greater control and charisma in front of others.	
5	It will have a positive impact in their thought process and problem-solving skills.	



SEMESTER – III									
Course Title	ADVANCE NUTRITION								
Course code	22MSFD211R	Total credits: 2 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives (Minimum 3)	<p>1. To study about different concepts of advance nutrition and nutritional requirement in special conditions.</p> <p>2. To study about the recent trends in nutrient modifications and their applications.</p>								
CO1	Understand the efficacy and importance of functional and bioactive components.								
CO2	Understand and apply nutritional knowledge in various aspects like sports nutrition, space nutrition, sea voyage, emergency care etc.								
CO3	Acquired knowledge on recent advances in nutrition.								
CO4	Deliver in depth knowledge on and metabolic role of various nutrients and their interactions in human nutrition.								
CO5	Analyze the pharmacological actions of nutrients and their implications.								
Unit- No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Concept of advanced nutrition:</b> Application of Nutrition Principles; Scope and Limitation of Food, Nutrition and Dietetics; Current advancements in nutrition.	5	Learn the concept of Nutrition and its principles				1,2		
II	<b>Food additives:</b> Functions and uses in processed food products. Chemical, technological and toxicological aspects. <b>Food fortification and Food enrichment:</b> Objectives, principles and nutritional aspects. <b>Epigenetics and Nutrigenomics: specific food modulating nutrigenomics(lycopene, omega3)</b> <b>Nutritional requirements for special conditions:</b> Special nutritional needs for space, military, emergency care and sea voyage.	10	Acquired knowledge of food additive				1,2		
III	<b>Immuno-nutrition:</b> Concept, Definition, Importance, Scope, Different immune-nutrients and their uses in different physiological conditions.	10	Acquired knowledge of immune- nutrients				1,2		
IV	<b>Neutraceuticals:</b> Definition and types, Efficacy and Safety, Dietary and resistant fibre, Probiotics, Prebiotics and Symbiotic, Antioxidant and Pro- Oxidant Aspects. <b>Functional and bioactive components of foods:</b> Definition, chemistry, sources, bioavailability and perspective of food	10	Acquired knowledge of Functional and bioactive components of foods				1,2		

	applications for: polyphenols, phytosterols, pigments (lycopenes, carotenoids), organo-sulphur compounds.			
<b>V</b>	<b>Nutritional requirements for special conditions:</b> special nutrition needs for space, military, emergency care, sea voyage	<b>10</b>	Acquired knowledge of Nutritional requirements for special conditions	1,2

### TEXT BOOKS:

T1: **Sareen S Gropper**, Advanced Nutrition and Human Metabolism, 1990

T2: **Goldberg**, Functional Foods: Designer foods, pharma foods, Nutraceuticals, Chapman & Hall, New York, 1994

### REFERENCE BOOKS:

R1: **Norman N. Potter and Joseph H. Hotchkiss** (1999) Food Science, Springer

R1: **Raffaele Caterina, Al Sareen S Gropper**, Advanced Nutrition and Human Metabolism, 1990

R2: **Goldberg**, Functional Foods: Designer foods, pharma foods, Nutraceuticals, Chapman & Hall, New York, 1994 **fredo Martinez, Martin Kohlmeier**, Principles of Nutrigenetics and Nutrigenomics, 2019, Elsevier

### OTHERLEARNINGRESOURCES:

Courseera, swayam

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand the efficacy and importance of functional and bioactive components.	1,2
2	Understand and apply nutritional knowledge in various aspects like sports nutrition, space nutrition, sea voyage, emergency care etc.	1,2
3	Acquired knowledge on recent advances in nutrition.	1,2
4	Deliver in depth knowledge on and metabolic role of various nutrients and their interactions in human nutrition.	1,2
5	Analyze the pharmacological actions of nutrients and their implications.	1,2

Mapping Table Missing

SEMESTER – III									
Course Title	ENTREPEURSNHIP AND MARKETING								
Course code	22MSFD212R	Total credits: 2 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives (Minimum 3)	1. To know about the concept of entrepreneurship. 2. To study about role and responsibilities of entrepreneur.								
CO1	Explain the concept of entrepreneurship								
CO2	Learn about entrepreneurs motivation								
CO3	Explore world of entrepreneurs								
CO4	Analyze difference between successful and failed entrepreneurs								
CO5	Understand the values and attitudes of successful entrepreneurs								
Unit- No.	Content		Contact Hour	Learning Outcome				KL	
I	Introduction on developing various food products and selection of target group. Market survey and Preparation of questionnaire.		2	Learn to developed novel food product					
II	Standardization of recipe, Preparation method, sensory evaluation.		2	Formulate Questionnaire					
III	Shelf life, packaging, labeling, costing, storage, transportation and distribution, advertising		2	Standardization method & Different packaging material					
IV	Transportation and distribution of the developed product Survey and selling of the developed product		2	Skill of marketing					
V	Report writing and Presentation.		2	Documentation					

#### TEXT BOOKS:

T1: **Manimala, M. J.** Entrepreneurship Theory at the Crossroads: Paradigms and Praxis, 2005

#### REFERENCE BOOKS:

R1: Earle M. and Earle, R. 2007. Case studies in food product development. Woodhead Publishing Ltd., Abington, Cambridge, UK.

R2: Frewer, Land Trijp, H. 2007. Understanding consumers of food products. Woodhead Publishing Ltd., Abington, Cambridge, UK.

#### OTHER LEARNING RESOURCES:

Courseera, swayam

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the concept of entrepreneurship	<b>5,7,8</b>
<b>2</b>	Learn about entrepreneurship motivation	<b>5,7,8</b>
<b>3</b>	Explore world of entrepreneurs	<b>5,7,8</b>
<b>4</b>	Analyze difference between successful and failed entrepreneurs	<b>5,7,8</b>
<b>5</b>	Understand the values and attitudes of successful entrepreneurs	<b>5,7,8</b>

<b>COURSE TITLE</b>	<b>Research Ethics</b>									
<b>COURSE CODE</b>	<b>22UMRE211R</b>	<b>TOTAL CREDITS:1</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>	
		<b>TOTAL HOURS:60</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>1</b>	
<b>PRE-REQUISITE</b>	<b>NA</b>	<b>CO-REQUISITE</b>	<b>NA</b>							
<b>PROGRAMME</b>	<b>Master of Science in Food Nutrition and Dietetics</b>									
<b>SEMESTER</b>	<b>Fall/ 3<sup>rd</sup> Semester of 2<sup>nd</sup> year of the program</b>									
<b>Course</b>	This course aims to lay a foundation for empirical research and make students aware of									

<b>Objectives</b>	relevant guidelines, policies, and codes relating to ethical research, as well as to provide, via a study of ethical theories, concepts.
<b>CO1</b>	<b>Describe and apply research ethics theories and methods.</b>
<b>CO2</b>	<b>Explain research ethics issues such as responsibility, vetting, and misconduct.</b>
<b>CO3</b>	<b>Illustrate arguments and results in ethical research inquiries.</b>
<b>CO4</b>	<b>Identify and apply procedures for sampling, data collection, and reporting.</b>
<b>CO5</b>	<b>Apply ethical principles to research design and evaluation</b>
<b>Unit no</b>	<b>Content</b>
<b>I</b>	<b>ETHICS:</b> Introduction to the course and each other; an introduction to moral theory. Ethics: definition, moral philosophy, nature of moral judgements and reactions. Research regulation; self – regulation; research ethics. Honesty, candor, compromise and integrity. Data ownership and stewardship; conflicts of interest; collaboration. Human and Non-Human subjects. Research and researchers in society.
<b>II</b>	<b>SCIENTIFIC CONDUCT-</b> Ethics with respect to science and research. Intellectual honesty and research integrity. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP). Redundant publications: duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data
<b>III</b>	<b>PUBLICATION ETHICS-</b> Publication ethics: definition, introduction and importance. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types. Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals.
<b>IV</b>	<b>OPEN ACCESS PUBLISHING-</b> Open access publications and initiatives. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies. Software tool to identify predatory publications developed by SPPU. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.
<b>V</b>	<b>PUBLICATION MISCONDUCT</b> Group Discussions; Subject specific ethical issues, FFP, authorship. Conflicts of interest. Complaints and appeals: examples and fraud from India and abroad. Software tools; Use of plagiarism software like Turnitin, Urkund and other open source software tools. <b>DATABASES AND RESEARCH METRICS</b> –Databases: Indexing databases. Citation databases: Web of Science, Scopus, etc. Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score. Metrics: h-index, g index, I 10 index, altmetrics.

### Text Books

Bird, A(2006).Philosophy of Science.Routledge.

MacIntyre, Alasdair (1967) A Short History of Ethics.London.

Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance(2019)

### Reference Books

National Academy of Science, National Academy of Engineering and Institute of Medicine (2009).

On Being a Scientist: A Guide of Responsible Conduct in Research: Third Edition, National academicsPress

George R, (2011). Sociological Theory, Rawat Publication, New Delhi, India.  
 GeorgeR,(2019).PostModernSocialTheory,RawatPublication,NewDelhi,India.

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe and apply research ethics theories and methods.	6
2	Explain research ethics issues such as responsibility, vetting, and misconduct.	6
3	Illustrate arguments and results in ethical research inquiries.	5, 6
4	Identify and apply procedures for sampling, data collection, and reporting.	2, 3, 4
5	Apply ethical principles to research design and evaluation	4, 9

SEMESTER – III									
Course Title	MINI RESEARCH (REVIEW OF LITERATURE-R3)								
Course code	22MSFD213R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Fall/ I semester of first year of the programme								
Course Objectives (Minimum 3)	1. Appreciate and understand the importance of various research writing and review. 2. Applying the techniques and skill for writing abstract, short communications.								
CO1	Develop competence in writing and abstracting skill								
CO2	Learn to write literature and review								
CO3	Develop competence in Project proposal								
CO4	Acquired the knowledge to conduct scientific project								
CO5	Analyze the significant aspect of scientific project								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Introduction, Comprehension on research search engines, Selection of Topic								
II	Tools for reference citation, Different methods for writing citation and references, Introduction to structure of Review and specific features of review, Plagiarism, ethical issue in writing the review, Mapping and selection of Journal of specific knowledge of discipline and submission for publications.								

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Develop competence in writing and abstracting skill	3
2	Learn to write literature and review	3
3	Develop competence in Project proposal	3
4	Acquired the knowledge to conduct scientific project	3
5	Analyze the significant aspect of scientific project	3

SEMESTER – III									
Course Title	BASIC OF NUTRITION								
Course code	22MSFD214R	Total credits: 2 Total hours: 30T	L	T	P	S	R	O/F	C
			2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives (Minimum 3)	<ol style="list-style-type: none"> <li>To introduce the students the basics of nutrition, importance of food.</li> <li>To understand the functions, sources of nutrients.</li> <li>To study about the requirements and importance of different macro and micronutrient in different stage of life</li> </ol>								
CO1	Understand the basic terms related to nutrition and its correlation with human health.								
CO2	Understand the functioning of macronutrients in details.								
CO3	Comprehend the knowledge on nutritional problems and complications								
CO4	Acquire knowledge on micronutrients in details								
CO5	Assess and compare diet and nutritional requirements relative to age, developmental and disease status								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<p><b>Food, nutrition and health:</b> Basic definitions, function of food, classification of food according to function and nutritive value, physiological, psychological and social function of food.</p> <p><b>Recommended dietary allowances:</b> Definition, biological value, bioavailability, Minimal and optimal Nutritional Requirements, Formulation of RDA and Dietary Guidelines- Reference Man and Reference women, factors affecting RDA.</p>	5	Learn the concept of Nutrition and its principles						

<b>II</b>	<b>Carbohydrates:</b> Definition, classification and function. glycemic index, dietary fiber and its importance, RDA, sources, metabolic disorder associated with carbohydrate.  <b>Protein:</b> Definition, classification and function, sources, disorders due to deficiency or excess.	<b>10</b>	Acquired knowledge of carbohydrates and its metabolism	
<b>III</b>	<b>Fat:</b> Definition, classification and functions, RDA, sources, disorders due to deficiency or excess, dietary fat and coronary heart disease.	<b>10</b>	Acquired knowledge of protein and its metabolism	
<b>IV</b>	<b>Vitamins and minerals:</b> Physiological role, requirements, sources, deficiency and excess(Fat soluble and water soluble) <b>Water:</b> Distribution of water in the body, function of water, requirements and human water balance system	<b>10</b>	Acquired knowledge of vitamins & minerals and its metabolism	
<b>V</b>	<b>Nutrition for Life Cycle:</b> Infancy, toddlers, childhood, adulthood-pregnancy and lactation, geriatric nutrition	<b>10</b>	Learning the nutritional requirements for different age group	

#### TEXT BOOKS:

T1: **Sumathi R. Mudambi, Rajagopal, M. V.**, Fundamentals of Foods and Nutrition, NewAge International (P) Ltd, Publishers, Third edition, 1997.

T2: **Srilakshmi, B.** Nutrition Science, New Age International (P) Ltd, Publishers, 2004.

#### REFERENCE BOOKS:

R1: **Srilakshmi. B.**, Dietetics, Wiley Eastern Ltd., New Delhi, 2003.

R2: **Robinson C. H., Lawer M. R., Chenoweth. WIC., and Garwich A. E.**, Normal and therapeutic nutrition, McMillan Publishers Co., Newyork, XVII Edition, 1986.

#### OTHER LEARNING RESOURCES:

Courseera, swayam

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand the basic terms related to nutrition and its correlation with human health.	1,2
2	Understand the functioning of macronutrients in details.	1,2
3	Comprehend the knowledge on nutritional problems and complications	1,2
4	Acquire knowledge on micronutrients in details	1,2
5	Assess and compare diet and nutritional requirements relative to age, developmental and disease status	1,2



SEMESTER – IV									
Course Title	INTERNSHIP								
Course code	22MSFD221R	Total credits: 6 Total hours: 24P	L	T	P	S	R	O/F	C
			0	0	0	24	0	0	6
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Fall/ 4 <sup>th</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives (Minimum 3)	1. To gain hands on experience of working in various institutions related to the area of Food and Nutrition. 2. To learn the inter-relationship and intra-relationship between the employee								
CO1	Extend field experience to apply therapeutic intervention strategies in hospital/industry setup								
CO2	Apply therapeutic knowledge and acquire practical skills in the field of expertise								
CO3	Evaluate and manage hospitalized patients with nutrition intervention strategies								
CO4	Analyze thoughtful assessments and plans for evaluation and management in the work								
CO5	Environment								

**Hospital internship will be continued in the downtown hospital for 60 days.**

- 1. Front page:** Name of University, University Logo, Name of the Student, Class, Department
- 2. Certificate**
- 3. Acknowledgement**
- 4. Contents**
- 5. Introduction**
- 6. Activities**
  - A. Activity I: Internship details**
    - Name of the Institution where the internship was undertaken
    - Dietitian incharge under whose Supervision Internship undertaken

(Name and Designation)

- Duration and date of internship
- Dietetic department profile and organization
- Posting schedule of the intern

Day/week	Posting	Activities schedule and undertaken

- Kitchen layout
- Food procurement and storage
- Schedule/timing for meal distribution
- Dietetic department menu

**B. Activity II: Modified therapeutic diets and special feeding methods**

**C. Activity III: Clinical posting and nutritional care of patients**

i. Ward posting detail

- Major disease conditions observed and Medical Nutrition Therapy recommended during ward posting

Sl.No	Ward Posting	Major disease conditions observed	Recommended diets

ii. Nutrition and diet counseling

- List of educational material available
- Nutrition and diet counselling for both In and Out patients

Date/Time	IPD/OPD Posting	Counseling details

Note: Separate table for IPD and OPD

**D. Activity IV: Casestudies**

**-Disease case**

Case problem (indicate the disease condition)

**-Patient**

**profile**

Patient name

Age

Weight (kg)

Food habits Occupation

Educational qualification lifestyle

Date of admission

Date of discharge

Duration of stay

Medical diagnosis

Past history

**Medical history of the case**

- **Present problem**
- **Physical parameters examination**
- **Biochemical parameters**

Parameters analyzed	At the time of admission	At the time of discharge	Normal values during the treatment

**Management and treatment details**

- i. Drug therapy (give the name of the drug/injections etc given/prescribed)
- ii. Blood glucose monitoring (record in tabular form and follow-up the patient's blood glucose level if analyzed before breakfast, before lunch and/or before dinner the period of hospitalization). (note: only for diabetes mellitus)
- iii. Dietary management of the disease condition
- iv. Nutrition/diet counseling
- v. Care prognosis:(comment on the portable course and outcome with respect to patient's condition/after the disease treatment in the hospital)
- vi. Case study outcome: (brief highlights how the case study helped in your understanding of the dietary management of the disease condition under study)

**E. Activity V: Presentation**

3. **Annexure/Appendices:** Abbreviations, Biochemical Parameters, Portion Size, Diet Sheets etc

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Extend field experience to apply therapeutic intervention strategies in hospital/industry setup	1,2,5,7
2	Apply therapeutic knowledge and acquire practical skills in the field of expertise	1,2,5,7
3	Evaluate and manage hospitalized patients with nutrition intervention strategies	1,2,5,7
4	Analyze thoughtful assessments and plans for evaluation and management in the work environment	1,2,5,7
5	Identify the scope of exposure and employment opportunities in the relevant field	1,2,5,7

Mapping Table Missing

SEMESTER – IV									
Course Title	RESEARCH/DATA ANALYSIS/DOCUMENTATION								
Course code	22MSFD222R	Total credits: 12	L	T	P	S	R	O/F	C
		Total hours: 20P	0	0	20	4	6	0	12
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Food Nutrition and Dietetics								
Semester	Fall/ 4 <sup>th</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives (Minimum 3)	1. Appreciate and understand the importance of importance of various research writing and review 2. Learning to write Abstract and short communication								
CO1	Develop competence in writing and abstracting skill								
CO2	Learn to write literature and review								
CO3	Develop competence in Project proposal								
CO4	Acquired the knowledge to conduct scientific project								
CO5	Analyze the significant aspect of scientific project								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Introduction Review of literature Materials and methods Results and Discussion Summary Annexure/Appendices Presentation of the research work								

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Develop competence in writing and abstracting skill	<b>3</b>
<b>2</b>	Learn to write literature and review	<b>3</b>
<b>3</b>	Develop competence in Project proposal	<b>3</b>
<b>4</b>	Acquired the knowledge to conduct scientific project	<b>3</b>
<b>5</b>	Analyze the significant aspect of scientific project	<b>3</b>

**MAPPING TABLE**

Course code	Course Name	PO1 *	PO2	PO3	PO4	PO5	PO6	PO7	PO8
22MSFD111R	Macronutrients	3	1	1					
22MSFD112R	Human Physiology	2	1						
22MSFD113R	Nutritional Biochemistry I	3							
22MSFD114R	Advance Food Science	3							
22MSCE111R	MOOCS-CE I								3
22UMFS111R	Fundamental of Statistics		3						
22MSFD115R	Mini Research(R1)			3					
22UMPD111R	Effective English				3				
22MSFD121R	Micronutrients	3							
22MSFD122R	Nutritional Biochemistry II	3							
22MSFD123R	Public Nutrition	3							
22MSFD124R	Food Microbiology and Food Safety	3							
22MSFD125R	Packaging Technology	3							
22UMPD121R	Communication Mastery				3				
22MSFD126R	Generic elective								3
22UUHV101R	Universal human Values					3			3
22UMRM121R	Research Methodology and Statistical Analysis	1		3					
22MSCE121R	Moocs-CE II								3
22MSFD127R	Mini Research(R2)			2	3				
22UUDL1103R	Computational System and Digital Literacy							1	3
22UMPD211R	Corporate Proficiency							1	3

22MSFD211R	Advance Nutrition	3							
22MSFD212R	Product Development and Marketing	3							
22MSFDCE211R	MOOCS-III								3
22MSFDCE212R	MOOCS-IV								3
22UMRE211R	Research Ethics				3				
22MSFD213R	Mini Research (Survey/Experiments-R3)		2	3					
22MSFD214R	Generic elective								3
22UUFL202R	Personal Financial Planning								3
22MSFD215R	Applied Nutrition I	3							
22MSFD216R	Applied Nutrition II	3							
22MSFD217R	Clinical Nutrition I	3							
22MSFD218R	Clinical Nutrition II	3							
22MSFD221R	Internship	3				3		3	
22MSFD222R	Research/Data Analysis/Documentation-R4			3					
22MSCE21R	MOOCS-V								3



# Assam down town University

## Curriculum and Syllabus

### Master of Science in Biotechnology



OUTCOME BASED EDUCATION FRAMEWORK  
CHOICE BASED CREDIT SYSTEM

Version: 2.0

**FACULTY OF SCIENCE**

July, 2022



## Preamble

Assam down town University is a premier higher educational institution which offers Bachelor, Master, and Ph.D. degree programmes across various faculties. These programmes, collectively embodies the vision and mission of the university. In keeping with the vision of evolutionary changes taking place in the educational landscape of the country, the university has restructured the course curriculum as per the guidelines of National Education Policy 2020. This document contains outline of teaching and learning framework and complete detailing of the courses. This document is a guidebook for the students to choose desired courses for completing the programme and to be eligible for the degree. This volume also includes the prescribed literature, study materials, texts, and reference books under different courses as guidance for the students to follow.

Recommended by the 22<sup>nd</sup> Board of Studies (BoS) meeting of the Faculty of Science held on dated 22/06/2022 and approved by the Emergent Academic Council (AC) meeting held on dated 30/07/2022



*Chairperson  
Board of Studies*



*Member Secretary  
Academic Council*



## ***Vision***

To become a Globally Recognized University from North Eastern Region of India, Dedicated to the Holistic Development of Students and Making Society Better

## ***Mission***

1. Creation of curricula that address the local, regional, national, and international needs of graduates, providing them with diverse and well-rounded education.
2. Build a diverse student body from various socio-economic backgrounds, provide exceptional value-based education, and foster holistic personal development, strong academic careers, and confidence.
3. Achieve high placement success by offering students skill-based, innovative education and strong industry connections.
4. Become the premier destination of young people, desirous of becoming future professional leaders through multidisciplinary learning and serving society better.
5. Create a highly inspiring intellectual environment for exceptional learners, empowering them to aspire to join internationally acclaimed institutions and contribute to global efforts in addressing critical issues, such as sustainable development, Climate mitigation and fostering a conflict-free global society.
6. To be renowned for creating new knowledge through high quality interdisciplinary research for betterment of society.
7. Become a key hub for the growth and excellence of AdtU's stakeholders including educators, researchers and innovators
8. Adapt to the evolving needs and changing realities of our students and community by incorporating national and global perspectives, while ensuring our actions are in harmony with our foundational values and objectives of serving the community.

# Programme Details

## Programme Overview

M Sc. Biotechnology offers a wide range of courses covering various basic and applied areas of life sciences. The student develops an aptitude and scientific temperament to apply the technical skills in various important areas of Biotechnology such as Immunology, Agricultural Biotechnology, Medical Biotechnology, Plant Biotechnology, and Molecular Biology. The course also offers various techno specific skills, universal ethics and elective courses considering overall development and employability scopes in research, industry and teaching sectors. The course duration is for a period of 2 years.

### I. Specific Features of the Curriculum

- Experiential learning
- Constructivist approach to learn
- Practical and project based learning

### II. Eligibility Criteria:

BSc in any area of life sciences with minimum of 45% marks or equivalent CGPA.

### III. Program Educational Objectives (PEOs):

**PEO-1:** Students will demonstrate expertise in the field of modern biotechnology through a dynamic, research-focused curriculum tailored to meet the demands of both academic and industrial settings.

**PEO-2:** Students will expand their career prospects in industries and laboratory environments, globally through hands-on experiences in cutting-edge laboratories and dissertation projects that encourage the development of global competencies.

**PEO-3:** Students will be equipped with leadership qualities that enable them to safeguard the product of their intellect, staying updated on emerging trends and adapting to industry demands required by national and international organizations.

### IV. Program Specific Outcomes (PSOs):

**PSO1: Interdisciplinary Knowledge:** Able to understand the concept of life sciences and apply the knowledge for empowerment to address challenges within the domains of biotechnology enabling employment opportunities in the relevant field.

**PSO2: Research & Innovation:** Should have the ability to promote a multidisciplinary approach for research exploration and collaboration with professionals across diverse disciplines of life science.

**PSO3: Entrepreneurial Ability Development:** Execute innovative ideas within the field of biological research and development by employing scientific methodologies to gain in-

depth knowledge, ultimately contributing to entrepreneurial developments.

#### **V. Program Outcome:**

**PO1: Biotechnology Knowledge:** Apply comprehensive knowledge of basic sciences, classical and applied life sciences, process technology, computational biology, biostatistics, and analytical techniques in rendering biological interventions to solve biotechnological problems.

**PO2: Problem Analysis:** Identify, formulate, review literature, design and evaluate complex biological problems by applying critical thinking to draw sustainable and strategic solutions.

**PO3: Solution Design:** Design solutions for complex life science problems and develop systems and processes for holistic socioeconomic development.

**PO4: Investigation and Research:** Conduct research applying comprehensive knowledge and scientific methods, data analyses and interpretation to provide conclusions.

**PO5: Communication:** Communicate effectively with peers, stakeholders and community, and able to prepare documents, scientific reports and impactful presentations.

**PO6: Professional Ethics and Values:** Comply with human values, ethics and norms of scientific practice in the profession.

**PO7: Environment and Sustainability:** Evaluate the impact of formulated biotechnological solutions in socio-economic and environmental contexts, and redesign it for sustainable global development.

**PO8: Leadership & Teamwork:** Work independently, and as a member/ leader in diverse teams, and in multidisciplinary settings

**PO9: Lifelong Learning:** Ability to engage in independent and life-long learning in the broadest context of scientific and technological advances.

#### **VI. Total Credits to be Earned: 100**

#### **VII. Career Prospects:**

M.Sc. in Biotechnology offers a range of dynamic career opportunities. Graduates can work in research and development, pharmaceuticals, and agricultural biotech. Roles include lab technicians, quality control analysts, and clinical researchers. Additionally, graduates can pursue careers in regulatory affairs, ensuring compliance with biotech regulations, or work in environmental biotech, focusing on sustainable solutions. Opportunities also exist in academia and education, where graduates can contribute to scientific knowledge and train future professionals.

## EVALUATION METHODS

The student performance shall be evaluated through In-semester (Sessional) and semester-end examinations. A weightage of 40% or as prescribed by the programme shall be added to the score of the end-semester examination.

### A. INTERNAL ASSESSMENT:

The teacher who offers the course shall be responsible for internal assessment by conducting in-semester (sessional) examination and evaluating the performance of the students pursuing that course. The components for internal assessment are illustrated in the table given below.

SN	Components/ Examinations	Marks Allotted
1.	In-Sem Exam – I (ISE-I) (Written Examination)*	30
2.	In-Sem Exam – II (ISE-II) (Written Examination)*	30
3.	Assignment	10
4.	Presentation (SP)	10
5.	Quiz	5
6.	Class Performance based score*	5

*\*are compulsory*

**Note:** Total Internal assessment should be out of 40

### INSTRUCTIONS

1. If a student fails to appear in the any of the component without any valid reason he/she shall be marked zero in that component. However, the course teacher at his discretion may arrange for the missed test on an alternate date for the absentee students after determining ground with genuine/valid reasons for the absent.
2. The report of evaluation of an activity towards the in-semester (sessional) component of a course shall be duly notified by the concerned course teacher within a week of completion.
3. The program coordinators should upload the in-semester marks to the ERP and forward acknowledgement of all the courses of the program to the Controller of Examinations before the start of the End-semester examination.

### B. SEMESTER END EXAMINATION:

Time table for end semester examination is published at least 25 days prior to the start of Examination.

## I. Pre-Examination:

### Eligibility Criteria for a student to appear in University Examinations:

The student shall only be allowed to appear in a University Examination, if:

- i) He/ She is a registered student of the University;
- ii) He/ She is of good conduct and character;
- iii) He/ She has completed the prescribed Programme of study with minimum percentage of attendance as laid down in the Regulations of the Programme concerned.

Under special cases, a student may be allowed to appear for an examination without being registered in the University but the result of the said student will be kept on hold till the registration of the concerned student is completed.

## II. Admit Card:

Admit card for the examination may be downloaded through ERP where the system will generate a Unique ID Card online.

The University shall have the right to cancel admission for examination of any candidate on valid grounds.

## III. Pattern of Question Papers:

The question paper shall follow the principles of Bloom's Taxonomy.

S. N.	Level	Questions /verbs for test
1	Remember	List, Define, tell, describe, recite, recall, identify, show who, when, where, etc.
2	Understand	Describe, explain, contrast, summarize, differentiate, discuss, etc.
3	Apply	Predict, apply, solve, illustrate, determine, examine, modify
4	Analyze	Classify, outline, categorize, analyze, diagrams, illustrate, infer, etc.
5	Evaluate	Assess, summarize, choose, evaluate, recommend, justify, compare etc.
6	Create	Design, Formulate, Modify, Develop, integrate, etc.

**Note:** No course is to be evaluated on basis of **all 6 knowledge levels**.

The format of the question paper across all the program follow a unique pattern and the total marks is 60

**Table 1: Question paper pattern for End semester examination**

<b>Sl no</b>	<b>Question pattern</b>	<b>Total marks</b>
1	MCQs (10 Questions)	10
2	2 Marks questions (10 Questions)	20
3	4 Marks questions (5 Questions)	20
4	10 Marks questions (1 Question)	10

#### **IV. Examination Duration:**

Each paper of 60 marks shall ordinarily be of two hours duration.

#### **V. Practical Examinations, Viva-Voce etc.:**

- i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.
- ii) Viva-Voce, Oral examinations of the Project report, Dissertation etc. shall be undertaken by a Board of Examiners constituted by the respective Dean of Program with the advice of Supervisor(s).

#### **VI. Procedure of Expulsion:**

If any candidate is found to be using any unfair-means during the examination, the invigilator may cease his/her answer sheet and report it directly to the Officer-in-Charge. The Office-in-Charge of the center may take appropriate decisions as per the rules and procedure of the examination. The Officer-in-Charge may allow the students to write the exam with new answer sheet or may expel the student from appearing the paper depending on the nature of unfair-means. In case of Computer based test, the students may be directed to write an apology letter and sign in the prescribe expulsion form. The student may not be allowed to write that examination.

#### **VII. Instruction to the Students:**

- (i) The students shall not bring to the Examination Hall, any electronic gadget used as a means of communication or record except electronic calculator, if required.
- (ii) The students shall not receive any book or printed or hand written or photo copy (Xerox) or blank-paper from any other person while he/she is in the examination-room or in laboratory or in any other place to which he/she is allowed to have access during course of examination.

- (iii) The students shall not communicate with any other candidate in the examination room or with any other person in and outside the examination-room.
- (iv) The students shall not see, read or copy anything written by any other candidate, nor shall he/she knowingly or negligently permit any other candidate to see, read or copy anything written by him/her or conveyed by him/her.
- (v) The students shall not write anything on the Question Paper or in other paper or materials during the examination, or pass any kind of paper to any other candidate in the examination-room, or to any person outside the room.
- (vi) The students shall not disclose his/her identity to the examiner by writing his/her name or putting any sign / symbol in any part of his answer-script.
- (vii) The students shall not use any abusive language or write any objectionable remark or make any appeal to examiner by writing in any part of his answer-script.
- (viii) The students shall not detach any page from the answer-script or insert any authorized or unauthorized loose sheet into it. He /she shall also not insert any other answer-script / loose sheet by removing the pins of the origin answer-scripts and re-fixing it.
- (ix) The students shall not resort to any disorderly conduct inside the examination-room or misbehave with the invigilator or any other examination official.

### **VIII. Provision for an Amanuensis (writer):**

- (i) A candidate may be provided with an Amanuensis (writer) to write down on dictation on his / her behalf on ground of his / her physical disability to write down by himself / herself due to accident or any other reason. The amanuensis may be provided till he / she recovers from the physical disability. The physical disability to write down by himself / herself must be supported by Medical Certificate from a competent Medical Officer.
- (ii) The qualifications of the amanuensis so provided must not be equal or higher than that of the candidate. This is also to be supported by Certificate from the Faculty of Study where the Amanuensis is provided.
- (iii) Such candidates are to be accommodated in a separate room under the supervision of an invigilator so that the fellow candidates are not disturbed in the process.

### **C. Credit Point:**

It is the product of grade point and number of credits for a course, thus,  $CP = GP \times CR$

#### **i. Credit:**

A unit by which the course work is measured. It determines the number of hours of instructions required per week. 'Credit' refers to the weightage given to a course, usually in



terms of the number of instructional hours per week assigned to it. Credits assigned for a single course always pay attention to how many hours it would take for an average learner to complete a single course successfully.

## ii. Grade Point:

Grade Point is a numerical weight allotted to each Grade Letter on a 10-point scale.

## iii. Letter Grade:

Letter Grade is an index of the performance of students in a said paper of a particular course. Grades are denoted by letters O, A+, A, B+, B, C, P, F and Abs. Student obtaining Grade F / Grade Abs shall be considered failed/ absent and, will be required to appear in the subsequent ESE. The UGC recommends a 10-point grading system with the following (Table: 1) Letter Grades:

- (i) A Letter Grade shall signify the level of qualitative/quantitative academic achievement of a student in a Course, while the Grade Point shall indicate the numerical weight of the Letter Grade on a 10-point scale.
- (ii) There shall be 08 (eight) Letter Grades bearing specific Grade Points as listed in Table 1, where the Letter Grades ‘O’ to ‘P’ shall indicate successful completion of a course.
- (iii) Apart from the 08 (eight) regular Letter Grades listed in Table 1, there shall be 03 (three) additional Letter Grades, which shall be awarded if a Course is withdrawn or spanned over the next Semester or remains incomplete as stated in Table 2.

**Table 2: Letter Grades and Grade Points**

Letter Grade	Grade Points	Description
O	10	Outstanding
A+	9	Excellent
A	8	Very Good
B+	7	Good
B	6	Above Average
C	5	Average
P	4	Pass
F	0	Fail
Abs	0	Absent
UFM	0	Unfair Means

#### iv. Grade Point Average:

##### a. SGPA (Semester Grade Point Average)

The SGPA of a student in a Semester shall be the weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered in that Semester, irrespective of whether he/she could or could not complete the Courses. More specifically, the calculation of SGPA shall take into account the Courses graded with Letter Grades 'O' to 'F' as given in Table 1.

$$SGPA = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i} \quad (1.1)$$

The SGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.1) up to two decimal places, where n is the total number of Credit Courses registered by the student in that Semester,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  registered Course and  $C_i$  is the Credit (weight) of that Course.

##### b. CGPA (Cumulative Grade Point Average)

- (i) The CGPA of a student in a Semester of a Programme shall be the accumulated weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered and successfully completed so far starting from the enrollment in the Programme. In other words, taking into account all the Courses graded with 'O' to 'P' as given in Table 1.1, generally the CGPA of a student shall be calculated starting from the first Semester of his/her enrolled Programme, while the CGPA of a lateral-entry student shall be calculated starting from the Semester of his/her enrollment.
- (ii) The CGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.2) up to two decimal places, where N is the total number of Credit Courses registered and successfully completed so far by the student,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  completed Course and  $C_i$  is the Credit (weight) of that Course.

$$CGPA = \frac{\sum_{i=1}^N C_i G_i}{\sum_{i=1}^N C_i} \quad (1.2)$$

- (iii) The CGPA shall be convertible into equivalent percentage of marks using Equation  
Conversion of CGPA to percentage marks: = CGPA\*10

## **D. Post-Examination**

### **i. Transcript or Grade Card or Certificate:**

A marking certificate shall be issued to all the registered students after every Semester. The Semester mark sheet will display the course details (code, title, number of credits, grade secured) along with total credit earned in that Semester.

### **ii. Grievance Readdressal Mechanism:**

Students with any dissatisfaction or grievance regarding the marks awarded in any of the Papers / Courses may appeal to the Controller of Examinations for remedial action such as Re-evaluation within 10 days of the declaration of result.

- (i) A student has options to appeal for re-evaluation of his /her answer script to the Controller of Examination.
- (ii) Application for re-evaluation / re-scrutiny of answer scripts shall be made in the definite proforma available with the Examination Office through the head of the respective departments within 10 days of declaration of the results of the respective examinations.
- (iii) The Controller of Examination may appoint an examiner for re-evaluation and will consider and recognize the evaluation done by a University appointed examiner.
- (iv) There shall be no provision for re-evaluation of the Practical Papers, Project Work, and Dissertation etc. However, the students fail in practical examination or viva voce and wish to appear again may apply to be evaluated can do so with the next schedule.
- (v) After screening the application for re-evaluation, the CoE may send the answer scripts of the student to the examiners appointed by the CoE with the approval of Vice Chancellor.
- (vi) The marks/grades achieved by the students after the re-evaluation shall be final and binding.

- (vii) Fresh Marks – sheets / Grade Card shall be issued only if the candidate secures pass marks / passing grade in the re-evaluated paper.
- (viii) Revaluation of answer scripts shall be deemed to be an additional facility provided to the students with a view to improving upon their results at the preceding examination result for any reason whatsoever shall not confer any right upon them for admission to next higher class which matters always be regulated in accordance with the relevant rules or regulations framed by the University.
- (ix) If as a result of revaluation of the candidate attracts the provision of condonation of deficiency, the same may be applied to his/her only for fresh attempt.

# INSTRUCTION TO TEACHERS AND STUDENTS

## (Teaching and Learning Methods)

In all the courses the teacher has to select topics for teacher-method which should not be less than 20 percent. The approach will be direct classroom teaching through a series of lectures delivering concepts using ITC facilities, white or blackboard. Notes may also be circulated to the students; however, the students are to be involved in the preparation of the notes. The teacher will be responsible for selecting the best note for circulation. The teacher-centric methodology has recently fallen out of favour because this strategy for teaching is seen to favour passive students.

### 1. Student- centric / Constructivist Approach:

The topics of the courses may be selected at the start of the class and assigned one topic to each of the students for studying by themselves, prepare presentations, notes, etc., and present at respective class time after consultation and discussion with the course teachers. The teacher facilitates the learning of the students by guiding and providing input and explaining concepts. 60 percent of the course contents may be selected for this purpose. To avoid behaviour problems, teachers must lay a lot of groundwork in student-centric classrooms. Typically, it involves instilling a sense of responsibility in students. In addition, students must learn internal motivation.

**a. Project-Based Learning:** The teacher may select 5 percent of the topics for the purpose and may conduct visits to the laboratory for experiments or field surveys. The selection of the topic may be done considering the available facility for the purpose. However, in the final semester of each of the programme the student has to undergo project-based learning at least 4 months duration. This approach will help the student to think critically, evaluate, analyze, make decisions, collaborate, and more.

**b. Inquiry-Based Learning:** The teacher/ students are supposed to list at least five questions in each contact hour and student solve these question or search for answer which becomes the home work for the students “question-driven” learning approach. The teacher may look for the correctness of the solution or the best possible answer and discuss in the successive class. This will help in the preparation for various competitive examination and develop a habit for search for solutions.

**c. Flipped Classroom:** About 10 percent of the course content has to be completed by this method. In this approach the students are asked to watch video or lecture prepared by the teacher or any video available (relevant to the course). A set of questions may be given to the students for searching answers by the students. The idea is that students should have more time in-classroom focusing on achieving these higher levels of thinking and learning. The Flipped classroom is also an acronym. The letters FLIP represent the four pillars included in this type of learning: Flexible environment, Learning culture shift, Intentional content, and Professional educator. This approach is also a student-centric teaching method.

**d. Cooperative Learning:** The remaining five percent has to be completed by cooperative learning approach. In this approach, the students are allotted problems. During library hours the students along with the teacher visit the library and search for probable solutions for the assigned problem. The same has to be done in groups so that the students discuss among themselves for the appropriate answers. Essentially, cooperative learning believes that social interactions can improve learning. In addition, the approach recreates real-world work situations in which collaboration and cooperation are required.

Teacher-centric or Direct Classroom Teaching: Delivery by series of lectures	20%
Student-centric Approach, Students present and deliver lectures in the presence of teacher and supervised by teacher	60%
Students visit fields or perform experiments or teachers perform demonstration	05%
Flipped Classroom approach	10%
Cooperative learning approach	05%

**Inquiry-based approach has to be followed in all of the classes**

The teacher has to distribute the topics to be considered for teaching by the above-mentioned approaches and prepare a lesson plan for execution and maintain a file.

## Curriculum Framework

### Breakdown of Credits

Sl. No	Category	Total number of Credits
1	University Core(UC)	13
2	University Elective (UE)	11
3	Program Core(PC)	72
4	Program Elective (PE)	0
5	Faculty Elective (FE)	4
<b>Total number of credit</b>		<b>100</b>

### Breakdown by categories of Courses

Sl no	Category	Credits	%
1	Science	92	92%
2	Engineering	1	1%
3	Humanities and Management	7	7%
<b>Total</b>		<b>100</b>	<b>100%</b>

## SEMESTER WISE COURSE DISTRIBUTION

Semester I	S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
					L	T	P	S	R	O		IA*	SEE*	PE*	
	1.	22MSBT111R	Bioinstrumentation	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22MSBT112R	Biochemistry	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22MSBT113R	Cell biology	PC	3	0	2	0	0	0	4	40	60	100	200
	4	22MSBT114R	Microbiome and microbial techniques	PC	3	0	2	0	0	0	4	40	60	100	200
	5	22UMFS111R	Fundamental of Statistics	UC	2	0	2	0	0	0	3	40	60	100	200
	6	22MSBT115R	Mini Research - R1	UC	0	0	0	4	6	0	2	50	0	50	100
	7	22UMPD111R	Effective English	UE	0	0	4	0	0	0	2	50	0	50	100
	8	22MSCE111R	MOOCs-I	FE	2	0	0	0	0	0	2	0	0	100	100
	<b>Total</b>										<b>25</b>				<b>1300</b>
Semester II	S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
					L	T	P	S	R	O		IA*	SEE*	PE*	
	1.	22MSBT121R	Immunology	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22MSBT122R	Molecular biology, genomics and genetic engineering	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22MSBT123R	Bioinformatics	PC	2	0	2	0	0	0	3	40	60	100	200
	4	22MSBT124R	Generic elective	UE	2	0	0	0	0	0	2	40	60	0	100
	5	22MSBT125R	Techno-professional skill-I	PC	0	0	4	0	0	0	2	0	0	100	100
	6	22MSCE121R	MOOCs-II	FE	2	0	0	0	0	0	2	0	0	100	100
	7	22UMRM121R	Research methodology and Statistical Analysis	UC	1	0	4	0	0	0	2	40	60	100	200
	8	22MSBT127R	Mini Research (Research gap analysis-R2)	UC	0	0	0	4	6	0	2	50	00	50	100
	9	22UUHV101R	Universal Human Values	UC	1	0	2	0	0	0	2	40	60	100	200
	10	22UMPD121R	Communication Mastery	UE	0	0	4	0	0	0	2	50	0	50	100
	11	22UCDL103R	Computational systems and digital world	UE	0	0	2	0	0	0	1	0	0	100	100
	<b>Total</b>										<b>26</b>				<b>1600</b>
Semester III	S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
					L	T	P	S	R	O		IA*	SEE*	PE*	
	1.	22MSBT215R	Techno-Professional Skills II	PC	0	0	4	0	0	0	2	0	0	100	100
	2	22MSCE211R	MOOCs-III	PC	2	0	0	0	0	0	2	0	0	100	100
	3	22MSCE212R	MOOCs-IV	PC	2	0	0	0	0	0	2	0	0	100	100
	4	22MSBT216R	Generic elective	UE	2	0	0	0	0	0	2	0	0	100	100



	5	22UMRE211R	Research Ethics	UC	0	0	0	4	0	0	1	50	0	50	100
	6	22UMPD211R	Corporate Competency	UE	0	0	4	0	0	0	2	50	0	50	100
	7	22MSBT215R	MINI RESEARCH (SURVEY/EXPERIMENTS)-R3	PC	0	0	6	4	0	0	4	50	0	50	100
	8	22UUFL202R	PERSONAL FINANCIAL PLANNING	UC	0	0	2	0	0	0	1	0	0	100	100
	<b>Discipline specific elective (DSE): Student has to take any three</b>														
	9	22MSBT211R	Plant and Animal Biotechnology	PC	3	0	2	0	0	0	4	40	60	100	200
	10	22MSBT212R	Medical Biotechnology	PC	3	0	2	0	0	0	4	40	60	100	200
	11	22MSBT213R	Bioprocess and Fermentation Technology	PC	3	0	2	0	0	0	4	40	60	100	200
	12	22MSBT214R	Food Biotechnology	PC	3	0	2	0	0	0	4	40	60	100	200
	<b>Total</b>											<b>28</b>			<b>1400</b>
<b>Semester IV</b>	<b>S. N.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Course Category</b>	<b>Engagement</b>							<b>Maximum Marks for</b>			
					<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O</b>	<b>C</b>	<b>IA*</b>	<b>SEE*</b>	<b>PE*</b>	<b>Total</b>
	1	22MSBT224R	Research/data analysis/documentation-R4)	PC	0	0	20	8	6	0	13	50	0	50	100
	<b>Elective course: Student has to take any two</b>														
	2	22MSBT221R	Organic farming	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22MSBT223R	Agriculture Biotechnology	PC	3	0	2	0	0	0	4	40	60	100	200
	4	22MSBT222R	Environmental Biotechnology	PC	3	0	2	0	0	0	4	40	60	100	200
	<b>Total</b>										<b>21</b>			<b>500</b>	

**\*IA: Internal Assessment, SEE: Semester End Examination,  
PE: Practical Examination**

SEMESTER – I									
Course Title	Bioinstrumentation								
Course code	22MSBT111R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To impart knowledge about the working of different Biomedical Instruments. 2. Basic working principle of different instruments. 3. Working principle of chromatography, centrifugation								
CO1	Discuss Chromatography techniques including history, classification, principles, operation, analysis and application.								
CO2	Define Centrifugation techniques, classification, principles, operation and its application.								
CO3	Explain and investigate Electrophoresis, its categorization, underlying principle, operational methods, pH meter functionality, dialysis, and blotting methodologies.								
CO4	Discuss radioisotope dating principles, including detection, measurement, isotopes, radiation, units and decay.								
CO5	Develop the comprehensive understanding of principles, and practical application skills in various spectroscopic methods for scientific analysis.								
Unit-No.	Content	CH	Learning Outcome				KL		
I	<b>Chromatography:</b> History; Classification; Types, principles, operation, application & analysis (Paper, Column, Adsorption column, Partition, Thin layer, Ion exchange, quantitative Ion exchange, and Gel Chromatography):	10	Able to describe, illustrate and explain the chromatography and their applications				1,2		
II	<b>Centrifugation:</b> Types; Application; Principle; rotors; density gradient & analytical centrifugation.	5	Able to describe, illustrate and explain the centrifuge				1,2		
III	<b>Gel Electrophoresis:</b> Application; Types; Principle; pH meter (Principle); Dialysis, <b>Blotting technique:</b> Southern, Western, & Northern blot	8	Able to describe, illustrate and explain the electrophoresis				1,2		
IV	<b>Radio- isotope dating technique:</b> Introduction, nature, detection & measurement of radioactivity, radioisotopes & radiation, units, radioactive decay.	7	Able to describe, illustrate and explain the radio isotopes.				1,2		
V	<b>Spectroscopic techniques:</b> Introduction, Principle and application of spectroscopy	10	Able to describe, illustrate and explain the spectroscope				1,2		
<b>Practical</b>	Operation of molecules from given sample by 1. Paper chromatography 2. Column chromatography 3. Thin layer chromatography 4. Separation of DNA and protein molecules by gel electrophoresis	30	Able to use various instruments for analysis				1,2, 3,4		

#### Text Books

T1. Upadhyay. Biophysical chemistry: principle and technique. 12th edition. Himalaya Publishing House Pvt. Ltd; 2017.

#### Reference Books

R1. Kakkar. Atomic and Molecular Spectroscopy. 1st edition. Cambridge English; 2017.

R2. Evans. Handbook of Chromatography. 2nd Edition, Willford Press; 2019.

R3. Holme and Peck. Analytical biochemistry. 3rd edition. Longman, 1983.

**Other Learning Resources:** <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/chromatography>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Discuss Chromatography techniques including history, classification, principles, operation, analysis and application.	<b>1,4, 5</b>
<b>2</b>	Define Centrifugation techniques, classification, principles, operation and its application.	<b>1, 4, 5</b>
<b>3</b>	Explain and investigate Electrophoresis, its categorization, underlying principle, operational methods, pH meter functionality, dialysis, and blotting methodologies.	<b>1,4, 5, 7</b>
<b>4</b>	Discuss radioisotope dating principles, including detection, measurement, isotopes, radiation, units and decay.	<b>1, 7</b>
<b>5</b>	Develop the comprehensive understanding of principles, and practical application skills in various spectroscopic methods for scientific analysis.	<b>1,9</b>

Course title	Biochemistry								
Course code	22MSBT112R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Fall/I Semester of First Year of the Program								
Course objectives	1. To study the structure of biomolecules, such as proteins, nucleic acids, carbohydrates and lipids 2. To know the functions and interactions of biomolecules, which will provide the knowledge of the structure of cells and the various functions performed by them which are associated with life? 3. To study the metabolic pathways of biomolecules like carbohydrate, amino acids etc.								
CO1	Improve the concept of chemical interactions and molecular organization of micro and macromolecules								
CO2	Understand the composition, structure and function of the biomolecules								
CO3	Enhance the understanding on metabolism and physiology of cell.								
CO4	Analyse the concepts of secondary metabolites for human benefits.								
CO5	Prepare the base for understanding courses such as molecular biology and cellular functioning at molecular level.								
Unit-No.	Content	CH	Learning Outcome				KL		
I	<b>Concept of biomolecules (composition, structure and functions):</b> Carbohydrates, Proteins, Lipids, Nucleic acids, Vitamins and Minerals.	10	Knowledge on the concept of biomolecules, differentiating the various biomolecules with thorough understanding on their types and functions				1,2		
II	<b>Bioenergetics:</b> Concept of thermodynamics (entropy, enthalpy and free energy), reaction kinetics: Substrate phosphorylation and oxidative phosphorylation, <b>Enzymology:</b> Principle of catalysis, enzyme and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, Importance of enzymes in diagnosis and therapy.	10	Demonstrate the fundamental knowledge of bioenergetics and enzyme and its kinetics for understanding of metabolism and learning its applications in clinical and therapeutics.				1,2		
III	<b>Metabolism of biomolecules:</b> <b>Carbohydrate metabolism:</b> Glycolysis and its regulation, Gluconeogenesis, Glycogenolysis TCA cycle, Pentose phosphate pathway, glyoxalate pathway. <b>Lipid metabolism:</b> oxidation of saturated and unsaturated fatty acid, odd chain fatty acid, regulation of fatty acid metabolism.	10	Build knowledge of the biochemical pathways of synthesis and degradation of the carbohydrate and lipids with its regulatory concept				1,2		
IV	<b>Amino acid metabolism:</b> Transamination, Deamination and its types, urea cycle <b>Nucleotide metabolism:</b> biosynthesis and degradation of purines and pyrimidines	8	Understand the amino acid and nucleotide synthesis and degradation with its biochemical and regulatory concept				1,2,3		
V	<b>Heme Metabolism and Photosynthesis and Secondary metabolites:</b> Heme synthesis and degradation, Photosynthesis: Structure of chloroplast, light reaction and dark reaction, Brief concept on the secondary metabolites (Flavonoids, terpenoids, phenolic acids and alkaloids)	7	Learn the synthesis and breakdown of heme, gain knowledge on the mechanism of photosynthesis and apply the concept of secondary metabolites for mankind.				1,2,3, 4		

<b>Practical</b>	Buffers: Preparation of acetate buffer, citrate buffer, tris buffer, phosphate buffer; Estimation of protein by Lowry's/Bradford method. Estimation of reducing sugar by DNS method. Estimation of RNA by orcinol method. Estimation of DNA by diphenyl amine method, Extraction and estimation of chlorophyll. Determination of total activity of amylase. Determination of total activity of protease, Qualitative analysis for protein, carbohydrate and its types, amino acid.	<b>30</b>	To apply the practical knowledge of biochemistry in various fields	1,2,3 , 4
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**Text books:**

**T1.** U Satyanarayana. Biochemistry. 13th edition. Elsevier Health Sciences;2017.

**Reference books:**

**R1.** David L. Nelson, Michael Cox. Leininger Principles of Biochemistry. 7th Edition. WH Freeman; 2017.

**R2.** Rodwell et al. Harper's Illustrated Biochemistry. 29th edition. McGraw Hill; 2012.

**R3.** Voet and Voet. Biochemistry. 3rd edition. John Wiley & Sons, 2004.

**Other learning resources:** <https://pubmed.ncbi.nlm.nih.gov/34809432/>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Improve the concept of chemical interactions and molecular organization of micro and macromolecules	<b>1,3</b>
<b>2</b>	Understand the composition, structure and function of the biomolecules	<b>1, 4</b>
<b>3</b>	Enhance the understanding on metabolism and physiology of cell.	<b>1,3,4</b>
<b>4</b>	Analyse the concepts of secondary metabolites for human benefits.	<b>1, 2, 7</b>
<b>5</b>	Prepare the base for understanding courses such as molecular biology and cellular functioning at molecular level.	<b>1, 9.</b>

Course Title	Cell Biology								
Course code	22MSBT113R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To make students understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles</li> <li>To define how the cellular components are used to generate and utilize energy in cells</li> <li>Familiarize the cellular components underlying mitotic cell division.</li> </ol>								
CO1	Improve understanding on the membrane structure and its functioning								
CO2	Improve understanding on structural organization of cell and its organelles.								
CO3	Describe and able to understand the process of cell division								
CO4	Able to understand the how the cell communicates for functioning of the cell.								
CO5	Prepare the base for understanding advance courses in Biological Sciences.								
Unit-No.	Content	CH	Learning Outcome				KL		
I	Membrane Structure and Function: (Structure of a model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes)	7	Knowledge of structure of cell membrane and function				1,2		
II	Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure and function of cytoskeleton and its role in motility)	10	To learn the basic structural organisation of intracellular organelles				1,2		
III	Cell Division and Cell Cycle (Mitosis and Meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle)	10	To understand the basics of how a cell divides and its importance in cell cycle.				1,2		
IV	Cell signalling: (Ligands and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signalling pathways, bacterial and plant two-component systems, light signalling pathways in plants, bacterial chemotaxis and quorum sensing) neurotransmission and its regulation	8	To know about the communications and signalling mechanisms in cells				1,2		
V	Cellular communication: (Regulation of haematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins.)	10	Knowledge on Basic regulatory mechanisms of cell				1,2		
Practical	<ol style="list-style-type: none"> <li>Staining and microscopic observation of various stages of Mitosis of given sample(s).</li> <li>Staining and microscopic observation of various stages in Meiosis of given sample(s).</li> </ol>	30	Describe, illustrate and explain and apply staining techniques and carry out microscopic examination.				1,2,3,4		

**Text Books**

T1: Alberts B, Johnson A, Lewis J, et al. Molecular Biology of the Cell. 4th edition. New York: Garland Science; 2002.

**Reference Books**

R1: Cooper GM. The Cell: A Molecular Approach. 2nd edition. Sunderland (MA): Sinauer Associates; 2000.

R2: Ambrose and Dorothy. Cell Biology. 2nd Edition. MEasy, ELBS Publications; 1970.

R3: Sharp, Lester W. Fundamentals of Cytology. 1st edition. Mc Graw Hill Company; 1943.

**Other Learning Resources:** <https://www.ncbi.nlm.nih.gov/books/NBK9839/?term=cell%20Biolpgy>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Improve understanding on the membrane structure and its functioning	<b>1, 3</b>
<b>2</b>	Improve understanding on structural organization of cell and its organelles.	<b>1, 3</b>
<b>3</b>	Describe and able to understand the process of cell division	<b>1, 4</b>
<b>4</b>	Able to understand the how the cell communicates for functioning of the cell.	<b>1, 3</b>
<b>5</b>	Explain the Cellular communication, involving haematopoiesis regulation, cell adhesion, gap junctions, extracellular matrix, and integrins, ensures proper tissue structure and function	<b>1, 3, 4, 7</b>

Course Title	Microbiome and Microbial Techniques								
Course code	22MSBT114R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Fall/I Semester of First Year of the Programme								
Course objectives	1.Introduction to Basic Microbiology and microbiome. 2.To develop and use critical thinking and problem-solving skills through the use of case studies and reviews of scientific literature. 3.To discuss the historical perspectives important in the development of microbiology along with the current diversity in the field. 4.To discuss and perform the various techniques associated with microbiology								
CO1	Explain the evolution of the field and focus on prokaryotic cell structure and functions								
CO2	Discuss the methods for culturing microorganisms.								
CO3	Elaborate the approaches for diversity study								
CO4	Explain the role of microorganisms in the field of Environment.								
CO5	Describe diversity of microbes								
Unit-No.	Content	CH	Learning Outcome				KL		
I	Microbiome, Concept of Microorganism & structure. Eukaryotic and Prokaryotic cell, Bacterial Structure and types, Gram positive and Gram-negative bacteria, Actinomycetes, Introduction to characteristics of fungi, molds and yeasts, Hyphae and Body of Fungus, Major polysaccharide components of fungal cell wall, Cell wall components of Fungi. Concept of microbial secondary metabolites: Antibiotics, Probiotics.	7	Knowledge on the basic structure of bacterial cells, difference between gram negative and gram-positive bacteria, introduction to fungi and its cell wall components				1,2		
II	Physical and chemical methods of sterilization: Sterilization by dry heat, moist heat, Chemical agents- Alcohol, Ethyl alcohol, Isopropyl alcohol, Aldehyde, Formaldehyde, Bacteriocidal, bacteriostatic. Effect of dyes, Gases. Staining technique: Gram staining, Aerobic and anaerobic culture, mixed culture and pure culture. Techniques of pure culture isolation: Streak plate, Pour plate, Spread plate methods. Definition of media, Peptone, & nutrient broth, types of media, uses of different types of media, transport media, Serial dilution technique, Colony Forming Units (CFU) and it's calculation, Preservation and maintenance of pure culture	10	Knowledge on physical, chemical techniques of sterilization, isolation, technique and media and staining preparation, preservation of culture				1,2		
III	Culture-dependent approaches for microbial diversity study, advantages, limitations, Exploration of Unculturable bacteria: Culture independent molecular methods studying of unculturable bacteria, expand the knowledge about bacterial growth requirements, met-genome concept. Microbial dysbiosis	10	Knowledge on difference between culture dependent and culture independent molecular methods, Bacterial growth requirement.				1,2		
IV	Gut microbial flora & its role, normal microflora of skin, Eyes, urogenital tract. Human microbiome & immunity	8	Knowledge on different types of microbial flora present on different parts of body				1,2		
V	Diversity of microbes in terrestrial ecosystem, Microbes in extreme environments – thermophiles, psychrophiles, barophiles, acidophiles, alkaliphiles and halophiles, Microbial interactions: Competition, ammensalism, parasitism, mutualism, commensalism, synergism, Endophytism, Plant endophytes relation	10	Knowledge on Microbial diversity in terrestrial ecosystem and their resistance towards the extreme environments.				1,2		
Practical	1. Laboratory Safety, preparation for experiment, and laboratory waste management.	30	Describe, illustrate and explain and apply				1,2,3,4		



	<ol style="list-style-type: none"> <li>2. Principle, operation and measurement of pH of a given sample</li> <li>3. Principle and operation of Hot air oven, Autoclave, Laminar airflow and centrifuge.</li> <li>4. Isolation of microbes from given sample by serial dilution techniques and estimation of the CFU (Pour plate and streak plate techniques also be learned)</li> <li>5. Staining (gram, acid fast, endospore or any appropriate staining) of the given microbial sample and observation under microscope.</li> </ol>		laboratory safety rules, set a microbiological experiment for microbial isolation, prepare slides by applying staining techniques and observe them under microscope.	
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**Text books:**

T1. Michael J. Pelczar; E.C.S. Chan. Microbiology (An Application Based Approach). 12th edition. Tata McGraw Hill; 2010.

**Reference books**

R1. L.E.J.R. Casida. Industrial Microbiology. 2nd edition. New AGE International Publisher, 2019

R2. P. S. Bisen. Frontiers in microbial technology. 1st edition. C.B.S. Publishers and Distributors; 1994

R3. Alan T. Bull. Biotechnology: International Trends and Perspectives, Issue 7. Organisation for Economic Co-operation and Development, 1982.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the evolution of the field and focus on prokaryotic cell structure and functions	<b>1, 4</b>
<b>2</b>	Discuss the methods for culturing microorganisms.	<b>1, 3, 4</b>
<b>3</b>	Elaborate the approaches for diversity study.	<b>1, 4, 7</b>
<b>4</b>	Explain the role of microorganisms in the field of Environment.	<b>1, 2, 7</b>
<b>5</b>	Describe diversity of microbes	<b>1, 4, 7</b>

Course Title	Fundamental of Statistics								
Course code	22UMFS111R	Total credits: 3 Total hours: 30T+30P	L	T	P	S	R	O/F	C
			2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Fall/I Semester of First Year of the Programme								
Course objectives	1. Help to understand the role of statistics in data analysis, decision-making, and scientific research 2. Introduce students to descriptive statistics, including measures of central tendency (mean, median, mode) and measures of dispersion (range, variance, standard deviation). 3. Teach students how to summarize and present data effectively using tables, charts, and graphs								
CO1	Improve understanding of Descriptive Statistics and Demography.								
CO2	Develop knowledge to understand the Probability theory, Distribution, and sampling methods.								
CO3	Develop knowledge to understand the methods for hypothesis testing and biological data analysis.								
CO4	Develop knowledge to understand the principles of various statistical analyses of data.								
CO5	Develop knowledge on R language for data analysis								
Unit-No.	Content	CH	Learning Outcome				KL		
I	<b>Statistical Methods:</b> Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio.	5	Foundational Understanding of Statistical Concepts				1,2		
II	<b>Presentation:</b> tabular and graphical, including histogram and ogives. Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, skewness and kurtosis.	5	Proficiency in Data Presentation and Analysis				1,2		
III	<b>Bivariate data:</b> Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, fitting of polynomials and exponential curves.	5	Knowledge on Analyzing Bivariate Data and Relationships				1,2		
IV	<b>Random experiment:</b> trial, sample point and sample space, event, Operations of Events, concepts of mutually exclusive and exhaustive events. Definition of probability: classical and relative frequency approach. Discrete probability space, Properties of probability, Independence of events, Conditional probability, total and compound probability rules, Normal probability Distribution, Binomial probability Distribution, Poisson Probability Distribution, Bayes' theorem and its applications.	8	Understanding of Probability and Distributions				1,2		
V	<b>Testing of hypothesis,</b> parametric test: t-test, z-test, chi-square test. Non-Parametric test: One sample Kolmogorov test, Wilcoxon Signed test, Mann-Whitney Test, Kruskal walls test.	7	Application of Hypothesis Testing and Statistical Tests				1,2		
<b>Practical</b>	1.Introduction to R - A programming language and environment for data analysis and graphics. Syntax of R expressions: Vectors and assignment, vector arithmetic, generating regular sequence, logical vector, character vectors, Index vectors; selecting and modifying subsets of dataset 2.Data objects: Basic data objects, matrices, partition	30	A brief knowledge on using R for data analysis and visualization				1,2,3,4		

	<p>of matrices, arrays, lists, creating and using these objects; Functions- Elementary functions and summary functions, applying functions to subsets of data. Data frames: The benefits of data frames, creating data frames, combining data frames, Adding new classes of variables to data frames; Data frame attributes.</p> <p>3.Importing data files: import. Data function, read. table function; Exporting data: export. data function, cat, write, and write. Table functions, function, formatting output - options, and format functions; Exporting graphs -export. Graph function. Graphics in R: creating graphs using plot function, box plot, histogram, line plot, steam and leaf plot, pie chart, bar chart, multiple plot layout, plot titles, formatting plot axes; Visualizing the multivariate data: Scatter plot, Q-Q plot, P-Pplot.</p> <p>4.Performing data analysis tasks: Reading data with scan function, exploring data using graphical tools, computing descriptive statistics, one sample tests, two sample tests, Goodness of fit tests.</p> <p>5.Parametric test and non-parametric test</p>		
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**Text books:**

**T1:** Methods in Biostatistics by K S Negi, ISBN:9789374735053,4th Edition, Year:2023, AITBS Publishers, INDIA

**Reference books**

R1: "Introduction to the Practice of Statistics" by David S. Moore, George P. McCabe, and Bruce A. Craig

R2: "Statistics" by David Freedman, Robert Pisani, and Roger Purves

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Improve understanding of Descriptive Statistics and Demography.	<b>1, 4</b>
<b>2</b>	Develop knowledge to understand the Probability theory, Distribution, and sampling methods.	<b>1, 4</b>
<b>3</b>	Develop knowledge to understand the methods for hypothesis testing and Biological data analysis.	<b>1, 4</b>
<b>4</b>	Develop knowledge to understand the principles of various statistical analyses of data.	<b>1, 4</b>
<b>5</b>	Develop knowledge on R language for data analysis	<b>1, 4, 9</b>

Course Title	MINI RESEARCH (REVIEW OF LITERATURE-R1)								
Course code	22MSBT115R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30P	0	0	0	4	6	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Fall/I Semester of First Year of the Programme								
Course objectives	To develop students scientific writing skill								
CO1	Employ databases and library resources to gather original research, books, and articles effectively								
CO2	Summarize and differentiate between various types of reviews, specifically analytical and descriptive reviews.								
CO3	Identify research topics and employ appropriate methods for collecting and filtering information.								
CO4	Critically analyze the demonstrations and findings of previous authors to comprehend their contributions and insights.								
CO5	Compose a detailed review that explains the prospects and future directions of the chosen study.								

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Employ databases and library resources to gather original research, books, and articles effectively	1, 2, 3, 4
2	Summarize and differentiate between various types of reviews, specifically analytical and descriptive reviews.	1, 2, 3, 4
3	Identify research topics and employ appropriate methods for collecting and filtering information.	1, 2, 3, 4
4	Critically analyze the demonstrations and findings of previous authors to comprehend their contributions and insights.	1, 2, 3, 4
5	Compose a detailed review that explains the prospects and future directions of the chosen study.	1, 2, 3, 4,6

Course Title	EFFECTIVE ENGLISH (Communicative English & Soft Skills)								
Course code	22UMPD111R	Total credits: 2 Total hours: 60P	L	T	P	S	R	O/F	C
			0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Fall/I Semester of First Year of the Programme								
Course objectives	1. To introduce the types of sentences and their significance. 2. To strengthen the students' vocabulary to enhance their speaking and writing skills. 3. To familiarize the students with the importance of dress codes in various organizations. 4. To introduce the 3P's (Planning, prioritizing & performing) of Time Management. 5. To give insight into English pronunciation and into central concepts in phonetics.								
CO1	This course will enable students to analysis and identify the different types of sentences.								
CO2	Learners will be able to integrate the skills of reading and speaking in professional communication.								
CO3	Dress code Etiquette sessions will boost their confidence and morals.								
CO4	Students will learn about the effective and efficient utilization of time.								
CO5	Introduction to Phonetics and its importance will improve the learners 'pronunciation								
MODULES	<b>Module 1- Grammar</b> Interchange of Interrogative and Assertive Sentences, Exclamatory and Assertive Sentences, Types of Tenses, Common Errors, Synonyms, Antonyms, Homonyms <b>Module 2- Reading Skills</b> Techniques of Effective Reading, gathering ideas and information from a text The SQ3R Technique Interpret the text <b>Module 3-Listening Skills</b> What is listening? The Process of Listening, Factors that adversely affect Listening, Difference between Listening and Hearing, Purpose and Importance of Effective Listening, How to Improve Listening Process, <b>Module 4- Conflict Management</b> Definition, Type of Conflict Management, Effects of Conflict Management, Methods to deal with Conflicts (Negative) <b>Module 5- Time-Management Skills</b> Introduction To Time Management, Purpose and Importance of Time Management, Basic Tips to Maintain Time. <b>Activity: Problem solving activity:</b> A situation will be given to the students and they will have to tell us how to handle the situation or solve the problem.								

**Text books:**

T1: Wren, P.C and Martin H. 1995. High School English Grammar and Composition, S Chand Publishing.

T2: English Grammar in Use, Raymond Murphy 4th edition, CUP.

T3: Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

**Reference books:**

R1; English Vocabulary in Use (Advanced), Michael McCarthy and Felicity, CUP.

R2: Effective Communication and Soft Skills, Nitin Bhatnagar, Pearsons.

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Analyse and identify the different types of sentences.	1, 5
2	Able to integrate the skills of reading and speaking in professional communication.	1, 5, 9
3	Illustrate code Etiquette sessions will boost their confidence and morals.	5, 6, 9

<b>4</b>	Describe about the effective and efficient utilization of time.	<b>5, 9</b>
<b>5</b>	Explain the concept of Phonetics and its importance will improve the learners 'pronunciation	<b>1, 5, 9</b>

2 <sup>nd</sup> Semester									
Course Title	Immunology								
Course code	22MSMB121R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Spring/II Semester of First Year of the Programme								
Course objectives	1. To make students understand the Immune system and its components, immune response, antigen, antibody, immunity, Hypersensitivity, Autoimmunity etc. 2. To make students learn various immunological concepts. 3. To make skilled students in diagnostic techniques.								
CO1	Describe the immune system and its components and their mode of action in defense mechanisms.								
CO2	Outline antigen and antibody structure, types, and properties including the processes of monoclonal and polyclonal antibody production								
CO3	Apply the knowledge of different immunological diagnostics tests, their principle, and interpretations aiding in the detection of the underlying cause of the diseases.								
CO4	Interpret transplantation and cancer immunology findings and their role in research.								
CO5	Discuss immunological disorders like autoimmunity and hypersensitivity, their prevention strategies, and management								
Unit-No.	Content	CH	Learning Outcome				K L		
I	<b>Introduction to immunology</b> – Definition, history, scope of immunology. Overview of the immune system-cells and organs of the immune system. Immune response- Humoral and cell mediated immune response. Immunity- types of immunity- Innate and acquired immunity, APC.	7	Knowledge of Immune system, Immunity, immune response				1,2		
II	<b>Antigens</b> – General features, haptens, adjuvants, epitopes. Antibody – Structure, types, antibody mediated effector functions – opsonisation, antibody activated complement, ADCC, isotypes, allotypes, idiotypes, <b>Antibody production and purification</b> – production of monoclonal antibodies, immunotoxins, abzymes, extraction of antibodies. Expression of immunoglobulin genes- antibody diversity, class switching of Immunoglobulins	10	Knowledge on antigens and their properties and antibodies and their types along with their production and purification process				1,2		
III	<b>Antigen-antibody interaction</b> – principle and application – RIA, ELISA, Western blotting, Immunofluorescence, Complement system – classical and alternative pathway, functions	10	Theoretical and practical knowledge on principle and process of different immunological diagnostic tests				1,2		
IV	<b>HLA</b> – Theories of antibody formation, HLA typing, MHC, T cell receptors, Transplantation immunology – Graft rejection, immune suppressive therapy, immune tolerance, clinical transplantation Immune effectors – Cytokines, IL and functions, cell mediated cytotoxicity, NK cells, TNF, Interferons, Inflammation, leukocyte activation, and migration	8	Knowledge on transplantation immunology and immune effectors.				1,2		
V	Hypersensitivity and types, Autoimmunity,	10	Knowledge on Hypersensitivity,				1,2		

	Cancer and immune system – tumour antigen, tumour evasion and immunotherapy of cancer, AIDS – primary and secondary immunodeficiency. Vaccines and its types		Autoimmunity, cancer immunology, immunodeficiency and vaccines	
<b>Practical</b>	Precipitation Reaction: i. Double Diffusion Reaction ii. Single Diffusion Reaction iii. Ouchterlony immunodiffusion iv. Immunelectrodifffusion Agglutination Reaction: (Qualitative and quantitative) WIDAL, ASO, VDRL, RPR, CRP Blood grouping and Rh typing, ELISA	30	Able to operate ELISA, RIA	1,2 , 3,4

### Text books

T1. Punt et al. Kuby Immunology 18th Edition. W H Freeman &Co (Sd); 2018.

### Reference books

R1. Abbas. Cellular and Molecular Immunology. 10th edition. Elsevier; 2021.

R2. Martin et al. Roitt's Essential Immunology (Essentials). 13th edition. Wiley-Blackwell, 2017.

R3. Westwood. Practical Immunology. 4th edition. Wiley-Blackwell; 2002.

**Other learning resources:** <https://pubmed.ncbi.nlm.nih.gov/28830733/>

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe the immune system and its components and their mode of action in defense mechanisms.	1, 2
2	Outline antigen and antibody structure, types, and properties including the processes of monoclonal and polyclonal antibody production	1, 4
3	Apply the knowledge of different immunological diagnostics tests, their principle, and interpretations aiding in the detection of the underlying cause of the diseases.	1, 4
4	Interpret transplantation and cancer immunology findings and their role in research.	1, 4
5	Discuss immunological disorders like autoimmunity and hypersensitivity, their prevention strategies, and management.	1, 2, 3



Course Title	MOLECULAR BIOLOGY, GENOMICS AND GENETIC ENGINEERING								
Course code	22MSBT122R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Spring/II Semester of First Year of the Programme								
Course objectives	1. To teach in depth about genome and its arrangement in eukaryotes and microbes. 2. To teach the central dogma of life (replication, transcription, translation and post transcriptional modifications) with the best possible teaching tools (explanation/power point presentation/seminar/assignment) and with utmost attention. 3. Important topics like mutation, DNA damage and repair are explained.								
CO1	Explain the fundamental of genomics concepts such as genome, DNA structure, RNA, proteins and the central dogma.								
CO2	Explain the methods for mapping genomes, describe markers, linkage analysis with different types of organisms, physical mapping, and basics of genome sequencing, shotgun sequencing.								
CO3	Compare prokaryotic and eukaryotic genomes, including the presence of extra chromosomal DNA and examine the vital function of DNA binding proteins in gene expression and regulation.								
CO4	Illustrate the dynamics of genome access, encompassing aspects such as euchromatin, heterochromatin, chromosome painting, nucleosome modifications, histone acetylation, DNA modifications, DNA methylation-induced gene silencing, and gene regulation in both prokaryotes and eukaryotes.								
CO5	Discuss the mutation causes, types of DNA mutation and DNA repair mechanisms, crucial for maintaining genetic stability and impacting human health.								
Unit-No.	Content		CH	Learning Outcome				KL	
I	Introduction to genomics, definitions of genome, DNA structure and composition, RNA and the transcriptome, proteins and the proteome, the central dogma		7	Introductory knowledge and refreshing the existing understanding				1,2	
II	Mapping of genomes, markers for genetic mapping, the basis to genetic mapping, linkage analysis with different types of organisms, physical mapping, basics of genome sequencing, shotgun sequencing		10	Sequencing techniques in detail followed by linkage mapping				1,2	
III	Genomes of prokaryotes and eukaryotes, extra chromosomal DNA, role of DNA binding proteins in genome expression: methods for studying DNA binding proteins and their attachment sites, special features of DNA binding proteins, interaction between DNA and its binding proteins		10	Knowledge on DNA replication in prokaryotes and eukaryotes with special emphasis on the proteins and enzymes involved				1,2	
IV	Accessing the genome: euchromatin and heterochromatin, chromosome painting, nucleosome modifications and genome expression, histone modification, acetylation, DNA modifications and genome expression, gene silencing by DNA methylation, gene regulation in prokaryotes and eukaryotes		8	Genome organisation is discussed in detail with various post translational events along with regulatory mechanisms				1,2	
V	Introduction to genetic engineering, Different DNA manipulating enzymes, methods for isolating DNA, vectors for bacteria, plant and animals, expression vectors, DNA libraries, application of genetic engineering.		10	By the end of this course, students will understand genetic engineering techniques, use vectors, evaluate expression vectors, and propose innovative				1,2	

			applications.	
<b>Practical</b>	Isolation of genomic DNA., Isolation of plasmid DNA, Polymerase chain reaction, Endonuclease digestion of DNA and analysis of DNA fragments by agarose electrophoresis.	30	Knowledge on extraction of DNA and plasmid from biological samples followed by their in vitro amplification and studying RFLP profile	1,2,3,4

#### Text books

T1. Watson et al. The Molecular Biology of the Gene. 7th edition. Pearson Publication; 2013.

#### Reference books

R1. Alberts et al. The Molecular Biology of the Cell. 7th Edition. WW Norton & Co, 2022.

R2. Rastogi. Cell and Molecular Biology. 4th edition. New Age International Private Limited; 2020.

R3. Som. Practical Manual of Molecular Biology. 1st edition. KAAV Publications, 2018.

**Other learning resources:** <https://pubmed.ncbi.nlm.nih.gov/28830733/>

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
<b>1</b>	Explain the fundamental of genomics concepts such as genome, DNA structure, RNA, proteins and the central dogma.	<b>1, 9</b>
<b>2</b>	Explain the methods for mapping genomes, describe markers, linkage analysis with different types of organisms, physical mapping, and basics of genome sequencing, shotgun sequencing.	<b>1, 4</b>
<b>3</b>	Compare prokaryotic and eukaryotic genomes, including the presence of extra chromosomal DNA and examine the vital function of DNA binding proteins in gene expression and regulation.	<b>1, 2</b>
<b>4</b>	Illustrate the dynamics of genome access, encompassing aspects such as euchromatin, heterochromatin, chromosome painting, nucleosome modifications, histone acetylation, DNA modifications, DNA methylation-induced gene silencing, and gene regulation in both prokaryotes and eukaryotes.	<b>1, 4</b>
<b>5</b>	Discuss the genetic engineering techniques, including DNA manipulation, vector use, and DNA libraries, and explore their applications.	<b>1, 2, 7</b>

Course Title	Bioinformatics								
Course code	22MSBT123R	Total credits: 3 Total hours: 30T+30P	L	T	P	S	R	O/F	C
			2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Spring/II Semester of First Year of the Programme								
Course objectives	1. To search and retrieve biological information from different biological databases. 2. Knowledge on computational database management system and its application in Biology 3. A basic idea on the structural biology using computer.								
CO1	A basic concept on Bioinformatics and its significance in the field of biological data analysis								
CO2	Knowledge on database management system and its application in Biology								
CO3	A good knowledge on sequence submission tools as well as biological search engines								
CO4	Knowledge on sequence alignment and analysis.								
CO5	Learn the concept of computer aided drug designing								
Unit-No.	Content			CH	Learning Outcome				KL
I	Introduction to Bioinformatics, Scope and Applications of Bioinformatics, Introduction to various molecular data and databases, Importance of Computers/IT in the field of Biology. Flatfile formats. Biological Database and its Types - General Introduction of Biological Databases: Nucleotide sequence databases (NCBI, DDBJ, and EMBL). Protein sequence databases (SWISS-PROT, PIR, Gen Pept), Specialized Genome databases: (SGD, TIGR etc). Structure databases (CATH, SCOP, and PDB, NDB, MMDB)			7	Knowledge on bioinformatics and its relation with molecular biology and its application.				1,2
II	Database Management System: Basic Concept of DBMS, Concepts of Entities, Attribute, Keys, Relationship. Three level architecture of a DBMS, Structure of a DBMS, Advantages & Disadvantages of a DBMS. File Based System, Traditional System, DBMS types Hierarchical, Network, Relational Data Model etc			6	Formation of a database and its application in biology				1,2
III	Bioinformatics Database search engines: Text-based search engines (Entrez, DBGET /Link DB). Sequence similarity-based search engines (BLAST and FASTA). Motif-based search engines (Scan Prosite and eMOTIF). Structure similarity-based search engines (Combinatorial Extension, VAST and DALI). Proteomics tools: - ExPASy server, EMBOSS.			7	Knowledge on different bioinformatics search engines and their applications in retrieving data				1,2
IV	Pairwise sequence alignments: Sequence similarity, identity, and homology. Global and local alignment, BLAST and PSI-Blast, Application of Blast tool, Multiple sequence alignments and Application of multiple sequence alignment.			5	A good knowledge on sequence alignment and its application				1,2
V	Computer assisted drug design- concept, methods and practical approaches, various computational methods applied to design the drugs, CADD software demonstration. Protein homology modeling			5	A brief knowledge on drug designing through computer as well as protein 3D modelling				1,2
Practical	Data retrieval from different biological database Sequence alignment through BLAST Protein homology modeling Phylogenetic Analysis through MEGA software Demonstration of Drug designing			30	Knowledge on different biological databases and sequence alignment tool.				1,2, 3,4

**Text books**

**T1.** Harisha S. Fundamental of Bioinformatics. 3rd edition. Dreamtech Press, 2019.

**Reference books**

**R1.** Sharma T. R. Genome Analysis and Bioinformatics: A Practical Approach (English) (Paperback). 1st edition. Dreamtech Press; 2019.

**R2.** Orengo C.A. et al. Bioinformatics: Genes, proteins and computers. 1st edition. Taylor & Francis, 2002.

**R3.** Kanguane P., Mathura V. Bioinformatics: A Concept-Based Introduction. 1st edition. Springer-Verlag New York Inc. 2009.

**Other learning resources:** <https://pubmed.ncbi.nlm.nih.gov/28830733/>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	A basic concept on Bioinformatics and its significance in the field of biological data analysis	<b>1, 4, 9</b>
<b>2</b>	Knowledge on database management system and its application in Biology	<b>1, 4, 5</b>
<b>3</b>	A good knowledge on sequence submission tools as well as biological search engines	<b>1, 4, 5</b>
<b>4</b>	Knowledge on sequence alignment and analysis.	<b>1, 4</b>
<b>5</b>	Learn the concept of computer aided drug designing	<b>1, 3, 4</b>

Course Title	Concepts of Organic Cultivation (Generic Elective)								
Course code	22MSBT124R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours:30	2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Offered by Program of Biotechnology for students of other Faculty of Studies								
Semester	Fall/Spring/II,IV(UG)/II,III (PG) Semesters other than Faculty of Science								
Course objectives	1. Introduction to Concept of Organic cultivation 2. To discuss the Organic Farming System (OFS), its importance and benefits. 3. To discuss the methods associated with organic farming – mulching, crop rotation, tillage, bio-fertilizer etc.								
CO1	Explain the OF, its principles and benefits for health and society.								
CO2	Discuss the relation between OF and natural processes such as nutrient cycles.								
CO3	Explain cultural, mechanical, and biological methods for crop protection and manage organic production for various crops.								
CO4	Illustrate crop protection strategies, including biopesticides and organic methods for key crops, and understand yield functions.								
CO5	Discuss the soil less farming system.								
Unit-No.	Content	CH	Learning Outcome	KL					
<b>I</b>	<b>Introduction</b> to Organic Farming (OF); Development of O F; Principles and Types of O F; Biodynamic Farming; Need and Benefits of O F; Conventional Farming (CF) Vs (OF); Scope of OF.	7	Understand organic farming, its types, principles, benefits and scope.	1,2					
<b>II</b>	<b>OF System;</b> Soil and Soil tillage, Choice of crop/ varieties, Propagation – Seed , planting material and seed treatments, Crop rotation, Intercropping, Water Management, Green Manuring, Mulching, Composting, Vermicomposting, Organic Manure, Biofertilizer	8	Describe illustrate and explain the organic farming system	1,2					
<b>III</b>	<b>Crop Protection:</b> Cultural and Mechanical method; Biopesticides and Botanical Pesticides, Bio-control agents, Weed Management	5	Describe and explain the various ways for protecting plants	1,2					
<b>IV</b>	<b>Organic crop production</b> of Rice, Zinzer, Turmeric, Banana and Vegetables Yield-its function and significances	5	Describe and explain the organic production of crop plants	1,2					
<b>V</b>	<b>Concept on modern organic farming methods</b> – Hydroponics, Aquaponics, Hydroponics	5	Describe and explain the modern methods of agriculture	1,2					

#### Text books

T1. J. M. Fortier. The Market Gardener – A successful Grower’s Handbook for Small- Scale OF. 1st edition. New Society Publishers, 2014.

#### Reference books

R1. A. L. Hansen. Organic Farming Manual: A Comprehensive Guide To Starting And Running A Certified Organic Farm. 1st edition. Storey Publishing LLC, 2010.

R2. C. Sarath Chandran et al. Organic Farming: New Advances Towards Sustainable Agriculture Systems, 1st edition, Springer; 2019.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the OF, its principles and benefits for health and society.	<b>1, 2, 3, 4</b>
<b>2</b>	Discuss the relation between OF and natural processes such as nutrient cycles.	<b>2, 7</b>
<b>3</b>	Explain cultural, mechanical, and biological methods for crop protection and manage organic production for various crops.	<b>3, 4, 7</b>
<b>4</b>	Illustrate crop protection strategies, including biopesticides and organic methods for key crops, and understand yield functions.	<b>3, 4, 7</b>
<b>5</b>	Discuss the soil less farming system	<b>3, 5</b>

Course Title	Techno Professional Skills - I								
Course code	22MSBT125R	Total credits: 2 Total hours:30	L	T	P	S	R	O/F	C
			0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Biotechnology								
Semester	Spring/II semester of first year of the programme								
Course objectives	1. To develop proficiency in different techniques involving microbiology, cell biology. 2. To enable students to interpret morphologies of microorganisms and chromosomes. 3. To make skilled students in microbiological and molecular biology experiments.								
CO1	Explain polytene chromosomes in Drosophila for chromosomal analysis.								
CO2	Discuss meiosis in grasshopper testis or onion buds to understand cell division.								
CO3	Perform various staining techniques for microbial analysis.								
CO4	Apply IMVIC tests for bacterial differentiation.								
CO5	Prepare buffers, conduct agarose gel electrophoresis, and use streaking methods for microbial culture.								
Unit-No.	Content	CH	Learning Outcome				KL		
I	1. Study of polytene chromosome in Drosophila. 2. Study of meiosis in grasshopper testis/ onion flower bud 3. Staining techniques: <ul style="list-style-type: none"> <li>• Capsule stain</li> <li>• Spore stain</li> <li>• Acid fast stain</li> <li>• Negative staining</li> </ul> 4. IMVIC test 5. Different Streaking methods for pure culture preparation 6. Isolation of fungi and their characterization from different sources 7. Preparation of different buffer system 8. Agarose gel electrophoresis	30	Understand the cellular organization and functions				1,2, 3,4		

#### Text books

T1. Aneja. Experiments in microbiology, brand petrology, tissue culture, and microbial biotechnology. 6th Edition, New Age international publication; 2022.

#### Reference books

R1. Brown. Benson's Microbiological Applications Laboratory Manual in General Microbiology. 10th edition. McGraw-Hill Education, 2006.

R2. Atlas. Handbook of Microbiological Media, 4th edition. ASM press, 2010.

R3. Mishra et al. Cell Biology. 12th Edition. Mahaveer Publications, 2020.

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1.	Explain polytene chromosomes in Drosophila for chromosomal analysis.	1, 2, 4
2.	Discuss meiosis in grasshopper testis or onion buds to understand cell division.	1, 2, 3
3.	Perform various staining techniques for microbial analysis.	1, 5
4.	Apply IMVIC tests for bacterial differentiation.	1, 2, 5

<b>5.</b>	Prepare buffers, conduct agarose gel electrophoresis, and use streaking methods for microbial culture.	<b>1, 2, 5</b>
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Course Title	MINI RESEARCH (REVIEW OF LITERATURE-R2)								
Course code	22MSBT127R	Total credits: 2 Total hours: 30P	L	T	P	S	R	O/F	C
			0	0	0	4	6	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Biotechnology								
Semester	Spring/II Semester of First Year of the Programme								
Course objectives	To develop students scientific writing skill								
CO1	Employ databases and library resources to gather original research, books, and articles effectively								
CO2	Summarize and differentiate between various types of reviews, specifically analytical and descriptive reviews.								
CO3	Identify research topics and employ appropriate methods for collecting and filtering information.								
CO4	Critically analyze the demonstrations and findings of previous authors to comprehend their contributions and insights.								
CO5	Compose a detailed review that explains the prospects and future directions of the chosen study.								

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Employ databases and library resources to gather original research, books, and articles effectively	1, 2, 3, 4
2	Summarize and differentiate between various types of reviews, specifically analytical and descriptive reviews.	1, 2, 3, 4
3	Identify research topics and employ appropriate methods for collecting and filtering information.	1, 2, 3, 4
4	Critically analyze the demonstrations and findings of previous authors to comprehend their contributions and insights.	1, 2, 3, 4
5	Compose a detailed review that explains the prospects and future directions of the chosen study.	1, 2, 3, 4,6

Course Title	Research Methodology and Statistical Analysis								
Course code	22UMRM121R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours:15T+60S	1	0	0	4	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
programme	Master of Science in Biotechnology								
Semester	Spring/II semester of First year of the programme								
Course objectives	<ol style="list-style-type: none"> <li>1. The course aims to enhances the students' a broad understanding of research methodology, includingtheoryofscienceandqualitativeandquantitativemethodsinresearch.</li> <li>2. The course seeks to enhance the students' skills for developing critical thinking through research literature review in different domain. Consequently, it aims to develop skills for preparation of a research proposal for a master' thesis project/Mini research.</li> <li>3. To develop Students competency in planning, conducting, evaluating and presenting a research project.</li> </ol>								
CO1	Students will have basic knowledge of Research methods.								
CO2	Students will gain the knowledge of Research Methodology.								
CO3	Students will be able to gain the Skill questionnaire development.								
CO4	Students will be able to acquire the knowledge of basic Report/dissertation Procedure.								
CO5	Knowledge on different IPR rights								
Unit no	Content		CH	Learning Outcome				KL	
I	Research Methodology- An Introduction- meaning and objectives of research, motivation in research, types and significance of research, criteria of good research. Defining the Research Problems- definition of research problem, necessity of defining research problem		2	Knowledge on fundamental concepts of research methodology, including the meaning and objectives of research				1,2	
II	Research Design- meaning and need of research design, features of a good design, different research designs, Sampling Design- steps in sampling design, Sample Size determination, criteria for selecting a sampling design, different types of sampling design, Experimental Design, Principles of Design of Experiment, One – way ANOVA, Two- Way ANOVA, CRD, RBD, LSD, 22, 23 Factorial Design		4	Able to understand and apply the fundamental principles of research design, including the meaning and necessity of research design				1,2	
III	Types of data, sources of data collection, tools of data collection, Nominal, ordinal, interval and ratio – Attitude scale construction and measurement, rating scales, semantic differential (SD), Use of scale in statistical analysis, Schedules for interviews preparation and standardization, development of survey instruments and item analysis for the questionnaire		3	A good knowledge on different types of data and identify various sources and tools for data collection				1,2	
IV	Planning and organizing research report, Format of research report, Different steps of writing report, lay out of the research report, How to organize thesis/Dissertation, mechanics of writing research report, standard methods of quoting- presenting the result, written and oral reports, Uses of abstract, format of research report, presentation of statistics - tabular and graphic references and uses of		3	Able to organize and write a comprehensive research report				1,2	

	references, Bibliography and presentation of bibliography			
<b>V</b>	Intellectual property right (IPR), Introduction and the need for IPR, IPR in India and worldwide, Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge and Geographical Indications, Patentable and non-patentable, patenting life, Filing of a patent application, The different layers of the international patent system, Case studies on Basmati rice, Turmeric, and Neem patents	3	Knowledge on importance of Intellectual Property Rights (IPR) both in India and globally	1,2
<b>Practical</b>	Laboratory using R Software: 1 Analysis of One-way ANOVA; 2 Analysis of Two-way ANOVA; 3 Analysis of CRD 4 Analysis of RBD 5 Analysis of 22 and 23 Factorial Experiment 6 Simulation-I using R (Bernoulli, Binomial, Poisson and Geometric distribution). 7 Simulation-II using R (Exponential and Normal distribution). 8 Simple random Sampling 9 Stratified Random Sampling	60	Knowledge on various statistical experiments and simulations using R	1,2,3,4

#### Text books

**T1:** Methods in Biostatistics by K S Negi, ISBN:9789374735053,4th Edition, Year:2023, AITBS Publishers, INDIA

#### Reference books

R1. Johnson & Christensen. (2004). Educational Research: Quantitative, qualitative and mixes approaches, 2nd Ed. Boston: Allyn & Bacon.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Students will have basic knowledge of Research methods.	<b>2, 4, 9</b>
<b>2</b>	Students will gain the knowledge of Research Methodology.	<b>2, 4, 9</b>
<b>3</b>	Students will be able to gain the Skill questionnaire development.	<b>2, 4, 5</b>
<b>4</b>	Students will be able to acquire the knowledge of basic Report/dissertation Procedure.	<b>4, 5</b>
<b>5</b>	Knowledge on different IPR rights	<b>6, 7</b>

Course Title	UNIVERSAL HUMAN VALUES (UHV) + PROFESSIONAL ETHICS								
Course code	22UUHV101R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours:15T+30P	1	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Biotechnology								
Semester	Winter/II semester of First year of the programme								
Course objectives	<ol style="list-style-type: none"> <li>To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings</li> <li>To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way</li> <li>To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature</li> </ol>								
CO1	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.								
CO2	It is free from any dogma or value prescriptions.								
CO3	It is a process of self-investigation and self-exploration, and not of giving sermons.								
CO4	Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.								
CO5	This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.								
Unit	Content								
I	<ul style="list-style-type: none"> <li>Understanding the need, basic guidelines, content and process for Value Education</li> <li>Self-Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self-exploration</li> <li>Continuous Happiness and Prosperity- A look at basic Human Aspirations</li> <li>Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority</li> <li>Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario</li> <li>Method to fulfil the above human aspirations: understanding and living in harmony at various levels.</li> </ul>								
II	<ul style="list-style-type: none"> <li>Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’</li> <li>Understanding the needs of Self (‘I’) and ‘Body’ - <i>Sukh</i> and <i>Suvidha</i></li> <li>Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)</li> <li>Understanding the characteristics and activities of ‘I’ and harmony in ‘I’</li> <li>Understanding the harmony of I with the Body: <i>Sanyam</i> and <i>Swasthya</i>; correct appraisal of Physical needs, meaning of Prosperity in detail</li> <li>Programs to ensure <i>Sanyam</i> and <i>Swasthya</i>-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>								
III	<p>Understanding Harmony in the family – the basic unit of human interaction</p> <p>Understanding values in human-human relationship; meaning of Nyaya and program for its fulfilment to ensure Ubhay-tripti;</p> <p>Trust (Vishwas) and Respect (Samman) as the foundational values of relationship</p> <p>Understanding the meaning of Vishwas;</p> <p>Difference between intention and competence</p> <p>Understanding the meaning of Samman, Difference</p> <p>Between respect and differentiation; the other salient values in relationship</p> <p>Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals</p> <p>Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family! -Practice Exercises and Case Studies will be taken up in Practice Sessions.</p>								

<p><b>IV</b></p>	<ul style="list-style-type: none"> <li>• Understanding the harmony in the Nature</li> <li>• Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature</li> <li>• Understanding Existence as Co-existence (<i>Sah-astitva</i>) of mutually interacting units in all-pervasive space</li> <li>• Holistic perception of harmony at all levels of existence-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>
<p><b>V</b></p>	<ul style="list-style-type: none"> <li>• Natural acceptance of human values</li> <li>• Definitiveness of Ethical Human Conduct</li> <li>• Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order</li> <li>• Competence in professional ethics: <ul style="list-style-type: none"> <li>➤ Ability to utilize the professional competence for augmenting universal human order</li> <li>➤ Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems,</li> <li>➤ Ability to identify and develop appropriate technologies and management patterns for above production systems.</li> </ul> </li> <li>• Case studies of typical holistic technologies, management models and production systems</li> <li>• Strategy for transition from the present state to Universal Human Order: <ul style="list-style-type: none"> <li>➤ At the level of individual: as socially and ecologically responsible engineers, technologists and managers</li> <li>➤ At the level of society: as mutually enriching institutions and organizations</li> </ul> </li> </ul>
<p><b>Guidelines and Content for Practice Sessions</b></p>	<p>UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education</p> <p>PS 1: Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? How do you differentiate between right and wrong? What have been your achievements and shortcomings in your life? Observe and analyze them.</p> <p>Expected outcome: the students start exploring themselves; get comfortable to each other and to the teacher and start finding the need and relevance for the course.</p> <p>PS 2: Now-a-days, there is a lot of voice about many techno-genic maladies such as energy and natural resource depletion, environmental pollution, global warming, ozone depletion, deforestation, soil degradation, etc. – all these seem to be man-made problems threatening the survival of life on Earth – What is the root cause of these maladies &amp; what is the way out in your opinion?</p> <p>On the other hand, there is rapidly growing danger because of nuclear proliferation, arms race, terrorism, criminalization of politics, large scale corruption, scams, breakdown of relationships, generation gap, depression &amp; suicidal attempts, etc – what do you think, is the root cause of these threats to human happiness and peace – what could be the way out in your opinion?</p> <p>Expected outcome: the students start finding that technical education without study of human values can generate more problems than solutions. They also start feeling that lack of understanding of human values is the root cause of all problems and the sustained solution could emerge only through understanding of human values and value based living. Any solution brought out through fear, temptation or dogma will not be sustainable.</p> <p>PS 3:</p> <ol style="list-style-type: none"> <li>1. Observe that each one of us has Natural Acceptance, based on which one can verify right or not right for him. Verify this in case of <ol style="list-style-type: none"> <li>i) What is Naturally Acceptable to you in relationship- Feeling of respect or disrespect?</li> <li>ii) What is Naturally Acceptable to you – to nurture or to exploit others? Is your living the same as your natural acceptance or different?</li> </ol> </li> <li>2. Out of the three basic requirements for fulfilment of your aspirations- right understanding, relationship and physical facilities, observe how the problems in your family are related to each. Also observe how much time &amp; effort you devote for each in your daily routine.</li> </ol> <p>Expected outcome:</p> <ol style="list-style-type: none"> <li>1. The students are able to see that verification on the basis of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with</li> </ol>

authenticity; it will only develop assumptions.

2. The students are able to see that their practice in living is not in harmony with their natural acceptance most of the time, and all they need to do is to refer to their natural acceptance to remove this disharmony.

3. The students are able to see that lack of right understanding leading to lack of relationship is the major cause of problems in their family and not the lack of physical facilities in most of the cases, while they have given higher priority to earning of physical facilities in their life ignoring relationships and not being aware that right understanding is the most important requirement for any human being.

UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!

PS 4: List down all your desires. Observe whether the desire is related to Self (I) or Body. If it appears to be related to both, see which part of it is related to Self (I) and which part is related to Body.

Expected outcome: the students are able to see that they can enlist their desires and the desires are not vague. Also they are able to relate their desires to 'I' and 'Body' distinctly. If any desire appears related to both, they are able to see that the feeling is related to I while the physical facility is related to the body. They are also able to see that 'I' and 'Body' are two realities, and most of their desires are related to 'I' and not body, while their efforts are mostly centered on the fulfilment of the needs of the body assuming that it will meet the needs of 'I' too.

PS 5:

1. a. Observe that any physical facility you use, follows the given sequence with time :  
Necessary & tasteful → unnecessary & tasteful → unnecessary & tasteless → intolerable

b. In contrast, observe that any feeling in you is either naturally acceptable or not acceptable at all. If naturally acceptable, you want it continuously and if not acceptable, you do not want it any moment!

2. List down all your activities. Observe whether the activity is of 'I' or of Body or with the participation of both 'I' and Body.

3. Observe the activities within 'I'. Identify the object of your attention for different moments (over a period of say 5 to 10 minutes) and draw a line diagram connecting these points. Try to observe the link between any two nodes.

**Expected outcome:**

1. The students are able to see that all physical facilities they use are required for a limited time in a limited quantity. Also they are able to see that in case of feelings, they want continuity of the naturally acceptable feelings and they do not want feelings which are not naturally acceptable even for a single moment.

2. the students are able to see that activities like understanding, desire, thought and selection are the activities of 'I' only, the activities like breathing, palpitation of different parts of the body are fully the activities of the body with the acceptance of 'I' while the activities they do with their sense organs like hearing through ears, seeing through eyes, sensing through touch, tasting through tongue and smelling through nose or the activities they do with their work organs like hands, legs etc. are such activities that require the participation of both 'I' and body.

3. The students become aware of their activities of 'I' and start finding their focus of attention at different moments. Also they are able to see that most of their desires are coming from outside (through preconditioning or sensation) and are not based on their natural acceptance.

PS 6:

1. Chalk out programs to ensure that you are responsible to your body- for the nurturing, protection and right utilisation of the body.

2. Find out the plants and shrubs growing in and around your campus. Find out their use for curing different diseases.

Expected outcome: The students are able to list down activities related to proper upkeep of the body and practice them in their daily routine. They are also able to appreciate the plants wildly growing in and around the campus which can be beneficial in curing different diseases.

UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

PS 7: Form small groups in the class and in that group initiate dialogue and ask the eight questions related to trust. The eight questions are:

1a. Do I want to make myself happy? 2a. Do I want to make the other happy?

3a. Does the other want to make him happy? 4a. Does the other want to make me happy?

What is the answer?

Intention (Natural Acceptance)

1b. Am I able to make myself always happy? 2b. Am I able to make the other always happy?

3b. Is the other able to make him always happy? 4b. Is the other able to make me always happy?

What is the answer?

Competence

Let each student answer the questions for himself and everyone else. Discuss the difference between intention and competence. Observe whether you evaluate your intention & competence as well as the others' intention & competence.

Expected outcome: The students are able to see that the first four questions are related to our Natural Acceptance i.e. Intention and the next four to our Competence. They are able to note that the intention is always correct, only competence is lacking! We generally evaluate ourselves on the basis of our intention and others on the basis of their competence! We seldom look at our competence and others' intention as a result we conclude that I am a good person and other is a bad person.

PS 8:

1. Observe on how many occasions you are respecting your related ones (by doing the right evaluation) and on how many occasions you are disrespecting by way of under- evaluation, over-evaluation or otherwise evaluation.

2. Also observe whether your feeling of respect is based on treating the other as yourself or on differentiations based on body, physical facilities or beliefs.

Expected outcome: The students are able to see that respect is right evaluation, and only right evaluation leads to fulfilment in relationship. Many present problems in the society are an outcome of differentiation (lack of understanding of respect), like gender biasness, generation gap, caste conflicts, class struggle, dominations through power play, communal violence, clash of isms, and so on so forth. All these problems can be solved by realizing that the other is like me as he has the same natural acceptance, potential and program to ensure a happy and prosperous life for him and for others though he may have different body, physical facilities or beliefs.

PS 9:

1. Write a note in the form of story, poem, skit, essay, narration, dialogue to educate a child. Evaluate it in a group.

2. Develop three chapters to introduce 'social science- its need, scope and content' in the primary education of children

Expected outcome: The students are able to use their creativity for educating children. The students are able to see that they can play a role in providing value education for children. They are able to put in simple words the issues that are essential to understand for children and comprehensible to them. The students are able to develop an outline of holistic model for social science and compare it with the existing model.

UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

PS 10: List down units (things) around you. Classify them in four orders. Observe and explain the mutual fulfilment of each unit with other orders.

Expected outcome: The students are able to differentiate between the characteristics and activities of different orders and study the mutual fulfilment among them. They are also able to see that human beings are not fulfilling to other orders today and need to take appropriate steps to ensure right participation (in terms of nurturing, protection and right utilization) in the nature.

PS 11:

1. Make a chart for the whole existence. List down different courses of studies and relate them to different units or levels in the existence.

2. Choose any one subject being taught today. Evaluate it and suggest suitable modifications to make it

	<p>appropriate and holistic.</p> <p>Expected outcome: The students feel confident that they can understand the whole existence; nothing is a mystery in this existence. They are also able to see the interconnectedness in the nature, and point out how different courses of study relate to the different units and levels. Also they are able to make out how these courses can be made appropriate and holistic.</p> <p>UNIT 5: Implications of the above Holistic Understanding of Harmony at all Levels of Existence</p> <p>PS 12: Choose any two current problems of different kind in the society and suggest how they can be solved on the basis of natural acceptance of human values. Suggest steps you will take in present conditions.</p> <p>Expected outcome: The students are able to present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.</p> <p>PS 13:</p> <p>1.Suggest ways in which you can use your knowledge of Technology/Engineering/Management for universal human order, from your family to the world family.</p> <p>2.Suggest one format of humanistic constitution at the level of nation from your side.</p> <p>Expected outcome: The students are able to grasp the right utilization of their knowledge in their streams of Technology/Engineering/ Management to ensure mutually enriching and recyclable productions systems.</p> <p>PS 14: The course is going to be over now. Evaluate your state before and after the course in terms of a. Thought b. Behaviour and c. Work d. Realization</p> <p>Do you have any plan to participate in the transition of the society after graduating from the institute? Write a brief note on it.</p> <p>Expected outcome: The students are able to sincerely evaluate the course and share with their friends. They are also able to suggest measures to make the course more effective and relevant. They are also able to make use of their understanding in the course for a happy and prosperous society.</p>
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**Text book**

1. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values an professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

**Reference**

- R1:** B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
- R2:** PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
- R3:** Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986,1991

**Other Learning Resources**

1. Value Education websites, <http://uhv.ac.in>, <http://www.uptu.ac.in>
2. Story of Stuff, <http://www.storyofstuff.com>
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story



<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.	<b>1, 2, 3, 4, 7</b>
<b>2</b>	It is free from any dogma or value prescriptions.	<b>1, 3, 4</b>
<b>3</b>	It is a process of self-investigation and self-exploration, and not of giving sermons.	<b>1, 2, 3</b>
<b>4</b>	Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.	<b>1, 3, 5</b>
<b>5</b>	This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.	<b>3, 8</b>

Course Title	COMMUNICATION MASTERY (Communicative English & Soft Skills)								
Course code	22UMPD121R	Total credits: 2 Total hours: 60P	L	T	P	S	R	O/F	C
			0	0	4	0	0	0	2
Pre-requisite	Effective English	Co-requisite	Nil						
programme	Master of Science in Biotechnology								
Semester	Spring/II semester of First year of the programme								
Course objectives	1. To familiarize students with the transformation of sentences and the appropriate use of prepositions. 2. To enhance the writing skills in different areas including CV and cover letter writing. 3. To convey meaning by reinforcing, substituting for or contradicting verbal communication. 4. Productivity and performance boosting activities for professional goal achievement.								
CO1	Explain prepositions, tag questions, and idioms correctly.								
CO2	Discuss and analyze different sentence types and voices.								
CO3	Explain effective paragraphs, precis, and professional documents.								
CO4	Describe SWOT analysis, goal setting, and personal hygiene principles.								
CO5	Illustrate non-verbal communication and body language concepts.								
Unit	Content								
Module 1- Grammar	I. Use of Prepositions II. Tag questions III. Idioms, Phrases and Clauses IV. Simple, complex, compound sentences								
Module 2- Grammar	I. Active and Passive Voice II. Direct and Indirect Speech								
Module 3- Writing Skills	I. The Basics of Writing; avoid ambiguity and vagueness II. Paragraph Writing III. Precis Writing IV. Letter Writing V. Resume, CV and Cover Letter								
Module 4- Self-Management Skills	I. SWOT Analysis II. Self-Regulation- Goal Setting III. Personal Hygiene								
Module 5- Non-Verbal Communication- Sciences of Body Language	I. What is Non-Verbal Communication & Body Language, II. Elements of Communication, III. Types of Body Language, IV. Importance and Impact of Body Language, V. Types of Communication through Body Language, VI. Introduction to Haptic, Introduction to Kinesics VII. Introduction to Proxemics, VIII. Body Language Do's and Don'ts, Doubt Clearing Session.								
Module 6- Group Discussion (Theory)	I. Importance, II. Planning, Elements, and Skills assessed; III. Effectively disagreeing, IV. Initiating, Summarizing and Attaining the Objective								

#### Text book

1. Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.
2. McDowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition).

**Reference books**

1. Communication Skills Training: A Practical Guide to Improving Your Social Intelligence, Presentation and Social Speaking, Ian Tuhovsky, 2019
2. A Textbook for AECC English Communication: Interface, Dr. Kironmoy Chetia and Pranami Bania Breez Mohan Hazarika, January 2019.

**Other Learning Resources:**

1. <https://youtu.be/x60GHpQ8gJk>
2. [https://youtu.be/Ke\\_oSN-BCaY](https://youtu.be/Ke_oSN-BCaY)
3. <https://youtu.be/TDPDtrLxT-c>
4. <https://www.classcentral.com/report/toefl-preparation/>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain prepositions, tag questions, and idioms correctly.	<b>5</b>
<b>2</b>	Discuss and analyze different sentence types and voices.	<b>2, 5</b>
<b>3</b>	Explain effective paragraphs, precis, and professional documents.	<b>3, 5</b>
<b>4</b>	Describe SWOT analysis, goal setting, and personal hygiene principles.	<b>5</b>
<b>5</b>	Illustrate non-verbal communication and body language concepts.	<b>5</b>

Course Title	Computational System and Digital Literacy								
Course code	22UUDLI103R	Total credits: 1 Total hours:30	L	T	P	S	R	O/F	C
			0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Biotechnology								
Semester	Spring/II semester of First year of the programme								
Course objectives	1. Students will be able to understand the fundamentals of computer systems and Internet search along with advanced features of MS-Office. 2. Students will be able to learn data management, statistical analysis and visualization. 3. Students will be able to use social media and e-commerce portals, Digital Payment systems, and other utility software.								
CO1	Explain computer systems and Internet search fundamentals.								
CO2	Describe data analysis and visualization problems with MS Office.								
CO3	Illustrate social media and e-commerce sites efficiently and ethically.								
CO4	Discuss about utility software for research and information management.								
CO5	Explain software tools for research and data management.								
Unit-No.	Content								
I	<b>Fundamentals of Computer Systems, Office Automation and Internet Search</b> i. Components of a Computer and their functions. ii. Office Automation using MS-Word, MS-Excel, and MS-PowerPoint. iii. Data management, Statistical Data Analysis and Data Visualization with MS-Excel. iv. Use of Functions, Graphs & Charts in MS-Excel.								
II	<b>Internet &amp; Cyber World</b> i. Introduction to Computer Networks, Internet and World Wide Web, Websites and Web portals. ii. Creation and use of Email Accounts. iii. Web browsing, Web Searching, Different aspects of Web Searching- Search Keywords, conditions and combinations. iv. Study of different Search Engines like Google, Microsoft Bing, Yahoo, Yandex, DuckDuckGo, Ask.Cometc. v. Cyber Crimes, Cyber Laws and IT Act 2000, India.								
III	<b>Introduction to Social Media and E-Commerce</b> i. Relevance of social media in present scenario. Posting different types of contents in social media. ii. Creating accounts and using some popular social media portals and Apps like WhatsApp, Facebook, etc. Social Media Etiquettes &Crimes. iii. Definition of E-Commerce; E-Commerce versus traditional Commerce. iv. Case studies of popular E-Commerce portals like Amazon. v. E-commerce Etiquettes &Crimes.								
IV	<b>Digital Payments and Digital Transactions</b> i. Introduction to Digital Payment Systems. ii. Creating accounts and using Digital Payment Systems like Credit Cards, Debit Cards, Net banking, UPI. Digital payments Etiquettes &Crimes.								
V	<b>Basic Accounting and Utility Software</b> i. Introduction to Basic accounting concepts, Introduction to an Accounting Software like GnuCash or Tally. ii. Introduction to Technical Document writing using LaTeX. iii. Introduction to Data Visualization software – Sigma, Google Charts, Tableau								

**Text books**

T1: Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems & Applications. 3rd ed. New Delhi: Publications.

T2: Goel, A, 2010. Computer Fundamentals, Pearson India.

**Reference books**

R1: Bala Guruswamy, E. 2009 Fundamentals of Computers, Tata McGraw-Hill Education.

R2: Bala Guruswamy, 2014. E. Fund Of Comp & Programming (Updated Ed Sem. I, Au) Tata McGraw-Hill Education.

R3: Lawson, C. 2022. Introduction to Social Media, Oklahoma State University.

**Other learning resources:**

<https://www.w3schools.com>

<https://edu.gcfglobal.org>

<https://www.tutorialspoint.com>

<https://www.javatpoint.com>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain computer systems and Internet search fundamentals.	<b>1</b>
<b>2</b>	Describe data analysis and visualization problems with MS Office.	<b>1, 3</b>
<b>3</b>	Illustrate social media and e-commerce sites efficiently and ethically.	<b>5</b>
<b>4</b>	Discuss about utility software for research and information management.	<b>2, 5</b>
<b>5</b>	Explain software tools for research and data management.	<b>2, 5</b>

Semester III									
Course Title	Techno-Professional Skills II (Biofertilizer production)								
Course Code	22MSBT215R	Total Credits: 2 Total Hours: 60p	L	T	P	S	R	O/F	C
			0	0	4	0	0	0	2
Pre-Requisite	Cell Biology, Biochemistry	Co-Requisite	NA						
Programme	MSc. Biotechnology								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	1. Appreciate the agronomic importance of beneficial micro-organisms 2. To make students learn and formulate biofertilizers 3. Produce and apply biofertilizers in a pilot scale								
CO1	Explain the Importance of biofertilizers in plant development.								
CO2	Describe mass cultivation and inoculation.								
CO3	Explain the importance of Azolla as a biofertilizers.								
CO4	Describe the importance of phosphate in biofertilizers.								
CO5	Apply the knowledge on the use of Fungi and Mycorrhiza.								
Unit no	Content	CH	Learning outcome	KL					
I	Biofertilizers – Introduction, scope. A general account of plant growth promoters and regulators – Cyanobacterial Biofertilizer: Algalization – mass cultivation of cyanobacterial biofertilizers	10	Importance of biofertilizers in plant development	1,2					
II	Nitrogen fixing Bacteria: Isolation, characterization, identification, mass cultivation and inoculation method of Rhizobium and Azospirillum. Mechanism of nitrogen fixation (free-living and symbiotic) - Biochemistry and molecular basis of nitrogen fixation.	10	Knowledge about mass cultivation and inoculation.	1,2					
III	Azolla – Structure and Morphology – Mass cultivation method and Application. Economic and Ecological importance of Azolla.	10	Importance of Azolla	1,2					
IV	Phosphate solubilizing Bacteria: Isolation, characterization, identification, mass cultivation and inoculation method of Phosphobacteria. Biochemistry of Phosphate solubilization and mobilization. Carrier based inoculum production methods and Field application References	10	Importance of phosphate in biofertilizers	1,2					
V	Mycorrhizal fungi as biofertilizers - Introduction, scope. A general account of Ecto, Endo and Arbuscular mycorrhizae (AM). Isolation and method of inoculation of Arbuscular mycorrhizae (AM), Legume - AM interactions	10	Importance of Fungi, Mycorrhiza	1,2					

#### Text Books

T1: A text book of microbiology, second reprint. S. Chand and Company Ltd., New Delhi. Ann Larkin Hansen, 2010,

#### Reference Books

- R1. Kannaiyan, S. 2002 Biotechnology of Biofertilizers. Narosa publishing house, New Delhi. Dubey, R.C. 2001.  
 R2. Dubey, R. C. 2008. A Textbook of Biotechnology. S. Chand & Co., New Delhi.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the Importance of biofertilizers in plant development.	<b>1, 2, 9</b>
<b>2</b>	Describe mass cultivation and inoculation.	<b>1, 2, 3</b>
<b>3</b>	Explain the importance of Azolla as a biofertilizers.	<b>1, 2, 9</b>
<b>4</b>	Describe the importance of phosphate in biofertilizers.	<b>1, 2, 9</b>
<b>5</b>	Apply the knowledge on the use of Fungi and Mycorrhiza.	<b>1, 9</b>

Course Title	Research Ethics									
Course Code	22UMRE211R	Total Credits:1	L	T	P	S	R	O/F	C	
		Total Hours:60	0	0	0	4	0	0	1	
Pre-Requisite	NA	Co-Requisite	NA							
Programme	MSc. Biotechnology									
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program									
Course Objectives	1. This course aims to lay a foundation for empirical research. 2. To make students aware of relevant guidelines, policies, and codes relating to ethical research. 3. To make students learn ethical theories and concepts.									
CO1	Describe and apply research ethics theories and methods.									
CO2	Explain research ethics issues such as responsibility, vetting, and misconduct.									
CO3	Illustrate arguments and results in ethical research inquiries.									
CO4	Identify and apply procedures for sampling, data collection, and reporting.									
CO5	Apply ethical principles to research design and evaluation									
Unit no	Content									
I	<b>ETHICS:</b> Introduction to the course and each other; an introduction to moral theory. Ethics: definition, moral philosophy, nature of moral judgements and reactions. Research regulation; self – regulation; research ethics. Honesty, candor, compromise and integrity. Data ownership and stewardship; conflicts of interest; collaboration. Human and non-human subjects. Research and researchers in society.									
II	<b>SCIENTIFIC CONDUCT-</b> Ethics with respect to science and research. Intellectual honesty and research integrity. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP). Redundant publications: duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data									
III	<b>PUBLICATION ETHICS-</b> Publication ethics: definition, introduction and importance. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types. Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals.									
IV	<b>OPEN ACCESS PUBLISHING-</b> Open access publications and initiatives. SHERPA/RoME0 online resource to check publisher copyright & self-archiving policies. Software tool to identify predatory publications developed by SPPU. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.									
V	<b>PUBLICATION MISCONDUCT</b> Group Discussions; Subject specific ethical issues, FFP, authorship. Conflicts of interest. Complaints and appeals: examples and fraud from India and abroad. Software tools; Use of plagiarism software like Turnitin, Urkund and other open-source software tools. <b>DATABASES AND RESEARCH METRICS</b> –Databases: Indexing databases. Citation databases: Web of Science, Scopus, etc. Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score. Metrics: h-index, g index, I 10 indexes, altimetric.									

#### Text Books

Bird, A (2006). Philosophy of Science. Routledge.

Macintyre, Alasdair (1967) A Short History of Ethics. London.

Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019)

#### Reference Books

National Academy of Science, National Academy of Engineering and Institute of Medicine (2009). On Being a Scientist: A Guide of Responsible Conduct in Research: Third Edition, National academics Press



George R, (2011). Sociological Theory, Rawat Publication, New Delhi, India. George R,(2019).Post Modern Social Theory, Rawat Publication, New Delhi, India.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe and apply research ethics theories and methods.	<b>6</b>
<b>2</b>	Explain research ethics issues such as responsibility, vetting, and misconduct.	<b>6</b>
<b>3</b>	Illustrate arguments and results in ethical research inquiries.	<b>5, 6</b>
<b>4</b>	Identify and apply procedures for sampling, data collection, and reporting.	<b>2, 3, 4</b>
<b>5</b>	Apply ethical principles to research design and evaluation	<b>4, 9</b>

Course Title	CORPORATE PROFICIENCY								
Course Code	22UMPD211R	Total Credits: 2	L	T	P	S	R	O/F	C
		Total Hours: 60	0	0	4	0	0	0	2
Pre-Requisite	Communication Mastery	Co-Requisite	NA						
Programmes	MSc. Biotechnology								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	<ol style="list-style-type: none"> <li>To acquaint students with the various tools of an effective presentation.</li> <li>To acquire the speaking skill, instruct, influence, engage, educate, or appease the listeners.</li> <li>To increase proficiency, present ability and quality of resume and provide guidance for self-promotion and self-evaluation in social media.</li> <li>To prepare and train the students for the campus drives &amp; walking interviews.</li> </ol>								
CO1	Able to speak with greater control and charisma in front of others.								
CO3	Discuss the positive impact in their thought process and problem-solving skills.								
CO3	Illustrate with all the necessary tools and skill sets to prepare professional resume.								
CO4	Discuss the highlights and assess themselves in social media.								
CO5	Explain the impart in them techniques to solve critical problems in an interview, develop strategies to crack interviews, improve their communication skills, boost their confidence								
Unit no	Content								
I	<b>Module 1- Presentation Skills</b> i. Introduction ii. Essential characteristics of a good presentation iii. Preparation of a good presentation								
II	<b>Module 2- Public Skills</b> i. Fear of Public Speaking, ii. Understanding and Overcoming Fear of Public Speaking, iii. Confidence and Control, iv. Physiology and Stress - Control/Process, v. Tips for Presentations and Public Speaking, vi. Tips for Using Visual Aids in Presentations, vii. Process for Preparing and Creating Presentations, viii. Delivering Presentations Successfully, ix. Doubt Clearing and Summary of Main Points								
III	<b>Module 3- Practical session on Resume, Curriculum Vitae, Writing cover letter &amp; LinkedIn Profile</b> i. Preparation, submission & screening of Resume. ii. Practical session on cover letter screening session iii. Creating a profile on LinkedIn iv. How to utilize it <b>Module 4- Leadership &amp; Management Skills</b> i. Concepts of Leadership, ii. Leadership Styles, iii. Manager VS Leader, iv. How to be an Effective Leader, v. Mock/ Practice Session, vi. Doubt Clearing Session.								
IV	<b>Module 5- Research Paper – Writing Skills</b> i. How to write a research paper ii. Key point in Research Work <b>Module 6- Interview Skills &amp; Dress code Ethics</b> i. Types of the interview- telephonic, virtual & face to face ii. Online interview, personal interview, iii. Panel interview,								

	iv. Group interview, v. JAM session, vi. Types of interview questions-traditional/common interview questions, vii. Case interview questions, viii. General Strategies for answering questions, ix. Marketing your skills and experiences, x. Preparation before the interview, xi. How to dress up for an interview, xii. How to maintain eye contact and positive body language, xiii. How to be presentable, xiv. Interview dos and don'ts, xv. Introduction to Dress Code Ethics, xvi. Purpose and Importance xvii. How to Make „FIRSTIMPRESSION“ xviii. What to Wear During Interviews or Any Other Formal Meetings – Male &Female
<b>V</b>	<b>Module 7- Mock Interview</b> i. Practical Mock Interview, ii. Feedback- Receiving Feedback, iii. Giving Feedback, iv. Advantages of Effective Feedback, v. How to deal with negative feedback.

### Text Books

T1. Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

T2. Mc Dowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition).

### Reference Books

Garg. Manoj Kr. (2018) English Communication: Theory and Practice

Other Learning Resources: <https://brightlinkprep.com/10-best-toefl-prep-books/>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Able to speak with greater control and charisma in front of others.	<b>5</b>
<b>2</b>	Discuss the positive impact in their thought process and problem-solving skills.	<b>2</b>
<b>3</b>	Illustrate with all the necessary tools and skill sets to prepare professional resume.	<b>5</b>
<b>4</b>	Discuss the highlights and assess themselves in social media.	<b>5</b>
<b>5</b>	Explain the impart in them techniques to solve critical problems in an interview, develop strategies to crack interviews, improve their communication skills, boost their confidence	<b>5, 6, 8</b>

<b>Course Title</b>	<b>MINI RESEARCH (SURVEY/EXPERIMENTS-R3)</b>								
<b>Course code</b>	<b>22MSBT217R</b>	<b>Total credits: 2</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
			<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>6</b>	<b>0</b>	<b>2</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programmes</b>	<b>Master of Science in Biotechnology</b>								
<b>Semester</b>	<b>Spring/II Semester of First Year of the Programme</b>								
<b>Course objectives</b>	To develop students scientific method								
<b>CO1</b>	To design an experiment using scientific method								
<b>CO2</b>	Apply the knowledge of sampling methods in sample collection.								
<b>CO3</b>	To store and work on the sample through various parametric assays.								
<b>CO4</b>	To structurize data and perform statistical analyses.								
<b>CO5</b>	To interpret and discuss the findings.								

Course Title	PERSONAL FINANCIAL PLANNING								
Course Code	22UUFL202R	Total Credits:1 Total Hours:30p	L	T	P	S	R	O/F	C
			0	0	2	0	0	0	1
Pre- Requisite	Introduction to Financial Budgeting And Planning	Co-Requisite	NIL						
Programmes	Master of Science in Biotechnology								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	<p>1. The course would offer an inclusive approach to understand the relevant concepts of money, borrowing, lending, taxes and their application to financial planning.</p> <p>2. Assess the personal financial planning process, the life cycle of financial plans, and methods of goal achievement.</p> <p>3. Formulate a budget, record-keeping system, and tax planning strategy based on current financial goals.</p>								
CO1	Explain the cash management and buying plan for homes or automobiles.								
CO2	Discuss a diversified investment portfolio for different objectives.								
CO3	Compare mutual funds, ETFs, and real estate investment options.								
CO4	Develop a financial plan for retirement and estate protection.								
CO5	Describe financial products and strategies for long-term goals								
Unit no	Content								
I	<b>Unit 1- Fundamentals of Financial Planning –</b> i. Functions of money; ii. Inflation- Meaning, causes, how it can be controlled; iii. process official planning, iv. Time value of money-simple and compound interest; v. Net Present Value and Future value, vi. Power of Compounding; vii. Doubling period and Rule of 72.								
II	<b>Unit 2- Income Tax Planning–</b> i. Meaning of Income, ii. Direct & Indirect Taxes, Taxable Income, various heads of Income for tax Calculation, iii. Non-taxable Income, iv. Tax evasion and tax avoidance, v. GST, Tax Planning Strategies.								
III	<b>Unit 3- Entrepreneurial planning –</b> i. Meaning of Entrepreneurship, prerequisites for becoming an entrepreneur, ii. Entrepreneurship Support Systems in India, iii. Institutional support systems for entrepreneurs, iv. Financial support systems for entrepreneurs; v. Venture Capital, Business Angels, vi. Assistant of Government, vii. Commercial Bank Loans and Overdraft.								
IV	<b>Unit 4-Planning for investing in securities market –</b>								

	<p>i. Investment avenues offered by Securities Markets, Primary Market and Secondary Market,</p> <p>ii. Stock market- meaning, features, functions of NSE, BSE DEMAT trading account,</p> <p>iii. Security repository, stock brokers, Operational aspects of securities markets: placement of orders, contract note, pay-in and pay-out, trading and settlement cycle,</p> <p>iv. Various risks involved in investing in securities markets; Role of Financial Intermediaries; Stock indices.</p> <p>v. Mutual Funds- meaning concept, definition, types, importance and drawbacks of mutual funds, mutual funds in India, investing in mutual funds,</p> <p>vi. Systematic Investment Plan (SIP) and its advantages.</p>
<b>V</b>	<p><b>Unit 5- Planning for debts and Retirement</b></p> <p>i. Consumer credit - Introduction to consumer credit; choosing a source of credit, the cost of credit alternatives,</p> <p>ii. Consumer Legal Protection;</p> <p>iii. Housing Decision: Factors and Finance; Vehicle Decisions.</p> <p>iv. Retirement planning - Meaning of cost of living; retirement need analysis; development of retirement plan, various retirement schemes,</p> <p>v. Estate Planning; Pension and Medicare Planning; Wills.</p>

**Text Books:**

1. Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems & The Million-Dollar Financial Advisor: Powerful Lessons and Proven Strategies from Top Producers by David J. Mullen Jr
2. Personal Finance and Planning by Dr. Rajni
3. Peaceful Personal Finance: A Short Read on the Basics of Personal Finance and Planning Kindle Edition by Hema Singh
4. Be Your Own Financial Advisor: Financial Planning, Investment Options, Risk Management, Tax Management, Succession Planning Kindle Edition y Sushil Bali
5. The Dumb Things Smart People Do with Their Money: Thirteen Ways to Right Your Financial Wrongs Kindle Edition y Jill Schlesinger

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the cash management and buying plan for homes or automobiles.	<b>5</b>
<b>2</b>	Discuss a diversified investment portfolio for different objectives.	<b>9</b>
<b>3</b>	Compare mutual funds, ETFs, and real estate investment options.	<b>2, 5, 9</b>
<b>4</b>	Develop a financial plan for retirement and estate protection.	<b>9</b>
<b>5</b>	Describe financial products and strategies for long-term goals	<b>5</b>

Course Title	Plant and Animal Biotechnology								
Course Code	22MSBT211R	Total Credits: 4	L	T	P	S	R	O/F	C
		Total Hours: 45t+30p	3	0	2	0	0	0	4
Pre-Requisite	Cell Biology, Biochemistry, Molecular Biology	Co-Requisite	NA						
Programme	MSc. Biotechnology								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduction to the best use of Plant Cell Culture media as well as maintenance of aseptic condition.</li> <li>2. To describe the plant cell, its characteristic organelles as well as the composition, structure and properties of the plant cell wall, and its practical possibilities</li> <li>3. Introduction to the best use of Animal Cell Culture media as well as maintenance of aseptic condition.</li> <li>4. Elucidation of various cell to cell interaction; adhesion, motility and metabolic co-operation.</li> </ol>								
CO1	Explain the advanced genetic modification techniques used in both plants and animals.								
CO2	Acquire and demonstrate the skills in plant and animal tissue culture, cloning, and propagation methods.								
CO3	Describe the knowledge of biotechnology to enhance crop yield, improve resistance to pests and diseases, and optimize agricultural practices.								
CO4	Discuss the knowledge of biotechnology in medicine and healthcare, particularly in the context of animal biotechnology.								
CO5	Explain the ethical issues related to plant and animal biotechnology.								
Unit No	Content		CH	Learning Outcome			KL		
I	Cell and tissue culture: Introduction to cell and Tissue Culture Laboratory facilities, Tissue culture media (composition and preparation) Callus and suspension cultures: initiation and maintenance of callus and suspension cultures; single cell clones.		10	To learn the basics of plant tissue culture			1,2		
II	Tissue and micropropagation, regeneration, production of haploids, protoplast culture and somatic hybridization. Cloning in plants - Ti plasmid organization. Concept of transgenic plants Bt cotton and other plant applications.		8	To harness ideas on embryogenesis and organogenesis			1,2		
III	Various techniques of animal cell and tissue culture: Culture media, growth factors, laboratory facilities. Characteristics of cells in culture: Contact inhibition, anchorage dependence, cell-cell communication etc.; Cell senescence; cell and tissue response to trophic factors. Primary culture, immortal cells, cell lines. d) Maintenance of cell lines in the laboratory.		8	To get the basic knowledge on the different techniques of animal cell culture			1,2		
IV	rDNA products: Brief idea about recombinant DNA products in medicine (insulin, somatostatin, vaccines), Concept of Gene therapy, Production of recombinant vaccines – hepatitis. Concept of transgenic animals In vitro fertilization and embryo transfer in humans and farm animals. Transgenic animals		10	To apply knowledge of DNA manipulation on the improvement of plant traits			1,2, 3,4		

<b>V</b>	PR proteins, nematode resistance, marker-assisted selection – strategies for introducing genes of biotic and abiotic stress resistance in plants. Ethical issues of plant and animal biotechnology	9	To learn the applications of biotechnology in the field of plant science	1,2, 3,4
<b>Practical</b>	Establishing a plant cell culture (both in solid and liquid media) – seed germination, callus culture, suspension cell culture, regeneration from callus cells. Cell count by hemocytometer. Artificial seed.	30	To apply the practical knowledge of plant biotechnology in various fields	1,2, 3,4

#### Text Books

1. Biotechnology by U. Satyanarayan.
2. Biotechnology; Expanding Horizon by B.D. Singh.
3. Biotechnology; S.S. Purohit

#### Reference Books

- Ravishankar G.A. and Venkataraman L.V. (197) Biotechnology Applications of plant Tissue & culture. Oxford & IBH Publishing Co, Pvt. Ltd.
- Bhan (1998) Tissue Culture, Mittal Publications, New Delhi.
- Islan A.C (1996) Plant Tissue Culture, Oxford & IBH Publishing Co. Pvt. Ltd.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the advanced genetic modification techniques used in both plants and animals.	<b>1, 2, 3</b>
<b>2</b>	Acquire and demonstrate the skills in plant and animal tissue culture, cloning, and propagation methods.	<b>1, 2, 3, 4</b>
<b>3</b>	Describe the knowledge of biotechnology to enhance crop yield, improve resistance to pests and diseases, and optimize agricultural practices.	<b>1, 2, 3</b>
<b>4</b>	Discuss the knowledge of biotechnology in medicine and healthcare, particularly in the context of animal biotechnology.	<b>1, 2, 7</b>
<b>5</b>	Explain the ethical issues related to plant and animal biotechnology.	<b>1, 2, 7</b>



Course Title	Medical Biotechnology								
Course Code	22MSBT212R	Total Credits: 4 Total Hours:45T+30p	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-Requisite	Molecular biology	Co-Requisite	NA						
Programmes	MSc. Biotechnology								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	1. To introduce the students about human genome project, concept of gene therapy, stems cells and various diseases. 2. To study the detail about diagnosis, treatment, control measurement of various diseases. 3. To study Nano biotechnology and its application in drug delivery.								
CO1	Explain Human Genome Project and its importance in the field medical science.								
CO2	Discuss gene therapy focusing on disease-associated genes and ethical consideration contributions to this field addressing genetic diseases.								
CO3	Describe the concept of stem cells and its properties.								
CO4	Describe Cancer Biology, explores and demonstrate microbial diseases, providing insights into infection modes, control measures for a holistic view of human health.								
CO5	Illustrate the concept of nano materials, their synthesis, and applications in biosensors, drug delivery, gene therapy, and cancer therapy.								
Unit no	Content	CH	Learning outcome				KL		
I	Human genome Project-Introduction, history, techniques, ethics, application.	10	To learn the basics and scopes of medical biotechnology				1,2		
II	Gene therapy- Introduction, genes responsible for disease, Principle, types, gene targeted for gene therapy, SCID, Humanized antibody, plasminogen activator, ethics, importance	8	To harness ideas on recent trends in the field of medical biotechnology				1,2		
III	Stem Cells: Introduction, Types of Stem Cells, Sources of Stem Cells Properties of Stem Cells	8	To get the basic knowledge of stem cell therapy				1,2		
IV	Cancer Biology: Introduction, Types of Tumours, Predisposing factors for cancer, Cellular changes involved in Tumour formation, Methods of Tumour detection, Treatment of cancer – Chemotherapy and Radiotherapy. Microbial diseases in Human – mode of infection, symptoms, epidemiology and control measures	10	To learn about cancer, diagnosis and therapies related to it.				1,2,		
V	Nanobiotechnology- introduction, Type of nano material, Synthesis of nano material, Nano Biosensor, Drug Delivery, Gene therapy, Drug Delivery, Cancer Therapy, Risk Potential of Nano Material. Molecular detection of presymptomatic genetic disease, its importance in health care, pre-natal diagnosis and genetic manipulation	9	To learn about the techniques for the detection of different diseases				1,2,3,4		
Practical	Study of Mycobacterium tuberculosis by AFB staining method. Diagnosis of venereal disease by using VDRL test. Study of Salmonella typhi by using Widal test	30	To apply the practical knowledge of detection of different diseases				1,2,3,4		

#### Text Books

T1: Medical Biotechnology, V. Rao p. Nallari, Oxford University Press

#### Reference Books

R1: Human Molecular Genetics 2nd Edition by Strachan & Read, Wiley and sons' publication.

R2: Medical Microbiology, Credic A Mims (2004) 3rd Edition, Mosgy Inc. Publication

R3: Nanobiotechnology, Subbiah Balaji, Neha Publishers & Distributors

R4: Nanobiotechnology: Concepts, Applications & Perspectives, Niemeyer C M, Wiley India Pvt. Ltd.-New Delhi.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain Human Genome Project and its importance in the field medical science.	<b>1, 2, 4, 6</b>
<b>2</b>	Discuss gene therapy focusing on disease-associated genes and ethical consideration contributions to this field addressing genetic diseases.	<b>1, 2, 3, 5</b>
<b>3</b>	Describe the concept of stem cells and its properties.	<b>1, 2</b>
<b>4</b>	Describe Cancer Biology, explores and demonstrate microbial diseases, providing insights into infection modes, control measures for a holistic view of human health.	<b>1, 2, 3, 4</b>
<b>5</b>	Illustrate the concept of nano materials, their synthesis, and applications in biosensors, drug delivery, gene therapy, and cancer therapy.	<b>1, 2, 3, 4</b>

Course Title	Bioprocess and Fermentation Technology								
Course Code	22MSBT213R	Total Credits: 4 Total Hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-Requisite	Biochemistry, Cell Biology, Microbiology	CO-REQUISITE	NA						
Programme	MSc. Biotechnology								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	1. To teach bacterial strain improvement techniques, inoculation procedures, media preparation, types and make up of bioreactors. 2. To teach the industrial production of Agar, Alcohols, Organic Acids, Amino Acids, Antibiotics, SCP, Vitamins, Enzymes. 3. To impart knowledge on upstream and downstream bioprocess technology								
CO1	Describe the historical development in Bioprocess Engineering, key inventions and discoveries and its application in different fields.								
CO2	Explain the design structure, function, and operation of bioreactors including, functional operations and specialised variation in designs of bioreactors.								
CO3	Illustrate the formulation strategies of fermentation media and different source of nutrients for fermentation media.								
CO4	Outline the techniques of downstream processing and different isolation and purification methods of biotechnological products.								
CO5	Summarize the different fermentation processes involved in fermented foods and HACCP concept and explain effective safety measures in producing fermented foods.								
Unit no	Content	CH	Learning outcome				KL		
I	Introduction to BPE, History, application, Inoculum production for bacterial and fungal process, Screening selection and strain improvement	7	By the end of this module, students will understand Bioprocess Engineering (BPE), its history, applications, and techniques for inoculum production and strain improvement in microbial processes				1, 2		
II	Bioreactors: Introduction, basic design, function, body construct, Temperature control, aeration, Baffles, Agitation systems Sterilization of fermentor, air supply and medium, Aseptic inoculation and sampling methods, Specialized bioreactor, Fluidized bed bioreactor, packed bed bioreactors, Photo bioreactor	10	Understand Bioprocess Engineering (BPE), its history, applications, and techniques for inoculum production and strain improvement in microbial processes.				1,2		
III	Media: Fermentation media, natural and synthetic media, Media formulation strategies, Sources of Carbon, Nitrogen, Vitamins, minerals, Buffers, Precursor, inhibitors, inducer, Antifoam agents, Solid state fermentation.	8	Understand fermentation media, including natural and synthetic types, media formulation strategies, and the sources and roles of carbon, nitrogen, vitamins, minerals, buffers, precursors, inhibitors, inducers, antifoam agents, and solid-state fermentation.				1,2		
IV	Downstream process: Introduction, Objective, criteria, cell disruption, precipitation, filtration, Centrifugation, Liquid-Liquid extraction,	12	Understand downstream processing, immobilization techniques, and the causes				1,2		

	Membrane filtration, Chromatography, Drying device, Crystallization, Packing and Quality assurance. Immobilization: Definition, concept, Process of immobilization, Enzyme and whole cell immobilization, application, Food spoilage: Introduction, types, spoilage due to bacteria, fungi, yeast, food processing principle, methods, Canning, Packing, Sterilization, Pasteurization		and prevention of food spoilage, along with food processing methods like canning, packing, sterilization, and pasteurization.	
<b>V</b>	Fermented food: Sausages, olives, Bread, Idli, Acidophilus milk, importance of fermented food, HACCP concept	8	Understand the fermentation processes in sausages, olives, bread, idli, and acidophilus milk, and the importance of fermented foods, including HACCP for food safety.	1,2
<b>Practical</b>	Production of acetic acid, citric acid, lactic acid	30		1,2, 3,4

#### Text Books

T1: Stanbury, P. F, Whitaker, A and Hal. S. J (1997), Principle of fermentation technology-Elsevier Science Limited, Aditya Book(P) ltd, New Delhi.

T2: Crueger & Crueger (2004) Industrial Microbiology. 3rd edition. Panima Books, New Delhi

#### Reference Books

R1: Prescott and Dunn (1984), Industrial Microbiology, Mc Graw Hill New York.

R2: Casida Jr L.E(1997), Industrial Microbiology, New Age International Pvt Ltd.

R3: Fraiser W.C and West off D.C(1998) Food Microbiology, Tata Mc Graw Hill Publication, New Delhi

R4: Mc Neil Band Harvey I. M. (1990) Fermentation, a practical approach. IRL Press, New York

R5: Doyle, MP et al, Food microbiology, ASM Press, Washington D.C.

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
<b>1</b>	Describe the historical development in Bioprocess Engineering, key inventions and discoveries and its application in different fields.	<b>1, 2</b>
<b>2</b>	Explain the design structure, function, and operation of bioreactors including, functional operations and specialised variation in designs of bioreactors.	<b>1, 2, 3</b>
<b>3</b>	Illustrate the formulation strategies of fermentation media and different source of nutrients for fermentation media.	<b>1, 2</b>
<b>4</b>	Outline the techniques of downstream processing and different isolation and purification methods of biotechnological products.	<b>1, 2</b>
<b>5</b>	Summarize the different fermentation processes involved in fermented foods and HACCP concept and explain effective safety measures in producing fermented foods.	<b>1, 2, 3, 9</b>

Course Title	FOOD BIOTECHNOLOGY								
Course Code	22MSBT214R	Total Credits: 4 Total Hours: 45p+30p	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-Requisite	Molecular biology, microbiology	Co-Requisite	NA						
Programmes	MSc. Biotechnology								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	1. Describe the applications and current situation of Biotechnology in relation to foods. 2. Knowledge on advantages and limitations of novel food products obtained through biotechnological approaches. 3. Apply the role of microorganisms and enzymes for the production and transformation of foods and most recent advances in foods made of/with genetically modified organisms.								
CO1	Explain the basic principles of fermentation.								
CO2	Describe selected fermentation systems.								
CO3	Discuss the mechanism of enzyme action and classification.								
CO4	Develop the skill to link food chemistry with industry.								
CO5	Develop entrepreneurship skills related to food biotechnology.								
Unit no	Content	CH	Learning outcome				KL		
I	Food biotechnology: Introduction, historical development	3	Understand the introduction and historical development of food biotechnology.				1,2		
II	Enhancing the nutritional quality of foods- manipulation of sucrose and starch content: manipulation of fatty acid composition of oils, enriching with protein content, increasing the content of methionine and lysine in feed storage proteins increasing the levels of vitamins and minerals.	10	Learn methods to enhance the nutritional quality of foods through manipulation of sucrose, starch, fatty acids, protein, vitamins, minerals, and amino acids.				1,2		
III	Removal or minimizing the anti-nutritional factors and toxic molecules from food- phytate, oxalic acids, neurotoxins etc., decreasing the contents of pesticides, herbicides and heavy metals-use of bio-insecticides, development of herbicide resistant plant etc.	12	Gain knowledge of techniques to remove or minimize anti-nutritional factors, toxins, pesticides, herbicides, and heavy metals from food.				1,2		
IV	Increasing the shelf life of the fruits Development of food value, metabolites-food colors, food Flavors, food additives, sweeteners etc. Animal biotechnology for increasing meat quality and meet production.	12	Explore methods to increase the shelf life and develop metabolites such as food colors, Flavors, additives, and sweeteners.				1,2		
V	Probiotics in foods: methods of incorporation and types of probiotics	8	Understand animal biotechnology for improving meat quality and production.				1,2		
Practical	Isolation of probiotics microorganisms from different sources	30	Learn about probiotics in foods, including methods of incorporation and types of probiotics used				1,2, 3,4		

**Text Books**

T1: Food Biotechnology - 2nd Edition - Martin Wiedmann

**Reference Books**

R1: Bio enhancement and Fortification of Foods for a Healthy Diet. Octavio Paredes-López, Oleksandr Shevchenko, Viktor Stabnikov, Volodymyr Ivanov. August 08, 2022

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the basic principles of fermentation.	<b>1</b>
<b>2</b>	Describe selected fermentation systems.	<b>1, 2</b>
<b>3</b>	Discuss the mechanism of enzyme action and classification.	<b>1, 2</b>
<b>4</b>	Develop the skill to link food chemistry with industry.	<b>1, 3</b>
<b>5</b>	Develop entrepreneurship skills related to food biotechnology.	<b>1, 2, 3, 9</b>

<b>Course Title</b>	<b>MINI RESEARCH (SURVEY/EXPERIMENTS-R4)</b>								
<b>Course code</b>	<b>22MSBT224R</b>	<b>Total credits: 2</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
			<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>6</b>	<b>0</b>	<b>2</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programmes</b>	<b>Master of Science in Biotechnology</b>								
<b>Semester</b>	<b>Spring/II Semester of First Year of the Programme</b>								
<b>Course objectives</b>	To develop students' scientific method								
<b>CO1</b>	To design an experiment using scientific method								
<b>CO2</b>	Apply the knowledge of sampling methods in sample collection.								
<b>CO3</b>	To store and work on the sample through various parametric assays.								
<b>CO4</b>	To structurize data and perform statistical analyses.								
<b>CO5</b>	To interpret and discuss the findings.								

SEMESTER IV									
Course Title	ORGANIC FARMING								
Course code	22MSBT221R	Total credits: 4 Total hours:45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Biotechnology								
Semester	Spring/IV Semester								
Course objectives	1. Introduction to Concept of Organic cultivation 2. To discuss the Organic Farming System (OFS), its importance and benefits. 3. To discuss the methods associated with organic farming – mulching, crop rotation, tillage, bio-fertilizer etc								
CO1	Explain organic Farming, its principles, scope and benefits for the health and society.								
CO2	Illustrate the relation between organic farming and natural processes such as nutrient cycles, soil preparation and choice of crop varieties, planting material and seed treatment.								
CO3	Discuss crop protection methods, analyse scenarios, propose strategies and evaluate effectiveness, preparing to innovate in pest and weed management.								
CO4	Explain the organic production of rice, zinger, turmeric, banana and vegetables.								
CO5	Describe the concept of soil less farming system.								
Unit-No.	Content	CH	Learning Outcome				KL		
I	<b>Introduction</b> to Organic Farming (OF); Development of OF; Principles and Types of OF; Biodynamic Farming; Need and Benefits of OF; Conventional Farming (CF) Vs (OF); Scope of OF.	10	Understand organic farming, its types, principles, benefits and scope.				1,2		
II	<b>OF System;</b> Soil and Soil tillage, Choice of crop/ varieties, Propagation – Seed, planting material and seed treatments, Crop rotation, Intercropping, Water Management, Green Manuring, Mulching, Composting, Vermicomposting, Organic Manure, Biofertilizer	8	Describe illustrate and explain the organic farming system				1,2		
III	<b>Crop Protection:</b> Cultural and Mechanical method; Biopesticides and Botanical Pesticides, Bio-control agents, Weed Management	8	Describe and explain the various ways for protecting plants				1,2		
IV	<b>Organic crop production</b> of Rice, Zinger, Turmeric, Banana and Vegetables Yield-its function and significances	10	Describe and explain the organic production of crop plants				1,2		
V	<b>Concept on modern organic farming methods</b> – Hydroponics, Aquaponics, Hydroponics	9	Describe and explain the modern methods of agriculture				1,2		
Practical	1. Prepare organic manure/ compost using given substrates. 2. Isolate, culture and identify microbes which may be used as a biofertilizer. 3. Apply any organisms obtained in (2) above and analyse their potentiality	30	Apply knowledge of organic farming				1,2,3,4		

#### Text books

T1. J. M. Fortier. The Market Gardener – A successful Grower’s Handbook for Small- Scale OF. 1st edition. New Society Publishers, 2014.

#### Reference books



- R1. A. L. Hansen. Organic Farming Manual: A Comprehensive Guide To Starting And Running A Certified Organic Farm. 1st edition. Storey Publishing LLC, 2010.
- R2. C. Sarath Chandran et al. Organic Farming: New Advances Towards Sustainable Agriculture Systems, 1st edition, Springer; 2019.
- R3. D. Nandwani (eds). Organic Farming for Sustainable Agriculture. 1st edition, Springer; 2016.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain organic Farming, its principles, scope and benefits for the health and society.	<b>1</b>
<b>2</b>	Illustrate the relation between organic farming and natural processes such as nutrient cycles, soil preparation and choice of crop varieties, planting material and seed treatment.	<b>1, 2</b>
<b>3</b>	Discuss crop protection methods, analyse scenarios, propose strategies and evaluate effectiveness, preparing to innovate in pest and weed management.	<b>2, 3</b>
<b>4</b>	Explain the organic production of rice, zinger, turmeric, banana and vegetables.	<b>1</b>
<b>5</b>	Describe the concept of soil less farming system.	<b>1</b>

Course Title	Environmental Biotechnology								
Course code	22MSBT222R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours:45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Biotechnology								
Semester	Spring/IV Semester								
Course objectives	<p>1. The course aims to provide an advanced understanding of all aspects of climate change, biodiversity and environmental management, pollution and control, population dynamics, ecosystems and urbanization.</p> <p>2. Modern-day technology and human actions are slowly ruining and draining the planet's ecosystem and natural resources. The study of environmental science helps to enlighten the world about global issues, such as forest denudation and dynamite fishing.</p> <p>3. Applying knowledge gained through environmental science is the only way to solve these problems so that the environment can be preserved. Ultimately, environmental science is necessary to save the environment from destruction and all of its dependents from extinction.</p>								
CO1	Understand the concept of climate changes and their management.								
CO2	Explain biodiversity and their conservation.								
CO3	Illustrate various alternative fuels and their production.								
CO4	Discuss microbial biodiversity and its role in biogeochemical cycles, linking microorganisms' eco-physiological aspects to terrestrial ecosystem function.								
CO5	Describe environmental problems and solutions.								
Unit-No.	Content	CH	Learning Outcome				KL		
1	Energy- Introduction, Renewable and non-renewable energy, resources and maintenance	6	To understand the basics of renewable energy				1,2		
2	Pollution- Introduction, sources and management of soil, air and water pollution, Water as an important natural resources, Importance of water management, waste water characteristic, treatment, Aerobic process- Activated sludge method, Oxidation ditch, Trickling filter, Oxidation pond Anaerobic digestion- Anaerobic filter, Membrane bioreactors, treatment of dairy effluents, treatment of distillery effluents, treatment of tannery effluents, treatment of textile effluents, treatment of sugar industry effluents, CEPT, reverse osmosis and ultrafiltration	6	To learn about pollution and water management				1,2		
3	Biomagnification- xenobiotic compounds and their sources Bioremediation-concept and principle, bioremediation of xenobiotics, soil, water contaminated with hydrocarbon and surfactants, Bio mining, Bioleaching, biosorption and bioaccumulation of heavy metals, Bio monitoring (Bio indicators), Phytoremediation Biofilm, Organ chloride compounds in Bleach plant effluents (Reduction)	6	To learn about biomagnification, phytoremediation				1,2		
4	Solid waste management: introduction, sources, Management, waste as a source of energy, Degradation of plant fibre, cell wall, lignin, Pulping of wood and pitch problem, Production of oil and fuel from wood waste. Biotechnological approach to solve slime	6	To learn about applications of environmental biotechnology				1,2		

	problem.			
5	Biogas production- methanol production and byproducts of sugar industry, composting and wormiculture, Global environmental Problems- Ozone depletion, its impact on the environment, Greenhouse effect, acid rain. Biodiversity-Status and conservation, biotechnological approach in conservation of biodiversity, GMO and its impact on the environment.	5	To learn about applications of environmental biotechnology	1,2
Practical	Extraction of enzymes from waste using microbial cultures, Visit to industrial wastewater treatment plants	30	To apply the knowledge of environmental biotechnology	1,2, 3,4

### Text books

T1: Environmental biotechnology, Kumar, Arvind, 2004

### Reference books

R1: Introduction to Environmental Biotechnology A.K.Chatterji, 2007

R2: Introduction to Environmental Science & Technology Dr. S. Amal Raj, First Edition, 2005

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Discuss the concept of climate changes and their management.	1
2	Explain biodiversity and their conservation.	2
3	Illustrate various alternative fuels and their production.	3
4	Discuss microbial biodiversity and its role in biogeochemical cycles, linking micro-organisms eco-physiological aspects to terrestrial ecosystem function.	4
5	Describe environmental problems and solutions.	5, 4

Course Title	Agriculture Biotechnology								
Course code	22MSBT223R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours:45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Biotechnology								
Semester	Spring/IV Semester								
Course objectives	1. To introduce the students about Bio pesticides, Biofertilizers etc. 2. To study post-harvest modification and stress management by plants. 3. To study the detail about seed certification process.								
CO1	Explain and apply the concept of Bio pesticides, biofertilizers to get better yield.								
CO2	Describe the concept of Post harvest modification to maximize the storage of food/ vegetables.								
CO3	Explain the various steps involve in seed certification.								
CO4	Discuss the principles and techniques of genetic engineering used to enhance abiotic stress tolerance in plants and to induce male sterility.								
CO5	Illustrate the potential applications of biotechnology in agriculture, including genetic modification, crop improvement, and sustainable farming practices.								
Unit no	Content	CH	Learning Outcome				KL		
1	Agricultural biotechnology-scopes and application	7	To understand the basics of agriculture biotechnology				1,2		
2	Biofertilizers-Definition, Types (bacterial, fungal, phosphate solubilizers, BGA, Plants-Azolla); Kind of association, Mode of application and merits, current practices & production of biofertilizers	8	To learn about biofertilizers				1,2		
3	Biopesticides- Introduction, types (bacterial-Bacillus thuringiensis, Viral –NPV, fungal-Trichoderma), Mode of action, factors influencing, Genes involved and target pests; Biological approach in pest management, Use of antisense RNA technology for extending self-life of fruits and flower, Importance of JH &JH analogs in pest controll	10	To learn about biopesticides				1,2		
4	Post-harvest management, Assessment of postharvest losses due to storage pests; Environmental factors and storage pests in stored perishables, cereals and grain legumes; Major groups of post-harvest pests (insects, mites and rodents) Management practices of economically important post-harvest pest; Application of Biotechnology in post-harvest management	12	To learn about post-harvest management				1,2		
5	Genetic engineering for abiotic stress, Male sterile plant, method of inducing male sterility, Bar star and barnase system	8	To learn about applications of biotechnology in agriculture				1,2,3		
Practical	Preparation and formulation of microbial biopesticide (bacteria, fungi and viruses), In vitro evaluation of medicinal plants against pathogenic microbes, Preparation and formulation of microbial biopesticide (bacteria, fungi and viruses), In vitro evaluation of medicinal plants against pathogenic microbes.	30	To apply the knowledge of agriculture biotechnology				1,2,3,4		

	Study of root/stem nodule& study of VAM, Vermicomposting Mushroom cultivation			
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**Text books**

T1: Corporate Crops: Biotechnology, Agriculture, and the Struggle for Control (English) (Paperback) by Gabriela, University of Texas Press

**Reference books**

R1: Biotechnology in Agriculture: Utilization of Molecular markers\nin Mango (Mangifera indica L.) (English) (Paperback) by Ahmed Mansour, Omayma M Mahmoud Ismail, Vdm Verlag Dr. Muller Aktienge sells chaft& Co. Kg

R2: Environmental Science and Engineering 2nd Edition (English) 2nd Edition (Paperback) by J. Glynn Henry, W. Gary Heinke, Phi Learning Pvt. Ltd.

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Discuss and apply the concept of Bio pesticides, biofertilizers to get better yield.	<b>1, 3,</b>
<b>2</b>	Apply the concept of Post harvest modification to maximize the storage of food/ vegetables.	<b>3</b>
<b>3</b>	Explain the various steps involve in seed certification.	<b>4</b>
<b>4</b>	Describe the principles and techniques of genetic engineering used to enhance abiotic stress tolerance in plants and to induce male sterility.	<b>1, 2</b>
<b>5</b>	Apply the potential applications of biotechnology in agriculture, including genetic modification, crop improvement, and sustainable farming practices.	<b>1, 2, 3</b>

## MAPPING TABLE

Course code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
22MSBT111R	Bioinstrumentation									
22MSBT112R	Biochemistry									
22MSBT113R	Cell biology									
22MSBT114R	Microbiome and microbial techniques									
22UMFS111R	Fundamental of Statistics									
22MSBT115R	Mini Research - R1									
22UMPD111R	Effective English									
22MSBT121R	Immunology									
22MSBT122R	Molecular biology, genomics and genetic engineering									
22MSBT123R	Bioinformatics									
22MSBT124R	Generic elective									
22MSBT125R	Techno-professional skill-I									
22MSCE121R	MOOCs-II									
22UMRM121R	Research methodology and Statistical Analysis									
22MSBT127R	Mini Research (Research gap analysis-R2)									
22UUHV101R	Universal Human Values									
22UMPD121R	Communication Mastery									
22UCDL103R	Computational systems and digital world									
22MSBT214R	Techno-Professional Skills II									
22MSCE211R	MOOCS-III									
22MSCE212R	MOOCS-IV									
22MSBT216R	Generic elective									
22UMRE211R	Research Ethics									
22UMPD211R	Corporate Competency									
22MSBT215R	MINI RESEARCH (SURVEY/EXPERIMENTS)-R3									

22UUFL202R	PERSONAL FINANCIAL PLANNING										
22MSBT211R	Plant and Animal Biotechnology										
22MSBT212R	Medical Biotechnology										
22MSBT213R	Bioprocess and Fermentation Technology										
22MSBT214R	Food Biotechnology										
22MSBT223R	Research/data analysis/documentati on-R4)										
22MSBT221R	Organic farming										
22MSBT224R	Agriculture Biotechnology										
22MSBT222R	Environmental Biotechnology										



# Assam down town University

## Curriculum and Syllabus

### Master of Science in Botany



OUTCOME BASED EDUCATION FRAMEWORK  
CHOICE BASED CREDIT SYSTEM

Version: 2.0

**FACULTY OF SCIENCE**

July, 2022



# Preamble

Assam down town University is a premier higher educational institution which offers Bachelor, Master, and Ph.D. degree programmes across various faculties. These programmes, collectively embodies the vision and mission of the university. In keeping with the vision of evolutionary changes taking place in the educational landscape of the country, the university has restructured the course curriculum as per the guidelines of National Education Policy 2020. This document contains outline of teaching and learning framework and complete detailing of the courses. This document is a guidebook for the students to choose desired courses for completing the programme and to be eligible for the degree. This volume also includes the prescribed literature, study materials, texts, and reference books under different courses as guidance for the students to follow.

Recommended by the 22<sup>nd</sup> Board of Studies (BoS) meeting of the Faculty of Science held on dated 22/06/2022 and approved by the Emergent Academic Council (AC) meeting held on dated 30/07/2022



*Chairperson  
Board of Studies*



*Member Secretary  
Academic Council*



## ***Vision***

To become a Globally Recognized University from North Eastern Region of India, Dedicated to the Holistic Development of Students and Making Society Better

## ***Missions***

1. Creation of curricula that address the local, regional, national, and international needs of graduates, providing them with diverse and well-rounded education.
2. Build a diverse student body from various socio-economic backgrounds, provide exceptional value-based education, and foster holistic personal development, strong academic careers, and confidence.
3. Achieve high placement success by offering students skill-based, innovative education and strong industry connections.
4. Become the premier destination of young people, desirous of becoming future professional leaders through multidisciplinary learning and serving society better.
5. Create a highly inspiring intellectual environment for exceptional learners, empowering them to aspire to join internationally acclaimed institutions and contribute to global efforts in addressing critical issues, such as sustainable development, Climate mitigation and fostering a conflict-free global society.
6. To be renowned for creating new knowledge through high quality interdisciplinary research for betterment of society.
7. Become a key hub for the growth and excellence of AdtU's stakeholders including educators, researchers and innovators
8. Adapt to the evolving needs and changing realities of our students and community by incorporating national and global perspectives, while ensuring our actions are in harmony with our foundational values and objectives of serving the community.



# Programme Details

## Programme Overview

M.Sc. in Botany is a 2-year postgraduate programme which deals with basic and advanced study on plants and develops understanding and knowledge for applying onto the agricultural, horticultural, floricultural and environment & forest sectors. Botany is one of the multi-disciplinary fields with great demand in various applications in the field of research and development. After completion of this course, students may opt for various higher studies like M.Phil, and PhD which will improve the chances for better jobs.

### I. Specific Features of the Curriculum

- Experiential learning
- Constructivist approach to learn
- Practical and project based learning

### II. Eligibility Criteria:

B.Sc. in Botany/Life Science/ Biological Science/Allied subject related to Botany.

### III. Program Educational Objectives (PEOs):

**PEO1:** AdtU Botany Postgraduates will be prepared for successful careers in both government and private sectors as botanists, angiosperm taxonomists, pathologists, plant microbiologists, ecologists and in allied areas.

**PEO2:** The Postgraduates will be academically prepared to become botanist and will contribute effectively to the growth of the profession.

**PEO3:** The Postgraduates will engage in professional activities to enhance their stature and simultaneously contribute to the profession and society at large and be successful in higher education in botany or interrelated disciplines if perused.

### IV. Program Specific Outcomes (PSOs):

**PSO1: Experiential Learning:** Demonstrate expertise in applied botany for sustainable community and societal outcomes.

**PSO2 Innovation and Entrepreneurship:** Ability to critically analyze research problems with proper gap analysis and design projects in the field of plant science to find appropriate innovative solutions.

**PSO3: Global Competency:** Demonstrate global competency through empowering lifelong learning and contributing to technological advancement in botanical science.

#### Program Outcome:

**PO1: Disciplinary Knowledge:** Apply comprehensive knowledge of basic sciences, biostatistics, biosciences and specialization in plant sciences to resolve complex agricultural, ecological and botanical challenges.

**PO2: Problem Solving:** Identify, formulate, analyse, and evaluate complex botanical problems by applying critical thinking and drawing a conclusive solution.

**PO3: Investigation and Research:** Apply research competency to design hypotheses and experiments using modern tools and techniques, and analyse and interpret the data to arrive at logical conclusions in the area of plant biology.

**PO4: Communication:** Effectively communicate information among the scientific community and society and be able to prepare documents and reports, and deliver impactful presentations.

**PO5: Professional Codes and Ethics:** Comply with values, professional codes and ethics in the profession.

**PO6: Environment and Sustainability:** Understand the impact of the suggested solutions in a socio-environmental context, and redesign it for better ecological balance and environmental sustainability.

**PO7: Leadership and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO8: Lifelong Learning:** Able to engage in lifelong learning independently in the broadest

context of scientific and technological advancement.

**IV. Total Credits to be Earned: 96**

As per the 22-23 Course Framework:

**V. Career Prospects:**

M.Sc. in Botany offers a range of dynamic career opportunities. Graduates can work in research and development, Agricultural, Horticultural, Floricultural and Environment & forest sectors. Roles include Environmental Impact Assessment for complex ecological and environmental problems to meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. Additionally, graduates can pursue careers in contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to application of plant resources in human welfare. Skill based courses like Mushroom Cultivation, Bio fertilizer etc. appropriately trained personnel for the promotion of mushroom production. Opportunities also exist in academia and education, where graduates can contribute to scientific knowledge and train future professionals.

# EVALUATION METHODS

The student performance shall be evaluated through In-semester (Sessional) and semester-end examinations. A weightage of 40% or as prescribed by the programme shall be added to the score of the end-semester examination.

## A. INTERNAL ASSESSMENT:

The teacher who offers the course shall be responsible for internal assessment by conducting in-semester (sessional) examination and evaluating the performance of the students pursuing that course. The components for internal assessment are illustrated in the table given below.

SN	Components/ Examinations	Marks Allotted
1.	In-Sem Exam – I (ISE-I) (Written Examination) *	30
2.	In-Sem Exam – II (ISE-II) (Written Examination) *	30
3.	Assignment	10
4.	Presentation (SP)	10
5.	Quiz	5
6.	Class Performance based score*	5

*\*are compulsory*

**Note:** Total Internal assessment should be out of 40

## INSTRUCTION

1. If a student fails to appear in the any of the component without any valid reason, he/she shall be marked zero in that component. However, the course teacher at his discretion may arrange for the missed test on an alternate date for the absentee students after determining ground with genuine/valid reasons for the absent.
2. The report of evaluation of an activity towards the in-semester (sessional) component of a course shall be duly notified by the concerned course teacher within a week of completion.
3. The program coordinators should upload the in-semester marks to the ERP and forward acknowledgement of all the courses of the program to the Controller of Examinations before the start of the End-semester examination.

## B. SEMESTER END EXAMINATION:

Time table for end semester examination is published at least 25 days prior to the start of Examination.

### I. Pre-Examination:

#### Eligibility Criteria for a student to appear in University Examinations:

The student shall only be allowed to appear in a University Examination, if:

- i) He/ She is a registered student of the University;
- ii) He/ She is of good conduct and character;
- iii) He/ She has completed the prescribed Programme of study with minimum percentage of attendance as laid down in the Regulations of the Programme concerned.

Under special cases, a student may be allowed to appear for an examination without being registered in the University but the result of the said student will be kept on hold till the registration of the concerned student is completed.

## II. Admit Card:

Admit card for the examination may be downloaded through ERP where the system will generate a Unique ID Cards through online.

The University shall have the right to cancel admission for examination of any candidate on valid grounds.

## III. Pattern of Question Papers:

The question paper shall follow the principles of Bloom's Taxonomy.

Table

S. N.	Level	Questions /verbs for test
1	Remember	List, Define, tell, describe, recite, recall, identify, show who, when, where, etc.
2	Understand	Describe, explain, contrast, summarize, differentiate, discuss, etc.
3	Apply	Predict, apply, solve, illustrate, determine, examine, modify
4	Analyze	Classify, outline, categorize, analyze, diagrams, illustrate, infer, etc.
5	Evaluate	Assess, summarize, choose, evaluate, recommend, justify, compare etc.
6	Create	Design, Formulate, Modify, Develop, integrate, etc.

**Note:** No course is to be evaluated on basis of **all 6 knowledge levels**.

The format of the question paper across all the program follow a unique pattern and the total marks is 60

**Table 1: Question paper pattern for End semester examination**

Sl no	Question pattern	Total marks
1	MCQs (10 Questions)	10
2	2 Marks questions (10 Questions)	20
3	4 Marks questions (5 Questions)	20
4	10 Marks questions (1 Question)	10

## IV. Examination Duration:

Each paper of 60 marks shall ordinarily be of two hours duration.

## V. Practical Examinations, Viva-Voce etc.:

- i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.

- ii) Viva-Voce, Oral examinations of the Project report, Dissertation etc. shall be undertaken by a Board of Examiners constituted by the respective Dean of Program with the advice of Supervisor(s).

## **VI. Procedure of Expulsion:**

If any candidate is found to be using any unfair-means during the examination, the invigilator may cease his/her answer sheet and report it directly to the Officer-in-Charge. The Office-in-Charge of the center may take appropriate decisions as per the rules and procedure of the examination. The Officer-in-Charge may allow the students to write the exam with new answer sheet or may expel the student from appearing the paper depending on the nature of unfair-means. In case of Computer based test, the students may be directed to write an apology letter and sign in the prescribe expulsion form. The student may not be allowed to write that examination.

## **VII. Instruction to the Students:**

- (i) The students shall not bring to the Examination Hall, any electronic gadget used as a means of communication or record except electronic calculator, if required.
- (ii) The students shall not receive any book or printed or hand written or photo copy (Xerox) or blank-paper from any other person while he/she is in the examination-room or in laboratory or in any other place to which he/she is allowed to have access during course of examination.
- (iii) The students shall not communicate with any other candidate in the examination room or with any other person in and outside the examination-room.
- (iv) The students shall not see, read or copy anything written by any other candidate, nor shall he/she knowingly or negligently permit any other candidate to see, read or copy anything written by him/her or conveyed by him/her.
- (v) The students shall not write anything on the Question Paper or in other paper or materials during the examination, or pass any kind of paper to any other candidate in the examination-room, or to any person outside the room.
- (vi) The students shall not disclose his/her identity to the examiner by writing his/her name or putting any sign / symbol in any part of his answer-script.
- (vii) The students shall not use any abusive language or write any objectionable remark or make any appeal to examiner by writing in any part of his answer-script.
- (viii) The students shall not detach any page from the answer-script or insert any authorized or unauthorized loose sheet into it. He /she shall also not insert any other answer-script / loose sheet by removing the pins of the origin answer-scripts and re-fixing it.
- (ix) The students shall not resort to any disorderly conduct inside the examination-room or misbehave with the invigilator or any other examination official.

## **VIII. Provision for an Amanuensis (writer):**

- (i) A candidate may be provided with an Amanuensis (writer) to write down on dictation on his / her behalf on ground of his / her physical disability to write down by himself / herself due to accident or any other reason. The amanuensis may be provided till he / she recovers from the physical disability. The physical disability to write down by



himself / herself must be supported by Medical Certificate from a competent Medical Officer.

- (ii) The qualifications of the amanuensis so provided must not be equal or higher than that of the candidate. This is also to be supported by Certificate from the Faculty of Study where the Amanuensis is provided.
- (iii) Such candidates are to be accommodated in a separate room under the supervision of an invigilator so that the fellow candidates are not disturbed in the process.

### **C. Credit Point:**

It is the product of grade point and number of credits for a course, thus,  $CP = GP \times CR$

#### **i. Credit:**

A unit by which the course work is measured. It determines the number of hours of instructions required per week. 'Credit' refers to the weightage given to a course, usually in terms of the number of instructional hours per week assigned to it. Credits assigned for a single course always pay attention to how many hours it would take for an average learner to complete a single course successfully.

#### **ii. Grade Point:**

Grade Point is a numerical weight allotted to each Grade Letter on a 10-point scale.

#### **iii. Letter Grade:**

Letter Grade is an index of the performance of students in a said paper of a particular course. Grades are denoted by letters O, A+, A, B+, B, C, P, F and Abs. Student obtaining Grade F / Grade Abs shall be considered failed/ absent and, will be required to appear in the subsequent ESE. The UGC recommends a 10-point grading system with the following (Table: 1) Letter Grades:

- (i) A Letter Grade shall signify the level of qualitative/quantitative academic achievement of a student in a Course, while the Grade Point shall indicate the numerical weight of the Letter Grade on a 10-point scale.
- (ii) There shall be 08 (eight) Letter Grades bearing specific Grade Points as listed in Table 1, where the Letter Grades 'O' to 'P' shall indicate successful completion of a course.
- (iii) Apart from the 08 (eight) regular Letter Grades listed in Table 1, there shall be 03 (three) additional Letter Grades, which shall be awarded if a Course is withdrawn or spanned over the next Semester or remains incomplete as stated in Table 2.

**Table 2: Letter Grades and Grade Points**

<b>Letter Grade</b>	<b>Grade Points</b>	<b>Description</b>
O	10	Outstanding
A+	9	Excellent
A	8	Very Good
B+	7	Good

B	6	Above Average
C	5	Average
P	4	Pass
F	0	Fail
Abs	0	Absent
UFM	0	Unfair Means

#### iv. Grade Point Average:

##### a. SGPA (Semester Grade Point Average)

The SGPA of a student in a Semester shall be the weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered in that Semester, irrespective of whether he/she could or could not complete the Courses. More specifically, the calculation of SGPA shall take into account the Courses graded with Letter Grades ‘O’ to ‘F’ as given in Table 1.

$$SGPA = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i} \quad (1.1)$$

The SGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.1) up to two decimal places, where n is the total number of Credit Courses registered by the student in that Semester,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  registered Course and  $C_i$  is the Credit (weight) of that Course.

##### b. CGPA (Cumulative Grade Point Average)

- (i) The CGPA of a student in a Semester of a Programme shall be the accumulated weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered and successfully completed so far starting from the enrollment in the Programme. In other words, taking into account all the Courses graded with ‘O’ to ‘P’ as given in Table 1.1, generally the CGPA of a student shall be calculated starting from the first Semester of his/her enrolled Programme, while the CGPA of a lateral-entry student shall be calculated starting from the Semester of his/her enrollment.
- (ii) The CGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.2) up to two decimal places, where N is the total number of Credit Courses registered and successfully completed so far by the student,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  completed Course and  $C_i$  is the Credit (weight) of that Course.

$$CGPA = \frac{\sum_{i=1}^N C_i G_i}{\sum_{i=1}^N C_i} \quad (1.2)$$

- (iii) The CGPA shall be convertible into equivalent percentage of marks using Equation  
Conversion of CGPA to percentage marks: = CGPA\*10

## **D. Post-Examination**

### **i. Transcript or Grade Card or Certificate:**

A marking certificate shall be issued to all the registered students after every Semester. The Semester mark sheet will display the course details (code, title, number of credits, grade secured) along with total credit earned in that Semester.

### **ii. Grievance Readdress Mechanism:**

Students with any dissatisfaction or grievance regarding the marks awarded in any of the Papers / Courses may appeal to the Controller of Examinations for remedial action such as Re-evaluation within 10 days of the declaration of result.

- (i) A student has options to appeal for re-evaluation of his /her answer script to the Controller of Examination.
- (ii) Application for re-evaluation / re-scrutiny of answer scripts shall be made in the definite proforma available with the Examination Office through the head of the respective departments within 10 days of declaration of the results of the respective examinations.
- (iii) The Controller of Examination may appoint an examiner for re-evaluation and will consider and recognize the evaluation done by a university appointed examiner.
- (iv) There shall be no provision for re-evaluation of the Practical Papers, Project Work, and Dissertation etc. However, the students fail in practical examination or viva voce and wish to appear again may apply to be evaluated can do so with the next schedule.
- (v) After screening the application for re-evaluation, the CoE may send the answer scripts of the student to the examiners appointed by the CoE with the approval of Vice Chancellor.
- (vi) The marks/grades achieved by the students after the re-evaluation shall be final and binding.
- (vii) Fresh Marks – sheets / Grade Card shall be issued only if the candidate secures pass marks / passing grade in the re-evaluated paper.
- (viii) Revaluation of answer scripts shall be deemed to be an additional facility provided to the students with a view to improving upon their results at the preceding examination result for any reason whatsoever shall not confer any right upon them for admission to next higher class which matters always be regulated in accordance with the relevant rules or regulations framed by the University.
- (ix) If as a result of revaluation of the candidate attracts the provision of condonation of deficiency, the same may be applied to his/her only for fresh attempt.

## **INSTRUCTION TO TEACHERS AND STUDENTS**

**(Teaching and Learning Methods)**

In all the courses the teacher has to select topics for teacher-method which should not be less than 20 percent. The approach will be direct classroom teaching through a series of lectures

delivering concepts using ITC facilities, white or blackboard. Notes may also be circulated to the students; however, the students are to be involved in the preparation of the notes. The teacher will be responsible for selecting the best note for circulation. The teacher-centric methodology has recently fallen out of favour because this strategy for teaching is seen to favour passive students.

### **1. Student- centric / Constructivist Approach:**

The topics of the courses may be selected at the start of the class and assigned one topic to each of the students for studying by themselves, prepare presentations, notes, etc., and present at respective class time after consultation and discussion with the course teachers. The teacher facilitates the learning of the students by guiding and providing input and explaining concepts. 60 percent of the course contents may be selected for this purpose. To avoid behaviour problems, teachers must lay a lot of groundwork in student-centric classrooms. Typically, it involves instilling a sense of responsibility in students. In addition, students must learn internal motivation.

**a. Project-Based Learning:** The teacher may select 5 percent of topics for the purpose and may conduct visits to the laboratory for experiments or field surveys. The selection of the topic may be done considering the available facility for the purpose. However, in the final semester of each of the programme the student has to undergo project-based learning at least 4 months duration. This approach will help the student to think critically, evaluate, analyze, make decisions, collaborate, and more.

**b. Inquiry-Based Learning:** The teacher/ students are supposed to list at least five questions in each contact hour and student solve these question or search for answer which becomes the home work for the students “question-driven” learning approach. The teacher may look for the correctness of the solution or the best possible answer and discuss in the successive class. This will help in the preparation for various competitive examination and develop a habit for search for solutions.

**c. Flipped Classroom:** About 10 percent of the course content has to be completed by this method. In this approach the students are asked to watch video or lecture prepared by the teacher or any video available (relevant to the course). A set of questions may be given to the students for searching answers by the students. The idea is that students should have more time in-classroom focusing on achieving these higher levels of thinking and learning. The Flipped classroom is also an acronym. The letters FLIP represent the four pillars included in this type of learning: Flexible environment, Learning culture shift, Intentional content, and Professional educator. As you can see, the second pillar refers to a culture shift from the traditional approach where students are more passive to an approach where students are active participants. As a result, this approach is also a student- centric teaching method.

**d. Cooperative Learning:** The remaining five percent has to be completed by cooperative learning approach. In this approach, the students are allotted problems. During library hours the students along with the teacher visit the library and search for probable solutions for the assigned problem. The same has to be done in groups so that the students discuss among themselves for the appropriate answers. Essentially, cooperative learning believes that social

interactions can improve learning. In addition, the approach recreates real-world work situations in which collaboration and cooperation are required.

**The percentage categorization for the completion of a theory course**

Teacher-centric or Direct Classroom Teaching: Delivery by series of lectures	20%
Student-centric Approach, Students present and deliver lectures in the presence of teacher and supervised by teacher	60%
Students visit fields or perform experiments or teachers perform demonstration	05%
Flipped Classroom approach	10%
Cooperative learning approach	05%

**Inquiry-based approach has to be followed in all of the classes**

The teacher has to distribute the topics to be considered for teaching by the above-mentioned approaches and prepare a lesson plan for execution and maintain a file.

**Curriculum Framework**

**Breakdown of Credits 2022-24**

Sl. No	Category	Total number of Credits
1	University Core (UC)	13
2	University Elective (UE)	11
3	Program Core (PC)	68
4	Program Elective (PE)	0
5	Faculty Elective (FE)	4
<b>Total number of credits</b>		<b>96</b>

**Breakdown by categories of courses**

Sl no	Category	Credits	%
1	Science	88	92%
2	Engineering	1	1%
3	Humanities and Management	7	7%
<b>Total</b>		<b>96</b>	<b>100%</b>

**SEMESTER WISE COURSE DISTRIBUTION**

Semester	S. N.	Course Code	Course Title	Course Category	Engagement	Maximum Marks for
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				L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
1.	22MSBO111R	Plant Diversity-I	PC	3	0	2	0	0	0	4	40	60	100	200
2	22MSBO112R	Plant Diversity-II	PC	3	0	2	0	0	0	4	40	60	100	200
3	22MSBO113R	Plant Ecology and Phytogeography	PC	3	0	2	0	0	0	4	40	60	100	200
4	22MSBO114R	Bioinstrumentation	PC	2	0	0	0	0	0	2	40	60	100	100
5	22MSBO115R	Field study- I	PC	0	0	4	0	0	0	2	0	0	100	100
6	22MSBO116R	Mini Research (Review of literature-R1)	PC	0	0	0	4	6	0	2	0	0	100	100
7	22UMFS111R	Fundamental of Statistics	UC	2	0	2	0	0	0	3	40	60	100	200
8	22UMPD111R	PDP-I	UE	2	0	0	0	0	0	2	0	0	100	100
	22MSCE111R	MOOCS-CE I	FE	0	0	0	1	0	0	2	0	0	100	100
<b>Total credits</b>										<b>25</b>				<b>1300</b>
S. No.	Course Code	Course Title	Course Category	Engagement						Maximum Marks for				
				L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
1.	22MSBO121R	Plant cell, Genetics and Plant Breeding	PC	3	0	2	0	0	0	4	40	60	100	200
2	22MSBO122R	Microbiology and Plant Pathology	PC	3	0	2	0	0	0	4	40	60	100	200
3	22MSBO123R	Plant Physiology and Biochemistry	PC	3	0	2	0	0	0	4	40	60	100	200
4	22MSBO124R	Techno-Professional Skills I	PC	0	0	4	0	0	0	2	0	0	100	100
5	22MSBO125R	Mini Research (Research gap analysis-R2)	PC	0	0	4	0	0	0	2	0	0	100	100
6		Generic Elective	UE	2	0	0	0	0	0	2	0	0	100	100
7	22UMRM121R	Research methodology and Statistical Analysis	UC	1	0	4	0	0	0	2	40	60	100	200
8	22UUVH101R	Universal Human Values	UC	0	0	0	4	0	0	2	40	60	0	100
9	22UMPD121R	PDP-II	UE	0	0	4	0	0	0	2	0	0	100	100
10	22MSCE121R	MOOCS -CE II	FE	0	0	4	0	0	0	2	50	0	50	100
11	22UCDL103R	Computational systems and Digital World	UC	0	0	2	0	0	0	1	0	0	100	100
<b>Total Credits</b>										<b>27</b>				<b>1500</b>
S. No.	Course Code	Course Title	Course Category	Engagement						Maximum Marks for				
				L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
1.	22MSBO211R	Techno-Professional Skills II	PC	0	0	4	0	0	0	2	0	0	100	100
2	22MSCE211R	MOOCS-III	FE	2	0	0	0	0	0	2	0	0	100	100
3	22MSCE212R	MOOCS-IV	FE	2	0	0	0	0	0	2	0	0	100	100
4	22MSBO217R	Generic elective	UE	2	0	0	0	0	0	2	0	0	100	100



5	22UMRE211R	Research Ethics	UC	0	0	0	4	0	0	1	50	0	50	100
6	22UMPD211R	Corporate Competency	UE	0	0	4	0	0	0	2	50	0	50	100
7	22MSBO212R	Mini Research (Survey/Experiments)-R3	PC	0	0	6	4	0	0	2	0	0	100	100
8	22UUFL202R	Personal Financial Planning	UC	0	0	2	0	0	0	1	0	0	100	100
6	<b>Discipline specific elective (DSE): Student has to take any three</b>													
7	22MSBO213R	Floral morphology, Embryology and palynology	PC	3	0	2	0	0	0	4	40	60	100	200
8	22MSBO214R	Economic Botany, ethnobotany and Pharmacognosy	PC	3	0	2	0	0	0	4	40	60	100	200
9	22MSBO215R	Plant Molecular Biology and Biotechnology	PC	3	0	2	0	0	0	4	40	60	100	200
10	22MSBO216R	Plant Anatomy, microtechnique & evolution	PC	3	0	2	0	0	0	4	40	60	100	200
<b>Total</b>										<b>26</b>				<b>1300</b>

S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1	22MSBO221R	Research/data analysis/documentation-R4)	PC	0	0	20	8	6	0	12	0	0	100	100
<b>Elective course: Student has to take any one special paper</b>														
<b>Group I Elective Paper: Angiosperm Taxonomy</b>														
2	22MSBO222R	AngiospermTaxonomy -I	PC	3	0	2	0	0	0	4	40	60	100	200
3	22MSBO223R	AngiospermTaxonomy -II	PC	2	0	0	0	0	0	2	40	60	0	100
<b>Group II Elective Paper: Microbiology</b>														
2	22MSBO222R	Microbiology-I	PC	3	0	2	0	0	0	4	40	60	100	200
3	22MSBO223R	Microbiology-II	PC	2	0	0	0	0	0	2	40	60	0	100
<b>Group III Elective Paper: Plant Ecology</b>														
2	22MSBO222R	Plant Ecology-I	PC	3	0	2	0	0	0	4	40	60	100	200
3	22MSBO223R	Plant Ecology-II	PC	2	0	0	0	0	0	2	40	60	0	100
<b>Total</b>										<b>18</b>				<b>400</b>

**\*IA: Internal Assessment, SEE: Semester End Examination, PE: Practical Examination**

SEMESTER – I									
Course Title	Plant Diversity-I								
Course code	22MSBO111R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Fall/ I semester of first year of the programme								

<b>Course Objectives</b>	1. Introduce the concept of diversity, life cycle pattern of vascular and non-vascular cryptogams. 2. To make learner understand about the Phylogeny and economic values of vascular and non-vascular cryptogams. 3. To impart various application of lower cryptogams for human welfare.			
<b>CO1</b>	Describe the characteristics of algae, identify, classify and their economic importance.			
<b>CO2</b>	Describe the characteristics, identify, classify fungi and lichen, and their economic importance.			
<b>CO3</b>	Describe the characteristics, identify, classify Bryophytes, and their economic importance.			
<b>CO4</b>	Describe the characteristics, identify, classify pteridophyte and their economic importance.			
<b>CO5</b>	Illustrate the industrial, agricultural and environmental aspects of algae and fungi.			
<b>Unit-No.</b>	<b>Content</b>	<b>CH</b>	<b>Learning Outcome</b>	<b>KL</b>
<b>I</b>	<b>ALGAE:</b> General account of Algae, Phylogenetic relationship, Classification of algae (Lee). Study of different classes of algae as per the classification of Lee (1989), Economic importance of algae.	8	Able to describe and explain about the different classes of algae and their economic importance.	1,2
<b>II</b>	<b>FUNGI:</b> General account of fungi, Evolution and Phylogeny, Classification of fungi (Alexopoulos and Mims). Study of different classes of fungi as per the classification of Alexopoulos and Mims (1979), Economic importance fungi. <b>LICHEN:</b> General account of lichen, structure and reproduction, Classification, Economic importance Lichen.	12	Able to describe and explain about the fungi and lichens and their economic importance.	1,2
<b>III</b>	<b>BRYOPHYTES:</b> General account of Bryophytes, Classification of Bryophytes (Reimer), Study of different classes of Bryophytes as the classification of Reimer, Economic importance bryophytes.	10	Able to describe and explain about the different classes of bryophytes and their economic importance.	1,2
<b>IV</b>	<b>PTERIDOPHYTES:</b> General account of Pteridophytes, Classification of Pteridophytes (Smith), Study of different classes of Pteridophytes as per the classification of Smith (1955), Economic importance Pteridophytes.	10	Able to describe and explain about the different classes of pteridophytes and their economic importance.	1,2
<b>V</b>	<b>APPLIED CRYPTOGRAMS:</b> Algal biotechnology: algal biofuels, algal biofertilizer, Algal culture, Bioremediation Fungal Biotechnology: Production of organic acid, Secondary metabolites, Single Cell Protein	5	Able to describe and explain about the different applications of algae and fungi.	1,2
<b>Practical</b>	1. Study of range of thallus organization and reproductive structures of algae with the help of suitable representatives. 2. Study of morphological, anatomical and reproductive features of some fungi growing in Assam. 3. Study of morphological and anatomical features of some lichens growing in Assam. 4. Study of some important genera of Bryophytes and Pteridophytes available in NE India with respect to their morphology, anatomy and reproductive structures.	30	Able to explain and demonstrate different groups of lower cryptogams	1,2, 3,4

#### Text Books

- T1. Textbook of Algae. B.P Sarabhai, C.K Arora, Anmol Publishing Pvt. Ltd. New Delhi.  
T2. Phycology (4th Edition) R.L. Lee, Cambridge University Press, 2008.

T3. Algae- An introduction to Phycology- C Van den Hoek, DG Mann, HM Janes, Cambridge University Press, 1995.

T4. Hand Book of Microalgal culture. Ed by A. Richmond. Blackwell Publishing House, 2003.

T5. Algae- Anatomy, Biochemistry and Biotechnology-L. Barsanti & P. Gualtieri.

Taylor & Francis, 2006

**Reference Books**

R1. Hand Book of Microalgal culture. Ed by A. Richmond. Blackwell Publishing House, 2003.

R2. Algae- Anatomy, Biochemistry and Biotechnology-L. Barsanti & P. Gualtieri. Taylor & Francis, 2006

**Other Learning Resources:**

<https://www.sciencedirect.com/journal/algal-research>

<https://www.sciencedirect.com/topics/immunology-and-microbiology/lichen-organism>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe the characteristics of algae, identify, classify and their economic importance.	1, 3, 4, 6
2	Describe the characteristics, identify, classify fungi and lichen, and their economic importance.	1, 3, 4, 6
3	Describe the characteristics, identify, classify Bryophytes, and their economic importance.	1, 3, 4, 6
4	Describe the characteristics, identify, classify pteridophyte and their economic importance.	1, 3, 4, 6
5	Illustrate the industrial, agricultural and environmental aspects of algae and fungi.	2, 3, 4, 6

SEMESTER – I									
Course Title	Plant Diversity-II								
Course code	22MSBO111R	Total credits: 4	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To understand the geological time scale and types of fossils. 2. To make learner understand about the Phylogeny and economic values of gymnosperms and angiosperms. 3. To understand, explain and demonstrate the methods of plant exploration techniques.								
CO1	Explain Geological Time-scale, fossils, and its role in oil exploration.								
CO2	Describe the characteristics, identify, classify gymnosperms, and their economic importance.								
CO3	Describe the characteristics, identify, classify Angiosperm based on their floral morphology.								
CO4	Discuss the method for classifying plants, ICN principles and taxa concept.								

CO5		Demonstrate the method to prepare and maintenance of herbarium.		
Unit-No.	Content	CH	Learning Outcome	KL
I	Geological Time-scale fossilization and Fossil types: Compressions, incrustation, casts, molds, petrifications, coal balls and compactions, carbon dating- –Role of fossil in oil exploration. Salient features and affinities of fossil gymnosperms- Pro-Gymnosperms, Pteridospermales, Bennettitales, Pentoxylales, Cordaitales	10	Able to describe and explain about the geological time scale and different types of fossils.	1,2
II	Classification of Gymnosperms (Sporne, 1965). Comparative study of vegetative, anatomy and reproductive structure of Cycadales, Ginkgoales, Taxales, Coniferales, Ephedrales & Gnetales Economic importance of Gymnosperm. Living fossils Affinities of Gymnosperms with Angiosperms and Pteridophytes.	8	Able to describe and explain about the gymnosperms and their economic importance.	1,2
III	Origin and evolution of Angiosperms; Inflorescence and flowers; Co- evolution of flower and pollinators; Morphology of stamens and carpels; staminodia; nectaries; types of ovaries, morphology of inferior ovary; placenta and placentation. Role of morphology and anatomy in plant taxonomy.	10	Able to describe and explain about the evolution and morphology of Angiospermic flower.	1,2
IV	Systems of Classification: Linnaeus, Bentham and Hooker, Takhtajan, Bessy dicta, APG I, II, III systems –Merits and demerits. International code of Botanical Nomenclature, Botanical Gardens and Botanical survey of India. International Code of Nomenclature (ICN). History, Principles and major rules of nomenclature. concept of taxa, species, genus and family, intraspecific categories.	10	Able to describe and explain about the different classification systems of angiosperms.	1,2
V	Methods of Plant exploration; Management of herbaria, major herbaria in India and the World, Specimen preparation for herbarium, Role of herbaria in taxonomy. Characteristic feature, Phylogeny, and botanical description of importance of selected order- Fabales, Rubiales, Lamiales, Malpighiales, Liliales & Poales	7	Able to describe and explain about the methods of plant exploration.	1,2
<b>Practica I</b>	1. Study of some important genera of gymnosperms available in NE India with respect to their morphology, anatomy and reproductive structures. 2. Study of Angiospermic flowers as well as stem and leaf with analytical drawings. 3. Collection and preparation of herbarium specimens of common plants for familiarization of herbarium techniques. 4. Botanical description and identification up to the rank of species.	30	Able to explain and demonstrate gymnosperms and angiosperms.	1,2, 3,4

#### Text Books

T1. A Text book of Botany: Angiosperms. B. P. Pandey; S.chand Publishers Introduction to Embryophyta –Pteridophytes, Parihar, N.S. 2005.– Central Book Dep, Allahabad.

T2. Palaeobotany. Shirpad N. Agashe. 1995. Oxford & IBH Publishing Co.Pvt.Ltd, NewDelhi.

#### Reference Books

R1. Plant Systematics, Gurucharan Singh, 2017. Oxford & IBH Publishing company (P) Ltd, New Delhi.

R2. Taxonomy of Angiosperms. Pandey.B.P. 2009. S. Chand& Co. Ltd. New Delhi.

**Other Learning Resources:**

<https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/fossil-plant>

<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/gymnosperm>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain Geological Time-scale, fossils, and its role in oil exploration.	1, 3, 6
2	Describe the characteristics, identify, classify gymnosperms, and their economic importance.	1, 3, 4
3	Describe the characteristics, identify, classify Angiosperm based on their floral morphology.	1, 3, 6
4	Discuss the method for classifying plants, ICN principles and taxa concept.	1, 3, 4
5	Demonstrate the method to prepare and maintenance of herbarium.	2, 3, 4, 6

SEMESTER – I									
Course Title	Plant ecology and phytogeography								
Course code	22MSBO111R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To study about physical and biotic environment and its interactions. 2. To study about environment pollution and the effects of pollution on plants and ecosystems. 3. To study about Population and Community Ecology, Ecological succession. 4. To study about the concept of phytogeography, different routes and barriers to plant migration, centers of origin, different Phytogeographical regions of India and the Biodiversity significance of NE region.								
CO1	Explain the factors influencing environment.								
CO2	Explain population and community ecology.								
CO3	Describe ecosystem structure and function.								
CO4	Explain the principle and approaches used for conservation.								
CO5	Describe principle, objectives, and dynamism of phytogeography, demonstrate phytogeography of India.								
Unit-No.	Content	CH	Learning Outcome				KL		
I	<b>The Environment:</b> Physical environment, biotic environment, Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Laws of limiting factor Environmental pollution: Origin of pollution, types of pollutants, kinds of sources of air, soil and water pollution, parameters to assess the pollution level, effects of pollution on plants and ecosystems, global warming and environmental change, Greenhouse gas, acid rain.	10	Able to understand about the ecosystem, environment and global warming.				1,2		

<b>II</b>	<b>Population Ecology and Community Ecology:</b> Characters of population ecology, density, Size of population, Spatial distribution, age structure, natality, mortality, biotic potential, population dynamics, growth rate of population, competition and co-existence, Species Interactions, Community Ecology: Nature of communities; community structure and Species diversity.	8	Able to describe and explain about the population and community ecology.	1,2
<b>III</b>	<b>Ecosystem Ecology:</b> Ecosystem structure; ecosystem function; energy flow and Biogeochemical cycles in Ecosystem: Atmospheric cycles, mineral cycling (C, N, S, P); Structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine), Ecological succession.	10	Able to explain about the structure and function of ecosystems.	1,2
<b>IV</b>	<b>Conservation Biology:</b> Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Project Elephant, Biosphere reserves), biodiversity: status, monitoring and documentation in situ conservation, ex-situ conservation, protected areas in India, sanctuaries, national parks, biosphere reserves. Botanical gardens, field gene banks, seed banks, in vitro repositories, cryobanks etc.	10	Able to describe and explain about nature and its conservation strategies.	1,2
<b>V</b>	<b>Phytogeography:</b> Definition, principles and objectives of Phytogeography, Descriptive and Dynamic Phytogeography, Continuous and discontinuous plant distribution in India; Routes and barriers to plant migration, Centers of origin (Primary and secondary centers’); Endemism Types; Endemism in Indian flora; Age and Area hypothesis, Phytogeographical regions of India. The biodiversity significance of NE region.	7	Able to describe and explain about phytogeography and endemism.	1,2
<b>Practica I</b>	1. Determination of minimum size, number of quadrates necessary to study herbaceous communities. 2. Determination of abundance, density, frequency of plant communities by quadrat method. 3. Preparation of a map of India showing biogeographical zones.	30	Able to explain and demonstrate minimum size of quadrat for population study and determine the results upon field study.	1,2, 3,4

#### Text Books

T1. A Textbook of Plant Ecology by R.S. Ambasht

T2. Palaeobotany. Shirpad N. Agashe. 1995. Oxford & IBH Publishing Co.Pvt.Ltd, NewDelhi.

#### Reference Books

R1. Ecology Environmental Science and Conservation by J.S. Singh, S.R. Gupta & S.P.Singh.

R2. Bharucha, F.R. - A textbook of plant geography. Oxford Uni Press.

#### Other Learning Resources:

<https://www.sciencedirect.com/journal/perspectives-in-plant-ecology-evolution-and-systematics>

<https://link.springer.com/journal/11258>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

#### CO PO Mapping

SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain the factors influencing environment.	1, 3, 6
2	Explain population and community ecology.	1, 2, 3, 6
3	Describe ecosystem structure and function.	1, 3, 6
4	Explain the principle and approaches used for conservation.	1, 3, 6, 7
5	Describe principle, objectives, and dynamism of phytogeography, demonstrate phytogeography of India.	1, 3

SEMESTER – I									
Course Title	Bioinstrumentation								
Course code	23MSBT111R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30T	2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. Working principle of chromatography, centrifugation, PCR, microscopy, gel electrophoresis etc. 2. To understand the different types of chromatography, microscopy etc. 3. Application of Electrophoresis, Blotting and Microscopic Techniques etc.								
CO1	Students will understand and differentiate between various chromatographic methods.								
CO2	Students will gain comprehensive knowledge of the types, principles, and applications of gel electrophoresis, PCR, blotting technique and microscopy.								
CO3	Understanding on different separation techniques using centrifugation.								
CO4	Understanding of Radio-Isotope Dating and its applications.								
CO5	Students will understand spectroscopic methods.								
Unit-No.	Content	CH	Learning Outcome				KL		
I	<b>Chromatography:</b> History; Classification; Types, principles, operation, application & analysis (Paper, Column, Adsorption column, Partition, Thin layer, Ion exchange, quantitative Ion exchange, and Gel Chromatography):	7	Able to describe, illustrate and explain the chromatography and their applications				1,2		
II	<b>Gel Electrophoresis:</b> Application; Types; Principle; pH meter (Principle); Dialysis, <b>PCR:</b> Introduction, types and application. <b>Blotting technique:</b> Southern, Western, & Northern blot. <b>Microscopy:</b> Introduction, types and application.	8	Able to describe, illustrate and explain the electrophoresis, PCR, blotting technique and microscopy.				1,2		
III	<b>Centrifugation:</b> Types; Application; Principle; rotors; density gradient & analytical centrifugation.	5	Able to describe, illustrate and explain the centrifuge						
IV	<b>Radio- isotope dating technique:</b> Introduction, nature, detection & measurement of radioactivity, radioisotopes & radiation, units, radioactive decay.	5	Able to describe, illustrate and explain the radio isotopes.				1,2		
V	<b>Spectroscopic techniques:</b> Introduction, Principle and application of spectroscopy.	5	Able to describe, illustrate and explain the spectroscope				1,2		

#### Text Books

T1. Upadhyay. Biophysical chemistry: principle and technique. 12th edition. Himalaya Publishing House Pvt. Ltd; 2017.

#### Reference Books

- R1. Kakkar. Atomic and Molecular Spectroscopy. 1st edition. Cambridge English; 2017.  
R2. Evans. Handbook of Chromatography. 2nd Edition, Willford Press; 2019.  
R3. Holme and Peck. Analytical biochemistry. 3rd edition. Longman, 1983.

**Other Learning Resources:**

<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/chromatography>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Students will understand and differentiate between various chromatographic methods.	3
2	Students will gain comprehensive knowledge of the types, principles, and applications of gel electrophoresis, PCR, blotting technique and microscopy.	3
3	Understanding on different separation techniques using centrifugation.	3
4	Understanding of Radio-Isotope Dating and its applications.	2
5	Students will understand spectroscopic methods.	2

SEMESTER – I									
Course Title	Field study-I								
Course code	23MSBT111R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30P	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To give the students the field knowledge of habit, habitat of different plantgroups. 2. Collection of wild plants from their habitat for preparation of herbarium. 3. Floristic study of a particular area and preparation of field reports.								
CO1	Illustrate the methods of plant specimen collection and preservation.								
CO2	Summarize strategies for plant specimen sample collection.								
CO3	Explain the methods of management and maintenance of the preserved plant specimens.								
CO4	Identify and preserve plant species of different plant groups.								
CO5	Write comprehensive report on the field exploration.								
Practical	Content	CH	Learning Outcome					KL	
	1. Field trip/excursion to the neighbouring states of Assam (5-7 days) for the collection and preservation of plant specimens like algae, fungi, lichen, bryophytes, pteridophytes, gymnosperms and angiosperms from their habitat. 2. Preservation of the collected specimens from field by herbarium technique. 3. Preservation of the collected algae, fungi specimens from field by preservatives. 4. Preparation and submission of field report and herbarium.	60	Able to describe, illustrate and explain the habit and habitats of different plant groups. Also able to describe, illustrate and explain the method of collection and preservation of specimens.					1,2	

**Text Books**



T1. Payel Paul, Sayantan Dhar, Dr. Monoranjan Chowdhury . Herbarium Technique: First Edition. OrangeBooks Publication Pvt. Ltd; 2020.

**Reference Books**

R1. **Handbook of Field and Herbarium Methods, Rao, R R & S K Jain, 2016.**

**Other Learning Resources:**

<https://www.sciencedirect.com/science/article/pii/S0169534722002956>

[https://www.researchgate.net/publication/349640811\\_Herbarium\\_Technique](https://www.researchgate.net/publication/349640811_Herbarium_Technique)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Illustrate the methods of plant specimen collection and preservation.	1
2	Summarize strategies for plant specimen sample collection.	3
3	Explain the methods of management and maintenance of the preserved plant specimens.	4,5
4	Identify and preserve plant species of different plant groups.	3
5	Write comprehensive report on the field exploration.	4,5

SEMESTER – I									
Course Title	MINI RESEARCH (REVIEW OF LITERATURE-R1)								
Course code	22MSBT114R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30P	0	0	0	4	6	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Botany								
Semester	Fall/I Semester of First Year of the Programme								
Course objectives	To develop students scientific writing skill								
CO1	Develop competence in writing and abstracting skills.								
CO2	Evaluate and understand technical writing skill.								
CO3	Comprehend different methods and techniques of research.								

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Employ databases and library resources to gather original research, books, and articles effectively	2
2	Summarize and differentiate between various types of reviews, specifically analytical and descriptive reviews.	2
3	Identify research topics and employ appropriate methods for collecting and filtering information.	2
4	Critically analyze the demonstrations and findings of previous authors to comprehend their contributions and insights.	3
5	Compose a detailed review that explains the prospects and future directions of the chosen study.	3

SEMESTER – I									
Course Title	Fundamentals of Statistics								
Course code	23UMFS111R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 30T+30P	2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Botany								
Semester	Fall/I Semester of First Year of the Programme								
Course objectives	1. Help to understand the role of statistics in data analysis, decision-making, and scientific research 2. Introduce students to descriptive statistics, including measures of central tendency (mean, median, mode) and measures of dispersion (range, variance, standard deviation). 3. Teach students how to summarize and present data effectively using tables, charts, and graphs.								
CO1	Improve understanding of Descriptive Statistics and Demography.								
CO2	Develop knowledge to understand the Probability theory, Distribution, and sampling methods.								
CO3	Develop knowledge to understand the methods for hypothesis testing and biological data analysis.								
CO4	Develop knowledge to understand the principles of various statistical analyses of data.								
CO5	Develop knowledge on R language for data analysis.								
Unit-No.	Content		CH	Learning Outcome				KL	
I	<b>Statistical Methods:</b> Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio.		5	Foundational Understanding of Statistical Concepts				1,2	
II	<b>Presentation:</b> tabular and graphical, including histogram and ogives. Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, skewness and kurtosis.		5	Proficiency in Data Presentation and Analysis				1,2	
III	<b>Bivariate data:</b> Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, fitting of polynomials and exponential curves.		5	Knowledge on Analyzing Bivariate Data and Relationships				1,2,3	
IV	<b>Random experiment:</b> trial, sample point and sample space, event, Operations of Events, concepts of mutually exclusive and exhaustive events. Definition of probability: classical and relative frequency approach. Discrete probability space, Properties of probability, Independence of events, Conditional probability, total and compound probability rules, Normal probability Distribution, Binomial probability Distribution, Poisson Probability Distribution, Bayes' theorem and its applications.		8	Understanding of Probability and Distributions				1,2,3	
V	<b>Testing of hypothesis,</b> parametric test: t-test, z-test, chi-square test. Non-Parametric test: One sample Kolmogorov test, Wilcoxon Signed test, Mann-Whitney Test, Kruskal walls test.		7	Application of Hypothesis Testing and Statistical Tests				1,2,3	
<b>Practical</b>	1.Introduction to R - A programming language and environment for data analysis and graphics. Syntax of R expressions: Vectors and assignment, vector arithmetic, generating regular sequence, logical vector,		30	A brief knowledge on using R for data analysis and visualization				1,2,3,4	

<p>character vectors, Index vectors; selecting and modifying subsets of dataset</p> <p>2.Data objects: Basic data objects, matrices, partition of matrices, arrays, lists, creating and using these objects; Functions- Elementary functions and summary functions, applying functions to subsets of data. Data frames: The benefits of data frames, creating data frames, combining data frames, Adding new classes of variables to data frames; Data frame attributes.</p> <p>3.Importing data files: import. data function, read. table function; Exporting data: export. data function, cat, write, and write. table functions, function, formatting output - options, and format functions; Exporting graphs -export. graph function. Graphics in R: creating graphs using plot function, box plot, histogram, line plot, steam and leaf plot, pie chart, bar chart, multiple plot layout, plot titles, formatting plot axes; Visualizing the multivariate data: Scatter plot, Q-Q plot, P-Pplot.</p> <p>4.Performing data analysis tasks: Reading data with scan function, exploring data using graphical tools, computing descriptive statistics, one sample tests, two sample tests, Goodness of fit tests.</p> <p>5.Parametric test and non-parametric test</p>	
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**Text books:**

**T1:** Methods in Biostatistics by K S Negi, ISBN:9789374735053,4th Edition, Year:2023, AITBS Publishers, INDIA

**Reference books**

R1; "Introduction to the Practice of Statistics" by David S. Moore, George P. McCabe, and Bruce A. Craig

R2: "Statistics" by David Freedman, Robert Pisani, and Roger Purves

**Other learning resources:**

<https://www.sciencedirect.com/journal/computational-statistics-and-data-analysis>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping										
SN	Course Outcome (CO)						Mapped Program Outcome			
1	Improve understanding of Descriptive Statistics and Demography.						2			
2	Develop knowledge to understand the Probability theory, Distribution, and sampling methods.						2			
3	Develop knowledge to understand the methods for hypothesis testing and biological data analysis.						2			
4	Develop knowledge to understand the principles of various statistical analyses of data.						2			
5	Develop knowledge on R language for data analysis						3			
SEMESTER – I										
Course Title	EFFECTIVE ENGLISH (Communicative English & Soft Skills)									
Course code	22UMPD111R	Total credits: 2		L	T	P	S	R	O/F	C
		Total hours: 60P		0	0	4	0	0	0	2
Pre-requisite	Nil		Co-requisite	Nil						
Programmes	Master of Science in Botany									
Semester	Fall/I Semester of First Year of the Programme									

<b>Course objectives</b>	<ol style="list-style-type: none"> <li>To introduce the types of sentences and their significance.</li> <li>To strengthen the students' vocabulary to enhance their speaking and writing skills.</li> <li>To familiarize the students with the importance of dress codes in various organizations.</li> <li>To introduce the 3P's (Planning, prioritizing &amp; performing) of Time Management.</li> <li>To give insight into English pronunciation and into central concepts in phonetics.</li> </ol>
<b>CO1</b>	This course will enable students to analysis and identify the different types of sentences.
<b>CO2</b>	Learners will be able to integrate the skills of reading and speaking in professional communication.
<b>CO3</b>	Dress code Etiquette sessions will boost their confidence and morals.
<b>CO4</b>	Students will learn about the effective and efficient utilization of time.
<b>CO5</b>	Introduction to Phonetics and its importance will improve the learners 'pronunciation.
<b>MODULES</b>	<p><b>Module 1- Grammar</b> Interchange of Interrogative and Assertive Sentences, Exclamatory and Assertive Sentences, Types of Tenses, Common Errors, Synonyms, Antonyms, Homonyms</p> <p><b>Module 2- Reading Skills</b> Techniques of Effective Reading, gathering ideas and information from a text The SQ3R Technique Interpret the text</p> <p><b>Module 3-Listening Skills</b> What is listening? The Process of Listening, Factors that adversely affect Listening, Difference between Listening and Hearing, Purpose and Importance of Effective Listening, How to Improve Listening Process,</p> <p><b>Module 4- Conflict Management</b> Definition, Type of Conflict Management, Effects of Conflict Management, Methods to deal with Conflicts (Negative)</p> <p><b>Module 5- Time-Management Skills</b> Introduction To Time Management, Purpose and Importance of Time Management, Basic Tips to Maintain Time.</p> <p><b>Activity: Problem solving activity:</b> A situation will be given to the students and they will have to tell us how to handle the situation or solve the problem.</p>

**Text books:**

T1: Wren,P.C and Martin,H. 1995. High School English Grammar and Composition, S Chand Publishing.

T2: English Grammar in Use, Raymond Murphy 4th edition, CUP.

T3: Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

**Reference books:**

R1; English Vocabulary in Use (Advanced), Michael McCarthy and Felicity, CUP.

R2: Effective Communication and Soft Skills, Nitin Bhatnagar, Pearsons.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	This course will enable students to analysis and identify the different types of sentences.	<b>2</b>
<b>2</b>	Learners will be able to integrate the skills of reading and speaking in professional communication.	<b>3</b>
<b>3</b>	Dress code Etiquette sessions will boost their confidence and morals.	<b>3</b>
<b>4</b>	Students will learn about the effective and efficient utilization of time.	<b>2</b>
<b>5</b>	Introduction to Phonetics and its importance will improve the learners 'pronunciation	<b>2</b>

SEMESTER – I									
Course Title	MOOCS-I								
Course code	22MSCE111R	Total credits: 2 Total hours:	L	T	P	S	R	O/F	C
			0	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Botany								
Semester	Fall/I Semester of First Year of the Programme								
Course objectives	As per the course opted.								
Course outcomes	As per the course opted.								
Course description	As per the online material available								

Teaching Objective	As per the course opted
Learning Outcomes/Course Outcome	As per the course opted

**Course content:**

As per the online material available.

**Reference:**

<https://www.coursera.org/programs/assam-downtown-university-on-coursera rzqtn?currentTab=CATALOG>

SEMESTER – II									
Course Title	Plant cell, genetics and plant breeding								
Course code	22MSBO121R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course Objectives	1. Introduce the basic concepts of genetics, helping students to develop their analytical, quantitative and problem- solving skills from classical to molecular genetics. 2. To provide insight into structure and functions of chromosomes, chromosome mapping, polyploidy and cytogenetic aspects of crop evolution. 3. To impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and genetic consequences, breeding methods for crop improvement.								
CO1	Describe the structure, function and biogenesis of cell and its organelles.								
CO2	Explain structure and function of chromatin, DNA condensation, plant cytoskeletal genes, cell cycle and apoptosis.								
CO3	Describe chromosome structure, its involvement in sex determination, aberrations and its impact on crop evolution.								
CO4	Explain the structure, regulation of prokaryotic and eukaryotic gene and its function.								
CO5	Describe hybridization, inbreeding, disease resistance, transgenes and practice backcross methods of plant breeding.								
Unit-No.	Content			CH	Learning Outcome				KL
I	Structure, functions and biogenesis of cell wall and plasma membrane. Structure and function of cytoplasmic cell organelles and biopolymers. Nucleus: Nuclear envelope, nuclear pore complex, trafficking between nucleus and cytoplasm.			10	Knowledge of structure of cell and its organelles.				1,2
II	Chromatin structure in eukaryotes, condensation and packaging of DNA in prokaryotes. Structure and			8	To learn the basic structural organisation of chromatin and				1,2

	function of plant cytoskeletal genes and gene products. Cell cycle and apoptosis.		genes.	
<b>III</b>	Chromosome: Structure and nomenclature, centromere and telomere. Sex determination: mechanisms, sex chromosomes, Chromosomal aberrations: Duplications, deficiencies/ deletions, inversions, interchanges/ translocations. Role of chromosomal aberrations in crop evolution. Ploidy changes: Haploids, polyploids and aneuploids.	10	To know about the chromosome and its behaviour.	1,2
<b>IV</b>	Fine structure of gene. Prokaryotic gene regulation. Mendelian and Non-Mendelian Inheritance. Chromosome theory of inheritance. Eukaryotic Genome: Evolution, structure and organization. Gene regulation. Recombination in Eukaryotes. Linkage and crossing over: basic concepts, linkage maps, correlation of genetic and physical maps, Post translational modifications of eukaryotes.	10	To understand the basics of gene structure and post transcriptional modifications.	1,2
<b>V</b>	Objectives and scope of plant breeding, hybridization in self and cross-pollinated crops, genetic basis of inbreeding depression and heterosis. Breeding for disease and insect resistance, transgenes and transgenic plants. Alien gene transfer through chromosome. Transfer of gene through individual chromosome for distant hybridization. Back Cross methods of plant breeding.	7	Able to describe and explain about the methods of plant breeding and its different applications.	1,2
<b>Practica I</b>	1. Preparation of stains and staining techniques for chromosome analysis. 2. Chromosome analysis, study of chromosome behaviour in mitosis and meiosis. 3. Karyotyping of dicot (mitosis)	30	Describe, illustrate and explain and apply staining techniques and carry out microscopic examination.	1,2, 3,4

#### Text Books

- T1. Genetics, B.D. Singh, Kalyani Publishers.  
T2. Introduction to Genetic Analysis, 9th edition by Griffiths et al, 2008.  
T3. Principles of Genetics by Snustad et al (2004).

#### Reference Books

- R1. Concepts of Genetics, Klug, Cummings and Spencer.  
R2. An Introduction to Plant Breeding, Jack Brown & Peter Caligiri.  
R3. Fundamentals of Plant Breeding, Kuckuck, Hermann, Kobabe,.

#### Other Learning Resources:

- <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/chromosome>  
<https://link.springer.com/journal/10577>

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe the structure, function and biogenesis of cell and its organelles.	1,3
2	To provide insight into structure and functions of chromosomes, chromosome mapping, polyploidy and cytogenetic aspects of crop evolution.	1,2
3	Describe chromosome structure, its involvement in sex determination, aberrations and its impact on crop evolution.	1,4
4	Explain the structure, regulation of prokaryotic and eukaryotic gene and its function.	1,2

5	Describe hybridization, inbreeding, disease resistance, transgenes and practice backcross methods of plant breeding.	1,4
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SEMESTER – II									
Course Title	Microbiology and Plant Pathology								
Course code	22MSBO122R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course Objectives	<p>1. The course deals with the introduction, distribution/ diversity of microbes in soil, water, air, milk and its application in the field of agriculture, industry.</p> <p>2. To make learner understand the method of isolation of microorganisms and their growth in the laboratory condition and also various culture techniques and instruments used for microbiological studies.</p> <p>3. To impart the concept of symptomology and epidemiology of different plant disease.</p>								
CO1	Describe about diversity of microorganisms.								
CO2	Demonstrate the method of isolation, pure culture, preservation of microbes and design to estimate microbial growth.								
CO3	Describe application of microorganisms in agriculture, fermented food, dairy, bio-waste management.								
CO4	Explain innate and acquired responses, antibodies, cells and tissues of immune system, serological reactions and sero diagnostics.								
CO5	Describe symptomatology, epidemiology and host-pathogen relationships, defense mechanisms, and strategies for plant disease control.								
Unit-No.	Content	CH	Learning Outcome				KL		
I	Microbial diversity- 'Species' and 'Strain' concept in microbiology, ICN for virus, bacteria and other microbes, microbiome concept, ecological significance of microbes, microbiology of soil, air, water and milk.	10	Knowledge of microbial diversity and ecology.				1,2		
II	Microbial techniques- Isolation of microbes, pure culture, preservation, types of culture, growth, media sterilization and disinfection, sterilization techniques, population estimation (direct spore count, CFU, spectrophotometric method), pure culture and visualization techniques, culture preservation and maintenance.	10	To learn about the microbial techniques.				1,2		
III	Applied microbiology- Application of microbes in the field of agriculture, fermented foods and dairy products, industry and bio-waste management.	7	To know about the applications of microbiology in different sectors.				1,2		
IV	Immunology- Immunity, Innate and acquired immunity, antibodies, cells and tissues of the immune system, immune diseases, serological reactions and sero diagnostics, cancer biology.	8	To understand the basics of immunology and cancer biology.				1,2		
V	Plant Pathology- Symptomatology and epidemiology, methods of studying plant diseases, stages in disease development, recognition and entry processes of different pathogens like Bacteria and fungi in plant host cells, host-pathogen relationship, Systemic Acquired Resistance (SAR) and Induced Systemic Resistance (ISR), Control of plant diseases.	10	Able to describe and explain about the disease caused by different microbial agents in plants.				1,2		

<b>Practica I</b>	1. Isolation and pure culture of microbes from soil, air, water and disease plant materials. 2. Identification and characterization of isolated pure cultures. 3. Estimation of bacterial growth by spectrophotometric method and counting of cells. 4. Study of plant pathogenic fungi from diseased specimens (symptoms, causal organism and their morphological & reproductive characters.	30	Describe, illustrate and explain and apply microbial and plant pathogenic techniques and carry out microscopic examination.	1,2,3,4
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#### Text Books

T1. Microbiology-Pelzer, Chan, Krieg Tata McGraw Hill Publications. 5<sup>th</sup> Edition.

T2. Prescotts Microbiology, Dorothy Wood, Joanne Willey, Kathleen Sandman.12th Edition.

#### Reference Books

R1. P D Sharma, Microbiology and Plant Pathology, Rastogi Publication.

R2. P Chakraborty, A Textbook of Microbiology, New Central Book Agency 3rd Edition (2013)

#### Other Learning Resources

<https://www.sciencedirect.com/journal/microbiologicalresearch>

<https://www.sciencedirect.com/special-issue/10DQJXMYLPT>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe about diversity of microorganisms.	1, 3, 4
2	Demonstrate the method of isolation, pure culture, preservation of microbes and design to estimate microbial growth.	1, 3, 6
3	Describe application of microorganisms in agriculture, fermented food, dairy, bio-waste management.	2, 3, 4, 5, 6
4	Explain innate and acquired responses, antibodies, cells and tissues of immune system, serological reactions and sero diagnostics	1, 2, 3
5	Describe symptomatology, epidemiology and host-pathogen relationships, defense mechanisms, and strategies for plant disease control.	1, 3, 4, 6

SEMESTER – II									
Course Title	Plant physiology and biochemistry								
Course code	22MSBO123R	Total credits: 4	L	T	P	S	R	O/F	C
			Total hours: 45T+30P	3	0	2	0	0	0
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course Objectives	1. This course aims to educate student on concepts of proteins, enzymes. 2. Basic plant signaling mechanisms, sensory photobiology. 3. The course further deals with physiology of plant hormones, reproduction, enzymology metabolism, photosynthesis and respiration.								
CO1	Describe membrane transport mechanism and environmental stress on plants.								



<b>CO2</b>	Explain mechanism of electron transport system during photosynthesis and pathway of photorespiration and respiration.			
<b>CO3</b>	Describe plant hormones, enzymes, regulation of enzymes and Enzyme Kinetics.			
<b>CO4</b>	Explain structure of protein and role of thermodynamics in plants.			
<b>CO5</b>	Describe signal transduction in Bacteria and plants.			
<b>Unit- No.</b>	<b>Content</b>	<b>CH</b>	<b>Learning Outcome</b>	<b>KL</b>
<b>I</b>	Membrane transport and translocation of water and solute. Stress physiology: Water stress, heat Stress, cold stress. Flooding and ROS formation and oxidative stress (Uniport, Symport, Antiport channels, Pressure flow model, Polymer trapping mode).	10	Knowledge of plant transport and stress biology.	1,2
<b>II</b>	Photosynthesis: Light harvesting system, Mechanisms of electron transport, photoprotective mechanisms, CO <sub>2</sub> fixation-C <sub>3</sub> , C <sub>4</sub> and CAM pathways. Respiration and photorespiration: Citric acid cycle; plant mitochondrial electron transport and ATP synthesis, alternate oxidase, photorespiratory pathway.	10	To learn about the plant photosynthesis reactions.	1,2
<b>III</b>	Plant hormones: Biosynthesis, storage, breakdown and translocation. Mechanism of action of plants hormones. Enzyme and regulation, Enzyme kinetics and other growth regulators, Derivation of Michaelis Menten equation.	7	To know about the biosynthesis and applications of plant hormones.	1,2
<b>IV</b>	Protein structure and protein synthesis (folding, ticketing, degradation, purification, detection and functional characterization), Application of principles of thermodynamics in biology. Nitrate and ammonium assimilation, amino acid biosynthesis complex, Translational proof-reading, Translational inhibitors and Post- Translational modification of proteins.	8	To understand the protein structure and functions.	1,2
<b>V</b>	Signal Transduction: Overview second messengers, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, specific signalling, mechanisms and their regulation. Specific signalling. Mechanism in bacteria and plants.	10	Able to describe and explain about the signal transduction in plants.	1,2
<b>Practica I</b>	1. Determination of water potential using gravimetric method. 2. Extraction of carbohydrates from plant materials and estimation of reducing and non-Reducing sugars. 3. Extraction and estimation of proteins from plant materials by Lowry's method using BSA standard curve. 4. Extraction of chloroplast pigments and quantitative estimation with determination of chlorophyll a/b ratio and total chlorophyll in C <sub>3</sub> , C <sub>4</sub> and CAM plants.	30	Describe, illustrate and explain and apply plant physiological and biochemical reactions.	1,2, 3,4

#### **Text Books**

T1. Buchanan B.B, Grussem W. and Jones R. L (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA

T2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.

### Reference Books

R1. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

### Other Learning Resources

<https://www.sciencedirect.com/journal/journal-of-plant-physiology>

<https://www.sciencedirect.com/topics/medicine-and-dentistry/plant-physiology>

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe membrane transport mechanism and environmental stress on plants.	1,2,6
2	Explain mechanism of electron transport system during photosynthesis and pathway of photorespiration and respiration.	1,3,8
3	Describe plant hormones, enzymes, regulation of enzymes and Enzyme Kinetics.	1,2,3
4	Explain structure of protein and role of thermodynamics in plants.	1,3,8
5	Describe signal transduction in Bacteria and plants.	1,3,8

Course Title	Techno Professional Skills – I (Mushroom Cultivation)								
Course code	22MSBO124R	Total credits: 2	L	T	P	S	R	O/f	C
		Total hours:30	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course objectives	<ol style="list-style-type: none"> <li>To create awareness about the Mushroom among the people.</li> <li>To strengthen the promotion of mushroom cultivation by establishing a well-equipped laboratory and offices.</li> <li>To know and explore the cultivation in Assam.</li> </ol>								
CO1	Describe the method of producing mushroom spawn and the cultivation process for mushrooms, including substrate preparation, inoculation, and environmental conditions required for successful growth.								
CO2	Illustrate the techniques involved in fungal culture for mushroom spawn production, such as agar plate methods, liquid culture techniques, and spawn generation using grain or sawdust.								
CO3	Explain the techniques for cultivating mushrooms, including methods for maintaining optimal humidity, temperature, and light conditions, as well as managing pests and diseases.								
CO4	Describe the management of spent mushroom substrate, including strategies for composting or vermicomposting to recycle organic waste and improve soil fertility.								
CO5	Explain the commercial aspects of mushroom production, including market analysis, business planning, and strategies for developing entrepreneurship in the mushroom industry.								
Practica	Content	CH	Learning Outcome				KL		
1	<ol style="list-style-type: none"> <li>Laboratory techniques for production of mushroom spawn Staining techniques:</li> <li>Method for cultivation of mushroom.</li> <li>Utilization of mushroom spent (waste).</li> <li>Hands on training on commercial cultivation</li> </ol>	30	Understand the cellular organization and functions				1,2,3,4		

	process of mushroom (field/ industry visit).			
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**Text books**

T1. Mushroom Cultivation Technology by Joy Sarkar, Krishnendu Acharya, Anirban Roy (Author).Publisher: Techno World.

T2. Handbook of Mushrooms 4th Edition by Bahl N, Oxford &Ibh Publishing

**Reference books**

R1. Mushroom Cultivation by Parveen Garg, Publisher: B.R. Publishing Corporation, ISBN: 9788193031421.

R2. Mushrooms: A Manual for Cultivation by S. Biswas, M. Datta, S. V. Ngachan, PHI Learning

**Other Learning Resources:**

<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/mushroom-growing>

<https://www.sciencedirect.com/science/article/pii/S2666833521000769>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe the method of producing mushroom spawn and the cultivation process for mushrooms, including substrate preparation, inoculation, and environmental conditions required for successful growth.	1,2,3
2	Illustrate the techniques involved in fungal culture for mushroom spawn production, such as agar plate methods, liquid culture techniques, and spawn generation using grain or sawdust.	1,2,3,4
3	Explain the techniques for cultivating mushrooms, including methods for maintaining optimal humidity, temperature, and light conditions, as well as managing pests and diseases.	2,3,6
4	Describe the management of spent mushroom substrate, including strategies for composting or vermicomposting to recycle organic waste and improve soil fertility.	2,3,7
5	Explain the commercial aspects of mushroom production, including market analysis, business planning, and strategies for developing entrepreneurship in the mushroom industry.	3,4,7

Course Title	Mini Research (research gap analysis-R2)								
Course code	22MSBO125R	Total credits: 2	L	T	P	S	R	O/f	C
		Total hours: 30	0	0	0	4	12	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course objectives	1.To determine whether the objectives of review of literature gap analysis have been met, if not what steps can be taken accordingly.								
CO1	Create and implement a plan to bridge the gap								
CO2	Find the gap and evaluate solutions.								
CO3	Identify the ideal future state/action plan								
CO4	To analyse the current state/work of research								
CO5	To implement the strategies to meet the research gap under supervision.								

**Text books**

1. T1. Multiple Stressors: Literature Review and Gap Analysis (WERF Research Report Series) by S.M. Swanson.

Course Title	Open elective- Coursera								
Course code	22MSBO126R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours:	0	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course objectives	As per the course opted.								
Course outcomes	As per the course opted.								
Course description	As per the online material available								

Teaching Objective	As per the course opted
Learning Outcomes/Course Outcome	As per the course opted

**Course content:**

As per the online material available.

**Reference:**

<https://www.coursera.org/programs/assam-downtown-university-on-coursera rzqtn?currentTab=CATALOG>

SEMESTER – II									
COURSE TITLE	Research Methodology and Statistical Analysis								
Course code	22UMRM121R	Total credits: 2	L	T	P	S	R	O/f	C
		Total hours:15T+60S	1	0	0	4	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course objectives	<ol style="list-style-type: none"> <li>1. The course aims to enhances the students' a broad understanding of research methodology, including theory of science and qualitative and quantitative methods in research.</li> <li>2. The course seeks to enhance the students' skills for developing critical thinking through research literature review in different domain. Consequently, it aims to develop skills for preparation of a research proposal for a master' thesis project/Mini research.</li> <li>3. To develop Students competency in planning, conducting, evaluating and presenting a research project.</li> </ol>								
CO1	Students will have basic knowledge of Research methods.								
CO2	Students will gain the knowledge of Research Methodology.								
CO3	Students will be able to gain the Skill questionnaire development.								
CO4	Students will be able to acquire the knowledge of basic Report/dissertation Procedure.								

CO5		Knowledge on different IPR rights		
Unit no	Content	CH	Learning Outcome	KL
I	Research Methodology- An Introduction-meaning and objectives of research, motivation in research, types and significance of research, criteria of good research. Defining the Research Problems- definition of research problem, necessity of defining research problem	2	Understand research methodology, motivations, types, significance, good research criteria, and defining research problems.	1,2
II	Research Design- meaning and need of research design, features of a good design, different research designs, Sampling Design- steps in sampling design, Sample Size determination, criteria for selecting a sampling design, different types of sampling design, Experimental Design, Principles of Design of Experiment, One – way ANOVA, Two- Way ANOVA, CRD, RBD, LSD, 22, 23 Factorial Design	4	Master research design principles, sampling methods, experimental design, and various ANOVA and factorial designs.	1,2
III	Types of data, sources of data collection, tools of data collection, Nominal, ordinal, interval and ratio– Attitude scale construction and measurement, rating scales, semantic differential (SD), Use of scale in statistical analysis, Schedules for interviews preparation and standardization, development of survey instruments and item analysis for the questionnaire	3	Learn data types, collection methods, scales, survey instruments, and statistical analysis for research questionnaires.	1,2
IV	Planning and organizing research report, Format of research report, Different steps of writing report, lay out of the research report, how to organize thesis/Dissertation, mechanics of writing research report, standard methods of quoting- presenting the result, written and oral reports, Uses of abstract, format of research report, presentation of statistics - tabular and graphic references and uses of references, Bibliography and presentation of bibliography	3	Master research report planning, formatting, writing, presentation, quoting methods, and bibliography preparation.	1,2
V	Intellectual property right (IPR), Introduction and the need for IPR, IPR in India and worldwide, Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge and Geographical Indications, Patentable and non-patentable, patenting life, Filing of a patent application, The different layers of the international patent system, Case studies on Basmati rice, Turmeric, and Neem patents	3	Understand IPR concepts, global and Indian frameworks, patents, trademarks, and key case studies.	1,2
<b>Practical I</b>	Laboratory using R Software: 1 Analysis of One-way ANOVA; 2 Analysis of Two-way ANOVA; 3 Analysis of CRD 4 Analysis of RBD 5 Analysis of 22 and 23 Factorial Experiment 6 Simulation-I using R (Bernoulli, Binomial, Poisson and Geometric distribution.).	60	Conduct and analyze ANOVA, CRD, RBD, factorial experiments, simulations, and sampling using R software.	1,2,3,4

7 Simulation-II using R (Exponential and Normal distribution).			
8 Simple random Sampling			
9 Stratified Random Sampling			

**Text books**

T1. Jerome L. Myers, Arnold D. Well, Robert F. Lorch, Jr. Research design and statistical analysis, 2010, 3<sup>rd</sup> edition.

**Reference books**

R1. Johnson & Christensen. (2004). Educational Research: Quantitative, qualitative and mixed approaches, 2nd Ed. Boston: Allyn & Bacon.

<https://www.sciencedirect.com/journal/statistical-methodology>

<https://www.sciencedirect.com/journal/computational-statistics-and-data-analysis>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Students will have basic knowledge of Research methods.	2
2	Students will gain the knowledge of Research Methodology.	3
3	Students will be able to gain the Skill questionnaire development.	3
4	Students will be able to acquire the knowledge of basic Report/dissertation Procedure.	1
5	Knowledge on different IPR rights	2

SEMESTER – II									
COURSE TITLE	UNIVERSAL HUMAN VALUES (UHV) + PROFESSIONAL ETHICS								
Course code	22UUHV101R**	Total credits: 2	L	T	P	S	R	O/f	C
		Total hours:15T+30P	1	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course objectives	<ol style="list-style-type: none"> <li>To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings</li> <li>To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way</li> <li>To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.</li> </ol>								
CO1	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.								
CO2	It is free from any dogma or value prescriptions.								
CO3	It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.								
CO4	This process of self-exploration takes the form of a dialogue between the teacher and the								

	students to begin with, and then to continue within the student leading to continuous self-evolution
<b>CO5</b>	This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.
<b>Unit</b>	<b>Content</b>
<b>I</b>	<ul style="list-style-type: none"> <li>• Understanding the need, basic guidelines, content and process for Value Education</li> <li>• Self-Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self-exploration</li> <li>• Continuous Happiness and Prosperity- A look at basic Human Aspirations</li> <li>• Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority.</li> <li>• Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario</li> <li>• Method to fulfil the above human aspirations: understanding and living in harmony at various levels.</li> </ul>
<b>II</b>	<ul style="list-style-type: none"> <li>• Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’</li> <li>• Understanding the needs of Self (‘I’) and ‘Body’ - <i>Sukh</i> and <i>Suvidha</i></li> <li>• Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)</li> <li>• Understanding the characteristics and activities of ‘I’ and harmony in ‘I’</li> <li>• Understanding the harmony of I with the Body: <i>Sanyam</i> and <i>Swasthya</i>; correct appraisal of Physical needs, meaning of Prosperity in detail</li> <li>• Programs to ensure <i>Sanyam</i> and <i>Swasthya</i>-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>
<b>III</b>	<ul style="list-style-type: none"> <li>• Understanding Harmony in the family – the basic unit of human interaction</li> <li>• Understanding values in human-human relationship; meaning of Nyaya and program for its fulfilment to ensure Ubhay-tripti;</li> <li>• Trust (Vishwas) and Respect (Samman) as the foundational values of relationship</li> <li>• Understanding the meaning of Vishwas; Difference between intention and competence.</li> <li>• Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship</li> <li>• Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals</li> <li>• Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family! -Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>
<b>IV</b>	<ul style="list-style-type: none"> <li>• Understanding the harmony in the Nature</li> <li>• Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature</li> <li>• Understanding Existence as Co-existence (<i>Sah-astitva</i>) of mutually interacting units in all-pervasive space</li> <li>• Holistic perception of harmony at all levels of existence-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ul>
<b>V</b>	<ul style="list-style-type: none"> <li>• Natural acceptance of human values</li> <li>• Definitiveness of Ethical Human Conduct</li> <li>• Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order</li> <li>• Competence in professional ethics: <ul style="list-style-type: none"> <li>➤ Ability to utilize the professional competence for augmenting universal human order</li> <li>➤ Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems,</li> <li>➤ Ability to identify and develop appropriate technologies and management patterns for above production systems.</li> </ul> </li> <li>• Case studies of typical holistic technologies, management models and production systems</li> <li>• Strategy for transition from the present state to Universal Human Order:</li> </ul>

	<ul style="list-style-type: none"> <li>➤ At the level of individual: as socially and ecologically responsible engineers, technologists and managers</li> <li>➤ At the level of society: as mutually enriching institutions and organizations</li> </ul>
<b>Guidelines and Content for Practice Sessions</b>	<p>UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education</p> <p>PS 1: Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? How do you differentiate between right and wrong? What have been your achievements and shortcomings in your life? Observe and analyze them</p> <p>Expected outcome: the students start exploring themselves; get comfortable to each other and to the teacher and start finding the need and relevance for the course.</p> <p>PS 2: Now-a-days, there is a lot of voice about many techno-genic maladies such as energy and natural resource depletion, environmental pollution, global warming, ozone depletion, deforestation, soil degradation, etc. – all these seem to be man-made problems threatening the survival of life on Earth – What is the root cause of these maladies &amp; what is the way out in your opinion?</p> <p>On the other hand, there is rapidly growing danger because of nuclear proliferation, armsrace, terrorism, criminalization of politics, large scale corruption, scams, breakdown of relationships, generation gap, depression &amp; suicidal attempts, etc – what do you think, is the root cause of these threats to human happiness and peace – what could be the way out in your opinion?</p> <p>Expected outcome: the students start finding that technical education without study of human values can generate more problems than solutions. They also start feeling that lack of understanding of human values is the root cause of all problems and the sustained solution could emerge only through understanding of human values and value based living. Any solution brought out through fear, temptation or dogma will not be sustainable.</p> <p>PS 3:</p> <ol style="list-style-type: none"> <li>1. Observe that each one of us has Natural Acceptance, based on which one can verify right or not right for him. Verify this in case of       <ol style="list-style-type: none"> <li>i) What is Naturally Acceptable to you in relationship- Feeling of respect or disrespect?</li> <li>ii) What is Naturally Acceptable to you – to nurture or to exploit others? Is your living the same as your natural acceptance or different?</li> </ol> </li> <li>2. Out of the three basic requirements for fulfillment of your aspirations- right understanding, relationship and physical facilities, observe how the problems in your family are related to each. Also observe how much time &amp; effort you devote for each in your daily routine.       <p>Expected outcome:</p> <ol style="list-style-type: none"> <li>1. The students are able to see that verification on the basis of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity; it will only develop assumptions.</li> <li>2. The students are able to see that their practice in living is not in harmony with their natural acceptance most of the time, and all they need to do is to refer to their natural acceptance to remove this disharmony.</li> <li>3. The students are able to see that lack of right understanding leading to lack of relationship is the major cause of problems in their family and not the lack of physical facilities in most of the cases, while they have given higher priority to earning of physical facilities in their life ignoring relationships and not being aware that right understanding is the most important requirement for any human being.</li> </ol> </li> </ol> <p>UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!</p> <p>PS 4: List down all your desires. Observe whether the desire is related to Self (I) or Body. If it appears to be related to both, see which part of it is related to Self (I) and which part is related to Body.</p> <p>Expected outcome: the students are able to see that they can enlist their desires and the desires are not vague. Also they are able to relate their desires to ‘I’ and ‘Body’ distinctly. If any desire appears related to both, they are able to see that the feeling is related to I while the physical facility is related to the body. They are also able to see that ‘I’ and ‘Body’ are two realities, and</p>



most of their desires are related to 'I' and not body, while their efforts are mostly centered on the fulfillment of the needs of the body assuming that it will meet the needs of 'I' too.

PS 5:

1. a. Observe that any physical facility you use, follows the given sequence with time : Necessary & tasteful → unnecessary & tasteful → unnecessary & tasteless → intolerable
- b. In contrast, observe that any feeling in you is either naturally acceptable or not acceptable at all. If naturally acceptable, you want it continuously and if not acceptable, you do not want it any moment!
2. List down all your activities. Observe whether the activity is of 'I' or of Body or with the participation of both 'I' and Body.
3. Observe the activities within 'I'. Identify the object of your attention for different moments (over a period of say 5 to 10 minutes) and draw a line diagram connecting these points. Try to observe the link between any two nodes.

Expected outcome:

1. The students are able to see that all physical facilities they use are required for a limited time in a limited quantity. Also they are able to see that in case of feelings, they want continuity of the naturally acceptable feelings and they do not want feelings which are not naturally acceptable even for a single moment.
2. the students are able to see that activities like understanding, desire, thought and selection are the activities of 'I' only, the activities like breathing, palpitation of different parts of the body are fully the activities of the body with the acceptance of 'I' while the activities they do with their sense organs like hearing through ears, seeing through eyes, sensing through touch, tasting through tongue and smelling through nose or the activities they do with their work organs like hands, legs etc. are such activities that require the participation of both 'I' and body.
3. The students become aware of their activities of 'I' and start finding their focus of attention at different moments. Also they are able to see that most of their desires are coming from outside (through preconditioning or sensation) and are not based on their natural acceptance.

PS 6:

1. Chalk out programs to ensure that you are responsible to your body- for the nurturing, protection and right utilisation of the body.
2. Find out the plants and shrubs growing in and around your campus. Find out their use for curing different diseases.

Expected outcome: The students are able to list down activities related to proper upkeep of the body and practice them in their daily routine. They are also able to appreciate the plants wildly growing in and around the campus which can be beneficial in curing different diseases.

### UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

PS 7: Form small groups in the class and in that group initiate dialogue and ask the eight questions related to trust. The eight questions are:

- 1a. Do I want to make myself happy? 2a. Do I want to make the other happy?
- 3a. Does the other want to make him happy? 4a. Does the other want to make me happy?

What is the answer?

Intention (Natural Acceptance)

- 1b. Am I able to make myself always happy? 2b. Am I able to make the other always happy?
- 3b. Is the other able to make him always happy? 4b. Is the other able to make me always happy?

What is the answer?

Competence

Let each student answer the questions for himself and everyone else. Discuss the difference between intention and competence. Observe whether you evaluate your intention & competence as well as the others' intention & competence.

Expected outcome: The students are able to see that the first four questions are related to our Natural Acceptance i.e. Intention and the next four to our Competence. They are able to note that the intention is always correct, only competence is lacking! We generally evaluate ourselves

on the basis of our intention and others on the basis of their competence! We seldom look at our competence and others' intention as a result we conclude that I am a good person and other is a bad person.

PS 8:

1. Observe on how many occasions you are respecting your related ones (by doing the right evaluation) and on how many occasions you are disrespecting by way of under- evaluation, over-evaluation or otherwise evaluation.

2. Also observe whether your feeling of respect is based on treating the other as yourself or on differentiations based on body, physical facilities or beliefs.

Expected outcome: The students are able to see that respect is right evaluation, and only right evaluation leads to fulfillment in relationship. Many present problems in the society are an outcome of differentiation (lack of understanding of respect), like gender biasness, generation gap, caste conflicts, class struggle, dominations through power play, communal violence, clash of isms, and so on so forth. All these problems can be solved by realizing that the other is like me as he has the same natural acceptance, potential and program to ensure a happy and prosperous life for him and for others though he may have different body, physical facilities or beliefs.

PS 9:

1. Write a note in the form of story, poem, skit, essay, narration, dialogue to educate a child. Evaluate it in a group.

2. Develop three chapters to introduce 'social science- its need, scope and content' in the primary education of children

Expected outcome: The students are able to use their creativity for educating children. The students are able to see that they can play a role in providing value education for children. They are able to put in simple words the issues that are essential to understand for children and comprehensible to them. The students are able to develop an outline of holistic model for social science and compare it with the existing model.

UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

PS 10: List down units (things) around you. Classify them in four orders. Observe and explain the mutual fulfillment of each unit with other orders.

Expected outcome: The students are able to differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them. They are also able to see that human beings are not fulfilling to other orders today and need to take appropriate steps to ensure right participation (in terms of nurturing, protection and right utilization) in the nature.

PS 11:

1. Make a chart for the whole existence. List down different courses of studies and relate them to different units or levels in the existence.

2. Choose any one subject being taught today. Evaluate it and suggest suitable modifications to make it appropriate and holistic.

Expected outcome: The students feel confident that they can understand the whole existence; nothing is a mystery in this existence. They are also able to see the interconnectedness in the nature, and point out how different courses of study relate to the different units and levels. Also they are able to make out how these courses can be made appropriate and holistic.

UNIT 5: Implications of the above Holistic Understanding of Harmony at all Levels of Existence

PS 12: Choose any two current problems of different kind in the society and suggest how they can be solved on the basis of natural acceptance of human values. Suggest steps you will take in present conditions.

Expected outcome: The students are able to present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.

PS 13:

1. Suggest ways in which you can use your knowledge of Technology/Engineering/Management for universal human order, from your family to the world family.

	<p>2. Suggest one format of humanistic constitution at the level of nation from your side. Expected outcome: The students are able to grasp the right utilization of their knowledge in their streams of Technology/Engineering/ Management to ensure mutually enriching and recyclable productions systems.</p> <p>PS 14: The course is going to be over now. Evaluate your state before and after the course in terms of a. Thought      b. Behavior and    c. Work d. Realization</p> <p>Do you have any plan to participate in the transition of the society after graduating from the institute? Write a brief note on it.</p> <p>Expected outcome: The students are able to sincerely evaluate the course and share with their friends. They are also able to suggest measures to make the course more effective and relevant. They are also able to make use of their understanding in the course for a happy and prosperous society.</p>
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**Text book**

T1: R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and Professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

**Reference**

- R1: B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
- R2. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
- R3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986,1991
- R4: Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
- R5: Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
- R6. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) KrishiTantra Shodh, Amravati.
- R7. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
- R8. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
- R9. A.N. Tripathy, 2003, Human Values, New Age International Publishers.

**Other Learning Resources**

- 1. Value Education websites, <http://uhv.ac.in>, <http://www.uptu.ac.in>
- 2. Story of Stuff, <http://www.storyofstuff.com>
- 3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
- 4. Charlie Chaplin, Modern Times, United Artists, USA
- 5. IIT Delhi, Modern Technology – the Untold Story

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.	2
2	It is free from any dogma or value prescriptions.	2
3	It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.	1
4	This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.	0
5	This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.	0

Semester-II									
COURSE TITLE	COMMUNICATION MASTERY (Communicative English & Soft Skills)								
Course code	22UMPD121R	Total credits: 2	L	T	P	S	R	O/f	C
		Total hours: 60P	1	0	2	0	0	0	2
Pre-requisite	22UMPD111R Effective English	Co-requisite	Nil						
programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course objectives	<ol style="list-style-type: none"> <li>To familiarize students with the transformation of sentences and the appropriate use of prepositions.</li> <li>To enhance the writing skills in different areas including CV and cover letter writing.</li> <li>To convey meaning by reinforcing, substituting for, or contradicting verbal communication.</li> <li>Productivity and performance boosting activities for professional goal achievement.</li> </ol>								
CO1	Practice of grammar will polish their writing skills.								
CO2	It will enhance their communication and interpretative skills.								
CO3	Introduction to behavioural skills, thoughts, and emotions will enable them to behave in a conscious and productive way.								
CO4	It will have a positive impact in their thought process and problem-solving skills.								
Unit	Content								
Module 1- Grammar	<ol style="list-style-type: none"> <li>Use of Prepositions</li> <li>Tag questions</li> <li>Idioms, Phrases and Clauses</li> <li>Simple, complex, compound sentences</li> </ol>								
Module 2- Grammar	<ol style="list-style-type: none"> <li>Active and Passive Voice</li> <li>Direct and Indirect Speech</li> </ol>								
Module 3- Writing Skills	<ol style="list-style-type: none"> <li>The Basics of Writing; avoid ambiguity and vagueness</li> <li>Paragraph Writing</li> <li>Precis Writing</li> <li>Letter Writing</li> <li>Resume, CV and Cover Letter</li> </ol>								
Module 4- Self-Management Skills	<ol style="list-style-type: none"> <li>SWOT Analysis</li> <li>Self-Regulation- Goal Setting</li> <li>Personal Hygiene</li> </ol>								
Module 5- Non- Verbal Communication- Sciences of Body Language	<ol style="list-style-type: none"> <li>What is Non-Verbal Communication &amp; Body Language,</li> <li>Elements of Communication,</li> <li>Types of Body Language,</li> <li>Importance and Impact of Body Language,</li> <li>Types of Communication through Body Language,</li> <li>Introduction to Haptic, Introduction to Kinesics</li> <li>Introduction to Proxemics,</li> <li>Body Language Do's and Don'ts, Doubt Clearing Session.</li> </ol>								
Module 6- Group Discussion (Theory)	<ol style="list-style-type: none"> <li>Importance,</li> <li>Planning, Elements, and Skills assessed;</li> <li>Effectively disagreeing,</li> <li>Initiating, Summarizing and Attaining the Objective</li> </ol>								

**Text book**

T1. Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

T2. McDowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition).

**Reference books**

R1. Communication Skills Training: A Practical Guide to Improving Your Social Intelligence, Presentation and Social Speaking, Ian Tuhovsky, 2019

R2. A Textbook for AECC English Communication: Interface, Dr. Kironmoy Chetia and Pranami Bania Breez Mohan Hazarika, January 2019.

**Other Learning Resources:**

<https://youtu.be/x60GHpQ8gJk>

[https://youtu.be/Ke\\_oSN-BCaY](https://youtu.be/Ke_oSN-BCaY)

<https://youtu.be/TDPDtrLxT-c>

<https://www.classcentral.com/report/toefl-preparation/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain prepositions, tag questions, and idioms correctly.	5
2	Discuss and analyze different sentence types and voices.	2, 5
3	Explain effective paragraphs, precis, and professional documents.	3, 5
4	Describe SWOT analysis, goal setting, and personal hygiene principles.	5
5	Illustrate non-verbal communication and body language concepts.	5

Semester-II										
Course Title	Computational System and Digital Literacy									
Course code	22UUDLI103R	Total credits: 4	L	T	P	S	R	O/f	C	
		Total hours:64	0	0	2	0	0	0	1	
Pre-requisite	Nil	Co-requisite	Nil							
Programmes	Master of Science in Botany									
Semester	Winter/II semester of First year of the programme									
Course objectives	1. Students will be able to understand the fundamentals of computer systems and Internet search along with advanced features of MS-Office. 2. Students will be able to learn data management, statistical analysis and visualization. Students will be able to use social media and e-commerce portals, Digital Payment Systems and other utility software.									
CO1	Students will have basic understanding of Computer Systems and Internet search.									
CO2	Students will be able to solve data analysis, management and visualization issues using MS-Office products									
CO3	Students will be able to efficiently and ethically use Social Media and e-commerce sites.									
CO4	Students will have introduction to various utility software used in research and information management.									
Unit-No.	Content									
I	<b>Fundamentals of Computer Systems, Office Automation and Internet Search</b> i. Components of a Computer and their functions. ii. Office Automation using MS-Word, MS-Excel, and MS-PowerPoint. iii. Data management, Statistical Data Analysis and Data Visualization with MS-Excel. iv. Use of Functions, Graphs & Charts in MS-Excel.									
II	<b>Internet &amp; Cyber World</b> i. Introduction to Computer Networks, Internet and World Wide Web, Websites and Web portals.									

	<ul style="list-style-type: none"> <li>ii. Creation and use of Email Accounts.</li> <li>iii. Web browsing, Web Searching, Different aspects of Web Searching- Search Keywords, conditions and combinations.</li> <li>iv. Study of different Search Engines like Google, Microsoft Bing, Yahoo, Yandex, DuckDuckGo, Ask. Cometc.</li> <li>v. Cyber Crimes, Cyber Laws and IT Act 2000, India.</li> </ul>
<b>III</b>	<p><b>Introduction to Social Media and E-Commerce</b></p> <ul style="list-style-type: none"> <li>i. Relevance of Social Media in present scenario. Posting different types of contents in Social Media.</li> <li>ii. Creating accounts and using some popular Social media portals and Apps like WhatsApp, Facebook, etc. Social Media Etiquettes &amp; Crimes.</li> <li>iii. Definition of E-Commerce; E-Commerce versus traditional Commerce.</li> <li>iv. Case studies of popular E-Commerce portals like Amazon.</li> <li>v. E-commerce Etiquettes &amp; Crimes.</li> </ul>
<b>IV</b>	<p><b>Digital Payments and Digital Transactions</b></p> <ul style="list-style-type: none"> <li>i. Introduction to Digital Payment Systems.</li> <li>ii. Creating accounts and using Digital Payment Systems like Credit Cards, Debit Cards, Netbanking, UPI.</li> </ul> <p>Digital payments Etiquettes &amp; Crimes.</p>
<b>V</b>	<p><b>Basic Accounting and Utility Software</b></p> <ul style="list-style-type: none"> <li>i. Introduction to Basic accounting concepts, Introduction to an Accounting Software like GnuCash or Tally.</li> <li>ii. Introduction to Technical Document writing using LaTeX.</li> <li>iii. Introduction to Data Visualization software – Sigma, Google Charts, Tableau</li> </ul>

#### Text books

- T1: Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems & Applications. 3rd ed. New Delhi: BPB Publications.
- T2: Goel, A, 2010. Computer Fundamentals, Pearson India.

#### Reference books

- R1: Balaguruswamy, E. 2009 Fundamentals of Computers, Tata McGraw-Hill Education.
- R2: Balaguruswamy, 2014. E. Fund Of Comp & Programming (Updated Ed Sem. I, Au) Tata McGraw-Hill Education.
- R3: Lawson, C. 2022. Introduction to Social Media, Oklahoma State University.

#### Other learning resources:

- <https://www.w3schools.com>
- <https://edu.gcfglobal.org>
- <https://www.tutorialspoint.com>
- <https://www.javatpoint.com>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain computer systems and Internet search fundamentals.	1
2	Describe data analysis and visualization problems with MS Office.	1, 3
3	Illustrate social media and e-commerce sites efficiently and ethically.	5
4	Discuss about utility software for research and information management.	2, 5

5	Explain software tools for research and data management.	2, 5
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SEMESTER – II									
Course Title	MOOCS-II								
Course code	22MSCE121R	Total credits: 2	L	T	P	S	R	O/F	C
			0	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course objectives	As per the course opted.								
Course outcomes	As per the course opted.								
Course description	As per the online material available								

Teaching Objective	As per the course opted
Learning Outcomes/Course Outcome	As per the course opted

**Course content:**

As per the online material available.

**Reference:**

[https://www.coursera.org/programs/assam-downtown-university-on-coursera\\_rzqtn?currentTab=CATALOG](https://www.coursera.org/programs/assam-downtown-university-on-coursera_rzqtn?currentTab=CATALOG)

SEMESTER – III									
Course Title	MOOCS-III								
Course code	22MSCE211R	Total credits: 2	L	T	P	S	R	O/F	C
			0	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Botany								
Semester	Fall/ III Semester of 2 <sup>nd</sup> year of the program								
Course objectives	As per the course opted.								
Course outcomes	As per the course opted.								
Course description	As per the online material available								

Teaching Objective	As per the course opted
Learning Outcomes/Course Outcome	As per the course opted

**Course content:**

As per the online material available.

**Reference:**

[https://www.coursera.org/programs/assam-downtown-university-on-coursera\\_rzqtn?currentTab=CATALOG](https://www.coursera.org/programs/assam-downtown-university-on-coursera_rzqtn?currentTab=CATALOG)

SEMESTER – III									
Course Title	MOOCS-IV								
Course code	22MSCE212R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours:	0	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Botany								
Semester	Fall/ III Semester of 2 <sup>nd</sup> year of the program								
Course objectives	As per the course opted.								
Course outcomes	As per the course opted.								
Course description	As per the online material available								

Teaching Objective	As per the course opted
Learning Outcomes/Course Outcome	As per the course opted

**Course content:**

As per the online material available.

**Reference:**

[https://www.coursera.org/programs/assam-downtown-university-on-coursera\\_rzqtn?currentTab=CATALOG](https://www.coursera.org/programs/assam-downtown-university-on-coursera_rzqtn?currentTab=CATALOG)

Semester III									
Course title	Techno-Professional Skills II (Biofertilizer production)								
Course code	22MSBT211R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 60P	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	NA						
Programme	MSc. Botany								
Semester	Fall/ III Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	1. Appreciate the agronomic importance of beneficial micro-organisms. 2. Formulate, produce and apply Biofertilizers in a pilot scale.								
CO1	Isolate nitrogen-fixing, phosphate-solubilizing bacteria, and mycorrhizal fungi cultures.								
CO2	Apply biofertilizers effectively in paddy fields, agriculture, and floriculture applications.								
CO3	Gain practical skills in commercial biofertilizer production through industry visits.								
Unit no	Content	CH	Learning outcome						KL
I	Isolation of pure culture of Nitrogen fixing, Phosphate solubilizing bacteria and mycohrizal fungi	10	Isolate pure cultures of nitrogen-fixing bacteria, phosphate-solubilizing bacteria, and mycorrhizal fungi.						1,2
II	Application of biofertilizer on paddy field, agricultural land and floriculture.	10	Apply biofertilizers in paddy fields, agriculture, and floriculture effectively.						1,2
III	Hand on training on commercial production of biofertilizer (industry visit)	10	Learn commercial biofertilizer production techniques through hands-on industry training visits.						1,2



### Text Books

T1: A text book of microbiology, second reprint. S. Chand and Company Ltd., New Delhi. Ann Larkin Hansen 2010,

### Reference Books

R1. Kannaiyan, S. 2002 Biotechnology of Biofertilizers. Narosa publishing house, New Delhi. Dubey, R.C. 2001.

R2. Dubey, R. C. 2008. A Textbook of Biotechnology. S. Chand & Co., New Delhi.

### Other learning resources:

<https://www.sciencedirect.com/science/article/pii/S2666517421000742>

<https://www.sciencedirect.com/topics/earth-and-planetary-sciences/biofertilizer>

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES5

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain the Importance of biofertilizers in plant development.	1, 2, 8
2	Describe mass cultivation and inoculation.	1, 2, 3
3	Explain the importance of Azolla as a biofertilizers.	1, 2, 8
4	Describe the importance of phosphate in biofertilizers.	1, 2, 8
5	Apply the knowledge on the use of Fungi and Mycorrhiza.	1, 8

SEMESTER – III									
Course Title	Open elective (Coursera)								
Course code	22MSBO217R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours:	0	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programmes	Master of Science in Botany								
Semester	Fall/ III Semester of 2 <sup>nd</sup> year of the program								
Course objectives	As per the course opted.								
Course outcomes	As per the course opted.								
Course description	As per the online material available								

Teaching Objective	As per the course opted
Learning Outcomes/Course Outcome	As per the course opted

### Course content:

As per the online material available.

### Reference:

[https://www.coursera.org/programs/assam-downtown-university-on-coursera\\_rzqtn?currentTab=CATALOG](https://www.coursera.org/programs/assam-downtown-university-on-coursera_rzqtn?currentTab=CATALOG)

Semester-III	
Course title	Research Ethics

<b>Course code</b>	22UMRE211R	<b>Total credits: 1</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
			<b>Total hours: 2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Pre-requisite</b>	NA	<b>Co-requisite</b>	NA						
<b>programme</b>	MSc. Botany								
<b>Semester</b>	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
<b>Course Objectives</b>	This course aims to lay a foundation for empirical research and make students aware of relevant guidelines, policies, and codes relating to ethical research, as well as to provide, via a study of ethical theories, concepts.								
<b>CO1</b>	To be able to describe and apply theories and methods in ethics and research ethics								
<b>CO2</b>	To acquire an overview of important issues in research ethics, like responsibility for research, ethical vetting, and scientific misconduct.								
<b>CO3</b>	To acquire skills of presenting arguments and results of ethical inquiries.								
<b>CO4</b>	To be able to Identify the concepts and procedures of sampling, data collection, analysis and reporting								
<b>Unit no</b>	<b>Content</b>								
<b>I</b>	<b>ETHICS:</b> Introduction to the course and each other; an introduction to moral theory. Ethics: definition, moral philosophy, nature of moral judgements and reactions. Research regulation; self – regulation; research ethics. Honesty, candor, compromise and integrity. Data ownership and stewardship; conflicts of interest; collaboration. Human and non-human subjects. Research and researchers in society.								
<b>II</b>	<b>SCIENTIFIC CONDUCT-</b> Ethics with respect to science and research. Intellectual honesty and research integrity. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP). Redundant publications: duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data								
<b>III</b>	<b>PUBLICATION ETHICS-</b> Publication ethics: definition, introduction and importance. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types. Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals.								
<b>IV</b>	<b>OPEN ACCESS PUBLISHING-</b> Open access publications and initiatives. SHERPA/RoME0 online resource to check publisher copyright & self-archiving policies. Software tool to identify predatory publications developed by SPPU. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.								
<b>V</b>	<b>PUBLICATION MISCONDUCT</b> Group Discussions; Subject specific ethical issues, FFP, authorship. Conflicts of interest. Complaints and appeals: examples and fraud from India and abroad. Software tools; Use of plagiarism software like Turnitin, Urkund and other open-source software tools. <b>DATABASES AND RESEARCH METRICS</b> –Databases: Indexing databases. Citation databases: Web of Science, Scopus, etc. Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score. Metrics: h-index, g index, I 10 indexes, altmetrics.								

#### Text Books

T1. Bird, A (2006). Philosophy of Science. Routledge.

T2. MacIntyre, Alasdair (1967) A Short History of Ethics. London.

T3. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019)

#### Reference Books

R1. National Academy of Science, National Academy of Engineering and Institute of Medicine (2009). On Being a Scientist: A Guide of Responsible Conduct in Research: Third Edition, National academics Press

R2. George R, (2011). Sociological Theory, Rawat Publication, New Delhi, India. George R, (2019). PostModernSocialTheory, Rawat Publication, New Delhi, India.

#### Other learning resources:

[https://researcheracademy.elsevier.com/uploads/2018-02/ethics\\_a5\\_booklet\\_update260617\\_web.pdf](https://researcheracademy.elsevier.com/uploads/2018-02/ethics_a5_booklet_update260617_web.pdf)

<https://researcheracademy.elsevier.com/publication-process/ethics>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe and apply research ethics theories and methods.	6
2	Explain research ethics issues such as responsibility, vetting, and misconduct.	6
3	Illustrate arguments and results in ethical research inquiries.	5, 6
4	Identify and apply procedures for sampling, data collection, and reporting.	2, 3, 4
5	Apply ethical principles to research design and evaluation	4,8

Semester- III									
Course title	Personal financial planning								
Course code	22UUFL202R	Total credits: 1	L	T	P	S	R	O	C
		Total hours: 2	0	0	2	0	0	0	1
Pre-requisite	22UUFL201R Introduction to Financial Budgeting And Planning	Co-requisite	Nil						
Programmes	Bachelor of Business Administration/Bachelor of Hotel Management and Catering Technology/Bachelor of Business Administration (I)/Bachelor of Business Administration (Industry Integrated)/Bachelor of Social Work/Bachelor of Arts in Sociology/Bachelor of Master of Science in Botany								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	1. The course would offer an inclusive approach to understand the relevant concepts of money, borrowing, lending, taxes and their application to financial planning. 2. Assess the personal financial planning process, the life cycle of financial plans, and methods of goal achievement. 3. Formulate a budget, record-keeping system, and tax planning strategy based on current financial goals.								
CO1	Explain the cash management and buying plan for homes or automobiles.								
CO2	Discuss a diversified investment portfolio for different objectives.								
CO3	Compare mutual funds, ETFs, and real estate investment options.								
CO4	Develop a financial plan for retirement and estate protection.								
CO5	Describe financial products and strategies for long-term goals								
Unit no	Content								
I	Unit 1- Fundamentals of Financial Planning – i. Functions of money; ii. Inflation- Meaning, causes, how it can be controlled; iii. process official planning ,								

	<ul style="list-style-type: none"> <li>iv. Time value of money-simple and compound interest;</li> <li>v. Net Present Value and Future value,</li> <li>vi. Power of Compounding;</li> <li>vii. Doubling period and Rule of 72.</li> </ul>
<b>II</b>	<p><b>Unit 2- Income Tax Planning–</b></p> <ul style="list-style-type: none"> <li>i. Meaning of Income,</li> <li>ii. Direct &amp; Indirect Taxes, Taxable Income, various heads of Income for tax Calculation,</li> <li>iii. Non-taxable Income,</li> <li>iv. Tax evasion and tax avoidance,</li> <li>v. GST, Tax Planning Strategies.</li> </ul>
<b>III</b>	<p><b>Unit 3- Entrepreneurial planning –</b></p> <ul style="list-style-type: none"> <li>i. Meaning of Entrepreneurship, prerequisites for becoming an entrepreneur,</li> <li>ii. Entrepreneurship Support Systems in India,</li> <li>iii. Institutional support systems for entrepreneurs,</li> <li>iv. Financial support systems for entrepreneurs;</li> <li>v. Venture Capital, Business Angels,</li> <li>vi. Assistant of Government,</li> <li>vii. Commercial Bank Loans and Overdraft.</li> </ul>
<b>IV</b>	<p><b>Unit 4-Planning for investing in securities market –</b></p> <ul style="list-style-type: none"> <li>i. Investment avenues offered by Securities Markets,. Primary Market and Secondary Market,</li> <li>ii. Stock market- meaning, features, functions of NSE,BSE DEMAT trading account,</li> <li>iii. Security repository, stock brokers, Operational aspects of securities markets: placement of orders, contract note, pay-in and pay-out, trading and settlement cycle,</li> <li>iv. Various risks involved in investing in securities markets; Role of Financial Intermediaries; Stock indices.</li> <li>v. Mutual Funds- meaning concept, definition, types, importance and drawbacks of mutual funds, mutual funds in India, investing in mutual funds,</li> <li>vi. Systematic Investment Plan (SIP) and its advantages.</li> </ul>
<b>V</b>	<p><b>Unit 5- Planning for debts and Retirement</b></p> <ul style="list-style-type: none"> <li>i. Consumer credit - Introduction to consumer credit; choosing a source of credit, the cost of credit alternatives,</li> <li>ii. Consumer Legal Protection;</li> <li>iii. Housing Decision: Factors and Finance; Vehicle Decisions.</li> <li>iv. Retirement planning - Meaning of cost of living; retirement need analysis; development of retirement plan, various retirement schemes,</li> <li>v. Estate Planning; Pension and Medicare Planning; Wills.</li> </ul>

**Text Books:**

1. Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems &The Million-Dollar Financial Advisor: Powerful Lessons and Proven Strategies from Top Producers by David J. Mullen Jr

2. Personal Finance and Planning by Dr. Rajni
3. Peaceful Personal Finance: A Short Read on the Basics of Personal Finance and Planning Kindle Edition by Hema Singh
4. Be Your Own Financial Advisor: Financial Planning, Investment Options, Risk Management, Tax Management, Succession Planning Kindle Edition y Sushil Bali
5. The Dumb Things Smart People Do with Their Money: Thirteen Ways to Right Your Financial Wrongs Kindle Edition y Jill Schlesinger

**Other learning resources:**

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain the cash management and buying plan for homes or automobiles.	5
2	Discuss a diversified investment portfolio for different objectives.	9
3	Compare mutual funds, ETFs, and real estate investment options.	2, 5, 9
4	Develop a financial plan for retirement and estate protection.	9
5	Describe financial products and strategies for long-term goals	5

Semester- III									
Course title	Corporate proficiency								
Course code	22UMPD211R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 4	0	0	4	0	0	0	2
Pre-requisite	22UMPD121R Communication Mastery	Co-requisite	NA						
Programmes	MSc. Botany								
Semester	Fall/ 3 <sup>rd</sup> Semester of 2 <sup>nd</sup> year of the program								
Course Objectives	<ol style="list-style-type: none"> <li>1. To acquaint students with the various tools of an effective presentation.</li> <li>2. To acquire the speaking skill, instruct, influence, engage, educate, or appease the listeners.</li> <li>3. To increase proficiency, present ability and quality of resume and provide guidance for self- promotion and self-evaluation in social media.</li> <li>4. To prepare and train the students for the campus drives &amp; walking interviews.</li> </ol>								
CO1	It will prepare the learners to speak with greater control and charisma in front of others.								
CO2	It will have a positive impact in their thought process and problem-solving skills.								
CO3	It will arm the students with all the necessary tools and skill sets to prepare professional resume.								
CO4	They will learn to highlight and assess themselves in social media.								
CO5	It will impart in them techniques to solve critical problems in an interview, develop								

strategies to crack interviews, improve their communication skills, boost their confidence	
Unit no	Content
I	<p><b>Module 1- Presentation Skills</b></p> <p>i. Introduction</p> <p>ii. Essential characteristics of a good presentation</p> <p>iii. Preparation of a good presentation</p>
II	<p><b>Module 2- Public Skills</b></p> <p>i. Fear of Public Speaking,</p> <p>ii. Understanding and Overcoming Fear of Public Speaking,</p> <p>iii. Confidence and Control,</p> <p>iv. Physiology and Stress - Control/Process,</p> <p>v. Tips for Presentations and Public Speaking,</p> <p>vi. Tips for Using Visual Aids in Presentations,</p> <p>vii. Process for Preparing and Creating Presentations,</p> <p>viii. Delivering Presentations Successfully,</p> <p>ix. Doubt Clearing and Summary of Main Points</p>
III	<p><b>Module 3- Practical session on Resume, Curriculum Vitae, Writing cover letter &amp; LinkedIn Profile</b></p> <p>i. Preparation, submission &amp; screening of Resume.</p> <p>ii. Practical session on cover letter screening session</p> <p>iii. Creating a profile on LinkedIn</p> <p>iv. How to utilize it</p> <p><b>Module 4- Leadership &amp; Management Skills</b></p> <p>i. Concepts of Leadership,</p> <p>ii. Leadership Styles,</p> <p>iii. Manager VS Leader,</p> <p>iv. How to be an Effective Leader,</p> <p>v. Mock/ Practice Session,</p> <p>vi. Doubt Clearing Session.</p>
IV	<p><b>Module 5- Research Paper – Writing Skills</b></p> <p>i. How to write a research paper</p> <p>ii. Key point in Research Work</p> <p><b>Module 6- Interview Skills &amp; Dress code Ethics</b></p> <p>i. Types of the interview- telephonic, virtual &amp; face to face</p> <p>ii. Online interview, personal interview,</p> <p>iii. Panel interview,</p> <p>iv. Group interview,</p> <p>v. JAM session,</p> <p>vi. Types of interview questions-traditional/common interview questions,</p> <p>vii. Case interview questions,</p> <p>viii. General Strategies for answering questions,</p> <p>ix. Marketing your skills and experiences,</p> <p>x. Preparation before the interview,</p> <p>xi. How to dress up for an interview,</p> <p>xii. How to maintain eye contact and positive body language,</p> <p>xiii. How to be presentable,</p> <p>xiv. Interview dos and don'ts,</p> <p>xv. Introduction to Dress Code Ethics,</p> <p>xvi. Purpose and Importance</p> <p>xvii. How to Make „FIRSTIMPRESSION“</p> <p>xviii. What to Wear During Interviews or Any Other Formal Meetings – Male &amp;Female</p>
V	<p><b>Module 7- Mock Interview</b></p> <p>i. Practical Mock Interview,</p>

	ii. Feedback- Receiving Feedback, iii. Giving Feedback, iv. Advantages of Effective Feedback, v. How to deal with negative feedback.
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**Text Books**

T1. Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

T2. McDowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition).

**Reference Books**

R1. Garg, Manoj Kr. (2018) English Communication: Theory and Practice

**Other Learning Resources:**

<https://brightlinkprep.com/10-best-toefl-prep-books/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	It will prepare the learners to speak with greater control and charisma in front of others.	5
2	It will have a positive impact in their thought process and problem-solving skills.	2
3	It will arm the students with all the necessary tools and skill sets to prepare professional resume.	5
4	They will learn to highlight and assess themselves in social media.	5
5	It will impart in them techniques to solve critical problems in an interview, develop strategies to crack interviews, improve their communication skills, boost their confidence	5, 6, 8

<b>Course Title</b>	<b>Mini Research (Survey/experiments-R3)</b>								
<b>Course code</b>	<b>22MSBO125R</b>	<b>Total credits: 2</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/f</b>	<b>C</b>
			<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>1</b>	<b>0</b>	<b>4</b>
		<b>Total hours: 30</b>					<b>2</b>		
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Master of Science in Botany</b>								
<b>Semester</b>	<b>Winter/II semester of First year of the programme</b>								
<b>Course objectives</b>	1.To determine whether the objectives of review of literature gap analysis have been met, if not what steps can be taken accordingly.								
<b>CO1</b>	Create and implement a plan to bridge the gap								
<b>CO2</b>	Find the gap and evaluate solutions.								
<b>CO3</b>	Identify the ideal future state/action plan								
<b>CO4</b>	To analyse the current state/work of research								
<b>CO5</b>	To implement the strategies to meet the research gap under supervision.								

**Text books**

SEMESTER – III										
Course Title	Floral morphology, Embryology and Palynology									
Course code	<b>22MSBO213R</b>	Total credits: 4	L	T	P	S	R	O/F	C	
		<b>Total hours: 45T+30P</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>							
<b>Programme</b>	<b>Master of Science in Botany</b>									
<b>Semester</b>	<b>Fall/ III semester of second year of the programme</b>									

<b>Course Objectives</b>	1. To understand the origin and evolution of different parts of flowering plants. 2. Knowledge on developmental biology. 3. Understand the pollen structure and its application.			
<b>CO1</b>	Describe the morphology of a flower, including advanced and primitive structures, and explain flower development stages.			
<b>CO2</b>	Explain the structure and function of microsporangium, megasporangium, pollen development (microsporogenesis), and sporogenesis.			
<b>CO3</b>	Describe endosperm types, the relationship between endosperm and embryo, and explain embryo culture techniques.			
<b>CO4</b>	Explain the applications of tissue culture techniques in plants, including micropropagation, genetic modification, somatic embryogenesis, disease eradication, and conservation.			
<b>CO5</b>	Describe palynology, including pollen and spore morphology, chemistry, and techniques for analyzing pollen and spore morphology using microscopy and staining methods.			
<b>Unit-No.</b>	<b>Content</b>	<b>CH</b>	<b>Learning Outcome</b>	<b>KL</b>
<b>I</b>	<b>Flower-</b> Morphology of flower, inflorescence. Primitive and Advanced structure of stamen and carpel, homologies of Development of flower. – evolution of flower and pollinator, Staminodia, Nectaris.	10	Able to describe and explain about the flower and its development.	1,2
<b>II</b>	<b>Microsporangium</b> –Structure and function of wall layers, Microsporogenesis, role of Callose and tapetum in pollen development, Pollen wall morphogenesis, Microspore/pollen mitosis, Division of generative cells, heterogeneity in sperms, Pollen fertility and male sterility, Pollen storage and germination.	8	Knowledge about microsporangia and megasporangia.	1,2
<b>III</b>	<b>Post-fertilization changes in embryosac-</b> Endosperm types and their development, Endosperm haustoria and their function, Embryogenesis in Monocot and dicot angiosperms, Structure, Cytology and function of suspensor, Physiological and Morphogenetical relationship of endosperm and embryo, Embryo culture.	10	Able to describe and explain about the post fertilization changes takes place in embryosac.	1,2
<b>IV</b>	<b>Plant Tissue culture:</b> History, Basic aspects of plant tissue culture, Types of plant tissue culture, and Methods of Sterilisation, Nutrient Medium (MS and White), Explant, Types of explants, Cellular Totipotency, Differentiation, Morphogenesis Organogenesis, Somatic Embryogenesis, Micropropagation, e.g., Banana,	10	Able to describe and explain about the different tissue cultural techniques.	1,2
<b>V</b>	<b>Palynology-</b> Branches of palynology. Spore, pollen morphology, Wall chemistry, exine ornamentation, Evolution of aperture types, Application of neopalynology and	7	To understand the pollen and its applications.	1,2



	palaeopalynology. Aeropalynology and pollen Allergy, melissopalynology.			
<b>Practica I</b>	1. Study of types of ovules and anther and stages of embryo (Globular type and heart shaped) 2. Micropropagation of important crops through tissue culture technique. 3. Study of pollen grains through Acetolysis technique	30	Able to explain and demonstrate, flower analysis and embryological and palynological study.	1,2,3,4

**Text Books**

T1. Shivanna KR and Johri BM (1985) The Angiosperm Pollen: Structure and Function. New Delhi, India: Wiley-Eastern.

T2. Introduction to Embryology: P. Maheswari.

**Reference Books**

R1. Studies in Botany (Vol-I), J.N.Mitra, D. Mitra and S.K.Chowdhuri, Moulik publishing, Kolkata.

R2. Bhojwani and Bhatnagar. Embryology of Angiosperms.

**Other Learning Resources:**

<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/embryo-plant>

<https://www.sciencedirect.com/journal/review-of-palaeobotany-and-palynology>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe the morphology of a flower, including advanced and primitive structures, and explain flower development stages.	1,2,3
2	Explain the structure and function of microsporangium, megasporangium, pollen development (microsporogenesis), and sporogenesis.	1,3,6
3	Describe endosperm types, the relationship between endosperm and embryo, and explain embryo culture techniques.	1,2,4
4	Explain the applications of tissue culture techniques in plants, including micropropagation, genetic modification, somatic embryogenesis, disease eradication, and conservation.	1,3,7
5	Describe palynology, including pollen and spore morphology, chemistry, and techniques for analyzing pollen and spore morphology using microscopy and staining methods.	1,3,4

SEMESTER – III									
Course Title	Economic botany, ethnobotany and pharmacognosy								
Course code	22MSBO214R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4

<b>Pre-requisite</b>	Nil	<b>Co-requisite</b>	Nil	
<b>Programme</b>	<b>Master of Science in Botany</b>			
<b>Semester</b>	<b>Fall/ III semester of second year of the programme</b>			
<b>Course Objectives</b>	1. To give knowledge about the different aspects of economic botany. 2. To uplift the knowledge of the students about the conventional use of medicinal plant. 3. To give knowledge to the students about development of new drugs for safe and morerational use of herbal preparations.			
<b>CO1</b>	Students can able to know the economically used plants.			
<b>CO2</b>	Describe and classify the economically important plants according to their use.			
<b>CO3</b>	Documentation of Ethnobotanically used plants along with the type of use.			
<b>CO4</b>	Understand the need for development of new drugs for safe and more rational use of herbal preparations.			
<b>CO5</b>	Develop laboratory skill in testing of herbal drugs and new commercial products.			
<b>Unit-No.</b>	<b>Content</b>	<b>CH</b>	<b>Learning Outcome</b>	<b>K L</b>
<b>I</b>	<b>Introduction to Economic Botany:</b> Different aspects of economic botany, Role of plants in relation to human welfare, Importance of forestry, their Utilization and commercial aspects, Centre of origin of cultivated plants Indian centre of wild plant genetic resources. Botany and uses of fodder and aromatic plants, Ornamental plants, Alcoholic beverage, Plants used for pollution control: Methods of control and examples. Mineral indicating plants.	10	Able to describe and explain about the economically important plants and their utility.	1, 2
<b>II</b>	<b>Classification of Economic Plants:</b> Classification of economically important plants, Cereals and Millets, Pulses and Legumes, Vegetables, Fruits, Beverage-yielding plants, Drug- yielding plants, Narcotic- yielding plants, Fiber-yielding plants, Timber-yielding plants and Bamboos, Rubber-yielding plants, Oil-yielding plants, Sugar-yielding plants, Mushroom cultivation etc.	8	Knowledge about economic plants' groups.	1, 2
<b>III</b>	<b>Ethnobotany:</b> Introduction to Ethnobotany, Different branches of Ethnobotany, Importance and Impact of Ethnobotany in herbal-medicine industry, Role of ethnomedicine and its scope in modern times, Role of Ethnobotany in conservation and sustainable development, Centres of Ethno botanical studies in India, Use of some ethnomedicinal plants by the ethnic communities of North East India.	10	Able to describe and explain about the role and scope of ethnobotany.	1, 2

	Wild and edible mushrooms of North-East India.			
IV	<b>Pharmacognosy:</b> Pharmacognosy and its importance, History of Pharmacognosy, Pharmaceutical Aids, pharmacologically active constituents: Carbohydrates, Proteins, Enzymes, Fixed oil, Fats and Waxes- Lipids, Volatile oils, Alkaloids, Resins, Tannins, Glycosides, Antibiotics etc, Adulteration, drug evaluation and pharmacopoeial standards.	10	Able to describe and explain about the different active constituents of drugs derived from plants.	1, 2
V	<b>Classification of Drugs:</b> Systems of classification of drugs from natural origin, Types of Plant drug and their Pharmacognostic study a) Rhizome and Root drugs: <i>Cyperus rotundus</i> , <i>Ipecac</i> , <i>Rauvolfia</i> , <i>Satavari</i> , <i>Withania</i> Ginger, <i>Turmeric</i> etc c) Leaf drugs: <i>Datura</i> , <i>Senna</i> , <i>Azadirachta</i> , <i>Andrographis</i> <i>Clitoria</i> etc d) Bark drugs: <i>Terminalia arjuna</i> , <i>Cinnamon</i> , <i>Cinchona</i> , <i>Holorrhena</i> e) Flower drugs: <i>Saffron</i> f) Seed drugs: <i>Black piper</i> , <i>Mucuna</i> g) Fruit drugs: <i>Cumin</i> , <i>Coriandrum</i> , <i>Amla</i> etc ) Whole plant drugs: <i>Catheranthus roseus</i> .	7	To understand development of drugs from plants.	1, 2
Practical I	1. Morphological and anatomical studies on economically important plants/ parts of Rice, Jute, <i>Rauvolfia</i> , <i>Ocimum</i> , Tea, Sugarcane. 2. Organoleptic and microscopic evaluation of the following drug plants: <i>Datura</i> / <i>Senna</i> / <i>Azadirachta</i> (Leaf drug) <i>Zingiber</i> / <i>Cyperus rotundus</i> (Rhizome & Root drug) <i>Coriandrum</i> / <i>Trachyspermum</i> / <i>Foeniculum</i> / <i>Cuminum</i> (Fruit drug) <i>Cinnamon</i> / <i>Cinchona</i> (Bark drug)	30	Able to explain and demonstrate, different economically important plant parts and pollens.	1, 2, 3, 4

#### Text Books

T1. Text book of Economic Botany, Sunidhi Miglani.

#### Reference Books

R1. Economic Botany, B. P. Pandey, S Chand.

R2. Bruneton J., 1999. Pharmacognosy, Phytochemistry, Medicinal Plants, Intercept Ltd., Paris. 2. Dewick P.M., 2002. Medicinal Natural Products: A biosynthetic approach, John Wiley & Sons Ltd.

R3. Pharmacognosy, J.S. Qadry.

#### Other Learning Resources:

<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/economic-botany>  
<https://link.springer.com/journal/12231>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

#### CO PO Mapping

SN	Course Outcome (CO)	Mapped Program Outcome
1	Students can able to know the economically used plants.	1,2
2	Describe and classify the economically important plants according to their use.	1,3,6
3	Documentation of Ethnobotanically used plants along with the type of use.	1,4
4	Understand the need for development of new drugs for safe and more rational use ofherbal preparations.	1,3
5	Develop laboratory skill in testing of herbal drugs and new commercial products.	1,3

SEMESTER – III									
Course Title	Plant molecular biology and biotechnology								
Course code	22MSBO215R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Fall/ III semester of second year of the programme								
Course Objectives	1. To introduce to rapid contemporary changes witnessed in plant molecular biology. 2. To define large-scale, systems-level, and high-throughput datasets to derive novel biological insights that are difficult to gain using other methods. 3. To give students the knowledge about DNA-based technology for a wide range of novel infectious disease diagnostic techniques.								
CO1	Describe DNA structure, replication, and sequencing principles.								
CO2	Describe RNA structures, synthesis, processing including small RNAs.								
CO3	Explain hormones, receptors, signalling, chemotaxis.								
CO4	Explain the application of genetic engineering.								
CO5	Describe the process of creation of genetically engineered plants.								
Unit-No.	Content	CH	Learning Outcome					K L	
I	Structure of DNA, forms and function, DNA topology, DNA - Protein Interactions, DNA replication, formation of leading and lagging strands, DNA topo isomerase, polymerases & DNA ligase, Principles of DNA sequencing.	10	Able to describe and explain about structure of DNA and its functions.					1, 2	
II	Structure of RNA, Synthesis and processing of genetic and non-genetic RNA, mRNA, tRNA, rRNA, RNA synthesis and Processing, RNA Splicing, Capping and Polyadenylation of mRNA, small RNAs.	8	Able to describe and explain about structure of RNA and its functions.					1, 2	
III	Hormones and their receptors, Cell surface receptors, signaling through G-protein coupled receptors, Signal transduction pathways, regulation of signaling pathways, Bacterial chemotaxis, genome analysis, genetic mapping, Molecular systematics and diagnosis, Autogenous regulation of ribosomal protein	10	Able to describe and explain about the role of hormones in signal transduction.					1, 2	

	synthesis. protein sorting and intracellular trafficking, post translational modifications,			
<b>IV</b>	Genetic engineering principles, cloning vectors, enzymes involved in rDNA technology, transformations, intellectual property rights, and legal and biosafety issues associated to GMOs. The use of DNA markers in genetic diversity research, genome analysis, genetic mapping, molecular diagnostics, and diagnosis. Human Genome Project.	10	Knowledge of genetic engineering.	1, 2
<b>V</b>	Genetically engineered plants, Chimeric DNA, DNA probes and Genomic/ cDNA libraries, chloroplast engineering, and transplastomic plants. Techniques for identification of diseased gene and insertion into host cell.	7	To understand Concepts of genetically engineered plants.	1, 2
<b>Practical I</b>	1. DNA isolation, quantification and electrophoresis. 2. RNA isolation, quantification and electrophoresis. 3. PCR reaction and gel electrophoresis. 4. Protein isolation and gel electrophoresis. 5. Restriction digestion and mapping.	30	Able to explain and demonstrate, different techniques of biotechnology.	1, 2, 3, 4

#### Text Books

- T1. Elements of Biotechnology- P.K Gupta, Rastogi Publication.  
T2. Biotechnology and Genomics- P.K Gupta, Rastogi Publications.  
T3. Lab Manual on Biotechnology- P. M. Swamy, Rastogi Publications

#### Reference Books

- R1. B. M. Turner, Chromatin & Gene regulation, 1st Edition, Wiley-Blackwell, 2002.  
R2. Benjamin Lewin, Gene IX, 9th Edition, Jones and Barlett Publishers, 2007.  
R3. Lodish et al., Molecular cell Biology, 4th Edition, W.H. Freeman & Company, 2000.  
R4. The Cell: A Molecular Approach by Geoffrey M. Cooper, Robert E. Hausman.  
R5. Molecular Cell Biology by Lodish H., Berk A, Kaiser C., KReiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P.

#### Other Learning Resources:

- <https://link.springer.com/journal/11103>  
<https://www.sciencedirect.com/journal/molecular-plant>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe DNA structure, replication, and sequencing principles.	1,2,7
2	Describe RNA structures, synthesis, processing including small RNAs.	1,3,6
3	Explain hormones, receptors, signalling, chemotaxis.	1,2,4
4	Explain the application of genetic engineering.	1,3,7

5	Describe the process of creation of genetically engineered plants.	1,3,4
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SEMESTER – III									
Course Title	Plant anatomy, microtechniques and evolution								
Course code	22MSBO216R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Fall/ III semester of second year of the programme								
Course Objectives	1. The course deals with the structural and functional development of cells and tissues. 2. To make learner understand about the concept of normal and anomalous secondary growth in dicots and monocots. 3. To impart concept of microtechniques and evolution.								
CO1	Describe meristems, vascular cambium, their types and factors affecting cambial activity.								
CO2	Explain vascular tissues its origin, structure, development, and ontogeny, compare reaction wood, distinctions between heartwood and sapwood, and identify and classify the plant specimen by assessing their anomalous secondary growth.								
CO3	Describe leaf ontogeny, vascular tissue development, and calculate plastochronic index, and describe transfer cells, floral anatomy, and explain its role in classification.								
CO4	Prepare specimens using microtome, maceration, squash, and clearing techniques, and assess.								
CO5	Explain the theories of evolution.								
Unit-No.	Content	CH	Learning Outcome				K L		
I	Meristems – characters, classification and theories – Apical cell theory, Tunica – Corpus theory and Korper -Kappe concept. Vascular Cambium – Types, divisions, arrangement and seasonal activity, Factors affecting cambial activity	10	Able to describe and explain about plant cell structure and functions.				1, 2		
II	Origin, Structure, development and ontogeny of xylem and phloem. Reaction wood – structure and properties. Heart wood and sap wood-strength, ability, grains, texture and defects. Anomalous secondary growth in Dicots and Monocots.	8	Able to describe and explain about structure of conducting tissues in plants.				1, 2		
III	Leaf ontogeny – initiation, apical, intercalary, marginal and axial growth, plate meristem and development of vascular tissues plastochronic index. Transfer cells –Structure, development and functions. Classical concept of flower; Floral anatomy and its role in classification. Plant galls; Types	10	Knowledge of leaf and floral anatomy of plants.				1, 2		
IV	Maceration, squash and clearing techniques. Sample preparation for light microscopy. Classification of fixatives, formulas, Sample	10	Able to describe and explain about the Macerati on, squash and clearing techniques.				1, 2		

	preparation for light microscopy: Fixation, dehydration and infiltration procedures. Microtomes: Rotary, sliding, cryostat.			
<b>V</b>	Organic evolution, Darwinism, Lamark theory, Neo Darwinism.	7	To understand Concepts of evolution in plants.	1, 2
<b>Practical I</b>	1. Study of anomalous secondary growth of selective families of Angiosperms. 2. Preparation of microtome block, Preparation of permanent slides by the process of microtome technique	30	Able to explain and demonstrate, different techniques of anatomy and micro technique.	1, 2, 3, 4

#### Text Books

- T1. Cutler, D.F. 1978, Applied plant Anatomy, Orient Longman Publishers, New Delhi.  
T2. Easu, 1987. The Anatomy of seed plants. Wiley Eastern Ltd., New Delhi.

#### Reference Books

- R1. Fahn, A. 1989 Plant Anatomy, Pergamon press, Oxford, New York.

#### Other Learning Resources:

[https://www.cell.com/trends/plant-science/abstract/S1360-1385\(01\)02050-7](https://www.cell.com/trends/plant-science/abstract/S1360-1385(01)02050-7)

<https://shop.elsevier.com/books/integrative-plant-anatomy/dickison/978-0-12-215170-5>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe meristems, vascular cambium, their types and factors affecting cambial activity.	1, 2, 6
2	Explain vascular tissues its origin, structure, development, and ontogeny, compare reaction wood, distinctions between heartwood and sapwood, and identify and classify the plant specimen by assessing their anomalous secondary growth.	1, 2, 3, 6
3	Describe leaf ontogeny, vascular tissue development, and calculate plastochronic index, and describe transfer cells, floral anatomy, and explain its role in classification.	1, 2, 6
4	Prepare specimens using microtome, maceration, squash, and clearing techniques, and assess.	1, 3, 6
5	Explain the theories of evolution.	1, 2, 6

<b>Course Title</b>	<b>Research/data analysis/documentation-R4</b>								
<b>Course code</b>	<b>22MSBO125R</b>	<b>Total credits: 2</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/f</b>	<b>C</b>
			<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>1</b>	<b>0</b>	<b>4</b>
		<b>Total hours: 30</b>					<b>2</b>		
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Master of Science in Botany</b>								
<b>Semester</b>	<b>Winter/II semester of First year of the programme</b>								
<b>Course objectives</b>	1.To determine whether the objectives of review of literature gap analysis have been met, if not what steps can be taken accordingly.								
<b>CO1</b>	Create and implement a plan to bridge the gap								

<b>CO2</b>	Find the gap and evaluate solutions.
<b>CO3</b>	Identify the ideal future state/action plan
<b>CO4</b>	To analyse the current state/work of research
<b>CO5</b>	To implement the strategies to meet the research gap under supervision.

**Text books**

<b>SEMESTER – IV</b>									
<b>Course Title</b>	<b>Angiosperm taxonomy-I</b>								
<b>Course code</b>	<b>22MSBO222R</b>	<b>Total credits: 4</b> <b>Total hours: 45T+30P</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/ F</b>	<b>C</b>
			<b>3</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Master of Science in Botany</b>								
<b>Semester</b>	<b>Winter/II semester of First year of the programme</b>								
<b>Course Objectives</b>	1. To study the fundamental concept of flowering plants for proper classification and identification. 2. Field visit help students to study the flowering plants and identify up to the genus level. 3. By visiting field students can gather knowledge about the ethnobotanical use of plants by local people. 4. To learn about the herbarium process, students visit research organisations like BSI, NBRI, FRI and can gather knowledge. 5. Students can apply for research fellowships for Ph. D. and other higher degrees in plant taxonomy in universities.								
<b>CO1</b>	Explain the principles, classifications and identification of plants.								
<b>CO2</b>	Describe botanical keys, taxonomic literature methods, and computer-assisted identification.								
<b>CO3</b>	Explain botanical nomenclature principles, rules, priority, effective publication, and related terms.								
<b>CO4</b>	Prepare herbarium, discuss botanical gardens, libraries, and the Botanical Survey of India, their significance in knowing plant species.								
<b>CO5</b>	Explain OTUs, character coding, resemblance measures, cluster analysis, dendrogram/ cladogram construction, bioinformatics, and sequencing methods.								
<b>Unit-No.</b>	<b>Content</b>	<b>CH</b>	<b>Learning Outcome</b>				<b>KL</b>		
<b>I</b>	<b>Basics of Taxonomy:</b> Aims, objective and principles. Pre and Post Darwinian Classifications, Phenetic, Phylogenetic, Cladistic and APG System, Alpha and Omega taxonomy, Taxonomic hierarchy, Concept of species, genus, family and infra-specific categories. <b>Concept of Characters</b> – Qualitative and quantitative characters, Good and bad characters, analytical and synthetic characters, conservative characters, co-relation of characters, Isolation and speciation of characters.	10	Knowledge of different classification systems and concept of characters.				1,2		
<b>II</b>	<b>Basics of Taxonomy:</b> Botanical keys -sequential keys, multi-access keys, automated pattern	8	To learn the basics of taxonomy, use of botanical				1,2		



	recognition systems, web identification Punched Card Keys; Taxonomic literature- Preparation and presentation of data in floras, rich and poor flora, manuals, monographs, revisions, icons, journals and others. Check list, annotated list, revisionary study, Computer in identification.		keys and taxonomic literature.	
<b>III</b>	<b>Botanical Nomenclature:</b> Principles and major rules, typification, rule of priority, effective and valid publication, retention, choice and rejection of names, illegitimate names, Authors' citation, synonym, basionym, nomen conservanda, St. Louis Code, Biocode, nomen nudum, tautonym, later homonym, Names of hybrids, Names of cultivated plants.	10	To know about the nomenclature of plants.	1,2
<b>IV</b>	<b>Herbarium techniques:</b> Methods of Collection, Identification and Documentation. Role and importance of herbaria. Kinds of herbaria. Important herbaria in the world and India. Virtual Herbarium. <b>Botanical Garden museums and Botanical library-</b> Function and role in taxonomic studies. <b>Botanical Survey of India:</b> Organization, activities and publications.	10	To understand the basics of herbarium techniques, function of botanical gardens and BSI.	1,2
<b>V</b>	<b>Taxometric-</b> Principles, OTUs, character coding, measure of resemblances, cluster analysis, commonly available software, construction of Dendrograms and cladograms, basic of bioinformatics, biological databases, data search, sequencing methods.	7	Able to describe and explain about the principle and applications of taxometric.	1,2
<b>Practica I</b>	1. Field excursion (5-7 days) to the neighbouring states of Assam/NE India, making collection of angiosperm plant species and describe the specimen using botanical terms and keying out the prominent characters for identification up to the rank of species for the preparation of a flora. (Students are required to submit at least 25 herbarium/ museum specimens). 2. Basing on collection of locally available angiospermic plants, students may be assigned to study any one of the following branches in relation to angiosperm taxonomy- (a) External morphology, (b) Anatomy, (c) Cytology, (d) Palynology (e) Chemotaxonomy. 3. Practices on Nomenclatural problems by handling of floras, manuals, icons and index kewensis etc. 4. Handling of taxonomic softwares.	30	Describe, illustrate and explain and apply taxonomic tools to solve critical problems related to identification and nomenclature of plant species.	1,2, 3,4

#### Text Books

T1. A Hand Book of Field and Herbarium Methods. Today and Tomorrow Publications, New Delhi. Jain, S.K. and Rao, R.R. Publications, New Delhi.

T2. Advanced Plant Taxonomy. Mondal, A.K. Central Book Agency, Kolkata.

- T3. An Introduction to Angiosperms, N.C.Kumar, Himalaya Publishing House, 1995.
- T4. Evolution and Classification of Flowering Plants. Cronquist, A. New York Botanic Gardens, Bronx, New York.
- T5. Evolution and Phylogeny of flowering plants; Hutchinson, J. Academic Press, London & New York.
- T6. Taxonomy of Angiosperms. Naik, V.N. Tata McGraw Hill, New Delhi.
- T7. The families of flowering plants: Hutchinson, J. Oxford University Press.
- T8. The geography of flowering plants. Good, R. Longman, London.
- T9. The Plant Book. Mabberley, D.J. Cambridge University Press, London.

**Reference Books**

- R1. Genera of flowering plants. Hutchinson, J. Cambridge University Press, London.
- R2. Greuter. W. et al. Scientific Books, Konigstein.
- R3. International Code of Botanical Nomenclature. St. Louis Code. Koeltz.
- R4. Introduction to the principles of plant taxonomy. Sivarajan, V.V. and Robinson Oxford IBH.
- R5. Modern Plant Taxonomy, N.S, Subrahmanyam, Vikas Publishing house Pvt. Ltd, Noida, 2008.
- R6. Origin and dispersal of Flowering Plants. Takhtajan, A.
- R7. Plant systematics, Singh, Gurcharan: Oxford IBH

**Other Learning Resources:**

<https://www.sciencedirect.com/journal/plant-Diversity>

<https://www.sciencedirect.com/journal/perspectives-in-plant-ecology-evolution-and-systematics>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain the principles, classifications and identification of plants.	1, 2
2	Describe botanical keys, taxonomic literature methods, and computer-assisted identification.	1, 2, 6
3	Explain botanical nomenclature principles, rules, priority, effective publication, and related terms.	1, 2, 6
4	Prepare herbarium, discuss botanical gardens, libraries, and the Botanical Survey of India, their significance in knowing plant species.	1, 3
5	Explain OTUs, character coding, resemblance measures, cluster analysis, dendrogram/ cladogram construction, bioinformatics, and sequencing methods.	1, 2, 6

SEMESTER – IV									
Course Title	Angiosperm taxonomy-II								
Course code	22MSBO223R	Total credits: 2	L	T	P	S	R	O/ F	C
		Total hours: 30T	2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course Objectives	<p>1. To study the plant morphology student will be benefitted to identify plants (visual identification) properly. Proper identification and classification are important in the fields like genetics, ecology, physiology, Embryology etc.</p> <p>2. To study all the applied disciplines of plant sciences such as Agriculture, Horticulture, Forestry, Pharmacognosy, Biotechnology, etc.</p> <p>3. By studying phytogeography students can able to know about the differences of plant species in different geographical zones.</p> <p>4. By studying forest types students can able to know about the different plant species distributed in different types of forests.</p>								
CO1	Describe taxonomic evidences, molecular taxonomy, diagnostic tools, PCR analysis, and applications of molecular markers.								
CO2	Explain angiosperm origin, characteristics, and evolution, as well as ethnobotanical uses concerning North-East tribes.								
CO3	Describe North East India's flora, endangered plant conservation, and sustainable forest management.								
CO4	Explain phytogeography, India's biodiversity, migration, and plant domestication.								
CO5	Explain phylogeny and evolution of Angiospermic taxa, covering key dicotyledons and monocotyledons.								
Unit-No.	Content	CH	Learning Outcome					KL	
I	<b>Sources of taxonomic evidences:</b> Morphology, Anatomy, Palynology, Ecology, Embryology, Cytology, genetics, Chemotaxonomy, Phytochemistry, Serology Biosystematics, Numerical taxonomy, Molecular plant taxonomy, diagnostic tools, PCR analysis, application of molecular markers in plant taxonomy, scope and importance of molecular taxonomy.	10	Knowledge of different taxonomic evidences for proper identification and classification of angiosperms.					1,2	
II	<b>Origin and evolution-</b> Origin of angiosperms with special reference to their ancestral stock, Characteristic features of Primitive and advanced angiosperms, Evolutionary trends in Angiosperms. Cradle of flowering plants. <b>Ethnobotany-</b> Use of plants by the tribal societies in North-Eastern India for subsistence, medicine and cultural purposes.	8	Knowledge of probable origin and evolution of angiosperms.					1,2	
III	<b>Forest types</b> - Flora and forest types of North East India, RET plants of India with special reference to N E India. Conservation of endanged plants and their habitats. endemic, exotic, alien and introduced elements in North East flora. Biodiversity assessment and magnitude, use of GPS and GIS. Conservation	10	To know about the forest types of North- east India and their conservation strategies.					1,2	

	and Utilization of forest resources.			
<b>IV</b>	<b>Phytogeography</b> -Concept, Static and Dynamic Phytogeography, Phytochoria and botanical provinces of India; Major theories, Ranges, Migration and Barriers, Vicariance biogeography, Endemism, IUCN categories, Hotspots, India as a megadiversity country. Plant introduction and plant domestication, Patterns of geographical distribution, Centre of Origin.	10	To understand the basics of phytogeography and IUCN.	1,2
<b>V</b>	<b>Phylogeny and evolution of angiospermic taxa-</b> <b>Dicotyledons:</b> Magnoliales, Ranunculales, Lamiales, Asterales, Malvales, Fabales, Scrophulariales, Caryophyllales, <b>Monocotyledons:</b> Arales, Orchidales, Poales, Cyperales, Zingiberales.	7	Able to describe and explain about the principle and applications of taxometric.	1,2

#### Text Books

- T1. Evolution and Phylogeny of flowering plants; Hutchinson, J. Academic Press, London & New York.
- T2. Genera of flowering plants. Hutchinson, J. Cambridge University Press, London Greuter. W. et al. Scientific Books, Konigstein.
- T3. International Code of Botanical Nomenclature. St. Louis Code. Koeltz.
- T4. Introduction to the principles of plant taxonomy. Sivarajan, V.V. and Robinson Oxford IBH.
- T5. Modern Plant Taxonomy, N.S, Subrahmanyam, Vikas Publishing house Pvt. Ltd, Noida, 2008.
- T6. Origin and dispersal of Flowering Plants. Takhtajan, A.
- T7. Plant Systematics: Theory and Practice. Gurcharan Singh, 2004. Oxford & Ibh Publishing Co. P. Ltd., New Delhi.
- T8. Plant Taxonomy, N.B. Saxena and Saxena, Pragati Prakashan, Meerat, 2010.
- T9. Taxonomy of Angiosperms, V. Singh and D.K. Jain, Rastogi Publication, Meerat 2005.
- T10. Taxonomy of Angiosperms. Naik, V.N. Tata McGraw Hill, New Delhi.
- T11. The Plant Book. Mabberley, D.J. Cambridge University Press, London.

#### Reference Books

- R1. Origin and dispersal of Flowering Plants. Takhtajan, A.
- R2. Plant Systematics: Theory and Practice. Gurcharan Singh, 2004. Oxford & Ibh Publishing Co. P. Ltd., New Delhi.
- R3. Plant Taxonomy, N.B. Saxena and Saxena, Pragati Prakashan, Meerat, 2010.
- R4. Taxonomy of Angiosperms, V. Singh and D.K. Jain, Rastogi Publication, Meerat 2005.
- R5. Taxonomy of Angiosperms. Naik, V.N. Tata McGraw Hill, New Delhi.
- R6. The Plant Book. Mabberley, D.J. Cambridge University Press, London.

#### Other Learning Resources:

<https://www.sciencedirect.com/topics/earth-and-planetary-sciences/phytogeography>

[https://link.springer.com/chapter/10.1007/978-90-481-8725-6\\_4](https://link.springer.com/chapter/10.1007/978-90-481-8725-6_4)

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe taxonomic evidences, molecular taxonomy, diagnostic tools, PCR analysis, and applications of molecular markers.	1, 2

2	Explain angiosperm origin, characteristics, and evolution, as well as ethnobotanical uses concerning North-East tribes.	1, 2, 6
3	Describe North East India's flora, endangered plant conservation, and sustainable forest management.	1, 2, 6
4	Explain phytogeography, India's biodiversity, migration, and plant domestication.	1, 3
5	Explain phylogeny and evolution of Angiospermic taxa, covering key dicotyledons and monocotyledons.	1, 2, 6

SEMESTER – IV									
Course Title	Microbiology-I								
Course code	22MSBO222R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/ F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course Objectives	1. The course deals with the microbial ecology, diversity of microorganisms in soil, water and air. 2. To make learner understand about the application of microorganisms in agriculture and industry. 3. The course deals with microorganisms involve in the food industry.								
CO1	Discuss microbial interactions, microbes in extreme environment.								
CO2	Describe the characteristics, isolate, identify, classify microbe present soil, air and water, and demonstrate the method of bacteriological analysis of water, antimicrobial activity of microbes.								
CO3	Describe microbial application in agriculture for crop production.								
CO4	Describe microbial application in industry including pharmaceuticals, food and beverage and biofuel industries.								
CO5	Describe food microbiology, food safely, preservation, and quality of products.								
Unit-No.	Content	CH	Learning Outcome					KL	
I	Microbial Ecology- Interaction among microbial population, microbial interaction with plants and animals, microbial interaction with xenobiotics and inorganic pollutants, Microbes of extreme environments.	10	Knowledge of microbial interaction with other organisms.					1,2	
II	Soil microbiology- Microbial diversity in soil, soil microbial communities and decomposition of organic matter, methods to detect and quantify soil microbes, soil metagenomics, biosensors to monitor soil health and toxicity. Air microbiology-Phyllosphere and phylloplane, distribution of microbes in Air, allergic disorders by air microflora, sampling techniques, Water microbiology- Microbial components of water, Purification of drinking water in municipal water supply, bacteriological analysis of water.	8	To learn the basics of microbial diversity in soil, water and air.					1,2	
III	Agricultural Microbiology- Agriculturally Important microbes, biological N <sub>2</sub> fixation,	10	To know about the agricultural microbiology.					1,2	

	phosphate solubilization, PGPRs, rhizosphere, Mycorrhiza, Biofertilizers, Crop diseases caused by different pathogens, Bio-control of plant diseases.			
IV	Industrial Microbiology- Industrial importance of microorganisms, Fermentation process, bioreactors, isolation, preservation and maintenance of industrial microbes, downstream processing, single cell protein, Industrial production of organic acids, antibiotics, ethanol, vitamins and amino acids.	10	To understand the basics of industrial microbiology.	1,2
V	Food microbiology- Fermented food (milk, meat, vegetables, beer, wine and vinegar), Food spoilage and preservation, Food borne diseases.	7	Able to describe and explain about the applications of microbes in food and dairy industry.	1,2
Practical I	1. Isolation of specific microorganisms using specific media. Study of microflora from the rhizosphere of agriculturally important crop. Study the spore and mycelia of different fungus and their morphological identification. Mycorrhiza – spore population and root colonization. 2. Assessment of antimicrobial activity of microbes against plant pathogens. Bacteriological analysis of water 3. Detection of organic acids produced by fungi by paper chromatography method. 4. Biochemical tests for identification of bacteria (catalase, IMViC, oxidase, etc.). 5. Field excursion (5-7 days) to the neighbouring states of Assam/ NE India to visit different research, educational institute, industry etc.	30	Describe, illustrate and explain and apply microbial tools and techniques for solving microbiological problems.	1,2, 3,4

**Text Books**

T1. Text book of Microbiology by Ananthanarayan and Paniker.

T2. Microbiology by Lansing M Prescott, Donald A Klein, John P Harley, Mc Graw Hill.

**Reference Books**

R1. Microbiology: Principles and Explorations by Jacquelyn Black 7e, John Wiley & Sons, inc.

R2. General Microbiology by Roger Y Stanier, John L Ingraham, Mark L Wheelis, 5th edition Tata Mac Graw Hill.

**Other Learning Resources:**

<https://www.sciencedirect.com/bookseries/progress-in-industrial-microbiology/vol/31/suppl/C>

<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/industrial-microbiology>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome

1	Explain the principles, classifications and identification of plants.	1, 2, 3, 6
2	Describe botanical keys, taxonomic literature methods, and computer-assisted identification.	1, 3, 4, 6
3	Explain botanical nomenclature principles, rules, priority, effective publication, and related terms.	1, 2, 3, 6
4	Prepare herbarium, discuss botanical gardens, libraries, and the Botanical Survey of India, their significance in knowing plant species.	1, 2, 3, 6
5	Explain OTUs, character coding, resemblance measures, cluster analysis, dendrogram/ cladogram construction, bioinformatics, and sequencing methods.	1, 2, 3, 6

SEMESTER – IV									
Course Title	Microbiology-II								
Course code	22MSBO223R	Total credits: 2	L	T	P	S	R	O/ F	C
		Total hours: 30T	2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course Objectives	1. The course deals with the microbial growth and microbial genetics. 2. To make learner understand about genetic recombination, microbial biotechnology and concept of genetic engineering. 3. To impart method of control of microorganisms.								
CO1	Explain the microbial growth pattern, continuous culture and batch culture.								
CO2	Explain microbial genetics, encompassing genetic materials, inheritance mechanisms, gene transfer processes, and fundamental aspects of DNA, RNA, and protein synthesis in microorganisms.								
CO3	Describe genetic recombination, molecular genetics, and gene expression regulation in bacteria.								
CO4	Explain microbial biotechnology, genetic engineering, and application of genetic engineering.								
CO5	Describe methods for controlling microorganisms, role of antibiotics, and challenges related to multidrug resistance in bacteria.								
Unit-No.	Content	CH	Learning Outcome					KL	
I	Microbial Growth- Definition of growth, Microbial growth conditions and growth curves, Mathematical expression of exponential growth phase, Measurement of growth and growth yields; Synchronous growth; Continuous culture, Effect of environmental factors on growth.	10	Knowledge of microbial growth and growth conditions.					1,2	
II	Microbial Genetics- Genetic materials, nuclear DNA, chloroplast DNA, mitochondrial DNA, plasmids, inheritance of traits, vertical and horizontal gene transfer, genes and	8	To learn the basics of microbial genetics and genetic materials.					1,2	

	chromosomes, DNA replication, RNA and protein synthesis.			
<b>III</b>	Genetic recombination, conjugation, transduction and transformation in bacteria, host cell restriction, mobile genetic elements, fine structure of a gene, Operon concept, promoter, enhancer, repressor, negative feedback, RNA processing (RNA capping, Poly (A) tail formation, RNA splicing).	10	To know about the forest types of North- east India and their conservation strategies.	1,2
<b>IV</b>	Microbial biotechnology for human welfare, cDNA and genomic DNA library, gene isolation, gene cloning, expression of cloned genes, gene therapy, DNA fingerprinting, GMOs, application of RNAi technology (miRNA and siRNA) in agriculture and medical sciences. Genetic engineering – tools and techniques, manipulation of natural genetical processes in biotechnology, restriction enzymes and ligases, cloning and expression vectors (plasmid, Ti plasmid, cosmid, fosmid, BAC, YAC and PAC).	10	To understand the basics of microbial biotechnology and genetic engineering.	1,2
<b>V</b>	Control of microorganisms: Physical, chemical and biological, Antibiotics, mode of action of antibiotics, multidrug resistance in bacteria.	7	Able to describe and explain about the control of microorganisms and control action.	1,2

#### Text Books

T1. Text book of Microbiology by Ananthanarayan and Paniker.

T2. Microbiology by Lansing M Prescott, Donald A Klein, John P Harley, Mc Graw Hill.

#### Reference Books

R1. Microbiology: Principles and Explorations by Jacquelyn Black 7e, John Wiley & Sons, inc.

R2. General Microbiology by Roger Y Stanier, John L Ingraham, Mark L Wheelis, 5th edition Tata Mac Graw Hill.

#### Other Learning Resources:

<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/soil-microbiology>

<https://www.sciencedirect.com/topics/immunology-and-microbiology/microbiology>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain the microbial growth pattern, continuous culture and batch culture.	1, 3, 6
2	Explain microbial genetics, encompassing genetic materials, inheritance mechanisms, gene transfer processes, and fundamental aspects of DNA, RNA, and protein synthesis in microorganisms.	1, 2, 3
3	Describe genetic recombination, molecular genetics, and gene expression regulation in bacteria.	1, 2, 3
4	Explain microbial biotechnology, genetic engineering, and application of genetic engineering.	1, 2, 3, 6



5	Describe methods for controlling microorganisms, role of antibiotics, and challenges related to multidrug resistance in bacteria.	1, 2, 3, 6
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SEMESTER – IV									
Course Title		Plant Ecology-I							
Course code	22MSBO222R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/ F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course Objectives	1. To study the detail about Plant Population and Plant community. 2. To study about Ecosystem stability, Ecosystem degradation and its consequences. 3. To study the different techniques of biowaste and e-waste management.								
CO1	Describe System Ecology, Evolutionary Ecology, Statistical Ecology and related branches.								
CO2	Explain characteristics of population and community, regulation of ecosystem processes, complex relationships with other organisms, patterns of development and diversity.								
CO3	Explain the ecological perturbations (natural and anthropogenic), bio resource sustainability, protect and conserve nature and analyse communities.								
CO4	Describe vegetation development, mechanism of ecological succession and changes in ecosystem properties.								
CO5	Describe bioremediation, biotransformation, biodegradation and ecological techniques for biowaste and e-waste management.								
Unit-No.	Content	CH	Learning Outcome					KL	
I	Development of ecology in India from ancient to recent times, evolutionary ecology, Interaction of ecological factors in the environment. Principles pertaining to limiting factors. Introduction and elements of system ecology; ecosystem modeling, conceptual model, working model, auxiliary variable and foresters' diagram. Basic concepts to statistical ecology, fundamental knowledge on pattern analysis, cluster analysis and ordination.	10	Knowledge of ecological development in India.					1,2	
II	Population concepts- characteristics, dynamics and control. Mechanisms of population regulation, habitat specific demography, population viability analysis. Species interactions-types of interactions, interspecific competition, herbivory, carnivory, symbiosis, allelopathy, weed-crop interference. Concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations. Ecological amplitude of a species and adaptation - ecads, ecotypes, ecospecies.	8	To learn the basics of population concepts in ecology.					1,2	
III	Ecosystem stability- Concept (resistance and resilience); ecological perturbations (natural and	10	To know about the stability in ecosystem.					1,2	

	anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion; Wetlands, its importance & benefits, causes of degradation and its consequences, Concepts of community and continuum; analysis of communities (analytical and synthetic characters); community coefficients; interspecific associations; ordination; concept of ecological niche, species diversity ( $\alpha$ , $\beta$ , $\gamma$ ).			
<b>IV</b>	Vegetation development, temporal changes (cyclic and non-cyclic); mechanism of ecological succession (relay floristics and initial floristic composition; facilitation, tolerance and inhibition models); changes in ecosystem properties during succession.	10	To understand the ecological succession.	1,2
<b>V</b>	Bioremediation, biotransformation, biodegradation and phytoremediation, In situ and Ex-situ practices. Use of microbes (algae, bacteria and fungi) and plants to check biodegradation, biotransformation; waste water treatment using aquatic plants; root zone treatment. Ecological techniques for biowaste and e- waste management.	7	Able to describe and explain about the	1,2
<b>Practical I</b>	<ol style="list-style-type: none"> <li>1. Estimation of above ground and below ground biomass from unit area.</li> <li>2. Effect of biotic disturbances on botanical composition.</li> <li>3. To study the similarity between plant communities using index of similarities and dissimilarities.</li> <li>4. To study primary productivity for herbaceous community by Harvest method; Leaf Area Index and anatomical adaptive features of plants.</li> <li>5. Field excursion to the neighbouring states of Assam/ NE India for ecological study of different vegetation pattern.</li> <li>6. Plant Geography: To study the distribution of vegetation type of India</li> <li>7. To study the vegetation type of North east India</li> <li>8. To plot Biosphere Reserves/ Ramsar sites/ National Parks/Wildlife Sanctuaries located in different biogeographical zones of India.</li> <li>9. To plot Biosphere Reserves/ Ramsar sites/ National Parks/Wildlife Sanctuaries located in NE India</li> <li>10. Study of dispersal mechanism of seeds in plant species.</li> </ol>	30	Describe, illustrate and explain and apply ecological methods of studying ecosystem.	1,2, 3,4

**Text Books**

T1. Freeman, B. (ed.), 1995. - Environmental Ecology- The ecological effects of pollution, disturbance, and other stresses. Academic press.

T2. Michael, P. 1990. - Ecological methods for field and laboratory investigations. TataMcGraw Hill, New.

**Reference Books**

R1. Odum, E.P. (1983), Basic Ecology, Sanders, Philadelphia.

R2. Smith, R.L. (1996), *Ecology and Field Biology*, Harper Collins, New York.

R3. Townsend, C.R., Begon, M. and Harper, J.L. 2003. *Essentials of Ecology*. Second Edition. Blackwell Publishing, Oxford.

**Other Learning Resources:**

<https://www.sciencedirect.com/topics/earth-and-planetary-sciences/plant-ecology>

<https://link.springer.com/journal/11258>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe System Ecology, Evolutionary Ecology, Statistical Ecology and related branches.	1, 2, 3, 6
2	Explain characteristics of population and community, regulation of ecosystem processes, complex relationships with other organisms, patterns of development and diversity.	1, 2, 3, 6
3	Explain the ecological perturbations (natural and anthropogenic), bio resource sustainability, protect and conserve nature and analyse communities.	1, 3, 6, 7
4	Describe vegetation development, mechanism of ecological succession and changes in ecosystem properties.	1, 3, 6, 7
5	Describe bioremediation, biotransformation, biodegradation and ecological techniques for biowaste and e-waste management.	1, 3, 6, 7

SEMESTER – IV									
Course Title	Plant Ecology-II								
Course code	22MSBO223R	Total credits: 2 Total hours: 30T	L	T	P	S	R	O/ F	C
			2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Master of Science in Botany								
Semester	Winter/II semester of First year of the programme								
Course Objectives	1. To study the detail about Plant Population and Plant community. 2. To study about Ecosystem stability, Ecosystem degradation and its consequences. 3. To study the different techniques of biowaste and e-waste management.								
CO1	Describe ecological restoration, ecosystem reconstruction and restoration of degraded ecosystem.								
CO2	Explain environmental management, sustainable development, environmental monitoring and apply environmental impact assessment methods.								

<b>CO3</b>	Explain forest ecology, different forest types of India, forest composition, discuss the Environmental issues of North East India.			
<b>CO4</b>	Explain remote sensing and Geographical Information System (GIS) in ecological studies.			
<b>CO5</b>	Describe phytogeographical regions of India, Vegetation types of India, Biodiversity significance of NE region.			
<b>Unit-No.</b>	<b>Content</b>	<b>CH</b>	<b>Learning Outcome</b>	<b>KL</b>
<b>I</b>	Concepts of ecological restoration, aims and strategies; ecosystem reconstruction, major tools used in restoration, restoration of biological diversity- Acceleration of ecological succession, reintroduction of biota; restoration of degraded ecosystems- Forest, grassland and lake including contaminated soils, mine spoils etc.	10	Knowledge of concepts of ecological restorations and strategies.	1,2
<b>II</b>	Scope of environmental management, basic concepts of sustainable development, advantages of environmental monitoring, deterioration of environmental quality with reference to anthropogenic impact; methods of assessment of environmental quality; Short term studies/ surveys; Rapid assessment; Continuous short- and long-term monitoring; general guidelines for the preparation of environmental impact statement.	8	Knowledge of environmental management and impact management.	1,2
<b>III</b>	Scope of environmental management: Forest ecology and forest types of India; changes in Forest Composition and Cover; issues and problems associated with shifting cultivation and industrialization; Environmental Impact of coal mining, quarrying of sand from hills and rivers; Extraction of petroleum and natural gas; issues relating to conservation of Ramsar sites of north-east India: Loktak lake, Deepar beel.	10	To know about the scopes of environmental management.	1,2
<b>IV</b>	Principles and basic concepts of remote sensing; application of remote sensing in environmental studies: forest survey, habitat analysis, water management, wetland survey, rainfall estimation, pollution studies, soil conservation, vegetation mapping. Geographical Information System (GIS) - basic principles, techniques and importance. Global Positioning System (GPS): basic principles, Applications in ecological studies.	10	To understand the basic concept and principle of remote sensing.	1,2
<b>V</b>	Phytogeography: Phytogeographical regions of India, Vegetation types of India (vegetation of Western Himalayas, Eastern Himalayas, Assam, Gangetic plain, Indus plain, Malabar, Deccan etc, Biodiversity significance of NE region.	7	Able to describe and explain about the phytogeography and vegetation pattern of India.	1,2

**Text Books**

- T1. Misra, R. 1968. - Ecology Work Book. Oxford & IBH, New Delhi.  
 T2. Mukherjee, B. 1996. - Environmental biology. Tata McGraw Hill Publ., New Delhi.  
 T3. Bharucha, F.R. - A textbook of plant geography. Oxford Uni Press.  
 T4. Cain, S.A. 1944. - Foundation of Plant Geography. Harper, New York.  
 T5. Freeman, B. (ed.), 1995. - Environmental Ecology- The ecological effect of pollution, disturbance, and other stresses. Academic press.

**Reference Books**

- R1. Cain, S.A. 1944. - Foundation of Plant Geography. Harper, New York.  
 R2. Freeman, B. (ed.), 1995.- Environmental Ecology- The ecological effects of pollution, disturbance, and other stresses. Academic press.

**Other Learning Resources:**

- <https://www.nature.com/subjects/plant-ecology/ncomms>  
<https://link.springer.com/journal/11258>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe ecological restoration, ecosystem reconstruction and restoration of degraded ecosystem.	1, 3, 6
<b>2</b>	Explain environmental management, sustainable development, environmental monitoring and apply environmental impact assessment methods.	1, 2, 3, 6
<b>3</b>	Explain forest ecology, different forest types of India, forest composition, discuss the Environmental issues of North East India.	1, 3, 6
<b>4</b>	Explain remote sensing and Geographical Information System (GIS) in ecological studies.	1, 2, 3, 6, 7
<b>5</b>	Describe phytogeographical regions of India, Vegetation types of India, Biodiversity significance of NE region.	1, 3

### MAPPING TABLE

Course code	Course Name	PO1*	PO2	PO3	PO4	PO5	PO6	PO7	PO8
22MSBO111R	Plant Diversity-I	3		1			1		
22MSBO112R	Plant Diversity-II	3					1		
22MSBO113R	Plant Ecology and Phytogeography	3					1		
22MSBO114R	Bioinstrumentation	2							
22MSBO115R	Field study- I	3			1		1		
22MSBO116R	Mini Research (Review of literature- R1)	2							
22UMFS111R	Fundamental of Statistics	3							
22UMPD111R	PDP-I	1							
22MSCE111R	MOOCS-CE I	1							
22MSBO121R	Plant cell, Genetics and Plant Breeding	3		1			1		
22MSBO122R	Microbiology and Plant Pathology	3			1		1		
22MSBO123R	Plant Physiology and Biochemistry	3					1		
22MSBO124R	Techno-Professional Skills I	2							
22MSBO125R	Mini Research (Research gap analysis-R2)	2							
	Generic Elective	1							
22UMRM121R	Research methodology and Statistical Analysis	2							
22UUHV101R	Universal Human Values	1							
22UMPD121R	PDP-II	1							
22MSCE121R	MOOCS -CE II	1							
22UCDL103R	Computational systems and Digital World	1							
22MSBO211R	Techno-Professional Skills II	2							
22MSCE211R	MOOCS-III	1							
22MSCE212R	MOOCS-IV	1							
22MSBO217R	Generic elective	1							
22UMRE211R	Research Ethics	2							
22UMPD211R	Corporate Competency	1							
22MSBO212R	Mini Research (Survey/Experiments)-	2							

	R3								
22UUFL202R	Personal Financial Planning	1							
22MSBO213R	Floral morphology, Embryology and palynology	3			1		1		
22MSBO214R	Economic Botany, ethnobotany and Pharmacognosy	3		1			1		
22MSBO215R	Plant Molecular Biology and Biotechnology	3		1			1		
22MSBO216R	Plant Anatomy, microtechnique & evolution	3			1		1		
22MSBO221R	Research/data analysis/documentation-R4)	2							
22MSBO222R	AngiospermTaxonomy -I	3					1		
22MSBO223R	AngiospermTaxonomy -II	3					1		
22MSBO222R	Microbiology-I	3					1		
22MSBO223R	Microbiology-II	3					1		
22MSBO222R	Plant Ecology-I	3					1		
22MSBO223R	Plant Ecology-II	3					1		



# **Assam down town University**

## **Curriculum and Syllabus**

### **Bachelor of Science in Biotechnology**

OUTCOME BASED EDUCATION FRAMEWORK

CHOICE BASED CREDIT SYSTEM

**Version: 2.0**

### **FACULTY OF SCIENCE**

**July, 2022**



# Preamble

Assam down town University is a premier higher educational institution which offers Bachelor, Master, and Ph.D. degree programmes across various faculties. These programmes, collectively embodies the vision and mission of the university. In keeping with the vision of evolutionary changes taking place in the educational landscape of the country, the university has restructured the course curriculum as per the guidelines of National Education Policy 2020. This document contains outline of teaching and learning framework and complete detailing of the courses. This document is a guidebook for the students to choose desired courses for completing the programme and to be eligible for the degree. This volume also includes the prescribed literature, study materials, texts, and reference books under different courses as guidance for the students to follow.

Recommended by the 22<sup>nd</sup> Board of Studies (BoS) meeting of the Faculty of Science held on dated 22/06/2022 and approved by the Emergent Academic Council (AC) meeting held on dated 30/07/2022



*Chairperson  
Board of Studies*



*Member Secretary  
Academic Council*



## ***Vision***

To become a Globally Recognized University from North Eastern Region of India,  
Dedicated to the Holistic Development of Students and Making Society Better

## ***Missions***

1. Creation of curricula that address the local, regional, national, and international needs of graduates, providing them with diverse and well-rounded education.
2. Build a diverse student body from various socio-economic backgrounds, provide exceptional value-based education, and foster holistic personal development, strong academic careers, and confidence.
3. Achieve high placement success by offering students skill-based, innovative education and strong industry connections.
4. Become the premier destination of young people, desirous of becoming future professional leaders through multidisciplinary learning and serving society better.
5. Create a highly inspiring intellectual environment for exceptional learners, empowering them to aspire to join internationally acclaimed institutions and contribute to global efforts in addressing critical issues, such as sustainable development, Climate mitigation and fostering a conflict-free global society.
6. To be renowned for creating new knowledge through high quality interdisciplinary research for betterment of society.
7. Become a key hub for the growth and excellence of AdtU's stakeholders including educators, researchers and innovators
8. Adapt to the evolving needs and changing realities of our students and community by incorporating national and global perspectives, while ensuring our actions are in harmony with our foundational values and objectives of serving the community.

# Programme Details

## Programme Overview:

B.Sc. in Biotechnology is a 3-year undergraduate programme which deals with basic and advanced study provides a comprehensive understanding of cell biology, molecular biology, and genetic engineering. Students learn the fundamentals of cell structure and function, gene manipulation techniques, and the principles of genetic engineering. The curriculum includes practical lab work, covering techniques like PCR, RFLP, and RAPD, and applications in vaccine production, gene therapy, and environmental biotechnology. Additionally, the program emphasizes ethical, social, and environmental responsibilities, preparing students for diverse biotechnological careers and further studies in this rapidly evolving field.

### I. Specific Features of the Curriculum:

This program outcome aims to provide students with an in-depth understanding of biotechnology's diverse applications, preparing them for future opportunities in this dynamic field. Students will gain hands-on experience with molecular biology techniques and biotechnological instruments, essential for analysis, measurement, and experimentation. Additionally, the curriculum emphasizes the importance of environmental, social, ethical, and professional responsibilities, ensuring that graduates are not only technically proficient but also mindful of the broader impacts of their work. This holistic approach prepares students to be innovative and responsible professionals in biotechnology.

### II. Eligibility Criteria:

Minimum 45% in 10+2 with English, Biology & Chemistry. 5% relaxation for SC/ST, EWS, and Specially abled candidates.

### III. Program Educational Objectives (PEOs):

**PEO-1:** To understand and incorporate the ability to apply, update, extend, and build deep knowledge through a flexible, research-intensive programme tailored to suit current academic and industry demands.

**PEO-2:** Establish professional integrity and an ethical attitude while being aware of global and national competencies, and consider the social implications of their job, particularly its impact on safety, health, and the environment for long-term growth.

**PEO-3:** Participate in individual and team-oriented, open-ended activities promoting productive thinking to provide opportunities for students to manage and work on multidisciplinary projects through interaction with their peers in the industry

#### **IV. Program Specific Outcomes (PSOs):**

**PSO1: Research and Reasoning:** Identify, formulate, review literature, and analyze complex Biotechnological problems reaching substantial conclusions using logical and critical thinking, and scientific principles.

**PSO2: Techno-Professional Efficiency:** Apply the understanding of multidisciplinary concepts of Biotechnology with interdisciplinary approaches in the service of mankind.

**PSO3: Global Competency:** Demonstrate global competency in addressing interdisciplinary Biotechnological issues through international certification courses.

#### **V. Program Outcome:**

**PO1: Scientific Knowledge:** Apply scientific knowledge for innovation and solving microbiological, biotechnological, nutritional, botanical, zoological, chemical or mathematical issues.

**PO2: Laboratory skills:** Develop skills with scientific, systematic experiential learning in respective field of study or discipline.

**PO3: Analytical skill:** Ability to understand and analyse problems relevant to socioeconomics, environmental, health etc.

**PO4: Problem solving skills:** Ability to find solutions to the problems and threats faced with the help of scientific research.

**PO5: Proficiency:** Develop proficiency in respective branch of science and scientific tools and equipment.

**PO6: Communication skill:** Develop communication skill to communicate among the peer and society to promote scientific thinking and research outcomes.

**PO7: Professional ethics:** Knowledge of professional ethics and their strict application in respective profession.

**PO8: Research:** Temperament to take up research as a career to develop new knowledge in thrust areas.

**PO9: Social Responsibility:** Sense of responsibility to do utmost possible for development of society by educating mass, solving problems, enhancing natural

resources, removing superstitions and thereby contribution to nation building as a whole.

**PO10. Environmental responsibility:** Sense of responsibility to maintain ecological balance. To be able to develop sustainable eco-friendly approaches favouring livelihood of all the components of nature.

**PO11. Life-long learning:** Recognition of the need for, and an ability to engage in life-long learning in the context of biological science.

**VI. Total Credits to be Earned:117**

**VII. Career Prospects:**

Graduates with a B.Sc in Biotechnology have excellent career prospects in research, healthcare, pharmaceuticals, agriculture, and environmental science. They can become research scientists, lab technicians, clinical research associates, or agricultural biotechnologists, driving innovation in medical therapies, crop improvement, and sustainable environmental solutions.

# EVALUATION METHODS

The student performance shall be evaluated through In-semester (Sessional) and semester-end examinations. A weightage of 40% or as prescribed by the programme shall be added to the score of the end-semester examination.

## A. INTERNAL ASSESSMENT:

The teacher who offers the course shall be responsible for internal assessment by conducting in-semester (sessional) examination and evaluating the performance of the students pursuing that course. The components for internal assessment are illustrated in the table given below.

SN	Components/ Examinations	Marks Allotted
1.	In-Sem Exam – I (ISE-I) (Written Examination) *	30
2.	In-Sem Exam – II (ISE-II) (Written Examination) *	30
3.	Assignment	10
4.	Presentation (SP)	10
5.	Quiz	5
6.	Class Performance based score*	5

*\*are compulsory*

**Note:** Total Internal assessment should be out of 40

## INSTRUCTION

1. If a student fails to appear in the any of the component without any valid reason he/she shall be marked zero in that component. However, the course teacher at his discretion may arrange for the missed test on an alternate date for the absentee students after determining ground with genuine/valid reasons for the absent.
2. The report of evaluation of an activity towards the in-semester (sessional) component of a course shall be duly notified by the concerned course teacher within a week of completion.

3. The program coordinators should upload the in-semester marks to the ERP and forward acknowledgement of all the courses of the program to the Controller of Examinations before the start of the End-semester examination.

## **B. SEMESTER END EXAMINATION:**

Time table for end semester examination is published at least 25 days prior to the start of Examination.

### **I. Pre-Examination:**

#### **Eligibility Criteria for a student to appear in University Examinations:**

The student shall only be allowed to appear in a University Examination, if:

- i) He/ She is a registered student of the University;
- ii) He/ She is of good conduct and character;
- iii) He/ She has completed the prescribed Programme of study with minimum percentage of attendance as laid down in the Regulations of the Programme concerned.

Under special cases, a student may be allowed to appear for an examination without being registered in the University but the result of the said student will be kept on hold till the registration of the concerned student is completed.

### **II. Admit Card:**

Admit card for the examination may be downloaded through ERP where the system will generate a Unique ID Cards through online.

The University shall have the right to cancel admission for examination of any candidate on valid grounds.

### **III. Pattern of Question Papers:**

The question paper shall follow the principles of Bloom's Taxonomy.

Table

<b>S. N.</b>	<b>Level</b>	<b>Questions /verbs for test</b>
1	Remember	List, Define, tell, describe, recite, recall, identify, show who, when, where, etc.
2	Understand	Describe, explain, contrast, summarize, differentiate, discuss, etc.
3	Apply	Predict, apply, solve, illustrate, determine, examine, modify
4	Analyze	Classify, outline, categorize, analyze, diagrams, illustrate, infer, etc.
5	Evaluate	Assess, summarize, choose, evaluate, recommend, justify, compare etc.
6	Create	Design, Formulate, Modify, Develop, integrate, etc.

**Note:** No course is to be evaluated on basis of **all 6 knowledge levels**.

The format of the question paper across all the program follow a unique pattern and the total marks is 60

**Table 1: Question paper pattern for End semester examination**

<b>Sl no</b>	<b>Question pattern</b>	<b>Total marks</b>
1	MCQs (10 Questions)	10
2	2 Marks questions (10 Questions)	20
3	4 Marks questions (5 Questions)	20
4	10 Marks questions (1 Question)	10

#### **IV. Examination Duration:**

Each paper of 60 marks shall ordinarily be of two hours duration.

#### **V. Practical Examinations, Viva-Voce etc.:**

- i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.
- ii) Viva-Voce, Oral examinations of the Project report, Dissertation etc. shall be undertaken by a Board of Examiners constituted by the respective Dean of Program with the advice of Supervisor(s).

#### **VI. Procedure of Expulsion:**

If any candidate is found to be using any unfair-means during the examination, the invigilator may cease his/her answer sheet and report it directly to the Officer-in-Charge. The Office-in-Charge of the center may take appropriate decisions as per the rules and procedure of the examination. The Officer-in-Charge may allow the students to write the exam with new answer sheet or may expel the student from appearing the paper depending on the nature of unfair-means. In case of Computer based test, the students may be directed to write an apology letter and sign in the prescribe expulsion form. The student may not be allowed to write that examination.

#### **VII. Instruction to the Students:**

- (i) The students shall not bring to the Examination Hall, any electronic gadget used as a means of communication or record except electronic calculator, if required.



- (ii) The students shall not receive any book or printed or hand written or photo copy (Xerox) or blank-paper from any other person while he/she is in the examination-room or in laboratory or in any other place to which he/she is allowed to have access during course of examination.
- (iii) The students shall not communicate with any other candidate in the examination room or with any other person in and outside the examination-room.
- (iv) The students shall not see, read or copy anything written by any other candidate, nor shall he/she knowingly or negligently permit any other candidate to see, read or copy anything written by him/her or conveyed by him/her.
- (v) The students shall not write anything on the Question Paper or in other paper or materials during the examination, or pass any kind of paper to any other candidate in the examination-room, or to any person outside the room.
- (vi) The students shall not disclose his/her identity to the examiner by writing his/her name or putting any sign / symbol in any part of his answer-script.
- (vii) The students shall not use any abusive language or write any objectionable remark or make any appeal to examiner by writing in any part of his answer-script.
- (viii) The students shall not detach any page from the answer-script or insert any authorized or unauthorized loose sheet into it. He /she shall also not insert any other answer-script / loose sheet by removing the pins of the origin answer-scripts and re-fixing it.
- (ix) The students shall not resort to any disorderly conduct inside the examination-room or misbehave with the invigilator or any other examination official.

### **VIII. Provision for an Amanuensis (writer):**

- (i) A candidate may be provided with an Amanuensis (writer) to write down on dictation on his / her behalf on ground of his / her physical disability to write down by himself / herself due to accident or any other reason. The amanuensis may be provided till he / she recovers from the physical disability. The physical disability to write down by himself / herself must be supported by Medical Certificate from a competent Medical Officer.

- (ii) The qualifications of the amanuensis so provided must not be equal or higher than that of the candidate. This is also to be supported by Certificate from the Faculty of Study where the Amanuensis is provided.
- (iii) Such candidates are to be accommodated in a separate room under the supervision of an invigilator so that the fellow candidates are not disturbed in the process.

### **C. Credit Point:**

It is the product of grade point and number of credits for a course, thus,  $CP = GP \times CR$

#### **i. Credit:**

A unit by which the course work is measured. It determines the number of hours of instructions required per week. 'Credit' refers to the weightage given to a course, usually in terms of the number of instructional hours per week assigned to it. Credits assigned for a single course always pay attention to how many hours it would take for an average learner to complete a single course successfully.

#### **ii. Grade Point:**

Grade Point is a numerical weight allotted to each Grade Letter on a 10-point scale.

#### **iii. Letter Grade:**

Letter Grade is an index of the performance of students in a said paper of a particular course. Grades are denoted by letters O, A+, A, B+, B, C, P, F and Abs. Student obtaining Grade F / Grade Abs shall be considered failed/ absent and, will be required to appear in the subsequent ESE. The UGC recommends a 10-point grading system with the following (Table: 1) Letter Grades:

- (i) A Letter Grade shall signify the level of qualitative/quantitative academic achievement of a student in a Course, while the Grade Point shall indicate the numerical weight of the Letter Grade on a 10-point scale.
- (ii) There shall be 08 (eight) Letter Grades bearing specific Grade Points as listed in Table 1, where the Letter Grades 'O' to 'P' shall indicate successful completion of a course.
- (iii) Apart from the 08 (eight) regular Letter Grades listed in Table 1, there shall be 03 (three) additional Letter Grades, which shall be awarded if a

Course is withdrawn or spanned over the next Semester or remains incomplete as stated in Table 2.

**Table 2: Letter Grades and Grade Points**

Letter Grade	Grade Points	Description
O	10	Outstanding
A+	9	Excellent
A	8	Very Good
B+	7	Good
B	6	Above Average
C	5	Average
P	4	Pass
F	0	Fail
Abs	0	Absent
UFM	0	Unfair Means

#### **iv. Grade Point Average:**

##### **a. SGPA (Semester Grade Point Average)**

The SGPA of a student in a Semester shall be the weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered in that Semester, irrespective of whether he/she could or could not complete the Courses. More specifically, the calculation of SGPA shall take into account the Courses graded with Letter Grades 'O' to 'F' as given in Table 1.

$$\text{SGPA} = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i}$$

(1.1)

The SGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.1) up to two decimal places, where n is the total number of Credit Courses registered by the student in that Semester,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  registered Course and  $C_i$  is the Credit (weight) of that Course.

### **b. CGPA (Cumulative Grade Point Average)**

- (i) The CGPA of a student in a Semester of a Programme shall be the accumulated weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered and successfully completed so far starting from the enrollment in the Programme. In other words, taking into account all the Courses graded with 'O' to 'P' as given in Table 1.1, generally the CGPA of a student shall be calculated starting from the first Semester of his/her enrolled Programme, while the CGPA of a lateral-entry student shall be calculated starting from the Semester of his/her enrollment.
- (ii) The CGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.2) up to two decimal places, where N is the total number of Credit Courses registered and successfully completed so far by the student,  $G_i$  is the Grade Point secured in the  $i$ th completed Course and  $C_i$  is the Credit (weight) of that Course.

$$CGPA = \frac{\sum_{i=1}^N C_i G_i}{\sum_{i=1}^N C_i} \quad (1.2)$$

- (iii) The CGPA shall be convertible into equivalent percentage of marks using Equation Conversion of CGPA to percentage marks: = CGPA\*10

## **D. Post-Examination**

### **i. Transcript or Grade Card or Certificate:**

A marking certificate shall be issued to all the registered students after every Semester. The Semester mark sheet will display the course details (code, title, number of credits, grade secured) along with total credit earned in that Semester.

### **ii. Grievance Readdress Mechanism:**

Students with any dissatisfaction or grievance regarding the marks awarded in any of the Papers / Courses may appeal to the Controller of Examinations for remedial action such as Re-evaluation within 10 days of the declaration of result.

- (i) A student has options to appeal for re-evaluation of his /her answer script to the Controller of Examination.
- (ii) Application for re-evaluation / re-scrutiny of answer scripts shall be made in the definite proforma available with the Examination Office through the head of the respective departments within 10 days of declaration of the results of the respective examinations.
- (iii) The Controller of Examination may appoint an examiner for re-evaluation and will consider and recognize the evaluation done by a University appointed examiner.
- (iv) There shall be no provision for re-evaluation of the Practical Papers, Project Work, and Dissertation etc. However, the students fail in practical examination or viva voce and wish to appear again may apply to be evaluated can do so with the next schedule.
- (v) After screening the application for re-evaluation, the CoE may send the answer scripts of the student to the examiners appointed by the CoE with the approval of Vice Chancellor.
- (vi) The marks/grades achieved by the students after the re-evaluation shall be final and binding.
- (vii) Fresh Marks – sheets / Grade Card shall be issued only if the candidate secures pass marks / passing grade in the re-evaluated paper.
- (viii) Revaluation of answer scripts shall be deemed to be an additional facility provided to the students with a view to improving upon their results at the preceding examination result for any reason whatsoever shall not confer any right upon them for admission to next higher class which matters always be regulated in accordance with the relevant rules or regulations framed by the University.
- (ix) If as a result of revaluation of the candidate attracts the provision of condonation of deficiency, the same may be applied to his/her only for fresh attempt.

# INSTRUCTION TO TEACHERS AND STUDENTS

## (Teaching and Learning Methods)

In all the courses the teacher has to select topics for teacher-method which should not be less than 20 percent. The approach will be direct classroom teaching through a series of lectures delivering concepts using ITC facilities, white or blackboard. Notes may also be circulated to the students; however, the students are to be involved in the preparation of the notes. The teacher will be responsible for selecting the best note for circulation. The teacher-centric methodology has recently fallen out of favour because this strategy for teaching is seen to favour passive students.

### 1. Student- centric / Constructivist Approach:

The topics of the courses may be selected at the start of the class and assigned one topic to each of the students for studying by themselves, prepare presentations, notes, etc., and present at respective class time after consultation and discussion with the course teachers. The teacher facilitates the learning of the students by guiding and providing input and explaining concepts. 60 percent of the course contents may be selected for this purpose. To avoid behaviour problems, teachers must lay a lot of groundwork in student-centric classrooms. Typically, it involves instilling a sense of responsibility in students. In addition, students must learn internal motivation.

**a. Project-Based Learning:** The teacher may select 5 percent of topics for the purpose and may conduct visits to the laboratory for experiments or field surveys. The selection of the topic may be done considering the available facility for the purpose. However, in the final semester of each of the programme the student has to undergo project-based learning at least 4 months duration. This approach will help the student to think critically, evaluate, analyze, make decisions, collaborate, and more.

**b. Inquiry-Based Learning:** The teacher/ students are supposed to list at least five questions in each contact hour and student solve these question or search for answer which becomes the home work for the students “question-driven” learning approach. The teacher may look for the correctness of the solution or the best possible answer and discuss in the successive class. This will help in the preparation for various competitive examination and develop a habit for search for solutions.

**c. Flipped Classroom:** About 10 percent of the course content has to be completed by this method. In this approach the students are asked to watch video or lecture prepared by the teacher or any video available (relevant to the course). A set of questions may be given to the students for searching answers by the students. The idea is that students should have more time in-classroom focusing on achieving these higher levels of thinking and learning. The Flipped classroom is also an acronym. The letters FLIP represent the four pillars included in this type of learning: Flexible environment, Learning culture shift, Intentional content, and Professional educator. As you can see, the second pillar refers to a culture shift from the traditional approach where students are more passive to an approach where students are active participants. As a result, this approach is also a student-centric teaching method.

**d. Cooperative Learning:** The remaining five percent has to be completed by cooperative learning approach. In this approach, the students are allotted problems. During library hours the students along with the teacher visit the library and search for probable solutions for the assigned problem. The same has to be done in groups so that the students discuss among themselves for the appropriate answers. Essentially, cooperative learning believes that social interactions can improve learning. In addition, the approach recreates real-world work situations in which collaboration and cooperation are required.

**The percentage categorization for the completion of a theory course**

Teacher-centric or Direct Classroom Teaching: Delivery by series of lectures	20%
Student-centric Approach, Students present and deliver lectures in the presence of teacher and supervised by teacher	60%
Students visit fields or perform experiments or teachers perform demonstration	05%
Flipped Classroom approach	10%
Cooperative learning approach	05%

**Inquiry-based approach has to be followed in all of the classes**

The teacher has to distribute the topics to be considered for teaching by the above-mentioned approaches and prepare a lesson plan for execution and maintain a file.

## Curriculum Framework

### Breakdown of Credits

Sl. No	Category	Total number of Credits
1	University Core(UC)	09
2	University Elective (UE)	18
3	Program Core(PC)	82
4	Program Elective (PE)	0
5	Faculty Elective (FE)	8
<b>Total number of credit</b>		<b>117</b>

### Breakdown by categories of courses

Sl no	Category	Credits	%
1	Science	105	89.74
2	Engineering	01	.85
3	Commerce and Management	01	.85
4	Humanities and Social Sciences	08	6.84
	Paramedical Sciences	02	1.72
<b>Total</b>		<b>117</b>	<b>100%</b>



## SEMESTER WISE COURSE DISTRIBUTION

	S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
					L	T	P	S	R	O		IA*	SEE*	PE*	
<b>Semester I</b>	1.	22BSBT111R	Cell biology	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22BSBT112R	General Microbiology	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSBT113R	Biomolecules	PC	3	0	2	0	0	0	4	40	60	100	200
	4	22BSBT114R	Basic chemistry	PC	3	0	0	0	0	0	3	40	60	0	100
	5	22UBPD113R	Introductory English	UE	0	0	4	0	0	0	2	0	0	100	100
	6	22UBEC111	Extra-curricular (Non -CGPA)	UC	0	0	0	4	0	0	1	0	0	0	0
	<b>Total</b>										<b>18</b>				<b>800</b>
<b>Semester II</b>	S. No.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
					L	T	P	S	R	O		IA*	SEE*	PE*	
	1.	22BSBT121R	Genetics	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22BSBT122R	Applied Biochemistry	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSBT123R	Biophysical Chemistry	PC	3	0	0	0	0	0	3	40	60	0	100
	4	22BSBT124R	Bioinstrumentation	PC	2	0	2	0	0	0	3	40	60	0	100
	5	22UBES101R	Environmental Studies	UE	2	0	0	0	0	0	2	40	60	0	100
	6	22UBPD123R	Implicative English	UE	0	0	4	0	0	0	2	0	0	100	100
	7	22UBCC121	Co-curricular (non -CGPA)	UC	0	0	0	4	0	0	1	0	0	0	0
	8	22UBEC121	Extra-curricular (non -CGPA)	UC	0	0	0	4	0	0	1	0	0	0	0
	9	22BSBT125R	Techno-Professional Skill-I	PC	0	0	2	0	0	0	1	0	0	100	100
10	22BSCE111R	MOOCs I	FE	0	0	4	0	0	0	2	0	0	100	100	
	22UCDL103R	Computational Systems and Digital World	UE	0	0	2	0	0	0	1	0	0	100	100	
<b>Total</b>										<b>24</b>				<b>1000</b>	

S. No.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1.	22BSBT211R	Immunology	PC	3	0	2	0	0	0	4	40	60	100	200
2	22BSBT212R	Molecular biology	PC	3	0	2	0	0	0	4	40	60	100	200
3	22BSBT213R	Developmental Biology	PC	3	0	0	0	0	0	3	40	60	0	100
4	22UBPD213R	Proficient Communication	UE	0	0	4	0	0	0	2	0	0	100	100
5	22UBCC211	Co-Curricular (Non - CGPA)	UC	0	0	0	4	0	0	1	0	0	0	0
6	22UBEC211	Extra-curricular (Non -CGPA)	UC	0	0	0	4	0	0	1	0	0	0	0
7	22UUHV101R	UHV+ Professional Ethics	UC	1	0	2	0	0	0	2	40	60	100	200
8	22BSBT219R	Techno-Professional Skill-II	PC	0	0	2	0	0	0	1	0	0	100	100
9	22BSBT2110R	Generic Elective	UE	2	0	0	0	0	0	2	40	60		100
10	22UUFL202R	Personal Financial Planning	UE	0	0	2	0	0	0	1	0	0	100	100
11	22UULS202R	Basic Life Saving Skills (BLSS)	UE	0	0	2	0	0	0	1	0	0	100	100
<b>Total</b>										<b>22</b>				<b>1300</b>

S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1.	22BSBT221R	Genetic engineering	PC	3	0	2	0	0	0	4	40	60	100	200
2	22BSBT222R	Biostatistics	PC	3	0	0	0	0	0	3	40	60	0	100
3	22BSBT223R	Bioinformatics and Computer Applications	PC	2	0	2	0	0	0	3	40	60	100	200
4	22UBPD213R	Campus to Corporate	UE	0	0	4	0	0	0	2	0	0	100	100
5	22UBCC221	Co-Curricular (Non - CGPA)	UC	0	0	0	4	0	0	1	0	0	0	100
6	22UBEC221	Extra-Curricular (Non -CGPA)	UC	0	0	0	4	0	0	1	0	0	0	100
7	22BSBT224R	Techno-Professional Skill-III	PC	0	0	2	0	0	0	1	40	60	0	100
8	22BSBT225R	Generic elective	UE	0	0	2	0	0	0	2	0	100	0	100
9	22BSCE221R	MOOCs-II	FE	0	0	4	0	0	0	2	0	0	100	100
10	22UULS201R	Basic Acclimatizing Skills (BAS)	UE	1	0	0	0	0	0	1	0	0	100	100
<b>Total</b>										<b>20</b>				<b>1200</b>

	S. N.	Course Code	Course Title	Course Category	Engagement							Maximum Marks for			
					L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
<b>Semester V</b>	1.	22BSBT311R	Medical Biotechnology	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22BSBT312R	Industrial Biotechnology	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSBT313R	Animal Biotechnology	PC	3	0	2	0	0	0	4	40	60	100	200
	4	22BSBT314R	Plant and Agriculture Biotechnology	PC	3	0	2	0	0	0	4	40	60	100	200
	5	22BSBT315R	Research project part I	PC	0	0	0	0	12	0	2	0	0	0	100
	6	22BSBT316R	Techno-professional skill-IV	UC	0	0	0	4	0	0	1	0	0	0	100
	7	22BSCE311R	MOOCs-III	FE	0	0	4	0	0	0	2	0	0	100	100
	<b>Total</b>										<b>21</b>				<b>1100</b>
<b>Semester VI</b>	S. N.	Course Code	Course Title	Course Category	Engagement							Maximum Marks for			
					L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
	1.	22BSBT321R	Research Methodology, Bioethics and IPR	PC	4	0	0	0	0	0	4	40	60	0	100
	2	22BSBT322R	Research Project Part II	PC	0	0	0	0	36	0	6	0	0	0	100
4	22BSCE321R	MOOCs-IV	FE	0	0	4	0	0	0	2	0	0	100	100	
<b>Total</b>											<b>12</b>				<b>300</b>

**\*IA: Internal Assessment, SEE: Semester End Examination,  
PE: Practical Examination**

SEMESTER – I									
Course Title	Cell Biology								
Course code	22BSBT111R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce and make students understand about the fundamentals and advances of cytology including structure and functions of cell and cell organelles, cell cycle, cell division, also by observing it under microscope.</li> <li>2. To inculcate knowledge and skills on various staining techniques, and understand cell structure by observing them under microscope</li> <li>3. Gain proficiency in laboratory techniques commonly used in cell biology research, including microscopy, cell culture, and molecular biology assays.</li> </ol>								
CO1	Understand cellular organization, functions, microscopy and structural differences.								
CO2	Describe membrane structure, function, cell organization and the proteins involved in transportation.								
CO3	Elaborate chromosomal structure and types.								
CO4	Understand the mechanism of cell-to-cell communication.								
CO5	Describe the cell cycle and division in general and in some specific cell types.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Fundamentals of Cell Biology:</b> (Cell theory, Prokaryote and Eukaryote cell: Structure and Function of cells); <b>Tools and Technique of Cytology:</b> (Microscopy and Staining).	7	Describe, illustrate and explain cell organization and functions, microscopy and structural differences.				1,2		
II	<b>Cell Membranes:</b> Model, Structure, function; Cell junctions and adhesion; Transport proteins; Membrane Proteins; Membrane potential; Transport across plasma membrane.	10	Describe, illustrate and explain membrane structure, function; cell organization and the proteins involved in transportation.				1,2		
III	<b>Chromosomes:</b> Morphology (Structural organization: nucleosome, solenoid model, chromatid, centromere and telomere); Types (special type).	10	Describe, illustrate and explain chromosomal structure and types.				1,2		
IV	<b>Cell trafficking and signalling:</b> cell signals; signalling pathways; cell surface receptors, protein phosphorylation; Quorum sensing phenomenon.	8	Describe, illustrate and explain the mechanism of cell to cell communication				1,2		
V	<b>Cell Division &amp; Cell Cycle:</b> regulation, growth and differentiation; Overview of Stem cells, Germ cells, Cancer cells, Apoptosis and Necrotic cell death	10	Describe, illustrate and explain the cell cycle and division in general and in some specific cell types				1,2		
Practical	<ol style="list-style-type: none"> <li>1. Staining and microscopic observation of various stages of Mitosis of given sample(s).</li> <li>2. Staining and microscopic observation of various stages in Meiosis of given sample(s).</li> </ol>	30	Describe, illustrate and explain and apply staining techniques and carry out microscopic examination.				1,2, 3,4		

**TEXT BOOKS:**

T1:Alberts B, Johnson A, Lewis J, et al. Molecular Biology of the Cell. 4th edition. New York: Garland Science; 2002.

**REFERENCE BOOKS:**

R1: Cooper GM. The Cell: A Molecular Approach. 2nd edition.Sunderland (MA): Sinauer Associates; 2000.

R2: Ambrose and Dorothy. Cell Biology. 2nd Edition. MEasty, ELBS Publications; 1970.

R3: Sharp, Lester W. Fundamentals of Cytology. 1st edition. Mc Graw Hill Company; 1943.

**OTHER LEARNING RESOURCES:**

<https://www.ncbi.nlm.nih.gov/books/NBK9839/?term=cell%20Biologpy>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Understand cellular organization, functions, microscopy and structural differences.	1, 2,3
2	Describe membrane structure, function, cell organization and the proteins involved in transportation.	1, 2
3	Elaborate chromosomal structure and types.	1, 2
4	Understand the mechanism of cell-to-cell communication.	1, 2
5	Describe the cell cycle and division in general and in some specific cell types.	1, 2

SEMESTER – I									
Course Title	General Microbiology								
Course code	22BSBT112R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To introduce the history, concept and importance of microorganisms in the field of biotechnology, medical, agriculture etc. 2. To impart knowledge and skills on various instruments and techniques used for isolation, culture and identification of microbes.								
CO1	Describe fundamentals of microbiology and contributions made by many eminent scientists.								
CO2	Describe and explain microscopes and their principle and uses.								
CO3	Apply the knowledge on the use of autoclave, hot air oven, laminar air flow, microscope and isolate microbes, and culture.								
CO4	Explain the methods of classification of microorganisms.								
CO5	Describe the methods for culturing microorganisms.								
Unit-No.	Content		Contact Hour	Learning Outcome					KL
I	<b>Fundamentals of Microbiology:</b> History (Contributions of A.V. Leeuwenhoek, Louis Pasteur, Koch Joseph Lister, and Alexander Flamming); Scope; Terms & Definition; Importance of Microbiology; Branches of Microbiology.		7	Describe, fundamentals of microbiology and contributions made by many eminent scientists.					1,2
II	<b>Microscopy:</b> Simple, compound, phase contrast and electron microscope.		10	Able to describe and explain microscopes and their principle and uses					1,2
III	<b>Microbial Techniques:</b> Sterilization & filter ( <b>Physical methods:</b> Autoclave, Hot air oven, Laminar airflow, Seitz filter, Sintered glass filter, membrane filter; <b>Chemical Methods:</b> Alcohol, Aldehydes, Phenols, Halogens and Gaseous agents; <b>Radiation:</b> UV rays and Gamma rays); <b>Staining Techniques:</b> Principles, Types (simple Structural stains, acid fast and Differential stains)		10	Describe, illustrate and explain the basic techniques such as sterilization, staining etc., used in a microbiological study.					1,2
IV	<b>Microbial Taxonomy:</b> Concept of species & strains; classification of bacteria; Typical bacterial cell (structure & function; forms); Gram positive & negative bacteria; Classification based on serotyping and nutrition of microbes; Microbes of extreme environment		8	Describe, illustrate and explain the methods of classification, structures and functions of a typical bacterial cell					1,2
V	<b>Culturing microbes:</b> Media & types; Isolation and screening; Growth curve; Maintenance and preservation of microbial cultures		10	Describe, illustrate and explain isolation, screening and culturing of microorganisms.					1,2

<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Laboratory Safety, preparation for experiment, and laboratory waste management.</li> <li>2. Principle, operation and measurement of pH of a given sample</li> <li>3. Principle and operation of Hot air oven, Autoclave, Laminar airflow and centrifuge.</li> <li>4. Isolation of microbes from given sample by serial dilution techniques and estimation of the CFU (Pour plate and streak plate techniques also be learned)</li> </ol> Staining (gram, acid fast, endospore or any appropriate staining) of the given microbial sample and observation under microscope.	<b>30</b>	Describe, illustrate and explain and apply laboratory safety rules, set a microbiological experiment for microbial isolation, prepare slides by applying staining techniques and observe them under microscope.	1,2,3,4
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**REFERENCE BOOKS:**

R1. L.E.J.R. Casida. Industrial Microbiology. 2nd edition. New AGE International Publisher, 2019

R2. P. S. Bisen. Fontiers in microbial technology. 1st edition. C.B.S. Publishers and Distributors; 1994

R3. Alan T. Bull. Biotechnology: International Trends and Perspectives, Issue 7. Organisation for Economic Co-operation and Development, 1982.

**OTHER LEARNING RESOURCES:** <https://www.ncbi.nlm.nih.gov/books/NBK7627/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Describe fundamentals of microbiology and contributions made by many eminent scientists.	1, 2,3
2	Describe and explain microscopes and their principle and uses.	1, 2
3	Apply the knowledge on the use of autoclave, hot air oven, laminar air flow, microscope and isolate microbes, and culture.	1, 2
4	Explain the methods of classification of microorganisms.	1, 2
5	Describe the methods for culturing microorganisms.	1, 2

SEMESTER – I									
Course Title	Bio-Molecules								
Course code	22BSBT113R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To impart knowledge and understanding on the various macro-molecules of life, their constitution, classification, structure and functions. 2. To develop skills for qualitative analysis of these molecules by biochemical methods.								
CO1	Comprehensive understanding of the structure, function and differentiation of the types of DNA and RNA								
CO2	Demonstrate the structure and correlate its properties, biological importance and the qualitative analytical tests for amino acid.								
CO3	Describe the various levels of protein organization and the forces driving them								
CO4	Outline the basics of carbohydrate in terms of its structure, classification, properties and the laboratory qualitative tests.								
CO5	Comprehensive understanding of the structure, function and differentiation of the types of lipids								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Nucleic acid:</b> Structure (Nitrogenous bases, ribose, deoxyribose, Nucleosides, nucleotides); In glycosidic and phosphodiester bonding, polynucleotide (formation, single letter code), DNA (Watson-Crick Model; forms [A,B,Z]; Physical Properties; denaturation and renaturation); RNA and its types; Clover leaf model of tRNA.	10	Describe, illustrate and explain the structure and function of nucleic acids including its different forms.				1,2		
II	<b>Amino acids:</b> Classifications; Essential and Non-Essential amino acids; Properties (physical, chemical & optical); Importance.	5	Describe, illustrate and explain the structure and properties of amino acids and classify them.				1,2		
III	<b>Protein:</b> Classification based on (shape [fibrous proteins (keratins, collagen and elastin), globular proteins (hemoglobin, myoglobin), lipoproteins, metallo proteins, glycoprotein and nucleoproteins]; chemical composition); Structure (primary, secondary, tertiary & quaternary); Denaturation and renaturation; Functions.	10	Describe, illustrate and explain the structure and function of proteins.				1,2		
IV	<b>Carbohydrates:</b> Classification; Isomerism, (D and L forms); Anomers, Epimers, Mutarotation; Monosaccharides (linear and cyclic). Disaccharides (structure, occurrence, properties and functions); Cellulose (occurrence, structure, properties and functions); Heteropolysaccharides (occurrence, types, composition and function), Homopolysaccharides.	10	Describe, illustrate and explain the structure and function of carbohydrates.				1,2		
V	<b>Lipids:</b> fatty acids; glycerol; sphingosine; classifications; and characterization; Saponification and iodine number; Properties (glycerol, fats and oils);	10	Describe, illustrate and explain the structure and function of lipids.				1,2		



	Properties and function (Phospholipids and Prostaglandins); Structure (sterols, Bile acids, steroid hormones, plant sterol, ergosterol, stigma sterol, cholesterol, glucocorticoid, mineralocorticoids); Lipoproteins (classification, composition and importance); Role of Lipids in cellular architecture and functions.			
<b>Practical</b>	Qualitative analysis of Carbohydrate <ol style="list-style-type: none"> <li>1. Fehling's Test</li> <li>2. Barfoed's Test</li> <li>3. Molisch's Test</li> <li>4. Benedict's test</li> </ol> Qualitative analysis of proteins <ol style="list-style-type: none"> <li>5. Biuret Test</li> <li>6. Xanthoproteic Test</li> <li>7. Precipitation test</li> <li>8. Heat and Acetic acid test</li> </ol> Qualitative analysis of amino acids Ninhydrin Test	<b>30</b>	Describe, illustrate and explain apply qualitative analysis of carbohydrate, protein and amino acids.	1,2,3,4

#### REFERENCE BOOKS:

**R1.** David L. Nelson, Michael Cox. Lehninger Principles of Biochemistry. 7th Edition. WH Freeman; 2017.

**R2.** Rodwell et al. Harper's Illustrated Biochemistry. 29th edition. McGraw Hill; 2012.

**R3.** Voet and Voet. Biochemistry. 3rd edition. John Wiley & Sons, 2004.

**OTHER LEARNING RESOURCES:** <https://www.ncbi.nlm.nih.gov/books/NBK545161/>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Comprehensive understanding of the structure, function and differentiation of the types of DNA and RNA	1, 2,3
2	Demonstrate the structure and correlate its properties, biological importance and the qualitative analytical tests for amino acid.	1, 2
3	Describe the various levels of protein organization and the forces driving them	1, 2
4	Outline the basics of carbohydrate in terms of its structure, classification, properties and the laboratory qualitative tests.	1, 2
5	Comprehensive understanding of the structure, function and differentiation of the types of lipids	1, 2

SEMESTER – I									
Course Title	Basic Chemistry								
Course code	22BSBT114R	Total credits: 3 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To give the knowledge about Chemical Kinetics and Ionic Equilibrium 2. To give a detailed description of atomic structure, different theories related to it and the knowledge of classical and quantum chemistry. 3. To give the knowledge of the periodic properties and HSAB theory								
CO1	Understand the order of the rate law equation, then characterize the "half-life" and temperature dependency of reaction rates using the Arrhenius equation.								
CO2	Explain the concepts of electrochemistry, electrochemical cells, acids/base, pH, buffers and solubility								
CO3	Illustrate atomic structure, Heisenberg Uncertainty principle, Quantum mechanics and Schrodinger wave equation.								
CO4	Elucidate the concepts of chemical bonding, periodic properties.								
CO5	Explain the different types of organic reactions along with their mechanisms, organic molecules and their stereochemistry.								
Unit- No.	Content		Contact Hour	Learning Outcome					KL
I	Chemical Kinetics: Order-molecularity. First and second order-nth order rate equation, temperature dependence of rate of reactions.		10	Understand underlying concepts of electrochemistry, electrochemical cells, acids/base, pH, buffers and solubility					1,2
II	Ionic equilibrium: Electrolytic conductance, Faraday's Law of electrolysis, Electrolytes, Lewis theory, Arrhenius theory for dissociation of electrolytes, ionization constants of weak acids and bases, pH, buffers, solubility products, salt effects and solubility		8	Understand atomic structure, Heisenberg Uncertainty principle, Quantum mechanics and Schrodinger wave equation. To learn about the graphical representation of different atomic orbital and how the electrons are filled in the orbital.					1,2
III	Atomic Structure: Recapitulation of Bohr's theory and its limitations, dual behaviour of matter and radiation, deBroglie's relation, Heisenberg Uncertainty principle. Need of a new approach to Atomic structure. What is Quantum mechanics, Time independent Schrodinger equation and meaning of various terms in it. Wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals. (Only graphical representation) Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy.		10	Understand the concepts of chemical bonding by using various theories, periodic properties like Atomic and Ionic size Ionization Energy Electron Affinity, Electro negativity of elements of periodic table.					1,2
IV	Chemical bonding- Various theories, covalent, hydrogen Bonding. Effective nuclear charge, atomic and ionic sizes. 6 Ionization energies, electron affinity and electronegativity, hard soft acids and bases.		10	Understand the different types of organic reactions along with their mechanisms. How to design syntheses of organic molecules. Acquire the					1,2

			knowledge of stereochemistry of organic molecules.	
V	Organic Reactions and Stereochemistry: Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule, Representations of 3 dimensional structures, structural isomers and stereo isomers. Configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.	10	Understand underlying concepts of electrochemistry, electrochemical cells, acids/base, pH, buffers and solubility	1,2

#### REFERENCE BOOKS:

R1. Graham Solomons. Solomons's Organic Chemistry, Global Edition. Wiley; 2017.

R2. Bahl, Bahl. A Textbook Of Organic Chemistry. 22th Edition. S Chand Publishing; 2019.

R3. Eliel and Wilen. Stereochemistry of Organic Compounds. 1st Edition. Wiley-Interscience. 1994.

#### OTHER LEARNING RESOURCES:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5869253/>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand the order of the rate law equation, then characterize the "half-life" and temperature dependency of reaction rates using the Arrhenius equation.	1,2
2	Explain the concepts of electrochemistry, electrochemical cells, acids/base, pH, buffers and solubility	1,2
3	Illustrate atomic structure, Heisenberg Uncertainty principle, Quantum mechanics and Schrodinger wave equation.	1,2
4	Elucidate the concepts of chemical bonding, periodic properties.	1,2
5	Explain the different types of organic reactions along with their mechanisms, organic molecules and their stereochemistry.	1,2

SEMESTER – I									
Course Title	Introductory English (Communicative English & Soft Skills)								
Course code	22UBPD113R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To recognize and identify parts of a sentence and their significance in a language.</li> <li>To enhance listening and speaking/skills for self-development.</li> <li>To give insight into English pronunciation and into central concepts in phonetics.</li> <li>Introduction to the various modes of communication will enhance their knowledge of communication.</li> </ol>								
CO1	Able to recognize the structure of a sentence and its variations as they learn to understand, speak and write.								
CO2	Illustrate the concept of Phonetics and its importance will improve the learners' pronunciation								
CO3	Explain the Knowledge of communication will be enhanced through practical examples								
CO4	Able to identify to pick and form different kinds of sentences.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Grammar</b> Parts of Speech; Articles; Auxiliary Verbs; Affirmative and Negative Sentences		10	Students will demonstrate a fundamental understanding of grammar rules.				1,2	
II	<b>Grammar</b> Determiners; Sentence Construction; Types of Sentences (Assertive, Imperative etc.); Degree of Comparison; Comprehension Exercises		8	Students will construct grammatically correct and varied sentence types.				1,2	
III	<b>Listening Skills</b> What is listening?; The Process of Listening; Factors that adversely affect Listening; Difference between Listening and Hearing; Purpose and Importance of Effective Listening; How to Improve Listening Process?		10	Students will confidently introduce themselves and engage in basic conversations with correct pronunciation.				1,2	
IV	<b>Speaking Skills</b> Introducing yourself; Self-discovery; Basics of Phonetics and pronunciation; Extempore speech; Video Recording for Self Reflection		10	Students will effectively communicate in both formal and informal settings.				1,2	
V	<b>Communication Skills</b> Introduction to Communication; Importance of Communication Skills; Purpose of Communication; Types of Communication; Formal and informal communication; Importance of Communication; Barriers to Communication; How to improve/ tips to improve Communication skills? Responding to different questions in various situations(formal/informal)		10	Students will demonstrate a fundamental understanding of communication skills				1,2	

#### REFERENCE BOOKS:

R1: Quirk, Randolp. (2010) A Comprehensive Grammar of the English Language Randolph Quirk, Sidney Greenbaum, Pearson Education India

R2: Marks, Jonathan. (2017) IELTS Advantage Speaking and Listening Skills: A step-by-stepguide to a high IELTS speaking and listening score. Book + CD-ROM, Delta Publishing byKle

**OTHER LEARNING RESOURCES:** <https://www.ef.com/wwen/english-resources/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Able to recognize the structure of a sentence and its variations as they learn to understand, speak and write.	1, 7
2	Illustrate the concept of Phonetics and its importance will improve the learners' pronunciation	1, 7
3	Explain the Knowledge of communication will be enhanced through practical examples	1, 7
4	Able to identify to pick and form different kinds of sentences.	1, 7

SEMESTER – I									
Course Title	Co-Curricular Activities								
Course code	23UBEC111	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To ascertain physical and mental development of the students and select best performers for state, national and international level competition. 2. To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.								
CO1	Students will learn to work well with others and communicate better.								
CO2	Students will learn to manage their time and stay organized.								
CO3	Students will enhance their creative abilities and think more critically.								
CO4	Students will improve their overall health and reduce stress.								
CO5	Students will become more aware of their role in society and contribute positively.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Co-curricular activities cover a wide range of experiences and pursuits that complement academic learning. They are typically organized and managed within educational institutions or communities and play a crucial role in holistic development. Some examples are  1. Sports and Physical Activities 2. Cultural Activities: 3. Academic Clubs and Competitions 4. Community Service and Volunteering 5. Leadership and Personal Development 6. Creative and Hobby-based Activities	60	1. Skill Development: Enhancing skills such as teamwork, leadership, communication, and critical thinking.  2. Holistic Growth: Supporting emotional, social, and physical development alongside academic learning.  3. Building Networks: Creating opportunities to interact with peers, mentors, and professionals.  4. Personal Fulfillment: Providing avenues for creativity, self-expression, and exploring personal interests.	1,2					

**REFERENCE BOOKS:**

R1: "Co-curricular Activities: A Pathway to Careers" by Ferguson.

R2: "Rahman, S.R., Islam, M.A., Akash, P.P., Parvin, M., Moon, N.N. and Nur, F.N., 2021. Effects of co-curricular activities on student's academic performance by machine learning. *Current Research in Behavioral Sciences*, 2, p.100057.

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will learn to work well with others and communicate better.	6,7
2	Students will learn to manage their time and stay organized.	6,7
3	Students will enhance their creative abilities and think more critically.	6,7
4	Students will improve their overall health and reduce stress.	6,7
5	Students will become more aware of their role in society and contribute positively.	6,7

SEMESTER – I									
Course Title	Extra-Curricular Activities								
Course code	23UBEC121	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To ascertain physical and mental development of the students and select best performers for state, national and international level competition. 2. To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.								
CO1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.								
CO2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.								
CO3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Based on the learner's interest they can participate in various sports, music, and co-curricular activities joining the clubs of the University (Football, Footshal; Cricket; Swimming; Basket ball; Badminton; Table Tennis; athletics and other outdoor and indoor games; Dance; Music; Vocals; Photography; Drama; Literary activities); The students are encouraged to participate in regular club activities, workshops, competitions as per their interest and hobbies; Renowned skilled professionals/ personalities are invited organising workshops to promote the talents of the students.	60	Participation in university clubs across sports, music, and extra-curricular activities cultivates diverse skills and personal growth. Students develop teamwork, leadership, and creativity through sports like football, cricket, and athletics. Musical pursuits and dance foster self-expression and coordination, while literary and drama activities enhance communication and critical thinking. Workshops led by skilled professionals provide industry insights and mentorship opportunities, preparing students for future challenges. By encouraging participation based on interests and hobbies, universities nurture well-rounded individuals who excel academically and socially, equipped with practical skills and a broadened perspective on cultural diversity and personal fulfilment.					1,2	



**REFERENCE BOOKS:**

R1: "Extracurricular Activities: Essential Guides for Students" by John G. Gabriel

R2: "Developing Personal, Social and Emotional Skills through Extra-Curricular Activities" by Sally Bailey

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.	6,7
2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.	6,7
3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.	6,7

SEMESTER – II									
Course Title	Genetics								
Course code	22BSBT121R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1. To familiarize with concepts of genetics, genetic materials, and the continuing process of evolution because of phenomenon such as linkage and crossing over, mutation etc. 2. To impart skills through hands on practice for some of the observational studies such as karyotyping and barr bodies etc.								
CO1	Describe structure of genetic material and Mendel's laws of inheritance and causes of variations.								
CO2	Explain the genetic mechanism of sex determination and dynamic structure of chromosomes.								
CO3	Illustrate the genetic mechanism crossing over that results recombination and genetic basis blood grouping in human.								
CO4	Analyze the genetic material exchange in bacteria through fundamental processes like transformation, conjugation, and transduction.								
CO5	Analyze various mechanisms of mutations and genetic stability and diversity in a population.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Fundamentals of Genetics:</b> Scope; DNA & RNA as genetic material, Structure (DNA & RNA); Mendel's Laws (Dominance, Segregation & Independent Assortment); Concepts (Alleles, Pleiotropy, Test cross, Incomplete dominance, Back cross and problems)	15	Able to describe, and explain genetic material and its implications..					1,2	
II	<b>Sex Determination:</b> (Plants, animals, humans, Drosophila); Chromosome, Autosomes; Allosomes; Sex linked genes & dosage compensation of X-linked genes.	10	Develop understanding on sex determination.					1,2	
III	<b>Linkage and Crossing Over:</b> Coupling & repulsion hypothesis; Linkage (maize, drosophila); Crossing over (mechanism, importance); chromosome mapping, (linkage mapping, physical mapping), gene interaction (supplementary factors, complementary factors, multiple factors, epistasis, allelism), blood groups in human.	10	Able to explain the linked genes and recombination because of crossing over and its role in evolution.					1,2	

<b>IV</b>	<b>Cytoplasmic Inheritance:</b> Chloroplast inheritance (Mirabilis); Mitochondria (yeast); kappa particles (paramecium); <b>Bacterial Genetics:</b> (Transformation, conjugation, Transduction)	10	Able to describe the extra-nuclear inheritance including bacterial genetics	1,2
<b>V</b>	<b>Mutations:</b> (Spontaneous; induced); Chromosomal mutation (deletions duplications, inversions), Trisomy and polyploidy. Aneuploids –Nullisomics, Monosomics, and disomics); Population genetics (Mendelian population, Hardy Weinberg equilibrium, maintenance and establishment of equilibrium)	15	Able to describe the various phenomenon associated with chromosomal aberration and mutations.	1,2
<b>Practical</b>	1. Preparation of buccal smear and observe the Barr bodies under a microscope, 2. Chromosomal staining for the observation of karyotypes 3. Practice on crosses based on Mendel's laws.	30	able to analyse the chromosome associated with various genetic problems	1,2, 3,4

#### REFERENCE BOOKS:

**R1.** Gupta. Genetics. 8<sup>th</sup> edition. Rastogi Publications; 2009.

**R2.** Gardener et al. Principles of Genetics. 12<sup>th</sup> edition. Wiley; 2004.

**R3.** Verma, Agarwal. Cell Biology, Genetics, Evolution & Ecology. 1<sup>st</sup> edition. S Chand Publication; 2006.

**OTHER LEARNING RESOURCES:** <https://www.ncbi.nlm.nih.gov/books/NBK115568/>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe structure of genetic material and Mendel's laws of inheritance and causes of variations.	1,2
2	Explain the genetic mechanism of sex determination and dynamic structure of chromosomes.	1,2
3	Illustrate the genetic mechanism crossing over that results recombination and genetic basis blood grouping in human.	1,2
4	Analyze the genetic material exchange in bacteria through fundamental processes like transformation, conjugation, and transduction.	1,2,3
5	Analyze various mechanisms of mutations and genetic stability and diversity in a population.	1,2

SEMESTER – II									
Course Title	Applied Biochemistry								
Course code	22BSBT122R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<p>1. To make the students understand about enzymes and their mechanisms of action, minerals &amp; vitamins, their role in regulating the function of cells, harness energy by carbohydrate and protein metabolisms and the plant growth regulators.</p> <p>2. To impart skills for quantitative estimation of DNA, RNA, proteins and carbohydrates and extraction</p>								
CO1	Describe enzymes, enzyme kinetics, including carbohydrates, and protein metabolism.								
CO2	Explain the physiological roles of vitamins and minerals and their contribution for overall growth and development of the human body.								
CO3	Describe the generation of cellular energy in our body through regulation of carbohydrate metabolism.								
CO4	Illustrate the interconnection between protein metabolism in our body and different associated metabolic pathways.								
CO5	Analyze the physiological effects of plant growth regulators in plant growth and development								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Enzyme:</b> History, Terminology, General characteristics Classification, nomenclature; Coenzyme; cofactor; active site; ribozyme; Mechanism OF action (Lock & key model; Induced fit model), <b>Enzyme Kinetics</b> (Michaelis-Menten equation, Line weaver Burk plot), Enzyme (inhibition, specificity, Application).	15	Able to describe, explain and illustrate the enzymes and enzyme kinetics.					1,2	
II	<b>Vitamins and Minerals:</b> Definition; Types; Functions; classification; sources; deficiency Disorder.	10	Able to explain the types, sources and functions of vitamins and minerals.					1,2	
III	<b>Carbohydrate metabolism:</b> Glycolysis, oxidation of pyruvate, TCA cycle, metabolism of glycogen, gluconeogenesis, pentose phosphate pathway, glyoxylate pathway, Mitochondrial electron transport, oxidative phosphorylation, inhibitors.	10	Able to explain and illustrate the pathway for carbohydrate metabolism and the enzymes involved.					1,2	
IV	<b>Protein Metabolism-</b> Degradation of proteins, Oxidative, Non- Oxidative deamination and decarboxylation of amino acids, Urea Cycle and Creatinine formation.	10	Able to explain and illustrate the pathway for protein metabolism and the enzymes involved.					1,2	

<b>V</b>	<b>Plant growth regulators-</b> Auxins, Gibberellins, Cytokinin's. Absciscic acid and ethylene. <b>Photosynthesis-</b> Structure of photosynthetic apparatus, C3 and C4 pathways, Light and Dark reaction, <b>Nitrogen metabolism</b> and fixation of nitrogen in leguminous plants.	15	Able to understand the plant growth regulators and their functions, and also explain and illustrate CO <sub>2</sub> and N <sub>2</sub> Fixation.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Quantitative estimation of Proteins (Lowry's method).</li> <li>2. DNA (Diphenylamine method),</li> <li>3. RNA (Orcinol method),</li> <li>4. Amino acids (Ninhydrin reaction),</li> <li>5. sugars (Dinitro salicylic acid method)</li> <li>6. Extraction of Protein from milk</li> </ol>	30	Able to estimate the sugars, proteins, DNA, RNA and amino acids of given sample and extract protein from milk.	1,2,3,4

#### REFERENCE BOOKS:

- R1. U Satyanarayana. Biochemistry. 13th edition. Elsevier Health Sciences; 2017.  
R2. David L. Nelson, Michael Cox. Leininger Principles of Biochemistry. 7th Edition. WH Freeman; 2017.  
R3. Rodwell et al. Harper's Illustrated Biochemistry. 29th edition. McGraw Hill; 2012.

**OTHER LEARNING RESOURCES:** <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4692135/>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe enzymes, enzyme kinetics, including carbohydrates, and protein metabolism.	1,2
2	Explain the physiological roles of vitamins and minerals and their contribution for overall growth and development of the human body.	1,2
3	Describe the generation of cellular energy in our body through regulation of carbohydrate metabolism.	1,2
4	Illustrate the interconnection between protein metabolism in our body and different associated metabolic pathways.	1,2
5	Analyze the physiological effects of plant growth regulators in plant growth and development	1,2

SEMESTER – II									
Course Title	Biophysical Chemistry								
Course code	22BSBT123R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1. Introduce the students about concept of buffer, pH, acid and base, chemical bonding and the energy relationships 2. Make them understand how the protein folds and what phenomenon lead to protein folding								
CO1	Learn the concepts of pH, buffers and related theories.								
CO2	Explain quantum mechanics and the laws associated with it.								
CO3	Illustrate the different bonding and forces for interaction of a molecule.								
CO4	Know the laws of thermodynamics.								
CO5	Explain the mechanism of protein folding								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>PH &amp; Buffer:</b> Introduction; Bronsted & Lowry theory; Lewis theory; Buffering action; Buffer Capacity; H-H equation; Biological Buffers; Properties of water	15	Describe, illustrate and explain pH, buffers and related theories				1,2		
II	<b>Quantum mechanics:</b> Atomic structure (Shape of atomic orbital); Black body radiation; Plank's law; Photoelectric effect; Hybridization structure of atom.	10	Describe, illustrate and explain quantum mechanics and the laws associated with it.				1,2		
III	<b>Chemical bonding:</b> Ionic, Covalent, Hydrogen bond; Peptidyl bond; Vander Waal Forces	10	Describe and explain the different bonding and forces for interaction of a molecule				1,2		
IV	<b>Thermodynamics:</b> First law (concept of internal energy); Second law (free energy, enthalpy, entropy); free energy in biological system, 3rd law; Significance and limitation	10	Describe, illustrate and explain the laws of thermodynamics				1,2		
V	<b>Concepts of protein folding:</b> (Amino acids, hydrophilic, & hydrophobic properties);Biophysics of cell membranes.	15	Describe, illustrate and explain the mechanism of protein folding				1,2		

#### REFERENCE BOOKS:

- R1.** Allen J. P. Biophysical chemistry. 1st Edition. Wiley-Blackwell; 2009.
- R2.** David L. Nelson, Michael Cox. Lehninger Principles of Biochemistry. 7th Edition. WH Freeman; 2017.
- R3.** Holde, Johnson and Ho. Principles of Physical Biochemistry. 2ndEdition. Pearson Prentice Hall; 2005.

**OTHER LEARNING RESOURCES:**

<https://pubmed.ncbi.nlm.nih.gov/21268996/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Learn the concepts of pH, buffers and related theories.	1,2
2	Explain quantum mechanics and the laws associated with it.	1,2
3	Illustrate the different bonding and forces for interaction of a molecule.	1,2
4	Know the laws of thermodynamics.	1,2
5	Explain the mechanism of protein folding	1,2

SEMESTER – II									
Course Title	Bioinstrumentation								
Course code	22BSBT124R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1. To make the students understand about the principle, types and applications of instruments such as chromatography, centrifugation, gel-electrophoresis, blotting, radioisotopes and spectroscopy. 2. To develop skills on operations of chromatography, centrifugation, gel-electrophoresis and spectroscopic analysis.								
CO1	Describe all the chromatographic techniques and their history, principles, working principle and applications in various fields.								
CO2	Explain centrifugation, its principles, and its diverse applications.								
CO3	Explain different techniques used in molecular biology techniques such as gel electrophoresis, pH measurement, dialysis, and blotting.								
CO4	Illustrate the principle, application of radioisotope dating and mechanism of radioactive decay.								
CO5	Analyze the working principle of various spectroscopic methods and their applications in determining concentration and molecular structure.								
Unit-No.	Content				Contact Hour	Learning Outcome			KL
I	<b>Chromatography:</b> History; Classification; Types, principles, operation, application & analysis (Paper, Column, Adsorption column, Partition, Thin layer, Ion exchange, quantitative Ion exchange, and Gel Chromatography):				15	Describe, illustrate and explain pH, buffers and related theories			1,2
II	<b>Centrifugation:</b> Types; Application; Principle; rotors; density gradient & analytical centrifugation.				10	Describe, illustrate and explain quantum mechanics and the laws associated with it.			1,2
III	<b>Gel Electrophoresis:</b> Application; Types; Principle; pH meter (Principle); Dialysis, <b>Blotting technique:</b> Southern, Western, & Northern blot				10	Describe and explain the different bonding and forces for interaction of a molecule			1,2
IV	<b>Radio- isotope dating technique:</b> Introduction, nature, detection & measurement of radioactivity, radioisotopes & radiation, units, radioactive decay.				10	Describe, illustrate and explain the laws of thermodynamics			1,2
V	<b>C Spectroscopic techniques:</b> Introduction, Principle and application of spectroscopy				15	Describe, illustrate and explain the mechanism of protein folding			1,2



<b>Practical</b>	Operation of molecules from given sample by 1. Paper chromatography 2. Column chromatography 3. Thin layer chromatography 4. Separation of DNA and protein molecules by gel Electrophoresis	30	Able to use various instruments for analysis	1,2
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#### REFERENCE BOOKS:

R1. Upadhyay. Biophysical chemistry: principle and technique. 12th edition. Himalaya Publishing House Pvt. Ltd; 2017.

R2. Kakkar. Atomic and Molecular Spectroscopy. 1st edition. Cambridge English; 2017.

R3. Evans. Handbook of Chromatography. 2nd Edition, Willford Press; 2019.

**OTHER LEARNING RESOURCES:** <https://pubmed.ncbi.nlm.nih.gov/22274891/>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe all the chromatographic techniques and their history, principles, working principle and applications in various fields.	1,2,3
2	Explain centrifugation, its principles, and its diverse applications.	1,2,3
3	Explain different techniques used in molecular biology techniques such as gel electrophoresis, pH measurement, dialysis, and blotting.	1,2,3
4	Illustrate the principle, application of radioisotope dating and mechanism of radioactive decay.	1,2,3
5	Analyze the working principle of various spectroscopic methods and their applications in determining concentration and molecular structure.	1,2,3

SEMESTER – II									
Course Title	Environmental Studies								
Course code	22UBES101R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30	2	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<p>1. To prepare students for careers as leaders in understanding and addressing complex environmental issues from a problem-oriented, interdisciplinary perspective.</p> <p>2. To develop a world population that is aware of and concerned about the environment and its associated problems and which has the knowledge, Skills, attitudes, motivations and commitment to work individually and collectively towards solutions of current problems and prevention of new ones.</p>								
CO1	The students will be able to appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.								
CO2	Students will learn about natural resource, its importance and environmental impacts of Human activities on natural resource								
CO3	Gain knowledge about environment and ecosystem, Students will be able to understand the concept of biodiversity and respect them								
CO4	Gain knowledge about the conservation of biodiversity and its importance.								
CO5	Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Multidisciplinary nature of environmental studies:</b> Definition, scope and importance, Need for public awareness.	4	Environmental studies combines sciences to tackle environmental issues. Its multidisciplinary approach is key to solving complex problems. Public awareness and education are vital for promoting sustainability				1,2		
II	<b>Natural Resources: Renewable and non-renewable resources,</b> Natural resources and associated problems. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by	6	Natural resources, both renewable and non-renewable, face exploitation issues, including deforestation, overuse of water resources, environmental challenges with minerals and food, and land degradation. Individuals play a crucial role in conserving resources and promoting sustainability.				1,2		

	<p>agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.</p> <p>Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles</p>			
<b>III</b>	<p><b>Ecosystems:</b> Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the Following ecosystem: - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)</p>	4	<p>This module covers ecosystems, including their concept, structure, functioning, and diversity. Students will learn about energy flow, ecological succession, and various ecosystem types like forests, grasslands, deserts, and aquatic ecosystems.</p>	1,2
<b>IV</b>	<p><b>Biodiversity and its conservation:</b> Introduction – Definition: genetic, species and ecosystem diversity. Bio-geographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a megadiversity nation• Hot-sports of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.</p>	5	<p>This module covers biodiversity, including its definition, value, levels, and threats. Students will learn about India's bio-geographical classification, its status as a megadiversity nation, and key biodiversity hotspots. They'll also explore threats like habitat loss, wildlife poaching, and human-wildlife conflicts, crucial for conservation efforts.</p>	1,2
<b>V</b>	<p><b>Environmental Pollution:</b> Definition Cause, effects and control measures of:- Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste, Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.</p>	5	<p>This module covers environmental pollution, including causes, effects, and control measures, alongside waste management and disaster preparedness strategies.</p>	1,2

	Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.			
<b>VI</b>	<p><b>Social Issues and the Environment:</b> From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case Studies.</p> <p><b>Environmental ethics:</b> Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Waste land reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.</p>	6	This module explores social-environmental dynamics, including urban energy challenges, water conservation, and resettlement issues. It delves into environmental ethics, climate change impacts, and relevant legislation like the Environment Protection Act, emphasizing public awareness and enforcement challenges.	1,2
<b>VII</b>	<p><b>Human Population and the Environment:</b> Population growth, variation among nations. Population explosion – Family Welfare Programme. Environment and human health. Human Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies.</p>	4	This module covers human population dynamics, including growth, impact on the environment and health, along with initiatives like Family Welfare Programs and the role of information technology, illustrated with case studies.	1,2
<b>VIII</b>	<p><b>Field work:</b> Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)</p>	5	Fieldwork objectives include documenting environmental assets like rivers and forests, assessing pollution in urban or rural sites, and studying local biodiversity and ecosystems such as ponds and hill slopes	1,2

**REFERENCE BOOKS:**

**R1.** Bharucha. Textbook of Environmental Studies for Undergraduate Courses. 2nd edition. Orient Black

swan Publishing; 2019.

**R2.** Trivedy Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and

II, Enviro Media(R). B.S. Publications; 2010.

**R3.** Trivedi, Goel. Introduction to air pollution. 1st publication. Techno-Science Publication (TB); 2003.

**OTHER LEARNING RESOURCES:** <https://pubmed.ncbi.nlm.nih.gov/22274891/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	The students will be able to appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.	1, 4
2	Students will learn about natural resource, its importance and environmental impacts of Human activities on natural resource	1, 4
3	Gain knowledge about environment and ecosystem, Students will be able to understand the concept of biodiversity and respect them	1, 4
4	Gain knowledge about the conservation of biodiversity and its importance.	1, 4
5	Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.	1, 4

SEMESTER – II									
Course Title	IMPLICATIVE ENGLISH (Communicative English & Soft Skills)								
Course code	22UBPD123R	Total credits: 2 Total hours: 30	L	T	P	S	R	O/F	C
			0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1. To introduce the types of sentences and their significance. 2. To strengthen the vocabulary of the students to enhance student' vocabulary to enhance their speaking and writing skills it the importance of dress codes in various organisations. 3. To introduce the 3P's (Planning, prioritizing & performing) of Time Management.								
CO1	Provide students with the ability to transform sentence types, utilize different tenses, and address common grammatical mistakes.								
CO2	Empower students to proficiently apply one-word substitutions, differentiate between homonyms and homophones, avoid frequently confused words, and incorporate idioms and phrases in their vocabulary.								
CO3	Assist students in comprehending the various aspects and types of listening, and in identifying and overcoming obstacles to effective listening.								
CO4	Facilitate students in employing effective reading strategies, extracting relevant information from texts, and utilizing the SQ3R method.								
CO5	Instruct students on the significance of time management and provide foundational strategies to manage their time efficiently.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	Grammar (flipped classroom)		6	Students will accurately construct and transform various sentence types and correct grammatical errors.				1,2,3	
i. Interchange of Interrogative and Assertive Sentences, Exclamatory and Assertive Sentences ii. Types of Tenses iii. Common Errors									
II	Vocabulary Development		6	Students will enhance their vocabulary and use words accurately in context.				1,2,3	
i. One word substitution ii. Homonyms and Homophones iii. Words often confused iv. Idioms and phrases									
III	Listening Skills		5	Students will demonstrate effective listening skills and identify listening barriers.				1,2,3	
I. What is listening? ii. Types of Listening iii. Understanding Listening Barriers									
IV	Reading Skills		5	Students will read efficiently and extract relevant information using the SQ3R technique.				1,2,3	
i. Techniques of Effective Reading ii. Gathering ideas and information from a text iii. The SQ3R Technique									
V	Time-Management Skills		4	Students will effectively manage their time using various strategies.				1,2,3	
i. Introduction to Time Management ii. Purpose and Importance of Time Management									

	iii. Basic Tips to Maintain Time			
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**REFERENCE BOOKS:**

**R1:** Wren, P.C and Martin, H. 1995. High School English Grammar and Composition, S ChandPublishing.

**R2:** Barrett, Grant. 2016. Perfect English Grammar: The Indispensible Guide to Excellent Writing and Speaking, ZephyrosPress

**R3:** Mccarthy. (2008) English Vocabulary in Use Upper - Intermediate with CD ROM, Cambridge UniversityPress

**OTHER LEARNING RESOURCES:** <https://pubmed.ncbi.nlm.nih.gov/22274891/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Provide students with the ability to transform sentence types, utilize different tenses, and address common grammatical mistakes.	1,7
2	Empower students to proficiently apply one-word substitutions, differentiate between homonyms and homophones, avoid frequently confused words, and incorporate idioms and phrases in their vocabulary.	1,7
3	Assist students in comprehending the various aspects and types of listening, and in identifying and overcoming obstacles to effective listening.	1,7
4	Facilitate students in employing effective reading strategies, extracting relevant information from texts, and utilizing the SQ3R method.	1,7
5	Instruct students on the significance of time management and provide foundational strategies to manage their time efficiently.	1,7

SEMESTER – II									
Course Title	Techno Professional Skills - I								
Course code	22BSBT125R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1. To develop proficiency in different techniques involving microbiology, cell biology. 2. To enable students to interpret morphologies of microorganisms and chromosomes. 3. To make students learn about microbiological techniques.								
CO1	Students will obtain proficiency in identification of microbial isolates								
CO2	Students will attain expertise in karyotyping and handling of chromosomal specimens.								
CO3	Students will understand the growth parameters of different microorganisms.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	1. Study of polytene chromosome in Drosophila. 2. Study of meiosis in grasshopper testis/ onion flower bud 3. Staining techniques: <ul style="list-style-type: none"> <li>• Capsule stain</li> <li>• Spore stain</li> <li>• Acid fast stain</li> <li>• Negative staining</li> </ul> 4. IMVIC test 5. Different Streaking methods for pure culture preparation 6. Isolation of fungi and their characterization from different sources 7. Preparation of different buffer system 8. Agarose gel electrophoresis	30	This module introduces key lab techniques: polytene chromosome analysis, meiosis study, staining methods (capsule, spore, acid-fast, negative), IMVIC test, streaking methods, fungi isolation, buffer prep, and agarose gel electrophoresis, fostering proficiency in biological research					1,2	

#### REFERENCE BOOKS:

**R1:** Brown. Benson's Microbiological Applications Laboratory Manual in General Microbiology. 10<sup>th</sup> edition. McGraw-Hill Education, 2006.

**R2:** Atlas. Handbook of Microbiological Media, 4th edition. ASM press, 2010.

**R3:** Mishra et al. Cell Biology. 12th Edition. Mahaveer Publications, 2020.

**OTHER LEARNING RESOURCES:** <https://pubmed.ncbi.nlm.nih.gov/22274891/>



**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM  
OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will obtain proficiency in identification of microbial isolates	1,2
2	Students will attain expertise in karyotyping and handling of chromosomal specimens.	1,2
3	Students will understand the growth parameters of different microorganisms.	1,2

SEMESTER – II									
Course Title	Computational System and Digital Literacy								
Course code	22UUDLI103R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>Students will be able to understand the fundamentals of computer systems and Internet search along with advanced features of MS-Office.</li> <li>Students will be able to learn data management, statistical analysis and visualization.</li> <li>Students will be able to use social media and e-commerce portals, Digital Payment systems, and other utility software.</li> </ol>								
CO1	Students will have basic understanding of Computer Systems and Internet search. Products.								
CO2	Students will be able to solve data analysis, management and visualization issues using MS-Office								
CO3	Students will be able to efficiently and ethically use social media and e-commerce sites.								
CO4	Students will have introduction to various utility software used in research and informationManagement.								
Unit-No.	Content	Contact Hour							KL
I	<b>Fundamentals of Computer Systems, Office Automation and Internet Search</b> i. Components of a Computer and their functions. ii. Office Automation using MS-Word, MS-Excel, and MS-PowerPoint. iii. Data management, Statistical Data Analysis and Data Visualization with MS-Excel. iv. Use of Functions, Graphs & Charts in MS-Excel.	4							1,2
II	<b>Internet &amp; Cyber World</b> i. Introduction to Computer Networks, Internet and World Wide Web, Websites and Web portals. ii. Creation and use of Email Accounts. iii. Web browsing, Web Searching, Different aspects of Web Searching- Search Keywords, conditions and combinations. iv. Study of different Search Engines like Google, Microsoft Bing, Yahoo, Yandex, DuckDuckGo, Ask.Cometc. v. Cyber Crimes, Cyber Laws and	6							1,2

	IT Act 2000, India.			
<b>III</b>	<b>Introduction to Social Media and E-Commerce</b> i. Relevance of social media in present scenario. Posting different types of contents in social media. ii. Creating accounts and using some popular social media portals and Apps like WhatsApp, Facebook, etc. Social Media Etiquettes & Crimes. iii. Definition of E-Commerce; E-Commerce versus traditional Commerce. iv. Case studies of popular E-Commerce portals like Amazon. v. E-commerce Etiquettes & Crimes.	4		1,2
<b>IV</b>	<b>Digital Payments and Digital Transactions</b> i. Introduction to Digital Payment Systems. ii. Creating accounts and using Digital Payment Systems like Credit Cards, Debit Cards, Net banking, UPI. iii. Digital payments Etiquettes & Crimes. <b>V Basic Accounting and Utility Software</b>	5		1,2
<b>V</b>	<b>Basic Accounting and Utility Software</b> i. Introduction to Basic accounting concepts, Introduction to an Accounting Software like GnuCash or Tally. ii. Introduction to Technical Document writing using LaTeX. iii. Introduction to Data Visualization software – Sigma, Google Charts, Tableau	5		1,2

**REFERENCE BOOKS:**

**R1:** Wren, P.C and Martin, H. 1995. High School English Grammar and Composition, S Chand Publishing.

**R2:** Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press

**R3:** McCarthy. (2008) English Vocabulary in Use Upper - Intermediate with CD ROM, Cambridge University Press b

**OTHER LEARNING RESOURCES:**

1. <https://www.w3schools.com>
2. <https://edu.gcfglobal.org>
3. <https://www.tutorialspoint.com>
4. <https://www.javatpoint.com>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will have basic understanding of Computer Systems and Internet search. Products.	1,2
2	Students will be able to solve data analysis, management and visualization issues using MS-Office	1,2
3	Students will be able to efficiently and ethically use social media and e-commerce sites.	1,2
4	Students will have introduction to various utility software used in research and information Management.	1,2

SEMESTER – II									
Course Title	Co-Curricular Activities								
Course code	23UBCC121	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	3. To ascertain physical and mental development of the students and select best performers for state, national and international level competition. 4. To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.								
CO1	Students will learn to work well with others and communicate better.								
CO2	Students will learn to manage their time and stay organized.								
CO3	Students will enhance their creative abilities and think more critically.								
CO4	Students will improve their overall health and reduce stress.								
CO5	Students will become more aware of their role in society and contribute positively.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Co-curricular activities cover a wide range of experiences and pursuits that complement academic learning. They are typically organized and managed within educational institutions or communities and play a crucial role in holistic development. Some examples are  7. Sports and Physical Activities 8. Cultural Activities: 9. Academic Clubs and Competitions 10. Community Service and Volunteering 11. Leadership and Personal Development 12. Creative and Hobby-based Activities	60	5. Skill Development: Enhancing skills such as teamwork, leadership, communication, and critical thinking.  6. Holistic Growth: Supporting emotional, social, and physical development alongside academic learning.  7. Building Networks: Creating opportunities to interact with peers, mentors, and professionals.  8. Personal Fulfilment: Providing avenues for creativity, self-expression, and exploring personal interests.	1,2					

**REFERENCE BOOKS:**

**R1:** "Co-curricular Activities: A Pathway to Careers" by Ferguson.

**R2:** "Rahman, S.R., Islam, M.A., Akash, P.P., Parvin, M., Moon, N.N. and Nur, F.N., 2021. Effects of co-curricular activities on student's academic performance by machine learning. *Current Research in Behavioral Sciences*, 2, p.100057.

**OTHER LEARNING RESOURCES:**

1. <https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will learn to work well with others and communicate better.	6,7
2	Students will learn to manage their time and stay organized.	6,8
3	Students will enhance their creative abilities and think more critically.	6,7
4	Students will improve their overall health and reduce stress.	6,7
5	Students will become more aware of their role in society and contribute positively.	6,7

SEMESTER – II									
Course Title	Extra-Curricular Activities								
Course code	23UBEC121	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To ascertain physical and mental development of the students and select best performers for state, national and international level competition. 2. To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.								
CO1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.								
CO2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.								
CO3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Based on the learner's interest they can participate in various sports, music, and co-curricular activities joining the clubs of the University (Football, Footshal; Cricket; Swimming; Basketball; Badminton; Table Tennis; athletics and other outdoor and indoorgames; Dance; Music;Vocals;Photography;Drama; Literary activities); The students are encouraged to participate in regular club activities, workshops, competitions as per their interest and hobbies; Renowned skilled professionals/ personalities are invited organising workshops to promote the talents of the students.	60	Participation in university clubs across sports, music, and extra-curricular activities cultivates diverse skills and personal growth. Students develop teamwork, leadership, and creativity through sports like football, cricket, and athletics. Musical pursuits and dance foster self-expression and coordination, while literary and drama activities enhance communication and critical thinking. Workshops led by skilled professionals provide industry insights and mentorship opportunities, preparing students for future challenges. By encouraging participation based on interests and hobbies, universities nurture well-rounded individuals who excel academically and socially, equipped with practical skills and a broadened perspective on cultural diversity and personal					1,2	

			fulfilment.	
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**REFERENCE BOOKS:**

**R1:** "Extracurricular Activities: Essential Guides for Students" by John G. Gabriel

**R2:** "Developing Personal, Social and Emotional Skills through Extra-Curricular Activities" by Sally Bailey

**OTHER LEARNING RESOURCES:**

1. <https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.	6,8
2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.	6,8
3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.	6,8



SEMESTER – III									
Course Title	Immunology								
Course code	22BSB211R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T + 60P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To introduce the student's immunology, immunity, antigen, antibody, cytokines, interleukin, vaccines and autoimmunity.</li> <li>To explain the components of immune systems, antigen antibody reaction, serological techniques like RIA and ELISA, vaccines and their types and actions.</li> </ol>								
CO1	Describe the general introduction of immunology and the various cells and organ involved in it.								
CO2	Discuss the mechanism of immune system.								
CO3	Demonstrate and analyse various immune based experiments using RIA, ELISA								
CO 4	Apply the concepts and types of vaccines and immunization process.								
CO 5	Illustrate the types and forms of auto immune diseases.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
<b>I</b>	<b>Introduction to Immunology:</b> Immune system; Natural & acquired immunity; General properties of immune responses: Cells, tissues and organ of immune system	<b>8</b>	Describe, illustrate and explain the immune system and its components				1,2		
<b>II</b>	<b>Immunity:</b> Acquired, Innate, Cell mediated & humoral Immunity; T cell and B cell activation, maturation. <b>Antigen and antibody:</b> structure, function and diversity, Antigenicity and immunogenicity, Antigen antibody interactions	<b>10</b>	Describe, illustrate and explain Immunity, antigen and antibody interactions				1,2		
<b>III</b>	<b>Cytokines and chemokine:</b> properties, families, cytokine antagonist; cytokine related disease, Immunogenicity. ELISA, RIA		Describe, illustrate and explain Cytokines and interleukins				1,2		
<b>IV</b>	Protective Immunity: active or passive immunization; conjugate or multivalent vaccine; adjuvants; recombinant vaccine; DNA vaccine.	<b>10</b>	Describe, illustrate and explain different type of vaccines and vaccinations.				1,2		
<b>V</b>	Autoimmunity & auto-immune diseases, factors contributing development of auto-immune diseases, mechanism of development, breakdown of self-tolerance, rejection of transplants,	<b>10</b>	Describe, illustrate and explain autoimmunity and auto-immune diseases				1,2		

	molecular mimicry, diagnosis & treatment of auto-immune diseases, replacement therapy, suppression of auto immune processes , transplantations			
<b>Practical</b>	Precipitation Reaction: i. Double Diffusion Reaction ii. Single Diffusion Reaction iii. Ouchterlony immunodiffusion iv. Immuno-electrodiffusion Agglutination Reaction: (Qualitative and quantitative) WIDAL, ASO, VDRL, RPR, CRP Blood grouping and Rh typing, ELISA	<b>60</b>	Able to operate ELISA, RIA	1,2,3,4

**REFERENCE BOOKS:**

**R1:** Abbas. Cellular and Molecular Immunology. 10<sup>th</sup> edition. Elsevier; 2021.

**R2:** Martin et al. Roitt's Essential Immunology (Essentials). 13<sup>th</sup> edition. Wiley-Blackwell, 2017.

**R3:** Westwood. Practical Immunology. 4<sup>th</sup> edition. Wiley-Blackwell; 2002.

**OTHER LEARNING RESOURCES:**

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6156898/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1.	Describe the general introduction of immunology and the various cells and organ involved in it.	1,2
2.	Discuss the mechanism of immune system.	1,2
3.	Demonstrate and analyse various immune based experiments using RIA, ELISA	1,2
4.	Apply the concepts and types of vaccines and immunization process.	1,2
5.	Illustrate the types and forms of auto immune diseases.	1,2

SEMESTER – III									
Course Title	Molecular Biology								
Course code	22BSBT212R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T + 60P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	To teach the basic concept of genome organisation and Nucleic acid, operon concept, holiday model. To teach the central dogma of life in detail.								
CO 1	Explain the organization of genome, its components and functions.								
CO 2	Describe the process of replication, transcription, splicing, and protein synthesis								
CO 3	Describe the DNA repair mechanism and transposition.								
CO 4	Apply the knowledge of genomic and plasmid DNA isolation and their polymorphism								
CO 5	Illustrate genetic code, Wobble hypothesis.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	<b>Genome:</b> Introduction; prokaryote and eukaryote genome; the central dogma; c-value paradox; genes are made of DNA; semi conservative mode of DNA replication; DNA re-association kinetics (Cot curve analysis); repetitive DNA sequences (satellite DNA, LINE, SINE etc); DNA melting and buoyant density; nucleosome phasing.	8	Understand the blueprint of life and its function	1,2					
II	<b>DNA Replication and Recombination:</b> Replication initiation, elongation and termination in prokaryotes and eukaryotes, Homologous recombination at the molecular level: Holliday model, double stranded break repair model	8	Describe, illustrate and explain the process of DNA replication and recombination	1,2					
III	<b>DNA damage and Repair:</b> Mutation- Nonsense, missense and point mutations, Intragenic and Intergenic suppression, Frameshift mutations, Physical, chemical and biological mutagens, <b>Transposition</b> - Transposable genetic elements in prokaryotes and eukaryotes, Mechanisms of transposition, Role of transposons in mutation, Base excision repair, Nucleotide excision repair, Mismatch correction, SOS repair.	8	Describe, illustrate and explain the process of DNA damage and repair mechanisms.	1,2					

<b>IV</b>	Prokaryotic & Eukaryotic Transcription. Post Transcriptional Modifications: Processing of hnRNA, tRNA, rRNA, 5'-Cap formation, 3'-end processing and polyadenylation, splicing, RNA editing, nuclear export of mRNA, mRNA stability	<b>8</b>	Describe, illustrate and explain the process of transcription and editing of various RNAs	1,2
<b>V</b>	Translation machinery, Ribosomes, Composition and assembly, Universal genetic code, Degeneracy of codons, Termination codons, Is accepting tRNA, Wobble hypothesis, Mechanism of initiation, elongation and termination, Co- and post-translational modifications, Genomics and proteomics	<b>8</b>	Describe, illustrate and explain the translation machineries and mechanisms	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Isolation of plasmid/ genomic DNA of bacteria/ Plant/ Animal cell sample.</li> <li>2. PCR amplification of selected genes</li> <li>3. Separation of DNA molecules using gel electrophoresis</li> <li>4. RFLP of PCR amplicons/ DNA typing by RAPD.</li> </ol>	<b>60</b>	Able to isolate DNA, amplify and separate them and analyse them by RFLP or RAPD techniques	1,2,3,4

**REFERENCE BOOKS:**

**R1:** Alberts et al. The Molecular Biology of the Cell. 7th Edition. WW Norton & Co, 2022.

**R2:** Rastogi. Cell and Molecular Biology. 4th edition. New Age International Private Limited; 2020.

**R3:** Som. Practical Manual of Molecular Biology. 1st edition. KAAV Publications, 2018.

**OTHER LEARNING RESOURCES:**

1. <https://www.ncbi.nlm.nih.gov/books/NBK518759/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1.	Explain the organization of genome, its components and functions.	1,2
2.	Describe the process of replication, transcription, splicing, and protein synthesis	1,2
3.	Describe the DNA repair mechanism and	1,2

	transposition.	
4.	Apply the knowledge of genomic and plasmid DNA isolation and their polymorphism	1,2,3
5.	Illustrate genetic code, Wobble hypothesis.	1,2

SEMESTER – III									
Course Title	Developmental Biology								
Course code	22BSBT213R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 45	3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1. Students will acquire fundamental knowledge of animal and plant's embryonic development that is how an egg develops into an adult. 2. Students will be prepared for more advanced course related with developmental biology such as Animal and Plant Biotechnology 3. The course will also provide them basic developmental biology concepts that are essential for other graduate-level cell and developmental biology subjects and for their research in developmental biology field								
CO 1	Explain the basic concepts of developmental biology								
CO 2	Illustrate how fertilization and cleavage occur								
CO 3	Describe the process and consequence of gastrulation								
CO 4	Discuss the basic concepts of organogenesis								
CO 5	Describe basic concepts of growth, regeneration								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Gametogenesis-I (Male):</b> History and Scope of embryology; Typical Angiosperm Flower, Structure of stamen, Microsporogenesis, Dehiscence; <b>Gametogenesis-II (Female)</b> , Structure of carpel, Types of Ovules Megasporogenesis; Structure of typical embryo sac, (Polygonum, Allium and Adoxa type)	8	Understand, describe, illustrate and explain gametogenesis				1,2		
II	<b>Pollination and fertilization:</b> Pollination, Pollen tube entry (Types), Syngamy and triple fusion, Double fertilization, Development of Endosperm	8	Understand, describe, illustrate and explain pollination and fertilization				1,2		
III	<b>Post-fertilization:</b> Types of endosperms, Functions of suspensors and synergids, Apomixis, Polyembryony, Fruit-development and maturation	8	Understand, describe, illustrate and explain post fertilization				1,2		
IV	<b>Gametogenesis in animals-I,</b> Ultra structure of Testis in mammals, Spermatogenesis-Formation of spermatids and spermiogenesis, Ultrastructure of Sperm. <b>Gametogenesis in animals-II,</b> Ultra structure of Ovary in mammals, Oogenesis in mammals, Typical egg	8	Understand, describe, illustrate and explain gametogenesis in animals				1,2		

	structure, Yolk-its function and significances			
<b>V</b>	Translation machinery, Ribosomes, Composition and assembly, Universal genetic code, Degeneracy of codons, Termination codons, Is accepting tRNA, Wobble hypothesis, Mechanism of initiation, elongation and termination, Co- and post-translational modifications, Genomics and proteomics	<b>8</b>	Describe, illustrate and explain the translation machineries and mechanisms	1,2

**REFERENCE BOOKS:**

**R1:** Allan. Essentials of Human Embryology. 2<sup>nd</sup> edition. Oxford University Press, New York,1969.

**R2:** Rana. Human Embryology made Easy. 1<sup>st</sup> edition. CRC Press; 2019.

**R3:** Lersten. Flowering Plant Embryology. 1<sup>st</sup> edition. Wiley-Blackwell; 2004.

**OTHER LEARNING RESOURCES:** <https://www.ncbi.nlm.nih.gov/books/NBK9983/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1.	Explain the basic concepts of developmental biology	1,2
2.	Illustrate how fertilization and cleavage occur	1,2
3.	Describe the process and consequence of gastrulation	1,2
4.	Discuss the basic concepts of organogenesis	1,2
5.	Describe basic concepts of growth, regeneration	1,2

SEMESTER – III									
Course Title	Techno Professional Skill – II (Mushroom Cultivation)								
Course code	22BSB219R	Total credits:c1	L	T	P	S	R	O/F	C
		Total hours: 30	0	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1. To create awareness about the Mushroom among the people. 2. To strengthen the promotion of mushroom cultivation by establishing a well-equipped laboratory and offices. 3. To know and explore the cultivation in Assam								
CO1	Explain different classes of mushroom.								
CO2	Describe reproduction and growth of mushroom.								
CO3	Explain mushroom spawn production.								
CO 4	Discuss the methods of cultivation of mushroom.								
CO 5	Explain the techniques for the utilization of mushroom spent								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Setting of laboratory for mushroom cultivation; preparation and production of mother culture, mother and commercial spawn; preparation and cultivation of mushroom; mushroom spent management by vermicomposting.	30	The student will be able to cultivate mushrooms	1,2					

**REFERENCE BOOKS:**

**R1:** Gogoi, R., Rathaiah, Y., & Borah, T. R. (2019). Mushroom cultivation technology. Scientific Publishers.

**R2:** Suman, B. C., & Sharma, V. P. (2007). Mushroom cultivation in India. Daya Books.

**R3:** Petre, M. (2015). Mushroom biotechnology: developments and applications. Academic Press.

**OTHER LEARNING RESOURCES:** [https://www.researchgate.net/profile/Samarendra-Hazarika/publication/342082516\\_Spawan\\_Production\\_Mushroompdf/data/5ee11b24299bf1b17a8b66ed/Spawan-Production-Mushroom.pdf](https://www.researchgate.net/profile/Samarendra-Hazarika/publication/342082516_Spawan_Production_Mushroompdf/data/5ee11b24299bf1b17a8b66ed/Spawan-Production-Mushroom.pdf)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain different classes of mushroom.	1,2
2	Describe reproduction and growth of mushroom.	1,2
3	Explain mushroom spawn production.	1,2
4	Discuss the methods of cultivation of mushroom.	1,2
5	Explain the techniques for the utilization of mushroom spent	1,2



Course Title	Proficient Communication								
Course code	22UBPD213R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours:30	0	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To acquaint students with the various tools of effective presentation.</li> <li>To acquire the speaking skill instruct, influence, engage, educate, or appease the listeners.</li> <li>To increase proficiency, present ability and quality of resume and provide guidance for self- promotion and self-evaluation in social media.</li> <li>To prepare and train the students for the campus drives &amp; walking interviews.</li> </ol>								
CO1	Enable students to use prepositions, construct simple, complex, and compound sentences, and distinguish between active and passive voice.								
CO2	Teach students the basics of writing, how to avoid ambiguity, write paragraphs and letters, and prepare resumes and cover letters.								
CO3	Help students conduct SWOT analyses, practice self-regulation, and maintain personal hygiene.								
CO 4	Equip students with knowledge about non-verbal communication, types of body language, and their impact.								
CO 5	Train students in planning and conducting group discussions, effectively disagreeing, and summarizing to attain objectives.								
CO 6	Prepare students for personal interviews, answer common interview questions, follow telephone interview etiquettes, and adhere to dress code and grooming standards.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
<b>I</b>	<b>Grammar (Flipped classroom)</b> i. Use of Prepositions ii. Simple, complex, compound sentences iii. Active and Passive Voice		6	Students will correctly use prepositions, create various sentence structures, and convert between active and passive voice.				2, 3	
<b>II</b>	<b>Writing Skills</b> I. The Basics of Writing; avoid ambiguity and vagueness II. Paragraph Writing III. Letter Writing IV. Resume and Cover Letter		6	Students will write clear and structured paragraphs, letters, resumes, and cover letters.				3, 4	
<b>III</b>	<b>Self-Management Skills</b> i. SWOT Analysis ii. Self-Regulation iii. Personal Hygiene		5	Students will perform SWOT analyses, self-regulate, and adhere to personal hygiene practices.				3, 4	
<b>IV</b>	<b>Non- Verbal Communication- Sciences of Body Language</b> i. What is Non-Verbal Communication & Body Language ii. Types of Body Language, iii. Importance and Impact of Body Language,		5	Students will understand and effectively use different types of body language in communication.				2, 3	

<b>V</b>	<b>Group Discussion</b> i. Planning and Elements of Group Discussion ii. Effectively disagreeing, iii. Summarizing and Attaining the Objective.	5	Students will plan and participate in group discussions, disagree constructively, and summarize discussions.	3, 4
<b>VI</b>	<b>Interview Skills &amp; Dress code Ethics</b> i. Personal Interview – Concept and Practice ii. Common Interview Questions and answering Strategies iii. Telephone Interview Etiquettes iv. Introduction to Dress Code and Grooming	5	Students will demonstrate effective interview techniques, answer common questions, follow telephone etiquettes, and dress appropriately.	2, 3

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Integrate presentation, communication, leadership, and interview skills.	6,7
2	Apply skills in real-world scenarios.	6,7,8
3	Reflect on personal development.	6,7
4	Collaborate effectively in group activities.	6,7
5	Demonstrate professionalism and ethical behavior.	5,6,7

SEMESTER – III									
Course Title	Extra-Curricular Activities								
Course code	23UBEC211	Total credits: 1 Total hours: 60	L	T	P	S	R	O/F	C
			0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ III semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To ascertain physical and mental development of the students and select best performers for state, national and international level competition.</li> <li>To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.</li> </ol>								
CO1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.								
CO2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.								
CO3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Based on the learner's interest they can participate in various sports, music, and co-curricular activities joining the clubs of the University (Football, Footshal; Cricket; Swimming; Basketball; Badminton; Table Tennis; athletics and other outdoor and indoor games; Dance; Music; Vocals; Photography; Drama; Literary activities); The students are encouraged to participate in regular club activities, workshops, competitions as per their interest and hobbies; Renowned skilled professionals/ personalities are invited organising workshops to promote the talents of the students.	60	Participation in university clubs across sports, music, and extra-curricular activities cultivates diverse skills and personal growth. Students develop teamwork, leadership, and creativity through sports like football, cricket, and athletics. Musical pursuits and dance foster self-expression and coordination, while literary and drama activities enhance communication and critical thinking. Workshops led by skilled professionals provide industry insights and mentorship opportunities, preparing students for future challenges. By	1,2					

			encouraging participation based on interests and hobbies, universities nurture well-rounded individuals who excel academically and socially, equipped with practical skills and a broadened perspective on cultural diversity and personal fulfilment.	
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**REFERENCE BOOKS:**

**R1:** "Extracurricular Activities: Essential Guides for Students" by John G. Gabriel

**R2:** "Developing Personal, Social and Emotional Skills through Extra-Curricular Activities" by Sally Bailey

**OTHER LEARNING RESOURCES:** <https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.	6,8
2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.	6,8
3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.	6,8

SEMESTER – III									
Course Title	Co-Curricular Activities								
Course code	23UBCC211	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To ascertain physical and mental development of the students and select best performers for state, national and international level competition.</li> <li>To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.</li> </ol>								
CO1	Students will learn to work well with others and communicate better.								
CO2	Students will learn to manage their time and stay organized.								
CO3	Students will enhance their creative abilities and think more critically.								
CO4	Students will improve their overall health and reduce stress.								
CO5	Students will become more aware of their role in society and contribute positively.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<p>Co-curricular activities cover a wide range of experiences and pursuits that complement academic learning. They are typically organized and managed within educational institutions or communities and play a crucial role in holistic development. Some examples are</p> <ol style="list-style-type: none"> <li>Sports and Physical Activities</li> <li>Cultural Activities:</li> <li>Academic Clubs and Competitions</li> <li>Community Service and Volunteering</li> <li>Leadership and Personal Development</li> <li>Creative and Hobby-based Activities</li> </ol>	60	<ol style="list-style-type: none"> <li>Skill Development: Enhancing skills such as teamwork, leadership, communication, and critical thinking.</li> <li>Holistic Growth: Supporting emotional, social, and physical development alongside academic learning.</li> <li>Building Networks: Creating opportunities to interact with peers, mentors, and professionals.</li> <li>Personal Fulfilment: Providing avenues for creativity, self-expression, and exploring personal interests.</li> </ol>	1,2					

**REFERENCE BOOKS:**

**R1:** "Co-curricular Activities: A Pathway to Careers" by Ferguson.

**R2:** "Rahman, S.R., Islam, M.A., Akash, P.P., Parvin, M., Moon, N.N. and Nur, F.N., 2021. Effects of co-curricular activities on student's academic performance by machine learning. *Current Research in Behavioural Sciences*, 2, p.100057.

**OTHER LEARNING RESOURCES:** <https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM  
OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will learn to work well with others and communicate better.	6,7
2	Students will learn to manage their time and stay organized.	6,7
3	Students will enhance their creative abilities and think more critically.	6,7
4	Students will improve their overall health and reduce stress.	6,7
5	Students will become more aware of their role in society and contribute positively.	6,7

SEMESTER – III									
Course Title	UNIVERSAL HUMAN VALUES (UHV) + PROFESSIONAL ETHICS								
Course code	22UUHV101R	Total credits:2	L	T	P	S	R	O/F	C
		Total hours: 30T	2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings</li> <li>2. Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence</li> <li>3. Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature</li> </ol>								
CO1	Understand ethical principles and dilemmas in both personal and professional contexts.								
CO2	Develop respect for different beliefs, values, and perspectives, fostering a tolerant and inclusive environment in both personal and professional interactions.								
CO3	Understand corporate social responsibility, sustainable development, and the impact of their actions on communities and the environment.								
CO 4	Understand the importance of upholding ethical standards and taking responsibility for their actions and decisions.								
CO 5	Develop skills to critically evaluate actions, make improvements, and strive for ethical excellence throughout life.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	<p>Course Introduction - Need, Basic Guidelines, Content and Process for Value Education</p> <ol style="list-style-type: none"> <li>1. Understanding the need, basic guidelines, content and process for Value Education</li> <li>2. Self-Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self-exploration</li> <li>3. Continuous Happiness and Prosperity- A look at basic Human Aspirations</li> <li>4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority</li> <li>5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario</li> <li>6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels</li> </ol>	8	Develop an understanding of the importance and methodology of value education	1,2					

<p><b>II</b></p>	<p>Understanding Harmony in the Human Being - Harmony in Myself! 1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body' 2. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha 3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) 4. Understanding the characteristics and activities of 'I' and harmony in 'I' 5. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail 6. Programs to ensure Sanyam and Swasthya-Practice Exercises and Case Studies will be taken up in Practice Sessions.</p>	<p><b>6</b></p>	<p>Develop Insight into the Harmony Within the Human Being</p>	<p>1,2</p>
<p><b>III</b></p>	<p>Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship 1. Understanding Harmony in the family – the basic unit of human interaction 2. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfilment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship 3. Understanding the meaning of Vishwas; Difference between intention and competence 4. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship 5. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals 6. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family!-Practice Exercises and Case Studies will be taken up in Practice Sessions.</p>	<p><b>6</b></p>	<p>Understand harmony in the family and society</p>	<p>1,2</p>
<p><b>IV</b></p>	<p>Understanding Harmony in the Nature and Existence - Whole existence as Co-existence 1. Understanding the harmony in the Nature 2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature 3. Understanding</p>	<p><b>4</b></p>	<p>Develop understanding in harmony in the nature and Existence</p>	<p>1,2</p>



	Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space 4. Holistic perception of harmony at all levels of existence-Practice Exercises and Case Studies will be taken up in Practice Sessions.			
V	Implications of the above Holistic Understanding of Harmony on Professional Ethics 1. Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 4. Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order b) Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems. 5. Case studies of typical holistic technologies, management models and production systems 6. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations	4	Apply harmony in professional ethics	1,2

**REFERENCE BOOKS:**

**R1:** R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

**R2:** B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008

**OTHER LEARNING RESOURCES:**

1. <https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand ethical principles and dilemmas in both personal and professional contexts.	5,8
2	Develop respect for different beliefs, values, and perspectives, fostering a tolerant and	5,8

	inclusive environment in both personal and professional interactions.	
3	Understand corporate social responsibility, sustainable development, and the impact of their actions on communities and the environment.	5,8
4	Understand the importance of upholding ethical standards and taking responsibility for their actions and decisions.	5,8
5	Develop skills to critically evaluate actions, make improvements, and strive for ethical excellence throughout life.	5,8

SEMESTER – III									
Course Title	Personal Financial Planning								
Course code	22UUFLL202R	Total credits: 1 Total hours: 30P	L	T	P	S	R	O/F	C
			0	0	1	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ III semester of second year of the programme								
Course Objectives	1. The course would offer an inclusive approach to understand the relevant concepts of money, borrowing, lending, taxes and their application to financial planning. 2. Assess the personal financial planning process, the life cycle of financial plans, and methods of goal achievement. 3. Formulate a budget, record-keeping system, and tax planning strategy based on current financial goals								
CO1	Develop a cash management strategy and a plan to facilitate the home or automobile buying Process								
CO2	Design a diversified investment portfolio that addresses several different investment objectives.								
CO3	Differentiate between open- and closed-end mutual funds, exchange-traded funds, and direct or indirect real estate investments.								
CO4	Create a financial plan that covers your income needs in retirement and helps protect you and your estate.								
CO5									
Unit-No.	Content		Contact Hour						KL
I	<b>Fundamentals of Financial Planning –</b> I. Functions of money; ii. Inflation- Meaning, causes, how it can be controlled; iii. process official planning, iv. Time value of money-simple and compound interest; v. Net Present Value and Future value, vi. Power of Compounding; vii. Doubling period and Rule of 72.		5						1,2
II	<b>Income Tax Planning–</b> i. Meaning of Income, ii. Direct & Indirect Taxes, Taxable Income, various heads of Income for tax Calculation, iii. Non-taxable Income, iv. Tax evasion and tax avoidance, v. GST, Tax Planning Strategies		5						1,2
III	<b>Entrepreneurial planning –</b> i. Meaning of Entrepreneurship, prerequisites for becoming an entrepreneur, ii. Entrepreneurship Support Systems in India, iii. Institutional support systems for entrepreneurs, iv. Financial support systems for entrepreneurs; v. Venture Capital, Business Angels, vi. Assistant of Government, vii. Commercial Bank Loans and Overdraft.		5						1,2
IV	<b>Planning for investing in securities market –</b> i. Investment avenues offered by Securities		5						1,2

	<p>Markets, Primary Market and Secondary Market,</p> <p>ii. Stock market- meaning, features, functions of NSE,BSE DEMAT trading account,</p> <p>iii. Security repository, stock brokers, Operational aspects of securities markets: placement of orders, contract note, pay-in and pay-out, trading and settlement cycle,</p> <p>iv. Various risks involved in investing in securities markets; Role of Financial Intermediaries; Stock indices.</p> <p>v. Mutual Funds- meaning concept, definition, types, importance and drawbacks of mutual funds, mutual funds in India, investing in mutual funds,</p> <p>vi. Systematic Investment Plan (SIP) and its advantages.</p>			
<b>V</b>	<p><b>Planning for debts and Retirement</b></p> <p>i. Consumer credit - Introduction to consumer credit; choosing a source of credit, the cost of credit alternatives,</p> <p>ii. Consumer Legal Protection;</p> <p>iii. Housing Decision: Factors and Finance; Vehicle Decisions.</p> <p>iv. Retirement planning - Meaning of cost of living; retirement need analysis; development of retirement plan, various retirement schemes,</p> <p>v. Estate Planning; Pension and Medicare Planning; Wills.</p>	<b>3</b>		1,2

**REFERENCE BOOKS:**

**R1:** Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems &The Million Dollar Financial Advisor: Powerful Lessons and Proven Strategies from Top Producers by David. Mullen Jr.

**R2:** Personal Finance and Planning by Dr. Rajni

**R3:** Peaceful Personal Finance: A Short Read on the Basics of Personal Finance and Planning Kindle Edition by Hema Singh

**OTHER LEARNING RESOURCES:**

1.<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Develop a cash management strategy and a plan to facilitate the home or automobile buying	1,8

	Process	
2	Design a diversified investment portfolio that addresses several different investment objectives.	1,8
3	Differentiate between open- and closed-end mutual funds, exchange-traded funds, and direct or indirect real estate investments.	1,8
4	Create a financial plan that covers your income needs in retirement and helps protect you and your estate.	1,8

SEMESTER – III									
Course Title	Basic Life Saving Skills (BLSS)								
Course code	22UULS202R	Total credits: 1 Total hours: 30P	L	T	P	S	R	O/F	C
			0	0	1	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ III semester of second year of the programme								
Course Objectives	The aim of the course is to provide the learners with basic knowledge and practical skills needed in an emergency fire situation, and to provide appropriate basic management and treatment for injuries.								
CO1	The students will be able to recognize respiratory arrest/ cardiac arrest, and provide oxygen to the patients to sustain tissue viability								
CO2	The students will be able to perform the importance of early CPR on Adult, child and infants' victims								
CO3	The students will be able to prevent injury from getting worse, aiding recovery, relieving pain and protecting the victims from deterioration								
CO4	Importance of physiology in forestry								
CO5	The students will be able to learn about the fire equipment's requirements, methods of operation and getting out alive.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	<b>Basic Life Support (BLS)</b> <ul style="list-style-type: none"> <li>• Introduction of BLS</li> <li>• Chain of survival</li> <li>• ABCs Assessment</li> <li>• CPR and Ventilation Technique</li> <li>• AED</li> <li>• Choking for adult and children</li> </ul>	5		1,2					
II	<b>First Aid</b> <ul style="list-style-type: none"> <li>• Golden rules of First aid</li> <li>• First aid Kits</li> </ul>	5		1,2					
III	<b>Trauma emergencies</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Priorities of Initial approach in pre-hospital care</li> <li>• Scene safety</li> <li>• Primary assessment</li> <li>• Bleeding control</li> <li>• Extrication of victims and safe transfer</li> <li>• Cervical spine stabilization and C-collar application</li> <li>• Splinting of broken Limbs</li> </ul>	5		1,2					
IV	<b>Triage system</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Flow chart approach of Triage</li> <li>• Triage of Single and Multiple Casualties in Pre-Hospital setting</li> </ul>	5		1,2					
V	<b>Medical emergencies</b> Introduction Victim centred approach and Management of :-	3		1,2					

	<ul style="list-style-type: none"> <li>• Seizures</li> <li>• heart attack</li> <li>• asthma</li> <li>• diabetic emergencies</li> <li>• emergency childbirth</li> <li>• Respiratory distress and failure</li> </ul>			
<b>VI</b>	<b>Environmental Emergency</b> <ul style="list-style-type: none"> <li>• Recognizing and caring for heat related illness such as: Heat stroke, heat cramps, heat exhaustion, dehydration.</li> <li>• Recognizing and caring for cold related illness such as frostbite, hypothermia.</li> <li>• Poisoning, Snake bite.</li> </ul>	<b>3</b>		
<b>VII</b>	<b>Safety of people in the event of fire</b> <ul style="list-style-type: none"> <li>• Recognition of possible fire sources and emergency procedures,</li> <li>• Construction techniques for eliminating fire.</li> <li>• Types of detecting devices and extinguishing agents and systems</li> <li>• Devising procedures in the event of fire and react to fire danger.</li> <li>• Safety goals and objectives, Identifying hazards and risks</li> </ul>	<b>3</b>		

**REFERENCE BOOKS:**

**R1:** Nancy Caroline's Emergency Care in the streets eight edition by Jones and Bartlett

**R2:** First Aid book by LC Gupta; Publisher Jaypee Brothers, 7th Edition.

**OTHER LEARNING RESOURCES:** <https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	The students will be able to recognize respiratory arrest/ cardiac arrest, and provide oxygen to the patients to sustain tissue viability	1,8
2	The students will be able to perform the importance of early CPR on Adult, child and infant's victims	1,8
3	The students will be able to prevent injury from getting worse, aiding recovery, relieving pain and protecting the victims from deterioration	1,8
4	Overcome environmental hazards	1,8
5	The students will be able to learn about the fire equipment's requirements, methods of operation and getting out alive.	1,8

SEMESTER – IV									
Course Title	Genetic Engineering								
Course code	22BSB221R	Total credits:4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To familiarize the molecular and genetic tools used to analyse genomes, modify genetic material and techniques for modifying organisms to produce desired products.</li> <li>Plan for and manage formulation and execution of protocols and innovative technologies and/or products.</li> <li>To expose students to various techniques to enhance organisms so that they are better able to thrive in certain environments.</li> </ol>								
CO1	Explain the concepts of genetic engineering								
CO2	Explain cloning techniques and the types.								
CO3	Explain and demonstrate molecular detection methods								
CO 4	Describe the applications of recombinant DNA technology.								
CO 5	Apply the methods of disease detection using molecular techniques.								
Unit- No.	Content		Contact Hour	Learning Outcome				KL	
<b>I</b>	<b>Introduction to Genetic Engineering:</b> Definition, history and scope. Restriction enzymes: definition, characteristics and uses.		<b>8</b>	Understand the concepts of genetic engineering				1,2	
<b>II</b>	<b>Cloning and cloning vectors:</b> plasmid vectors, $\lambda$ vectors. Construction and screening of genomic DNA library and cDNA library		<b>10</b>	Describe and illustrate cloning techniques				1,2	
<b>III</b>	<b>Molecular detection techniques-</b> Southern, Northern and Western hybridization, polymerase chain reaction (PCR), Restriction Fragment Length Polymorphism(RFLP), Random Amplified Polymorphic DNA (RAPD), DNA finger printing. Nucleic acid sequencing: Di- deoxy and chemical sequencing methods		<b>8</b>	Describe, illustrate and explain molecular detection and analysis methods				1,2	
<b>IV</b>	Practical application of Recombinant DNA technology: Engineering of bacteria, genetically engineered biopharmaceuticals (insulin and growth hormones), Ti plasmid in plant biotechnology, Vaccine production		<b>10</b>	Describe, illustrate and explain the application of recombinant DNA technology				1,2	
<b>V</b>	<b>Molecular detection of disease:</b> AIDS, Sickle chain anaemia, cystic fibrosis, Duchenne muscular dystrophy		<b>10</b>	Describe, illustrate and explain the methods for disease detection using molecules				1,2	



<b>Practical</b>	Isolation of DNA from various sources, agarose gel electrophoresis, SDS PAGE, to measure concentration of DNA & RNA by UV Spectrophotometry	<b>60</b>	Able to use various methods for analysis of DNA, RNA and Proteins	1,2,3,4
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**REFERENCE BOOKS:**

**R1:** Primrose S.B. et al. Principles of Gene Manipulation. 6th Edition. John Wiley Blackwell; 2001.

**R2:** Watson J. D. et al. Molecular Biology of the Gene. 7<sup>th</sup> edition. Pearson; 2013.

**R3:** Brown. T. A. Gene Cloning and DNA Analysis: an introduction. 7<sup>th</sup> edition. JOHN WILEY; 2016.

**OTHER LEARNING RESOURCES:** <https://www.annualreviews.org/doi/abs/10.1146/annurev-arplant-042809-112116>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Explain the concepts of genetic engineering	1,2
2	Explain cloning techniques and the types.	1,2,3
3	Explain and demonstrate molecular detection methods	1,2,3
4	Describe the applications of recombinant DNA technology.	1,2
5	Apply the methods of disease detection using molecular techniques.	1,2,3

SEMESTER – IV									
Course Title	Biostatistics								
Course code	22BSB222R	Total credits:3	L	T	P	S	R	O/F	C
		Total hours: 45T	3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1.To familiarize the students with how to determine the data to be collected, organize and summarize the information to draw valid conclusions or inferences about the population. 2.To make aware with how to record the collected data in tables and representing in graphs. 3.To analyze the nature of the data through central tendency and dispersion, interpreting the results and the conclusion.								
CO1	Organize and present statistical data graphically using frequency distributions.								
CO2	Analyze it through measures of central tendency, measures of dispersion.								
CO3	Define binomial outcomes and compute probability of getting X successes in N trials.								
CO 4	Identify the characteristics of different discrete and continuous distributions, type of statistical situation to which different distributions can be applied.								
CO 5	Use Poisson, Normal probability distribution to solve statistical problems.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Introduction to Statistics; Data collection- Types of data, Methods, techniques and sources; Frequency Distributions-Tabular and Graphical representation.	8	To learn methods and representation of statistical data.				1,2		
II	Descriptive statistics- Measures of Central tendency and their applications, Relationship between mean, median and mode; Measures of Dispersion and their applications;	10	To understand measures of central tendency				1,2		
III	Probability distributions-Binomial distribution, Poisson distribution and Normal distribution and their applications.	7	To learn about probability				1,2		
IV	Introduction to Correlation analysis of Bivariate data, Covariance, Karl Pearson's Correlation coefficient	10	To learn about correlation analysis				1,2		
V	Hypothesis testing- Null hypothesis, Alternative hypothesis, Types of errors; Introduction to statistical tests- Student's t test, F-test, Chi square test.	10	To learn about hypothesis testing				1,2		

#### REFERENCE BOOKS:

**R1:** Arora P. N. Biostatistics. 3<sup>rd</sup> edition. Himalaya Publishing House; 2013.

**R2:** Gupta S. C. Fundamentals of Applied Statistics. 4<sup>th</sup> edition. Sultan Chand & Sons, 2014.

**R3:** Jeyapriya S P. Statistical Methods in Biology. 1<sup>st</sup> edition. LAP Lambert Academic Publishing, 2020.

**OTHER LEARNING RESOURCES:**

[https://www.academia.edu/download/60384896/ Robert R. Sokal F. James Rohlf Introduction to bi20190824-71257-1o0ngav.pdf](https://www.academia.edu/download/60384896/Robert_R._Sokal_F._James_Rohlf_Introduction_to_bi20190824-71257-1o0ngav.pdf)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Organize and present statistical data graphically using frequency distributions.	1,2
2	Analyze it through measures of central tendency, measures of dispersion.	1,2
3	Define binomial outcomes and compute probability of getting X successes in N trials.	1,2
4	Identify the characteristics of different discrete and continuous distributions, type of statistical situation to which different distributions can be applied.	1,2
5	Use Poisson, Normal probability distribution to solve statistical problems.	1,2

SEMESTER – IV									
Course Title	Bioinformatics and Computer Applications								
Course code	22BSBT223R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours:30T+30P	2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To give basic computer knowledge and their practical application.</li> <li>Knowledge on computational database management system and its application in Biology</li> <li>A basic idea on the structural biology using computer</li> </ol>								
CO1	Describe basics of computer and its applications in Biology, including data analysis.								
CO2	Explain molecular sequence and structure databases.								
CO3	Apply bioinformatics tools for sequence alignment and analysis.								
CO 4	Demonstrate data retrieval and alignment of the sequences and various formats								
CO 5	Describe the existing biological database and their utilization								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Computer Fundamentals- History of computers, Generations and Classification of computers, Hardware and Software concepts, Block Diagram of Digital Computer, Limitations and Capabilities of computers, I/O devices, Storage devices, RAM ROM, Memory unit- primary and Auxiliary.	5	To understand to basics of computer	1,2					
II	Internet and Networking - Introduction, Importance, Network – LAN, MAN, WAN, Electronic Mailing, Chatting, Search Engine, Web Pages, Virus, Antivirus, Malware, Multimedia - Introduction, Applications, Components and its Uses.	6	To obtain knowledge about networking	1,2					
III	Database management system (DBMS) - Introduction to database management system (DBMS) and its different types.	7	To learn about management of biological database	1,2					
IV	Introduction to bioinformatics and data generation- commonly used tools for alignment (FASTA, BLAST, BLAT), visualization software(RASMOL, MMDB viewer, MolMol etc). Flatfile formats. Protein homology modelling, physiochemical property calculation	8	To learn about basics of bioinformatics and softwares used	1,2					

<b>V</b>	Biological Database - Nucleotide sequence databases (NCBI, DDBJ, and EMBL). Protein sequence databases (SWISS-PROT, PIR, GenPept) ,Specialized Genome databases: (SGD, TIGR etc).Structure databases (CATH, SCOP, and PDB, NDB, MMDB), pathway database(KEGG)	<b>5</b>	To search and retrieve biological database	1,2
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**REFERENCE BOOKS:**

**R1:** Sharma T. R. Genome Analysis and Bioinformatics: A Practical Approach (English) (Paperback). 1<sup>st</sup> edition. Dreamtech Press; 2019.

**R2:** Orenge C.A. et al. Bioinformatics: Genes, proteins and computers. 1<sup>st</sup> edition. Taylor & Francis, 2002.

**R3:** Kanguane P., Mathura V. Bioinformatics: A Concept-Based Introduction. 1<sup>st</sup> edition. Springer-Verlag New York Inc. 2009.

**OTHER LEARNING RESOURCES:**

1. <https://www.ncbi.nlm.nih.gov/books/NBK44939/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1.	Describe basics of computer and its applications in Biology, including data analysis.	1,2
2.	Explain molecular sequence and structure databases.	1,2
3.	Apply bioinformatics tools for sequence alignment and analysis.	1,2
4.	Demonstrate data retrieval and alignment of the sequences and various formats	1,2
5.	Describe the existing biological database and their utilization	1,2

SEMESTER – IV									
Course Title	Techno-professional Skills – III (Biofertilizer Production)								
Course code	22BSBT224R	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours:30	0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	On successful completion of the course, the students will be able to Familiarize with the basic principle and techniques of Biofarming								
CO1	Demonstrate proficiency in the isolation techniques for N <sub>2</sub> -fixing bacteria from various environmental samples, including soil and plant root nodules								
CO2	Apply molecular and biochemical methods for the accurate identification and classification of N <sub>2</sub> -fixing bacteria.								
CO3	Utilize selective media and culture techniques to isolate phosphate stabilizing bacteria from diverse soil and rhizospheric samples.								
CO 4	Apply molecular and morphological methods for the accurate identification and classification of AMF species.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Isolation, identification and analysis of the potentialities of N <sub>2</sub> fixing bacteria, Isolation , identification and analysis of the potentialities of phosphate stabilizing bacteria, Isolation , identification and assess the potentialities of Arbuscular mycorrhizas fungi of rhizospheric soil	30	Students will be able to understand the process of biofertilizer production using microorganisms	1,2,3,4					

#### REFERENCE BOOKS:

**R1:** Kannaiyan, S. 2002 Biotechnology of Biofertilizers. Narosa publishing house, New Delhi.  
**Dubey, R.C.** 2001.

**R2:** P. S. Bisen. Fontiers in microbial technology. 1st edition. C.B.S. Publishers and Distributors; 1994

#### OTHER LEARNING RESOURCES:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9227430/>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1.	Demonstrate proficiency in the isolation techniques for N <sub>2</sub> -fixing bacteria from various environmental samples, including soil and plant root nodules	1,2
2.	Apply molecular and biochemical methods for the accurate identification and classification of N <sub>2</sub> -fixing bacteria.	1,2
3.	Utilize selective media and culture techniques to	1,2

	isolate phosphate stabilizing bacteria from diverse soil and rhizospheric samples.	
4.	Apply molecular and morphological methods for the accurate identification and classification of AMF species.	1,2

SEMESTER – IV									
Course Title	Campus to Corporate (Communicative English & Soft Skills)								
Course code	22UBPD213R	Total credits: 4 Total hours:64	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1. To acquaint students with the various tools of effective presentation. 2. To acquire the speaking skill, instruct, influence, engage, educate, or appease the listeners. 3. To increase proficiency, present ability and quality of resume and provide guidance for self-promotion and self-evaluation in social media. 4. To prepare and train the students for the campus drives & walking interviews.								
CO1	Integrate presentation, communication, leadership, and interview skills.								
CO2	Apply skills in real-world scenarios.								
CO3	Reflect on personal development.								
CO 4	Collaborate effectively in group activities.								
CO 5	Demonstrate professionalism and ethical behavior.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Presentation Skills:</b> Introduction; Essential characteristics of a good presentation; Preparation of a good presentation	8	By the end of this module, learners will understand the importance of effective presentation skills and be adept at preparing and delivering engaging presentations				1,2		
II	<b>Public Skills:</b> Fear of Public Speaking; Understanding and Overcoming Fear of Public Speaking; Confidence and Control; Physiology and Stress-Control/Process; Tips for Presentations and Public Speaking; Tips for Using Visual Aids in Presentations; Process for Preparing and Creating Presentations; Delivering Presentations Successfully; Doubt Clearing and Summary of Main Points	10	By course end, students master public speaking, gaining confidence, using visuals effectively, delivering engaging presentations, and summarizing key points adeptly while addressing doubts				1,2		
III	<b>Practical session on Resume, Curriculum Vitae, Writing cover letter &amp; LinkedIn Profile:</b> Preparation, submission & screening of Resume; Practical session on cover letter screening session; Creating profile in LinkedIn; How to utilize it?		Students master practical communication (resumes, cover letters, LinkedIn) and leadership concepts through mock sessions, enhancing interview skills with dress code awareness				1,2		



<b>IV</b>	<b>Leadership &amp; Management Skills:</b> Concepts of Leadership; Leadership Styles; Manager VS Leader; How to be an Effective Leader? Mock/Practice Session; Doubt Clearing Session	<b>10</b>	Students will learn leadership concepts and styles, differentiate between managers and leaders, and develop effective leadership skills through mock sessions and doubt-clearing exercises.	1,2
<b>V</b>	<b>Interview Skills &amp; Dress code Ethics:</b> Types of interview- telephonic, virtual & face to face; Online interview, personal interview; Panel interview; Group interview; JAM session; Types of interview questions- traditional/common interview questions; Case interview questions; General Strategies for answering questions; Marketing your skills and experiences; Preparation before the interview; How to dress up for an interview?; How to maintain eye contact and positive body language; How to be presentable?; Interview dos and don'ts?; Introduction to Dress Code Ethics; Purpose and Importance; How to Make FIRSTIMPRESSION; What to Wear During Interviews or Any Other Formal Meetings – Male &Female.	<b>10</b>	excel in diverse interview formats, grasp dress code ethics, and make a positive impression with appropriate attire and confident body language.	1,2
<b>VI</b>	<b>Mock Interview:</b> Practical Mock Interview; Feedback-Receiving Feedback; Giving Feedback; Advantages of Effective Feedback; How to deal with negative feedback?	<b>60</b>	engage in practical mock interviews, learning to give and receive constructive feedback effectively, and handle negative feedback	1,2,3,4

**REFERENCE BOOKS:**

**R1:** Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

**R2:** McDowell, Gayle Laakmann.2008.

Cracking the Coding Interview (Indian Edition)

**OTHER LEARNING RESOURCES:**

1.<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9134667/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1.	Integrate presentation, communication, leadership, and interview skills.	6,7
2.	Apply skills in real-world scenarios.	6,7
3.	Reflect on personal development.	6,7
4.	Collaborate effectively in group activities.	6,7
5.	Demonstrate professionalism and ethical behavior.	5,6,7

SEMESTER – IV									
Course Title	Extra-Curricular Activities								
Course code	22UBEC221	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To ascertain physical and mental development of the students and select best performers for state, national and international level competition. 2. To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.								
CO1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.								
CO2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.								
CO3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Based on the learner's interest they can participate in various sports, music, and co-curricular activities joining the clubs of the University (Football, Footshal; Cricket; Swimming; Basketball; Badminton; Table Tennis; athletics and other outdoor and indoor games; Dance; Music; Vocals; Photography; Drama; Literary activities); The students are encouraged to participate in regular club activities, workshops, competitions as per their interest and hobbies; Renowned skilled professionals/ personalities are invited organising workshops to promote the talents of the students.	60	Participation in university clubs across sports, music, and extra-curricular activities cultivates diverse skills and personal growth. Students develop teamwork, leadership, and creativity through sports like football, cricket, and athletics. Musical pursuits and dance foster self-expression and coordination, while literary and drama activities enhance communication and critical thinking. Workshops led by skilled professionals provide industry insights and mentorship opportunities, preparing students for future challenges. By encouraging participation based on interests and hobbies, universities nurture well-rounded individuals who excel academically and socially, equipped with practical skills and a broadened perspective on cultural diversity and personal fulfilment.				1,2		

**REFERENCE BOOKS:****R1:** "Extracurricular Activities: Essential Guides for Students" by John G. Gabriel**R2:** "Developing Personal, Social and Emotional Skills through Extra-Curricular Activities" by Sally Bailey**OTHER LEARNING RESOURCES:**1. <https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.	6,8
2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.	6,8
3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.	6,8

SEMESTER – IV									
Course Title	Co-Curricular Activities								
Course code	22UBCC211	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To ascertain physical and mental development of the students and select best performers for state, national and international level competition. 2. To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.								
CO1	Students will learn to work well with others and communicate better.								
CO2	Students will learn to manage their time and stay organized.								
CO3	Students will enhance their creative abilities and think more critically.								
CO4	Students will improve their overall health and reduce stress.								
CO5	Students will become more aware of their role in society and contribute positively.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Co-curricular activities cover a wide range of experiences and pursuits that complement academic learning. They are typically organized and managed within educational institutions or communities and play a crucial role in holistic development. Some examples are  1. Sports and Physical Activities 2. Cultural Activities: 3. Academic Clubs and Competitions 4. Community Service and Volunteering 5. Leadership and Personal Development 6. Creative and Hobby-based Activities	60	Skill Development: Enhancing skills such as teamwork, leadership, communication, and critical thinking.  Holistic Growth: Supporting emotional, social, and physical development alongside academic learning.  Building Networks: Creating opportunities to interact with peers, mentors, and professionals.  Personal Fulfilment: Providing avenues for creativity, self-expression, and exploring personal interests.				1,2		

**REFERENCE BOOKS:**

**R1:** "Co-curricular Activities: A Pathway to Careers" by Ferguson.

**R2:** "Rahman, S.R., Islam, M.A., Akash, P.P., Parvin, M., Moon, N.N. and Nur, F.N., 2021. Effects of co-curricular activities on student's academic performance by machine learning. *Current Research in Behavioural Sciences*, 2, p.100057.

**OTHER LEARNING RESOURCES:**

1. <https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will learn to work well with others and communicate better.	6,7
2	Students will learn to manage their time and stay organized.	6,7
3	Students will enhance their creative abilities and think more critically.	6,7
4	Students will improve their overall health and reduce stress.	6,7
5	Students will become more aware of their role in society and contribute positively.	6,7

SEMESTER – IV									
Course Title	BASIC ACCLIMATIZING SKILLS (BAS)								
Course code	22UULS201R	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 30P	0	0	1	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ III semester of second year of the programme								
Course Objectives	1. To impart knowledge of the fundamentals of Hospitality industry and its applications. 2. Students will be able to familiarize with the cooking equipment's & Utensils. 3. Students will be able to handle different modes of reservations.								
CO1	Students will have basic knowledge of cooking methods.								
CO2	Students will gain the knowledge of organizing & Cleaning of Rooms.								
CO3	Students will be able to gain the travel management concept.								
CO4	Students will be able to acquire the knowledge of basic household amenities for day to-day use.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	Introduction to Accommodation Management: Telephone handling technique, Organizing of Rooms. Cleaning agents. Cleaning equipments and uses. Bed making Process		5					1,2	
II	Fundamentals of Cooking Definition of cookery – Aim & Objectives of cooking. Use of basic Cooking equipments • Personal Hygiene and Safety Use of Fire & Fuels		5					1,2	
III	Methods of Cooking Different Cuts. Use of Herbs and Spices. Basic Food and Beverage Preparation. Regional food Habits.		5					1,2	
IV	Forms & Format's C – form Reservation form, Registration form Passport Application form Legal Rent Agreement		5					1,2	

**REFERENCE BOOKS:**

**R1:** Nancy Caroline's Emergency Care in the streets eight edition by Jones and Bartlett

**R2:** First Aid book by LC Gupta; Publisher Jaypee Brothers, 7th Edition.

**OTHER LEARNING RESOURCES:**

1. <https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM  
OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will have basic knowledge of cooking methods.	1,8
2	Students will gain the knowledge of organizing & Cleaning of Rooms.	1,8
3	Students will be able to gain the travel management concept.	1,8
4	Students will be able to acquire the knowledge of basic household amenities for day to-day use.	1,8



SEMESTER – V									
Course Title	Animal Biotechnology								
Course code	22BSBT313R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T + 30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1.Introduction to the best use of Animal Cell Culture media as well as maintenance of aseptic condition. 2.Elucidation of various cell to cell interaction; adhesion, motility and metabolic co-operation. 3.Evaluation of Cell cytotoxicity.								
CO1	Explain the evolution of animal cell culture.								
CO2	Describe the applications of animal cell culture technology with special reference to vaccines and proteins of medical importance.								
CO3	Illustrate on assisted reproduction techniques and basics of human fertilization process.								
CO 4	Describe the overview on gene therapy and its techniques.								
CO 5	Explain DNA forensics, molecular diagnostics, cloning, stem cell research and bio processing Techniques.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
<b>I</b>	Introduction, history of animal cell culture. Basic requirement for animal cell culture, Animal cell, Tissue and organ cultures, Primary culture, secondary cell culture, Continuous cell lines, Suspension culture, Cell cloning and hybridization, 3D cultures, Scaling up. Growth factors. Cell line and maintenance, viability test, cytotoxicity	<b>10</b>	Students will be able to understand basics of animal cell culture	1,2					
<b>II</b>	Application of cell culture technology in production of different vaccines and pharmaceutical proteins.	<b>9</b>	Students will be able to understand and apply the knowledge of cell culture in vaccine production	1,2					
<b>III</b>	Structure of sperms and ovum, cryopreservation of sperms and ova of live stocks, IVF, super ovulation, in-vitro fertilization, culture of embryos, cryopreservation of embryos, embryo transfer.	<b>10</b>	Students will be able to understand reproductive structures and applications like artificial fertilization	1,2					
<b>IV</b>	Gene therapy: overview, history, types, applications, advantages and disadvantages, tissue engineering overview. Transgenic and somatic cell nucleus transfer technology	<b>8</b>	Students will be able to understand the applications of cell culture in gene therapy	1,2					

<b>V</b>	Cell differentiation during development and role of homeotic genes and other developmental genes in pattern formation (Drosophila). Human forensics, bio-terror agents, Bio-crimes and Bio-terrorism, ethical consideration on animal biotechnology.	<b>8</b>	Students will be able to understand ethical issues	1,2
<b>Practical</b>	1.Laboratory safety 2.Setting of Animal cell culture lab 3. Field visit to animal cell culture laboratory 4.Examination of permanent slide samples and explanation to the observation 5. Measurement of cell size.	<b>30</b>	Students will be able to understand the applications of cell culture in various practical applications	1,2,3,4

**REFERENCE BOOKS:**

**R1:**Satyanarayana U. Biotechnology. 15th edition. Books & Allied Ltd; 2020.

**R2:**Singh B. D. Biotechnology; Expanding Horizon. 20th edition. Kalyani Publisher; 2020.

**R3:**Brown T. A. Gene Cloning and DNA Analysis: an introduction. 7th edition. John Wiley; 2016

**OTHER LEARNING RESOURCES:**

1.<https://www.ncbi.nlm.nih.gov/books/NBK207575/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1.	Explain the evolution of animal cell culture.	1,2
2.	Describe the applications of animal cell culture technology with special reference to vaccines and proteins of medical importance.	1,2
3.	Illustrate on assisted reproduction techniques and basics of human fertilization process.	1,2
4.	Describe the overview on gene therapy and its techniques.	1,2
5.	Explain DNA forensics, molecular diagnostics, cloning, stem cell research and bio processing Techniques.	1,2,3

SEMESTER – V									
Course Title	Plant and Agriculture Biotechnology								
Course code	22BSBT314R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T + 30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduction to the best use of Plant Cell Culture media as well as maintenance of aseptic condition.</li> <li>2. To describe the plant cell, its characteristic organelles as well as the composition, structure and properties of the plant cell wall, and its practical possibilities</li> <li>3. To make students understand immense transformation that has taken place in the field of agriculture practices.</li> <li>4. To make better understanding of basics of plant science and agriculture technologies.</li> </ol>								
CO1	Illustrate on basic techniques and concepts of plant tissue culture.								
CO2	Describe different methods for transformation of plants or plant cells, including their specific advantages and applications,								
CO3	Elaborate on somatic hybridization and associated techniques								
CO 4	Explain on the methods of genetic engineering technology.								
CO 5	Apply the concepts of biotechnological advances for crop improvement through genetic engineering technologies.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Basic techniques and tools in Plant Tissue Culture. Totipotency. Establishment of plant tissue culture lab: equipment, culture vessels Surface sterilization of various explants, pre-treatment of explant, Subculture and repeated transfer of explants and cultures. Composition of various tissue culture media and their preparation. Establishment of callus, suspension cultures	10	To learn the basics of plant tissue culture				1,2		
II	Somatic embryogenesis, Introduction to the processes of embryogenesis and organogenesis and their practical applications: Soma clonal variations and its significance.	8	To harness ideas on embryogenesis and organogenesis				1,2		
III	Introduction of somatic hybridization, Introduction to protoplast isolation, Principles of protoplast isolation and applications, Testing of viability of isolated protoplasts, Various steps in the regeneration of protoplasts.	8	To get the basic knowledge on the different techniques of hybridization				1,2		

	Cybridization & Cybrids- definition and application			
<b>IV</b>	Gene therapy: overview, history, types, applications, advantages and disadvantages, tissue engineering overview. Transgenic and somatic cell nucleus transfer technology	<b>8</b>	Students will be able to understand the applications of cell culture in gene therapy	1,2
<b>V</b>	Cell differentiation during development and role of homeotic genes and other developmental genes in pattern formation (Drosophila). Human forensics, bio-terror agents, Bio-crimes and Bio-terrorism, ethical consideration on animal biotechnology.	<b>8</b>	Students will be able to understand ethical issues	1,2
<b>Practical</b>	1. Study of VAM from plant root, 2. Bio inoculant: mass production of Rhizobium, 3. Tissue culture media preparation, 4. Callus and suspension cultures: initiation and maintenance of callus and suspension cultures, 5. Tissue and micropropagation, suspension culture, callus formation, regeneration, production of haploids, protoplast culture and somatic hybridization	<b>30</b>	To apply the practical knowledge of plant biotechnology in various fields	1,2,3,4

**REFERENCE BOOKS:**

- R1.** Singh B. D. Biotechnology; Expanding Horizon. 20<sup>th</sup> edition. Kalyani Publisher; 2020.  
**R2.** Lindsey K. Plant Tissue Culture Manual: Supplement 1. 2<sup>nd</sup> edition. Springer, 1999.  
**R3.** Razdan M K. Introduction to Plant Tissue Culture. 3<sup>rd</sup> edition. Oxford & IBH Publishing; 2019

**OTHER LEARNING RESOURCES:**

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7216575/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Illustrate on basic techniques and concepts of plant tissue culture.	1,2
	Describe different methods for transformation of plants or plant cells, including their specific advantages and applications,	1,2
	Elaborate on somatic hybridization and associated techniques	1,2

	Explain on the methods of genetic engineering technology.	1,2,3
	Apply the concepts of biotechnological advances for crop improvement through genetic engineering technologies.	1,2

SEMESTER – V									
Course Title	Industrial Biotechnology								
Course code	22BSBT312R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T + 30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1.To teach about fermenters, sterilisation techniques, cell growth kinetics, bioreactors. 2.To teach the techniques for production of Enzymes, Organic acids-citric acid, Amino acid- glutamic acid, Antibiotics-Penicillin, Solvent-Ethanol, Vitamins-Riboflavin and SCP. 3.To impart knowledge on bioreactor structure, function and manufacturing processes of Biofuels, Bioinsecticides, Composting								
CO1	Trace the historical evolution of fermentation, highlighting key milestones and advancements in the understanding and application of this process over time.								
CO2	Discuss the formulation of media in the context of a media preparation process, and delve into various sterilization techniques employed in the production of media for applications such as microbiology or cell culture.								
CO3	To Elaborate on the design and functionality of bioreactors, detailing the key components and principals involved in creating controlled environments for biological processes.								
CO 4	Describe the process of producing microbial products, outlining the key steps involved in cultivating and harvesting microorganisms to obtain desired products.								
CO 5	To explain about Biofertilizers, biopesticides, and mushroom technology represent sustainable and environmentally friendly approaches in agriculture.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Historical development in fermentation, Outline of upstream processing. Screening of industrially important microbes. Strain improvement, Inoculum development	10	To learn the basics of fermentation technology	1,2					
II	Media formulation, sterilization, batch and continuous culture system, types of fermentation, Stoichiometry of cell growth and kinetics. Methods of immobilization	8	To harness ideas on optimization of media for fermentation	1,2					
III	Bioreactor- Design, parts and their function. Types of bioreactor-ctr. Air lift, Bubble column, Packed bed, Tower, monitoring and control of process variables (Temperature, pH and DO)	8	To get the basic knowledge design of bioreactors	1,2					
IV	Production of microbial products: Enzymes-amylase, Organic acids-citric acid, Amino acid-glutamic acid, Antibiotics-Penicillin, Solvent-Ethanol, Vitamins-Riboflavin and SCP	10	To apply knowledge of fermentation technology for the production of industrially important products	1,2					

<b>V</b>	Biofertilizers, Biopesticides, Mushroom technology, Verm technology, Biofuel technology, Biodyes, MEOR	<b>9</b>	To learn the applications of industrial biotechnology in the production of industrially important products	1,2
<b>Practical</b>	1.Immobilization study by sodium alginate method(yeast), 2.Bioinoculant: Study of the fermenter, 3. Production of yoghurt by using specific starter culture, 4. Visit to industry and biotech park and to be submitted along with the record	<b>30</b>	To apply the practical knowledge of industrial biotechnology in various fields	1,2,3,4

**REFERENCE BOOKS:**

**R1:** Patel AH. Industrial microbiology, 2<sup>nd</sup> edition. Laxmi Publications; 2022.

**R2:**Crueger and Crueger. Industrial Microbiology. 3<sup>rd</sup> edition. Panima Books; 2004.

**R3:** Satyanarayana U. Biotechnology. 15<sup>th</sup> edition. Books & Allied Ltd; 2020.

**OTHER LEARNING RESOURCES:**

1.<https://www.ncbi.nlm.nih.gov/books/NBK305455/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Trace the historical evolution of fermentation, highlighting key milestones and advancements in the understanding and application of this process over time.	1,2
2	Discuss the formulation of media in the context of a media preparation process, and delve into various sterilization techniques employed in the production of media for applications such as microbiology or cell culture.	1,2
3	To Elaborate on the design and functionality of bioreactors, detailing the key components and principals involved in creating controlled environments for biological processes.	1,2
4	Describe the process of producing microbial products, outlining the key steps involved in cultivating and harvesting microorganisms to obtain desired products.	1,2
5	To explain about Biofertilizers, biopesticides, and mushroom technology represent sustainable and environmentally friendly approaches in agriculture.	1,2

SEMESTER – V									
Course Title	Medical Biotechnology								
Course code	22BSBT311R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T + 30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To teach about the deadly diseases.</li> <li>To acquaint the students with frontier areas of biomedical research such as stem cells and gene therapy.</li> <li>To make the student learn the insight of cancer biology.</li> </ol>								
CO1	Learn the utilization of medical biotechnology within the realm of medical science.								
CO2	Explain the process of gene therapy.								
CO3	Ability to provide an introduction to stem cell varieties, delve into the origins of stem cells, and outline their distinctive characteristics.								
CO 4	Explore on cancer biology by shedding light on the predisposing factors that contribute to the development of cancer.								
CO 5	Elaborate on the mode of infection and infectious diseases.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Introduction to Medical biotechnology and its Scopes. Human Genome Project.	10	To learn the basics and scopes of medical biotechnology				1,2		
II	Gene Therapy, Introduction Genes Targeted for Gene Therapy	8	To harness ideas on recent trends in the field of medical biotechnology				1,2		
III	Stem Cells: Introduction, Types of Stem Cells, Sources of Stem Cells; Properties of Stem Cells	8	To get the basic knowledge of stem cell therapy				1,2		
IV	Cancer Biology: Introduction, Types of Tumor, Predisposing factors for cancer, Cellular changes involved in Tumor formation, Methods of Tumor detection, Treatment of cancer – Chemotherapy and Radiotherapy	10	To learn about cancer, diagnosis and therapies related to it.				1,2		
V	Microbial diseases in Human – mode of infection, symptoms, epidemiology and control measures, AIDS, Hepatitis – B, Rabies, HSV - 1, STD (sexually transmitted disease), TB, Plague, Aspergillosis, Histoplasmosis, Cryptococcosis, Malaria, Amoebiasis	9	To learn about the techniques for the detection of different diseases				1,2		
Practical	1.Study of Mycobacterium	30	To apply the practical				1,2,3,4		



	tuberculosis by AFB staining method. 2.Diagnosis of venereal disease by using VDRL test. 3.Study of Salmonella typhi by using Widal test		knowledge of detection of different diseases	
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**REFERENCE BOOKS:**

**R1:** Strachan T, Andrew P. Human Molecular Genetics. 2<sup>nd</sup> Edition. Wiley and sons; 1999.

**R2:** Mims C. et al. Medical Microbiology. 3<sup>rd</sup> Edition. Mosby Inc. Publication, 2004.

**R3:** Balaji S. Nanobiotechnology, 1<sup>st</sup> edition. Neha Publishers & Distributors, 2021.

**OTHER LEARNING RESOURCES:**

1.<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6153617/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Learn the utilization of medical biotechnology within the realm of medical science.	1,2
2	Explain the process of gene therapy.	1,2
3	Ability to provide an introduction to stem cell varieties, delve into the origins of stem cells, and outline their distinctive characteristics.	1,2
4	Explore on cancer biology by shedding light on the predisposing factors that contribute to the development of cancer.	1,2,3
5	Elaborate on the mode of infection and infectious diseases.	1,2

SEMESTER – V									
Course Title	Research Project – Part I								
Course code	22BSBT315R	Total credits: 2 Total hours: 12R	L	T	P	S	R	O/F	C
			0	0	0	0	12	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1. Apply experimental methods to solve a given scientific task, collect data for evaluation and for statistical treatment, if relevant, 2. Use relevant scientific literature.								
CO1	Develop a research proposal, formulating research questions, reviewing literature, interpreting data, and understanding the implications of research findings.								
CO2	Develop skills in crafting a concise and well-structured research proposal.								
CO3	Learn to formulate research questions, objectives, and hypotheses.								
CO 4	Conduct a focused review of relevant literature related to the chosen mini research topic.								
CO 5	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Crafting a concise and well-structured research proposal, writing a draft of a research proposal on a chosen topic.	15	Develop skills in crafting a concise and well-structured research proposal.				1,2,3,4		
II	Formulating Research Questions and Hypotheses in small groups, submitting formulated research questions and hypotheses for feedback.	15	Learn to formulate research questions, objectives, and hypotheses.				1,2,3,4		
III	Use of academic databases and tools for literature review, conduct a literature review on the chosen research topic and submit a summary.	20	Conduct a focused review of relevant literature related to the chosen mini research topic.				1,2,3,4		
IV	Hands-on practice with data analysis software, analyse sample data sets and interpret the results.	10	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.				1,2,3,4		
V	Presentations and discussions on the broader implications of students' research findings, reflect on the implications of the research findings and submit a final research report.	10	Develop an awareness of the implications of findings within the scope of the mini research.				1,2,3,4		

#### REFERENCE BOOKS:

**R1:** "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches" by John W. Creswell and J. David Creswell

**R2:** "The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams

**R3:** Research Methodology: Methods and Techniques" by C.R. Kothari

#### OTHER LEARNING RESOURCES:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6153617/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM  
OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Develop a research proposal, formulating research questions, reviewing literature, interpreting data, and understanding the implications of research findings.	1,2,3
2	Develop skills in crafting a concise and well-structured research proposal.	1,2,3
3	Learn to formulate research questions, objectives, and hypotheses.	1,2,3
4	Conduct a focused review of relevant literature related to the chosen mini research topic.	1,2,3
5	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.	1,2,3

SEMESTER – V									
Course Title	Techno-professional skill-IV (Experimental and statistical data analysis)								
Course code	22BSBT316R	Total credits: 1 Total hours: 30S	L	T	P	S	R	O/F	C
			0	0	0	2	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>Students will be able to gain the Analytical Skill concept</li> <li>Students will be able to acquire the knowledge of basic Data Analysis Procedure for day-to-day use.</li> <li>Students will gain the knowledge of organizing &amp; Cleaning of Data.</li> </ol>								
CO1	Gain proficiency in using R as a programming language and environment for performing data analysis tasks and creating graphical representations of data.								
CO2	Create, manipulate, and manage data objects in R, as well as efficiently import data from various file formats into their R environment.								
CO3	Develop the skills necessary to perform a variety of data analysis tasks using R, including data exploration, cleaning, transformation, and visualization.								
CO 4	compute and interpret descriptive statistics such as measures of central tendency, variability, and correlation coefficients using R.								
CO 5	Understand the principles behind one-sample tests, two-sample tests, goodness-of-fit tests, as well as parametric and non-parametric tests.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<ol style="list-style-type: none"> <li>Introduction to R - A programming language and environment for data analysis and graphics,</li> <li>Data objects, Importing data files,</li> <li>Performing data analysis tasks,</li> <li>Computing descriptive statistics,</li> <li>One sample tests, two sample tests,</li> <li>Goodness of fit tests,</li> <li>Parametric test and Non-Parametric test</li> </ol>		To learn different aspects of statistical analysis for research work				1,2		

**REFERENCE BOOKS:**

**R1.** Gupta S. C. Fundamentals of Applied Statistics. 4<sup>th</sup> edition. Sultan Chand & Sons, 2014.

**R2.** Jeyapriya S P. Statistical Methods in Biology. 1<sup>st</sup> edition. LAP Lambert Academic Publishing, 2020.

**R3.** Banerjee B. Mahajan's Methods in Biostatistics for Medical Students and Research Workers. 9<sup>th</sup> edition. Jaypee Brothers Medical Publishers; 2018.

**OTHER LEARNING RESOURCES:**

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6153617/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Gain proficiency in using R as a programming language and environment for performing data analysis tasks and creating graphical representations of data.	1,2
2	Create, manipulate, and manage data objects in R, as well as efficiently import data from various file formats into their R environment.	1,2
3	Develop the skills necessary to perform a variety of data analysis tasks using R, including data exploration, cleaning, transformation, and visualization.	1,2
4	compute and interpret descriptive statistics such as measures of central tendency, variability, and correlation coefficients using R.	1,2
5	Understand the principles behind one-sample tests, two-sample tests, goodness-of-fit tests, as well as parametric and non-parametric tests.	1,2

SEMESTER – VI									
Course Title	Research Methodology, IPR and Bioethics								
Course code	22BSBT321R	Total credits: 4 Total hours: 45T + 30P	L	T	P	S	R	O/F	C
			3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To teach the basics of research objectives, design, methodology and analysis.</li> <li>To prepare the students for various filed of research.</li> <li>To explain the students about IPR and various ways of its violation and protection along with the laws and regulations associated with the process.</li> <li>To learn various moral and ethical issues associated with research; medical biotechnology in particular.</li> <li>To teach them about various conventions and their resolutions.</li> </ol>								
CO1	Explain and illustrate research objectives, design, methodology, analysis and research.								
CO2	Describe data collection and sampling methods.								
CO3	Explain property rights and ways of its protection along with the laws and regulations associated with the process.								
CO 4	Understand trademarks and geographical indications and process of obtaining them.								
CO 5	Explain moral and ethical issues associated with researches including various conventions								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Introduction to Research Methods and Methodology- Format of thesis and dissertation, Research article, Reviews, Monographs, Bibliography, Literature search, Significance of research, Research methods versus methodology, Research and Scientific methods, Defining the research Problem and Research design. Scientific Methods, Hypotheses Generation and Evaluation, Various Steps in Scientific Research, Types of Research; Research Purposes - Research Design - Survey Research - Case Study Research.	10	To learn about methods of research				1,2		
II	Data Collection and Sampling Design- Sources of Data: Primary Data, Secondary Data; Procedure Questionnaire- Survey and Experiments – Design of Survey and Experiments - Sampling Merits and Demerits - Control Observations - Procedures – Sampling Errors.	8	To harness ideas on data collection and interpretation				1,2		

<b>III</b>	Introduction to Intellectual Property - Concept of Intellectual Property, Patentsetc, Kinds of Intellectual Property, Economic importance of Intellectual Property. International Scenario: Introduction to the leading international instruments concerning intellectual property rights: the Berne Convention, Universal Copyright Convention, the Paris Convention, TRIPS, the World Intellectual Property Rights Organization (WIPO) and the UNESCO	<b>8</b>	To get the basic knowledge property rights	1,2
<b>IV</b>	An Introduction to Trademarks and Geographical Indications - Registration of Trademarks and Rights of Registered trademark owners, Concept of Appellations of Origin, Indication of Source and geographical Indication	<b>10</b>	To learn about trademarks and methods to obtain them	1,2
<b>V</b>	Bio-ethics- Purpose and scope, Principles, Medical ethics, Perspectives and methodology, Moral and ethical issues in Biotechnology	<b>9</b>	To learn about bioethics and issues related to bioethics	1,2

**REFERENCE BOOKS:**

**R1:** Bendat and Piersol, Random data: Analysis and Measurement Procedures. 4<sup>th</sup> edition. Wiley Interscience, 2001.

**R2:** Cornish W.R et al. Intellectual Property. 8<sup>th</sup> edition. Sweet & Maxwell, London; 2013

**R3:** Keeling D. et al. Kerly's Law of Trade Marks and Trade Names, 16<sup>th</sup> Edition, Sweet & Maxwell, 2017.

**OTHER LEARNING RESOURCES:**

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7121592/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain and illustrate research objectives, design, methodology, analysis and research.	1,2
2	Describe data collection and sampling methods.	1,2
3	Explain property rights and ways of its protection	1,2

	along with the laws and regulations associated with the process.	
4	Understand trademarks and geographical indications and process of obtaining them.	1,2
5	Explain moral and ethical issues associated with researches including various conventions	1,2



SEMESTER – VI									
Course Title	Research Project – Part II								
Course code	22BSBT322R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T + 30P	0	0	0	0	36	0	6
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Apply experimental methods to solve a given scientific task,</li> <li>2. Collect data for evaluation and for statistical treatment, if relevant,</li> <li>3. Use relevant scientific literature.</li> <li>4. Compile data</li> </ol>								
CO1	Develop a research proposal, formulating research questions, reviewing literature, interpreting data, and understanding the implications of research findings.								
CO2	Develop skills in crafting a concise and well-structured research proposal.								
CO3	Learn to formulate research questions, objectives, and hypotheses.								
CO 4	Conduct a focused review of relevant literature related to the chosen mini research topic.								
CO 5	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Introduction, Comprehension on research search engines, Selection of Topic		To learn about methods of research				1,2		
II	Tools for reference citation, Different methods for writing citation and references, Introduction to structure of Review and specific features of review, Plagiarism, ethical issue in writing the review, Mapping and selection of Journal of specific knowledge of discipline and submission for publications		To harness ideas on data collection and interpretation				1,2		

#### REFERENCE BOOKS:

**R1:** "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches" by John W. Creswell and J. David Creswell

**R2:** "The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams

**R3:** "Research Methodology: A Step-by-Step Guide for Beginners" by Ranjit Kumar.

#### OTHER LEARNING RESOURCES:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5037944/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM  
OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1.	Develop a research proposal, formulating research questions, reviewing literature, interpreting data, and understanding the implications of research findings.	1,2,3
2.	Develop skills in crafting a concise and well-structured research proposal.	1,2,3
3.	Learn to formulate research questions, objectives, and hypotheses.	1,2,3
4.	Conduct a focused review of relevant literature related to the chosen mini research topic.	1,2,3
5.	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.	1,2,3



# Assam down town University

## Curriculum and Syllabus

### Bachelor of Science in Microbiology



OUTCOME BASED EDUCATION FRAMEWORK  
CHOICE BASED CREDIT SYSTEM  
Version: 2.0

**FACULTY OF SCIENCE**

July, 2022

## Preamble

Assam down town University is a premier higher educational institution which offers Bachelor, Master, and Ph.D. degree programmes across various faculties. These programmes, collectively embodies the vision and mission of the university. In keeping with the vision of evolutionary changes taking place in the educational landscape of the country, the university has restructured the course curriculum as per the guidelines of National Education Policy 2020. This document contains outline of teaching and learning framework and complete detailing of the courses. This document is a guidebook for the students to choose desired courses for completing the programme and to be eligible for the degree. This volume also includes the prescribed literature, study materials, texts, and reference books under different courses as guidance for the students to follow.

Recommended by the 22<sup>nd</sup> Board of Studies (BoS) meeting of the Faculty of Science held on dated 22/06/2022 and approved by the Emergent Academic Council (AC) meeting held on dated 30/07/2022



*Chairperson  
Board of Studies*



*Member Secretary  
Academic Council*



## ***Vision***

To become a Globally Recognized University from North Eastern Region of India, Dedicated to the Holistic Development of Students and Making Society Better

## ***Missions***

1. Creation of curricula that address the local, regional, national, and international needs of graduates, providing them with diverse and well-rounded education.
2. Build a diverse student body from various socio-economic backgrounds, provide exceptional value-based education, and foster holistic personal development, strong academic careers, and confidence.
3. Achieve high placement success by offering students skill-based, innovative education and strong industry connections.
4. Become the premier destination of young people, desirous of becoming future professional leaders through multidisciplinary learning and serving society better.
5. Create a highly inspiring intellectual environment for exceptional learners, empowering them to aspire to join internationally acclaimed institutions and contribute to global efforts in addressing critical issues, such as sustainable development, Climate mitigation and fostering a conflict-free global society.
6. To be renowned for creating new knowledge through high quality interdisciplinary research for betterment of society.
7. Become a key hub for the growth and excellence of AdtU's stakeholders including educators, researchers and innovators
8. Adapt to the evolving needs and changing realities of our students and community by incorporating national and global perspectives, while ensuring our actions are in harmony with our foundational values and objectives of serving the community.

# Programme Details

## Programme Overview

Bachelor of Science in Microbiology is a 3-year undergraduate programme which deals with fundamental and advanced study of the microorganisms, including microbial cellular processes, their harmful and beneficial aspects, microbes for human welfare, molecular details of microbial cells and develops knowledge and understanding for applying it for societal benefits which may include sectors such as healthcare, agriculture, soil and environment, food processing, pharmaceutical etc. The objective of this programme is to produce intellectual and proficient microbiologists by enhancing the abilities and skills of students for application of microbiology theories and expertise in the live problems faced by the industry.

### I. Specific Features of the Curriculum

After the successful completion of Bachelor of Science in Microbiology programme students will be able to:

- 1:** Develop proficiency in theoretical and practical application of microbiology.
- 2:** Generate knowledge about harmful impacts of microorganisms in causing various infectious diseases and their diagnosis.
- 3:** Understand and apply the knowledge about beneficial effects of microorganisms and their role in environmental agricultural and industrial sectors.
- 4:** Get equipped with the knowledge of molecular techniques and immunological techniques and their application.
- 5:** Take up entrepreneurship in the field of microbiology through the knowledge and proficiency generated during the tenure of the graduation program.

II. **Eligibility Criteria:** Minimum 45% in 10+2 with English, Biology & Chemistry. 5% relaxation for SC/ST, EWS, and Especially abled candidates.

### III. Program Educational Objectives (PEOs):

**PEO-1:** AdtU Microbiology Graduates will be prepared for successful careers in applied fields of microbiology in both government and private sectors and as entrepreneurs.

**PEO-2:** Microbiology Graduates will possess expertise in core microbiology areas as well as interdisciplinary fields for significant contributions to the service of humankind.

**PEO-3:** Graduates will be successful in higher education and research in areas of microbiology if pursued.

### IV. Program Specific Outcomes (PSOs):

**PSO1: Holistic Development:** Exhibit interpersonal ability and adaptability in diverse sociocultural societies for efficient working in the profession through life-skill learning, and co-curricular and extracurricular activities.

**PSO2: Global Certification:** Demonstrate competency in the profession by attaining global certification offered by international universities of repute.

**PSO3: Techno-Professional Proficiency:** Apply the knowledge of interdisciplinary microbiological approaches with industrial applications to become competent professionals.

#### V. **Program Outcome:**

**PO1: Microbiological Knowledge:** Apply the knowledge of basic sciences, fundamentals of microbiology and applied biological sciences to address issues related to agriculture, healthcare, industry and the environment.

**PO2: Problem Analysis:** Critically analyze microbiological problems in interdisciplinary aspects to resolve associated challenges with rational solutions.

**PO3: Modern Techniques Usage:** Apply standardized methods, contemporary analytical techniques and tools to conduct experiments and systematic analyses.

**PO4: Environmental Sustainability:** Assess the impacts of provided solutions on the environment, and redesign it for better sustainability.

**PO5: Communication:** Communicate scientific information effectively across diverse audiences, and prepare documents, reports, presentations etc.

**PO6: Ethics and Values:** Apply universal human values, and follow ethical principles and scientific norms in the profession.

**PO7: Individual and Teamwork:** Perform efficiently as an individual, and as a member/ leader in a team of diverse professionals, and in multidisciplinary settings

**PO8: Continual Learning:** Engage in continuous learning, fostering advances in scientific knowledge and technology.

#### VI. **Total Credits to be Earned: 120**

#### VII. **Career Prospects:**

After completion of the course one can pursue Master degree in Microbiology or opt for career in:

- Research and development laboratories as a research scholar.
- Hospital laboratories as a Microbiologist.
- In various foods processing industries as Microbiologist and Quality control officer.
- In beverage industries and pharmaceutical industries.
- In various biotechnological industries.
- In various agricultural and environmental organisations.

## EVALUATION METHODS

The student performance shall be evaluated through In-semester (Sessional) and semester-end examinations. A weightage of 40% or as prescribed by the programme shall be added to the score of the end-semester examination.

### A. INTERNAL ASSESSMENT:

The teacher who offers the course shall be responsible for internal assessment by conducting in-semester (sessional) examination and evaluating the performance of the students pursuing that course. The components for internal assessment are illustrated in the table given below.

SN	Components/ Examinations	Marks Allotted
1.	In-Sem Exam – I (ISE-I) (Written Examination) *	30
2.	In-Sem Exam – II (ISE-II) (Written Examination) *	30
3.	Assignment	10
4.	Presentation (SP)	10
5.	Quiz	5
6.	Class Performance based score*	5

*\*are compulsory*

Note: Total Internal assessment should be out of 40

### INSTRUCTION

1. If a student fails to appear in the any of the component without any valid reason he/she shall be marked zero in that component. However, the course teacher at his discretion may arrange for the missed test on an alternate date for the absentee students after determining ground with genuine/valid reasons for the absent.
2. The report of evaluation of an activity towards the in-semester (sessional) component of a course shall be duly notified by the concerned course teacher within a week of completion.
3. The program coordinators should upload the in-semester marks to the ERP and forward acknowledgement of all the courses of the program to the Controller of Examinations before the start of the End-semester examination.

### B. SEMESTER END EXAMINATION:

Time table for end semester examination is published at least 25 days prior to the start of Examination.

#### Pre-Examination:

#### Eligibility Criteria for a student to appear in University Examinations:

The student shall only be allowed to appear in a University Examination, if:

- i) He/ She is a registered student of the University;
- ii) He/ She is of good conduct and character;



iii) He/ She has completed the prescribed Programme of study with minimum percentage of attendance as laid down in the Regulations of the Programme concerned.

Under special cases, a student may be allowed to appear for an examination without being registered in the University but the result of the said student will be kept on hold till the registration of the concerned student is completed.

#### I. Admit Card:

Admit card for the examination may be downloaded through ERP where the system will generate a Unique ID Cards through online.

The University shall have the right to cancel admission for examination of any candidate on valid grounds.

#### II. Pattern of Question Papers:

The question paper shall follow the principles of Bloom's Taxonomy.

Table

S. N.	Level	Questions /verbs for test
1	Remember	List, Define, tell, describe, recite, recall, identify, show who, when, where, etc.
2	Understand	Describe, explain, contrast, summarize, differentiate, discuss, etc.
3	Apply	Predict, apply, solve, illustrate, determine, examine, modify
4	Analyze	Classify, outline, categorize, analyze, diagrams, illustrate, infer, etc.
5	Evaluate	Assess, summarize, choose, evaluate, recommend, justify, compare etc.
6	Create	Design, Formulate, Modify, Develop, integrate, etc.

**Note:** No course is to be evaluated on basis of **all 6 knowledge levels**.

The format of the question paper across all the program follow a unique pattern and the total marks is 60

**Table 1: Question paper pattern for End semester examination**

Sl no	Question pattern	Total marks
1	MCQs (10 Questions)	10
2	2 Marks questions (10 Questions)	20
3	4 Marks questions (5 Questions)	20
4	10 Marks questions (1 Question)	10

#### III. Examination Duration:

Each paper of 60 marks shall ordinarily be of two hours duration.

#### IV. Practical Examinations, Viva-Voce etc.:

i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.

- ii) Viva-Voce, Oral examinations of the Project report, Dissertation etc. shall be undertaken by a Board of Examiners constituted by the respective Dean of Program with the advice of Supervisor(s).

**V. Procedure of Expulsion:**

If any candidate is found to be using any unfair-means during the examination, the invigilator may cease his/her answer sheet and report it directly to the Officer-in-Charge. The Office-in-Charge of the center may take appropriate decisions as per the rules and procedure of the examination. The Officer-in-Charge may allow the students to write the exam with new answer sheet or may expel the student from appearing the paper depending on the nature of unfair-means. In case of Computer based test, the students may be directed to write an apology letter and sign in the prescribe expulsion form. The student may not be allowed to write that examination.

**VI. Instruction to the Students:**

- (i) The students shall not bring to the Examination Hall, any electronic gadget used as a means of communication or record except electronic calculator, if required.
- (ii) The students shall not receive any book or printed or hand written or photo copy (Xerox) or blank-paper from any other person while he/she is in the examination-room or in laboratory or in any other place to which he/she is allowed to have access during course of examination.
- (iii) The students shall not communicate with any other candidate in the examination room or with any other person in and outside the examination-room.
- (iv) The students shall not see, read or copy anything written by any other candidate, nor shall he/she knowingly or negligently permit any other candidate to see, read or copy anything written by him/her or conveyed by him/her.
- (v) The students shall not write anything on the Question Paper or in other paper or materials during the examination, or pass any kind of paper to any other candidate in the examination-room, or to any person outside the room.
- (vi) The students shall not disclose his/her identity to the examiner by writing his/her name or putting any sign / symbol in any part of his answer-script.
- (vii) The students shall not use any abusive language or write any objectionable remark or make any appeal to examiner by writing in any part of his answer-script.
- (viii) The students shall not detach any page from the answer-script or insert any authorized or unauthorized loose sheet into it. He /she shall also not insert any other answer-script / loose sheet by removing the pins of the origin answer-scripts and re-fixing it.
- (ix) The students shall not resort to any disorderly conduct inside the examination-room or misbehave with the invigilator or any other examination official.

**VII. Provision for an Amanuensis (writer):**

- (i) A candidate may be provided with an Amanuensis (writer) to write down on dictation on his / her behalf on ground of his / her physical disability to write down by himself / herself due to accident or any other reason. The amanuensis may be provided till he / she recovers from the physical disability. The physical disability to write down by himself / herself must be supported by Medical Certificate from a competent Medical Officer.
- (ii) The qualifications of the amanuensis so provided must not be equal or higher than that of the candidate. This is also to be supported by Certificate from the Faculty of Study where the Amanuensis is provided.

- (iii) Such candidates are to be accommodated in a separate room under the supervision of an invigilator so that the fellow candidates are not disturbed in the process.

**C. Credit Point:**

It is the product of grade point and number of credits for a course, thus,  $CP = GP \times CR$

**i. Credit:**

A unit by which the course work is measured. It determines the number of hours of instructions required per week. 'Credit' refers to the weightage given to a course, usually in terms of the number of instructional hours per week assigned to it. Credits assigned for a single course always pay attention to how many hours it would take for an average learner to complete a single course successfully.

**ii. Grade Point:**

Grade Point is a numerical weight allotted to each Grade Letter on a 10-point scale.

**iii. Letter Grade:**

Letter Grade is an index of the performance of students in a said paper of a particular course. Grades are denoted by letters O, A+, A, B+, B, C, P, F and Abs. Student obtaining Grade F / Grade Abs shall be considered failed/ absent and, will be required to appear in the subsequent ESE. The UGC recommends a 10-point grading system with the following (Table: 1) Letter Grades:

- (i) A Letter Grade shall signify the level of qualitative/quantitative academic achievement of a student in a Course, while the Grade Point shall indicate the numerical weight of the Letter Grade on a 10-point scale.
- (ii) There shall be 08 (eight) Letter Grades bearing specific Grade Points as listed in Table 1, where the Letter Grades 'O' to 'P' shall indicate successful completion of a course.
- (iii) Apart from the 08 (eight) regular Letter Grades listed in Table 1, there shall be 03 (three) additional Letter Grades, which shall be awarded if a Course is withdrawn or spanned over the next Semester or remains incomplete as stated in Table 2.

**Table 2: Letter Grades and Grade Points**

Letter Grade	Grade Points	Description
O	10	Outstanding
A+	9	Excellent
A	8	Very Good
B+	7	Good
B	6	Above Average
C	5	Average
P	4	Pass
F	0	Fail
Abs	0	Absent

UFM	0	Unfair Means
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**iv. Grade Point Average:**

**a. SGPA (Semester Grade Point Average)**

The SGPA of a student in a Semester shall be the weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered in that Semester, irrespective of whether he/she could or could not complete the Courses. More specifically, the calculation of SGPA shall take into account the Courses graded with Letter Grades ‘O’ to ‘F’ as given in Table 1.

$$SGPA = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i} \quad (1.1)$$

The SGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.1) up to two decimal places, where n is the total number of Credit Courses registered by the student in that Semester,  $G_i$  is the Grade Point secured in the  $i^{th}$  registered Course and  $C_i$  is the Credit (weight) of that Course.

**b. CGPA (Cumulative Grade Point Average)**

- (i) The CGPA of a student in a Semester of a Programme shall be the accumulated weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered and successfully completed so far starting from the enrollment in the Programme. In other words, taking into account all the Courses graded with ‘O’ to ‘P’ as given in Table 1.1, generally the CGPA of a student shall be calculated starting from the first Semester of his/her enrolled Programme, while the CGPA of a lateral-entry student shall be calculated starting from the Semester of his/her enrollment.
- (ii) The CGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.2) up to two decimal places, where N is the total number of Credit Courses registered and successfully completed so far by the student,  $G_i$  is the Grade Point secured in the  $i^{th}$  completed Course and  $C_i$  is the Credit (weight) of that Course.

$$CGPA = \frac{\sum_{i=1}^N C_i G_i}{\sum_{i=1}^N C_i} \quad (1.2)$$

- (iii) The CGPA shall be convertible into equivalent percentage of marks using Equation Conversion of CGPA to percentage marks: = CGPA\*10

**D. Post-Examination**

**i. Transcript or Grade Card or Certificate:**

A marking certificate shall be issued to all the registered students after every Semester. The Semester mark sheet will display the course details (code, title, number of credits, grade secured) along with total credit earned in that Semester.

## **ii. Grievance Readdress Mechanism:**

Students with any dissatisfaction or grievance regarding the marks awarded in any of the Papers / Courses may appeal to the Controller of Examinations for remedial action such as Re-evaluation within 10 days of the declaration of result.

- (i) A student has options to appeal for re-evaluation of his /her answer script to the Controller of Examination.
- (ii) Application for re-evaluation / re-scrutiny of answer scripts shall be made in the definite proforma available with the Examination Office through the head of the respective departments within 10 days of declaration of the results of the respective examinations.
- (iii) The Controller of Examination may appoint an examiner for re-evaluation and will consider and recognize the evaluation done by a University appointed examiner.
- (iv) There shall be no provision for re-evaluation of the Practical Papers, Project Work, and Dissertation etc. However, the students fail in practical examination or viva voce and wish to appear again may apply to be evaluated can do so with the next schedule.
- (v) After screening the application for re-evaluation, the CoE may send the answer scripts of the student to the examiners appointed by the CoE with the approval of Vice Chancellor.
- (vi) The marks/grades achieved by the students after the re-evaluation shall be final and binding.
- (vii) Fresh Marks – sheets / Grade Card shall be issued only if the candidate secures pass marks / passing grade in the re-evaluated paper.
- (viii) Revaluation of answer scripts shall be deemed to be an additional facility provided to the students with a view to improving upon their results at the preceding examination result for any reason whatsoever shall not confer any right upon them for admission to next higher class which matters always be regulated in accordance with the relevant rules or regulations framed by the University.
- (ix) If as a result of revaluation of the candidate attracts the provision of condonation of deficiency, the same may be applied to his/her only for fresh attempt.

## INSTRUCTION TO TEACHERS AND STUDENTS

### (Teaching and Learning Methods)

In all the courses the teacher has to select topics for teacher-method which should not be less than 20 percent. The approach will be direct classroom teaching through a series of lectures delivering concepts using ITC facilities, white or blackboard. Notes may also be circulated to the students; however, the students are to be involved in the preparation of the notes. The teacher will be responsible for selecting the best note for circulation. The teacher-centric methodology has recently fallen out of favour because this strategy for teaching is seen to favour passive students.

#### **1. Student- centric / Constructivist Approach:**

The topics of the courses may be selected at the start of the class and assigned one topic to each of the students for studying by themselves, prepare presentations, notes, etc., and present at respective class time after consultation and discussion with the course teachers. The teacher facilitates the learning of the students by guiding and providing input and explaining concepts. 60 percent of the course contents may be selected for this purpose. To avoid behaviour problems, teachers must lay a lot of groundwork in student-centric classrooms. Typically, it involves instilling a sense of responsibility in students. In addition, students must learn internal motivation.

**a. Project-Based Learning:** The teacher may select 5 percent of topics for the purpose and may conduct visits to the laboratory for experiments or field surveys. The selection of the topic may be done considering the available facility for the purpose. However, in the final semester of each of the programme the student has to undergo project-based learning at least 4 months duration. This approach will help the student to think critically, evaluate, analyze, make decisions, collaborate, and more.

**b. Inquiry-Based Learning:** The teacher/ students are supposed to list at least five questions in each contact hour and student solve these question or search for answer which becomes the home work for the students “question-driven” learning approach. The teacher may look for the correctness of the solution or the best possible answer and discuss in the successive class. This will help in the preparation for various competitive examination and develop a habit for search for solutions.

**c. Flipped Classroom:** About 10 percent of the course content has to be completed by this method. In this approach the students are asked to watch video or lecture prepared by the teacher or any video available (relevant to the course). A set of questions may be given to the students for searching answers by the students. The idea is that students should have more time in-classroom focusing on achieving these higher levels of thinking and learning. The Flipped classroom is also an acronym. The letters FLIP represent the four pillars included in this type of learning: Flexible environment, Learning culture shift, Intentional content, and Professional educator. As you can see, the second pillar refers to a culture shift from the traditional approach where students are more passive to an approach where students are active participants. As a result, this approach is also a student-centric teaching method.

**d. Cooperative Learning:** The remaining five percent has to be completed by cooperative learning approach. In this approach, the students are allotted problems. During library hours the students along with the teacher visit the library and search for probable solutions for the assigned problem. The same has to be done in groups so that the students discuss among themselves for the appropriate answers. Essentially, cooperative learning believes that social interactions can improve learning. In addition, the approach recreates real-world work situations in which collaboration and cooperation are required.

**The percentage categorization for the completion of a theory course**

Teacher-centric or Direct Classroom Teaching: Delivery by series of lectures 20% Student-centric Approach, Students present and deliver lectures in the presence of teacher and supervised by teacher 60% Students visit fields or perform experiments or teachers perform demonstration 05% Flipped Classroom approach 10% Cooperative learning app

**Inquiry-based approach has to be followed in all of the classes**

The teacher has to distribute the topics to be considered for teaching by the above-mentioned approaches and prepare a lesson plan for execution and maintain a file

**Curriculum Framework**  
**Breakdown of Credits (for 2022-23 Syllabus)**

<b>Sl. No</b>	<b>Category</b>	<b>Total number of Credits</b>
1	University Core (UC)	11
2	University Elective (UE)	12
3	Program Core (PC)	93
4	Program Elective (PE)	0
5	Faculty Elective (FE)	4
<b>Total number of credit</b>		<b>120</b>

**Breakdown by categories of courses**

<b>Sl. no</b>	<b>Category</b>	<b>Credits</b>	<b>%</b>
1	Science	111	92.5%
2	Engineering	4	3.3%
3	Commerce and Management	5	4.2%
<b>Total</b>		<b>120</b>	<b>100%</b>

**PCI, INC, AICTE regulated programs shall have to follow the regulating body**



### SEMESTER WISE COURSE DISTRIBUTION

	S. N.	Course Code	Course Title	Course Category	Engagement							C	Maximum Marks for			Total
					L	T	P	S	R	O	IA*		SEE*	PE*		
<b>Semester I</b>	1.	22BSMB111R	Principles of Microbiology and Microbial Diversity	PC	3	0	4	0	0	0	5	40	60	100	200	
	2	22BSMB112R	Zoology	PC	3	0	2	0	0	0	4	40	60	100	200	
	3	22BSMB113R	Principles of Biochemistry	PC	3	0	2	0	0	0	4	40	60	100	200	
	4	22BSMB114R	Basic Chemistry	PC	3	0	2	0	0	0	4	40	60	100	200	
	5	22UBPD113R	PDP: Introductory English	UE	0	0	4	0	0	0	2	0	0	100	100	
	6	22UBEC111	Extra- Curricular	UC	0	0	0	4	0	0	1	0	0	0	0	
	<b>Total</b>										<b>20</b>				<b>900</b>	
<b>Semester II</b>	S. No.	Course Code	Course Title	Course Category	L	T	P	S	R	O	C	IA*	SEE*	PE*	Total	
	1.	22BSMB121R	Cell Biology and Microbial Physiology	PC	3	0	4	0	0	0	5	40	60	100	200	
	2	22BSMB122R	Biophysical Chemistry	PC	3	0	0	0	0	0	3	40	60	0	100	
	3	22BSMB123R	Applied Biochemistry	PC	3	0	2	0	0	0	4	40	60	100	200	
	4	22BSMB124R	Bioinstrumentation	PC	2	0	2	0	0	0	3	40	60	100	200	
	5	22UBPD123R	PDP: Implicative English	UE	0	0	4	0	0	0	2	0	0	100	100	
	6	22UUDLI103R	Computational System and Digital Literacy	UE	0	0	2	0	0	0	1	0	0	100	100	
	7	22UBEC121	Extra-curricular (non - CGPA)	UC	0	0	0	4	0	0	1	0	0	0	0	
	8	22UBES101R	Environmental Science	UC	2	0	0	0	0	0	2	40	60	0	100	

	9	22BSMB125R	Microbial Culture Techniques	PC	0	0	2	0	0	0	1	0	0	100	100
	10	22BSMB126R	MOOCs	FE	1	0	0	0	0	0	1	0	100	0	100
	<b>Total</b>										<b>23</b>				<b>1200</b>
<b>Semester III</b>	S. No.	Course Code	Course Title	Course Category	Engagement							Maximum Marks for			
					L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
	1.	22BSMB211R	Immunology	PC	3	0	4	0	0	0	5	40	60	100	200
	2	22BSMB212R	Microbial Genetics	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSMB213R	Tissue Culture	PC	2	0	0	0	0	0	2	40	60	0	100
	4	22UBPD213R	PDP: English Language for Excellence	UE	0	0	4	0	0	0	2	0	0	100	100
	5	22UUFL202R	Personal Financial Planning	UE	0	0	2	0	0	0	1	0	0	100	100
	6	22UULS202R	Basic Life Saving Skills (BLSS)	UE	0	0	2	0	0	0	1	0	0	100	100
	7	22UUHV101R	Universal Human Value and Professional Ethics	UC	1	0	2	0	0	0	2	40	60	100	200
	8	22BSMB214R	Analytical Biochemistry	PC	0	0	2	0	0	0	1	0	0	100	100
	9		Generic Elective	UE	2	0	0	0	0	0	2	40	60	0	100
	10	22UBCC211	Co-Curricular (Non - CGPA)	UC	0	0	0	4	0	0	1	0	0	0	0
	<b>Total</b>										<b>21</b>				<b>1200</b>
<b>Semester IV</b>	S. N.	Course Code	Course Title	Course Category	Engagement							Maximum Marks for			
					L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
	1.	22BSMB221R	Molecular Biology and RDT	PC	3	0	2	0	0	0	4	40	60	100	200

	2	22BSMB222R	Soil and Agricultural Microbiology	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSMB223R	Bioinformatics	PC	2	0	2	0	0	0	3	40	60	100	200
	4	22UBPD223R	PDP: Campus to Corporate	UE	0	0	4	0	0	0	2	0	0	100	100
	5	22UBEC221	Extra- Curricular	UC	0	0	0	4	0	0	1	0	0	0	0
	6	22BSMB224R	Composting and Biofertilizer Production	PC	0	0	2	0	0	0	1	0	0	100	100
	7		Generic Elective	UE	2	0	0	0	0	0	2	40	60	0	100
	8	22BSMB225R	MOOCs	FE	1	0	0	0	0	0	1		100	0	100
	9	22UULS201R	Basic Acclimatizing Skills (BAS)	UE	1	0	0	0	0	0	1	0	0	100	100
		<b>Total</b>									<b>19</b>				<b>1100</b>
<b>Semester V</b>	<b>S. N.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Course Category</b>	<b>Engagement</b>							<b>Maximum Marks for</b>			
					<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O</b>	<b>C</b>	<b>IA*</b>	<b>SEE*</b>	<b>PE*</b>	<b>Total</b>
	1	22BSMB311R	Medical Bacteriology and Virology	PC	3	0	4	0	0	0	5	40	60	100	200
	2	22BSMB312R	Medical Mycology and Parasitology	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSMB313R	Biostatistics	PC	3	0	0	0	0	0	3	40	60	0	100
	4	22BSMB314R	Pharmaceutical Microbiology	PC	3	0	0	0	0	0	3	40	60	0	100
	5	22BSMB315R	Food and Dairy Microbiology	PC	3	0	2	0	0	0	4	40	60	100	200
	6	22BSMB316R	Research Project I	PC	0	0	0	0	18	0	3	0	0	100	100
	7	22BSMB317R	Experimental and Statistical Data analysis	PC	0	0	2	0	0	0	1	0	0	100	100
	8	22BSMB318R	MOOCs	FE	1	0	0	0	0	0	1	0	100	0	100
		<b>Total</b>									<b>24</b>				<b>1100</b>

S. N.	Course Code	Course Title	Course Category	Engagement								Maximum Marks for			
				L	T	P	S	R	O	C	IA*	SEE*	PE*	Total	
				1.	22BSMB321R	Fermentation Technology and Industrial Microbiology	PC	3	0	2	0	0	0	4	40
2	22BSMB322R	Research Methodology, Bioethics and IPR	PC	3	0	0	0	0	0	3	40	60	0	<b>100</b>	
3	22BSMB323R	Research Project II	PC	0	0	0	0	30	0	5	0	0	100	<b>100</b>	
4	22BSMB324R	MOOCs	FE	1	0	0	0	0	0	1	0	100	0	<b>100</b>	
<b>Total</b>										<b>13</b>				<b>500</b>	
<b>Total for all six semesters</b>										<b>120</b>				<b>6000</b>	

**\*IA: Internal Assessment, SEE: Semester End Examination, PE: Practical Examination**

SEMESTER – I											
Course Title		Introduction to Microbiology									
Course code	22BSMB111R	Total credits: 5			L	T	P	S	R	O/F	C
		Total hours: 45T+60P			3	0	4	0	0	0	5
Pre-requisite		Nil		Co-requisite			Nil				
Programme		Bachelor of Science in Microbiology									
Semester		Fall/ I semester of first year of the programme									
Course Objectives		1. The objective of this paper is to familiarize the students with the basic concepts of microbiology and diversity of microorganisms. 2. To teach the students about the different staining techniques of microorganisms. 3. The course provides insights concerning aspects of different types of microorganisms, culturing and staining of microorganisms.									
CO1		Describe the microbial classification and contributions of key microbiologists in development of microbiology.									
CO2		Describe the characteristic of bacteria and virus and their various habitats									
CO3		Explore the different culture media and the concepts of sterilization.									
CO4		Apply different bacteriological staining techniques for viewing.									
CO5		Explain the mechanism of antimicrobial compounds and their production.									
Unit-No.	Content			Contact Hour	Learning Outcome				KL		
I	<b>History of microbiology:</b> Contributions of Spallanzani, Pasteur, Joseph Lister, Koch, Edward Jenner and Fleming; Scopes of Microbiology; <b>Microbial Classification:</b> two kingdom, three kingdom and five kingdom classification; Morphology of bacteria, Ultrastructure of Bacterial cell, Nutritional types, classification on the basis of oxygen requirements.			15	Describe, illustrate and explain history of microbiology and classification of microorganisms, the morphology, cell structure and nutrition of bacteria.				1,2		
II	Microbes in different environments: Thermophiles, hyperthermophiles, psychrophiles, acidophiles, alkaliphiles, halophiles, Barophiles, Methanogens General characteristics and structure of virus, lytic and lysogenic cycle. Ultrastructure of algal and fungal cells.			13	Describe, illustrate and explain different types of extremophiles. Understand the structure and replication of bacteriophage.				1,2		
III	Culture media and types: Culture Preservation Methods, Concept of Sterilization - definition, types - Physical and chemical, Determination of phenol coefficient of disinfectant.			7	Describe, illustrate and explain the different types of culture media and Preservation Methods of microorganisms and the different methods of sterilization.				1,2		
IV	Stains and Staining Techniques: Definition of auxochrome, chromophores and dyes. Types of staining - Gram, Acid Fast, Negative, Flagella and Endospore.			7	Describe, illustrate and explain the different staining techniques.				1,2		

<b>V</b>	Antibiotics and types: Antibiotic producing microorganisms, Antifungal and antibacterial.	<b>3</b>	Describe and explain the different types of antibiotics.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. The components, use and care of bright field microscope, and various microbiological instruments.</li> <li>2. Enumeration (counting) of bacteria by plate count or serial dilution – Agar Plate Technique.</li> <li>3. Counting of bacterial population by the use of spectrophotometer.</li> <li>4. Preparation of bacterial smear and staining (Simple, Grams, Negative and Acid fast).</li> <li>5. Preparation of culture media and isolation of pure culture – serial dilution, pour plates technique, spread plate technique, types of streaking.</li> <li>6. Fungal staining: KOH mounting, LPCB. Study of temperature and PH sensitivity of microbes.</li> </ol>	<b>60</b>	Describe, illustrate and explain and apply staining techniques and carry out microscopic examination.	1,2,3,4

### TEXT BOOKS:

- T1. Text book of Microbiology by Prescott, Harley, and Klein's  
T2. Text Book of Microbiology by PC Trivedi, S Pandey & S Bhaduria  
T3. Textbook of Microbiology by Ananthnarayanan and Panicker

### REFERENCE BOOKS:

- R1. Microbiology – A systems Approach by Cowan and Talaro  
R2. Experiments in Microbiology, Plant Pathology and Biotechnology by K.R. Aneja

### OTHER LEARNING RESOURCES:

<https://microbenotes.com/>

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
<b>1</b>	Describe the microbial classification and contributions of key microbiologists in development of microbiology.	1, 2, 3
<b>2</b>	Describe the characteristic of bacteria and virus and their various habitats	1, 2
<b>3</b>	Explore the different culture media and the concepts of sterilization.	1, 2, 3

<b>4</b>	Apply different bacteriological staining techniques for viewing.	1, 2, 3
<b>5</b>	Explain the mechanism of antimicrobial compounds and their production.	1, 2

SEMESTER – I										
Course Title		Zoology								
Course code	22BSMB112R	Total credits: 4		L	T	P	S	R	O/F	C
		Total hours: 45T+30P		3	0	2	0	0	0	4
Pre-requisite		Nil		Co-requisite		Nil				
Programme		Bachelor of Science in Microbiology								
Semester		Fall/ I semester of first year of the programme								
Course Objectives		1. Analyze the diversity, structure, and classification of the animal kingdom, focusing on triploblastic coelomate organization. 2. Understand life processes including osmoregulation, excretion, neural conduction, endocrine regulation, and reproduction. 3. Examine the relationships between insects and microbes, and explore integrated pest management strategies. 4. Explore the principles of evolution, biodiversity, and genetics, including Mendelian and non-Mendelian inheritance patterns.								
CO1		Identify and classify species of animal kingdom.								
CO2		Explain various biochemical processes occurring in living being								
CO3		Explain and illustrate phenomena of animal reproductive biology								
CO4		Illustrate the evolution process, importance of biodiversity hotspot								
CO5		Describe classical genetics of living organism								
Unit-No.	Content			Contact Hour	Learning Outcome			KL		
I	Diversity of Animal Kingdom: Triploblastic coelomate organization: Animals with mantle: Phylum Mollusca, Animals with enterocoel: Phylum Echinodermata, Phylum Hemichordata, Phylum Chordata, Subphylum Urochordata, Subphylum Cephalochordata, Subplylum Vertebrata, Super class: Agnatha, Class Cyclostomata, Superclass: Gnathostomata, Class Pisces (Cartilaginous and bony fish), Class Amphibia, Class Reptilia, Class Aves, Class Mammalia			5	Describe, illustrate and explain the basic concepts associated with each system of the body in vertebrates and invertebrates. Identify structures that are in place in the body systems to perform the functions according to the habits or habitats of the animals.			1,2		
II	Life processes Concepts of osmoregulation and excretion, Categorization of animals on the basis of principle nitrogenous excretory products. Ornithine cycle, formation of urea, determination and detoxification. Control and Coordination, Irritability, Structure of neuron, sense organs - human eye and ear. Conduction of nerve impulse: Resting potential, action potential and refractory period. Synaptic transmission, Endocrine regulation: Hormones as chemical messengers, feedback mechanisms. Reproduction: Gametogenesis, structures of egg and sperm of mammal. Fertilization and in vitro fertilization, oviparity, viviparity and ovo-viviparity.			6	Describe, illustrate and explain the knowledge of different life processes, endocrine regulation and reproductive biology of animal.			1,2		



<b>III</b>	Insect microbiology: Mutualistic associations between insects and microbes Insect nutrition and the importance of microbe's Fungal symbioses: Ant fungal gardens and termites Microorganisms and insect behavior. Insects as Vectors of Animal pathogens; Integrated pest management for vector control	<b>5</b>	Describe, illustrate and explain different types of associations of insects, insect behaviour and role of insect as a vector of various diseases.	1,2
<b>IV</b>	Evolution and Biodiversity: Evolution, Origin of life: Emergence of life on primitive earth, Evolution and adaptations: Microevolution, Role of Natural Selection in microevolution, Co-evolution. Ecological niches and adaptations. Biodiversity, Definition, Biodiversity hotspots, Benefits of Biodiversity, Biodiversity conservation, Bio- wealth of India. Human activities affecting biodiversity. Future of evolution.	<b>7</b>	Describe, illustrate and explain the evolution and diversity.	1,2
<b>V</b>	Genetics: Gene and gene concepts, Mendelian inheritance: Monohybrid and dihybrid cross, Concept of dominance. Exception to Mendelian inheritance: incomplete dominance, co-dominance; Interaction of genes: (Epistasis: recessive, dominant, double recessive and double dominant epistasis), lethal genes, Cytoplasmic inheritance: Kappa particles in Paramecium, sigma factor in Drosophila and shell coiling in Limnea. Introduction to human genetics: Mendelian phenotypic traits in humans: Dominant, recessive and X- linked characters (2 examples each), Pedigreeanalysis: Dominant, recessive and X- linked traits, Genetic counselling, Risk of inheriting a disease from consanguineous marriage.	<b>7</b>	Describe, illustrate and explain the classical genetics and learn about diseases associated with genetic disorder	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Identification and study of salient features of selected Vertebrates and Invertebrates.</li> <li>2. Morphological study of ant and termites</li> <li>3. Introduction to basic laboratory safety practices, precautions and safety rules</li> <li>4. Handling of common laboratory equipments (Instrument and glassware): Burner, autoclave, centrifuge, colorimeter, balance, homogenizer, electrophoresis apparatus</li> <li>5. Study of microscope: Use care and functions of its components</li> <li>6. To study the osmosis process by potato osmometer</li> </ol>	<b>30</b>	Identification and Study of Salient Features of Selected Vertebrates and Invertebrates. Students will differentiate between the morphological structures of ants and termites.	1,2,3,4

	<p>7. Study of bacteria using gram stain</p> <p>8. To evaluate the quality of milk by methylene blue reduction method</p> <p>9. To solve the given genetic problem</p> <p>10. Human pedigree analysis: Dominant, recessive and X-linked characters</p>			
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**TEXTBOOKS:**

- T1. Principles of Genetics by Snustad and Simmons(7thEdition) John Wiley and Sons, USA.
- T2. Textbook of physiology by Dr. A. K. Jain. (9thEdition). APS books.
- T3. Edward O. Wilson, 1996, Biodiversity,521pp., National Academy Press.
- T4. Alison J. Statters field, Michael J. Crosby, Adrian J. Long, and David C. Wege. 1998. Endemic Bird Areas of the World: Priorities for Biodiversity Conservation .846pp.
- T5. Maule, A. G. and Dr. N. J. Marks Parasitic Flatworms, Molecular Biology, Biochemistry, Immunology, Physiology.

**REFERENCE BOOKS:**

- R1. Romer, A. S. Vertebrate Body.
- R2. Majupuria, T. S. Introduction to Chordates.
- R3. Hartl D. L. and A. G. Clark (1989&1997): Principles of Population Genetics. Sinauer
- R4. Ridley M. (1993): Evolution. Blackwell.
- R5. Microbiology: An Introduction by Tortora, G. J., Funke, B. R. and Case, C. L., 944pp. Benjamin/Cummings, Redwood City, CA

**OTHER LEARNING RESOURCES:**

<https://microbenotes.com/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Identify and classify species of animal kingdom.	1, 2
2	Explain various biochemical processes occurring in living being	1, 2
3	Explain and illustrate phenomena of animal reproductive biology	1, 2
4	Illustrate the evolution process, importance of biodiversity hotspot	1, 2
5	Describe classical genetics of living organism	1, 2

SEMESTER – I									
Course Title	Principles of Biochemistry								
Course code	22BSMB113R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To study the structures of biomolecules, such as proteins, nucleic acids, carbohydrates and lipids. 2. To know the functions and interactions of biomolecules, which will provide the knowledge of the structure of cells and the various functions performed by them which are associated with life. 3. To study the metabolic pathways of biomolecules like carbohydrate, amino acids etc.								
CO1	Describe the structure, functions and types of DNA and RNA.								
CO2	Outline the properties of essential and non-essential amino acid.								
CO3	Describe various structure of proteins and classification								
CO4	Outline the basics of carbohydrate in terms of its structure, classification, properties and the laboratory qualitative tests in their analysis.								
CO5	Identify and categorize lipids and their derivatives								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Introduction to Biochemistry and Biomolecules, Cellular components: Basic knowledge of Biochemistry and Biomolecules, Structure and functions of bio-membrane with special reference to active transport of ions and metabolites. Extra and intracellular communication.	5	Knowledge on basics of biochemistry and biomolecules and the structural component of bio-membrane and communication mechanisms				1,2		
II	Carbohydrates and lipids: Definition, Structure and properties of carbohydrates with special emphasis of biologically important carbohydrates including storage and structural polysaccharides and bacterial polysaccharides. Structure and properties of fatty acids and its types. Lipid and its classification. prostaglandins. Basic principles of estimation and analysis of carbohydrates and lipids.	11	Learning carbohydrates and lipids with thorough understanding on their types and functions and its analysis and estimation using various qualitative and quantitative tests				1,2		
III	Amino acids, proteins and nucleic acid: Amino acids, structure and properties. Proteins, peptide bond and functions, Primary, secondary, tertiary and quaternary structure of proteins. Glycoproteins, lipoproteins, nucleoproteins, fibrous and globular proteins, Structure and functions of immune globulins, myoglobin and hemoglobin. Nucleic acid: Structure and functions of different types of nucleic acids. Difference between DNA and RNA. Watson and Crick Model of DNA.	11	Build knowledge on the structure, properties and functions of different proteins and nucleic acids types				1,2		

<b>IV</b>	Enzymes: Major classes of enzymes, general properties, kinetics and mechanism of enzyme action. Activation energy and transitionstate, Co enzymes and cofactor. Regulation of enzyme activity and enzyme inhibition. Isoenzymes and enzymes of clinical significance. Industrial application of enzymes	10	Demonstrate the fundamental knowledge of enzyme, coenzyme and cofactors, its kinetics for understanding of metabolism and learning its applications in Clinical	1,2
<b>V</b>	Vitamins and Minerals: Structure and metabolic functions of water soluble and lipid soluble vitamins. Minerals, Trace elements and their role in biological processes. Deficiencies and nutritional significance of vitamins and trace elements	8	Learn the importance of vitamins and minerals in the body and their role insignificance and deficiency	1,2
<b>Practical</b>	1.Demonstration of Lab wares glassware and instruments 2.Qualitative analysis of carbohydrates 3.Qualitative analysis of proteins 4.Lipid solubilitytest 5.Acid value determination of free fatty acid activity in the microbial Screening of amylase isolate	<b>30</b>	Proficiency in Various qualitative tests to detect the presence of absence of carbohydrates, lipid and proteins in a sample Gaining the basics of labware's and instruments in the laboratory Knowledge in finding the acid value and screening amylase enzyme	1,2,3,4

### TEXT BOOKS:

T1. U Satyanarayana. Biochemistry. 13th edition. Elsevier Health Sciences;2017.

### REFERENCE BOOKS:

R1. David L. Nelson, Michael Cox. Lehninger Principles of Biochemistry. 7th Edition. WH Freeman; 2017.

R2. Rodwell et al. Harper's Illustrated Biochemistry. 29th edition. McGraw Hill; 2012. R3. Voet and Voet. Biochemistry. 3rd edition. John Wiley & Sons, 2004.

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Describe the structure, functions and types of DNA and RNA.	1, 2,3
2	Outline the properties of essential and non-essential amino acid.	1, 2
3	Describe various structure of proteins and classification	1, 2
4	Outline the basics of carbohydrate in terms of its structure, classification, properties and the laboratory qualitative tests in their analysis.	1, 2
5	Identify and categorize lipids and their derivatives	1, 2

SEMESTER – I									
Course Title	Basic Chemistry								
Course code	22BSMB114R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To give the knowledge about Chemical Kinetics and Ionic Equilibrium 2. To give a detailed description of atomic structure, different theories related to it and the knowledge of classical and quantum chemistry. 3. To give the knowledge of the periodic properties and HSAB theory								
CO1	Identify the order of the rate law equation, then characterize the "half-life" and temperature dependency of reaction rates using the Arrhenius equation.								
CO2	Describe concepts of electrochemistry, electrochemical cells, acids/base, pH, buffers and solubility								
CO3	Describe and analyze atomic structure, Heisenberg Uncertainty principle, Quantum mechanics and Schrodinger wave equation.								
CO4	Describe concepts of chemical bonding, periodic properties.								
CO5	Describe the different types of organic reactions along with their mechanisms. organic molecules and their stereochemistry								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Chemical Kinetics: Order-molecularity. First and second order-nth order rate equation, temperature dependence of rate of reactions.	5	To identify the order (0, 1 or 2) associated with each integrated rate law equation, to describe the "half- life" of a chemical reaction. Understand the temperature dependence of rate of reactions through Arrhenius equation.				1,2		
II	Ionic equilibrium: Electrolytic conductance, Faraday's Law of electrolysis, Electrolytes, Lewis theory, Arrhenius theory for dissociation of electrolytes, ionization constants of weak acids and bases, pH, buffers, solubility products, salt effects and solubility	9	Understand underlying concepts of electrochemistry, electrochemical cells, acids/base, pH, buffers and solubility				1,2		
III	Atomic Structure: Recapitulation of Bohr's theory and its limitations, dual behaviour of matter and radiation, deBroglie's relation, Heisenberg Uncertainty principle. Need of a new approach to Atomic structure. What is Quantum mechanics, Time independent Schrodinger equation and meaning of various terms in it. Wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals. (Only graphical representation) Rules for filling electrons in various orbitals, Electronic	11	Understand atomic structure, Heisenberg Uncertainty principle, Quantum mechanics and Schrodinger wave equation. To learn about the graphical representation of different atomic orbital and how the electrons are filled in the orbital.				1,2		

	configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy.			
<b>IV</b>	Chemical bonding- Various theories, covalent, hydrogen Bonding. Effective nuclear charge, atomic and ionic sizes. 6 Ionization energies, electron affinity and electronegativity, hard soft acids and bases.	10	Understand the concepts of chemical bonding by using various theories, periodic properties like Atomic and Ionic size Ionization Energy Electron Affinity, Electro negativity of elements of periodic table.	1,2
<b>V</b>	Organic Reactions and Stereochemistry: Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule, Representations of 3 dimensional structures, structural isomers and stereo isomers. Configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.	10	Understand the different types of organic reactions along with their mechanisms. How to design syntheses of organic molecules. Acquire the knowledge of stereochemistry of organic molecules.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Qualitative Organic Analysis (Minimum 6 number of samples)</li> <li>2. Estimation of Iron Using standard <math>KMnO_4</math> solution</li> <li>3. Determination of Total Hardness of water and Estimation of Ca</li> <li>4. Determination of surface tension of given liquid</li> <li>5. Determination of viscosity of given liquid</li> </ol>	<b>30</b>	Gaining knowledge how to detect the different functional groups present. Acquiring practical knowledge about estimation of total hardness of a given water sample by EDTA method.	1,2,3,4

### TEXT BOOKS:

T1. E. L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill

T2. Organic chemistry: structure and function by P. Volhardt and N. Schore.

T3. Essentials of Physical Chemistry, Arun Bahl., B. S. Bahl., G. D. Tuli.

T4. Concise Inorganic Chemistry, J. D. Lee.

**REFERENCE BOOKS:**

- R1. T. W. Graham Solomon's: Organic Chemistry, John Wiley and Sons.
- R2. Arun Bahland B. S. Bahl: Advanced Organic Chemistry, S. Chand.
- R3. E. L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Identify the order of the rate law equation, then characterize the "half-life" and temperature dependency of reaction rates using the Arrhenius equation.	1,2
<b>2</b>	Describe concepts of electrochemistry, electrochemical cells, acids/base, pH, buffers and solubility	1,2
<b>3</b>	Describe and analyze atomic structure, Heisenberg Uncertainty principle, Quantum mechanics and Schrodinger wave equation.	1,2
<b>4</b>	Describe concepts of chemical bonding, periodic properties.	1,2
<b>5</b>	Describe the different types of organic reactions along with their mechanisms. organic molecules and their stereochemistry	1,2

SEMESTER – I									
Course Title	Introductory English (Communicative English & Soft Skills)								
Course code	22UBPD113R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To recognize and identify parts of a sentence and their significance in a language. 2. To enhance listening and speaking/skills for self-development. 3. To give insight into English pronunciation and in to central concepts in phonetics. 4. Introduction to the various modes of communication will enhance their knowledge of communication.								
CO1	Equip students to recognize and apply parts of speech, articles, and auxiliary verbs, and to create both affirmative and negative sentences.								
CO2	Teach students to apply determiners, form different types of sentences, and comprehend degrees of comparison.								
CO3	Prepare students to confidently introduce themselves, use proper pronunciation, intonation, and stress, and effectively ask for and provide information.								
CO4	Help students grasp the communication process, differentiate between communication types, manage both formal and informal communication, and identify barriers to effective communication.								
CO5	Teach students the key components of an effective presentation and how to use visual aids proficiently.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	<b>Module1-Grammar</b> 1.Parts of Speech 2. Articles 3.Auxiliary Verbs 4.Affirmative and Negative Sentences			1,2					
II	<b>Module2-Grammar</b> i. Determiners ii. Sentence Construction iii. Types of Sentences (Assertive, Imperative etc.) iv. Degree of Comparison v. Comprehension Exercises			1,2					
III	<b>Module3-Listening Skills</b> i. What is listening? ii. The Process of Listening iii. Factors that adversely affect listening iv. Difference between Listening and Hearing, v. Purpose and Importance of Effective Listening vi. How to Improve Listening Process			1,2					
IV	<b>Module4-SpeakingSkills</b> i. Introducing yourself ii. Self-discovery iii. Basics of Phonetics, pronunciation iv. Extempore speech			1,2					



	v. Video Recording for Self-Reflection	
<b>V</b>	<b>Module5-CommunicationSkills</b> i. Introduction to Communication, ii. Importance of Communication Skills iii. Purpose of Communication iv. Types of Communication v. Formal and informal communication vi. Importance of Communication vii. Barriers to Communication viii. How to improve/tips to improve Communication skills. ix. Responding to different questions in various situations (formal/informal)	1,2

**Text Books:**

T1. Chaturvedi, P.D., Chaturvedi Mukesh, 2011. Business Communication: Concepts, Cases and Applications, second edition, Pearson, Noida.

T2. Alex K., Chand, S, 2009. Soft Skills: Know Yourself and Know the World, first edition, S.Chand & Company Ltd.: New Delhi.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Equip students to recognize and apply parts of speech, articles, and auxiliary verbs, and to create both affirmative and negative sentences.	1, 7
<b>2</b>	Teach students to apply determiners, form different types of sentences, and comprehend degrees of comparison.	1, 7
<b>3</b>	Prepare students to confidently introduce themselves, use proper pronunciation, intonation, and stress, and effectively ask for and provide information.	1, 7
<b>4</b>	Help students grasp the communication process, differentiate between communication types, manage both formal and informal communication, and identify barriers to effective communication.	1, 7
<b>5</b>	Teach students the key components of an effective presentation and how to use visual aids proficiently.	1, 7

SEMESTER – I									
Course Title	Extra-Curricular Activities								
Course code	22UBEC111R	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	1. To ascertain physical and mental development of the students and select best performers for state, national and international level competition. 2. To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.								
CO1	Enhance Leadership Skills-Students will develop leadership abilities through various activities.								
CO2	Improve Social Interaction-Students will learn to interact and build relationships with others.								
CO3	Develop Personal Interests and Hobbies- Students will explore and develop their personal interests and hobbies.								
CO4	Strengthen Problem-Solving Skills- Students will improve their ability to solve problems creatively and effectively.								
CO5	Foster Cultural Awareness- Students will gain a better understanding and appreciation of different cultures.								
Unit- No.	Content	Contact Hour	Learning Outcome				K	L	
I	Based on the learner's interest they can participate in various sports, music, and co-curricular activities joining the clubs of the University (Football, Futsal; Cricket; Swimming; Basketball; Badminton; Table Tennis; athletics and other outdoor and indoor games; Dance; Music; Vocals; Photography; Drama; Literary activities); The students are encouraged to participate in regular club activities, workshops, competitions as per their interest and hobbies; Renowned skilled professionals/ personalities are invited organising workshops to promote the talents of the students.	60						1,2	

**REFERENCE BOOKS:**

R1: "Extracurricular Activities: Essential Guides for Students" by John G. Gabriel

R2: "Developing Personal, Social and Emotional Skills through Extra-Curricular Activities" by Sally Bailey

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Enhance Leadership Skills-Students will develop leadership abilities through various activities.	6, 7
<b>2</b>	Improve Social Interaction-Students will learn to interact and build relationships with others.	6, 7
<b>3</b>	Develop Personal Interests and Hobbies- Students will explore and develop their personal interests and hobbies.	6, 7
<b>4</b>	Strengthen Problem-Solving Skills- Students will improve their ability to solve problems creatively and effectively.	6, 7
<b>5</b>	Foster Cultural Awareness- Students will gain a better understanding and appreciation of different cultures.	6, 7

SEMESTER – II									
Course Title	Cell Biology and Microbial Physiology								
Course code	22BSMB121R	Total credits: 5	L	T	P	S	R	O/F	C
		Total hours: 45T+60P	3	0	4	0	0	0	5
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ II semester of first year of the programme								
Course Objectives	1. The structures within a cell and their functions, including an understanding of the processes by which cells divide and die. 2. Considers how cell structure and function can be adapted to specialize cells for particular purposes, and begins to consider how different types of cells are able to interact with one another and their environment in order to form higher order structures such as tissues and organs. 3. To study the structure, function, energy metabolism, growth and regulatory mechanisms of microorganisms. 4. To learn the microorganisms involved for metabolic processes common to all living things. 5. To emphasize the incredible metabolic diversity exhibited by microorganisms.								
CO1	Understanding the students the basic cell biology techniques.								
CO2	Students will be able to understand the microbial growth and nutritional requirements.								
CO3	Explain how to develop a concept of integrative rules of biochemistry and genetics governing biological systems leading to the microbial physiology and metabolism.								
CO4	Understanding the students the basic cell biology techniques.								
CO5	Students will be able to understand the microbial growth and nutritional requirements.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Structure of Eukaryotic and Prokaryotic cells and their differences, Structure of cell membrane</b> The nucleus: Structure -Nuclear Envelope, Nucleolus, Lamina, NPC, Differences between chromatin, chromatid and chromosomes Endoplasmic Reticulum Structure, types, Golgi Apparatus-General Characteristics and functions. Mitochondria– Structure and General Characters, Chloroplasts –Types of Plastids, Photosynthetic apparatus, Peroxisomes – General Characters, enzymes present and functions	14	To understand the structure of Eukaryotic and Prokaryotic cells and their differences Students will learn about the different cell organelles				1,2		
II	<b>Cells</b> –cell interaction – cell junctions, cell-cell adhesion, cell matrix adhesion Phases of Mitosis and meiosis Phases of mitosis and meiosis	12	Students will be able to learn about the different types of cell interactions Students will be able to identify the different stages of mitosis and meiosis				1,2		
III	<b>Cancer</b> its types and treatments	3	The students will know about different types of cancer. Students will know about the different methods for cancer treatment				1,2		
IV	<b>Basic concepts of metabolism</b> –Mechanism of ATP formation–Substrate level phosphorylation, ETC, Photophosphorylation. Bacterial Enzymes–classification and properties	8	Students will be able to explain about ATP formation – Substrate level phosphorylation. Students will understand about the classification and properties of bacterial enzymes				1,2		
V	<b>Concept of Aerobic Respiration</b> , Anaerobic Respiration and Fermentation. Central Metabolic Pathways –EMP, ED, PP,	8	Students will be able to discuss the basic and applied aspects of anaerobic respiration and				1,2		

	TCA , Alcohol fermentation and Pasteur Effect		fermentation. Students will understand the different metabolic pathways	
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Demonstration of Mitosis</li> <li>2. Determination of Bacterial growth by turbidity method and its growth enumeration</li> <li>3. Determination of TDT</li> <li>4. Determination of fungal growth by linear measurement</li> <li>5. Effect of salt on bacterial growth</li> <li>6. Lethal effect of radiations on microorganisms</li> <li>7. Sugar Fermentation by bacteria.</li> </ol>	<b>30</b>	<ol style="list-style-type: none"> <li>1. Students will learn the different stage of bacterial growth curve</li> <li>2. Students will learn to calculate the thermal death time of microorganisms</li> <li>3. Students can determine of fungal growth</li> <li>4. Students will learn the effect of salt on bacterial growth</li> <li>5. Students will learn the effect of radiations on microorganisms</li> <li>6. Students will learn the different types of sugar fermented by bacteria</li> </ol>	1,2,3,4

**Text Books:**

T1. Biophysical Chemistry: James P. Allen

T2. Lehninger Principles of Biochemistry: Michael M. Cox

**Reference Books:**

R1. Biophysical Chemistry by C. R. Cantor and P. R. Schimmel

R2. Physical Biochemistry by K. E. van Holde, C. Johnson and P. S. Ho

R3. Protein-Ligand Interactions by S. E. Harding and B. Z. Chowdhry.

**OTHERLEARNINGRESOURCES:**

<https://microbenotes.com>

[www.youtube.com](http://www.youtube.com)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understanding the students the basic cell biology techniques.	1, 2, 3
2	Students will be able to understand the microbial growth and nutritional requirements.	1, 2, 3
3	Explain how to develop a concept of integrative rules of biochemistry and genetics governing biological systems leading to the microbial physiology and metabolism.	1, 2, 3

<b>4</b>	Understanding the students the basic cell biology techniques.	1, 2, 3
<b>5</b>	Students will be able to understand the microbial growth and nutritional requirements.	1, 2, 3

SEMESTER – II									
Course Title	Biophysical Chemistry								
Course code	22BSMB122R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 45T	3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ II semester of first year of the programme								
Course Objectives	1. To introduce the students about the concept of buffer, $P^H$ , various concept of acid base, chemical bonding etc. 2.To study the various laws of thermodynamics and their significances 3.Tostudy concept of protein folding								
CO1	Analyze the buffer concept and their importance in biological system.								
CO2	UnderstandthevarioustypesofchemicalbondingpresentinbiologicalsystemCO								
CO3	To understand quantum mechanics and structure of atoms								
CO4	Understand the concept of protein folding and their application								
CO5	Understand the various molecules transport across the membrane								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	PH & Buffer: Introduction, Bronsted and Lowry theory, Lewis theory, Buffering action, Buffer Capacity, H-H equation, Biological Buffers and their importance; Properties of water	10	Students will learn about buffers and pH and biological buffers and applications. Learn about properties of water					1,2	
II	Quantum mechanics and atomic structure: Black body radiation. Plank's radiation law. Photoelectric effect. Shape of atomic orbital. Hybridization	7	Students will learn about structure of atoms and shape of atomic orbital.					1,2	
III	Chemical bonding: Ionic bond, Covalent Bond, Hydrogen bond, Peptide bond, Vander Waal forces: Properties Significance, Various theories.	10	Students will learn about different types of bonds and their significances					1,2	
IV	Thermodynamics: First law of thermodynamics, concept of internal energy, Second law of thermodynamics, free energy, enthalpy, entropy, free energy in biological reaction, 3 <sup>rd</sup> law Significance and limitation of all laws.	10	Students will learn about laws of thermodynamic and their significance					1,2	
V	Concepts of protein folding: Amino acids, hydrophilic, hydrophobic. Biophysics of cell membranes.	8	Students will learn about folding of correct3Dstructure of proteins and behavior of cell membrane					1,2	

#### Text Books:

- T1. Biophysical Chemistry: James P. Allen  
 T2. Lehninger Principles of Biochemistry: Michael M. Cox

#### Reference Books:

- R1. Biophysical Chemistry by C.R. Cantor and P.R. Schimmel  
 R2. Physical Biochemistry by K.E.van Holde, C. Johnson and P. S. Ho  
 R3. Protein-Ligand Interactions by S. E.Harding and B. Z. Chowdhry.

**OTHER LEARNING RESOURCES:**

- <https://microbenotes.com>
- [www.youtube.com](http://www.youtube.com)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Analyze the buffer concept and their importance in biological system.	1,2
<b>2</b>	Understand the various types of chemical bonding present in biological system CO	1,2
<b>3</b>	To understand quantum mechanics and structure of atoms	1,2
<b>4</b>	Understand the concept of protein folding and their application	1,2
<b>5</b>	Understand the various molecules transport across the membrane	1,2



SEMESTER – II									
Course Title	Applied Biochemistry								
Course code	22BSMB123R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To study the various metabolic pathways of carbohydrates, proteins, lipids and nucleic acid and how they are interrelated to each other.</li> <li>To know the functions, mechanism of hormone action and focus on their significance and disorders.</li> <li>To learn the various antinutritional factors, detoxification concepts and bioactive metabolites with their chemical knowledge and functions.</li> </ol>								
CO1	Understand the metabolism and bioenergetics of carbohydrates and lipids, including glycolysis, TCA cycle, pentose phosphate pathway, fatty acid oxidation, and the role of volatile fatty acids in ruminants.								
CO2	Comprehend the metabolism of amino acids and nucleic acids, including transamination, deamination, urea cycle, and the biosynthesis and breakdown of purines and pyrimidines.								
CO3	Analyze the integration of carbohydrate, lipid, and amino acid metabolism and the hormonal regulation of these processes, including disorders due to hypo- or hypersecretion of major endocrine glands.								
CO4	Identify naturally occurring antinutritional factors, common toxins in feeds and forages, and methods of detoxification, as well as the health hazards of residual pesticides and environmental pollutants.								
CO5	Understand the chemistry and bioactive principles of terpenoids, alkaloids, phenolics, plant pigments, saponins, and nutraceuticals, including natural antioxidants and food colorants.								
Unit-No.									KL
I	<b>Metabolism and Bioenergetics of Carbohydrates and Lipids:</b> Introduction and its types. Glycolysis, TCA cycle, Pentose phosphate pathway and glycogenesis. Bioenergetics, biological oxidation, respiratory chain and oxidative phosphorylation. Oxidation of fatty acids. Volatile fatty acids as source of energy in ruminants. Ketogenesis and cause of ketosis.		11		Build knowledge of the biochemical pathways of synthesis and degradation of the carbohydrate and lipids and ketone bodies				1,2
II	<b>Metabolism of Amino acids and Nucleic acids:</b> Transamination, Deamination and its types, urea cycle. Biosynthesis and breakdown of purines and pyrimidines. Integration of carbohydrate, lipid and amino acid metabolism.		9		Understand the amino acid and nucleotide synthesis and degradation and finally build the concept of integrating carbohydrate, lipid and amino acid metabolism				1,2
III	<b>Hormones:</b> General description of nature of hormones, receptors and mechanisms of their action. Metabolic function of different hormones and associated disorders due to hypo or hyper secretions of major endocrine glands viz. pituitary, thyroid, adrenal, pancreas and gonads.		8		Learn the basics of hormones and receptors with knowledge on their types, mode of action, metabolic significance and disorders associated with them				1,2
IV	<b>Antinutritional factors:</b> Naturally occurring antinutritional factors and common toxins in feeds and forages. Methods of detoxification, Health hazards due to residual pesticides in feeds and forages -		10		Demonstrate the fundamental knowledge of antinutritional factors highlighting common toxins in feeds and forages, detoxification concept and health hazards relating to residual				1,2

	Environmental pollutants.		pesticides.	
<b>V</b>	<b>Bioactive Principles:</b> Chemistry of terpenoids, alkaloids, phenolics, plant pigments, steroidal and triterpenic saponins and saponigenis. Plant derived nutraceuticals: chemistry of natural antioxidants and food colorants.		Knowledge on the chemistry and importance of the metabolites, natural antioxidants and food colorants	1,2
<b>Practical</b>	1.Antioxidant activity by DPPH method 2.Estimation of total 3.flavonoid content 4.Estimation of total phenolic content 5.Isolation of plant pigment Estimation of vitamin C by titration method	<b>6</b>	Proficiency in various estimation methods related to antioxidants, flavonoids, phenols ,vitamin C. Knowledge in isolating the pigments present in plants	1,2, 3,4

### TEXT BOOKS:

- T1. Harper's Illustrated Biochemistry - R. K. Murray et al., McGraw Hill.  
T2. Biochemistry by Zubey, GL WCB Publishers.  
T3. Biochemistry by U. Satyanarayana, Books and Allied (P) Ltd.  
T4. Fundamentals of Biochemistry by J. L. Jain, Nitin Jain and Sunjay Jain, S. Chand Group.

### REFERENCE BOOKS:

- R1. Biochemistry by L. Stryer, W.H. Freeman and Co.  
R2. Biochemistry by Donald Voet and Judith Voet, John Wiley and Sons NY.  
R3. Lehninger's Principle of Biochemistry by David L. Nelson and Michael M. Cox. W. H. Freeman and Co.

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
<b>1</b>	Understand the metabolism and bioenergetics of carbohydrates and lipids, including glycolysis, TCA cycle, pentose phosphate pathway, fatty acid oxidation, and the role of volatile fatty acids in ruminants.	1,2
<b>2</b>	Comprehend the metabolism of amino acids and nucleic acids, including transamination, deamination, urea cycle, and the biosynthesis and breakdown of purines and pyrimidines.	1,2
<b>3</b>	Analyze the integration of carbohydrate, lipid, and amino acid metabolism and the hormonal regulation of these processes, including disorders due to hypo- or hypersecretion of major endocrine glands.	1,2
<b>4</b>	Identify naturally occurring antinutritional factors, common toxins	1,2

	in feeds and forages, and methods of detoxification, as well as the health hazards of residual pesticides and environmental pollutants.	
5	Understand the chemistry and bioactive principles of terpenoids, alkaloids, phenolics, plant pigments, saponins, and nutraceuticals, including natural antioxidants and food colorants.	1,2

SEMESTER – II										
Course Title	Bioinstrumentation									
Course code	22BSMB124R	Total credits: 3 Total hours: 30T+30P	L	T	P	S	R	O/F	C	
			2	0	2	0	0	0	3	
Pre-requisite	Nil	Co-requisite	Nil							
Programme	Bachelor of Science in Microbiology									
Semester	Spring/ II semester of first year of the programme									
Course Objectives (Minimum 3)	1. Explain the principles, types, and applications of various microscopy techniques. 2. Understand the history, classification, and separation techniques in chromatography. 3. Comprehend the principles and applications of centrifugation and gel electrophoresis. Analyze the principles and applications of different spectroscopic techniques.									
CO1	Describe the different microscopy principles and techniques.									
CO2	Develop proficiency in different chromatographic techniques.									
CO3	Explore different analytical centrifugation and their applications.									
CO4	Explore different analytical centrifugation and their applications.									
CO5	Interpret the principles and applications of spectroscopy									
Unit-No.										KL
I	<b>Microscopy:</b> Types of microscopes and their principle, resolving power, numerical aperture						Understand the applications of different types of microscopes			1,2
II	<b>Chromatography:</b> Introduction, History, Classification, Separation techniques, Choice of method. Column Chromatography: Adsorption column chromatography, Partition chromatography. Thin layer chromatography, Paper chromatography, Ion exchange chromatography			10			Knowledge on the concept of chromatography and its types with its working principle that enables separation of biomolecules from a mixture sample			1,2
III	<b>Centrifugation:</b> Introduction, principle, rotors, application of density gradient and analytical centrifugation. Different types of centrifugations and its application			7			Demonstrate the Fundamental knowledge of the centrifugation technique along with its different types and applications			1,2
IV	<b>Gel Electrophoresis:</b> Introduction, principle, types, application, Blotting technique: Southern blot, Western Blot and Northern blot			10			Build a theoretical knowledge of the gel electrophoretic technique highlighting its working principle and application. Also enable learning about the different blotting techniques.			1,2
V	<b>Electrophoresis</b> –principle and application - agarose gel electrophoresis, SDS-PAGE <b>Spectroscopic techniques:</b> Introduction, Principle and application of spectroscopy			12			Learn the technique of electrophoresis and spectroscopy in terms of its working principle and applications.			1,2
Practical	Operation of molecules from given sample by 1. Paper chromatography 2. Column chromatography 3. Thin layer chromatography 4. Separation of DNA and protein molecules by gel electrophoresis			30			Describe, illustrate and explain the use various instruments for analysis			1,2, 3,4

**TEXT BOOKS:**

- T1. Biophysical Chemistry: principle and technique by Upadhyay and Nath.  
T2. Spectroscopy: atomic and molecular by Gurdeep R. Chatawal and Sham K. Anand.

**REFERENCE BOOKS:**

- R1. C.R. Cantor and P.R. Schimmel; Biophysical Chemistry (Vol. 2-3). W.H. Freeman, 1980.  
R2. T.E. Creighton; Protein Structure. I.R.E. Press, 1989.  
R3. T.G. Cooper; The Tools of Biochemistry. Wiley Intersciences, 1977.  
R4. D. Holme & H. Peck; Analytical Biochemistry. Longman, 1983.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe the different microscopy principles and techniques.	1,2,3
<b>2</b>	Develop proficiency in different chromatographic techniques.	1,2,3
<b>3</b>	Explore different analytical centrifugation and their applications.	1,2,3
<b>4</b>	Explore different analytical centrifugation and their applications.	1,2,3
<b>5</b>	Interpret the principles and applications of spectroscopy	1,2,3

SEMESTER – II									
Course Title	<b>Implicative English (Communicative English &amp; Soft Skills)</b>								
Course code	22UBPD121R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 32	0	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To equip students with the skills to interchange sentence types, use various tenses, and correct common grammatical errors.</li> <li>To enable students to effectively use one-word substitutions, understand homonyms and homophones, avoid commonly confused words, and use idioms and phrases..</li> <li>To help students understand the nature and types of listening, and overcome barriers to effective listening.</li> <li>To enable students to apply effective reading techniques, gather information from texts, and use the SQ3R technique.</li> <li>To teach students the importance of time management and basic strategies to maintain it.</li> <li>To guide students in developing a comprehensive and professional LinkedIn profile.</li> </ol>								
CO1	Provide students with the ability to transform sentence types, utilize different tenses, and address common grammatical mistakes.								
CO2	Empower students to proficiently apply one-word substitutions, differentiate between homonyms and homophones, avoid frequently confused words, and incorporate idioms and phrases in their vocabulary.								
CO3	Assist students in comprehending the various aspects and types of listening, and in identifying and overcoming obstacles to effective listening.								
CO4	Facilitate students in employing effective reading strategies, extracting relevant information from texts, and utilizing the SQ3R method.								
CO5	Instruct students on the significance of time management and provide foundational strategies to manage their time efficiently.								
CO6	Lead students in creating a well-rounded and professional LinkedIn profile.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Grammar (flipped classroom)</b> i. Interchange of Interrogative and Assertive Sentences, Exclamatory and Assertive Sentences ii. Types of Tenses iii. Common Errors		6	Students will accurately construct and transform various sentence types and correct grammatical errors.				1,2,3	
II	<b>Vocabulary Development</b> i. One word substitution ii. Homonyms and Homophones iii. Words often confused iv. Idioms and phrases		6	Students will enhance their vocabulary and use words accurately in context.				1,2,3	
III	<b>Listening Skills</b> i. What is listening? ii. Types of Listening iii. Understanding Listening Barriers		5	Students will demonstrate effective listening skills and identify listening barriers.				1,2,3	
IV	<b>Reading Skills</b> i. Techniques of Effective Reading ii. Gathering ideas and information from a text		5	Students will read efficiently and extract relevant information using the SQ3R technique.				1,2,3	

	iii. The SQ3R Technique			
<b>V</b>	<b>Time-Management Skills</b> i. Introduction to Time Management ii. Purpose and Importance of Time Management iii. Basic Tips to Maintain Time	4	Students will effectively manage their time using various strategies.	1,2,3
<b>VI</b>	<b>Creation of LinkedIn Profile</b>	6	Students will create a professional LinkedIn profile.	2, 3

### Text Books:

T1. Wren, P.C and Martin, H. 1995. High School English Grammar and Composition, S Chand Publishing.

T2. Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press

### Reference Books:

R1. Mccarthy. (2008) English Vocabulary in Use Upper - Intermediate with CD ROM, Cambridge University Press

R2. Tracy, Brian. (2018) Time Management: The Brian Tracy Success Library, Manjul Publishing House

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Provide students with the ability to transform sentence types, utilize different tenses, and address common grammatical mistakes.	1,7
2	Empower students to proficiently apply one-word substitutions, differentiate between homonyms and homophones, avoid frequently confused words, and incorporate idioms and phrases in their vocabulary.	1,7
3	Assist students in comprehending the various aspects and types of listening, and in identifying and overcoming obstacles to effective listening.	1,7
4	Facilitate students in employing effective reading strategies, extracting relevant information from texts, and utilizing the SQ3R method.	1,7
5	Instruct students on the significance of time management and provide foundational strategies to manage their time efficiently.	1,7
6	Lead students in creating a well-rounded and professional LinkedIn profile.	1,7

SEMESTER – II									
Course Title	Computational System and Digital Literacy								
Course code	22UUDLI103R	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 30	0	0	4	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>Students will be able to understand the fundamentals of computer systems and Internet search along with advanced features of MS-Office.</li> <li>Students will be able to learn data management, statistical analysis and visualization.</li> <li>Students will be able to use social media and e-commerce portals, Digital Payment systems, and other utility software.</li> </ol>								
CO1	Students will have basic understanding of Computer Systems and Internet search. Products.								
CO2	Students will be able to solve data analysis, management and visualization issues using MS-Office								
CO3	Students will be able to efficiently and ethically use social media and e-commerce sites.								
CO4	Students will have introduction to various utility software used in research and information Management.								
Unit- No.	Content	Contact Hour	Learning Outcome					K L	
I	<b>Fundamentals of Computer Systems, Office Automation and Internet Search</b> i. Components of a Computer and their functions. ii. Office Automation using MS-Word, MS-Excel, and MS-PowerPoint. iii. Data management, Statistical Data Analysis and Data Visualization with MS-Excel. iv. Use of Functions, Graphs & Charts in MS-Excel.	4						1,2	
II	<b>Internet &amp; Cyber World</b> i. Introduction to Computer Networks, Internet and World Wide Web, Websites and Web portals. ii. Creation and use of Email Accounts. iii. Web browsing, Web Searching, Different aspects of Web Searching- Search Keywords, conditions and combinations. iv. Study of different Search Engines like Google, Microsoft Bing, Yahoo, Yandex, DuckDuckGo, Ask. Com etc. v. Cyber Crimes, Cyber Laws and IT Act 2000, India.	6						1,2	



<b>III</b>	<b>Introduction to Social Media and E-Commerce</b> i. Relevance of social media in present scenario. Posting different types of contents in social media. ii. Creating accounts and using some popular social media portals and Apps like WhatsApp, Facebook, etc. Social Media Etiquettes & Crimes. iii. Definition of E-Commerce; E-Commerce versus traditional Commerce. iv. Case studies of popular E-Commerce portals like Amazon. v. E-commerce Etiquettes & Crimes.	4		1,2
<b>IV</b>	<b>Digital Payments and Digital Transactions</b> i. Introduction to Digital Payment Systems. ii. Creating accounts and using Digital Payment Systems like Credit Cards, Debit Cards, Net banking, UPI. iii. Digital payments Etiquettes & Crimes. <b>V Basic Accounting and Utility Software</b>	5		1,2
<b>V</b>	<b>Basic Accounting and Utility Software</b> i. Introduction to Basic accounting concepts, Introduction to an Accounting Software like GnuCash or Tally. ii. Introduction to Technical Document writing using LaTeX. iii. Introduction to Data Visualization software – Sigma, Google Charts, Tableau	5		1,2

#### REFERENCE BOOKS:

- R1. Wren, P.C and Martin, H. 1995. High School English Grammar and Composition, S Chand Publishing.
- R2 Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press
- R3. Mccarthy. (2008) English Vocabulary in Use Upper - Intermediate with CD ROM, Cambridge University Press

#### OTHER LEARNING RESOURCES:

1. <https://www.w3schools.com>
2. <https://edu.gcfglobal.org>
3. <https://www.tutorialspoint.com>
4. <https://www.javatpoint.com>

## RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will have basic understanding of Computer Systems and Internet search. Products.	1,2
2	Students will be able to solve data analysis, management and visualization issues using MS-Office	1,2
3	Students will be able to efficiently and ethically use social media and e-commerce sites.	1,2
4	Students will have introduction to various utility software used in research and information Management.	1,2

SEMESTER – II									
COURSE TITLE	Extra-Curricular Activities								
COURSE CODE	22UBEC111	TOTAL CREDITS:	L	T	P	S	R	O/F	C
		TOTAL HOURS:	0	0	0	4	0	0	1
PRE-REQUISITE	Nil								
ANTI-REQUISITE	Nil								
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ II semester of first year of the programme								
Course Objectives	It is to develop the social and soft skills and to promote a holistic development of the learners								
CO1	The students will be engaged in different activities headed under different clubs namely dance, music, photography, drama, literacy, etc.								
CO2	The students will participate in regular club activities like workshops, competitions as per their interest and hobbies.								
CO3	The students will be trained to represent ADTU in various inter university, state and national level competitions.								
CO4	The students will be given a platform to earn from invited experts in their respective fields.								
CO5	The students will get an exposure of 360 degree learning methodology considering the overall growth along with the academics.								
SL NO	Contents								
	AdtU encourages a range of activities outside the regular curriculum intended to meet learner's interest, These activities are aimed to develop the social and soft skills and promote a holistic development of the learners, Keeping in mind the 360 degree learning methodology the students are engaged in different activities headed under different clubs viz. Dance, music, photography, drama, literary etc., The students are encouraged to participate in regular club activities, workshops, competitions as per their interest and hobbies, The student members of the club are trained represent AdtU in various inter University student and national level competitions, Renewed personalities are invited to conduct workshop that benefit the members and students by giving them								

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	The students will be engaged in different activities headed under different clubs namely dance, music, photography, drama, literacy, etc.	6, 7
2	The students will participate in regular club activities like workshops, competitions as per their interest and hobbies.	6, 7
3	The students will be trained to represent ADTU in various inter university, state and national level competitions.	6, 7
4	The students will be given a platform to earn from invited experts in their respective fields.	6, 7
5	The students will get an exposure of 360 degree learning	6, 7

	methodology considering the overall growth along with the academics.	
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SEMESTER – II									
Course Title	Environmental Science								
Course code	22UBES101R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30T	2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ II semester of first year of the programme								
Course Objectives (Minimum 3)	<p>1.To prepare students for careers as leaders in understanding and addressing complex environmental issues from a problem-oriented, interdisciplinary perspective.</p> <p>2. To develop a world population that is aware of and concerned about the environment and its associated problems and which has the knowledge, Skills, attitudes, motivations and commitment to work individually and collectively towards solutions of current problems and prevention of new ones.</p>								
CO1	Gain knowledge about environment and ecosystem								
CO2	Students will learn about natural resource, its importance and environmental impacts of Human activities on natural resource								
CO3	The students will be able to appreciate the ethical, cross cultural, and historical context of environmental issues and the links between human and natural systems.								
CO4	Students will be able to understand the concept of biodiversity and respect them.								
CO5	Gain knowledge about the conservation of biodiversity and its importance. Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Multi-disciplinary nature of environmental studies:</b> Definition, scope and importance Need for public awareness	4	Environmental studies combine sciences to tackle environmental issues. Its multidisciplinary approach is key to solving complex problems. Public awareness and education are vital for promoting sustainability					1,2	
II	<b>Natural Resources:</b> <b>Renewable and non-renewable resources:</b> Natural resources and associated problems. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. Land resources: Land as a resource, land degradation,	6	Natural resources, both renewable and non-renewable, face exploitation issues, including deforestation, overuse of water resources, environmental challenges with minerals and food, and land degradation. Individuals play a crucial role in conserving resources and promoting sustainability.					1,2	

	man induced and slides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.			
<b>III</b>	<b>Ecosystems</b> Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the Following ecosystem: -Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	<b>4</b>	This module covers ecosystems, including their concept, structure, functioning, and diversity. Students will learn about energy flow, ecological succession, and various ecosystem types like forests, grasslands, deserts, and aquatic ecosystems.	1,2
<b>IV</b>	<b>Biodiversity and its conservation</b> Introduction – Definition: genetic, species and ecosystem diversity. Bio geographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega- diversity nation• Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity	<b>5</b>	This module covers biodiversity, including its definition, value, levels, and threats. Students will learn about India's bio-geographical classification, its status as a megadiversity nation, and key biodiversity hotspots. They'll also explore threats like habitat loss, wildlife poaching, and human-wildlife conflicts, crucial for conservation efforts.	1,2
<b>V</b>	<b>Environmental Pollution</b> Definition Cause, effects and control measures of:- Air pollution, Water pollution, Soil pollution, Marinepollution,Noisepollution,Thermalpollution, Nuclearhazards.Solidwaste. Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides	<b>5</b>	This module covers environmental pollution, including causes, effects, and control measures, alongside waste management and disaster preparedness strategies.	1,2
<b>VI</b>	<b>Social Issues and the Environment</b> From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case Studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Waste land reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of	<b>6</b>	This module explores social-environmental dynamics, including urban energy challenges, water conservation, and resettlement issues. It delves into environmental ethics, climate change impacts, and relevant legislation like the Environment Protection Act, emphasizing public awareness and enforcement challenges.	1,2

	Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness			
<b>VII</b>	<b>Human Population and the Environment</b> Population growth, variation among nations. Population explosion–Family Welfare Programme. Environment and human health. Human Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies	<b>4</b>	This module explores social-environmental dynamics, including urban energy challenges, water conservation, and resettlement issues. It delves into environmental ethics, climate change impacts, and relevant legislation like the Environment Protection Act, emphasizing public awareness and enforcement challenges.	1,2
<b>VII</b>	<b>Fieldwork</b> Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain. Visit to a local polluted site-Urban/ Rural/ Industrial/ Agricultural. Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hillslopes, etc. <b>(Field work Equal to 5 lecture hours)</b>	<b>5</b>	Fieldwork objectives include documenting environmental assets like rivers and forests, assessing pollution in urban or rural sites, and studying local biodiversity and ecosystems such as ponds and hill slopes	1,2

#### **Text Books:**

- T1. Harucha E. B, Textbook of Environmental Studies, Orient Black swan Publishing.
- T2. Tiwari V. K A Textbook of Environmental Studies, Himalaya Publishing House
- T3. Chatwal G. R. & Sharma H. Environmental Studies, Himalaya Publishing House

#### **Reference Books:**

- R1. Trivedi R. K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Voll and II, Enviro Media(R)
- R2. Trivedi R. K. and P. K. Goel, Introduction to air pollution, Techno-Science Publication (TB)
- R3. Agarwal, K. C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner. Bharucha Erach, The Biodiversity of India, Map in Publishing Pvt. Ltd., Ahmedabad–380013, India, [Email: mapin@icenet.net](mailto:mapin@icenet.net)(R)
- R4. Brunner R. C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p Clark R. S., Marine Pollution, Clanderson Press Oxford (TB)

#### **RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	The students will be engaged in different activities headed under different clubs namely dance, music, photography, drama, literacy, etc.	1,4
<b>2</b>	The students will participate in regular club activities like workshops, competitions as per their interest and hobbies.	1,4
<b>3</b>	The students will be trained to represent ADTU in various inter university, state and national level competitions.	1,4
<b>4</b>	The students will be given a platform to earn from invited experts in their respective fields.	1,4
<b>5</b>	Gain knowledge about the conservation of biodiversity and its importance. Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.	1,4



SEMESTER – II									
Course Title	Microbial Culture Techniques								
Course code	22BSMB126R	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 30P	0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Develop proficiency in aseptic techniques for handling microorganisms safely and preventing contamination in microbial cultures.</li> <li>2. Acquire skills in culturing and isolating diverse microorganisms from natural environments, clinical samples, and industrial sources.</li> <li>3. Understand the principles of microbial growth kinetics and physiology by monitoring growth parameters such as optical density, colony-forming units, biomass, and metabolic activity using spectrophotometry, viable cell counts, and biochemical assays.</li> </ol>								
CO1	Proficient in aseptic techniques to prevent contamination.								
CO2	Ability to prepare diverse culture media for microbial growth.								
CO3	Competence in isolating and identifying microorganisms using various techniques.								
CO4	Understanding of culture maintenance principles and preservation methods.								
CO5	Develop critical analysis skills and troubleshoot common issues in microbial cultures.								
Unit-No.									
I	Bacterial and Fungal Culture Techniques: Preparation of liquid, semi solid and solid media (plates and slants). Isolation of Pure culture from different sources. (Serial dilution, pour plating, spread plating, streak plating) Culturing in basal media, differential media, selective media and enriched media. Interpretation of colony characteristics on different media. Evaluation of growth parameters: temperature, P <sup>H</sup> , nutrients.		30			Proficiency in various microbial culture techniques for bacterial and fungal identification.			

**TEXT BOOKS:**

T1. Experiments in microbiology, brand petrology, tissue culture, and microbial biotechnology by K R Aneja, New Age international publication.

T2. Benson’s Microbiological Applications Laboratory Manual in General Microbiology by Alfred Brown and Auburn University Heidi Smith, McGraw-Hill Education.

T3. Hand book of MICROBIOLOGICAL MEDIA, Ronald M. Atlas, ASM press

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping
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<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Proficient in aseptic techniques to prevent contamination.	1, 2
<b>2</b>	Ability to prepare diverse culture media for microbial growth.	1, 2
<b>3</b>	Competence in isolating and identifying microorganisms using various techniques.	1, 2
<b>4</b>	Understanding of culture maintenance principles and preservation methods.	1, 2
<b>5</b>	Develop critical analysis skills and troubleshoot common issues in microbial cultures.	1, 2

SEMESTER – III									
Course Title	Immunology								
Course code	22BSMB211R	Total credits: 5	L	T	P	S	R	O/F	C
		Total hours: 45T+60P	3	0	2	0	0	0	5
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ III semester of second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Identify and describe the contributions of key scientists to the development of immunology.</li> <li>2. Explain the functions and properties of various immune cells and organs.</li> <li>3. Differentiate between types of immunity and understand antibody-antigen interactions.</li> <li>4. Analyze hypersensitivity, autoimmunity, vaccines, secondary immunodeficiency, and graft types.</li> </ol>								
CO1	Describe the historical prospect and concept of innate and adaptive immunity.								
CO2	Illustrate the properties and functions of different Immune cell, organs.								
CO3	Discuss the structure and properties of antigen and antibody.								
CO4	Apply the principle of antigen antibody interaction for detection of disease								
CO5	Identify immunological disorders like hypersensitivity and autoimmunity.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Concept of Innate and Adaptive immunity: Contributions of following scientists to the development of field of immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa	10	Describe, illustrate and explain the contributions of scientists towards the development of Immunology					1,2	
II	Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT	10	Describe, illustrate and explain about Immune cells their functions and properties					1,2	
III	Immunity – types - active passive Antibody – property structure, antigens– properties, haptens,	8	Describe, illustrate and explain the different types of immunity, properties of antibody, antigen, haptens and structure of antibody					1,2	
IV	Antigen-antibody reactions – agglutination, precipitation, immune diffusion, ELISA, RIA, monoclonal antibodies functions	8	Describe, illustrate and explain the knowledge on principles and process of immune techniques						
V	Hypersensitivity – types, autoimmunity- types, vaccines – types, secondary immunodeficiency, graft and its types	9	Describe, illustrate and explain the different types of Hypersensitivity, vaccines, graft and secondary immune deficiency						
Practical	<ol style="list-style-type: none"> <li>1. ABO Blood Grouping and Rh typing</li> <li>2. Precipitation reaction: ODD, RID, WIDAL, VDRL / RPR, ASO, CRP, HCG</li> <li>3. Demonstration of RIA and ELISA</li> </ol>	30	Proficiency in various diagnostic disease diagnosis						

**TEXT BOOKS:**

- T1. Immunology by Kuby, W.H Freeman & Co.  
T2. Immunology and Immuno technology by Chakraborty, Oxford University Press  
T3. Clinical Immunology: Principles and Practice. Robert R. Rich, Thomas A. Fleisher, William T. Shearer, Harry W. Schroeder Jr., Anthony J. Frew, Cornelia M. Weyand. Elsevier Health Sciences, 2018  
T4. Basic Immunology, 6e: South Asia Edition Paperback, 2019, by, Andrew H. Lichtman, Shiv Pillai.  
T5. Practical Immunology, 4th Edition, C. Hay, Olwyn MR Westhood, Blackwell Series. 2008.

**REFERENCE BOOKS:**

- R1. Cellular and Molecular Immunology; Abbas and Lichtman. ed.: Malley, J.; Schmitt, B. - Fifth edition, updated. Elsevier Saunders, 2005.  
R2. An Introduction 1st Edition (English) 4th Edition, Ian Tizard, Brooks/Cole publication

**OTHER LEARNING RESOURCES:**

<https://microbenotes.com/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe the historical prospect and concept of innate and adaptive immunity.	1, 2, 3
<b>2</b>	Illustrate the properties and functions of different Immune cell, organs.	1, 2, 3
<b>3</b>	Discuss the structure and properties of antigen and antibody.	1, 2, 3
<b>4</b>	Apply the principle of antigen antibody interaction for detection of disease	1, 2, 3
<b>5</b>	Identify immunological disorders like hypersensitivity and autoimmunity.	1, 2, 3

SEMESTER – III									
Course Title	Microbial Genetics								
Course code	23BSMB212R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ III semester of second year of the programme								
Course Objectives (Minimum 3)	1. Understand the detailed structures of DNA forms (Z-DNA, A & B DNA) and genome organization in prokaryotes and eukaryotes. 2. Explain DNA replication mechanisms, transcription processes, and RNA types and their processing. 3. Analyze gene regulation mechanisms, mutagens, mutations, and DNA repair processes. Describe bacterial recombination, transformation, conjugation, transduction, and transposable elements.								
CO1	Describe the DNA structure and its mode of replication.								
CO2	Illustrate the concept of transcription, post transcriptional modification, translation, post translational modification in prokaryotic and eukaryotic cells.								
CO3	Describe the DNA mutation, damage and their repair mechanism.								
CO4	Explain bacterial recombination in different mode of gene transfer								
CO5	Outline transposable elements and their different application.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Detailed structure of DNA, Z-DNA, A & B DNA, Genome organization in prokaryotes and eukaryotes, Enzymes involved in DNA replication, Modes of DNA replication- Detailed mechanism of Semiconservative replication. Plasmids: nature, classification, properties and replication.	9	Describe, illustrate and explain the structural organization of DNA and their Modes of replication					1,2	
II	Prokaryotic and eukaryotic transcription: Structure and processing of m-RNA, r-RNA, t-RNA. Ribozyme, Genetic code and Wobble hypothesis, Translation in Prokaryotes. Post translational modifications, Gene regulation and expression – Lac operon, tryptophane operons, gene rearrangement, promoters, enhancer elements.	10	Describe, illustrate and explain about processes such as transcription and translation in both prokaryotes and eukaryotes					1,2	
III	Types of mutagens, molecular basis of mutations, analysis of mutations, site directed mutagenesis. Detailed mutagenesis and repair mechanism of UV, Ethidium Bromide and Nitrus oxide. DNA damage and repair mechanisms. Isolation and applications of mutants.	8	Describe, illustrate and explain about the different types of mutations and their role in evolution					1,2	
IV	Bacterial Recombination's- Discovery, gene transfer, molecular mechanism, detection, efficiency calculation and applications. Bacterial transformation- Competency and resistance. Bacterial conjugation – Sex factor in bacteria, F and HFR transfer, linkage mapping. Bacterial transduction– transduction phenomenon, methods of transduction, generalized, specialized and abortive transduction, sex-ductions	10	Describe, illustrate and explain the different methods of transfer of genes from one organism to another					1,2	
V	Transposable elements – Definition, detection of transposition in bacteria, types of bacterial transposons and applications of transposons	8	Describe, illustrate and explain about the rearrangement of genes are major force in evolution					1,2	

<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Gel casting and gel loading</li> <li>2. Isolation of DNA, protein</li> <li>3. Agarose Gel Electrophoresis, PAGE</li> <li>4. Demonstration of conjugation, transformation and Transduction</li> <li>5. Blotting techniques</li> </ol>	<b>30</b>	Proficiency in various molecular techniques for DNA, protein isolation	1,2, 3,4
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**TEXT BOOKS:**

T1. Molecular Biology of the Gene 4th edition by J D Watson, N H Hoppkins, Roberts, Steitz and Weiner. 1987. The Benjamin Cummings Publication Co. Inc Californis

T2. Microbial genetics. David Freifelder, Jones and Bartlett, 1987

**REFERENCE BOOKS:**

R1. Microbial genetics by Maloy et al. 1994, Jones and Bartlett Publishers

R2. Molecular Genetics of Bacteria by J W Dale, 1994, John Wiley and Sons

R3. Modern Microbial Genetics. 1991 by Streips and Yasbin. Niley Ltd.

**OTHER LEARNING RESOURCES:**

<https://microbenotes.com/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe the DNA structure and its mode of replication.	1, 2, 3
<b>2</b>	Illustrate the concept of transcription, post transcriptional modification, translation, post translational modification in prokaryotic and eukaryotic cells.	1, 2, 3
<b>3</b>	Describe the DNA mutation, damage and their repair mechanism.	1, 2, 3
<b>4</b>	Explain bacterial recombination in different mode of gene transfer	1, 2, 3
<b>5</b>	Outline transposable elements and their different application.	1, 2, 3

SEMESTER – III									
Course Title	Tissue Culture								
Course code	22BSMB213R	Total credits: 3 Total hours: 30T	L	T	P	S	R	O/F	C
			2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ III semester of second year of the programme								
Course Objectives (Minimum 3)	1. Introduction to the best use of Plant Cell Culture media as well as maintenance of aseptic condition. 2. Introduction to the best use of Animal Cell Culture media as well as maintenance of aseptic condition. 3. Describe the methods of in vitro fertilization and DNA fingerprinting								
CO1	Demonstrate proficiency in in vitro culture techniques, including washing, sterilization, and aseptic transfer for plant tissue culture.								
CO2	Formulate and prepare culture media and reagents, understanding their composition, nutritional requirements, and hormonal influences on plant tissue cultures.								
CO3	Apply micro-culture techniques to plant tissue culture, including callus culture, cell suspension, and organ-specific micro-propagation methods.								
CO4	Analyze and implement animal cell culture methodologies, including primary and secondary cell cultures, continuous cell lines, and suspension cultures.								
CO5	Evaluate the applications of animal tissue culture, including hybridoma technology, monoclonal antibodies, in vitro fertilization, embryo transfer, and their role in producing transgenic animals and cell culture products.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Introduction and overview:</b> Invitro Culture-Washing & Sterilization, Preparatory steps for tissue culture, surface, sterilization of plant material, basic procedures for Aseptic tissue transfer, incubation of culture. Preparation of Culture media & Reagents – Media composition, Nutrition, Hormones. Tissue Culture–Callus culture, Cell suspension		5	To understand the basics of plant tissue culture				1,2	
II	Plant tissue culture: Organ Micro-culture - Shoot tip, excise droot, Leaf culture. Plant micro-propagation–micro-culture of plants		8	To learn about techniques of micropropagation				1,2	
III	Introduction: Review of animal cell culture: History of animal cell culture. Media: Structure of Animal Cell		6	To understand the basics of plant tissue culture				1,2	
IV	Animal Cell Tissue and organ cultures, Primary culture, secondary cell culture, Continuous cell lines, Suspension culture		6	To learn about culture techniques in animal cell Culture				1,2	
V	Animal tissue culture: Hybridoma technology and Monoclonal antibodies, In vitro fertilization and embryo transfer in human Applications: Transgenic animals, Cell culture products, DNA finger printing		5	To learn about applications of animal tissue culture				1,2	

## TEXT BOOK

T1. Plant tissue culture: Basics and Applied by Jha and Ghosh, Orient Black swan Publishers

T2. Principles and Practice of Animal Tissue Culture, by Sudha Gangal, Orient Black swan Publishers

## REFERENCE BOOK

R1. Animal Cell Tissue Culture, Freshney

R2. Plant Cell and Tissue Culture, by S Narayanaswamy, Tata McGraw Hill

## RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Demonstrate proficiency in in vitro culture techniques, including washing, sterilization, and aseptic transfer for plant tissue culture.	1, 2, 3
2	Formulate and prepare culture media and reagents, understanding their composition, nutritional requirements, and hormonal influences on plant tissue cultures.	1, 2, 3
3	Apply micro-culture techniques to plant tissue culture, including callus culture, cell suspension, and organ-specific micro-propagation methods.	1, 2, 3
4	Analyze and implement animal cell culture methodologies, including primary and secondary cell cultures, continuous cell lines, and suspension cultures.	1, 2, 3
5	Evaluate the applications of animal tissue culture, including hybridoma technology, monoclonal antibodies, in vitro fertilization, embryo transfer, and their role in producing transgenic animals and cell culture products.	1, 2, 3



SEMESTER – III									
Course Title	English Language for Excellence								
Course code	22UBPD212R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 32	0	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ III semester of second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To understand and apply grammar rules effectively.</li> <li>To develop clear and structured writing skills.</li> <li>To cultivate self-management skills.</li> <li>To understand and utilize non-verbal communication.</li> <li>To enhance group discussion skills</li> <li>To master interview skills and dress code ethics</li> </ol>								
CO1	Enable students to use prepositions, construct simple, complex, and compound sentences, and distinguish between active and passive voice.								
CO2	Teach students the basics of writing, how to avoid ambiguity, write paragraphs and letters, and prepare resumes and cover letters.								
CO3	Help students conduct SWOT analyses, practice self-regulation, and maintain personal hygiene.								
CO4	Equip students with knowledge about non-verbal communication, types of body language, and their impact.								
CO5	Train students in planning and conducting group discussions, effectively disagreeing, and summarizing to attain objectives.								
CO6	Prepare students for personal interviews, answer common interview questions, follow telephone interview etiquettes, and adhere to dress code and grooming standards.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Grammar (Flipped classroom)</b> i. Use of Prepositions ii. Simple, complex, compound sentences iii. Active and Passive Voice	6	Students will correctly use prepositions, create various sentence structures, and convert between active and passive voice.					2, 3	
II	<b>Writing Skills</b> I. The Basics of Writing; avoid ambiguity and vagueness II. Paragraph Writing III. Letter Writing IV. Resume and Cover Letter	6	Students will write clear and structured paragraphs, letters, resumes, and cover letters.					3, 4	
III	<b>Self-Management Skills</b> i. SWOT Analysis ii. Self-Regulation iii. Personal Hygiene	5	Students will perform SWOT analyses, self-regulate, and adhere to personal hygiene practices.					3, 4	
IV	<b>Non- Verbal Communication-Sciences of Body Language</b> i. What is Non-Verbal Communication & Body Language ii. Types of Body Language, iii. Importance and Impact of Body Language,	5	Students will understand and effectively use different types of body language in communication.					2, 3	
V	<b>Group Discussion</b> i. Planning and Elements of Group Discussion ii. Effectively disagreeing,	5	Students will plan and participate in group discussions, disagree constructively, and summarize					3, 4	

	iii. Summarizing and Attaining the Objective.		discussions.	
<b>VI</b>	<b>Interview Skills &amp; Dress code Ethics</b> i. Personal Interview – Concept and Practice ii. Common Interview Questions and answering Strategies iii. Telephone Interview Etiquettes iv. Introduction to Dress Code and Grooming	5	Students will demonstrate effective interview techniques, answer common questions, follow telephone etiquettes, and dress appropriately.	2, 3

### TEXT BOOK

T1. Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

T2. McDowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition).

### REFERENCE BOOK

R1. Zinsser, William. (2006) On Writing Well: The Classic Guide to Writing Nonfiction, Harper Perennial

R2. Taylor J. and Wright, J., IELTS Advantage Reading Skills: A step-by-step guide to a high IELTS reading score, Delta Publishing by Klett

R3. Murphy, Raymond, (2012) English Grammar in Use Book with Answers: A Self- Study and Practice Book for Intermediate Learners of English, Cambridge University Press

### OTHER LEARNING RESOURCES

<https://learning.shine.com/talenteconomy/career-help/top-group-discussion-skills/>

<https://www.coursera.org/articles/conflict-management>

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Enable students to use prepositions, construct simple, complex, and compound sentences, and distinguish between active and passive voice.	1,7
2	Teach students the basics of writing, how to avoid ambiguity, write paragraphs and letters, and prepare resumes and cover letters.	1,7
3	Help students conduct SWOT analyses, practice self-regulation, and maintain personal hygiene.	1,7

<b>4</b>	Equip students with knowledge about non-verbal communication, types of body language, and their impact.	1,7
<b>5</b>	Train students in planning and conducting group discussions, effectively disagreeing, and summarizing to attain objectives.	1,7
<b>6</b>	Prepare students for personal interviews, answer common interview questions, follow telephone interview etiquettes, and adhere to dress code and grooming standards.	1,7

SEMESTER – III									
Course Title	Universal Human Values (UHV) + Professional Ethics								
Course code	22UUHV101R	Total credits:2	L	T	P	S	R	O/F	C
		Total hours: 30T	2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Biotechnology								
Semester	Fall/ III semester of second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings</li> <li>2. Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence</li> <li>3. Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature</li> </ol>								
CO1	Understand ethical principles and dilemmas in both personal and professional contexts.								
CO2	Develop respect for different beliefs, values, and perspectives, fostering a tolerant and inclusive environment in both personal and professional interactions.								
CO3	Understand corporate social responsibility, sustainable development, and the impact of their actions on communities and the environment.								
CO 4	Understand the importance of upholding ethical standards and taking responsibility for their actions and decisions.								
CO 5	Develop skills to critically evaluate actions, make improvements, and strive for ethical excellence throughout life.								
Unit-No.	Content	Contact Hour	Learning Outcome				K	L	
I	Course Introduction - Need, Basic Guidelines, Content and Process for Value Education 1. Understanding the need, basic guidelines, content and process for Value Education 2. Self Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation–as the mechanism for self exploration 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations 4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario 6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels	8	Develop an understanding of the importance and methodology of value education					1,2	
II	Understanding Harmony in the Human Being - Harmony in Myself! 1. Understanding human being as a co-existence of the sentient ‘I’ and the	6	Develop Insight into the Harmony Within the Human Being					1,2	

	<p>material 'Body' 2. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha 3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) 4. Understanding the characteristics and activities of 'I' and harmony in 'I' 5. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail 6. Programs to ensure Sanyam and Swasthya-Practice Exercises and Case Studies will be taken up in Practice Sessions.</p>			
<b>III</b>	<p>Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship 1. Understanding Harmony in the family – the basic unit of human interaction 2. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship 3. Understanding the meaning of Vishwas; Difference between intention and competence 4. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship 5. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals 6. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha) - from family to world family!-Practice Exercises and Case Studies will be taken up in Practice Sessions.</p>	<b>6</b>	Understand harmony in the family and society	1,2
<b>IV</b>	<p>Understanding Harmony in the Nature and Existence - Whole existence as Co-existence 1. Understanding the harmony in the Nature 2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature 3. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space 4. Holistic perception of harmony at all levels of existence-Practice Exercises and Case Studies will be taken up in Practice Sessions.</p>	<b>4</b>	Develop understanding in harmony in the nature and Existence	1,2

V	Implications of the above Holistic Understanding of Harmony on Professional Ethics 1. Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 4. Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order b) Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems. 5. Case studies of typical holistic technologies, management models and production systems 6. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations	4	Apply harmony in professional ethics	1,2
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**TEXT BOOK:**

T1. R. R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN978-8-174-46781-2

**REFERENCE BOOKS:**

**R1:** R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

**R2:** B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

## RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.	5,8
2	It is free from any dogma or value prescriptions.	5,8
3	It is a process of self-investigation and self-exploration, and not of giving sermons.	5,8
4	Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.	5,8
5	This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.	5,8

SEMESTER – III									
Course Title	Basic Life Saving Skills (BLSS)								
Course code	22UULS202R	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 30T	0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ III semester of second year of the programme								
Course Objectives	1. The aim of the course is to provide the learners with basic knowledge and practical skills needed in an emergency fire situation, and to provide appropriate basic management and treatment for injuries								
CO1	The students will be able to recognize respiratory arrest/ cardiac arrest, and provide oxygen to the patients to sustain tissue viability								
CO2	The students will be able to perform the importance of early CPR on Adult, child and infants victims								
CO3	The students will be able to prevent injury from getting worse, aiding recovery, relieving pain and protecting the victims from deterioration								
CO4	Importance of physiology in forestry								
CO5	The students will be able to learn about the fire equipment's requirements, methods of operation and getting out alive.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Basic Life Support (BLS)</b> • Introduction of BLS • Chain of survival • ABCs Assessment • CPR and Ventilation Technique • AED • Choking for adult and children	5						1,2	
II	<b>First Aid</b> • Golden rules of First aid • First aid Kits	5						1,2	
III	<b>Trauma emergencies</b> • Introduction • Priorities of Initial approach in pre-hospital care • Scene safety • Primary assessment • Bleeding control • Extrication of victims and safe transfer • Cervical spine stabilization and C-collar application • Splinting of broken Limbs	5						1,2	
IV	<b>Triage system</b> • Introduction • Flow chart approach of Triage • Triage of Single and Multiple Casualties in Pre-Hospital setting	5						1,2	
V	<b>Medical emergencies</b> Introduction Victim centred approach and Management of: -	4						1,2	



	<ul style="list-style-type: none"> <li>• Seizures</li> <li>• heart attack</li> <li>• asthma</li> <li>• diabetic emergencies</li> <li>• emergency childbirth</li> <li>• Respiratory distress and failure</li> </ul>			
<b>VI</b>	<b>Environmental Emergency</b> <ul style="list-style-type: none"> <li>• Recognizing and caring for heat related illness such as: Heat stroke,</li> <li>• heat cramps, heat exhaustion, dehydration.</li> <li>• Recognizing and caring for cold related illness such as frostbite,</li> <li>• hypothermia.</li> <li>• Poisoning, Snake bite.</li> </ul>	<b>3</b>		1,2
<b>VII</b>	<b>Safety of people in the event of fire</b> <ul style="list-style-type: none"> <li>• Recognition of possible fire sources and emergency procedures,</li> <li>• Construction techniques for eliminating fire.</li> <li>•Types of detecting devices and extinguishing agents and systems</li> <li>• Devising procedures in the event of fire and react to fire danger.</li> <li>• Safety goals and objectives, Identifying hazards and risks</li> </ul>	<b>3</b>		1,2

**REFERENCE BOOKS:**

R1: Nancy Caroline'S Emergency Care in the streets eight edition by Jones and Bartlett

R2: First Aid book by LC Gupta; Publisher Jaypee Brothers, 7<sup>th</sup> Edition.

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	The students will be able to recognize respiratory arrest/ cardiac arrest, and provide oxygen to the patients to sustain tissue viability	1,8
<b>2</b>	The students will be able to perform the importance of early CPR on Adult, child and infants' victims	1,8
<b>3</b>	The students will be able to prevent injury from getting worse, aiding recovery, relieving pain and protecting the victims from deterioration	1,8
<b>4</b>	Importance of physiology in forestry	1,8

<b>5</b>	The students will be able to learn about the fire equipment's requirements, methods of operation and getting out alive.	1,8
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SEMESTER – III									
Course Title	Personal Financial Planning								
Course code	22UUFL202R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30	0	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ III semester of second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>The course would offer an inclusive approach to understand the relevant concepts of money, borrowing, lending, taxes and their application to financial planning.</li> <li>Assess the personal financial planning process, the life cycle of financial plans, and methods of goal achievement.</li> <li>Formulate a budget, record-keeping system, and tax planning strategy based on current financial goals</li> </ol>								
CO1	Develop a cash management strategy and a plan to facilitate the home or automobile buying process								
CO2	Design a diversified investment portfolio that addresses several different investment objectives.								
CO3	Differentiate between open- and closed-end mutual funds, exchange-traded funds, and direct or indirect real estate investments.								
CO4	Create a financial plan that covers your income needs in retirement and helps protect you and your estate.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	<b>Fundamentals of Financial Planning –</b> i. Functions of money; ii. Inflation- Meaning, causes, how it can be controlled; iii. process official planning, iv. Time value of money-simple and compound interest; v. Net Present Value and Future value, vi. Power of Compounding; vii. Doubling period and Rule of 72.	6	Understand fundamentals of financial planning	1,2					
II	<b>Income Tax Planning–</b> i. Meaning of Income, ii. Direct & Indirect Taxes, Taxable Income, various heads of Income for tax Calculation, iii. Non-taxable Income, iv. Tax evasion and tax avoidance, v. GST, Tax Planning Strategies	6	Understand tax planning	1,2					
III	<b>Entrepreneurial planning –</b> i. Meaning of Entrepreneurship, prerequisites for becoming an entrepreneur, ii. Entrepreneurship Support Systems in India, iii. Institutional support systems for entrepreneurs, iv. Financial support systems for entrepreneurs; v. Venture Capital, Business Angels, vi. Assistant of Government, vii. Commercial Bank Loans and Overdraft.	6	Explain Entrepreneurial planning	1,2					

IV	<b>Planning for investing in securities market –</b> i. Investment avenues offered by Securities Markets, Primary Market and Secondary Market, ii. Stock market- meaning, features, functions of NSE, BSE DEMAT trading account, iii. Security repository, stock brokers, Operational aspects of securities markets: placement of orders, contract note, pay-in and pay-out, trading and settlement cycle, iv. Various risks involved in investing in securities markets; Role of Financial Intermediaries; Stock indices. v. Mutual Funds- meaning concept, definition, types, importance and drawbacks of mutual funds, mutual funds in India, investing in mutual funds, vi. Systematic Investment Plan (SIP) and its advantages.	6	Discuss planning for investing in securities market	1,2
V	<b>Planning for debts and Retirement</b> i. Consumer credit - Introduction to consumer credit; choosing a source of credit, the cost of credit alternatives, ii. Consumer Legal Protection; iii. Housing Decision: Factors and Finance; Vehicle Decisions. iv. Retirement planning - Meaning of cost of living; retirement need analysis; development of retirement plan, various retirement schemes, v. Estate Planning; Pension and Medicare Planning; Wills.	6	Discuss planning for debts and Retirement	1,2

**REFERENCE BOOK:**

R1: Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems & The Million Dollar Financial Advisor: Powerful Lessons and Proven Strategies from Top Producers by David J. Mullen Jr.

R2: Personal Finance and Planning by Dr. Rajni

R3: Peaceful Personal Finance: A Short Read on the Basics of Personal Finance and Planning Kindle Edition by Hema Singh

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Develop a cash management strategy and a plan to facilitate the home or automobile buying process	1,8
2	Design a diversified investment portfolio that addresses several different investment objectives.	1,8
3	Differentiate between open- and closed-end mutual funds, exchange-traded funds, and direct or indirect real estate investments.	1,8
4	Create a financial plan that covers your income needs in retirement and helps protect you and your estate.	1,8

SEMESTER – III									
Course Title	Analytical Biochemistry								
Course code	22BSMB214R	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 30	0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ III semester of second year of the programme								
Course Objectives (Minimum 3)	1. <b>Principles of Analytical Techniques:</b> Understand the fundamental principles underlying analytical techniques commonly used in biochemistry, including spectroscopy (UV-visible, fluorescence, IR), chromatography (HPLC, GC), electrophoresis, mass spectrometry, and immunoassays. 2. <b>Quantitative Analysis:</b> Learn how to perform accurate and precise quantitative analysis of biomolecules such as proteins, nucleic acids, carbohydrates, lipids, and metabolites using various analytical techniques. 3. <b>Sample Preparation and Handling:</b> Develop skills in sample preparation and handling techniques essential for biochemical analysis, including extraction, purification, and derivatization methods.								
CO1	Acquire concept of buffer solutions and their role in various experiments.								
CO2	Develop basic understanding on acid and base, pH of solution and use of pH meters.								
CO3	Apply the principle of Lambert-Beer law with the help of colorimeter and spectrophotometer.								
CO4	Explain biomolecule separation through thin layer chromatography.								
CO5	Demonstrate paper chromatography and its use in amino acids separation								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	Preparation of Buffer Solutions		5	Proficiency in buffer preparation.				3,4,5	
II	Determination of pH of given samples using pH meter		7	Proficiency in learning the operation and function of various analytical tools like pH meter				3,4,5	
III	Verification of Beer- Lambert's Law		6	Relating the theoretical concepts with practical application in terms of Beer-Lambert Law verification				3,4,5	
IV	Separation of a mixture of lipids using Thin-layer Chromatography		5	Proficiency in Chromatography technique				3,4,5	
V	Paper chromatographic separation and detection of amino acids and simple sugars		7	Proficiency in separation and detection of amino acids and simple sugars				3,4,5	

### TEXT BOOKS:

T1. Introductory Biochemistry Practical by Sawhney and Singh, Narosa Publishing House

### REFERENCE BOOKS:

- R1. Laboratory manual in Biochemistry - Jayaraman.  
 R2. Biochemical methods - S.Sadasivan and Manickam.  
 R3. Introduction to Practical Biochemistry - David T. Plummer.

## **OTHER LEARNING RESOURCES:**

ERP, YouTube links, Google etc.

### **RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Acquire concept of buffer solutions and their role in various experiments.	1, 2, 3
<b>2</b>	Develop basic understanding on acid and base, pH of solution and use of pH meters.	1, 2, 3
<b>3</b>	Apply the principle of Lambert-Beer law with the help of colorimeter and spectrophotometer.	1, 2, 3
<b>4</b>	Explain biomolecule separation through thin layer chromatography.	1, 2, 3
<b>5</b>	Demonstrate paper chromatography and its use in amino acids separation	1, 2, 3

SEMESTER – III									
COURSE TITLE	CO-Curricular Activities								
COURSE CODE	22UBCC211	TOTAL CREDITS:	L	T	P	S	R	O/F	C
		TOTAL HOURS:	0	0	0	4	0	0	1
PRE-REQUISITE	Nil								
ANTI-REQUISITE	Nil								
Programme	Bachelor of Science in Microbiology								
Semester	Semester-III								
Course Objectives	It is to develop the social and soft skills and to promote a holistic development of the learners								
CO1	The students will be engaged in different activities headed under different clubs namely dance, music, photography, drama, literacy, etc.								
CO2	The students will participate in regular club activities like workshops, competitions as per their interest and hobbies.								
CO3	The students will be trained to represent ADTU in various inter university, state and national level competitions.								
CO4	The students will be given a platform to earn from invited experts in their respective fields.								
CO5	The students will get an exposure of 360 degree learning methodology considering the overall growth along with the academics.								
SL NO	Contents								
	<p>AdtU encourages a range of activities outside the regular curriculum intended to meet learner's interest, These activities are aimed to develop the social and soft skills and promote a holistic development of the learners, Keeping in mind the 360 degree learning methodology the students are engaged in different activities headed under different clubs viz. Dance, music, photography, drama, literary etc., The students are encouraged to participate in regular club activities, workshops, competitions as per their interest and hobbies, The student members of the club are trained represent AdtU in various inter University student and national level competitions, Renewed personalities are invited to conduct workshops that benefit the members and students by giving them</p>								

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	The students will be engaged in different activities headed under different clubs namely dance, music, photography, drama, literacy, etc.	6,8
2	The students will participate in regular club activities like workshops, competitions as per their interest and hobbies.	6,8
3	The students will be trained to represent ADTU in various inter university, state and national level competitions.	6,8
4	The students will be given a platform to earn from invited experts in their respective fields.	6,8
5	The students will get an exposure of 360 degree learning	6,8



	methodology considering the overall growth along with the academics.	
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SEMESTER – IV									
Course Title	Molecular Biology and RDT								
Course code	22BSMB221R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ IV semester of second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. To teach key topics like DNA structure, central dogma, modifications in RNA and proteins, DNA repair and recombination.</li> <li>2. To make students aware of various molecular biology techniques.</li> <li>3. To make students understand the key topics like cloning, vectors, DNA sequencing, Genome mapping</li> <li>4. To make students understand the application of RDT</li> </ol>								
CO1	Describe the role of DNA as genetic material, its replication and transcription.								
CO2	Explore the bacterial Recombination process with understanding their DNA repair mechanisms and applying the basic molecular biology techniques								
CO3	Summarize various restriction enzymes, vectors and their use in RDT.								
CO4	Applying the DNA amplification techniques in practical scenarios								
CO5	Describe the various gene transfer techniques and recombinant DNA technology for producing pharmaceutical proteins.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Molecular biology an overview: Discovery of DNA as genetic material, Structure of DNA, RNAs and their structure & function, DNA as the carrier of genetic information, Chromosomes, chromatin and function, The Central Dogma. Eukaryotic DNA Replication: Enzymes and proteins involved in DNA replication. Eukaryotic Transcription, post transcriptional modifications Eukaryotic translation, post translational modification	12	Knowledge on DNA structure, replication. Transcription and translation of eukaryotic DNA					1,2	
II	<b>Recombination:</b> Homologous (Holliday model) and Non homologous recombination <b>DNA repair:</b> Base excision repair, nucleotide excision repair, Mismatch repair, SOS repair. <b>Basic Molecular Biology Techniques</b> a. Isolation of plasmid DNA, chromosomal DNA b. Agarose gel Electrophoresis c. Southern blot d. Northern blot Western blotting	6	Knowledge on Process of recombination. Understanding DNA repair mechanisms, Understanding and applying basic molecular biology techniques for DNA isolation and separation					1,2	
III	<b>Overview Gene cloning tools</b> - Restriction enzymes- class I, II and class III restriction enzymes, and their features. Ligases, polymerases, alkaline phosphatases, kinases, transferases and other DNA engineering enzymes. Vectors	7	Knowledge on different tools for gene cloning and their application					1,2	

	- Plasmid vectors, bacteriophage, cosmids and phagemids, Expression vectors, shuttle vectors			
<b>IV</b>	<b>DNA amplification through PCR:</b> Basic features and applications of PCR, types and modifications. DNA sequencing techniques: Maxam – Gilbert’s method, Sanger’s dideoxy chain termination method, Automated DNA sequencing. Genome Mapping: Concept and applications. Restriction enzyme digestion and restriction mapping. Dot blots and slot blots. RFLP, RAPD, microarray	<b>12</b>	Knowledge on principle and process of PCR of DNA sequencing process, Genome mapping and localization of a gene.	1,2
<b>V</b>	<b>Gene transfer:</b> Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion, Microlaser and Agrobacterium mediated gene transfer. Applications of Recombinant DNA technology: Production of recombinant proteins of pharmaceutical importance- insulin, human growth hormone, recombinant vaccines (hepatitis B) etc. Transgenic plants and animals	<b>8</b>	Knowledge on gene transfer mechanism and application of RDT in production of recombinant proteins, transgenic animals and plants.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Demonstration of PCR</li> <li>2. Demonstration of centrifuge</li> <li>3. Demonstration of</li> <li>4. spectrophotometer</li> <li>5. Isolation of Plasmid DNA, chromosomal DNA, Eukaryotic DNA DNA,</li> <li>6. Study of Plasmid Vector</li> <li>7. Competent cell preparation, Blue and white screening, Restriction digestion,</li> <li>8. Electrophoresis</li> <li>9. Replica Plating Technique</li> </ol>	<b>30</b>	Proficiency in DNA isolation and separation techniques. Transformation technique and screening	

### TEXT BOOKS:

- T1. Alberts, B., et al. Molecular Biology of the Cell, Garland, 4th ed., 2002
- T2. Lodish, H., et al. Molecular Cell Biology, WH Freeman, 2003.
- T3. Essentials of Molecular Biology by David Freifelder, 2009
- T4. Molecular Biology of gene, James d. Watson, Alexander gann, Tania a. Baker, Michael levine, Stephen p. Bell, Richard losick, Cold Spring harbor laboratory press
- T5. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
- T6. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
- T7. Willey JM, Sherwood LM, and Woolverton CJ. (2008) Prescott, Harley and Klein’s Microbiology. 7<sup>th</sup> edition. McGraw Hill Higher Education.

### REFERENCE BOOKS:

- R1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc
- R2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- R3. Basic Methods in Molecular Biology by Davis et al. 2007(Elsevier)
- R4. Clark DP and Pazdernik NJ. (2009). Biotechnology-Appling the Genetic Revolution. Elsevier Academic Press, USA.
- R5. Glick BR and Pasternak JJ. (2003). Molecular Biotechnology. 3rd edition. ASM Press Washington D.C.
- R6. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
- R7. Alcamo IE. (2001). DNA Technology: The Awesome Skill. 2nd edition. Elsevier Academic Press, USA.

#### **RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe the role of DNA as genetic material, its replication and transcription.	1, 2, 3
<b>2</b>	Explore the bacterial Recombination process with understanding their DNA repair mechanisms and applying the basic molecular biology techniques	1, 2, 3
<b>3</b>	Summarize various restriction enzymes, vectors and their use in RDT.	1, 2, 3
<b>4</b>	Applying the DNA amplification techniques in practical scenarios	1, 2, 3
<b>5</b>	Describe the various gene transfer techniques and recombinant DNA technology for producing pharmaceutical proteins.	1, 2, 3

SEMESTER – IV									
Course Title	Soil and Agricultural Microbiology								
Course code	22BSMB222R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ IV semester of second year of the programme								
Course Objectives (Minimum 3)	1. To familiarize the students about the different types of soil and soil profile. 2. To teach about the different types of microorganisms found in soil and their application in improvement of soil fertility								
CO1	Analyze soil types, profiles, physico-chemical characteristics, and the inter-relationship between soil and microorganisms, including factors influencing bacterial survival and the roles of rhizosphere and rhizoplane microflora.								
CO2	Understand the mechanisms and ecological and economic importance of asymbiotic and symbiotic nitrogen fixation, nitrification, and denitrification, including the microorganisms involved and the factors influencing these processes.								
CO3	Understand the degradation of carbonaceous materials such as cellulose, hemicelluloses, pectin, and lignin in soil, and their role in humus formation.								
CO4	Understand plant growth-promoting rhizobacteria, phosphate mobilization, biocontrol of pathogens, mycorrhiza types, and microbial plant growth hormones.								
CO5	Understand the significance of Azolla as a biofertilizer, biocomposting processes, and the development and use of biopesticides like Bacillus thuringiensis.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Terrestrial Ecosystem:</b> Types of Soil, soil Profile, Physico- Chemical Characteristics, Inter- relationship of soil and microorganisms, Factors influencing bacterial survival in soils: Biotic & Abiotic, Rhizosphere and Rhizoplane Microflora		7	To understand soil as a Living environment and how microorganisms' function in the soil ecosystem Students will learn the interactions between microbes and their physical, chemical and biological environment				1,2	
II	<b>Nitrogen fixation</b> –Asymbiotic and symbiotic nitrogen Fixation, microorganisms involved, ecological and economic importance of nitrogen fixation, Nitrification Microbes involved, factors influencing nitrification, Denitrification–microbes involved, factors influencing and the mechanism of denitrification		6	Students will be able to identify the different bacteria involved in each step of nitrification Students will be able to describe the physiology of nitrification Identify the most important mechanism by which ammonium is assimilated into soils Discuss some of the environmental consequences of denitrification				1,2	
III	<b>Degradation of carbonaceous materials in soil</b> –cellulose, hemicelluloses, pectin and lignin, humus formation		5	The students will know about the Reservoirs of earth and discuss how biogeochemists use changes in those environments to assess carbon flow in the environment. The students will				1,2	

			identify the structures of the most important organic carbon compounds that plants contribute to the soil environment	
<b>IV</b>	<b>Plant growth promoting Rhizobacteria</b> , phosphate mobilization and bio control of plant pathogens, Mycorrhiza Ectomycorrhiza, Endomycorrhiza, VAM structure & significance. Plant growth promoting hormones from microbes viz. Bacteria and fungi & their significance	<b>7</b>	Students will be able to explain about PGPR as well as other factors responsible for growth of plants	1,2
<b>V</b>	<b>Biofertilizers:</b> An Overview, Azolla as Biofertilizer, Biocomposting. Biopesticides- (Biocontrol agents for agriculturally important crop plants)-Development and their significance; Source Organisms: Bacteria-Bacillus thuringiensis, Bt based commercial products, other Bacilli producing pesticides	<b>5</b>	Students will be able to discuss the basic and applied aspects of microbial inoculants Production and their impact on Production and protection of plant health against insect pests	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Isolation of bacteria, fungi and action bacteria from soils</li> <li>2. Isolation of nitrogen fixing bacteria from Legume root nodules</li> <li>3. Microscopic observations of root colonization by VAM fungi</li> <li>4. Isolation of phyllosphere microflora</li> <li>5. Isolation of Phosphorus solubilizing microorganisms</li> </ol>	<b>30</b>	<ol style="list-style-type: none"> <li>1. Students will be able to achieve proficiency in isolating and identifying bacteria, fungi and Actinobacteria from soil</li> <li>2. Students will learn to identify nitrogen fixing bacteria from leguminous plants</li> <li>3. Students will learn to identify VAM fungi</li> <li>4. Students will learn to identify microorganisms from phyllosphere</li> <li>5. Students will learn to isolate and identify Phosphorus solubilizing microorganisms</li> </ol>	

### TEXTBOOKS:

T1. Martin A. (1977). An Introduction to Soil Microbiology. 2<sup>nd</sup> edition. John Wiley & Sons Inc. New York & London.

T2. Subba Rao NS. (1999). Soil Microbiology .4<sup>th</sup> edition. Oxford & IBH Publishing Co. New Delhi

### REFERENCEBOOKS:

R1. Microbiology–Michael J. Pelczar, J R. E. C. S. Chan Noel K. Krieg, Vth Edition (2005), Publisher–TATA McGraw Hill.

R2. Plant Diseases– R. S. Singh, IXth Edition, Oxford and IBH (N. Delhi)

**OTHERLEARNINGRESOURCES:**

[http://www.jnkvv.org/PDF/02042020180252Yogranjan\\_Lecture%20notes\\_AgriculturalMicrobiology.pdf](http://www.jnkvv.org/PDF/02042020180252Yogranjan_Lecture%20notes_AgriculturalMicrobiology.pdf)

[www.youtube.com](http://www.youtube.com)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Analyze soil types, profiles, physico-chemical characteristics, and the inter-relationship between soil and microorganisms, including factors influencing bacterial survival and the roles of rhizosphere and rhizoplane microflora.	1, 2, 3
<b>2</b>	Understand the mechanisms and ecological and economic importance of asymbiotic and symbiotic nitrogen fixation, nitrification, and denitrification, including the microorganisms involved and the factors influencing these processes.	1, 2, 3
<b>3</b>	Understand the degradation of carbonaceous materials such as cellulose, hemicelluloses, pectin, and lignin in soil, and their role in humus formation.	1, 2, 3
<b>4</b>	Understand plant growth-promoting rhizobacteria, phosphate mobilization, biocontrol of pathogens, mycorrhiza types, and microbial plant growth hormones.	1, 2, 3
<b>5</b>	Understand the significance of Azolla as a biofertilizer, biocomposting processes, and the development and use of biopesticides like Bacillus thuringiensis.	1, 2, 3

SEMESTER – IV									
Course Title	Bioinformatics								
Course code	23BSMB223R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 30T+30P	2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ IV semester of second year of the programme								
Course Objectives	1. To give basic computer knowledge and their practical application. 2. Knowledge on computational database management system and its application in Biology 3. A basic idea on the structural biology using computer.								
CO1	Explain the basics of computer and its applications in Biology, including data analysis								
CO2	Explain the basis and applications of internet in biology.								
CO3	Inculcate the foundation of database management								
CO4	To impart knowledge on various molecular sequence and structure databases								
CO5	Develop skills in using bioinformatics tools for sequence alignment and analysis.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Computer Fundamentals-History of computers, Generations and Classification of computers, Hardware and Software concepts, Block Diagram of Digital Computer, Limitations and Capabilities of computers, I/O devices, Storage devices, RAM ROM, Memory unit- primary and Auxiliary.	5	Describe and explain fundamental of computer and its capabilities and limitation	1,2					
II	Introduction to MS office Tools- MSWord-Introduction, starting MS Word, Standard menus– file, edit, view, formatting a text, layouts, inserting a diagram, graph, page numbers, borders, bullet & numbering, spelling and grammar, letter and mailing, mail merge, tables and its applications. MS Excel and MS PowerPoint. Internet and Networking - Introduction, Importance, Network– LAN, MAN, WAN, Electronic Mailing, Chatting, Search Engine, Web Pages, Virus, Antivirus, Malware, Multimedia-Introduction, Applications, Components and its Uses.	5	Describe, illustrate and explain use of MS office tools in Biology, networking, multimedia and its uses	1,2					
III	Database management system (DBMS)-Introduction to database management system (DBMS) and its different types.	5	Describe, illustrate and explain formation of a database and its application in biology	1,2					
IV	Introduction to bioinformatics and data generation-What is bioinformatics and its relation with molecular biology. Examples of related tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, Pubmed, PDB) and visualization software(RASMOL, MMDB viewer, Mol Mol etc).Applications of Bioinformatics, Pharmaceutical	7	Describe, illustrate and explain bioinformatics and its relation with molecular biology and its application	1,2					



	companies and Bioinformatics. Flat file formats. Protein homology modelling, physiochemical property calculation, introduction to different literature database			
<b>V</b>	Biological Database and its Types-General Introduction of Biological Databases: Nucleotide sequence databases (NCBI, DDBJ and EMBL). Protein sequence databases (SWISS-PROT, PIR, GenPept), Specialized Genome databases: (SGD, TIGR etc). Structure databases (CATH, SCOP, and PDB, NDB, MMDB), introduction to cheminformatics, immunoinformatics, pharmacoinformatics,	<b>8</b>	Describe, illustrate and explain the various biological databases, including nucleotide, protein, genome, and structure databases, and an introduction to cheminformatics, immunoinformatics, and pharmacoinformatics.	1,2
<b>Practical</b>	1. Base sequence analysis of gene/protein sequence. 2. Computer aided survey of scientific literature.	<b>30</b>	Proficiency in DNA isolation and separation techniques. Transformation technique and screening	1,2, 3,4

### TEXT BOOKS:

T1. Fundamental of Bioinformatics: Harisha S.

T2. Instant Notes: Bioinformatics. DR Westhead, JH Parish, RM Twyman. BIOS Scientific Publishers , Oxford, 2002.

### REFERENCE BOOKS:

R1. Genome Analysis and Bioinformatics: A Practical Approach (English) (Paperback) by T. R. Sharma, I K International Publishing House

R2. Bioinformatics: Genes, proteins and computers. C.A. Orengo, D.T. Jones and J.M. Thornton

R3. Introduction to Bioinformatics: T.K. Attwood, D.J. Parry-Smith and S. Phukan

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
<b>1</b>	Explain the basics of computer and its applications in Biology, including data analysis	1, 2, 3
<b>2</b>	Explain the basis and applications of internet in biology.	1, 2, 3
<b>3</b>	Inculcate the foundation of database management	1, 2, 3
<b>4</b>	To impart knowledge on various molecular sequence and structure databases	1, 2, 3
<b>5</b>	Develop skills in using bioinformatics tools for sequence alignment and analysis.	1, 2, 3

SEMESTER – IV									
Course Title	PDP: Campus to Corporate								
Course code	22UBPD223R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 60P	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ IV semester of second year of the programme								
Course Objectives (Minimum 3)	1) To acquaint students with the various tools of effective presentation. 2) To acquire the speaking skill instruct, influence, engage, educate, or appease the listeners. 3) To increase proficiency, presentability and quality of resume and provide guidance for self-promotion and self-evaluation in social media. 4) To prepare and train the students for the campus drives & walking interviews.								
CO1	Enable students to prepare scripts, understand nonverbal cues, overcome fear, and practice public speaking strategies.								
CO2	Equip students with skills to prepare, submit, and screen resumes and cover letters.								
CO3	Teach students the different parts of an email and effective email drafting techniques.								
CO4	Prepare students for interviews by practicing commonly asked questions and participating in mock interview sessions.								
CO5	Students will understand the concept of conflict management, identify different types, and analyze its effects.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Module1-Presentation Skills</b> i. Introduction ii. Essential characteristics of a good presentation iii. Preparation of a good presentation	12						1,2	
II	<b>Module2–Public Skills</b> i. Fear of Public Speaking, ii. Understanding and Overcoming Fear of Public Speaking, iii. Confidence and Control, iv. Physiology and Stress-Control/Process, v. Tips for Presentations and Public Speaking, vi. Tips for Using Visual Aids in Presentations, vii. Process for Preparing and Creating Presentations, viii. Delivering Presentations Successfully, ix. Doubt Clearing and Summary of Main Points	7						1,2	
III	<b>Module 3- Practical session on Resume, Curriculum Vitae, Writing cover letter &amp; LinkedIn Profile</b> i. Preparation, submission & screening of Resume. ii. Practical session on cover letter screening session iii. Creating profile in LinkedIn iv. How to utilize it	7						1,2	
IV	<b>Module 4-Leadership &amp; Management Skills</b> i. Concepts of Leadership ii. Leadership Styles	8						1,2	

	iii. Manager VS Leader iv. How to be an Effective Leader v. Mock/Practice Session, vi. Doubt Clearing Session			
<b>V</b>	<b>Module5–Interview Skills &amp; Dress code Ethics</b> i. Types of interview-telephonic, virtual & face to face ii. Online interview, personal interview, iii. Panel interview, iv. Group interview, v. JAM session, vi. Types of interview questions-traditional/common interview questions, vii. Case interview questions, viii. General Strategies for answering questions, ix. Marketing your skills and experiences, x. Preparation before the interview, xi. How to dress up for an interview, xii. How to maintain eye contact and positive body language, xiii. How to be presentable, xiv. Interview dos and don'ts, xv. Introduction to Dress Code Ethics, xvi. Purpose and Importance xvii. How to Make FIRST IMPRESSION, xviii. What to Wear During Interviews or Any Other Formal Meetings – Male & Female	<b>11</b>		1,2
	<b>Module6-Mock Interview</b> i. Practical Mock Interview, ii. Feedback-Receiving Feedback, iii. Giving Feedback, iv. Advantages of Effective Feedback v. How to deal with negative feedback	<b>20</b>		1,2

**TEXT BOOKS:**

T1. Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

T2. McDowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome

<b>1</b>	Enable students to prepare scripts, understand nonverbal cues, overcome fear, and practice public speaking strategies.	6,7
<b>2</b>	Equip students with skills to prepare, submit, and screen resumes and cover letters.	6,7
<b>3</b>	Teach students the different parts of an email and effective email drafting techniques.	6,7
<b>4</b>	Prepare students for interviews by practicing commonly asked questions and participating in mock interview sessions.	6,7
<b>5</b>	Students will understand the concept of conflict management, identify different types, and analyze its effects.	6,7

SEMESTER – IV									
COURSE TITLE	Extra-Curricular Activities								
COURSE CODE	22UBEC221	TOTAL CREDITS:	L	T	P	S	R	O/F	C
		TOTAL HOURS:	0	0	0	4	0	0	1
PRE-REQUISITE	Nil								
ANTI-REQUISITE	Nil								
Program me	Bachelor of Science in Microbiology								
Semester	Semester-IV								
Course Objectives	It is to develop the social and soft skills and to promote a holistic development of the learners								
CO1	The students will be engaged in different activities headed under different clubs namely dance, music, photography, drama, literacy, etc.								
CO2	The students will participate in regular club activities like workshops, competitions as per their interest and hobbies.								
CO3	The students will be trained to represent ADTU in various inter university, state and national level competitions.								
CO4	The students will be given a platform to earn from invited experts in their respective fields.								
CO5	The students will get an exposure of 360 degree learning methodology considering the overall growth along with the academics.								
SL NO	Contents								
	<p>AdtU encourages a range of activities outside the regular curriculum intended to meet learner's interest, These activities are aimed to develop the social and soft skills and promote a holistic development of the learners, Keeping in mind the 360 degree learning methodology the students are engaged in different activities headed under different clubs viz. Dance, music, photography, drama, literary etc., The students are encouraged to participate in regular club activities, workshops, competitions as per their interest and hobbies, The student members of the club are trained represent AdtU in various inter University student and national level competitions, Renewed personalities are invited to conduct workshops that benefit the members and students by giving them</p>								

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	The students will be engaged in different activities headed under different clubs namely dance, music, photography, drama, literacy, etc.	6,8
2	The students will participate in regular club activities like workshops, competitions as per their interest and hobbies.	6,8
3	The students will be trained to represent ADTU in various inter university, state and national level competitions.	6,8
4	The students will be given a platform to earn from invited experts	6,8

	in their respective fields.	
<b>5</b>	The students will get an exposure of 360 degree learning methodology considering the overall growth along with the academics.	6,8

SEMESTER – IV									
Course Title	Composting and Bio Fertilizer Preparation								
Course code	22BSMB224R	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 30P	0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ IV semester of second year of the programme								
Course Objectives	1) Appreciate the agronomic importance of beneficial micro-organisms 2) Formulate, produce and apply Biofertilizers in a pilotscale								
CO1	Learn about composting and vermicomposting technology and comprehend the role of microbes and earthworms in increasing the soil fertility.								
CO2	Understand about phosphate solubilising microbes, Nitrogen fixers in soil and their isolation.								
CO3	Analyze the role of VAM in soil fertility and biofertilizer technology								
CO4	Create indigenous way for production and specific requirements for each bio-fertilizers.								
CO5	Apply the knowledge gained to generate opportunities of self-employability and restore the soil fertility towards sustainable agriculture practices via organic farming.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
Practical	1. Composting 2. Vermicomposting 3. Isolation of phosphate solubilizing 4. bacteria from soil and their application 5. Isolation of nitrogen fixing bacteria 6. and their application 7. Isolation and application of VAM 8. Formulation of biofertilizer	30	Knowledge on preparation of compost and biofertilizer	1, 2, 3, 4					

#### TEXT BOOKS:

T1. A text book of microbiology, second reprint. S. Chand and Company Ltd., New Delhi.

T2. Dubey, R. C. 2008. A Textbook of Biotechnology. S. Chand & Co., New Delhi.

#### REFERENCE BOOKS:

R1. Kannaiyan, S. 2002 Biotechnology of Biofertilizers. Narosa publishing house, New Delhi. Dubey, R.C. 2001.

## RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Learn about composting and vermicomposting technology and comprehend the role of microbes and earthworms in increasing the soil fertility.	1, 2, 3
<b>2</b>	Understand about phosphate solubilising microbes, Nitrogen fixers in soil and their isolation.	1, 2, 3
<b>3</b>	Analyze the role of VAM in soil fertility and biofertilizer technology	1, 2, 3
<b>4</b>	Create indigenous way for production and specific requirements for each bio-fertilizers.	1, 2, 3
<b>5</b>	Apply the knowledge gained to generate opportunities of self-employability and restore the soil fertility towards sustainable agriculture practices via organic farming.	1, 2, 3



SEMESTER – IV									
Course Title	Basic Acclimatizing Skills (BAS)								
Course code	22UULS201R	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 30P	0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ IV semester of second year of the programme								
Course Objectives	1) 1. To impart knowledge of the fundamentals of Hospitality industry and its applications. 2) Students will be able to familiarize with the cooking equipment's & Utensils. 3) Students will be able to handle different modes of reservations.								
CO1	Students will have basic knowledge of cooking methods.								
CO2	Students will gain the knowledge of organizing & Cleaning of Rooms.								
CO3	Students will be able to gain the travel management concept.								
CO4	Students will be able to acquire the knowledge of basic household amenities for dayto-day use.								
Unit-No.	Content		Contact Hour	Learning Outcome					KL
I	Introduction to Accommodation Management: Telephone handling technique, Organizing of Rooms. Cleaning agents, cleaning equipment's and uses. Bed making Process		8	Explain accommodation management					1,2
II	Fundamentals of Cooking Definition of cookery – Aim & Objectives of cooking. Use of basic cooking equipment's, Personal Hygiene and Safety Use of Fire & Fuels		7	Explain fundamentals of cooking					1,2
III	Methods of Cooking Different Cuts. Use of Herbs and Spices. Basic Food and Beverage Preparation. Regional food Habits.		8	Discuss methods of cooking					1,2
IV	Forms & Format's C –form Reservation form Registration form Passport Application form Legal Rent Agreement		5	Understand formats of different forms					1,2

#### REFERENCE BOOKS:

R1: Nancy Caroline'S Emergency Care in the streets eight edition by Jones and Bartlett

R2: First Aid book by LC Gupta; Publisher Jaypee Brothers, 7<sup>th</sup> Edition.

#### OTHER LEARNING RESOURCES:

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Students will have basic knowledge of cooking	1,8

	methods.	
2	Students will gain the knowledge of organizing & Cleaning of Rooms.	1,8
3	Students will be able to gain the travel management concept.	1,8
4	Students will be able to acquire the knowledge of basic household amenities for dayto-day use.	1,8

SEMESTER – V									
Course Title	Medical Bacteriology and Virology								
Course code	22BSMB311R	Total credits: 5	L	T	P	S	R	O/F	C
		Total hours: 45T+60P	3	0	4	0	0	0	5
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ V semester of third year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To familiarize the students about the different diseases caused by bacteria &amp; viruses and prevention and control measures of the diseases</li> <li>To teach different diagnostic tests to identify the causative organisms</li> </ol>								
CO1	Describe the types and characteristics of normal and transient flora of human body.								
CO2	Compare different virulence factors of viral and bacterial pathogens and their role in pathogenesis.								
CO3	Explain Common Bacterial Pathogens and Strategies for Prevention and Control								
CO4	Apply different staining and biochemical test for diagnosis of bacterial disease.								
CO5	Explain Viral Pathogens and Effective Disease Management Strategies.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Beneficial Microbial Interactions with Human:</b> Normal microbial population-Skin, mouth, upper respiratory tract, intestinal tract, urino-genital tract, eye.		7	Knowledge on the normal microbial in habitants of humanbody				1,2	
II	<b>Harmful Microbial Interactions with Human:</b> Definitions of Pathogen Infection, Invasion, Endemic, Pandemic and Epidemic. Virulence and Virulence factors, Entry of pathogens into the host and mechanism of bacterial pathogenicity, exotoxins, enterotoxins, endotoxins, neurotoxins, Carriers and their types, Opportunistic infections, Nosocomial infections, Transmission of infections, Sepsis and septic shock, types of bacterial pathogens		6	Knowledge on microbial virulence factors and pathogenicity				1,2	
III	<b>Human diseases caused by bacterial pathogens-</b> List of diseases of various organ systems and their causative agents, symptoms, mode of transmission, pathogenicity, prophylaxis and control of the following diseases. <i>Staphylococcus aureus</i> , <i>Streptococcus pyogenes</i> , <i>Haemophilus influenzae</i> , <i>Mycobacterium tuberculosis</i> , <i>Escherichia coli</i> , <i>Salmonella</i> , <i>Vibrio cholerae</i> , <i>Helicobacter pylori</i> , <i>Bacillus anthracis</i> , <i>Clostridium</i> , <i>Treponema pallidum</i>		15	Knowledge on different bacterial diseases, their causative organisms, mode of transmission, pathogenesis, prophylaxis.				1,2	
IV	<b>Staining techniques and biochemical test used in diagnosis of pathogens–</b> Staining techniques: Endospore, cell wall, flagella, metachromatic granules, hanging drop Biochemical tests: IMViC, Catalase, Coagulase,		10	Theoretical and practical knowledge on principle and process of different diagnostic tests for identification of a bacterial pathogen				1,2	

	Oxidase, TSI, fermentation of carbohydrates, starch hydrolysis, urease, gelatine liquefaction Use of selective media for specific bacteria			
<b>V</b>	<b>Basic Virology:</b> – General properties, Morphology, Epidemiology, pathogenesis - pathology - diagnostics procedure -clinical manifestation - prevention and control measures of- HIV, Pox virus, Influenza virus, Rabies virus, Polio Virus, Hepatitis Virus, Mumps, Measles, Rubella, Arbovirus	<b>10</b>	Knowledge on different bacterial diseases, their causative organisms, mode of transmission, pathogenesis, prophylaxis.	1,2
<b>Practical</b>	1.Study of normal micro-biota of mouth; isolation, identification and preservation of microorganisms Study of normal micro-biota of skin; Isolation identification and preservation of microorganisms 2.Staining Capsular staining by negative staining, endospore staining, metachromatic granules, motility, Fungal staining 1. Biochemical tests: IMViC, Catalase, Coagulase, Oxidase, TSI, fermentation of carbohydrates, starch hydrolysis, urease, gelatin liquefaction Use of selective media for specific bacteria 2. Antibiotic Sensitivity test Methods of isolation and identification of fungi from Human Body: Staining methods-KOH and LPCB.	<b>30</b>	Proficiency in various diagnostic tests for bacteria and fungal identification.	1,2, 3,4

### TEXT BOOKS:

T1. Medical Microbiology by Anantanarayan & Panikar Orient Longman Limited.

T2. Medical Parasitology by Arora and Arora, CBS Publishers & Distributors.

### REFERENCEBOOKS:

R1. Medical Microbiology by David Green Wood Richard slack & John Peuthrer. Churchill Livingston Company.

R2. Parasitology by K. P. Chattergy Medical Microbiology by Jawelz, Melnick, Geo R. Brokes McGraw-Hill Company.

R3. Medical Mycology by Jagedeese Chander

R4. Medical Microbiology by Jawetz

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Describe the types and characteristics of normal and transient flora of human body.	1, 2, 3
<b>2</b>	Compare different virulence factors of viral and bacterial pathogens and their role in pathogenesis.	1, 2, 3
<b>3</b>	Explain Common Bacterial Pathogens and Strategies for Prevention and Control	1, 2, 3
<b>4</b>	Apply different staining and biochemical test for diagnosis of bacterial disease.	1, 2, 3
<b>5</b>	Explain Viral Pathogens and Effective Disease Management Strategies.	1, 2, 3

SEMESTER – V									
Course Title	Medical Mycology and Parasitology								
Course code	22BSMB312R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ V semester of third year of the programme								
Course Objectives	1. To familiarize the students about the Morphology and taxonomy of fungi and the parasites. 2. To familiarize students about different diseases caused by fungi and parasites 3. To familiarize about the prevention and control measures of the diseases caused by fungi and parasites								
CO1	Comprehend the basic concepts of medically significant fungi and its application in detecting and recovering fungi from clinical samples.								
CO2	Enhance the knowledge of superficial, subcutaneous, cutaneous, systemic, and opportunistic infections with respect to etiology, pathogenesis, clinical manifestations, laboratory diagnosis, treatment, and preventive measures.								
CO3	Build foundation of the structures and the pathogenicity associated with various mycotoxins								
CO4	Acquire proficiency in the classification, morphology, pathogenicity, and laboratory diagnosis of prevalent protozoan diseases								
CO5	Developing skills in diagnosing in parasitic metazoan diseases through laboratory techniques and methods								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>General Introduction:</b> Morphology and taxonomy of fungi of medical importance. Detection and recovery of fungi from clinical specimens. Yeasts of medical importance, dimorphic fungi	10	Understand the morphology and taxonomy of medically important fungi. Understand the diagnostic procedure from the clinical specimens.				1,2		
II	<b>Mycoses</b> – superficial, subcutaneous, cutaneous, systemic and opportunistic–etiology, pathogenesis, clinical manifestation, lab diagnosis, treatment, prevention	15	Understand the pathogenesis, clinical manifestation, lab diagnosis, treatment and prevention of superficial, subcutaneous, cutaneous, systemic, opportunistic mycoses				1,2		
III	<b>Fungal toxins</b> -mycotoxins-structure, types and its pathogenicity	5	Understand and learn the types of fungal toxins and disease				1,2		
IV	<b>Classification, Morphology, Pathogenicity, lab diagnosis of common protozoan diseases</b> - Amoebiasis, Giardiasis, Trypanosomiasis, Malaria, Toxoplasmosis, Leishmaniasis. Classification Morphology, Pathogenicity	7	Understand and learn the types of parasites host, source of infection, mode of infection, lab diagnosis  Understand the morphology, pathogenesis and lab diagnosis of Protozoa, Flagellates, Sporozoa				1,2		
V	<b>Laboratory diagnosis of common parasitic metazoan diseases</b> – Ascariasis, Hookworm, Filariasis, Taenia infection	8	Understand the morphology, pathogenesis and lab Diagnosis of Ascaris, Hookworm, Filariasis, Taenia infection				1,2		
<b>Practical</b>	1. Microscopic Examination of filamentous fungi	30	Proficiency in various diagnostic tests				1,2,		

	and yeast  2. Staining-lacto phenol cotton blue staining, gram's staining  3. KOH mount, skin scrapping, cultivation  4. Preparation of Sabouraud's medium with and without antibiotics  5. Identification, sensitivity tests for antifungal agents  6. Leishman Staining and Giemsa Staining		for fungal and parasitic identification	3,4
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**TEXT BOOKS:**

T1. Medical Microbiology by Anantanarayan & Panikar Orient Longman Limited.

T2. Medical Parasitology by Arora and Arora, CBS Publishers & Distributors.

**REFERENCEBOOKS:**

R1. Medical Microbiology by David Green Wood Richard slack & John Peuthrer. Churchill Livingston Company.

R2. Parasitology by K. P. Chattergy Medical Microbiology by Jawelz, Melnick, Geo R. Brokes McGraw-Hill Company.

R3. Medical Mycology by Jagedeese Chander

R4. Medical Microbiology by Jawetz

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Comprehend the basic concepts of medically significant fungi and its application in detecting and recovering fungi from clinical samples.	1, 2, 3
2	Enhance the knowledge of superficial, subcutaneous, cutaneous, systemic, and opportunistic infections with respect to etiology, pathogenesis, clinical manifestations, laboratory diagnosis,	1, 2, 3

	treatment, and preventive measures.	
<b>3</b>	Build foundation of the structures and the pathogenicity associated with various mycotoxins	1, 2, 3
<b>4</b>	Acquire proficiency in the classification, morphology, pathogenicity, and laboratory diagnosis of prevalent protozoan diseases	1, 2, 3
<b>5</b>	Developing skills in diagnosing in parasitic metazoan diseases through laboratory techniques and methods	1, 2, 3



SEMESTER – V									
Course Title	Biostatistics								
Course code	22BSMB313R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 45T	3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ V semester of third year of the programme								
Course Objectives	1. To familiarize the students with how to determine the data to be collected, organize and summarize the information to draw valid conclusions or inferences about the population. 2. To make aware with how to record the collected data in tables and representing in graphs. 3. To analyze the nature of the data through central tendency and dispersion, interpreting the results and the conclusion.								
CO1	Explain the basics of computer and its applications in Biology, including data analysis.								
CO2	Explain the basis and applications of internet in biology								
CO3	Inculcate the foundation of database management								
CO4	To impart knowledge on various molecular sequence and structure databases								
CO5	Develop skills in using bioinformatics tools for sequence alignment and analysis								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Introduction to Statistics; Data collection- Types of data, Methods, techniques and sources; Frequency Distributions-Tabular and Graphical representation.	8	Knowledge on the subject Statistics, methods of data collection for any study, research and how to record the raw data for any statistical analysis.					1,2	
II	Descriptive statistics-Measures of Central tendency and their applications, Relationship between mean, median and mode; Measures of Dispersion and their applications;	9	Knowledge about the nature of data collected, by measuring the amount of concentration and dispersion among the values.					1,2	
III	Probability distributions-Binomial distribution, Poisson distribution and Normal distribution and their applications.	9	Knowledge of a random variable, its values and the relationship between the values and their respective probabilities.					1,2	
IV	Introduction to Correlation analysis of Bivariate data, Covariance, Karl Pearson's Correlation coefficient	9	Knowledge of the correlation between any two variables					1,2	
V	Hypothesis testing-Null hypothesis, Alternative hypothesis, Types of errors; Introduction to statistical tests-Student's t test, F-test, Chi-square test.	10	Testing any hypothesis using statistical tests					1,2	

### TEXT BOOKS:

T1. Biostatistics, P. N.Arora and P. L. Malhan

T2. Mahajan's Methods in Biostatistics, Mahajan.

T3. Biostatistical Analysis, J. H. Zar

T4. Introductory biostatistics, Chap T. Le. John Wiley, USA

**REFERENCEBOOKS:**

R1. Fundamentals of Statistics by S. C. Gupta.

R2. Statistical Methods in Biology, N. T. J. Bailey

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the basics of computer and its applications in Biology, including data analysis.	1, 2, 3
<b>2</b>	Explain the basis and applications of internet in biology	1, 2, 3
<b>3</b>	Inculcate the foundation of database management	1, 2, 3
<b>4</b>	To impart knowledge on various molecular sequence and structure databases	1, 2, 3
<b>5</b>	Develop skills in using bioinformatics tools for sequence alignment and analysis	1, 2, 3

SEMESTER –V									
Course Title	Pharmaceutical Microbiology								
Course code	22BSMB314R	Total credits: 3 Total hours: 45T	L	T	P	S	R	O/F	C
			3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ V semester of third year of the programme								
Course Objectives	1.To incorporate a strong understanding and in-depth knowledge of pharmaceutical microbiology principles, techniques, processes 2.Study the strategies in order to avoid any potentially costly and life-threatening failures and consequences.								
CO1	Understand basic pharmaceutical concepts such as definitions, sources, terminology, and classification, and recognize the primary aspects of pharmacodynamics, including actions, therapeutic effects, and potential adverse or toxic reactions.								
CO2	Comprehend the fundamentals of pharmacokinetics, covering absorption, distribution, metabolism, interaction, and excretion processes.								
CO3	Understand the principles and apply the knowledge of Good Manufacturing Practices (GMP) in the pharmaceutical and cosmetic industries.								
CO4	Attain proficiency in quality management and regulatory aspects related to premises and contamination control, encompassing knowledge in location, design, structure, layout, services, and cleaning protocols.								
CO5	Acquire expertise in the analytical aspects of pharmaceutical and cosmetic product quality control, incorporating Good Clinical Laboratory Practices (GCLP) principles.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Introduction to pharmacology:</b> Definitions, sources, terminology used, classification, Pharmacodynamics–Actions, Therapeutic, Adverse, toxic	<b>8</b>	Knowledge about the Pharmacodynamics of drugs				1,2		
II	<b>Pharmacokinetics</b> –absorption, distribution, metabolism, interaction, excretion, Routes of drug administration, Storage of various drugs	<b>9</b>	Understanding of Pharmacokinetics of drugs and mode of drug storage				1,2		
III	<b>Principles and applications of GMP in pharmaceuticals and cosmetics</b> Principles– Applications and Definitions The concept of Quality The regulatory factors QC, QA and GMP. Quality assurance beyond GMP ISO Sanitary practices in cosmetic manufacturing	<b>9</b>	Understanding of quality aspect of drug manufacturing, quality assurance, sanitary practice				1,2		
IV	<b>Quality management and regulatory aspects</b> Premises and contamination control, location, design, structure, layout, services and cleaning. Personnel management, training, Hygiene and health. Documentation Quality control and GCLP Sterile and other products. Global regulatory and toxicological aspects of cosmetic preservation	<b>9</b>	Knowledge about quality management aspect of premises, Personnel Hygiene, documentation and regulatory.				1,2		
V	<b>Analytical aspects for pharmaceutical and cosmetic Products</b> Quality control and GCLP Sterile and other	<b>10</b>	Knowledge about Sterile and non-sterile pharmaceutical products, efficacy and evaluation of				1,2		

products. Validation Cosmetics microbiology-testing methods and preservation antimicrobial preservation efficacy and microbial content testing Validation method for cosmetics Preservation strategy Evaluation of antimicrobial mechanism		preservatives use in pharmaceuticals and cosmetics	
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**TEXTBOOKS:**

- T1. Pharmaceutical Microbiology, by Dr. C. R. Kokare  
T2. Pharmaceutical Microbiology, Tim Sandle

**REFERENCE BOOKS:**

- R1. Pharmacology by Harvey and Champe, Wolters Kluwer Publication, 4<sup>th</sup> Edition  
R2. Principles of Pharmacology, Armstrong, Wolters Kluwer Publication  
R3. Basic and Clinical Pharmacology, by Katzung, McGraw Hill, 10<sup>th</sup> edition  
R4. Pharmacology, Principles and Practice, Bachmann, Hecker, Messer, AP Publication

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand basic pharmaceutical concepts such as definitions, sources, terminology, and classification, and recognize the primary aspects of pharmacodynamics, including actions, therapeutic effects, and potential adverse or toxic reactions.	1, 2, 3
2	Comprehend the fundamentals of pharmacokinetics, covering absorption, distribution, metabolism, interaction, and excretion processes.	1, 2, 3
3	Understand the principles and apply the knowledge of Good Manufacturing Practices (GMP) in the pharmaceutical and cosmetic industries.	1, 2, 3
4	Attain proficiency in quality management and regulatory aspects related to premises and contamination control, encompassing knowledge in location, design, structure, layout, services, and cleaning protocols.	1, 2, 3
5	Acquire expertise in the analytical aspects of pharmaceutical and cosmetic product quality control, incorporating Good Clinical Laboratory Practices (GCLP) principles.	1, 2, 3

SEMESTER – V									
Course Title	Food and Dairy Microbiology								
Course code	22BSMB315R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ V semester of third year of the programme								
Course Objectives	1. To teach students the microbial ecology of foods and the ecological factors that affect the presence, survival, growth and death of microorganisms in food. 2. To teach students about the principles of food preservation techniques 3. To teach students about the microbiology of various food and dairy products and the pathogenesis of the food borne and water borne diseases.								
CO1	Understanding the various natural microflora in different foods types and comprehending the fundamental principles of microbial spoilage in food.								
CO2	Remembering the various principles underlying physical and chemical methods of food preservation with the Application of Preservation Technique								
CO3	Determine the basic composition of milk and its nutritional components with the factors influencing the quality of milk and Recognizing sources of contamination in milk and examining the fermentation processes of cheese, butter, and buttermilk.								
CO4	Remembering the various food borne diseases with their causative agents and preventive measures.								
CO5	Analysis the various Detection Methods of water samples and understanding the Membrane Filter Technique and Hands-On Competence.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>INTRODUCTION TO FOOD AND DAIRY MICROBIOLOGY:</b> Natural flora and Sources of Contamination of foods in general. Microbial spoilage: principles, intrinsic and extrinsic factors that affect growth and survival of microbes in foods. Spoilage of vegetables, fruits, meat, eggs, cereals, canned foods.	10	Students will learn about the general microbes present in foods and the factors that support the growth. Students will also learn about spoilage of Various food products					1,2	
II	<b>PRINCIPLES AND METHODS OF FOOD PRESERVATION:</b> Principles, physical methods of food preservation: Low temperature, High temperature, Pasteurization, Drying, Canning; Irradiation; Chemical methods of food preservation: salt, sugar, organic acids, SO <sub>2</sub> and antibiotics.	8	Students will learn about the principles and methods of food preservation technique					1,2	
III	<b>ROLE OF MICROBES IN MILK AND DAIRY PRODUCTS</b> – Composition of milk, Sources, contamination and spoilage of milk and milk products, Various types of microbiological analysis of milk. Fermented dairy products-Fermented Cheese, butter, buttermilk, curd	8	Students will learn about the composition of milk, the source of Contamination of milk and milk products, various microbiological analysis of milk and the fermented dairy products					1,2	
IV	<b>FOOD BORNE DISEASES-</b> Definition of food poisoning, food Infections and	9	Students will learn about the various types of food borne					1,2	

	toxication. Causative agents, Foods involved, symptoms and preventive measures. Food intoxications: <i>Staphylococcus aureus</i> , <i>Clostridium botulinum</i> and mycotoxins; Food infections: <i>Bacillus cereus</i> , <i>Escherichia coli</i> , <i>Shigella</i> , <i>Listeria monocytogenes</i> . <i>Salmonella</i> , <i>Cholera</i>		diseases, their pathogenesis, symptoms, and prevention	
<b>V</b>	<b>TREATMENT AND SAFETY OF DRINKING (POTABLE)</b> WATER-methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for fecal coliforms (b) Membrane filter technique	<b>10</b>	Students will learn the Methods to detect potability of water samples.	1,2
<b>Practical</b>	1. MBRT of milk samples and their standard plate count. 2. Isolation of borne bacteria fungi from products. 3. Most Probable Number Analysis 4. Microbiological examination canned foods 5. Isolation of spoilage bacteria from fruits and vegetables. 6. Adulterant test– formalin and starch test 7. Effect of temperature on the spoilage of Food products. 8. Production of fermented food and their microbial examination.	30	Develop skills in assessing microbial quality, detecting adulterants, and analyzing spoilage and fermentation in various food products through microbiological techniques.	1,2, 3,4

#### **TEXT BOOKS:**

- T1. Frazier W.C. and Westhoff D.C. (2008) Food Microbiology, 4th Edn. Tata McGraw Hill Publishing Co., New Delhi.  
T2. Bamforth C.W. (2005) Food, Fermentation and Microorganisms, Blackwell Science.

#### **REFERENCE BOOKS:**

- R1. Doyle M.P. and Buchanan R.L. (Ed.) (2013) Food Microbiology: Fundamentals and Frontiers, 4th Edn. ASM press.  
R2. Jay J.M., Loessner M.J. and Golden D.A. (2005) Modern Food Microbiology, 7th Edn. Springer Publishers.  
R3. Robinson R.K. (2002) Dairy Microbiology: Milk and Milk Products, 3rd Edn. Wiley Publishers.

#### **OTHER LEARNING RESOURCES:**

- [www.youtube.com](http://www.youtube.com)  
<https://microbenotes.com>

#### **RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understanding the various natural microflora in different foods types and comprehending the fundamental principles of microbial spoilage in food.	1, 2, 3
<b>2</b>	Remembering the various principles underlying physical and chemical methods of food preservation with the Application of Preservation Technique	1, 2, 3
<b>3</b>	Determine the basic composition of milk and its nutritional components with the factors influencing the quality of milk and Recognizing sources of contamination in milk and examining the fermentation processes of cheese, butter, and buttermilk.	1, 2, 3
<b>4</b>	Remembering the various food borne diseases with their causative agents and preventive measures.	1, 2, 3
<b>5</b>	Analysis the various Detection Methods of water samples and understanding the Membrane Filter Technique and Hands-On Competence.	1, 2, 3

SEMESTER –V									
Course Title	Research Project I								
Course code	22BSMB316R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 18R	0	0	0	0	18	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ V semester of third year of the programme								
Course Objectives	1. Apply experimental methods to solve a given scientific task, collect data for evaluation and for statistical treatment, if relevant, 2. Use relevant scientific literature.								
CO1	Develop a research proposal, formulating research questions, reviewing literature, interpreting data, and understanding the implications of research findings.								
CO2	Develop skills in crafting a concise and well-structured research proposal.								
CO3	Learn to formulate research questions, objectives, and hypotheses.								
CO4	Conduct a focused review of relevant literature related to the chosen mini research topic.								
CO5	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	Crafting a concise and well-structured research proposal, writing a draft of a research proposal on a chosen topic.		15	Develop skills in crafting a concise and well-structured research proposal.				1,2,3,4	
II	Formulating Research Questions and Hypotheses in small groups, submitting formulated research questions and hypotheses for feedback.		15	Learn to formulate research questions, objectives, and hypotheses.				1,2,3,4	
III	Use of academic databases and tools for literature review, conduct a literature review on the chosen research topic and submit a summary.		20	Conduct a focused review of relevant literature related to the chosen mini research topic.				1,2,3,4	
IV	Hands-on practice with data analysis software, analyse sample data sets and interpret the results.		10	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.				1,2,3,4	
V	Presentations and discussions on the broader implications of students' research findings, reflect on the implications of the research findings and submit a final research report.		10	Develop an awareness of the implications of findings within the scope of the mini research.				1,2,3,4	

#### REFERENCE BOOKS:

**R1.** "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches" by John W. Creswell and J. David Creswell

**R2.** "The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams

**R3.** Research Methodology: Methods and Techniques" by C.R. Kothari

#### OTHER LEARNING RESOURCES:



**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Develop a research proposal, formulating research questions, reviewing literature, interpreting data, and understanding the implications of research findings.	1,2,3
2	Develop skills in crafting a concise and well-structured research proposal.	1,2,3
3	Learn to formulate research questions, objectives, and hypotheses.	1,2,3
4	Conduct a focused review of relevant literature related to the chosen mini research topic.	1,2,3
5	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.	1,2,3

SEMESTER – V									
Course Title	Experimental and statistical data analysis								
Course code	22BSMB317R	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 30P	0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Fall/ V semester of third year of the programme								
Course Objectives	1) Students will be able to gain the Analytical Skill concept 2) Students will be able to acquire the knowledge of basic Data Analysis Procedure for day-to-day use. 3) Students will gain the knowledge of organizing & Cleaning of Data.								
CO1	Gain proficiency in using R as a programming language and environment for performing data analysis tasks and creating graphical representations of data.								
CO2	Create, manipulate, and manage data objects in R, as well as efficiently import data from various file formats into their R environment.								
CO3	Develop the skills necessary to perform a variety of data analysis tasks using R, including data exploration, cleaning, transformation, and visualization.								
CO4	compute and interpret descriptive statistics such as measures of central tendency, variability, and correlation coefficients using R.								
CO5	Understand the principles behind one-sample tests, two-sample tests, goodness-of-fit tests, as well as parametric and non-parametric tests.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
Practical	1. Introduction to R - A programming language and environment for data analysis and graphics, 2. Data objects, Importing data files, 3. Performing data analysis tasks, 4. Computing descriptive statistics, 5. One sample tests, two sample tests, 6. Goodness of fit tests, 7. Parametric test and Non-Parametric test	30	To learn different aspects of statistical analysis for research work				1, 2, 3, 4		

**REFERENCE BOOKS:**

**R1.** Gupta S. C. Fundamentals of Applied Statistics. 4<sup>th</sup> edition. Sultan Chand & Sons, 2014.

**R2.** Jeyapriya S P. Statistical Methods in Biology. 1<sup>st</sup> edition. LAP Lambert Academic Publishing, 2020.

**R3.** Banerjee B. Mahajan's Methods in Biostatistics for Medical Students and Research Workers. 9<sup>th</sup> edition. Jaypee Brothers Medical Publishers; 2018.

**OTHER LEARNING RESOURCES:**

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6153617/>

## RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Gain proficiency in using R as a programming language and environment for performing data analysis tasks and creating graphical representations of data.	1,2
2	Create, manipulate, and manage data objects in R, as well as efficiently import data from various file formats into their R environment.	1,2
3	Develop the skills necessary to perform a variety of data analysis tasks using R, including data exploration, cleaning, transformation, and visualization.	1,2
4	compute and interpret descriptive statistics such as measures of central tendency, variability, and correlation coefficients using R.	1,2
5	Understand the principles behind one-sample tests, two-sample tests, goodness-of-fit tests, as well as parametric and non-parametric tests.	1,2

SEMESTER –VI									
Course Title	Fermentation Technology and Industrial Microbiology								
Course code	22BSMB321R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ VI semester of third year of the programme								
Course Objectives	1.The objective of this paper is to familiarize the students with the concept of fermentation processes & the use of different microorganisms in industries. 2. To teach the students about the different industrial products produced by microorganisms								
CO1	Understand bioreactors and their various types, enabling them to apply this knowledge in diverse bioprocessing scenarios.								
CO2	Understand different types fermentation processes, empowering them to make informed decisions in biotechnological applications.								
CO3	Students will be well versed with fermentation media, inoculum preparation, Scale up Processes and with the various downstream processes of fermentation industries								
CO4	Students will be well versed with the screening techniques, Microbial assays, Primary & Secondary metabolites.								
CO5	Understand the production process of different types of fermentation product.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Design of a basic fermenter, bioreactor. Configuration, design features, individual parts, baffles, impellers, foam separators, sparger, culture vessel, cooling and heating devices	5	To understand the structure of a fermenter and different parts of fermenter					1,2	
II	<b>Growth of cultures in the fermenter-types</b> -batch, continuous and fed batch, importance of media in fermentation, media formulation and modification	5	Students will be able to learn about the Different types fermentation processes					1,2	
III	<b>Biomass separation on by centrifugation</b> , filtration flocculation and other recent developments. Cell disintegration, extraction, purification by different methods, drying and crystallization	5	The students will know about different methods of biomass separation. Students will know about the different methods of Cell disintegration					1,2	
IV	<b>Isolation, selection and improvement of microbial cultures:</b> Screening and isolation of microorganisms, primary and secondary metabolites, preservation of cultures After strain improvement programme Immobilization of cells and enzymes-Principle, Method of mobilization and its applications	7	Students will be able to understand the different methods of isolation and preservation of industrially important microorganisms Students will					1,2	
V	<b>Production of pharmaceuticals:</b> Antibiotics(penicillin), hormones(humulin), vaccines (Hepatitis B), VitaminB12 Production of organic acids: Acetic Acid, Citric Acid, Lactic Acid Production of Amino acids: Lysine, Glutamic Acid Production of Enzymes: Protease, Amylase	8	Students will be able to discuss the different products produced by microorganisms					1,2	

	Production of Fuels: Ethanol, Methanol Mushroom Cultivation and Wine production			
<b>Practical</b>	1. Preparation of Saurkraut 2. Role of yeast in bread making 3. Wine preparation 4. Vinegar production 5. Production of mushroom 6. Citric acid estimation 7. Production of fermented milk products	<b>30</b>	Gain expertise in preparing and analyzing various fermented foods and beverages, including sauerkraut, bread, wine, vinegar, mushrooms, and fermented milk products, as well as estimating citric acid content.	1,2, 3,4

**TEXT BOOKS:**

T1. Stanbury P. F., A. Whitaker, S. J. Hall, Principles of Fermentation Technology  
Publisher: Butterworth-Heinemann

T2. Shuler M. L. and F. Kargi: Bioprocess Engineering Basic Concepts by Publisher  
Prentice Hall

**REFERENC EBOOKS:**

R1. Prescott and Dunn's Industrial Microbiology, Publisher: Gerald Reed: Books

R2. W. Crueger and A. Crueger: Biotechnology. A textbook of Industrial Microbiology,  
Publisher: Sinauer Associates.

**OTHERLEARNINGRESOURCES:**

<https://microbenotes.com/>

[www.youtube.com](http://www.youtube.com)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand bioreactors and their various types, enabling them to apply this knowledge in diverse bioprocessing scenarios.	1,2,3
2	Understand different types fermentation processes, empowering them to make informed decisions in biotechnological applications.	1,2,3
3	Students will be well versed with fermentation media, inoculum preparation, Scale up Processes and with the various downstream processes of fermentation industries	1,2,3
4	Students will be well versed with the screening techniques, Microbial assays, Primary & Secondary metabolites.	1,2,3
5	Understand the production process of different types of fermentation product.	1,2,3

SEMESTER – VI									
Course Title	Research Methodology, Bio-Ethics and IPR								
Course code	22BSMB322R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 60T	4	0	0	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ VI semester of third year of the programme								
Course Objectives	1. To teach the basics of research objectives, design, methodology and analysis. 2. To prepare the students for various filed of research. 3. To explain the students about IPR and various ways of its violation and Protection a long with the laws and regulations associated with the process. 4. To learn various moral and ethical issues associated with research; medical biotechnology in particular. 5. To teach them about various conventions and their resolutions.								
CO1	To impart scientific bent of mind among the students.								
CO2	To recognize importance of biosafety practices and guidelines in research								
CO3	To impart good scientific ethics in them.								
CO4	To improve thesis/dissertation/article etc. writing skills.								
CO5	Explain moral and ethical issues associated with researches including various conventions								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	Introduction to Research Methods and Methodology-Format of thesis and dissertation, Research article, Reviews, Monographs, Bibliography, Literature search, Significance of research, Research methods versus methodology, Research and Scientific methods, Defining their search Problem and Research design. Scientific Methods, Hypotheses Generation and Evaluation, Various Steps in Scientific Research, Types of Research; Research Purposes-Research Design-Survey Research- Case Study Research.	12	Knowledge about methods of research and literature survey					1,2	
II	Data Collection and Sampling Design- Sources of Data: Primary Data, Secondary Data; Procedure Questionnaire- Survey and Experiments-Design of Survey and Experiments- Sampling Merits and Demerits- Control Observations-Procedures- Sampling Errors.	12	Knowledge about data collection					1,2	
III	Introduction to Intellectual Property –Concept of Intellectual Property, Patents etc, Kinds of Intellectual Property, Economic importance of Intellectual Property. International Scenario: Introduction to the leading international instruments concerning intellectual property rights: the Berne Convention, Universal Copyright Convention, the Paris Convention, TRIPS, the World Intellectual Property Rights Organization (WIPO) and the UNESCO	12	Importance and applications of property rights, different organizations protecting copyright.					1,2	

<b>IV</b>	An Introduction to Trademarks and Geographical Indications- Registration of Trademarks and Rights of Registered trademark owners, Concept of Appellations of Origin, Indication of Source and geographical Indication	<b>12</b>	Knowledge about trade mark and other important resources	1,2
<b>V</b>	Bio-ethics Purpose and scope, Principles, Medical ethics, Perspectives and methodology, Moral and ethical issues in Microbiology	<b>12</b>	Application of ethical issues in different fields	1,2

**TEXT BOOKS:**

T1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa Prakashan, 2006.

**REFERENCE BOOKS:**

R1. Bendat and Piersol, Random data: Analysis and Measurement Procedures, Wiley Interscience, 2001.

R2. Shumway and Stoffer, Time Series Analysis and its Applications, Springer, 2000.

R3. Jenkins, G.M., and Watts, D.G., Spectral Analysis and its Applications, Holden Day, 1986.

R4. W.R. Cornish, Intellectual Property, Sweet & Maxwell, London (2000)

R5. Kerly's Law of Trade Marks and Trade Names, 14th Edition, Thomson, Sweet & Maxwell.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	To impart scientific bent of mind among the students.	1,2,3
<b>2</b>	To recognize importance of biosafety practices and guidelines in research	1,2,3
<b>3</b>	To impart good scientific ethics in them.	1,2,3
<b>4</b>	To improve thesis/dissertation/article etc. writing skills.	1,2,3
<b>5</b>	Explain moral and ethical issues associated with researches including various conventions	1,2,3

SEMESTER – VI									
Course Title	Research Project II								
Course code	22BSMB323R	Total credits: 5	L	T	P	S	R	O/F	C
		Total hours: 30R	0	0	0	0	30	0	5
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Microbiology								
Semester	Spring/ VI semester of third year of the programme								
Course Objectives	1. Apply experimental methods to solve a given scientific task, 2. Collect data for evaluation and for statistical treatment, if relevant, 3. Use relevant scientific literature. 4. Compile data								
CO1	Develop a research proposal, formulating research questions, reviewing literature, interpreting data, and understanding the implications of research findings.								
CO2	Develop skills in crafting a concise and well-structured research proposal.								
CO3	Learn to formulate research questions, objectives, and hypotheses.								
CO4	Conduct a focused review of relevant literature related to the chosen mini research topic.								
CO5	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	Introduction, Comprehension on research search engines, Selection of Topic		10	To learn about methods of research				1,2	
II	Tools for reference citation, Different methods for writing citation and references, Introduction to structure of Review and specific features of review, Plagiarism, ethical issue in writing the review, Mapping and selection of Journal of specific knowledge of discipline and submission for publications		20	To harness ideas on data collection and interpretation				1,2	

**REFERENCE BOOKS:**

**R1.** "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches" by John W. Creswell and J. David Creswell

**R2.** "The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams

**R3.** "Research Methodology: A Step-by-Step Guide for Beginners" by Ranjit Kumar.

**OTHER LEARNING RESOURCES:**

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5037944/>



## RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Develop a research proposal, formulating research questions, reviewing literature, interpreting data, and understanding the implications of research findings.	1,2,3
<b>2</b>	Develop skills in crafting a concise and well-structured research proposal.	1,2,3
<b>3</b>	Learn to formulate research questions, objectives, and hypotheses.	1,2,3
<b>4</b>	Conduct a focused review of relevant literature related to the chosen mini research topic.	1,2,3
<b>5</b>	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.	1,2,3



# Assam down town University

## Curriculum and Syllabus

### Bachelor of Science in Food Nutrition and Dietetics



OUTCOME BASED EDUCATION FRAMEWORK

CHOICE BASED CREDIT SYSTEM

Version: 2.0

**FACULTY OF SCIENCE**

July, 2022

# Preamble

Assam down town University is a premier higher educational institution which offers Bachelor, Master, and Ph.D. degree programmes across various faculties. These programmes, collectively embodies the vision and mission of the university. In keeping with the vision of evolutionary changes taking place in the educational landscape of the country, the university has restructured the course curriculum as per the guidelines of National Education Policy 2020. This document contains outline of teaching and learning framework and complete detailing of the courses. This document is a guidebook for the students to choose desired courses for completing the programme and to be eligible for the degree. This volume also includes the prescribed literature, study materials, texts, and reference books under different courses as guidance for the students to follow.

Recommended by the 22<sup>nd</sup> Board of Studies (BoS) meeting of the Faculty of Science held on dated 22/06/2022 and approved by the Emergent Academic Council (AC) meeting held on dated 30/07/2022



*Chairperson  
Board of Studies*



*Member Secretary  
Academic Council*



## ***Vision***

To become a Globally Recognized University from North Eastern Region of India, Dedicated to the Holistic Development of Students and Making Society Better

## ***Missions***

1. Creation of curricula that address the local, regional, national, and international needs of graduates, providing them with diverse and well-rounded education.
2. Build a diverse student body from various socio-economic backgrounds, provide exceptional value-based education, and foster holistic personal development, strong academic careers, and confidence.
3. Achieve high placement success by offering students skill-based, innovative education and strong industry connections.
4. Become the premier destination of young people, desirous of becoming future professional leaders through multidisciplinary learning and serving society better.
5. Create a highly inspiring intellectual environment for exceptional learners, empowering them to aspire to join internationally acclaimed institutions and contribute to global efforts in addressing critical issues, such as sustainable development, Climate mitigation and fostering a conflict-free global society.
6. To be renowned for creating new knowledge through high quality interdisciplinary research for betterment of society.
7. Become a key hub for the growth and excellence of AdtU's stakeholders including educators, researchers and innovators
8. Adapt to the evolving needs and changing realities of our students and community by incorporating national and global perspectives, while ensuring our actions are in harmony with our foundational values and objectives of serving the community.

# Programme Details

## Programme Overview:

B.Sc. in Food Nutrition and Dietetics is a 3-year undergraduate programme which deals with offers a wide range of courses covering various basic and applied areas of nutritional sciences. The student develops an aptitude and scientific temperament to apply the technical skills in various important areas of Nutrition and Food such as Food Science, Nutritional biochemistry, Food Microbiology, Clinical Nutrition, Food Technology and Food Science. The course also offers various techno specific skills, universal ethics and elective courses considering overall development and employability scopes in research, industry and teaching sectors. The course duration is for a period of 3 years.

### I. Specific Features of the Curriculum:

- Experiential learning
- Constructivist approach to learn
- Practical and project-based learning

### Eligibility Criteria: (To be aligned with the admission office)

Minimum 45% in 10+2 with English, Biology & Chemistry 5% relaxation for SC/ST, EWS, and Specially abled candidates.

### II. Program Educational Objectives (PEOs):

- PEO 1-AdtU nutrition and dietetics graduates will be well-prepared for successful careers in industry, institution and/ or government sectors in one or more relevant disciplines/ subdisciplines.
- PEO 2-The nutrition and dietetics graduates will be academically prepared to become diet counsellor/ certified dieticians for evaluating nutritional status to improve health.
- PEO 3-AdtU nutrition and dietetics graduates will actively participate in professional endeavours to elevate personal standing while concurrently making impactful contributions to the profession and society, achieving success in higher education within specific or interdisciplinary domains if pursued.

### III. Program Specific Outcomes (PSOs):

- PSO 1 Techno-Professional Ability: Demonstrate a comprehensive understanding of multidisciplinary concepts of food nutrition and dietetics with an interdisciplinary approach to address nutritional challenges.
- PSO 2 Outreach Competency: Fostering outreach competency for creating awareness in society through nutrition education and intervention for better public health.

- PSO 3 Global Proficiency: Exhibit global competency to excel in the profession through international certification courses

**Program Outcome:**

- PO 1-Disciplinary Knowledge: Apply the knowledge of food science and dietetics principles, human biology, biochemistry, microbiology and fundamentals of functional foods for better human health. Develop diet for specific health conditions
- PO 2- Problem-Solving: Identify, assess, analyze and plan an appropriate diet for specific health conditions.
- PO 3-Communication: Effectively communicate to provide diet counselling, and personalized diet plans, conveying specialized nutritional knowledge to the individuals and community at large.
- PO 4-Professional Ethics and Values: Comply with human values and ethics and its strict application in the profession.
- PO 5-Research-In-Practice: Foster evidence-based advancements in nutritional science and dietary practices to address emerging challenges and improve public health.
- PO 6-Food Formulation: Formulation and standardization of food products for value addition applying interdisciplinary knowledge.
- PO 7-Individual and Teamwork: Function efficiently as an individual or a member/leader in multidisciplinary teams.
- PO 8- Lifelong learning: Ability to engage in independent lifelong learning in the broadest context of lifestyle, healthcare and technological advancement.

**Total Credits to be Earned: 125**

**IV. Career Prospects:**

B.Sc. in Food Nutrition and Dietetics offers a range of dynamic career opportunities. Graduates can work in research and development, hospitals, and food processing industries. Roles include nutritionist, quality control analysts, and clinical researchers. Opportunities also exist in academia and education, where graduates can contribute to scientific knowledge and train future professionals.

## EVALUATION METHODS

The student performance shall be evaluated through In-semester (Sessional) and semester-end examinations. A weightage of 40% or as prescribed by the programme shall be added to the score of the end-semester examination.

### A. INTERNAL ASSESSMENT:

The teacher who offers the course shall be responsible for internal assessment by conducting in-semester (sessional) examination and evaluating the performance of the students pursuing that course. The components for internal assessment are illustrated in the table given below.

SN	Components/ Examinations	Marks Allotted
1.	In-Sem Exam – I (ISE-I) (Written Examination)*	30
2.	In-Sem Exam – II (ISE-II) (Written Examination)*	30
3.	Assignment	10
4.	Presentation (SP)	10
5.	Quiz	5
6.	Class Performance based score*	5

*\*are compulsory*

**Note:** Total Internal assessment should be out of 40

### INSTRUCTION

1. If a student fails to appear in the any of the component without any valid reason he/she shall be marked zero in that component. However, the course teacher at his discretion may arrange for the missed test on an alternate date for the absentee students after determining ground with genuine/valid reasons for the absent.
2. The report of evaluation of an activity towards the in-semester (sessional) component of a course shall be duly notified by the concerned course teacher within a week of completion.

3. The program coordinators should upload the in-semester marks to the ERP and forward acknowledgement of all the courses of the program to the Controller of Examinations before the start of the End-semester examination.

## **B. SEMESTER END EXAMINATION:**

Time table for end semester examination is published at least 25 days prior to the start of Examination.

### **I. Pre-Examination:**

#### **Eligibility Criteria for a student to appear in University Examinations:**

The student shall only be allowed to appear in a University Examination, if:

- i) He/ She is a registered student of the University;
- ii) He/ She is of good conduct and character;
- iii) He/ She has completed the prescribed Programme of study with minimum percentage of attendance as laid down in the Regulations of the Programme concerned.

Under special cases, a student may be allowed to appear for an examination without being registered in the University but the result of the said student will be kept on hold till the registration of the concerned student is completed.

### **II. Admit Card:**

Admit card for the examination may be downloaded through ERP where the system will generate a Unique ID Cards through online.

The University shall have the right to cancel admission for examination of any candidate on valid grounds.

### **III. Pattern of Question Papers:**

The question paper shall follow the principles of Bloom's Taxonomy.

Table

<b>S. N.</b>	<b>Level</b>	<b>Questions /verbs for test</b>
1	Remember	List, Define, tell, describe, recite, recall, identify, show who, when, where, etc.
2	Understand	Describe, explain, contrast, summarize, differentiate, discuss, etc.
3	Apply	Predict, apply, solve, illustrate, determine, examine, modify
4	Analyze	Classify, outline, categorize, analyze, diagrams, illustrate, infer, etc.



5	Evaluate	Assess, summarize, choose, evaluate, recommend, justify, compare etc.
6	Create	Design, Formulate, Modify, Develop, integrate, etc.

**Note:** No course is to be evaluated on basis of **all 6 knowledge levels**.

The format of the question paper across all the program follow a unique pattern and the total marks is 60

**Table 1: Question paper pattern for End semester examination**

Sl no	Question pattern	Total marks
1	MCQs (10 Questions)	10
2	2 Marks questions (10 Questions)	20
3	4 Marks questions (5 Questions)	20
4	10 Marks questions (1 Question)	10

#### **IV. Examination Duration:**

Each paper of 60 marks shall ordinarily be of two hours duration.

#### **V. Practical Examinations, Viva-Voce etc.:**

- i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.
- ii) Viva-Voce, Oral examinations of the Project report, Dissertation etc. shall be undertaken by a Board of Examiners constituted by the respective Dean of Program with the advice of Supervisor(s).

#### **VI. Procedure of Expulsion:**

If any candidate is found to be using any unfair-means during the examination, the invigilator may cease his/her answer sheet and report it directly to the Officer-in-Charge. The Office-in-Charge of the center may take appropriate decisions as per the rules and procedure of the examination. The Officer-in-Charge may allow the students to write the exam with new answer sheet or may expel the student from appearing the paper depending on the nature of unfair-means. In case of Computer based test, the students may be directed to write an apology letter and sign in the prescribe expulsion form. The student may not be allowed to write that examination.

## **VII. Instruction to the Students:**

- (i) The students shall not bring to the Examination Hall, any electronic gadget used as a means of communication or record except electronic calculator, if required.
- (ii) The students shall not receive any book or printed or hand written or photo copy (Xerox) or blank-paper from any other person while he/she is in the examination-room or in laboratory or in any other place to which he/she is allowed to have access during course of examination.
- (iii) The students shall not communicate with any other candidate in the examination room or with any other person in and outside the examination-room.
- (iv) The students shall not see, read or copy anything written by any other candidate, nor shall he/she knowingly or negligently permit any other candidate to see, read or copy anything written by him/her or conveyed by him/her.
- (v) The students shall not write anything on the Question Paper or in other paper or materials during the examination, or pass any kind of paper to any other candidate in the examination-room, or to any person outside the room.
- (vi) The students shall not disclose his/her identity to the examiner by writing his/her name or putting any sign / symbol in any part of his answer-script.
- (vii) The students shall not use any abusive language or write any objectionable remark or make any appeal to examiner by writing in any part of his answer-script.
- (viii) The students shall not detach any page from the answer-script or insert any authorized or unauthorized loose sheet into it. He /she shall also not insert any other answer-script / loose sheet by removing the pins of the origin answer-scripts and re-fixing it.
- (ix) The students shall not resort to any disorderly conduct inside the examination-room or misbehave with the invigilator or any other examination official.

## **VIII. Provision for an Amanuensis (writer):**

- (i) A candidate may be provided with an Amanuensis (writer) to write down on dictation on his / her behalf on ground of his / her physical disability to write down by himself / herself due to accident or any other reason. The amanuensis may be provided till he / she recovers from the physical disability. The physical disability to write down by himself / herself must be supported by Medical Certificate from a competent Medical Officer.
- (ii) The qualifications of the amanuensis so provided must not be equal or higher than that of the candidate. This is also to be supported by Certificate from the Faculty of Study where the Amanuensis is provided.
- (iii) Such candidates are to be accommodated in a separate room under the supervision of an invigilator so that the fellow candidates are not disturbed in the process.

## **C. Credit Point:**

It is the product of grade point and number of credits for a course, thus,  $CP = GP \times CR$

### **i. Credit:**

A unit by which the course work is measured. It determines the number of hours of instructions required per week. 'Credit' refers to the weightage given to a course, usually in terms of the number of instructional hours per week assigned to it. Credits assigned for a single course always pay attention to how many hours it would take for an average learner to complete a single course successfully.

### **ii. Grade Point:**

Grade Point is a numerical weight allotted to each Grade Letter on a 10-point scale.

### **iii. Letter Grade:**

Letter Grade is an index of the performance of students in a said paper of a particular course. Grades are denoted by letters O, A+, A, B+, B, C, P, F and Abs. Student obtaining Grade F / Grade Abs shall be considered failed/ absent and, will be required to appear in the subsequent ESE. The UGC recommends a 10-point grading system with the following (Table: 1) Letter Grades:

- (i) A Letter Grade shall signify the level of qualitative/quantitative academic achievement of a student in a Course, while the Grade Point shall indicate the numerical weight of the Letter Grade on a 10-point scale.
- (ii) There shall be 08 (eight) Letter Grades bearing specific Grade Points as listed in Table 1, where the Letter Grades 'O' to 'P' shall indicate successful completion of a course.
- (iii) Apart from the 08 (eight) regular Letter Grades listed in Table 1, there shall be 03 (three) additional Letter Grades, which shall be awarded if a Course is withdrawn or spanned over the next Semester or remains incomplete as stated in Table 2.

**Table 2: Letter Grades and Grade Points**

<b>Letter Grade</b>	<b>Grade Points</b>	<b>Description</b>
O	10	Outstanding
A+	9	Excellent
A	8	Very Good
B+	7	Good
B	6	Above Average
C	5	Average
P	4	Pass
F	0	Fail
Abs	0	Absent
UFM	0	Unfair Means

#### iv. Grade Point Average:

##### a. SGPA (Semester Grade Point Average)

The SGPA of a student in a Semester shall be the weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered in that Semester, irrespective of whether he/she could or could not complete the Courses. More specifically, the calculation of SGPA shall take into account the Courses graded with Letter Grades 'O' to 'F' as given in Table 1.

$$SGPA = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i} \quad (1.1)$$

The SGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.1) up to two decimal places, where n is the total number of Credit Courses registered by the student in that Semester,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  registered Course and  $C_i$  is the Credit (weight) of that Course.

##### b. CGPA (Cumulative Grade Point Average)

(i) The CGPA of a student in a Semester of a Programme shall be the accumulated weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered and successfully completed so far starting from the enrollment in the Programme. In other words, taking into account all the Courses graded with 'O' to 'P' as given in Table 1.1, generally the CGPA of a student shall be calculated starting from the first Semester of his/her enrolled Programme, while the CGPA of a lateral-entry student shall be calculated starting from the Semester of his/her enrollment.

(ii) The CGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.2) up to two decimal places, where N is the total number of Credit Courses registered and successfully completed so far by the student,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  completed Course and  $C_i$  is the Credit (weight) of that Course.

$$CGPA = \frac{\sum_{i=1}^N C_i G_i}{\sum_{i=1}^N C_i} \quad (1.2)$$

(iii) The CGPA shall be convertible into equivalent percentage of marks using Equation Conversion of CGPA to percentage marks: = CGPA\*10

## **D. Post-Examination**

### **i. Transcript or Grade Card or Certificate:**

A marking certificate shall be issued to all the registered students after every Semester. The Semester mark sheet will display the course details (code, title, number of credits, grade secured) along with total credit earned in that Semester.

### **ii. Grievance Readdress Mechanism:**

Students with any dissatisfaction or grievance regarding the marks awarded in any of the Papers / Courses may appeal to the Controller of Examinations for remedial action such as Re-evaluation within 10 days of the declaration of result.

- (i) A student has options to appeal for re-evaluation of his /her answer script to the Controller of Examination.
- (ii) Application for re-evaluation / re-scrutiny of answer scripts shall be made in the definite proforma available with the Examination Office through the head of the respective departments within 10 days of declaration of the results of the respective examinations.
- (iii) The Controller of Examination may appoint an examiner for re-evaluation and will consider and recognize the evaluation done by a University appointed examiner.
- (iv) There shall be no provision for re-evaluation of the Practical Papers, Project Work, and Dissertation etc. However, the students fail in practical examination or viva voce and wish to appear again may apply to be evaluated can do so with the next schedule.
- (v) After screening the application for re-evaluation, the CoE may send the answer scripts of the student to the examiners appointed by the CoE with the approval of Vice Chancellor.
- (vi) The marks/grades achieved by the students after the re-evaluation shall be final and binding.
- (vii) Fresh Marks – sheets / Grade Card shall be issued only if the candidate secures pass marks / passing grade in the re-evaluated paper.
- (viii) Revaluation of answer scripts shall be deemed to be an additional facility provided to the students with a view to improving upon their results at the preceding examination result for any reason whatsoever shall not confer any right upon them for admission to next higher class which matters always be regulated in accordance with the relevant rules or regulations framed by the University.
- (ix) If as a result of revaluation of the candidate attracts the provision of condonation of deficiency, the same may be applied to his/her only for fresh attempt.

# INSTRUCTION TO TEACHERS AND STUDENTS

## (Teaching and Learning Methods)

In all the courses the teacher has to select topics for teacher-method which should not be less than 20 percent. The approach will be direct classroom teaching through a series of lectures delivering concepts using ITC facilities, white or blackboard. Notes may also be circulated to the students; however, the students are to be involved in the preparation of the notes. The teacher will be responsible for selecting the best note for circulation. The teacher-centric methodology has recently fallen out of favour because this strategy for teaching is seen to favour passive students.

### **1. Student- centric / Constructivist Approach:**

The topics of the courses may be selected at the start of the class and assigned one topic to each of the students for studying by themselves, prepare presentations, notes, etc., and present at respective class time after consultation and discussion with the course teachers. The teacher facilitates the learning of the students by guiding and providing input and explaining concepts. 60 percent of the course contents may be selected for this purpose. To avoid behaviour problems, teachers must lay a lot of groundwork in student-centric classrooms. Typically, it involves instilling a sense of responsibility in students. In addition, students must learn internal motivation.

**a. Project-Based Learning:** The teacher may select 5 percent of topics for the purpose and may conduct visits to the laboratory for experiments or field surveys. The selection of the topic may be done considering the available facility for the purpose. However, in the final semester of each of the programme the student has to undergo project-based learning at least 4 months duration. This approach will help the student to think critically, evaluate, analyze, make decisions, collaborate, and more.

**b. Inquiry-Based Learning:** The teacher/ students are supposed to list at least five questions in each contact hour and student solve these question or search for answer which becomes the home work for the students “question-driven” learning approach. The teacher may look for the correctness of the solution or the best possible answer and discuss in the successive class. This will help in the preparation for various competitive examination and develop a habit for search for solutions.

**c. Flipped Classroom:** About 10 percent of the course content has to be completed by this method. In this approach the students are asked to watch video or lecture prepared by the teacher or any video available (relevant to the course). A set of questions may be given to the students for searching answers by the students. The idea is that students should have more time in-classroom focusing on achieving these higher levels of thinking and learning. The Flipped classroom is also an acronym. The letters FLIP represent the four pillars included in this type of learning: Flexible environment, Learning culture shift, Intentional content, and Professional educator. As you can see, the second pillar refers to a culture shift from the traditional approach where students are more passive to an approach where students are active participants. As a result, this approach is also a student-centric teaching method.

**d. Cooperative Learning:** The remaining five percent has to be completed by cooperative learning approach. In this approach, the students are allotted problems. During library hours the students along with the teacher visit the library and search for probable solutions for the assigned problem. The same has to be done in groups so that the students discuss among themselves for the appropriate answers. Essentially, cooperative learning believes that social interactions can improve learning. In addition, the approach recreates real-world work situations in which collaboration and cooperation are required.

**The percentage categorization for the completion of a theory course**

Teacher-centric or Direct Classroom Teaching: Delivery by series of lectures	20%
Student-centric Approach, Students present and deliver lectures in the presence of teacher and supervised by teacher	60%
Students visit fields or perform experiments or teachers perform demonstration	05%
Flipped Classroom approach	10%
Cooperative learning approach	05%

**Inquiry-based approach has to be followed in all of the classes**

The teacher has to distribute the topics to be considered for teaching by the above-mentioned approaches and prepare a lesson plan for execution and maintain a file.

## Curriculum Framework

### Breakdown of Credits

Sl. No	Category	Total number of Credits
1	University Core (UC)	8
2	University Elective (UE)	21
3	Program Core (PC)	93
4	Program Elective (PE)	0
5	Faculty Elective (FE)	8
<b>Total number of credit</b>		<b>125</b>

### Breakdown by categories of courses

Sl no	Category	Credits	%
1	Science	110	88
2	Paramedical	6	4.8
3	Engineering	3	2.4
4	Commerce and Management	6	4.8
<b>Total</b>		<b>125</b>	<b>100%</b>

**PCI, INC, AICTE regulated programs shall have to follow the regulating body**



### SEMESTER WISE COURSE DISTRIBUTION

	S. No.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			Total
					L	T	P	S	R	O		IA*	SEE*	PE*	
<b>Semester I</b>	1.	22BSFD111R	Basics of Food Science	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22BSFD112R	Human Nutrition	PC	3	0	0	0	0	0	3	40	60	0	100
	3	22BSFD113R	Nutrition through life cycle	PC	3	0	0	0	0	0	3	40	60	0	100
	4	22BSFD114R	Basics of human physiology	PC	3	0	0	0	0	0	3	40	60	0	100
	5	22UBPD113R	PDP 1 (Introductory English)	UE	0	0	4	0	0	0	2	0	0	100	100
	6	22UBEC111R	Extra-Curricular	UC	0	0	0	4	0	0	1	100	0	0	100
	<b>Total</b>					<b>12</b>	<b>0</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>16</b>			
<b>Semester II</b>	1.	22BSFD121R	Food Sanitation & Hygeine	PC	3	0	0	0	0	0	3	40	60	0	100
	2	22BSFD122R	Applied Food Science	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSFD123R	Food Preservation	PC	3	0	2	0	0	0	4	40	60	100	200
	4	22BSFD124R	Adv. Human Physiology	PC	3	0	0	0	0	0	3	40	60	0	100
	5	22BSFD125R	Techno-Professional Skills I (Techniques of preservation)	PC	0	0	2	0	0	0	1	0	0	100	100
	6	22BSFD126R	EVS	UE	2	0	0	0	0	0	2	0	0	100	100
	7	22SFD127R	MOOCS CE I	FE	0	0	4	0	0	0	2	0	100	0	100
	8	22UBCC121	Co-Curricular (Non-CGPA)	UC	0	0	0	0	4	0	1	0	0	0	100
	9	22UBEC121	Extra-Curricular (Non-CGPA)	UC	0	0	0	0	4	0	1	0	0	0	100
	10	22UBPD123R	PDP II	UE	0	0	4	0	0	0	2	0	0	100	100
	11	22UUDL103R	Computational systems and Digital World	UE	0	0	2	0	0	0	1	0	0	0	100
	<b>Total</b>					<b>14</b>	<b>0</b>	<b>14</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>24</b>			
<b>Semester III</b>	1.	22BSFD211R	Institutional Food Service Management	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22BSFD212R	Food Technology	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSFD213R	Nutritional Biochemistry	PC	3	0	2	0	0	0	4	40	60	100	200
	4	22BSFD214R	Food Microbiology	PC	3	0	2	0	0	0	4	40	60	100	200

5	22BSFD215R	Techno-Professional Skills II(Bakery Science)	PC	0	0	4	0	0	0	2	0	0	100	100
6	22UBPD213R	PDP III	UE	2	0	0	0	0	0	2	0	0	100	100
7	22UBCC211	Co-Curricular	UC	0	0	4	0	0	0	1	0	0	100	100
8	22UUHV101R	UHV+ Professional Ethics	UC	0	0	2	0	0	0	1	0	0	100	100
9	22UBEC211	Extra-Curricular	UC	1	0	0	0	0	1	1	0	100	0	100
10	22BSFD216R	Generic Elective	UE	0	0	0	0	0	0	1	0	100	0	100
11	22UUFL202R	Personal Financial Planning	UE	0	0	2	0	0	0	1	0	0	100	100
12	22UULS202R	Basic Life Saving Skills (BLSS)	UE	0	0	2	0	0	0	1	0	0	100	100
<b>Total</b>				15	0	20	0	0	0	26				1600

S. N.	Course Code	Course Title	Course Category	Engagement							C	Maximum Marks for			Total
				L	T	P	S	R	O	IA*		SEE*	PE*		
1.	22BSFD221R	Adv. Food Technology	PC	2	0	0	0	0	0	4	40	60	100	200	
2	22BSFD222R	Basic Dietetics	PC	3	0	2	0	0	0	4	40	60	100	200	
3	22BSFD223R	Community Nutrition	PC	2	0	0	0	0	0	4	40	60	100	200	
4	22BSFD225R	Community Experience Learning (CEL)	PC	0	0	2	0	0	0	1	0	0	100	100	
5	22UBPD223R	PDP IV Campus to Corporate	UE	0	0	1	2	0	0	1	0	0	100	100	
6	22UBCC221	Co-Curricular	UC	0	0	0	0	0	4	1	0	0	100	100	
7	22UBEC221	Extra-Curricular	UC	0	0	0	0	0	0	1	0	100	0	100	
8	22BSCE221R	MOOCS CE II	FE	0	0	2	0	0	0	2	0	0	100	100	
9	22BSFD226R	Generic Elective	UE	0	0	0	2	0	0	2	0	0	100	100	
10	22UULS201R	Basic Acclimatizing Skills (BAS)	UE	1	0	0	0	0	0	1	0	0	100	100	
<b>Total</b>										21				1300	

  

S. N.	Course Code	Course Title	Course Category	Engagement							C	Maximum Marks for			Total
				L	T	P	S	R	O	IA*		SEE*	PE*		
1.	22BSFD311R	Adv. Dietetics & Counseling	PC	3	0	2	0	0	0	4	40	60	100	200	
2	22BSFD312R	Food Product Development	PC	3	0	2	0	0	0	4	40	60	100	200	
3	22BSFD313R	Entrepreneurship Development	PC	3	0	2	0	0	0	3	40	60	0	100	
4	22BSFD314R	Diet Counseling and Patient Care	PC	0	0	1	2	0	0	1	0	0	100	100	
5	22BSFD315R	Research Project Part I	PC	0	0	2	4	0	8	2	0	0	100	100	
6	22BSFD316R	MOOCS CE III	FE	3	0	2	0	0	0	2	0	0	100	100	
7	22BSFD317R	45 Days Internship (Hospital/Food)	PC	2	0	0	0	0	0	6	0	0	100	100	

		<b>Total</b>										22				<b>900</b>
<b>Semester VI</b>	<b>S. N.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Course Category</b>	<b>Engagement</b>							<b>Maximum Marks for</b>				
					<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O</b>	<b>C</b>	<b>IA*</b>	<b>SEE*</b>	<b>PE*</b>	<b>Total</b>	
	1.	22BSFD321R	Geriatric And Pediatric Nutrition	PC	4	0	0	0	0	0	2	40	60	0	100	
	2	22BSFD322R	45 Days Internship (Hospital/Food Industries)	PC	0	0	0	0	36	0	6	0	0	100	100	
	3	22BSFD323R	Research Project	PC	0	0	4	0	0	0	6	0	100	0	100	
	4	22BSFD3224R	MOOCS CE IV	FE	0	0	0	0	0	0	2	0	100	0	100	
<b>Total</b>										<b>16</b>				<b>400</b>		

**\*IA: Internal Assessment, SEE: Semester End Examination,  
PE: Practical Examination**

**SEMESTER – I**

<b>SEMESTER – I</b>									
<b>Course Title</b>	<b>BASIC OF FOOD SCIENCE</b>								
<b>Course code</b>	<b>22BSFD111R</b>	<b>Total credits: 4</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
			<b>3</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>B.Sc. Food, Nutrition &amp; Dietetics</b>								
<b>Semester</b>	<b>1<sup>st</sup> Semester, 1<sup>st</sup> Year</b>								
<b>Course Objectives</b>	1. To introduce the students the basics of nutrition. 2. To study the basic food groups, cooking methods in details. 3. To learn the new concept of food science.								
<b>CO1</b>	Discuss the fundamentals of food and nutrition and cooking methods.								
<b>CO2</b>	Explain the structure, composition and nutritive value of cereals and starch								
<b>CO3</b>	Explain the nutritional aspect, selection, preparation, and application of pulses, nuts and oilseeds and its toxic constituents								
<b>CO4</b>	Explain the nutritional importance, storage and cooking techniques and changes during cooking of vegetables and fruits								
<b>CO5</b>	Summarize the culinary role, nutritive value of sugar, fats and oil and the key processes like caramelization, hydrolysis and crystallization.								
<b>Unit-No.</b>	<b>Content</b>	<b>Contact Hour</b>	<b>Learning Outcome</b>				<b>KL</b>		
<b>I</b>	<b>Food Groups:</b> Definition, classification of food according to origin and functions, functions of food groups, need for grouping foods, ICMR five food groups, balanced diet. <b>Methods of Cooking:</b> Objectives / reasons & advantage of cooking, different cooking media, different cooking methods, merits and demerits of different cooking methods, their effect on nutrients	<b>10</b>	To make them understand the difference between the foodgroups  Cooking activities for students can confidence and skills that can prepare them for a lifetime of healthy habits.				1,2		
<b>II</b>	<b>Cereals:</b> Structure, composition, nutritive value of cereals, storage and care, breakfast cereals, Characteristics of starch, use in variety of preparations selection	<b>9</b>	Learning about cereals and composition				1,2		
<b>III</b>	<b>Pulses, Nuts &amp; Oilseeds:</b> Chemical composition, Selection and variety, use in variety of preparation, nutritional aspects and cost, effect of cooking & storage on nutritive value of pulses, nuts & oilseeds, Nutritive value of commonly used nuts & oilseeds in our diet, Highlighting soyabeans, Toxic constituents of pulses, Lathyrism.	<b>10</b>	To learn about the nutritional composition, antinutritional factor and their health benefits.				1,2		
<b>IV</b>	<b>Vegetables &amp; Fruits-</b> Classification, composition & nutritive value, importance in human nutrition, storage, cooking of vegetables, changes in vegetables and fruits on cooking, effects of heat, acids & alkali	<b>8</b>	Learning the difference between vegetable and their health benefits				1,2		
<b>V</b>	<b>Fats &amp; Oils-</b> Nutritive values, types of fats & oils, role of fat in cookery. <b>Sugar and Related Products:</b> Nutritive value, Properties, characteristics & uses, sugar cookery, Form of sugar and liquid sweetness, Caramelization, Hydrolysis, Crystallization.	<b>9</b>	Learning the importance of fat & oil and sugar in diet and chemical reactions.				1,2		
<b>Practical</b>	1. Prepare a recipe from each food group 2. Determination of hundred grain weight 3. Determination of moisture content	<b>12</b>	Learning and analyzing the importance of recipe of different food groups				1,2, 3,4		

of legumes and oilseeds. 4. Analyse the ph of different fruit juices by titration method 5. Study about different extraction process of oils	Understanding the weight and portion size of different grains	1,2,3,4
	Learning and analyzing the moisture content of pulses	1,2,3,4
	Analyzing the pH content of juices	1,2,3,4
	Learning and analyzing the different extraction process of oil	1,2,3,4

### TEXT BOOKS:

**T1: Norman N. Potter and Joseph H. Hotchkiss**, Food Science, CBS publishers and distributors, Fifth edition, 2000

**T2: Manay Shakunthala, N and Shadaksharaswamy M.** Foods facts and Principles, New Age International (P) Ltd Publishers, 4<sup>th</sup> edition 2020.

### REFERENCE BOOKS:

**R1: Srilakshmi B.** Food Science, New Age International (P) Ltd Publishers, 7<sup>th</sup> edition, 2018.

**R2: Rangana (2017)** Manual Analysis of Fruits and Vegetables Product. Tata McGraw Hill Co. Ltd., New Delhi.

### OTHER LEARNING RESOURCES:

<https://ugcmocs.inflibnet.ac.in/assets/uploads/1/319/13821/et/20200430121204043333.pdf>

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Discuss the fundamentals of food and nutrition and cooking methods.	1,8
2	Explain the structure, composition and nutritive value of cereals and starch	1,2,8
3	Explain the nutritional aspect, selection, preparation, and application of pulses, nuts and oilseeds and its toxic constituents	1,2,8
4	Explain the nutritional importance, storage and cooking techniques and changes during cooking of vegetables and fruits	1,2,8
5	Summarize the culinary role, nutritive value of sugar, fats and oil and the key processes like caramelization, hydrolysis and crystallization.	1,2,6,8

SEMESTER – I									
Course Title	HUMAN NUTRITION								
Course code	22BSFD112R	Total credits: 3 Total hours:	L	T	P	S	R	O/F	C
			3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	1 <sup>st</sup> Semester ' 1 <sup>st</sup> Year								
Course Objectives (Minimum 3)	1. To introduce the students the basics of nutrition, importance of food. 2. To understand the functions, digestion, absorption, sources of nutrients								
CO1	Learn the basic terms related to nutrition and its correlation with human health.								
CO2	Discuss the requirement of energy and the importance of carbohydrate								
CO3	Discuss the classification, function and requirement of protein in human health								
CO4	Explain the classification, function and requirement of fat in human health								
CO5	Analyze the physiological role of vitamin,mineral and water in human health, effect of deficiency and excess.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Food, Nutrition and Health:</b> Basic definitions, function of food, classification of food according to function and nutritive value, physiological, psychological and social function of food, history of nutrition and importance of food and nutrition in day today life. <b>Recommended Dietary Allowances:</b> Definition, biological value, bioavailability, Minimal and optimal Nutritional Requirements, Formulation of RDA and Dietary Guidelines- Reference Man and Reference women, factors affecting RDA.		8	Understand the relation of food and health				1,2	
II	<b>Energy:</b> Energy Balance, Assessment of Energy Requirements, Deficiency and Excess. <b>Carbohydrates:</b> Definition, classification and function. Digestion and absorption, glycemic index, dietary fiber and its importance, RDA, sources, metabolic disorder associated with carbohydrate.		12	To understand the requirement of energy and importance of CHO				1,2	
III	<b>Protein:</b> Definition, classification and function, Assessment of protein quality (BV, PER, NPU), digestion and absorption, RDA, sources, disorders due to deficiency or excess.		12	To understand the classification, composition and requirement of protein				1,2	
IV	<b>Fat:</b> Definition, classification and functions, digestion and absorption, Types of fatty acids, role and nutritional significance (SFA, MUFA, PUFA, omega-3). RDA, sources, disorders due to deficiency or excess, dietary fat and coronary heart disease.		10	To understand the classification, composition and requirement of fat				1,2	
V	<b>Vitamins:</b> Physiological role, Bio-availability and requirements, sources, deficiency and excess (Fat soluble and water soluble) <b>Minerals:</b> Physiological role, bio-availability and requirements, sources, Deficiency and Excess (Calcium, Phosphorus, Magnesium, Iron, Fluoride, Zinc, Iodine)		8	To understand the classification n, composition and requirement of Vitamins and minerals and learn the importance of water in healthy lifestyle.				1,2	

	<b>Water:</b> Distribution of water in the body, function of water, requirements and human water balance system, acid base balance			
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**TEXT BOOKS:**

**T1: Sumathi R. Mudambi, Rajagopal, M.V.,** Fundamentals of Foods and Nutrition, New Age International (P) Ltd, Publishers, 6<sup>th</sup> edition, 2020.

**REFERENCE BOOKS:**

**R1: Bamji, M. S.,** Textbook of Human Nutrition, Oxford, IBH Publishing (P) Ltd, 4<sup>th</sup> edition 2019.

**R2: Srilakshmi, B.** Nutrition Science, New Age International (P) Ltd, Publishers 7<sup>th</sup> edition (2017).

**OTHER LEARNING RESOURCES:**

<https://www.ahfesproject.com/app/uploads/2021/10/P3-M2-Human-Nutrition-and-Dietary-Needs.-PDF.pdf>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Learn the basic terms related to nutrition and its correlation with human health.	1,8
<b>2</b>	Discuss the requirement of energy and the importance of carbohydrate	1,2,8
<b>3</b>	Discuss the classification, function and requirement of protein in human health	1, 2,8
<b>4</b>	Explain the classification, function and requirement of fat in human health	1, 2,8
<b>5</b>	Analyze the physiological role of vitamin,mineral and water in human health, effect of deficiency and excess.	1,2,8

SEMESTER I									
Course Title	NUTRITION THROUGH LIFECYCLE								
Course code	22BSFD113R	Total credits: 3 Total hours:	L	T	P	S	R	O/F	C
			3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	1 <sup>st</sup> Semester · 1 <sup>st</sup> Year								
Course Objectives (Minimum 3)	<ul style="list-style-type: none"> <li>To understand the physiological stages of different age groups.</li> <li>To understand the nutritional requirements in different age groups.</li> <li>To plan menu based on the requirements of various age groups.</li> </ul>								
CO1	Learn the concept of balanced diet and meal planning								
CO2	Discuss the physiology and dietary requirements during pregnancy and lactation.								
CO3	Discuss the nutritional requirements during infancy and school-going children								
CO4	Describe the physiological changes in the nutritional needs of adolescents and adults								
CO5	Gain knowledge on changes during various stages of growth and development throughout lifecycle.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Balance diet and meal planning:</b> Definition, importance of balance diet for different age groups, important guide lines to be followed while planning a balance diet, Food Pyramid, Principles and steps involved in meal planning, factors influence meal planning, food groups.		8	To know about the balance diet and its requirement.				1,2	
II	<b>Nutrition in pregnancy and lactation:</b> Pregnancy- Physiological stages of pregnancy, nutrition requirements and Complications of pregnancy. Lactation- Physiology of lactation, role of hormones, nutritional requirements. Meal planning for pregnant and lactating women		10	To learn the changes and nutritional requirement during pregnancy and lactation				1,2	
III	<b>Nutrition during infancy:</b> Infancy- Growth and development, nutritional requirements, breast feeding, weaning, infant formula. Introduction of supplementary foods, weaning foods. Meal planning for infants. <b>Nutritional needs during childhood:</b> Early childhood (Toddlers and Preschoolers) - growth spurt, nutrient needs, nutritional related problems, feeding Pattern and problems School children- Nutritional requirements, Importance of snacks, school lunch. Meal planning for children		14	To learn the nutritional requirement during infancy and childhood				1,2	
IV	<b>Nutrition adolescence:</b> Physiological and psychological changes, body image, growth, nutrient need, food choice, eating habits, factors influencing needs and eating disorders. Meal planning for adolescents <b>Nutritional needs during adulthood:</b> Importance of balance diet, nutritional demands according to the level of activity		12	To learn the physical and hormonal changes and nutritional requirement				1,2	



	patterns. Meal planning for adults			
V	<b>Nutritional needs during old age:</b> Process of ageing, common health problems during old age, and dietary modifications specially reference to consistency of the food. Meal planning for old age peoples.	<b>10</b>	To learn the nutritional requirement during old age	<b>1,2</b>

**TEXT BOOKS:**

T1: Robinson C. H., Lawer M. R., Chenoweth. WIC., and Garwich A. E., Normal and Therapeutic Nutrition, McMillan Publishers Co., Newyork, 17th Edition,1990.

**REFERENCE BOOKS:**

R1: Srilakshmi. B., Dietetics, 7th edition, Willey Eastern Ltd., New Delhi, 2014.

**OTHER LEARNING RESOURCES:**

[https://www.researchgate.net/publication/367340201\\_Balanced\\_Diet#:~:text=A%20balanced%20meal%20would%20incorporate,role%20of%20foods%20is%20used](https://www.researchgate.net/publication/367340201_Balanced_Diet#:~:text=A%20balanced%20meal%20would%20incorporate,role%20of%20foods%20is%20used).

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Learn the concept of balanced diet and meal planning	<b>1</b>
<b>2</b>	Discuss the physiology and dietary requirements during pregnancy and lactation.	<b>1</b>
<b>3</b>	Discuss the nutritional requirements during infancy and school-going children	<b>1</b>
<b>4</b>	Describe the physiological changes in the nutritional needs of adolescents and adults	<b>1</b>
<b>5</b>	Gain knowledge on changes during various stages of growth and development throughout lifecycle.	<b>1,8</b>

SEMESTER I									
Course Title	BASIC OF HUMAN PHYSIOLOGY								
Course code	22BSFD112R	Total credits: 3 Total hours:	L	T	P	S	R	O/F	C
			3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	1 <sup>st</sup> Semester ' 1 <sup>st</sup> Year								
Course Objectives (Minimum 3)	1. To introduce the students the basics of human physiology. 2. To understand how the various body organs perform in day today basis.								
CO1	Understand the basics of human physiology.								
CO2	Understand the functioning of the various parts of the body.								
CO3	Evaluate the activity of the body functions.								
CO4	Relate the Physiology of the human body with Food and Nutritional requirement.								
CO5	Recognize the Clinical Symptoms of Nutritional Deficiencies based on anatomical considerations								
Unit- No.	Content		Contact Hour	Learning Outcome					K L
I	<b>General Physiology:</b> Organization of human body, cell structure and organelle, Tissues and functions.		6	To learn and understand the working of human body system					
II	<b>Blood:</b> Blood volume and body fluids, Composition and functions of blood, Structure and formation and function of RBC, WBC and platelets, Haemoglobin, Plasma, blood coagulation, Blood groups		8	To learn and understand the composition and structure of blood					
III	<b>Digestive System:</b> General introduction, organizational plan of digestive system, Movement of G.I. Tract and functions of various components, Composition, functions and regulation of salivary, gastric, pancreatic, intestinal and biliary secretion, Functions of liver, Gall bladder and pancreas, Digestion and absorption of carbohydrate, protein and fat.		15	To learn and understand the digestion of food, role of enzyme and glands					
IV	<b>Respiratory System:</b> General organization, Mechanics of respiration, Regulation of respiration, Gaseous exchange in lung and tissues, Pulmonary ventilation, volumes and capacities, Effect of exercise on respiration, hypoxia.		15	To learn and understand the working of respiratory system					
V	<b>Cardio vascular system:</b> General organization, structure and properties of cardiac muscles, Cardiac output, cardiac cycle, conducting system of heart, Heart sounds, regulation of H.R., pulse, blood pressure and its regulation, Systemic circulation, pulmonary circulation and coronary circulation, ECG, cardio respiratory changes during exercise.		10	To learn and understand the complete physiology of cardiac system					

**TEXT BOOKS:**

T1: **Meyer B J, Meij H S and Meyer A C.**, Human Physiology, AITBS Publishers and Distributors, Third Edition, 2004.

T2: **Wilson, K. J. W and Waugh, A.: Ross and Wilson**, Anatomy and Physiology in Health and Illness, Fourteenth Edition, Churchill Livingstone, 2022.

#### REFERENCE BOOKS:

R1: **Ranganathan, T.S.:** A Textbook of Human Anatomy, Chand & Co.N.Delhi, Second Edition, 2018.

R2: **Jain, A. K.,** Textbook of Physiology, Vol. I and II, Avichal Publishing Co., NewDelhi, Seventh Edition, 2017.

R3: **Chatterjee C. C.:** Human Physiology, Vol. I & II, Medical Allied Agency, Guyton, A. G. and Hall, Fourteenth Edition, 2022

#### OTHER LEARNING RESOURCES:

[https://www.researchgate.net/publication/367340201\\_Balanced\\_Diet#:~:text=A%20balanced%20meal%20would%20incorporate,role%20of%20foods%20is%20used.](https://www.researchgate.net/publication/367340201_Balanced_Diet#:~:text=A%20balanced%20meal%20would%20incorporate,role%20of%20foods%20is%20used.)

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand the basics of human physiology.	1,8
2	Understand the functioning of the various parts of the body.	1,8
3	Evaluate the activity of the body functions.	1,8
4	Relate the Physiology of the human body with Food and Nutritional requirement.	1,8
5	Recognize the Clinical Symptoms of Nutritional Deficiencies based on anatomical considerations	1,8

SEMESTER – I									
Course Title	Introductory English (Communicative English & Soft Skills)								
Course code	22UBPD113R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To recognize and identify parts of a sentence and their significance in a language.</li> <li>To enhance listening and speaking/skills for self-development.</li> <li>To give insight into English pronunciation and into central concepts in phonetics.</li> <li>Introduction to the various modes of communication will enhance their knowledge of communication.</li> </ol>								
CO1	Able to recognize the structure of a sentence and its variations as they learn to understand, speak and write.								
CO2	Illustrate the concept of Phonetics and its importance will improve the learners' pronunciation								
CO3	Explain the Knowledge of communication will be enhanced through practical examples								
CO4	Able to identify to pick and form different kinds of sentences.								
Unit- No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Grammar</b> Parts of Speech; Articles; Auxiliary Verbs; Affirmative and Negative Sentences		10	Students will demonstrate a fundamental understanding of grammar rules.				1,2	
II	<b>Grammar</b> Determiners; Sentence Construction; Types of Sentences (Assertive, Imperative etc.); Degree of Comparison; Comprehension Exercises		8	Students will construct grammatically correct and varied sentence types.				1,2	
III	<b>Listening Skills</b> What is listening?; The Process of Listening; Factors that adversely affect Listening; Difference between Listening and Hearing; Purpose and Importance of Effective Listening; How to Improve Listening Process?		10	Students will confidently introduce themselves and engage in basic conversations with correct pronunciation.				1,2	
IV	<b>Speaking Skills</b> Introducing yourself; Self-discovery; Basics of Phonetics and pronunciation; Extempore speech; Video Recording for Self Reflection		10	Students will effectively communicate in both formal and informal settings.				1,2	
V	<b>Communication Skills</b> Introduction to Communication; Importance of Communication Skills; Purpose of Communication; Types of Communication; Formal and informal communication; Importance of Communication; Barriers to Communication; How to improve/ tips to improve Communication skills? Responding to different questions in various situations(formal/informal)		10	Students will demonstrate a fundamental understanding of communication skills				1,2	

#### REFERENCE BOOKS:

R1: Quirk, Randolp. (2010) A Comprehensive Grammar of the English Language Randolph Quirk, Sidney Greenbaum, Pearson Education India

R2: Marks, Jonathan. (2017) IELTS Advantage Speaking and Listening Skills: A step-by- stepguide to a high IELTS speaking and listening score. Book + CD-ROM, Delta Publishing byKle

#### OTHER LEARNING RESOURCES:

<https://www.ef.com/wwen/english-resources/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES:**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Able to recognize the structure of a sentence and its variations as they learn to understand, speak and write.	1, 7
2	Illustrate the concept of Phonetics and its importance will improve the learners' pronunciation	1, 7
3	Explain the Knowledge of communication will be enhanced through practical examples	1, 7
4	Able to identify to pick and form different kinds of sentences.	1, 7

SEMESTER – I									
Course Title	Co-Curricular Activities								
Course code	23UBEC111	Total credits: 1 Total hours: 60	L	T	P	S	R	O/F	C
			0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To ascertain physical and mental development of the students and select best performers for state, national and international level competition.</li> <li>To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.</li> </ol>								
CO1	Students will learn to work well with others and communicate better.								
CO2	Students will learn to manage their time and stay organized.								
CO3	Students will enhance their creative abilities and think more critically.								
CO4	Students will improve their overall health and reduce stress.								
CO5	Students will become more aware of their role in society and contribute positively.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<p>Co-curricular activities cover a wide range of experiences and pursuits that complement academic learning. They are typically organized and managed within educational institutions or communities and play a crucial role in holistic development. Some examples are</p> <ol style="list-style-type: none"> <li>Sports and Physical Activities</li> <li>Cultural Activities:</li> <li>Academic Clubs and Competitions</li> <li>Community Service and Volunteering</li> <li>Leadership and Personal Development</li> <li>Creative and Hobby-based Activities</li> </ol>	60	<ol style="list-style-type: none"> <li><b>Skill Development:</b> Enhancing skills such as teamwork, leadership, communication, and critical thinking.</li> <li><b>Holistic Growth:</b> Supporting emotional, social, and physical development alongside academic learning.</li> <li><b>Building Networks:</b> Creating opportunities to interact with peers, mentors, and professionals.</li> <li><b>Personal Fulfillment:</b> Providing avenues for creativity, self-expression, and exploring personal interests.</li> </ol>				1,2		

#### REFERENCE BOOKS:

R1: "Co-curricular Activities: A Pathway to Careers" by Ferguson.

R2: "Rahman, S.R., Islam, M.A., Akash, P.P., Parvin, M., Moon, N.N. and Nur, F.N., 2021. Effects of co-curricular activities on student's academic performance by machine learning. *Current Research in Behavioral Sciences*, 2, p.100057.

#### OTHER LEARNING RESOURCES:

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will learn to work well with others and communicate better.	6,7
2	Students will learn to manage their time and stay organized.	6,7
3	Students will enhance their creative abilities and think more critically.	6,7
4	Students will improve their overall health and reduce stress.	6,7
5	Students will become more aware of their role in society and contribute positively.	6,7

SEMESTER – I									
Course Title	Extra-Curricular Activities								
Course code	23UBEC121	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To ascertain physical and mental development of the students and select best performers for state, national and international level competition.</li> <li>To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.</li> </ol>								
CO1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.								
CO2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.								
CO3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.								
Unit- No.	Content	Contact Hour	Learning Outcome	KL					
I	Based on the learner's interest they can participate in various sports, music, and co-curricular activities joining the clubs of the University (Football, Footshal; Cricket; Swimming; Basket ball; Badminton; Table Tennis; athletics and other outdoor and indoor games; Dance; Music; Vocals; Photography; Drama; Literary activities); The students are encouraged to participate in regular club activities, workshops, competitions as per their interest and hobbies; Renowned skilled professionals/ personalities are invited organising workshops to promote the talents of the students.	60	Participation in university clubs across sports, music, and extra-curricular activities cultivates diverse skills and personal growth. Students develop teamwork, leadership, and creativity through sports like football, cricket, and athletics. Musical pursuits and dance foster self-expression and coordination, while literary and drama activities enhance communication and critical thinking. Workshops led by skilled professionals provide industry insights and mentorship opportunities, preparing students for future challenges. By encouraging participation based on interests and hobbies, universities nurture well-rounded individuals who excel academically and socially,	1,2					



			equipped with practical skills and a broadened perspective on cultural diversity and personal fulfilment.	
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**REFERENCE BOOKS:**

R1: "Extracurricular Activities: Essential Guides for Students" by John G. Gabriel

R2: "Developing Personal, Social and Emotional Skills through Extra-Curricular Activities" by Sally Bailey

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.	6,7
2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.	6,7
3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.	6,7

SEMESTER – II									
Course Title	FOOD SANITATION AND HYGEINE								
Course code	22BSFD121R	Total credits: 3 Total hours:	L	T	P	S	R	O/F	C
			3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	2 <sup>nd</sup> Sem, 1 <sup>st</sup> Year								
Course Objectives (Minimum 3)	1. To know about hygiene and sanitation. 2. To know about Sources of contamination and protection against contamination. 3. To know the importance of personnel hygiene in prevention of disease transmission								
CO1	Understand personal and environmental hygiene.								
CO2	Learn the methods of inhibiting contamination and waste management.								
CO3	Apply the importance of good hygiene in Food service management.								
CO4	Evaluate the significance of food hygiene								
CO5	Learn about the importance of personnel hygiene in prevention of disease transmission								
Unit- No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Sanitation</b> -Definition and meaning. Microbial growth pattern and factors affecting microbial proliferation. Assessment of microbial load-Total plate count technique, press plate technique, indicator or dye reduction test.		8	To learn the importance of hygiene and sanitation				1,2,3	
II	<b>Contamination</b> -Sources of contamination and Protection against contamination, adulteration <b>Methods of killing microorganism</b> -Use of heat, chemicals and radiation. <b>Methods of inhibiting microbial growth</b> -Use of refrigeration, chemicals, dehydration and fermentation.		10	To learn the Different types of contaminants and contamination and their hazard				1,2,3	
III	<b>Cleaning compounds</b> -Characteristics of good cleaning compound, classification and selection of cleaning compound. <b>Sanitizers</b> -Thermal sanitizing and chemical sanitizing. <b>Food service sanitation</b> - Cleaning steps, cleaning of equipments, mechanized cleaning and sanitizing.		10	To learn the and understand the application of hygiene and sanitation in different sectors				1,2,3	
IV	<b>Waste disposal</b> - Disposal of solid waste; Wastewater handling: Pretreatment, primary treatment, secondary treatment, tertiary treatment and disinfection.		10	To learn the proper waste disposal and treatments				1,2,3	
V	<b>Personnel hygiene</b> -Meaning and importance; Hygienic practices of employees; personal hygiene and contamination of food products; methods of disease transmission		8	To learn about the importance of personal hygiene and its effect on health				1,2,3	

#### REFERENCE BOOKS:

R1: Roday, S. **Food Hygiene & Sanitation**. Tata McGraw-Hill Education, Second Edition, 2017

**OTHER LEARNING RESOURCES:**

[https://ec.europa.eu/programmes/erasmus-plus/project-result-content/908fceb3-6d8d-43a0-bc76-d780aeb1a13b/Hygiene-Sanitation-Handbook\\_ENG.pdf](https://ec.europa.eu/programmes/erasmus-plus/project-result-content/908fceb3-6d8d-43a0-bc76-d780aeb1a13b/Hygiene-Sanitation-Handbook_ENG.pdf)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand personal and environmental hygiene.	<b>1,8</b>
<b>2</b>	Understand methods of inhibiting contamination and waste management.	<b>1,8</b>
<b>3</b>	Apply the importance of good hygiene in Food service management.	<b>1,8</b>
<b>4</b>	Evaluate the significance of food hygiene	<b>1,8</b>
<b>5</b>	Learn different types of menu planning	<b>1,8</b>

SEMESTER – II									
Course Title	APPLIED FOOD SCIENCE								
Course code	22BSFD122R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours:	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	2 <sup>nd</sup>								
Course Objectives	<ol style="list-style-type: none"> <li>To introduce the students the details of food groups.</li> <li>To study the structure and nutritional composition of meat products</li> <li>To learn the health benefits of Spices and Condiments and their use in Indian recipe</li> </ol>								
CO1	Understand composition & nutritional importance of milk and milk products								
CO2	Understand Structure, composition, nutritive value of egg								
CO3	Learn and understand the different kinds of meats are used to eat								
CO4	Learn the proper storage method of poultry and fish								
CO5	Understand the importance of Spices and Condiments and apply the knowledge in food preparations.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	<b>Milk &amp; Milk Products:</b> Composition & nutritive value, properties and effect of heat, nutritional importance	6	To learn the nutritional composition of different milk	1,2					
II	<b>Egg-</b> Structure, composition, nutritive value, tasting of freshness in eggs, uses of egg in food preparation, storage of egg <b>Baking -</b> Types of bake products & its nutritive value.	10	To learn the structure and nutritional composition of egg. To understand the importance Of bakery	1,2					
III	<b>Meat:</b> Sources of edible meat, composition & nutritive value, selection of meat, postmortem changes, changes on cooking, storage, factors effecting tenderness of meat	14	To learn and understand the different kinds of meats are used to eat.	1,2					
IV	<b>Poultry &amp; Fish:</b> Composition & nutritive value, selection and storage, indication of freshness	10	To learn the proper storage method of poultry and fish	1,2					
V	<b>Spices and Condiments:</b> Types, uses in Indian recipe <b>Health foods:</b> Functional foods, Prebiotics, Probiotics, Nutraceuticals, Organic foods, GM foods <b>Beverages:</b> Coffee,tea,andcocoa,processing compositionandpreparation	9	To learn the use of different spices and their role in, culinary and human system, to know and understand the nutraceuticals and importance and preparation of beverages	1,2					
VI Practical	Experimental cooking on milk	4	Learning and analyzing the change of milk with the effect of heat						
	Experimental cooking on egg	2	Learning and analyzing the change of egg with the effect of heat						
	Experimental cooking on meat, fish and poultry.	8	Learning and analyzing the change of during the cooking.						
	Development of health beverages.	6	Learn to develop healthy beverage for different condition.						

	Effect of use of spices and condiments in food.	2	Learning And analyzing the change of flavor aroma and taste of food and its Beneficial effect	
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#### REFERENCE BOOKS:

**R1: Manay Shakunthala, N and Shadaksharaswamy M.** Foods facts and Principles, New Age International (P) Ltd Publishers, Reprint, Fifth Edition, 2020.

**R2: Srilakshmi B.** Food Science, New Age International (P) Ltd Publishers, Seventh edition, 2018.

**R3: Norman N. Potter and Joseph H. Hotchkiss,** Food Science, CBS Publishers and Distributors, Fifth Edition, 2007.

#### OTHER LEARNING RESOURCES:

[https://www.researchgate.net/publication/278785108\\_Composition\\_and\\_nutritional\\_value\\_of\\_raw\\_milk#:~:text=Milk%20is%20a%20considerable%20resource,%2C%20vitamins%2C%20and%20dissolved%20gases](https://www.researchgate.net/publication/278785108_Composition_and_nutritional_value_of_raw_milk#:~:text=Milk%20is%20a%20considerable%20resource,%2C%20vitamins%2C%20and%20dissolved%20gases)

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand composition & nutritional importance of milk and milk products	1,2
2	Understand Structure, composition, nutritive value of egg	1,2
3	Learn and understand the different kinds of meats are used to eat	1,2
4	Learn the proper storage method of poultry and fish	1,2
5	Understand the importance of Spices and Condiments and apply the knowledge in food preparations.	1,2

SEMESTER – II									
Course Title	FOOD PRESERVATION								
Course code	22BSFD123R	Total credits: 4 Total hours:	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	II								
Course Objectives (Minimum 3)	1. To understand importance and need of preservation. 2. To understand principles and process of preservation. 3. To understand different preservation methods.								
CO1	Learn and discuss different preservation techniques and methods in India								
CO2	Provide knowledge on principles and methods of preservation								
CO3	Analyze various canning methods and their effects on the nutritional aspects of food.								
CO4	Describe the processing of Vegetables.								
CO5	Explain the fruit processing methods, focusing on fruit beverages, jam, jelly, marmalade, preserves, candies.								
Unit- No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Introduction to preservation:</b> History of Food Preservation. Scope of Food and Vegetable Preservation in India.	8	To learn and understand the chronology of food processing and preservation				1,2		
II	<b>Principles and methods of preservation:</b> Food Spoilage, Principles of preservation, Methods of preservation: Pasteurization, sterilization, blanching, canning, drying, refrigeration.	10	To learn the different preservation method and its principal				1,2		
III	<b>Canning of fruits and vegetables:</b> Canning: Introduction, can manufacture, canning process, selection of fruits and vegetables, grading, washing, peeling, cutting, blanching, cooling, filling, exhausting, sealing, processing, cooling and storage; types of canning pressure canning and water bath canning, common causes of spoilage in canning of foods.	12	To learn the different process of preservation applicable in fruits and vegetable				1,2		
IV	<b>Processing of vegetables:</b> Pickling, chutneys and Sauces/ketchups, mushroom processing, potato processing, Some other Valuable Products from vegetables.	10	To learn the processing and development of preserved product of vegetable				1,2		
V	<b>Processing of fruits:</b> Fruit Beverages, Jam, Jelly and Marmalade, Preserve, Candied and Crystallized Fruits, Some other Valuable Products from Fruits	12	To learn the processing and development of preserved product of fruits				1,2		
VI Practical	Pickling of fruits and vegetables	4	Learning and application of fruits and vegetable preservation				1,2,3,4		
	Pickling of meat and fish	4	Learning and application of meat and fish				1,2,3,4		
	Preparation of chutneys	2	Learning and application of post harvest technique				1,2,3,4		
	Preparation of Sauces/ketchups	2	Learning and application and development of product				1,2,3,4		

	Preparation of jam and jellies	2	Learning and application of postharvest technique of fruits	1,2,3,4
	Preparation of squash, RTS etc.	4	Application and development of beverages	1,2,3,4

**TEXT BOOKS:**

T1: Desrosier, N. W. and Desrosier, J. N. (1987). The Technology of Food Preservation. CBS Publishers and Distributors, New Delhi

**REFERENCE BOOKS:**

R1: Srivastava, R. P. and Kumar, S. (1998). Fruit and Vegetable preservation –Principles and practices. CBS Publishers and Distributors, New Delhi

**OTHER LEARNING RESOURCES:**

<https://actascientific.com/ASNH/pdf/ASNH-03-0529.pdf>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Learn and discuss different preservation techniques and methods in India	1,8
2	Provide knowledge on principles and methods of preservation	1,2,6,8
3	Analyze various canning methods and their effects on the nutritional aspects of food.	1,2,6
4	Describe the processing of Vegetables.	1,6
5	Explain the fruit processing methods, focusing on fruit beverages, jam, jelly, marmalade, preserves, candies.	1,6

SEMESTER – II									
Course Title	ADVANCE HUMAN PHYSIOLOGY								
Course code	22BSFD124R	Total credits: 3 Total hours:	L	T	P	S	R	O/F	C
			3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	II								
Course Objectives (Minimum 3)	1. To introduce the students the basics of human physiology. 2. To understand how the various body organs perform in day today basis.								
CO1	Understand the structure and function of key endocrine glands and the hormones they produce.								
CO2	Understand the human excretory system and its crucial role in maintaining overall health.								
CO3	Comprehend the study of human reproductive system, focusing on key aspects of both male and female biology								
CO4	Interpret about the interaction of nervous systems to yield integrated physiological responses in human body.								
CO5	Learn the function of Lymphatic system and immunological system								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Endocrine system:</b> Structure and hormones of endocrine glands, pituitary, thyroid, parathyroid, Pancreas, Adrenal, testes and ovary, Functions and regulation of secretion of hormones.	10	To learn about the endocrine gland and hormone					1,2,3	
II	<b>Excretory system:</b> Structure and functions of kidneys, nephron, ureter, urinary bladder and urethra, Urine formation, Renal function tests.	6	To learn about the function of excretory system					1,2,3	
III	<b>Reproductive system:</b> Male and female reproductive organs and changes during puberty, Menstrual cycle, ovulation, Physiological changes during pregnancy, Placenta and placental circulation.	8	To learn about the function of reproductive system and reproduction					1,2,3	
IV	<b>Nervous system and muscle:</b> Organization of nervous system, Structure and function of muscle and nerve cells, Functions of brain, Spinal cord, cranial and spinal nerves, Motor system, Sensory system, ANS, Synapse, neuromuscular transmission reflex arc, reflex action and reflexes, Cerebro spinal fluid	12	To learn about the function of nervous system					1,2,3	
V	<b>Lymphatic and immunological system:</b> Lymph glands and circulation of lymph, Spleen structure and function, Immunity– Formation of T-cells and B-cells, Antigen, Antibody and Immune response	15	To learn about the function of Lymphatic system					1,2,3	

#### TEXT BOOKS:

**T1: Meyer B J, Meij H S and Meyer A C.,** Human Physiology, AITBS Publishers and Distributors, Third Edition, 2004.

**T2: Wilson, K. J. Wand Waugh, A.:** Ross and Wilson, Anatomy and Physiology in Health and Illness, Churchill Livingstone, Fourteenth Edition, 2022.



**REFERENCE BOOKS:**

R1: **Ranganathan, T. S. (2004):** A Textbook of Human Anatomy, Chand & Co.N. Delhi, Second Edition, 2018.

R2: **Jain, A. K.,**Textbook of Physiology, Vol. I and II, Avichal Publishing Co., New Delhi, Seventh Edition, 2017.

R3: **Chatterjee C. C.:** Human Physiology, Vol. I & II, Medical Allied Agency, Calcutta, Fourteenth Edition, 2022.

R4: **Guyton, A. G. and Hall, J. B.:** Text Book of Medical Physiology, Prism Books (Pvt.) Ltd., Bangalore, Fourteenth Edition, 2020.

**OTHER LEARNING RESOURCES:**

<https://www.hopkinsmedicine.org/health/wellness-and-prevention/anatomy-of-the-endocrine-system>

[https://www.researchgate.net/publication/367340201\\_Balanced\\_Diet#:~:text=A%20balanced%20meal%20would%20incorporate.role%20of%20foods%20is%20used.](https://www.researchgate.net/publication/367340201_Balanced_Diet#:~:text=A%20balanced%20meal%20would%20incorporate.role%20of%20foods%20is%20used.)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the structure and function of key endocrine glands and the hormones they produce.	1,8
<b>2</b>	Understand the human excretory system and its crucial role in maintaining overall health.	1,8
<b>3</b>	Comprehend the study of human reproductive system, focusing on key aspects of both male and female biology	1,8
<b>4</b>	Interpret about the interaction of nervous systems to yield integrated physiological responses in human body.	1,8
<b>5</b>	Learn the function of Lymphatic system and immunological system	1,8

SEMESTER – II									
Course Title	TECHNIQUE OF FOOD PRESERVATION								
Course code	22BSFD125R	Total credits: 3 Total hours:	L	T	P	S	R	O/F	C
			2	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	II								
Course Objectives (Minimum 3)	1. To understand importance and need of preservation. 2. To understand principles and process of preservation. 3. To understand different preservation methods.								
CO1	Have the basic knowledge on postharvest handling practices for fruits and vegetables								
CO2	Understand Processing and preservation by different traditional and advance methods								
CO3	Provide complete knowledge of all the chemical additives used in foods and standards								
CO4	Analyze various heat processing methods and their effects on the nutritional aspects of food.								
CO5	Adapt conventional practices and modern technology to arrive at efficient processing.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	<b>Post harvest handling and preparation of foods:</b> Storage and transportation of raw materials. <b>Preparatory operations:</b> cleaning, sorting, grading, size reduction, blanching, sulphiting, minimal processing technology. <b>Heat processing:</b> Pasteurization, sterilization, <b>Canning:</b> unit operations. <b>Retort operation:</b> equipment. Effect of heat processing: nutrients, microorganisms. <b>Low temperature preservation:</b> refrigeration: methods and equipments. Cold storage: requirements, insulation, air circulation, humidity, refrigeration load, controlled atmospheric storage. <b>Use of chemical additives:</b> contaminants, adulterants, additives. <b>Food additives:</b> classification, criteria for selection, GRAS additives, permissible limits, food safety, E-numbers. <b>Preservation by fermentation technology:</b> principles, objectives, types-alcoholic, acetic and lactic fermentations.	18	Learning the postharvest handling	3,4					
II	Blanching and sulphiting of selected fruits, vegetables. Freezing of fruits and vegetables. Drying and Dehydration of fruits and vegetables. Drying foods in tray dryer and fluidized bed dryer, vacuum freeze dryer. Use of food additives in preservation of food products. Preservation of vegetables with vinegar, and pickles. Evaluation of bottled, frozen and dehydrated products. Visit to food industries.	15	Learning the Processing and preservation by different traditional and advance methods	3,4					
III	<b>Post harvest handling and preparation of foods:</b> Storage and transportation of raw materials. <b>Preparatory operations:</b> cleaning, sorting, grading, size reduction, blanching, sulphiting, minimal processing technology. <b>Heat processing:</b> Pasteurization, sterilization,	16	Learning and application of different treatment of sterilization and shelf life technique	3,4					

	<p><b>Canning:</b> unit operations. <b>Retort operation:</b> equipment. Effect of heat processing: nutrients, microorganisms.</p> <p><b>Low temperature preservation:</b> refrigeration: methods and equipments. Cold storage: requirements, insulation, air circulation, humidity, refrigeration load, controlled atmospheric storage.</p> <p><b>Use of chemical additives:</b> contaminants, adulterants, additives. <b>Food additives:</b> classification, criteria for selection, GRAS additives, permissible limits, food safety, E-numbers.</p> <p><b>Preservation by fermentation technology:</b> principles, objectives, types- alcoholic, acetic and lactic fermentations.</p>		
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### TEXT BOOKS:

T1: **Awan, J.A.**, Food processing and preservation. Unitech Communications, Faisalabad, Pakistan, 2011.  
T2: **Awan, J. A. and Rehman, S. U.**, Food preservation manual. Unitech Communications, Faisalabad, Pakistan, 2011.

### REFERENCE BOOKS:

R1: **Rahman, M.S.**, Handbook of food preservation. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA, Second Edition, 2007.  
R2: **Brennan, J G.**, Food processing handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany, Second Edition, 2011.

### OTHER LEARNING RESOURCES:

<https://www.youtube.com/watch?v=BMIUAVhzRuc&list=PLgYHty1vjcGjhmAnec3LVKxnahBRR9aGx>

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Have the basic knowledge on postharvest handling practices for fruits and vegetables	1,2,6,7
2	Understand Processing and preservation by different traditional and advance methods	1,2,6,7
3	Provide complete knowledge of all the chemical additives used in foods and standards	1,2,6,7
4	Analyze various heat processing methods and their effects on the nutritional aspects of food.	1,2,6,7
5	Adapt conventional practices and modern technology to arrive at efficient processing.	1,2,6,7

SEMESTER – II									
Course Title	Environmental Studies								
Course code	22UBES101R	Total credits: 2 Total hours: 30	L	T	P	S	R	O/F	C
			2	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<p>1. To prepare students for careers as leaders in understanding and addressing complex environmental issues from a problem-oriented, interdisciplinary perspective.</p> <p>2. To develop a world population that is aware of and concerned about the environment and its associated problems and which has the knowledge, Skills, attitudes, motivations and commitment to work individually and collectively towards solutions of current problems and prevention of new ones.</p>								
CO1	The students will be able to appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.								
CO2	Students will learn about natural resource, its importance and environmental impacts of Human activities on natural resource								
CO3	Gain knowledge about environment and ecosystem, Students will be able to understand the concept of biodiversity and respect them								
CO4	Gain knowledge about the conservation of biodiversity and its importance.								
CO5	Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.								
Unit- No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Multidisciplinary nature of environmental studies:</b> Definition, scope and importance, Need for public awareness.		4	Environmental studies combines sciences to tackle environmental issues. Its multidisciplinary approach is key to solving complex problems. Public awareness and education are vital for promoting sustainability				1,2	
II	<b>Natural Resources: Renewable and non-renewable resources,</b> Natural resources and associated problems. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral		6	Natural resources, both renewable and non-renewable, face exploitation issues, including deforestation, overuse of water resources, environmental challenges with minerals and food, and land degradation. Individuals play a crucial role in conserving resources and promoting sustainability.				1,2	

	<p>resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.</p> <p>Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles</p>			
<b>III</b>	<p><b>Ecosystems:</b> Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the Following ecosystem: - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)</p>	4	<p>This module covers ecosystems, including their concept, structure, functioning, and diversity. Students will learn about energy flow, ecological succession, and various ecosystem types like forests, grasslands, deserts, and aquatic ecosystems.</p>	1,2
<b>IV</b>	<p><b>Biodiversity and its conservation:</b> Introduction – Definition: genetic, species and ecosystem diversity. Bio-geographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a megadiversity nation• Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.</p>	5	<p>This module covers biodiversity, including its definition, value, levels, and threats. Students will learn about India's bio-geographical classification, its status as a megadiversity nation, and key biodiversity hotspots. They'll also explore threats like habitat loss, wildlife poaching, and human-wildlife conflicts, crucial for conservation efforts.</p>	1,2
<b>V</b>	<p><b>Environmental Pollution:</b> Definition Cause, effects and control measures of:- Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste, Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.</p>	5	<p>This module covers environmental pollution, including causes, effects, and control measures, alongside waste management and disaster preparedness strategies.</p>	1,2

	Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.			
<b>VI</b>	<p><b>Social Issues and the Environment:</b> From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case Studies.</p> <p><b>Environmental ethics:</b> Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Waste land reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.</p>	6	This module explores social-environmental dynamics, including urban energy challenges, water conservation, and resettlement issues. It delves into environmental ethics, climate change impacts, and relevant legislation like the Environment Protection Act, emphasizing public awareness and enforcement challenges.	1,2
<b>VII</b>	<p><b>Human Population and the Environment:</b> Population growth, variation among nations. Population explosion – Family Welfare Programme. Environment and human health. Human Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies.</p>	4	This module covers human population dynamics, including growth, impact on the environment and health, along with initiatives like Family Welfare Programs and the role of information technology, illustrated with case studies.	1,2
<b>VIII</b>	<p><b>Field work:</b> Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Visit to a local polluted site- Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)</p>	5	Fieldwork objectives include documenting environmental assets like rivers and forests, assessing pollution in urban or rural sites, and studying local biodiversity and ecosystems such as ponds and hill slopes	1,2

#### REFERENCE BOOKS:

- R1. Bharucha. Textbook of Environmental Studies for Undergraduate Courses. 2nd edition. Orient Black swan Publishing; 2019.
- R2 Trivedy Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media(R). B.S. Publications; 2010.

**OTHER LEARNING RESOURCES:**

<https://pubmed.ncbi.nlm.nih.gov/22274891/>

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	The students will be able to appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.	<b>1,6,7</b>
<b>2</b>	Students will learn about natural resource, its importance and environmental impacts of Human activities on natural resource	<b>1,6,7</b>
<b>3</b>	Gain knowledge about environment and ecosystem, Students will be able to understand the concept of biodiversity and respect them	<b>1,6,7</b>
<b>4</b>	Gain knowledge about the conservation of biodiversity and its importance.	<b>1,6,7</b>
<b>5</b>	Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.	<b>1,6,7</b>

SEMESTER – II									
Course Title	IMPLICATIVE ENGLISH (Communicative English & Soft Skills)								
Course code	22UBPD123R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	1. To introduce the types of sentences and their significance. 2. To strengthen the vocabulary of the students to enhance student' vocabulary to enhance their speaking and writing skills it the importance of dress codes in various organisations. 3. To introduce the 3P's (Planning, prioritizing & performing) of Time Management.								
CO1	Provide students with the ability to transform sentence types, utilize different tenses, and address common grammatical mistakes.								
CO2	Empower students to proficiently apply one-word substitutions, differentiate between homonyms and homophones, avoid frequently confused words, and incorporate idioms and phrases in their vocabulary.								
CO3	Assist students in comprehending the various aspects and types of listening, and in identifying and overcoming obstacles to effective listening.								
CO4	Facilitate students in employing effective reading strategies, extracting relevant information from texts, and utilizing the SQ3R method.								
CO5	Instruct students on the significance of time management and provide foundational strategies to manage their time efficiently.								
Unit- No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Grammar (flipped classroom)</b> i. Interchange of Interrogative and Assertive Sentences, Exclamatory and Assertive Sentences ii. Types of Tenses iii. Common Errors		6	Students will accurately construct and transform various sentence types and correct grammatical errors.				1,2, 3	
II	<b>Vocabulary Development</b> i. One word substitution ii. Homonyms and Homophones iii. Words often confused iv. Idioms and phrases		6	Students will enhance their vocabulary and use words accurately in context.				1,2, 3	
III	<b>Listening Skills</b> i. What is listening? ii. Types of Listening iii. Understanding Listening Barriers		5	Students will demonstrate effective listening skills and identify listening barriers.				1,2, 3	
IV	<b>Reading Skills</b> i. Techniques of Effective Reading ii. Gathering ideas and information from a text iii. The SQ3R Technique		5	Students will read efficiently and extract relevant information using the SQ3R technique.				1,2, 3	
V	<b>Time-Management Skills</b> i. Introduction to Time Management ii. Purpose and Importance of Time Management iii. Basic Tips to Maintain Time		4	Students will effectively manage their time using various strategies.				1,2, 3	



## RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

### REFERENCE BOOKS:

- R1. Wren, P.C and Martin, H. 1995. High School English Grammar and Composition, S ChandPublishing.
- R2 Barrett, Grant. 2016. Perfect English Grammar: The Indispensible Guide to Excellent Writing and Speaking, ZephyrosPress
- R3. Mccarthy. (2008) English Vocabulary in Use Upper - Intermediate with CD ROM, Cambridge UniversityPress

### OTHER LEARNING RESOURCES:

<https://pubmed.ncbi.nlm.nih.gov/22274891/>

## RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Provide students with the ability to transform sentence types, utilize different tenses, and address common grammatical mistakes.	1,7
2	Empower students to proficiently apply one-word substitutions, differentiate between homonyms and homophones, avoid frequently confused words, and incorporate idioms and phrases in their vocabulary.	1,7
3	Assist students in comprehending the various aspects and types of listening, and in identifying and overcoming obstacles to effective listening.	1,7
4	Facilitate students in employing effective reading strategies, extracting relevant information from texts, and utilizing the SQ3R method.	1,7
5	Instruct students on the significance of time management and provide foundational strategies to manage their time efficiently.	1,7

SEMESTER – II									
Course Title	Computational System and Digital Literacy								
Course code	22UUDLI103R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 30	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>Students will be able to understand the fundamentals of computer systems and Internet search along with advanced features of MS-Office.</li> <li>Students will be able to learn data management, statistical analysis and visualization.</li> <li>Students will be able to use social media and e-commerce portals, Digital Payment systems, and other utility software.</li> </ol>								
CO1	Students will have basic understanding of Computer Systems and Internet search. Products.								
CO2	Students will be able to solve data analysis, management and visualization issues using MS-Office								
CO3	Students will be able to efficiently and ethically use Social Media and e-commerce sites.								
CO4	Students will have introduction to various utility software used in research and information Management.								
Unit- No.	Content							Contact Hour	KL
I	<b>Fundamentals of Computer Systems, Office Automation and Internet Search</b> <ol style="list-style-type: none"> <li>Components of a Computer and their functions.</li> <li>Office Automation using MS-Word, MS-Excel, and MS-PowerPoint.</li> <li>Data management, Statistical Data Analysis and Data Visualization with MS-Excel.</li> <li>Use of Functions, Graphs &amp; Charts in MS-Excel.</li> </ol>							4	1,2
II	<b>Internet &amp; Cyber World</b> <ol style="list-style-type: none"> <li>Introduction to Computer Networks, Internet and World Wide Web, Websites and Web portals.</li> <li>Creation and use of Email Accounts.</li> <li>Web browsing, Web Searching, Different aspects of Web Searching- Search Keywords, conditions and combinations.</li> <li>Study of different Search Engines like Google, Microsoft Bing, Yahoo, Yandex, DuckDuckGo, Ask.Com etc.</li> <li>Cyber Crimes, Cyber Laws and IT Act 2000, India.</li> </ol>							6	1,2
III	<b>Introduction to Social Media and E-Commerce</b> <ol style="list-style-type: none"> <li>Relevance of Social Media in present scenario. Posting different types of contents in Social Media.</li> <li>Creating accounts and using some popular Social media portals and Apps like WhatsApp, Facebook, etc. Social Media Etiquettes &amp; Crimes.</li> <li>Definition of E-Commerce; E-Commerce versus traditional Commerce.</li> <li>Case studies of popular E-Commerce portals like Amazon.</li> <li>E-commerce Etiquettes &amp; Crimes.</li> </ol>							4	1,2

<b>IV</b>	<b>Digital Payments and Digital Transactions</b> i. Introduction to Digital Payment Systems. ii. Creating accounts and using Digital Payment Systems like Credit Cards, Debit Cards, Netbanking, UPI. iii. Digital payments Etiquettes & Crimes. <b>V Basic Accounting and Utility Software</b>	5	1,2
<b>V</b>	<b>Basic Accounting and Utility Software</b> i. Introduction to Basic accounting concepts, Introduction to an Accounting Software like GnuCash or Tally. ii. Introduction to Technical Document writing using LaTeX. iii. Introduction to Data Visualization software – Sigma, Google Charts, Tableau	5	1,2

**TEXT BOOKS:**

BGE S1-S3 Computing Science and Digital Literacy: Third and Fourth Levels

**REFERENCE BOOKS:**

- R1. Wren, P.C and Martin, H. 1995. High School English Grammar and Composition, S ChandPublishing.  
R2 Barrett, Grant. 2016. Perfect English Grammar: The Indispensible Guide to Excellent Writing and Speaking, ZephyrosPress  
R3. Mccarthy. (2008) English Vocabulary in Use Upper - Intermediate with CD ROM, Cambridge UniversityPress

**OTHER LEARNING RESOURCES:**

1. <https://www.w3schools.com>
2. <https://edu.gcfglobal.org>
3. <https://www.tutorialspoint.com>
4. <https://www.javatpoint.com>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Students will have basic understanding of Computer Systems and Internet search.	1,2
2	Students will be able to solve data analysis, management and visualization issues using MS-Office	1,2
3	Students will be able to efficiently and ethically use Social Media and e-commerce sites.	1,2
4	Students will have introduction to various utility software used in research and information Management.	1,2

SEMESTER – I									
Course Title	Co-Curricular Activities								
Course code	23UBEC111	Total credits: 1 Total hours: 60	L	T	P	S	R	O/F	C
			0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	3. To ascertain physical and mental development of the students and select best performers for state, national and international level competition. 4. To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.								
CO1	Students will learn to work well with others and communicate better.								
CO2	Students will learn to manage their time and stay organized.								
CO3	Students will enhance their creative abilities and think more critically.								
CO4	Students will improve their overall health and reduce stress.								
CO5	Students will become more aware of their role in society and contribute positively.								
Unit- No.	Content		Contact Hour	Learning Outcome				KL	
I	Co-curricular activities cover a wide range of experiences and pursuits that complement academic learning. They are typically organized and managed within educational institutions or communities and play a crucial role in holistic development. Some examples are  7. Sports and Physical Activities 8. Cultural Activities: 9. Academic Clubs and Competitions 10. Community Service and Volunteering 11. Leadership and Personal Development 12. Creative and Hobby-based Activities		60	Skill Development: Enhancing skills such as teamwork, leadership, communication, and critical thinking.  Holistic Growth: Supporting emotional, social, and physical development alongside academic learning.  Building Networks: Creating opportunities to interact with peers, mentors, and professionals.  Personal Fulfillment: Providing avenues for creativity, self-expression, and exploring personal interests.				1,2	

#### REFERENCE BOOKS:

R1: "Co-curricular Activities: A Pathway to Careers" by Ferguson.

R2: "Rahman, S.R., Islam, M.A., Akash, P.P., Parvin, M., Moon, N.N. and Nur, F.N., 2021. Effects of co-curricular activities on student's academic performance by machine learning. *Current Research in Behavioral Sciences*, 2, p.100057.

#### OTHER LEARNING RESOURCES:

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will learn to work well with others and communicate better.	6,7
2	Students will learn to manage their time and stay organized.	6,8
3	Students will enhance their creative abilities and think more critically.	6,7
4	Students will improve their overall health and reduce stress.	6,7
5	Students will become more aware of their role in society and contribute positively.	6,7

SEMESTER – II									
Course Title	Extra-Curricular Activities								
Course code	23UBEC121	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	3. To ascertain physical and mental development of the students and select best performers for state, national and international level competition. 4. To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.								
CO1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.								
CO2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.								
CO3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.								
Unit- No.	Content	Contact Hour	Learning Outcome	KL					
I	Based on the learner's interest they can participate in various sports, music, and co-curricular activities joining the clubs of the University (Football, Footshal; Cricket; Swimming; Basket ball; Badminton; Table Tennis; athletics and other outdoor and indoor games; Dance; Music;Vocals;Photography;Drama; Literary activities); The students are encouraged to participate in regular club activities, workshops, competitions as per their interest and hobbies; Renowned skilled professionals/ personalities are invited organising workshops to promote the talents of the students.	60	Participation in university clubs across sports, music, and extra-curricular activities cultivates diverse skills and personal growth. Students develop teamwork, leadership, and creativity through sports like football, cricket, and athletics. Musical pursuits and dance foster self-expression and coordination, while literary and drama activities enhance communication and critical thinking. Workshops led by skilled professionals provide industry insights and mentorship opportunities, preparing students for future challenges. By encouraging participation based on interests and hobbies, universities nurture well-rounded individuals who excel academically and socially, equipped with practical	1,2					

			skills and a broadened perspective on cultural diversity and personal fulfilment.	
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**REFERENCE BOOKS:**

R1: "Extracurricular Activities: Essential Guides for Students" by John G. Gabriel

R2: "Developing Personal, Social and Emotional Skills through Extra-Curricular Activities" by Sally Bailey

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.	6,8
2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.	6,8
3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.	6,8

SEMESTER III									
Course Title	INSTITUTIONAL FOOD SERVICE MANAGEMENT								
Course code	22BSFD211R	Total credits: 3 Total hours:	L	T	P	S	R	O/F	C
			3	0	0	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	III								
Course Objectives	1. To introduce with catering industry and food service system. 2. To know about principles, tools and techniques of management.								
CO1	Classify the food service system its components, and assess their functions.								
CO2	Acquire knowledge of floor planning, layout characteristics, and equipment necessary for food service facilities.								
CO3	Develop a menu plan and learn to standardize different recipes.								
CO4	Explain the food service management system								
CO5	Apply the knowledge of financial and personnel management in a food service unit								
Unit- No.	Content		Contact Hour	Learning Outcome					KL
I	<b>Catering industry</b> -Definition of catering. Classification of food service institutions according to a. Function: Profit oriented, service oriented and public health facility oriented. b. Processing method: Conventional system, commissary system and fast food service systems. Service of food: Self service, tray service and waiter-waitress service.		9	Learning about functioning of food Service institutions					1,2
II	<b>Floor planning and layout</b> -Characteristics of typical food service facilities. Plan of work areas-Receiving, storing, food preparation, cooking, serving, dining, dishwashing, pot and pan washing and garbage disposal: flow space relationship. Working heights and dimensions of work centers.  Equipment-Classification, factors involved in selection, use and care of major equipment.		10	Learning about division and distribution of working areas in food service institutions					1,2
III	<b>Quantity food preparation</b> -Selection, purchasing methods and storage of foods. Menu planning – Definition, principles involved in planning and types of menus. Standardization of recipe – Definition, standard recipe format and uses. Standard portion sizes-Definition, Portioning equipments and portion control. Use of left over foods		13	Learning about menu planning and quality control					1,2
IV	<b>Management</b> -Definition, principles and techniques of effective management. Tools of management-Organization chart, work study and work improvement. Use of computers in food service establishments.		10	Learning about running a food institution in an organized manner					1,2



V	<b>Financial management</b> -Principles and methods of food cost control, factors affecting food cost, labor cost, operating cost and over head cost.  Personnel management-Methods of selection, orientation, training, supervision and motivation of employees.	12	Learning about financial management while running a food service institution	1,2
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**TEXT BOOKS:**

T1: Sethi M., Catering Management: An Integrated Approach. New Age International (P) Ltd, Publishers, Third edition, 2015.

**REFERENCE BOOKS:**

R1: Sethi M., Institutional Food Management. New Age International (P) Ltd, Publishers, Third edition, 2008.

**OTHER LEARNING RESOURCES:**

<https://ebooks.inflibnet.ac.in/hsp05/chapter/classification-and-objectives-of-the-food-service/>

<https://egyankosh.ac.in/bitstream/123456789/33522/3/Unit-12.pdf>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Classify the food service system its components, and assess their functions.	1
2	Acquire knowledge of floor planning, layout characteristics, and equipment necessary for food service facilities.	1
3	Develop a menu plan and learn to standardize different recipes.	1
4	Explain the food service management system	1
5	Apply the knowledge of financial and personnel management in a food service unit	1,2,8

SEMESTER – III									
Course Title	FOOD TECHNOLOGY I								
Course code	23BSFD212R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	III								
Course Objectives	1. To know about processing of cereals, pulses, oilseeds, fruits and vegetables, meat etc. 2. To know about preservation of various foods.								
CO1	Learn about the processing technology and composition of cereals and millet.								
CO2	Explain the processing technology and composition of pulses and legumes.								
CO3	Acquire knowledge about the processing and quality attributes of fats and oils.								
CO4	Learn about the classification and post-harvest changes in fruits and vegetables.								
CO5	Analyse the post-mortem changes in meat and various preservation methods.								
Unit- No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Cereal &amp; Millets:</b> Processing of cereals, Composition and uses, by-products of cereals and coarse cereals, Process of malting, Gelatinization of starch, types of browning. Rice-Composition of rice obtained by different dehusking methods, milling of rice, by-products of rice milling, Processing-Milling, polishing, parboiling, flaking, parching, roasting. Millets-Varieties, composition and uses of maize, sorghum, barley, rye, oats, triticale, pearl millet and finger millet.	9	Learning about structure, use and processing of cereals and millets					1,2	
II	<b>Pulses &amp; Legumes:</b> Milling of legumes, processing of pulses-soaking, germination, decortications, cooking and fermentation. Toxic constituents in pulses and its detoxification processes. New improved technologies of legume processing- canning, quick cooking legumes, instant legume powder, legume protein concentrates	10	Learning about structure, use and processing of pulses and legumes					1,2	
III	<b>Fats and Oils</b> - Methods of oil extraction, refining of oil, types- steam refining, alkali refining, bleaching, steam, deodorization, hydrogenation, winterization, randomization/ Interest erification, Rancidity - hydrolytic and oxidative rancidity and its prevention. Define - margarine, butter, hydrogenated vegetable oil, lard.	13	Learning about processing and quality attributes of fats and oils					1,2	
IV	<b>Fruits and Vegetables</b> Classification of fruits and vegetables, general composition, enzymatic browning, names and sources of pigments, Post harvest change in fruits and vegetables – Climateric rise, horticultural maturity, physiological maturity, physiological changes, physical changes, chemical changes, pathological changes during the storage of fruits and vegetables.	10	Learning about quality attributes, Use and processing of fruits and vegetables					1,2	

<b>V</b>	<b>Meat</b> - post mortem changes, ageing of meat, tenderizing meat, storage & preservation of meat, cuts & grades of meat.  <b>Fish</b> -preservation of fish-drying, curing, brining, fermentation. <b>Poultry</b> - Preservation of eggs, egg powder, frozen eggs.	<b>12</b>	Learning about quality attributes and preservation methods of meat, fish and poultry	<b>1,2</b>
<b>VI Practical</b>	Market survey on processed foods	<b>5</b>	Learning about the availability of different processed foods in the market	<b>1,2, 3,4</b>
	Introduction to laboratory instruments/equipments	<b>2</b>	Learning about equipments used for processing and preservation	<b>1,2, 3,4</b>
	Development of processed cereal products	<b>3</b>	Learning about development of cereal-based products	<b>1,2, 3,4</b>
	Development of processed pulse products	<b>3</b>	Learning about Development of pulse based products	<b>1,2, 3,4</b>
	Development of processed product from meat and fish	<b>3</b>	Learning about development of meat and fish-based products	<b>1,2, 3,4</b>

**TEXT BOOKS:**

T1: Rahman, M. S., Handbook of Food Preservation. MARCELDEKKER Inc. 1999

**REFERENCE BOOKS:**

R1: James G. Brennan, Food Processing Handbook, 2011

**OTHER LEARNING RESOURCES:**

[https://www.fssai.gov.in/upload/uploadfiles/files/Manual\\_Meat\\_Fish\\_09\\_01\\_2017\(1\).pdf](https://www.fssai.gov.in/upload/uploadfiles/files/Manual_Meat_Fish_09_01_2017(1).pdf)

[https://www.pfndai.org/Document/Association\\_News/dairy\\_processing/Dairy\\_Products\\_Processing-Dr\\_Kanade.pdf](https://www.pfndai.org/Document/Association_News/dairy_processing/Dairy_Products_Processing-Dr_Kanade.pdf)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Learn about the processing technology and composition of cereals and millet.	1
<b>2</b>	Explain the processing technology and composition of pulses and legumes.	1
<b>3</b>	Acquire knowledge about the processing and quality attributes of fats and oils.	1
<b>4</b>	Learn about the classification and post-harvest changes in fruits and vegetables.	1,8
<b>5</b>	Analyse the post-mortem changes in meat and various preservation methods.	1,2

SEMESTER – III									
Course Title	NUTRITIONAL BIOCHEMISTRY								
Course code	22BSFD213R	Total credits:	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	III								
Course Objectives (Minimum 3)	1. To review about the different biochemical metabolism reaction of the body. 2. To understand how this metabolism takes place in co-relation with the nutrients of the food.								
CO1	Discuss the basic metabolic reaction of the body.								
CO2	Apply the knowledge of enzymes in terms of their structure, classification, properties and metabolic processes.								
CO3	Analyze the various classes of lipids and correlate their catabolic and anabolic pathways								
CO4	Demonstrate the ability to assess fluid, electrolyte, and acid-base balance and to make informed clinical management strategies during imbalance.								
CO5	Explain the importance and clinical manifestations of hormones and their associated imbalances and disorders								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>Carbohydrates</b> -Definition, classification. Structure (linear) of Monosaccharide-Glucose, fructose and galactose; Disaccharides-Maltose, lactose and sucrose; Polysaccharides-Starch and glycogen. Metabolism-Glycolytic pathway, electron transport chain and oxidative phosphorylation. Metabolism of carbohydrates: glycolysis and tricarboxylic acid (TCA) cycle, HMP shunt.	9	Learning about the structure and function of carbohydrates					1,2	
II	<b>Protein</b> - Definition, classification, structure, physical properties, chemical properties and utilization. Metabolism of proteins:- Transamination, deamination, decarboxylation, urea cycle. Enzymes and co-enzymes- Definition, types, classification and factors affecting velocity of enzyme catalyzed reactions. Diagnostic value of serum enzymes - Creatinine kinase, Alkaline phosphatase, Acid phosphatase, LDH, SGOT, SGPT, Amylase, Lipase, Carbonican hydrase etc.	10	Learning about the structure and function of proteins					1,2	
III	<b>Lipids</b> -Definition, classification and properties. Metabolism- Oxidation and biosynthesis of fatty acids. Ketone bodies, ketogenesis and ketosis.	10	Learning about the structure and function of lipids					1,2	
IV	<b>Acid – base balance</b> - Acid-base balance in normal health, definition of buffers, principles of buffers, major sources of acid produced in the body, physiological buffer system and role of different buffer systems. <b>Fluid and electrolyte balance</b> -Distribution of fluids in the body, ECF, ICF, Water metabolism, dehydration. Maintenance in normal health.	13	Learning about the role of fluids and electrolytes					1,2	

<b>V</b>	<b>Hormones</b> - Classification, general mode of action, hormones of Pituitary, Thyroid, Parathyroid, Adrenals, Reproductive Glands, Pancreas, hormonal disorders, counter regulatory hormones.	<b>12</b>	Learning about the classification and function of hormones	<b>1,2</b>
<b>VI Practical</b>	Identification of carbohydrates (Qualitative Tests)	<b>3</b>	Learning about analysis of carbohydrates	<b>1,2,3,4</b>
	Identification of proteins (Qualitative Tests)	<b>3</b>	Learning about analysis of proteins	<b>1,2,3,4</b>
	To study general properties of the enzyme Urease & Achromatic time of salivary amylase.	<b>3</b>	Learning about properties of enzymes	<b>1,2,3,4</b>
	Estimation of glucose in urine by Benedict's methods	<b>3</b>	Learning about analysis of glucose	<b>1,2,3,4</b>
	Urine analysis - normal and abnormal constituents of urine.	<b>3</b>	Learning about analysis of urine	<b>1,2,3,4</b>

### TEXT BOOKS:

T1: Deb. A .C., Fundamental of Biochemistry, New Central Book Agency (P) Ltd, reprint2004

### REFERENCE BOOKS:

R1: Pattabiraman. T.N. Concise text Book of Bio- Chemistry, 2nd edition, All India Publishers and Distributors, Regd., 1998.

R2: Ambika Shanmugam, Fundamentals of biochemistry for Medical students, Karthik printers, 7th edition, 1992.

### OTHER LEARNING RESOURCES:

<https://www.ncbi.nlm.nih.gov/books/NBK557556/>

<https://dhingcollegeonline.co.in/attendance/classnotes/files/1603564542.pdf>

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
<b>1</b>	Discuss the basic metabolic reaction of the body.	<b>1</b>
<b>2</b>	Apply the knowledge of enzymes in terms of their structure, classification, properties and metabolic processes.	<b>1,8</b>
<b>3</b>	Analyze the various classes of lipids and correlate their catabolic and anabolic pathways	<b>1</b>
<b>4</b>	Demonstrate the ability to assess fluid, electrolyte, and acid-base balance and to make informed clinical management strategies during imbalance.	<b>1,2</b>
<b>5</b>	Explain the importance and clinical manifestations of hormones and their associated imbalances and disorders	<b>1</b>

SEMESTER – III									
Course Title	FOOD MICROBIOLOGY								
Course code	22BSFD214R	Total credits: 4 Total hours:	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	III								
Course Objectives (Minimum 3)	1. To know about microbiology. 2. To know food contamination and spoilage.								
CO1	Discuss the history of microbiology.								
CO2	Describe the role and importance of bacteria in food microbiology.								
CO3	Comprehend the morphology, physiology, and role of fungi in food microbiology.								
CO4	Understand the occurrence, classification, and diseases caused by viruses.								
CO5	Acquire knowledge of the morphology, classification, and role of algae.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Introduction &amp; History of Microbiology</b> -The theory of Spontaneous generation, different terminology, heterotrophic nutrition, autotrophic nutrition, saprophytic holozoic, host culture, parasites		3	Learning about basic terms related to microbiology				1,2	
II	<b>Bacteria</b> - morphology, reproduction, growth curve, genera, importance in food microbiology		5	Learning about role of bacteria in food microbiology				1,2	
III	<b>Fungi</b> - Morphology, reproduction, classification, physiology & nutrition,		7	Learning about role of Fungi in food microbiology				1,2	
IV	<b>Virus</b> - Occurrence, morphology, reproduction, classification, diseases		5	Learning about role of virus in food microbiology				1,2	
V	<b>Algae</b> -Occurrence, morphology, reproduction, importance, general principles of spoilage, fitness & refines, of food microorganisms in food factors affecting growth		5	Learning about role of algae in food microbiology				1,2	
VI Practical	Study of equipments in a microbiology lab		2	Learning about equipments used in microbiology lab				1,2,3,4	
	Preparation of laboratory media and special media, cultivation of bacteria, yeasts and moulds		3	Learning about preparation of media				1,2,3,4	
	Staining of bacteria: gram-staining		2	Learning about straining of bacteria				1,2,3,4	

	Cultivation and identifications of important molds and yeast in food items	3	Learning about molds and yeasts in food items	1,2,3,4
	Demonstration of available rapid methods and diagnostic kits used in identification of microorganisms or their products.	2	Learning about diagnostic methods for identification of microorganisms	1,2,3,4

**TEXT BOOKS:**

T1: Ray B. and Bhunia A. Fundamental Food Microbiology, CRC Press Fifth Edition, 2014

**REFERENCE BOOKS:**

R1: Frazier, Westhoff, Vanitha N M, Food Microbiology, 5th Edition, 2014

**OTHER LEARNING RESOURCES:**

[https://www.researchgate.net/publication/358954675\\_introduction\\_history\\_and\\_development\\_of\\_microbiology](https://www.researchgate.net/publication/358954675_introduction_history_and_development_of_microbiology)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Discuss the history of microbiology.	1,2
2	Describe the role and importance of bacteria in food microbiology.	1,2
3	Comprehend the morphology, physiology, and role of fungi in food microbiology.	1,2
4	Understand the occurrence, classification, and diseases caused by viruses.	1,2
5	Acquire knowledge of the morphology, classification, and role of algae.	1,2

SEMESTER – III									
Course Title	BAKERY SCIENCE								
Course code	22BSFD215R	Total credits:	L	T	P	S	R	O/F	C
			0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	III								
Course Objectives (Minimum 3)	1. The course provides sciences behind bakery product. 2. The course will provide basic functions of all the ingredients used in different products								
CO1	Have an insight on the science behind baking								
CO2	Learn about dough development and bread-making processes.								
CO3	Acquire knowledge of confectionery manufacturing and manufacturing processes and production.								
CO4	Learn about various bakery equipment, their functions and applications.								
CO5	Acquire knowledge on sensory evaluation of baked products								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	<b>Science of bakery product:</b> Raw materials: grains, milling; grades and types of flours – Chorleywood bread flour, patent, soft, wholemeal, brown and low moisture flours; leavening agents; flour treatments; fats; emulsifiers; colors; flavors; antioxidants; sugars; dairy ingredients; gums and gelling agents. Bread making: chemistry of dough development, making of bread, types of breads. Products other than bread: pastry, biscuits, wafers, cakes, and other chemically leavened products. <b>Confectionery:</b> significance, classification, industries in India. Sugar confectionery: ingredients, manufacturing-high boiled sweets, caramel, toffee, fudge, Chocolate. Sugar free confectionery: need, ingredients, manufacture.	3	Learning about principles, methods, and role of ingredients in bakery and confectionary				1,2		
II	Study of bakery equipments Quality test for wheat flour used in the baked products. Maltose Number, Water Absorption, Sedimentation value, Alcohol Acidity. Preparation and quality evaluation of bread/bun/pizza. Preparation and quality evaluation of cakes. Preparation and quality evaluation of biscuits. Preparation and quality evaluation of nankhatai  Preparation and quality evaluation of cookies	3	Learning about equipments used in bakery and confectionary				1,2		

#### TEXT BOOKS:

T1: Norman N. Potter and Joseph H. Hotchkiss, Food Science, CBS Publishers and Distributors, Fifth Edition, 2000.

#### REFERENCE BOOKS:



**OTHER LEARNING RESOURCES:**

[https://students.aiu.edu/submissions/profiles/resources/onlineBook/h5d3M4\\_Science\\_of\\_Bakery\\_Products.pdf](https://students.aiu.edu/submissions/profiles/resources/onlineBook/h5d3M4_Science_of_Bakery_Products.pdf)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Have an insight on the science behind baking	1,6,8
<b>2</b>	Learn about dough development and bread-making processes.	1,6,8
<b>3</b>	Acquire knowledge of confectionery manufacturing and manufacturing processes and production.	1,6,8
<b>4</b>	Learn about various bakery equipment, their functions and applications.	1,6,8
<b>5</b>	Acquire knowledge on sensory evaluation of baked products	1,6,8

Course Title		Proficient Communication							
Course code	22UBPD213R	Total credits: 2	L	T	P	S	R	O/F	C
			0	0	2	0	0	0	2
		Total hours:30							
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To acquaint students with the various tools of effective presentation.</li> <li>To acquire the speaking skill instruct, influence, engage, educate, or appease the listeners.</li> <li>To increase proficiency, present ability and quality of resume and provide guidance for self- promotion and self-evaluation in social media.</li> <li>To prepare and train the students for the campus drives &amp; walking interviews.</li> </ol>								
CO1	Enable students to use prepositions, construct simple, complex, and compound sentences, and distinguish between active and passive voice.								
CO2	Teach students the basics of writing, how to avoid ambiguity, write paragraphs and letters, and prepare resumes and cover letters.								
CO3	Help students conduct SWOT analyses, practice self-regulation, and maintain personal hygiene.								
CO 4	Equip students with knowledge about non-verbal communication, types of body language, and their impact.								
CO 5	Train students in planning and conducting group discussions, effectively disagreeing, and summarizing to attain objectives.								
CO 6	Prepare students for personal interviews, answer common interview questions, follow telephone interview etiquettes, and adhere to dress code and grooming standards.								
Unit- No.	Content		Contact Hour	Learning Outcome				KL	
<b>I</b>	<b>Grammar (Flipped classroom)</b> i. Use of Prepositions ii. Simple, complex, compound sentences iii. Active and Passive Voice		6	Students will correctly use prepositions, create various sentence structures, and convert between active and passive voice.				2, 3	
<b>II</b>	<b>Writing Skills</b> I. The Basics of Writing; avoid ambiguity and vagueness II. Paragraph Writing III. Letter Writing IV. Resume and Cover Letter		6	Students will write clear and structured paragraphs, letters, resumes, and cover letters.				3, 4	
<b>III</b>	<b>Self-Management Skills</b> i. SWOT Analysis ii. Self-Regulation iii. Personal Hygiene		5	Students will perform SWOT analyses, self-regulate, and adhere to personal hygiene practices.				3, 4	
<b>IV</b>	<b>Non- Verbal Communication-Sciences of Body Language</b> i. What is Non-Verbal Communication & Body Language ii. Types of Body Language, iii. Importance and Impact of Body Language,		5	Students will understand and effectively use different types of body language in communication.				2, 3	

<b>V</b>	<b>Group Discussion</b> i. Planning and Elements of Group Discussion ii. Effectively disagreeing, iii. Summarizing and Attaining the Objective.	5	Students will plan and participate in group discussions, disagree constructively, and summarize discussions.	3, 4
<b>VI</b>	<b>Interview Skills &amp; Dress code Ethics</b> i. Personal Interview – Concept and Practice ii. Common Interview Questions and answering Strategies iii. Telephone Interview Etiquettes iv. Introduction to Dress Code and Grooming	5	Students will demonstrate effective interview techniques, answer common questions, follow telephone etiquettes, and dress appropriately.	2, 3

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Integrate presentation, communication, leadership, and interview skills.	6,7
2	Apply skills in real-world scenarios.	6,7,8
3	Reflect on personal development.	6,7
4	Collaborate effectively in group activities.	6,7
5	Demonstrate professionalism and ethical behavior.	5,6,7

SEMESTER – III									
Course Title	Extra-Curricular Activities								
Course code	23UBEC211	Total credits: 1 Total hours: 60	L	T	P	S	R	O/F	C
			0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To ascertain physical and mental development of the students and select best performers for state, national and international level competition.</li> <li>To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.</li> </ol>								
CO1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.								
CO2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.								
CO3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Based on the learner's interest they can participate in various sports, music, and co-curricular activities joining the clubs of the University (Football, Footshal; Cricket; Swimming; Basket ball; Badminton; Table Tennis; athletics and other outdoor and indoor games; Dance; Music;Vocals;Photography;Drama;Literary activities); The students are encouraged to participate in regular club activities, workshops, competitions as per their interest and hobbies; Renowned skilled professionals/ personalities are invited organising workshops to promote the talents of the students.	60	Participation in university clubs across sports, music, and extra-curricular activities cultivates diverse skills and personal growth. Students develop teamwork, leadership, and creativity through sports like football, cricket, and athletics. Musical pursuits and dance foster self-expression and coordination, while literary and drama activities enhance communication and critical thinking. Workshops led by skilled professionals provide industry insights and mentorship opportunities, preparing students for future challenges. By encouraging participation based on interests and hobbies, universities nurture well-rounded individuals who excel academically and socially, equipped with practical skills and a broadened perspective on cultural	1,2					

			diversity and personal fulfilment.	
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**REFERENCE BOOKS:**

R1: "Extracurricular Activities: Essential Guides for Students" by John G. Gabriel

R2: "Developing Personal, Social and Emotional Skills through Extra-Curricular Activities" by Sally Bailey

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.	6,8
2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.	6,8
3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.	6,8

SEMESTER – III									
Course Title	Co-Curricular Activities								
Course code	23UBEC111	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	5. To ascertain physical and mental development of the students and select best performers for state, national and international level competition. 6. To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.								
CO1	Students will learn to work well with others and communicate better.								
CO2	Students will learn to manage their time and stay organized.								
CO3	Students will enhance their creative abilities and think more critically.								
CO4	Students will improve their overall health and reduce stress.								
CO5	Students will become more aware of their role in society and contribute positively.								
Unit- No.	Content	Contact Hour	Learning Outcome	KL					
I	Co-curricular activities cover a wide range of experiences and pursuits that complement academic learning. They are typically organized and managed within educational institutions or communities and play a crucial role in holistic development. Some examples are  13. Sports and Physical Activities 14. Cultural Activities: 15. Academic Clubs and Competitions 16. Community Service and Volunteering 17. Leadership and Personal Development 18. Creative and Hobby-based Activities	60	5. Skill Development: Enhancing skills such as teamwork, leadership, communication, and critical thinking. 6. Holistic Growth: Supporting emotional, social, and physical development alongside academic learning. 7. Building Networks: Creating opportunities to interact with peers, mentors, and professionals. 8. Personal Fulfillment: Providing avenues for creativity, self-expression, and exploring personal interests.	1,2					

#### REFERENCE BOOKS:

R1: "Co-curricular Activities: A Pathway to Careers" by Ferguson.

R2: "Rahman, S.R., Islam, M.A., Akash, P.P., Parvin, M., Moon, N.N. and Nur, F.N., 2021. Effects of co-curricular activities on student's academic performance by machine learning. *Current Research in Behavioral Sciences*, 2, p.100057.

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will learn to work well with others and communicate better.	6,7
2	Students will learn to manage their time and stay organized.	6,7
3	Students will enhance their creative abilities and think more critically.	6,7
4	Students will improve their overall health and reduce stress.	6,7
5	Students will become more aware of their role in society and contribute positively.	6,7

SEMESTER – III									
Course Title	UNIVERSAL HUMAN VALUES (UHV) + PROFESSIONAL ETHICS								
Course code	22UUHV101R	Total credits:2	L	T	P	S	R	O/F	C
		Total hours: 30T	2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings</li> <li>2. Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence</li> <li>3. Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature</li> </ol>								
CO1	Understand ethical principles and dilemmas in both personal and professional contexts.								
CO2	Develop respect for different beliefs, values, and perspectives, fostering a tolerant and inclusive environment in both personal and professional interactions.								
CO3	Understand corporate social responsibility, sustainable development, and the impact of their actions on communities and the environment.								
CO 4	Understand the importance of upholding ethical standards and taking responsibility for their actions and decisions.								
CO 5	Develop skills to critically evaluate actions, make improvements, and strive for ethical excellence throughout life.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	Course Introduction - Need, Basic Guidelines, Content and Process for Value Education 1. Understanding the need, basic guidelines, content and process for Value Education 2. Self Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation–as the mechanism for self exploration 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations 4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario 6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels		8	Develop an understanding of the importance and methodology of value education				1,2	
II	Understanding Harmony in the Human Being - Harmony in Myself! 1. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’ 2. Understanding the needs of Self (‘I’) and ‘Body’ - Sukh and Suvidha 3. Understanding the Body as an		6	Develop Insight into the Harmony Within the Human Being				1,2	



	instrument of 'I' (I being the doer, seer and enjoyer) 4. Understanding the characteristics and activities of 'I' and harmony in 'I' 5. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail 6. Programs to ensure Sanyam and Swasthya-Practice Exercises and Case Studies will be taken up in Practice Sessions.			
<b>III</b>	Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship 1. Understanding Harmony in the family – the basic unit of human interaction 2. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship 3. Understanding the meaning of Vishwas; Difference between intention and competence 4. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship 5. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals 6. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha )- from family to world family!-Practice Exercises and Case Studies will be taken up in Practice Sessions.	<b>6</b>	Understand harmony in the family and society	1,2
<b>IV</b>	Understanding Harmony in the Nature and Existence - Whole existence as Co-existence 1. Understanding the harmony in the Nature 2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature 3. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space 4. Holistic perception of harmony at all levels of existence-Practice Exercises and Case Studies will be taken up in Practice Sessions.	<b>4</b>	Develop understanding in harmony in the nature and Existence	1,2
<b>V</b>	Implications of the above Holistic Understanding of Harmony on Professional Ethics 1. Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 4. Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal	<b>4</b>	Apply harmony in professional ethics	1,2

	<p>human order b) Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems. 5. Case studies of typical holistic technologies, management models and production systems 6. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations</p>			
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**TEXT BOOKS:**

A Foundation Course in Human Values and Professional Ethics. by R.R. Gaur, R. Sangal , G.P. Bagaria

**REFERENCE BOOKS:**

**R1:** R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

**R2:** B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Understand ethical principles and dilemmas in both personal and professional contexts.	5,8
2	Develop respect for different beliefs, values, and perspectives, fostering a tolerant and inclusive environment in both personal and professional interactions.	5,8
3	Understand corporate social responsibility, sustainable development, and the impact of their actions on communities and the environment.	5,8
4	Understand the importance of upholding ethical standards and taking responsibility for their actions and decisions.	5,8
5	Develop skills to critically evaluate actions, make improvements, and strive for ethical excellence throughout life.	5,8

SEMESTER – III									
<b>Course Title</b>	Personal Financial Planning								
<b>Course code</b>	22UUFL202R	<b>Total credits: 1</b> <b>Total hours: 30P</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
			<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Bachelor of Science in Food Nutrition and Dietetics</b>								
<b>Semester</b>	<b>Fall/ III semester of second year of the programme</b>								
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>1. The course would offer an inclusive approach to understand the relevant concepts of money, borrowing, lending, taxes and their application to financial planning.</li> <li>2. Assess the personal financial planning process, the life cycle of financial plans, and methods of goal achievement.</li> <li>3. Formulate a budget, record-keeping system, and tax planning strategy based on current financial goals</li> </ol>								
<b>CO1</b>	Develop a cash management strategy and a plan to facilitate the home or automobile buying Process								
<b>CO2</b>	Design a diversified investment portfolio that addresses several different investment objectives.								
<b>CO3</b>	Differentiate between open- and closed-end mutual funds, exchange-traded funds, and direct or indirect real estate investments.								
<b>CO4</b>	Create a financial plan that covers your income needs in retirement and helps protect you and your estate.								
<b>CO5</b>									
<b>Unit-No.</b>	<b>Content</b>				<b>Contact Hour</b>	<b>Learning Outcome</b>			<b>KL</b>
<b>I</b>	<b>Fundamentals of Financial Planning –</b> i.Functions of money; ii.Inflation- Meaning, causes, how it can be controlled; iii.process official planning , iv.Time value of money-simple and compound interest; v.Net Present Value and Future value, vi.Power of Compounding; vii.Doubling period and Rule of 72.				<b>5</b>				1,2
<b>II</b>	<b>Income Tax Planning–</b> i.Meaning of Income, ii.Direct & Indirect Taxes, Taxable Income, various heads of Income for tax Calculation, iii.Non-taxable Income, iv.Tax evasion and tax avoidance, v.GST, Tax Planning Strategies				<b>5</b>				1,2
<b>III</b>	<b>Entrepreneurial planning –</b> i. Meaning of Entrepreneurship, prerequisites for becoming an entrepreneur, ii. Entrepreneurship Support Systems in India, iii. Institutional support systems for entrepreneurs, iv. Financial support systems for entrepreneurs; v. Venture Capital, Business Angels, vi. Assistant of Government, vii. Commercial Bank Loans and Overdraft.				<b>5</b>				1,2
<b>IV</b>	<b>Planning for investing in securities market –</b> i. Investment avenues offered by Securities Markets,. Primary Market and Secondary Market, ii. Stock market- meaning, features, functions of NSE,BSE DEMAT trading account, iii. Security repository, stock brokers, Operational aspects of securities markets: placement of				<b>5</b>				1,2

	orders, contract note, pay-in and pay-out, trading and settlement cycle, iv. Various risks involved in investing in securities markets; Role of Financial Intermediaries; Stock indices. v. Mutual Funds- meaning concept, definition, types, importance and drawbacks of mutual funds, mutual funds in India, investing in mutual funds, vi. Systematic Investment Plan (SIP) and its advantages.			
<b>V</b>	<b>Planning for debts and Retirement</b> i. Consumer credit - Introduction to consumer credit; choosing a source of credit, the cost of credit alternatives, ii. Consumer Legal Protection; iii. Housing Decision: Factors and Finance; Vehicle Decisions. iv. Retirement planning - Meaning of cost of living; retirement need analysis; development of retirement plan, various retirement schemes, v. Estate Planning; Pension and Medicare Planning; Wills.	<b>3</b>		1,2

**TEXT BOOKS:**

Personal Financial Planning by Shalu Garg

**REFERENCE BOOKS:**

R1: Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems & The Million Dollar Financial Advisor: Powerful Lessons and Proven Strategies from Top Producers by David J. Mullen Jr.

R2: Personal Finance and Planning by Dr. Rajni

R3: Peaceful Personal Finance: A Short Read on the Basics of Personal Finance and Planning Kindle Edition by Hema Singh

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Develop a cash management strategy and a plan to facilitate the home or automobile buying Process	1,8
2	Design a diversified investment portfolio that addresses several different investment objectives.	1,8
3	Differentiate between open- and closed-end mutual funds, exchange-traded funds, and direct or indirect real estate investments.	1,8
4	Create a financial plan that covers your income needs in retirement and helps protect you and your estate.	1,8

SEMESTER – III									
<b>Course Title</b>	Basic Life Saving Skills (BLSS)								
<b>Course code</b>	22UULS202R	<b>Total credits: 1</b> <b>Total hours: 30P</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
			<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Bachelor of Science in Food Nutrition and Dietetics</b>								
<b>Semester</b>	<b>Fall/ III semester of second year of the programme</b>								
<b>Course Objectives</b>	The aim of the course is to provide the learners with basic knowledge and practical skills needed in an emergency fire situation, and to provide appropriate basic management and treatment for injuries.								
<b>CO1</b>	The students will be able to recognize respiratory arrest/ cardiac arrest, and provide oxygen to the patients to sustain tissue viability								
<b>CO2</b>	The students will be able to perform the importance of early CPR on Adult, child and infants victims								
<b>CO3</b>	The students will be able to prevent injury from getting worse, aiding recovery, relieving pain and protecting the victims from deterioration								
<b>CO4</b>	Importance of physiology in forestry								
<b>CO5</b>	The students will be able to learn about the fire equipments requirements, methods of operation and getting out alive.								
<b>Unit-No.</b>	<b>Content</b>				<b>Contact Hour</b>	<b>Learning Outcome</b>		<b>KL</b>	
<b>I</b>	<b>Basic Life Support ( BLS)</b> <ul style="list-style-type: none"> <li>• Introduction of BLS</li> <li>• Chain of survival</li> <li>• ABCs Assessment</li> <li>• CPR and Ventilation Technique</li> <li>• AED</li> <li>• Choking for adult and children</li> </ul>				<b>5</b>			<b>1,2</b>	
<b>II</b>	<b>First Aid</b> <ul style="list-style-type: none"> <li>• Golden rules of First aid</li> <li>• First aid Kits</li> </ul>				<b>5</b>			<b>1,2</b>	
<b>III</b>	<b>Trauma emergencies</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Priorities of Initial approach in pre-hospital care</li> <li>• Scene safety</li> <li>• Primary assessment</li> <li>• Bleeding control</li> <li>• Extrication of victims and safe transfer</li> <li>• Cervical spine stabilization and C-collar application</li> <li>• Splinting of broken Limbs</li> </ul>				<b>5</b>			<b>1,2</b>	
<b>IV</b>	<b>Triage system</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Flow chart approach of Triage</li> <li>• Triage of Single and Multiple Casualties in Pre-Hospital setting</li> </ul>				<b>5</b>			<b>1,2</b>	
<b>V</b>	<b>Medical emergencies</b> Introduction Victim centred approach and Management of :- <ul style="list-style-type: none"> <li>• Seizures</li> <li>• heart attack</li> <li>• asthma</li> </ul>				<b>3</b>			<b>1,2</b>	

	<ul style="list-style-type: none"> <li>• diabetic emergencies</li> <li>• emergency childbirth</li> <li>• Respiratory distress and failure</li> </ul>			
<b>VI</b>	<b>Environmental Emergency</b> <ul style="list-style-type: none"> <li>• Recognizing and caring for heat related illness such as: Heat stroke,</li> <li>• heat cramps, heat exhaustion, dehydration.</li> <li>• Recognizing and caring for cold related illness such as frostbite,</li> <li>• hypothermia.</li> <li>• Poisoning, Snake bite.</li> </ul>	<b>3</b>		
<b>VI</b>	<b>Safety of people in the event of fire</b> <ul style="list-style-type: none"> <li>• Recognition of possible fire sources and emergency procedures,</li> <li>• Construction techniques for eliminating fire.</li> <li>• Types of detecting devices and extinguishing agents and systems</li> <li>• Devising procedures in the event of fire and react to fire danger.</li> <li>• Safety goals and objectives, Identifying hazards and risks</li> </ul>	<b>3</b>		

#### REFERENCE BOOKS:

R1: Nancy Caroline'S Emergency Care in the streets eight edition by Jones and Bartlett

R2: First Aid book by LC Gupta; Publisher Jaypee Brothers, 7th Edition.

#### OTHER LEARNING RESOURCES:

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	The students will be able to recognize respiratory arrest/ cardiac arrest, and provide oxygen to the patients to sustain tissue viability	1,8
2	The students will be able to perform the importance of early CPR on Adult, child and infants victims	1,8
3	The students will be able to prevent injury from getting worse, aiding recovery, relieving pain and protecting the victims from deterioration	1,8
4	Overcome environmental hazards	1,8
5	The students will be able to learn about the fire equipments requirements, methods of operation and getting out alive.	1,8

**SEMESTER IV**

SEMESTER IV									
Course Title	ADVANCED FOOD TECHNOLOGY								
Course code	22BSFD221R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	4 <sup>th</sup> Seester, 2 <sup>nd</sup> Year								
Course Objectives	1. To know about processing of dairy, extruded and irradiated food. 2. To know about preservation of various foods. 3. To about packaging technology.								
CO1	Discuss various food processing and preservation techniques								
CO2	Learn about dairy technology. Discuss different processing techniques of milk and milk products								
CO3	Gain insight on extrusion technology in food product processing								
CO4	Learn about the classification of food irradiation and it's probable uses in food processing								
CO5	Discuss packaging materials, food additives and food quality evaluation techniques in product development								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
<b>I</b>	<p><b>Introduction to various food processing and preservation technologies</b></p> <p>Freezing-Introduction to refrigeration and freezing, definition, principle of freezing, changes occurring during freezing, types of freezing, thawing, changes during thawing and its effect on food.</p> <p>Drying and Dehydration-Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), heat and mass transfer, factors affect ingrate of drying, types of driers used in the food industry.</p>	<b>10</b>	Learning about various food processing and preservation technologies	<b>1,2</b>					
<b>II</b>	<p><b>Dairy technology-</b> Introduction, pasteurization, homogenization, drying, packaging, standardization, recombination, reconstitution, different processing for different milk products, Co-operative Dairying, National Dairy Development Board, Operation Flood, Development in milk processing</p>	<b>8</b>	Learning about dairy technology and its advanced processing technique	<b>1,2</b>					
<b>III</b>	<p><b>Extruded foods-</b> introduction, classification of extruders, merits &amp; demerits of extrusion technology, effect of Extruded foods on nutritive value of foods.</p>	<b>7</b>	Learning about Extruded product and its processing techniques	<b>1,2</b>					
<b>IV</b>	<p><b>Food Irradiation-</b>Introduction, kinds of ionizing radiations used in food irradiation, uses of radiation processing in food industry, concept of cold sterilization, functions, effects of food irradiation, safety of irradiated foods</p> <p><b>Thermal Processing-</b>Concept of pasteurization, sterilization, commercial sterilization and</p>	<b>10</b>	Learning about various aspect of advanced food processing	<b>1,2</b>					

	blanching.			
<b>V</b>	<b>Packaging technology</b> -introduction, basic packaging materials, effects on nutritive value of foods  <b>Food Additives</b> - introduction, classification, uses, merits & demerits, Fortification & Enrichment-definition & importance of fortified and enriched foods  <b>Evaluation of Food Quality</b>	<b>9</b>	Learning about packing technology and food additives	<b>1,2</b>
<b>VI Practical</b>	Setting up of sensory evaluation lab and introducing the concept of organoleptic testing.	<b>3</b>	Learning about sensory evaluation	<b>1,2,3,4</b>
	Drying of food products	<b>2</b>	Learning about drying process	<b>1,2,3,4</b>
	To give the concept of shelf life of different foods (processed and unprocessed)	<b>5</b>	Learning about shelf life of processed and unprocessed product	<b>1,2,3,4</b>
	Identification of different types of packaging materials used in the food industry	<b>3</b>	Learning about different packaging materials	<b>1,2,3,4</b>
	Visit to different food processing industries	<b>2</b>	Learning about techniques of food industries	<b>1,2,3,4</b>

#### TEXT BOOKS:

**T1:** Food Science, Fifth Edition, Norman N. Potter, Joseph H. Hotchkiss

#### REFERENCE BOOKS:

**R1:** Rahman, M. S., Handbook of Food Preservation. MARCELDEKKERInc. 1999

#### OTHER LEARNING RESOURCES:

<https://www.youtube.com/watch?v=kfExSuaCq5Q>

<https://www.youtube.com/watch?v=yVPWcnBiFeQ>

<https://tn.gov/education/article/cte-cluster-agriculture-food-naturalresources>.

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
<b>1</b>	Discuss various food processing and preservation techniques	<b>1</b>
<b>2</b>	Learn about dairy technology. Discuss different processing techniques of milk and milk products	<b>1</b>
<b>3</b>	Gain insight on extrusion technology in food product processing	<b>1</b>
<b>4</b>	Learn about the classification of food irradiation and it's probable uses in food processing	<b>1,5</b>
<b>5</b>	Discuss packaging materials, food additives and food quality evaluation techniques in product development	<b>1,8</b>



SEMESTER – IV									
Course Title	BASIC DIETETICS								
Course code	22BSFD222R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	IV								
Course Objectives	1. To study about different aspect of diet modification and adaptations. 2. To study about the different nutrient modification at different disease state.								
CO1	Explain the concept of diet therapy and role of a dietician in health care industry.								
CO2	Apply different aspects of diet modification and adaptations for weight management.								
CO3	Explain the importance of a hospital diet in febrile conditions.								
CO4	Apply the knowledge of nutrition in diet modification for gastrointestinal tract disorders.								
CO5	Apply the knowledge of nutrition in diet modification for liver and biliary system problems								
Unit-No.	Content		Contact Hour	Learning Outcome			KL		
I	<b>Concept of diet therapy:</b> growth and source of dietetics, purpose and principles of Therapeutic diets, modification of normal diet, classification of therapeutic diets, role of Dietician, definition of nutritional care, interpersonal relationship with patient, planning and implementary dietary care. Nutritional care process. Medical History assessment. Assessment of patient needs. Dietary counseling-Evaluation of the effectiveness of counseling. Education of the patient and follow up. Role of Dietitian–Professional code and ethics of a dietitian. Problems in feeding children at the hospitals, Psychology of feeding the patient.		9	Learning about different concept of diet therapy			1,2		
II	<b>Nutritional care for weight management-</b> Obesity and overweight: Identification, etiology, dietary management and behavioural modifications. Underweight: Etiology, assessment and dietary management.		7	Learning about nutritional care for weight management			1,2		
III	<b>Nutritional care for febrile condition</b> –Acute, chronic and recurrent: Malaria, Typhoid and TB–Etiology, symptoms and dietary management.		7	Learning about nutritional care			1,2		
IV	<b>Nutritional care for diseases of the gastrointestinal tract-</b> Gastric and duodenal ulcer, diarrhoea, constipation, malabsorption syndrome, hemorrhoids, ulcerative colitis, flatulence and steatorrhea–Etiology, symptoms and dietary management.		7	Learning about nutritional care for diseases			1,2		
V	<b>Nutritional care for diseases of liver and biliary system-</b> Viral hepatitis, cirrhosis of liver, cholelithiasis and cholecystitis: Etiology, symptoms and dietary management.		10	Learning about nutritional care for various clinical condition			1,2		
VI Practical	Planning, preparations and calculations of diets with modified consistency		3	Learn to plan & prepare different diet			1,2, 3,4		
	Planning, preparations and calculations of diets with modified fibre and residue		5	Learn to plan & prepare diets with modified fibre and residue			1,2, 3,4		

	Planning, preparation and calculation of diets in diarrhea	2	Learn to plan & prepare diets for diarrhea	1,2,3,4
	Planning, preparation and calculation of diets in constipation	3	Learn to plan & Prepare diets in constipation	1,2,3,4
	Planning, preparation and calculation of diets in peptic ulcer.	2	Learn to plan & prepare diets in peptic ulcer.	1,2,3,4
	Planning, preparations and calculations of diets with modified consistency	3	Learn to plan & prepare different diet	1,2,3,4

**TEXT BOOKS:**

T1: Srilakshmi, B., Dietetics, New Age International (P) limited Publications, 2004.

**REFERENCE BOOKS :**

R1: Joshi, S. A., Nutrition and Dietetics, Tata McGraw Hill Publications, New Delhi, 2004.

**OTHER LEARNING RESOURCES:**

1.<https://www.youtube.com/watch?v=2K07gJ2t5u8>

2.<https://www.youtube.com/watch?v=PXWZ8vzcJI0>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Explain the concept of diet therapy and role of a dietician in health care industry.	1, 8
2	Apply different aspects of diet modification and adaptations for weight management.	1,2,8
3	Explain the importance of a hospital diet in febrile conditions.	1, 2
4	Apply the knowledge of nutrition in diet modification for gastrointestinal tract disorders.	1,2, 8
5	Apply the knowledge of nutrition in diet modification for liver and biliary system problems	1,2,8

SEMESTER – IV									
Course Title	COMMUNITY NUTRITION								
Course code	22BSFD223R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	IV								
Course Objectives	1. To know about nutritional problems prevailing in India. 2. To impart nutrition education to the community. 3. To understand different assessment methods								
CO1	Familiarize with nutritional problems revealing among various communities in the society								
CO2	Enable to assess nutritional status of people/groups through different method of assessment.								
CO3	Plan, implement and evaluate nutrition intervention programs to combat malnutrition								
CO4	Understand on national and international agencies to uplifting nutritional status								
CO5	Different method of assessing nutritional status.								
Unit- No.	Content		Contact Hour	Learning Outcome			KL		
I	Nutrition and Health in National development. Definition, IMR, NMR and MMR. RAP, nutritional status assessment and surveillance.  <b>Nutritional Problems in India</b> -Malnutrition-meaning, factors contributing to malnutrition, overnutrition.  Nutritional disorders-Epidemiology, clinical features, prevention and dietary treatment for Protein Energy malnutrition, nutritional anaemias & vitamin deficiency disorders.		10	Learning about nutrition, health and deficiency disorder			1,2		
II	<b>Methods of assessing nutritional status:</b> a) Sampling techniques, Identification of risk groups, b) Direct assessment-Diet surveys, anthropometric, clinical and biochemical estimation. c) Indirect assessment- Food balance sheet, ecological parameters and vital statistics.  <b>Growth chart</b> Meaning, WHO Chart, and charts used in India, uses, meaning of reference curve and growth curve.		9	Learning about various methods to assess the nutritional status			1,2		
III	<b>Communication methods</b> -introduction, need, audio-visual aids, teaching aids <b>Nutrition education</b> - Meaning, objectives, types and methods; Principles of planning, execution and evaluation of nutrition education program; Merits and limitations.  <b>Improvement of nutrition of a community:</b> a) Modern methods of improvement or nutritional quality of food, food fortification, enrichment and nutrient supplementations. Nutrition education themes and messages in		12	Learning about nutritional education to improve communication			1,2		

	nutrition and health, Antenatal and postnatal care.			
<b>IV</b>	<b>Nutritional and infection relationship:</b> Immunization and its importance, Food borne infection and intoxication diseases, foods involved, methods of prevention, Infestation of food borne diseases, Outbreak, Prevention signs and control of infection.	<b>7</b>	Learning about nutritional deficiency and its relationship	1,2
<b>V</b>	<b>National and International agencies in uplifting the nutritional status-</b> WHO, UNICEF, CARE, ICMR, ICAR, CSIR	<b>8</b>	Learning about various national and international agencies	1,2

**TEXT BOOKS:**

**T1:** Public Nutrition, Indira Gandhi National Open University School of Continuing Education

**REFERENCE BOOKS:**

**R1:** Temple, N. J. and Steyn, N. Community Nutrition for Developing Countries Athabasca University Press and UNISAPress2016

**OTHER LEARNING RESOURCES:**

<https://www.youtube.com/watch?v=UT4uitoPnwk>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Familiarize with nutritional problems revealing among various communities in the society	<b>1, 8</b>
<b>2</b>	Enable to assess nutritional status of people/groups through different method of assessment.	<b>1,2,8</b>
<b>3</b>	Plan, implement and evaluate nutrition intervention programs to combat malnutrition	<b>1, 2</b>
<b>4</b>	Understand on national and international agencies to uplifting nutritional status	<b>1,2, 8</b>
<b>5</b>	Different method of assessing nutritional status.	<b>1,2,8</b>

SEMESTER – IV									
Course Title	COMMUNITY EXPERIENCE LEARNING (CEL)								
Course code	22BSFD225R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	IV								
Course Objectives	1. To familiarize the student with concepts of community, working with community and also organizations working in the field of health and nutrition								
CO1	Study the community as a concept and the dynamic formation of its structures								
CO2	Gain insight regarding the health issues faced in the community and communities understanding of their own issues.								
CO3	Prepare material for health and nutritional awareness.								
CO4	Explain various national and international health organizations								
CO5	Understand the programs in nutrition & Health								
Unit- No.	Content				Contact Hour	Learning Outcome			KL
I	<b>Concept of public nutrition:</b> Relationship between health and nutrition. The role of public nutritionists in the fields of health care and public policy related to nutrition and health				3	Learning the concept of public nutrition			
II	<b>Communicating with Communities:</b> Principles of Communication. Definitions of Communication. Functions of Communication. Types & Levels of Communication. Barriers in Communication: Collecting information on community–nutritional and health practices.				3	Learning about the communication			
III	<b>Communication Methods:</b> Interpersonal and group. Steps in community activity planning: Preparing visual aids–presentations, posters, charts, information booklets etc.				2	Learning about different communication method			
IV	<b>Traditional Media in Community Nutrition:</b> Role and use of theatre, folksongs, puppetry in creating awareness in the community.				4	Learning about community nutrition			
V	<b>Policies&amp;ProgramsinNutrition&amp;Health:</b> International organizations,NationalOrganizations,PrimaryHealthCar ein India4.Health Programs in India				3	Learning about programs in Nutrition & Health			

#### TEXT BOOKS:

- **Srilakshmi B.**, Community Nutrition, New Age International Pvt. Limited, First Edition, 2022.

#### REFERENCE BOOKS:

1. **Temple, N. J. and Steyn, N.**, Community Nutrition for Developing Countries Athabasca University Press and UNISA Press, 2016
2. **Park, K.:** Textbook of preventive and social medicine, 27th Edition, 2023.

#### OTHER LEARNING RESOURCES:

[https://www.researchgate.net/publication/233706475\\_Health\\_Nutrition\\_and\\_Public\\_Policy](https://www.researchgate.net/publication/233706475_Health_Nutrition_and_Public_Policy)

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Study the community as a concept and the dynamic formation of its structures	<b>1,2,3,5,7</b>
<b>2</b>	Gain insight regarding the health issues faced in the community and communities understanding of their own issues.	<b>1,2,3,5,7</b>
<b>3</b>	Prepare material for health and nutritional awareness.	<b>1,2,3,5,7</b>
<b>4</b>	Explain various national and international health organizations	<b>1,2,3,5,7</b>
<b>5</b>	Understand the programs in nutrition & Health	<b>1,2,3,5,7</b>

SEMESTER – IV									
Course Title	Campus to Corporate (Communicative English & Soft Skills)								
Course code	22UBPD213R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours:64	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ II semester of first year of the Programme								
Course Objectives	5. To acquaint students with the various tools of effective presentation. 6. To acquire the speaking skill instruct, influence, engage, educate, or appease the listeners. 7. To increase proficiency, present ability and quality of resume and provide guidance for self- promotion and self-evaluation in social media. 8. To prepare and train the students for the campus drives & walking interviews.								
CO1	Integrate presentation, communication, leadership, and interview skills.								
CO2	Apply skills in real-world scenarios.								
CO3	Reflect on personal development.								
CO 4	Collaborate effectively in group activities.								
CO 5	Demonstrate professionalism and ethical behavior.								
Unit- No.	Content		Contact Hour	Learning Outcome				KL	
I	<b>Presentation Skills:</b> Introduction; Essential characteristics of a good presentation; Preparation of a good presentation		8	By the end of this module, learners will understand the importance of effective presentation skills and be adept at preparing and delivering engaging presentations				1,2	
II	<b>Public Skills:</b> Fear of Public Speaking; Understanding and Overcoming Fear of Public Speaking; Confidence and Control; Physiology and Stress-Control/Process; Tips for Presentations and Public Speaking; Tips for Using Visual Aids in Presentations; Process for Preparing and Creating Presentations; Delivering Presentations Successfully; Doubt Clearing and Summary of Main Points		10	By course end, students master public speaking, gaining confidence, using visuals effectively, delivering engaging presentations, and summarizing key points adeptly while addressing doubts				1,2	
III	<b>Practical session on Resume, Curriculum Vitae, Writing cover letter &amp; LinkedIn Profile:</b> Preparation, submission & screening of Resume; Practical session on cover letter screening session; Creating profile in LinkedIn; How to utilize it?			Students master practical communication (resumes, cover letters, LinkedIn) and leadership concepts through mock sessions, enhancing interview skills with dress code awareness				1,2	
IV	<b>Leadership &amp; Management Skills:</b> Concepts of Leadership; Leadership Styles; Manager VS Leader; How to be an Effective Leader?; Mock/Practice Session; Doubt Clearing Session		10	Students will learn leadership concepts and styles, differentiate between managers and leaders, and develop effective leadership skills through mock sessions and doubt-clearing exercises.				1,2	

<b>V</b>	<b>Interview Skills &amp; Dress code Ethics:</b> Types of interview-telephonic, virtual & face to face; Online interview, personal interview; Panel interview; Group interview; JAM session; Types of interview questions-traditional/common interview questions; Case interview questions; General Strategies for answering questions; Marketing your skills and experiences; Preparation before the interview; How to dress up for an interview?; How to maintain eye contact and positive body language; How to be presentable?; Interview dos and don'ts?; Introduction to Dress Code Ethics; Purpose and Importance; How to Make FIRSTIMPRESSION; What to Wear During Interviews or Any Other Formal Meetings – Male &Female.	<b>10</b>	excel in diverse interview formats, grasp dress code ethics, and make a positive impression with appropriate attire and confident body language.	1,2
<b>VI</b>	<b>Mock Interview:</b> Practical Mock Interview; Feedback-Receiving Feedback; Giving Feedback; Advantages of Effective Feedback; How to deal with negative feedback?	<b>60</b>	engage in practical mock interviews, learning to give and receive constructive feedback effectively, and handle negative feedback	1,2,3,4

**REFERENCE BOOKS:**

R1: Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

R2: McDowell, Gayle Laakmann.2008.Cracking the Coding Interview (Indian Edition)

**OTHER LEARNING RESOURCES:**

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9134667/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1.	Integrate presentation, communication, leadership, and interview skills.	6,7
2.	Apply skills in real-world scenarios.	6,7
3.	Reflect on personal development.	6,7
4.	Collaborate effectively in group activities.	6,7
5.	Demonstrate professionalism and ethical behavior.	5,6,7



SEMESTER – IV									
Course Title	Extra-Curricular Activities								
Course code	22UBEC221	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<p>3. To ascertain physical and mental development of the students and select best performers for state, national and international level competition.</p> <p>4. To enhance and improve student’s talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.</p>								
CO1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.								
CO2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.								
CO3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.								
Unit- No.	Content	Contact Hour	Learning Outcome	KL					
I	Based on the learner’s interest they can participate in various sports, music, and co-curricular activities joining the clubs of the University (Football, Footshal; Cricket; Swimming; Basket ball; Badminton; Table Tennis; athletics and other outdoor and indoor games; Dance; Music; Vocals; Photography;Drama;Literary activities); The students are encouraged to participate in regular club activities, workshops, competitions as per their interest and hobbies; Renowned skilled professionals/ personalities are invited organising workshops to promote the talents of the students.	60	Participation in university clubs across sports, music, and extra-curricular activities cultivates diverse skills and personal growth. Students develop teamwork, leadership, and creativity through sports like football, cricket, and athletics. Musical pursuits and dance foster self-expression and coordination, while literary and drama activities enhance communication and critical thinking. Workshops led by skilled professionals provide industry insights and mentorship opportunities, preparing students for future challenges. By encouraging participation based on interests and hobbies, universities nurture well-rounded individuals who excel academically and socially, equipped with practical skills and a broadened perspective on cultural diversity and personal fulfilment.	1,2					

**REFERENCE BOOKS:**

R1: "Extracurricular Activities: Essential Guides for Students" by John G. Gabriel

R2: "Developing Personal, Social and Emotional Skills through Extra-Curricular Activities" by Sally Bailey

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Identify and describe various sports, music, and co-curricular activities available at the university, and explain the benefits of participating in these activities.	6,8
2	Apply skills and techniques learned in workshops and club activities to participate effectively in sports, music, and other co-curricular competitions, and analyze their performance to identify areas of improvement.	6,8
3	Discuss the reflective essay or presentation assessing how involvement in various activities has contributed to their personal and professional growth, and design a plan for future engagement and skill development.	6,8

SEMESTER – IV									
Course Title	Co-Curricular Activities								
Course code	22UBEC211	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 60	0	0	0	4	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ I semester of first year of the Programme								
Course Objectives	<ol style="list-style-type: none"> <li>To ascertain physical and mental development of the students and select best performers for state, national and international level competition.</li> <li>To enhance and improve student's talents in the field of sports, yoga, music, dance, drama, etc through AdtU club activities and workshops.</li> </ol>								
CO1	Students will learn to work well with others and communicate better.								
CO2	Students will learn to manage their time and stay organized.								
CO3	Students will enhance their creative abilities and think more critically.								
CO4	Students will improve their overall health and reduce stress.								
CO5	Students will become more aware of their role in society and contribute positively.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	<p>Co-curricular activities cover a wide range of experiences and pursuits that complement academic learning. They are typically organized and managed within educational institutions or communities and play a crucial role in holistic development. Some examples are</p> <ol style="list-style-type: none"> <li>Sports and Physical Activities</li> <li>Cultural Activities:</li> <li>Academic Clubs and Competitions</li> <li>Community Service and Volunteering</li> <li>Leadership and Personal Development</li> <li>Creative and Hobby-based Activities</li> </ol>		60	<p><b>Skill Development:</b> Enhancing skills such as teamwork, leadership, communication, and critical thinking.</p> <p><b>Holistic Growth:</b> Supporting emotional, social, and physical development alongside academic learning.</p> <p><b>Building Networks:</b> Creating opportunities to interact with peers, mentors, and professionals.</p> <p><b>Personal Fulfillment:</b> Providing avenues for creativity, self-expression, and exploring personal interests.</p>				1,2	

#### REFERENCE BOOKS:

R1: "Co-curricular Activities: A Pathway to Careers" by Ferguson.

R2: "Rahman, S.R., Islam, M.A., Akash, P.P., Parvin, M., Moon, N.N. and Nur, F.N., 2021. Effects of co-curricular activities on student's academic performance by machine learning. *Current Research in Behavioral Sciences*, 2, p.100057.

**OTHER LEARNING RESOURCES:**

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will learn to work well with others and communicate better.	6,7
2	Students will learn to manage their time and stay organized.	6,7
3	Students will enhance their creative abilities and think more critically.	6,7
4	Students will improve their overall health and reduce stress.	6,7
5	Students will become more aware of their role in society and contribute positively.	6,7

SEMESTER – III									
Course Title	BASIC ACCLIMATIZING SKILLS (BAS)								
Course code	22UULS201R	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours: 30P	0	0	1	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Food Nutrition and Dietetics								
Semester	Fall/ III semester of second year of the programme								
Course Objectives (Minimum 3)	1. To impart knowledge of the fundamentals of Hospitality industry and its applications. 2. Students will be able to familiarize with the cooking equipments & Utensils. 3. Students will be able to handle different modes of reservations.								
CO1	Students will have basic knowledge of cooking methods.								
CO2	Students will gain the knowledge of organizing & Cleaning of Rooms.								
CO3	Students will be able to gain the travel management concept.								
CO4	Students will be able to acquire the knowledge of basic household amenities for day-to-day use.								
Unit-No.	Content		Contact Hour	Learning Outcome					KL
I	Introduction to Accommodation Management: Telephone handling technique, Organizing of Rooms. Cleaning agents. Cleaning equipments and uses. Bed making Process		5						1,2
II	Fundamentals of Cooking Definition of cookery – Aim & Objectives of cooking. Use of basic Cooking equipments • Personal Hygiene and Safety Use of Fire & Fuels		5						1,2
III	Methods of Cooking Different Cuts. Use of Herbs and Spices. Basic Food and Beverage Preparation. Regional food Habits.		5						1,2
IV	Forms & Format's C – form Reservation form Registration form Passport Application form Legal Rent Agreement		5						1,2

#### REFERENCE BOOKS:

R1: Nancy Caroline's Emergency Care in the streets eight edition by Jones and Bartlett

R2: First Aid book by LC Gupta; Publisher Jaypee Brothers, 7th Edition.

#### OTHER LEARNING RESOURCES:

<https://www.prospects.ac.uk/applying-for-university/university-life/the-importance-of-extra-curricular-activities>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
1	Students will have basic knowledge of cooking methods.	1,8
2	Students will gain the knowledge of organizing & Cleaning of Rooms.	1,8
3	Students will be able to gain the travel management concept.	1,8
4	Students will be able to acquire the knowledge of basic household amenities for dayto-day use.	1,8

**SEMESTER V**

SEMESTER V									
Course Title	ADVANCE DIETETICS AND COUNSELING								
Course code	22BSFD311R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	V								
Course Objectives (Minimum 3)	1. To study about different metabolic and systemic diseases and nutrient drug interactions. 2. To study about the different nutrient modification at different disease state. 3. To acquire knowledge of therapeutic medications for specific diet								
CO1	Learn and discuss the different aspect of dietician in healthcare sector. Acquire the knowledge of the relationship of dietician with health and develop skills required in Nutritional counseling								
CO2	Learn and apply adaptation of therapeutic diets in different disease state								
CO3	Acquired knowledge on nutritional management in infections and fever								
CO4	Apply the importance of therapeutic diet in cardiovascular disease, diabetes and gout.								
CO5	Evaluate the significance in the modifications of diet in gastrointestinal diseases. Understand different Malabsorption Syndrome								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
<b>I</b>	Nutritional care for metabolic disorders- Diabetes mellitus: Types, etiology, symptoms, metabolic changes and dietary management.  Gout, phenylketonuria, lactose intolerance, hypo and hyper thyroidism-Causes, symptoms and dietary management.	<b>10</b>	Learn the importance of application of therapeutic diet in different conditions.				<b>1,2</b>		
<b>II</b>	Nutritional care for diseases of cardiovascular systems-Hypertension, hyperlipidaemia, atherosclerosis, coronary heart disease, congestive heart failure: Etiology, symptoms and dietary management. Relationship between dietary fat and development of cardiovascular diseases.	<b>9</b>	Understand and describe different cardiovascular disease and modify the diet according to the disease condition of the patient				<b>1,2</b>		
<b>III</b>	Nutritional care for diseases of kidney and urinary tract- Nephritis, nephritic syndrome, nephrolithiasis, renal failure: Etiology, symptoms, dietary management and renal dialysis.	<b>8</b>	Understand and describe different renal diseases and modify the diet according to the disease condition of the patient				<b>1,2</b>		
<b>IV</b>	Nutritional care for cancer and aids: Causative and risk factors, chronic complications, different stages of both the disorders, dietary modifications, food to be included and foods to be avoided.  Food Allergy – Diagnosis and treatment. Surgery, trauma and burns- Physiological	<b>10</b>	Develops the skills to use the knowledge of modifying the diet according to the disease condition of the patient Understand the term surgery and will be able to guide and modify the diet according to the disease condition and				<b>1,2</b>		

	changes, nutritional care and management. Use of food exchange list in diet planning.		nutritional requirement of the patient	
<b>V</b>	Nutritional care in eating disorders: Dietary treatment and other recommendation, addictive behavior in anorexia nervosa, bulimia & alcoholism. v Nutrient drug interaction.  Patient education and counseling- Assessment of patient needs, establishing rapport, counseling relationship, resources and aids to counseling.	<b>8</b>	Describe the term dietician and different roles played. Understand the relationship of dietician with health and develop skills required in nutritional counseling	<b>1,2</b>
<b>VI</b> <b>Practical</b>	Planning, preparation and calculation of diets for insulin dependent Diabetes mellitus.	<b>2</b>	Understand, apply and assess the patient suffering from diabetes and plan the modified diet accordingly	<b>1,2,3,4</b>
	Planning snacks, desserts and beverages for diabetes.	<b>2</b>	Plan the therapeutic diet according to the modified requirement of the patient	<b>1,2,3,4</b>
	Planning, preparation and calculation of diet in cardio vascular diseases.	<b>2</b>	Understand, apply and assess the patient suffering from cardiovascular disease and plan the modified diet accordingly	<b>1,2,3,4</b>
	Planning, preparation and calculation of diet in kidney failure, kidney transplant, renal complication and kidney stones.	<b>4</b>	Understand, apply and assess the patient suffering from kidney disease and plan the modified diet accordingly	<b>1,2,3,4</b>
	Planning, preparation and calculation of diet in cancer.	<b>2</b>	Plan the therapeutic diet according to the modified increased requirement of the patient	<b>1,2,3,4</b>

**TEXT BOOKS:**

T1: **Srilakshmi B.**, Dietetics, New Age International (P) limited Publications, 2004.

T2: **Singh J.**, Handbook of Nutrition and Dietetics, Lotus Press, 2012

**REFERENCE BOOKS:**

R1: Joshi, S. A., Nutrition and Dietetics, Tata McGraw Hill Publications, New Delhi, 2004.

R2: Srilakshmi B., Dietetics, New Age International (P) limited Publications, 2004.

**OTHER LEARNING RESOURCES:**

[https://www.researchgate.net/publication/332318698\\_Counselling\\_Skills\\_for\\_a\\_Dietitian](https://www.researchgate.net/publication/332318698_Counselling_Skills_for_a_Dietitian)



**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Learn and discuss the different aspect of dietician in healthcare sector. Acquire the knowledge of the relationship of dietician with health and develop skills required in Nutritional counseling	<b>1,8</b>
<b>2</b>	Learn and apply adaptation of therapeutic diets in different disease state	<b>1,2</b>
<b>3</b>	Acquired knowledge on nutritional management in infections and fever	<b>1,2</b>
<b>4</b>	Apply the importance of therapeutic diet in cardiovascular disease, diabetes and gout.	<b>1,2</b>
<b>5</b>	Evaluate the significance in the modifications of diet in gastrointestinal diseases. Understand different Malabsorption Syndrome	<b>1,8</b>

SEMESTER V									
Course Title	FOOD PRODUCT DEVELOPMENT AND QUALITY CONTROL								
Course code	22BSFD312R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	V								
Course Objectives (Minimum 3)	1. To know about the concept of product development. 2. To study about steps involved in development of new products and quality control of the products.								
CO1	Reflect on the role of food trends in the new product development process								
CO2	Design a food product through the application of knowledge of food ingredients and Functional foods								
CO3	Create and evaluate a product using the development process; Design and apply packaging For food products								
CO4	Acquired knowledge on evaluating product quality and sensory properties								
CO5	Combine theoretical knowledge and practical skills to reproduce existing food products by ensuring proper food standards								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
I	<b>New food product-</b> Definition, classification, factors shaping new product development: social concern, health concern, impact of market place influence and technology.	8	Reflect on the role of food trends in the new product development process					1,2	
II	<b>Product development-</b> Steps, standardization methods. Portion size and portion control; Calculation of nutritive value and cost of production. Shelf life and storage stability evaluation procedure.	8	Design a food product through the application of knowledge of food ingredients and Functional foods					1,2	
III	<b>Product evaluation-</b> Development of scorecard and analysis of data. Selection and training of judges. <b>Packaging-</b> Suitability, development of packages and Labeling.	10	Create and evaluate a product using the development process; Design and apply packaging For food products					1,2	
IV	<b>Quality control</b> – Objectives, importance, functions of quality control, stages of quality control in food industry. <b>Food quality assurance</b> – Design of company quality assurance program and microbiological concerns. Managing quality in supply chain and marketing of food products.	9	Evaluate product quality and sensory properties					1,2	
V	<b>Government regulations in quality control</b> –FAO/WHO codex Alimentarius commission, PFA, AGMARK, BIS, FPO, fair average quality (FAQ) specification for foodgrains, ISO9000 series. <b>HACCP</b> –Background, principles, benefits	10	Combine theoretical knowledge and practical skills to reproduce existing food products by ensuring proper food standards					1,2	

	and limitation. Consumer Protection Act (CPA) <b>Food adulteration</b> – Common adulterants and tests to detect common adulterants.			
<b>VI</b> <b>Practical</b>	Introduction on developing various food products and selection of target group.	<b>2</b>	Reflect on the role of food trends in the new product Development process	<b>1,2,3,4</b>
	Market survey and Preparation of questionnaire.	<b>2</b>	Learning about trends and innovation in food markets and developing a questionnaire	<b>1,2,3,4</b>
	Standardization of recipe, Preparation method, sensory evaluation.	<b>4</b>	Quality and sensory testing for food products; evaluate product quality and sensory properties	<b>1,2,3,4</b>
	Shelf life, packaging, labeling, costing, storage, transportation and distribution, advertising	<b>2</b>	Evaluation of food shelf life and development of food packaging for food products	<b>1,2,3,4</b>
	Report writing and Presentation.	<b>4</b>	Combine theoretical knowledge and practical skills for established products and learning to present as a report	<b>1,2,3,4</b>

**TEXT BOOKS:**

T1: **Fuller, G. W.** New food product development. Taylor and Francis, CRC Press, 2011

**REFERENCE BOOKS:**

R1: **Fuller, G. W.** New food product development. Taylor and Francis, CRC Press, 2011

**OTHER LEARNING RESOURCES:**

<https://www.destechpub.com/wp-content/uploads/2015/01/Methods-for-Developing-New-Food-Products-preview.pdf>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Develop novel nutrient dense food products	<b>1,2,5,6</b>
<b>2</b>	Interpret the importance of quality control and food safety.	<b>1,2,5,6</b>
<b>3</b>	Discover different packaging material	<b>1,2,5,6</b>
<b>4</b>	Acquired knowledge on the techniques of food development	<b>1,2,5,6</b>
<b>5</b>	Learn different government scheme and regulations for food safety	<b>1,2,5,6</b>

SEMESTER V									
Course Title	Entrepreneurship Development								
Course code	22BSFD313R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	V								
Course Objectives (Minimum 3)	1. To know about the concept of entrepreneurship. 2. To study about role and responsibilities of entrepreneur.								
CO1	Learn about key concepts of entrepreneurship and its application in the product development								
CO2	Engage with a range of entrepreneurs to deliver creative and sustainable solutions to Specific problems								
CO3	Learn about emerging entrepreneurs and design creative strategies for pursuing, exploiting and further developing new opportunities								
CO4	Learn about key concepts under pinning innovation and the issues associated with developing and sustaining innovation within organizations								
CO5	Learn about issues associated with securing and managing financial resources in new and established organisations; respond positively and effectively to problems in unfamiliar contexts								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Introduction to Entrepreneurship:  Unit1-Definition, Concept and Need for entrepreneurship.  Unit 2- Types of entrepreneurs: Spontaneous, Motivated and Induced. (Explain and discuss case studies in class and invite different types of entrepreneurs to share the reasons and causes to entrepreneurship as a profession)  Unit 3- Kinds of Entrepreneurship: Proprietary, Partnership and Group Entrepreneurship. (Explain and discuss case studies in class and invite different kinds of entrepreneurs to share their experiences and talk about the advantages and disadvantages of proprietary partnership and group enterprises)	10	Learn about key concepts under pinning entrepreneurship and its application in the recognition and exploitation of product/service/ process opportunities						
II	Exploring the World of Entrepreneurs:  Unit 1- Legendary, Business, Social and Environmental,  Artistic and Aesthetic Entrepreneurs (Students to document case studies and present using different audiovisual aids, maybe individual or group activity) Unit 2- Entrepreneurs in Shadows, failed Entrepreneurship (Students to Document case studies and present using different audiovisual aids, maybe individual or group activity)	8	Engage with a range of entrepreneurs to deliver creative and sustainable solutions to Specific problems						

<p><b>III</b></p>	<p>New Internet Entrepreneurs. (Students to document case studies and present using different audio visual aids, may be individual or group activity)</p> <p>Entrepreneurial Assets</p> <p>Unit 1- Entrepreneurial Values and attitudes.</p> <p>Unit2-Entrepreneurial Qualities.</p> <p>Unit 3- Role demands and Requirements of Entrepreneurs.</p> <p>Unit4-Barriers to entrepreneurship.</p> <p>(Teachers to discuss and expose students to entrepreneurs to share their views and importance they give to particular entrepreneurial values, attitudes, qualities, role demands, requirements and barriers)</p>	<p><b>9</b></p>	<p>Learn about emerging entrepreneurs and design creative strategies for pursuing, exploiting and further developing new opportunities</p>	
<p><b>IV</b></p>	<p>Entrepreneurial Motivation</p> <p>Unit1-Definition and Meaning of Achievement Motivation.</p> <p>Unit 2- Need for Achievement Motivation</p> <p>Unit 3- Motivating Factors: Internal and External.</p> <p>(Teachers to explain with examples)</p> <p>Entrepreneurial Ideas</p> <p>Unit1- Creativity and Idea Generation</p> <p>Unit 2- Searching and selecting Entrepreneurial Ideas.</p> <p>Unit3-Dynamics of project Identification.</p> <p>Unit4-Matching Project and enterprise. (Teachers to guide students)</p> <p>Unit5- Gather information on what works, how to succeed and mistakes to avoid.</p> <p>(Students to interact with particular business persons related to their identified project/ field of interest, have brain storming sessions and share ideas and strategies in class)</p> <p>Unit 6 - Select research articles written about the industry related to their product or service.</p> <p>Organize visits to industries and organizations helping entrepreneurship.</p>	<p><b>10</b></p>	<p>Learn about key concepts under pinning innovation and the issues associated with developing and sustaining innovation within organizations</p>	
<p><b>V</b></p>	<p>Gaining Personal Focus and Developing Skills</p> <p>Unit 1- Communication Skills: Written and verbal communication.</p> <p>Unit 2- Barriers to communication.</p> <p>Unit 3- Developing Listening skills. (Teachers to explain the dos and don'ts of communication. Students to practice written and spoken office communication.</p>	<p><b>8</b></p>	<p>Learn about issues associated with securing and managing financial resources in new and established organisations; respond positively and effectively to problems in unfamiliar contexts</p>	

Unit 3- Personality Development: experts in the field to take sessions with students. Unit4-Gaining Personal Focus: Defining one's own Intentions, goals and purpose. Internal Intentions: (Students to share what business will accomplish for him/her in life, like prestige, economic independence etc. External Intentions: (Students to describe how and who the business will help)			
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**TEXT BOOKS:**

T1: **Manimala, M. J.** Entrepreneurship Theory at the Crossroads: Paradigms and Praxis, 2005

**REFERENCE BOOKS:**

R1: **Manimala, M. J.** Entrepreneurship Theory at the Crossroads: Paradigms and Praxis, 2005

**OTHER LEARNING RESOURCES:**

<https://www.researchgate.net/publication/275667239> The role of personal purpose and personal goals in symbiotic visions

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Learn about key concepts of entrepreneurship and its application in the product development	1,2,3,4
2	Engage with a range of entrepreneurs to deliver creative and sustainable solutions to Specific problems	1,2,3,4
3	Learn about emerging entrepreneurs and design creative strategies for pursuing, exploiting and further developing new opportunities	1,2,3,4
4	Learn about key concepts under pinning innovation and the issues associated with developing and sustaining innovation within organizations	1,2,3,4
5	Learn about issues associated with securing and managing financial resources in new and established organisations; respond positively and effectively to problems in unfamiliar contexts	1,2,3,4

SEMESTER V									
Course Title	DIET COUNSELING AND PATIENT CARE								
Course code	22BSFD314R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	V								
Course Objectives (Minimum 3)	<ol style="list-style-type: none"> <li>To review about various techniques used in counselling.</li> <li>To understand the use of various types and techniques of counselling in order to motivate patients to achieve well-being</li> </ol>								

<b>CO1</b>	Understand the principles and procedures of diet counseling and the role of the counselor.			
<b>CO2</b>	Give them a clear picture of influence of lifestyle on health and wellbeing.			
<b>CO3</b>	Analyze how acute and chronic illness affects the emotional, psychological well being and behavior of the individuals.			
<b>CO4</b>	Learn the techniques and skill of dietitian			
<b>CO5</b>	Evaluate the significance of dietitian in modifications of therapeutic diet			
<b>Unit- No.</b>	<b>Content</b>	<b>Contact Hour</b>	<b>Learning Outcome</b>	<b>KL</b>
<b>I</b>	Diet Counselling –Definition, counselling process-interviewing, counseling and consulting, role of the dietitian, code of ethics, limits. Techniques for obtaining relevant information: nutritional status assessment-anthropometry, clinical information, medical history and general profile, dietary assessment- diet history, 24 hr diet recall, MNA, FFQ, lifestyles, physical activity, stress Theories of counselling, approaches and techniques	<b>8</b>	Learn about the Role of a dietitian, ethical codes and responsibilities, assessment of nutritional status and techniques of counseling	
<b>II</b>	Developing resources and nutritional aids for education and counseling Developing nutritional assessment form (for ambulatory and non-ambulatory patients) Working with Hospitalized patients and Outpatients Follow up Monitoring and Evaluation of outcome	<b>8</b>	Learn to develop counseling techniques, planning of modified diet charts according to different conditions	

#### REFERENCE BOOKS:

**R1.** "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches" by John W. Creswell and J. David Creswell

**R2.** "The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams

**R3.** Research Methodology: Methods and Techniques" by C.R. Kothari

#### OTHER LEARNING RESOURCES:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6153617/>

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
<b>1</b>	Understand the principles and procedures of diet counseling and the role of the counselor.	<b>1,2,3,8</b>
<b>2</b>	Give them a clear picture of influence of lifestyle on health and wellbeing.	<b>1,2,3,8</b>
<b>3</b>	Analyze how acute and chronic illness affects the emotional, psychological well being and behavior of the individuals.	<b>1,2,3,8</b>
<b>4</b>	Learn the techniques and skill of dietitian	<b>1,2,3,8</b>
<b>5</b>	Evaluate the significance of dietitian in modifications of therapeutic diet	<b>1,2,3,8</b>

SEMESTER V									
Course Title	INTERNSHIP (3month)								
Course code	22BSFD317R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	0	0	0	0	0	48	6
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	V								
Course Objectives (Minimum 3)	To gain hands on experience of working in various institutions related to the area of Food and Nutrition. To learn the inter-relationship and intra-relationship between the employee								
CO1	Extend field experience to apply therapeutic intervention strategies in hospital/industry setup								
CO2	Apply therapeutic knowledge and acquire practical skills in the field of expertise								
CO3	Evaluate and manage hospitalized patients with nutrition intervention strategies								
CO4	Analyze thoughtful assessments and plans for evaluation and management in the work environment								
CO5	Identify the scope of exposure and employment opportunities in the relevant field								

**Hospital internship will be continued in the downtown hospital for 45 days.**

1. **Front page:** Name of University, University Logo, Name of the Student, Class, Department
2. **Certificate**
3. **Acknowledgement**
4. **Contents**
5. **Introduction**
6. **Activities**
  - A. **Activity I: Internship details**
    - Name of the Institution where the internship was undertaken
    - Dietitian incharge under whose Supervision Internship undertaken (Name and Designation)
    - Duration and date of internship
    - Dietetic department profile and organization
    - Posting schedule of the intern

Day/week	Posting	Activities schedule and undertaken

- Kitchen layout
- Food procurement and storage
- Schedule/timing for meal distribution
- Dietetic department menu

- B. **Activity II: Modified therapeutic diets and special feeding methods**



**C. Activity III: Clinical posting and nutritional care of patients**

- i. Ward posting detail
  - Major disease conditions observed and Medical Nutrition Therapy recommended during ward posting

Sl.No	Ward Posting	Major disease conditions observed	Recommended diets

- ii. Nutrition and diet counseling
  - List of educational material available
  - Nutrition and diet counselling for both In and Out patients

Date/Time	IPD/OPD Posting	Counseling details

Note: Separate table for IPD and OPD

**D. Activity IV: Case studies**

**-Disease case**

Case problem (indicate the disease condition)

**-Patient profile**

Patient name

Age

Weight (kg)

Food habits Occupation

Educational qualification lifestyle

Date of admission

Date of discharge

Duration of stay

Medical diagnosis

Past history

**Medical history of the case**

- **Present problem**
- **Physical parameters examination**
- **Biochemical parameters**

Parameters analyzed	At the time of admission	At the time of discharge	Normal values during the treatment

**Management and treatment details**

- i. Drug therapy (give the name of the drug/injections etc given/prescribed)
- ii. Blood glucose monitoring (record in tabular form and follow-up the patient's blood glucose level if analyzed before breakfast, before lunch and/or before dinner the period of hospitalization). (note: only for diabetes mellitus)

- iii. Dietary management of the disease condition
- iv. Nutrition/diet counseling
- v. Care prognosis:(comment on the portable course and outcome with respect to patient's condition/after the disease treatment in the hospital)
- vi. Case study outcome: (brief highlights how the case study helped in your understanding of the dietary management of the disease condition under study)

**E. Activity V: Presentation**

- 1. Annexure/Appendices:** Abbreviations, Biochemical Parameters, Portion Size, Diet Sheets etc

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Extend field experience to apply therapeutic intervention strategies in hospital/industry setup	<b>1,2,3,4,5</b>
<b>2</b>	Apply therapeutic knowledge and acquire practical skills in the field of expertise	<b>1,2,3,4,5</b>
<b>3</b>	Evaluate and manage hospitalized patients with nutrition intervention strategies	<b>1,2,3,4,5</b>
<b>4</b>	Analyze thoughtful assessments and plans for evaluation and management in the work environment	<b>1,2,3,4,5</b>
<b>5</b>	Identify the scope of exposure and employment opportunities in the relevant field	<b>1,2,3,4,5</b>

SEMESTER VI									
GERIATRIC AND PEDIATRIC NUTRITION									
Course Title									
Course code	22BSFD321R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	2	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	VI								
Course Objectives (Minimum 3)	1. To know the nutritional requirements at different stages from infancy to adolescence and the recommendations/guidelines of expert groups 2. Understand the multifaceted aspects of aging.								
CO1	Understand the specific needs of children and the effects of various diseases on nutritional status and nutritional requirements at these stages of the life cycle.								
CO2	Understand the specific needs of elderly and the effects of various diseases on nutritional status and nutritional requirements at these stages of the life cycle								
CO3	Analyze for recommend / provide appropriate nutritional care based on pathophysiology, prevention/ and treatment of the various diet-related disorders/diseases								
CO4	Learn the significance relationship between the feeding of nutrients in old age								
CO5	Learn the significance relationship between the feeding of nutrients in infant								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Infant and young child feeding practices-breastfeeding, composition, advantages, artificial feeding, infant formulas, advantages & disadvantages, supplementary feeding, weaning Infancy- growth & development, nutritional requirements, preterm & LBW infant Childhood (toddlers, preschoolers, school children)-growth & development, nutritional requirements, Adolescence-growth & development, body composition, nutritional requirements	5	Learn different feeding practices; learn about the physical and social changes taking place during childhood and Adolescence						
II	Nutritional problems in childhood-PEM,SAM, VADD, nutritional anemia, obesity and their nutritional management	3	Have knowledge about nutritional problems occurring in Childhood						
III	Process of ageing, physiological changes and impact on nutritional status, nutritional requirements, food requirements, modification of diet Use of various modern and traditional approaches in promoting fitness and well-being of elderly	4	Learn the physical and social changes taking place during the elderly period of life						
IV	Nutritional problems in elderly- undernutrition, obesity, osteoporosis, neurological dysfunction, anemia, constipation and their nutritional management	4	Have knowledge about the diseases caught by the Elderly people and their nutritive demands						

#### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand the specific needs of children and the effects of various diseases on nutritional status and nutritional requirements at these stages of the life cycle.	1,2,8
2	Understand the specific needs of elderly and the effects of various diseases on nutritional status and nutritional requirements at these stages of the life cycle	1,2,8
3	Analyze for recommend / provide appropriate nutritional care based on pathophysiology, prevention/ and treatment of the various diet-related disorders/diseases	1,2,8
4	Learn the significance relationship between the feeding of nutrients in old age	1,2,8
5	Learn the significance relationship between the feeding of nutrients in infant	1,2,8

SEMESTER VI									
Course Title	INTERNSHIP (3month)								
Course code	22BSFD317R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	0	0	0	0	0	48	6
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	VI								
Course Objectives (Minimum 3)	To gain hands on experience of working in various institutions related to the area of Food and Nutrition. To learn the inter-relationship and intra-relationship between the employee								
CO1	Extend field experience to apply therapeutic intervention strategies in hospital/industry setup								
CO2	Apply therapeutic knowledge and acquire practical skills in the field of expertise								
CO3	Evaluate and manage hospitalized patients with nutrition intervention strategies								
CO4	Analyze thoughtful assessments and plans for evaluation and management in the work environment								
CO5	Identify the scope of exposure and employment opportunities in the relevant field								

**Hospital internship will be continued in the downtown hospital for 45 days.**

**7. Front page:** Name of University, University Logo, Name of the Student, Class, Department

**8. Certificate**

**9. Acknowledgement**

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**12. Activities**

**A. Activity I: Internship details**

- Name of the Institution where the internship was undertaken
- Dietitian incharge under whose Supervision Internship undertaken (Name and Designation)
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- Dietetic department profile and organization

- Posting schedule of the intern

Day/week	Posting	Activities schedule and undertaken

- Kitchen layout
- Food procurement and storage
- Schedule/timing for meal distribution
- Dietetic department menu

**B. Activity II: Modified therapeutic diets and special feeding methods**

**C. Activity III: Clinical posting and nutritional care of patients**

iii. Ward posting detail

- Major disease conditions observed and Medical Nutrition Therapy recommended during ward posting

Sl.No	Ward Posting	Major disease conditions observed	Recommended diets

iv. Nutrition and diet counseling

- List of educational material available
- Nutrition and diet counselling for both In and Out patients

Date/Time	IPD/OPD Posting	Counseling details

Note: Separate table for IPD and OPD

**D. Activity IV: Case studies**

**-Disease case**

Case problem (indicate the disease condition)

**-Patient profile**

Patient name

Age

Weight (kg)

Food habits Occupation

Educational qualification lifestyle

Date of admission

Date of discharge

Duration of stay

Medical diagnosis

Past history

**Medical history of the case**

- **Present problem**

- **Physical parameters examination**
- **Biochemical parameters**

Parameters analyzed	At the time of admission	At the time of discharge	Normal values during the treatment

### Management and treatment details

- i. Drug therapy (give the name of the drug/injections etc given/prescribed)
- ii. Blood glucose monitoring (record in tabular form and follow-up the patient's blood glucose level if analyzed before breakfast, before lunch and/or before dinner the period of hospitalization). (note: only for diabetes mellitus)
- iii. Dietary management of the disease condition
- iv. Nutrition/diet counseling
- v. Care prognosis:(comment on the portable course and outcome with respect to patient's condition/after the disease treatment in the hospital)
- vi. Case study outcome: (brief highlights how the case study helped in your understanding of the dietary management of the disease condition under study)

#### E. Activity V: Presentation

2. **Annexure/Appendices:** Abbreviations, Biochemical Parameters, Portion Size, Diet Sheets etc

### RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Extend field experience to apply therapeutic intervention strategies in hospital/industry setup	1,2,5,7
2	Apply therapeutic knowledge and acquire practical skills in the field of expertise	1,2,5,7
3	Evaluate and manage hospitalized patients with nutrition intervention strategies	1,2,5,7
4	Analyze thoughtful assessments and plans for evaluation and management in the work environment	1,2,5,7
5	Identify the scope of exposure and employment opportunities in the relevant field	1,2,5,7

SEMESTER VI									
RESEARCH PROJECT PART II									
Course Title									
Course code	22BSFD323R	Total credits:	L	T	P	S	R	O/F	C
		Total hours:	0	0	12	0	0	0	6
Pre-requisite	Nil	Co-requisite	Nil						
Programme	B.Sc. Food, Nutrition & Dietetics								
Semester	VI								
Course Objectives (Minimum 3)	1. Appreciate and understand the importance of various research writing and review 2. Collect data for evaluation and for statistical treatment, if relevant, 3. Learning to write abstract and short communication								
CO1	Develop a research proposal, formulating research questions, reviewing literature, interpreting data, and understanding the implications of research findings.								
CO2	Develop skills in crafting a concise and well-structured research proposal.								
CO3	Learn to formulate research questions, objectives, and hypotheses.								
CO4	Conduct a focused review of relevant literature related to the chosen mini research topic.								
CO5	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.								

**REFERENCE BOOKS:**

**R1.** "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches" by John W. Creswell and J. David Creswell

**R2.** "The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams

**R3.** "Research Methodology: A Step-by-Step Guide for Beginners" by Ranjit Kumar.

**OTHER LEARNING RESOURCES:**

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5037944/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
	Develop a research proposal, formulating research questions, reviewing literature, interpreting data, and understanding the implications of research findings.	1,2,3
	Develop skills in crafting a concise and well-structured research proposal.	1,2,3
	Learn to formulate research questions, objectives, and hypotheses.	1,2,3
	Conduct a focused review of relevant literature related to the chosen mini research topic.	1,2,3
	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.	1,2,3

**REFERENCE BOOKS:**

**R1.** "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches" by John W. Creswell and J. David Creswell

**R2.** "The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams

**R3.** "Research Methodology: A Step-by-Step Guide for Beginners" by Ranjit Kumar.

**OTHER LEARNING RESOURCES:**

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5037944/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
	Develop a research proposal, formulating research questions, reviewing literature, interpreting data, and understanding the implications of research findings.	1,2,3
	Develop skills in crafting a concise and well-structured research proposal.	1,2,3
	Learn to formulate research questions, objectives, and hypotheses.	1,2,3
	Conduct a focused review of relevant literature related to the chosen mini research topic.	1,2,3
	Learn to interpret data, draw meaningful conclusions, and relate results to the research question.	1,2,3



**MAPPING TABLE**

Course code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
22BSFD111R	Basics of Food Science	3			.	.	.	.	.
22BSFD112R	Human Nutrition	3			.	.	.	.	.
22BSFD113R	Nutrition through life cycle	3	2		.	.	.	.	.
22BSFD114R	Basics of human physiology	3	2		.	.	.	.	.
22UBPD113R	PDP 1 (Introductory English)		.	3	.	.	.	.	.
22UBEC111R	Extra-Curricular	.	.	.	.	.	.	2	.
22BSFD121R	Food Sanitation & Hygiene	3	.	.	.	.	.	.	.
22BSFD122R	Applied Food Science	3	.	.	.	.	.	.	.
22BSFD123R	Food Preservation	3	.	.	.	.	.	.	.
22BSFD124R	Adv. Human Physiology	3	.	.	.	.	.	.	.
22BSFD125R	Techno-Professional Skills I (Techniques of preservation)	3	.	.	.	.	.	.	.
22BSFD126R	EVS		2.	.	.	.	.	.	.
22SFD127R	MOOCS CE I		.	.	.	.	.	3	
22UBCC121	Co-Curricular (Non-CGPA)	.	.	.	.	.	.	3	.
22UBEC121	Extra-Curricular (Non-CGPA)	.	.	.	.	.	.	3	.
22UBPD123R	PDP II	.	.	3	.	.	.	.	.
22UUDL103R	Computational systems and Digital World	.	.		.	.	.	.	3
22BSFD211R	Institutional Food Service Management	3	.	2	2	.	.	2	.
22BSFD212R	Food Technology	3			.	.	3	.	.

22BSFD213R	Nutritional Biochemistry	3	.	.	.	.	.	.	.
22BSFD214R	Food Microbiology	3	.	.	.	3	.	.	.
22BSFD215R	Techno-Professional Skills II(Bakery Science)	3	.	.	.	.	.	3	.
22UBPD213R	PDP III	.	.	3	.	.	.	.	.
22UBCC211	Co-Curricular	.	.	.	.	.	.	3	.
22UUHV101R	UHV+ Professional Ethics	.	.	.	3	.	.	.	.
22UBEC211	Extra-Curricular	.	.	.	.	.	.	3	.
22BSFD216R	Generic Elective	.	.	.	.	.	.	.	3
22UUFL202R	Personal Financial Planning	.	.	.	.	.	.	.	3
22UULS202R	Basic Life Saving Skills (BLSS)	.	.	.	.	.	.	.	3
22BSFD221R	Adv. Food Technology	3	.	.	.	.	.	.	.
22BSFD222R	Basic Dietetics	3	.	.	.	.	.	.	.
22BSFD223R	Community Nutrition	3	.	3	.	3	.	.	.
22BSFD225R	Community Experience Learning (CEL)	3	.	.	.	.	.	.	.
22UBPD223R	PDP IV Campus to Corporate	.	.	3	.	.	.	.	.
22UBCC221	Co-Curricular	.	.	.	.	.	.	3	.
22UBEC221	Extra-Curricular	.	.	.	.	.	.	3	.
22BSCE221R	MOOCS CE II	.	.	.	.	.	.	.	3
22BSFD226R	Generic Elective	.	.	.	.	.	.	.	3
22UULS201R	Basic Acclimatizing Skills (BAS)	.	.	.	.	.	.	.	3
22BSFD311R	Adv. Dietetics & Counseling	3	.	.	.	3	.	.	.
22BSFD312R	Food Product Development	3	.	.	.	3	.	.	.
22BSFD313R	Entrepreneurship Development	1	.	.	2	.	.	.	2

22BSFD314R	Diet Counseling and Patient Care	3	.	3		3			
22BSFD315R	Research Project Part I	3	.	.					
22BSFD316R	MOOCS CE III	.	.	.					2
22BSFD317R	45 Days Internship (Hospital/Food	3	.	.				3	2
22BSFD321R	Geriatric And Pediatric Nutrition	3	.	.					
22BSFD322R	45 Days Internship (Hospital/Food Industries)	3							
22BSFD323R	Research Project II							3	
22BSFD3224R	MOOCS CE IV							3	



# Assam down town University

## Curriculum and Syllabus

### Bachelor of Science in Forensic Science



**OUTCOME BASED EDUCATION FRAMEWORK**  
**CHOICE BASED CREDIT SYSTEM**

**Version: 1.0**

**FACULTY OF SCIENCE**

**July, 2022**

## Preamble

Assam down town University is a premier higher educational institution which offers Bachelor, Master, and Ph.D. degree programmes across various faculties. These programmes, collectively embodies the vision and mission of the university. In keeping with the vision of evolutionary changes taking place in the educational landscape of the country, the university has restructured the course curriculum as per the guidelines of National Education Policy 2020. This document contains outline of teaching and learning framework and complete detailing of the courses. This document is a guidebook for the students to choose desired courses for completing the programme and to be eligible for the degree. This volume also includes the prescribed literature, study materials, texts, and reference books under different courses as guidance for the students to follow.

Recommended by the 22<sup>nd</sup> Board of Studies (BoS) meeting of the Faculty of Science held on dated 22/06/2022 and approved by the Emergent Academic Council (AC) meeting held on dated 30/07/2022



*Chairperson  
Board of Studies*



*Member Secretary  
Academic Council*



## ***Vision***

To become a Globally Recognized University from North Eastern Region of India,  
Dedicated to the Holistic Development of Students and Making Society Better

## ***Missions***

1. Creation of curricula that address the local, regional, national, and international needs of graduates, providing them with diverse and well-rounded education.
2. Build a diverse student body from various socio-economic backgrounds, provide exceptional value-based education, and foster holistic personal development, strong academic careers, and confidence.
3. Achieve high placement success by offering students skill-based, innovative education and strong industry connections.
4. Become the premier destination of young people, desirous of becoming future professional leaders through multidisciplinary learning and serving society better.
5. Create a highly inspiring intellectual environment for exceptional learners, empowering them to aspire to join internationally acclaimed institutions and contribute to global efforts in addressing critical issues, such as sustainable development, Climate mitigation and fostering a conflict-free global society.
6. To be renowned for creating new knowledge through high quality interdisciplinary research for betterment of society.
7. Become a key hub for the growth and excellence of AdtU's stakeholders including educators, researchers and innovators
8. Adapt to the evolving needs and changing realities of our students and community by incorporating national and global perspectives, while ensuring our actions are in harmony with our foundational values and objectives of serving the community.

# Programme Details

## Programme Overview

B.Sc. in Forensic Science is a 3-year undergraduate programme under Faculty of Science of Assam downtown University, Guwahati, Assam. The main aim of the Programme is to create experts in the field of forensic science with the application of advanced scientific techniques. This course targets to develop a platform where students can get to learn and practice about the scientific methodology and techniques that can be used to the field of crime investigation so that justice can be served to the right person in less time which is the need of the hour for society. A graduate in forensic science course may avail jobs in the Forensic science laboratories, Research and Development, Education, Armed forces and Private sector also.

### I. Specific Features of the Curriculum

The curriculum integrates multidisciplinary concepts of forensic science, fostering an in-depth understanding necessary for solving complex forensic problems. It emphasizes holistic development through activities that enhance interpersonal skills, adaptability, and teamwork in diverse socio-cultural settings. Additionally, the curriculum promotes global competency by incorporating international standards and offering global certification courses, enabling students to address forensic issues on a worldwide scale. This comprehensive approach ensures that graduates are well-equipped with both technical expertise and soft skills essential for thriving in the forensic science profession.

### II. Eligibility Criteria:

Minimum 45% in 10+2 with English, Biology & Chemistry.

### III. Program Educational Objectives (PEOs):

**PEO-1:** AdtU forensic science graduates will be well-prepared for successful careers in industry, corporate, research organizations and/or government sectors in one or more of the disciplines/sub-disciplines of forensic science.

**PEO-2:** The forensic graduates will be academically prepared to apply advanced technologies for analyzing forensic evidence, leading diverse teams and delivering impartial scientific opinions.

**PEO-3:** AdtU forensic graduates will play a vital role in fostering a safe and vibrant society by serving as forensic experts for crime awareness, with the

potential for successful pursuits in higher education in forensic science if pursued.

#### **IV. Program Specific Outcomes (PSOs):**

**PSO1: Techno-Professional Ability:** Apply the comprehensive understanding of multidisciplinary concepts of forensic science with interdisciplinary approaches to address complex forensic problems.

**PSO2: Holistic Development:** Foster interpersonal ability and adaptability in diverse socio-cultural teams and efficient working in the profession through co-curricular and extra-curricular activities.

**PSO3: Global Competency:** Ability to address forensic issues and understand international scenarios through global certification courses.

#### **V. Program Outcome:**

**PO1: Forensic Knowledge:** Apply fundamental concepts of basic and applied sciences, criminal laws aspects, forensic science principles and analytical processes with psycho-social aspects in investigation to support the agencies and the criminal justice system.

**PO2: Crimes Scene Reconstruction:** Examine physical evidence, witness statements, and forensic findings to understand the sequence of evidence, addressing intricate forensic challenges and formulating logical procedural approaches.

**PO3: Analysis and Interpretation:** Identify and analyze complex forensic problems using standard analytical protocols and methods.

**PO4: Practice-In-Research:** Identify, formulate and analyze forensic problems utilizing evidence-based research to draw logical conclusions.

**PO5: Communication:** Communicate efficiently with individuals, peers, investigating agencies and other stakeholders, and prepare quality reports to convey findings.

**PO6: Code of Conduct:** Adhere to the code of conduct and ethical values in the profession.

**PO7: Teamwork:** Perform efficiently as a member or leader in collaboration with multidisciplinary teams and diverse settings.



**PO8: Modern Tool Practice:** Recognize and apply appropriate techniques, resources and modern scientific theories with an understanding of scientific principles.

**PO9: Lifelong Learning:** Engage in lifelong learning staying abreast of advancements in forensic technology and practices.

**VI. Total Credits to be Earned: 134**

**VII. Career Prospects:**

Graduates with a B.Sc. in Forensic Science have excellent career prospects in laboratories and research, criminal justice agencies, armed forces, academics etc. They can become Crime Scene Expert, Document Examiner in banks and different sectors, Forensic Scientist, Advisor and Guide to insurance agencies and banks, Academic Profession, Research & development scientist in respective industries, Research (Food & Beverage, medicine and disease research), Food safety department, Narcotics department and Defence sector.

## EVALUATION METHODS

The student performance shall be evaluated through In-semester (Sessional) and semester-end examinations. A weightage of 40% or as prescribed by the programme shall be added to the score of the end-semester examination.

### A. INTERNAL ASSESSMENT:

The teacher who offers the course shall be responsible for internal assessment by conducting in-semester (sessional) examination and evaluating the performance of the students pursuing that course. The components for internal assessment are illustrated in the table given below.

SN	Components/ Examinations	Marks Allotted
1.	In-Sem Exam – I (ISE-I) (Written Examination)*	30
2.	In-Sem Exam – II (ISE-II) (Written Examination)*	30
3.	Assignment	10
4.	Presentation (SP)	10
5.	Quiz	5
6.	Class Performance based score*	5

*\*are compulsory*

**Note:** Total Internal assessment should be out of 40

### INSTRUCTION

1. If a student fails to appear in the any of the component without any valid reason he/she shall be marked zero in that component. However, the course teacher at his discretion may arrange for the missed test on an alternate date for the absentee students after determining ground with genuine/valid reasons for the absent.
2. The report of evaluation of an activity towards the in-semester (sessional) component of a course shall be duly notified by the concerned course teacher within a week of completion.

3. The program coordinators should upload the in-semester marks to the ERP and forward acknowledgement of all the courses of the program to the Controller of Examinations before the start of the End-semester examination.

## **B. SEMESTER END EXAMINATION:**

Time table for end semester examination is published at least 25 days prior to the start of Examination.

### **I. Pre-Examination:**

#### **Eligibility Criteria for a student to appear in University Examinations:**

The student shall only be allowed to appear in a University Examination, if:

- i) He/ She is a registered student of the University;
- ii) He/ She is of good conduct and character;
- iii) He/ She has completed the prescribed Programme of study with minimum percentage of attendance as laid down in the Regulations of the Programme concerned.

Under special cases, a student may be allowed to appear for an examination without being registered in the University but the result of the said student will be kept on hold till the registration of the concerned student is completed.

### **II. Admit Card:**

Admit card for the examination may be downloaded through ERP where the system will generate a Unique ID Cards through online.

The University shall have the right to cancel admission for examination of any candidate on valid grounds.

### **III. Pattern of Question Papers:**

The question paper shall follow the principles of Bloom's Taxonomy.  
Table

<b>S. N.</b>	<b>Level</b>	<b>Questions /verbs for test</b>
1	Remember	List, Define, tell, describe, recite, recall, identify, show who, when, where, etc.
2	Understand	Describe, explain, contrast, summarize, differentiate, discuss, etc.
3	Apply	Predict, apply, solve, illustrate, determine, examine, modify
4	Analyze	Classify, outline, categorize, analyze, diagrams, illustrate,

		infer, etc.
5	Evaluate	Assess, summarize, choose, evaluate, recommend, justify, compare etc.
6	Create	Design, Formulate, Modify, Develop, integrate, etc.

**Note:** No course is to be evaluated on basis of **all 6 knowledge levels**.

The format of the question paper across all the program follow a unique pattern and the total marks is 60

**Table 1: Question paper pattern for End semester examination**

Sl no	Question pattern	Total marks
1	MCQs (10 Questions)	10
2	2 Marks questions (10 Questions)	20
3	4 Marks questions (5 Questions)	20
4	10 Marks questions (1 Question)	10

#### **IV. Examination Duration:**

Each paper of 60 marks shall ordinarily be of two hours duration.

#### **V. Practical Examinations, Viva-Voce etc.:**

- i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.
- ii) Viva-Voce, Oral examinations of the Project report, Dissertation etc. shall be undertaken by a Board of Examiners constituted by the respective Dean of Program with the advice of Supervisor(s).

#### **VI. Procedure of Expulsion:**

If any candidate is found to be using any unfair-means during the examination, the invigilator may cease his/her answer sheet and report it directly to the Officer-in-Charge. The Office-in-Charge of the center may take appropriate decisions as per the rules and procedure of the examination. The Officer-in-Charge may allow the students to write the exam with new answer sheet or may expel the student from appearing the paper depending on the nature of unfair-means. In case of Computer based test, the students may be directed to write an apology letter and sign in the prescribe expulsion form. The student may not be allowed to write that examination.

## **VII. Instruction to the Students:**

- (i) The students shall not bring to the Examination Hall, any electronic gadget used as a means of communication or record except electronic calculator, if required.
- (ii) The students shall not receive any book or printed or hand written or photo copy (Xerox) or blank-paper from any other person while he/she is in the examination-room or in laboratory or in any other place to which he/she is allowed to have access during course of examination.
- (iii) The students shall not communicate with any other candidate in the examination room or with any other person in and outside the examination-room.
- (iv) The students shall not see, read or copy anything written by any other candidate, nor shall he/she knowingly or negligently permit any other candidate to see, read or copy anything written by him/her or conveyed by him/her.
- (v) The students shall not write anything on the Question Paper or in other paper or materials during the examination, or pass any kind of paper to any other candidate in the examination-room, or to any person outside the room.
- (vi) The students shall not disclose his/her identity to the examiner by writing his/her name or putting any sign / symbol in any part of his answer-script.
- (vii) The students shall not use any abusive language or write any objectionable remark or make any appeal to examiner by writing in any part of his answer-script.
- (viii) The students shall not detach any page from the answer-script or insert any authorized or unauthorized loose sheet into it. He /she shall also not insert any other answer-script / loose sheet by removing the pins of the origin answer-scripts and re-fixing it.
- (ix) The students shall not resort to any disorderly conduct inside the examination-room or misbehave with the invigilator or any other examination official.

### **VIII. Provision for an Amanuensis (writer):**

- (i) A candidate may be provided with an Amanuensis (writer) to write down on dictation on his / her behalf on ground of his / her physical disability to write down by himself / herself due to accident or any other reason. The amanuensis may be provided till he / she recovers from the physical disability. The physical disability to write down by himself / herself must be supported by Medical Certificate from a competent Medical Officer.
- (ii) The qualifications of the amanuensis so provided must not be equal or higher than that of the candidate. This is also to be supported by Certificate from the Faculty of Study where the Amanuensis is provided.
- (iii) Such candidates are to be accommodated in a separate room under the supervision of an invigilator so that the fellow candidates are not disturbed in the process.

### **C. Credit Point:**

It is the product of grade point and number of credits for a course, thus,  $CP = GP \times CR$

#### **i. Credit:**

A unit by which the course work is measured. It determines the number of hours of instructions required per week. 'Credit' refers to the weightage given to a course, usually in terms of the number of instructional hours per week assigned to it. Credits assigned for a single course always pay attention to how many hours it would take for an average learner to complete a single course successfully.

#### **ii. Grade Point:**

Grade Point is a numerical weight allotted to each Grade Letter on a 10-point scale.

#### **iii. Letter Grade:**

Letter Grade is an index of the performance of students in a said paper of a particular course. Grades are denoted by letters O, A+, A, B+, B, C, P, F and Abs. Student obtaining Grade F / Grade Abs shall be considered failed/ absent

and, will be required to appear in the subsequent ESE. The UGC recommends a 10-point grading system with the following (Table: 1) Letter Grades:

- (i) A Letter Grade shall signify the level of qualitative/quantitative academic achievement of a student in a Course, while the Grade Point shall indicate the numerical weight of the Letter Grade on a 10-point scale.
- (ii) There shall be 08 (eight) Letter Grades bearing specific Grade Points as listed in Table 1, where the Letter Grades 'O' to 'P' shall indicate successful completion of a course.
- (iii) Apart from the 08 (eight) regular Letter Grades listed in Table 1, there shall be 03 (three) additional Letter Grades, which shall be awarded if a Course is withdrawn or spanned over the next Semester or remains incomplete as stated in Table 2.

**Table 2: Letter Grades and Grade Points**

<b>Letter Grade</b>	<b>Grade Points</b>	<b>Description</b>
O	10	Outstanding
A+	9	Excellent
A	8	Very Good
B+	7	Good
B	6	Above Average
C	5	Average
P	4	Pass
F	0	Fail
Abs	0	Absent
UFM	0	Unfair Means

#### **iv. Grade Point Average:**

##### **a. SGPA (Semester Grade Point Average)**

The SGPA of a student in a Semester shall be the weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered in that Semester, irrespective of whether he/she could or could not complete the Courses. More specifically, the calculation of SGPA

shall take into account the Courses graded with Letter Grades ‘O’ to ‘F’ as given in Table 1.

$$\text{SGPA} = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i}$$

(1.1)

The SGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.1) up to two decimal places, where n is the total number of Credit Courses registered by the student in that Semester,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  registered Course and  $C_i$  is the Credit (weight) of that Course.

### **b. CGPA (Cumulative Grade Point Average)**

- (i) The CGPA of a student in a Semester of a Programme shall be the accumulated weighted average of the Grade Points secured by the student in all the Credit Courses (both Core and Elective Courses) he/she registered and successfully completed so far starting from the enrollment in the Programme. In other words, taking into account all the Courses graded with ‘O’ to ‘P’ as given in Table 1.1, generally the CGPA of a student shall be calculated starting from the first Semester of his/her enrolled Programme, while the CGPA of a lateral-entry student shall be calculated starting from the Semester of his/her enrollment.
- (ii) The CGPA of a student in a Semester shall be calculated on a 10-point scale using Equation (1.2) up to two decimal places, where N is the total number of Credit Courses registered and successfully completed so far by the student,  $G_i$  is the Grade Point secured in the  $i^{\text{th}}$  completed Course and  $C_i$  is the Credit (weight) of that Course.

$$\text{CGPA} = \frac{\sum_{i=1}^N C_i G_i}{\sum_{i=1}^N C_i} \quad (1.2)$$



- (iii) The CGPA shall be convertible into equivalent percentage of marks using Equation Conversion of CGPA to percentage marks: = CGPA\*10

## **D. Post-Examination**

### **i. Transcript or Grade Card or Certificate:**

A marking certificate shall be issued to all the registered students after every Semester. The Semester mark sheet will display the course details (code, title, number of credits, grade secured) along with total credit earned in that Semester.

### **ii. Grievance Readdress Mechanism:**

Students with any dissatisfaction or grievance regarding the marks awarded in any of the Papers / Courses may appeal to the Controller of Examinations for remedial action such as Re-evaluation within 10 days of the declaration of result.

- (i) A student has options to appeal for re-evaluation of his /her answer script to the Controller of Examination.
- (ii) Application for re-evaluation / re-scrutiny of answer scripts shall be made in the definite proforma available with the Examination Office through the head of the respective departments within 10 days of declaration of the results of the respective examinations.
- (iii) The Controller of Examination may appoint an examiner for re-evaluation and will consider and recognize the evaluation done by a University appointed examiner.
- (iv) There shall be no provision for re-evaluation of the Practical Papers, Project Work, and Dissertation etc. However, the students fail in practical examination or viva voce and wish to appear again may apply to be evaluated can do so with the next schedule.
- (v) After screening the application for re-evaluation, the CoE may send the answer scripts of the student to the examiners appointed by the CoE with the approval of Vice Chancellor.

- (vi) The marks/grades achieved by the students after the re-evaluation shall be final and binding.
- (vii) Fresh Marks – sheets / Grade Card shall be issued only if the candidate secures pass marks / passing grade in the re-evaluated paper.
- (viii) Revaluation of answer scripts shall be deemed to be an additional facility provided to the students with a view to improving upon their results at the preceding examination result for any reason whatsoever shall not confer any right upon them for admission to next higher class which matters always be regulated in accordance with the relevant rules or regulations framed by the University.
- (ix) If as a result of revaluation of the candidate attracts the provision of condonation of deficiency, the same may be applied to his/her only for fresh attempt.

# INSTRUCTION TO TEACHERS AND STUDENTS

## (Teaching and Learning Methods)

In all the courses the teacher has to select topics for teacher-method which should not be less than 20 percent. The approach will be direct classroom teaching through a series of lectures delivering concepts using ITC facilities, white or blackboard. Notes may also be circulated to the students; however, the students are to be involved in the preparation of the notes. The teacher will be responsible for selecting the best note for circulation. The teacher-centric methodology has recently fallen out of favour because this strategy for teaching is seen to favour passive students.

### 1. Student- centric / Constructivist Approach:

The topics of the courses may be selected at the start of the class and assigned one topic to each of the students for studying by themselves, prepare presentations, notes, etc., and present at respective class time after consultation and discussion with the course teachers. The teacher facilitates the learning of the students by guiding and providing input and explaining concepts. 60 percent of the course contents may be selected for this purpose. To avoid behaviour problems, teachers must lay a lot of groundwork in student-centric classrooms. Typically, it involves instilling a sense of responsibility in students. In addition, students must learn internal motivation.

**a. Project-Based Learning:** The teacher may select 5 percent of topics for the purpose and may conduct visits to the laboratory for experiments or field surveys. The selection of the topic may be done considering the available facility for the purpose. However, in the final semester of each of the programme the student has to undergo project-based learning at least 4 months duration. This approach will help the student to think critically, evaluate, analyze, make decisions, collaborate, and more.

**b. Inquiry-Based Learning:** The teacher/ students are supposed to list at least five questions in each contact hour and student solve these question or search for answer which becomes the home work for the students “question-driven” learning approach. The teacher may look for the correctness of the solution or the best possible answer and discuss in the successive class. This will help in the

preparation for various competitive examination and develop a habit for search for solutions.

**c. Flipped Classroom:** About 10 percent of the course content has to be completed by this method. In this approach the students are asked to watch video or lecture prepared by the teacher or any video available (relevant to the course). A set of questions may be given to the students for searching answers by the students. The idea is that students should have more time in-classroom focusing on achieving these higher levels of thinking and learning. The Flipped classroom is also an acronym. The letters FLIP represent the four pillars included in this type of learning: Flexible environment, Learning culture shift, Intentional content, and Professional educator. As you can see, the second pillar refers to a culture shift from the traditional approach where students are more passive to an approach where students are active participants. As a result, this approach is also a student- centric teaching method.

**d. Cooperative Learning:** The remaining five percent has to be completed by cooperative learning approach. In this approach, the students are allotted problems. During library hours the students along with the teacher visit the library and search for probable solutions for the assigned problem. The same has to be done in groups so that the students discuss among themselves for the appropriate answers. Essentially, cooperative learning believes that social interactions can improve learning. In addition, the approach recreates real-world work situations in which collaboration and cooperation are required.

### **The percentage categorization for the completion of a theory course**

Teacher-centric or Direct Classroom Teaching: Delivery by series of lectures	20%
Student-centric Approach, Students present and deliver lectures in the presence of teacher and supervised by teacher	60%
Students visit fields or perform experiments or teachers perform demonstration	05%
Flipped Classroom approach	10%
Cooperative learning approach	05%

### **Inquiry-based approach has to be followed in all of the classes**

The teacher has to distribute the topics to be considered for teaching by the above-mentioned approaches and prepare a lesson plan for execution and maintain a file.

## Curriculum Framework

### Breakdown of Credits (for 2022-25 Syllabus)

Sl. No	Category	Total number of Credits
1	University Core(UC)	15
2	University Elective (UE)	13
3	Program Core(PC)	101
4	Program Elective (PE)	0
5	Faculty Elective (FE)	5
<b>Total number of credit</b>		<b>134</b>

### Breakdown by categories of courses

Sl no	Category	Credits	%
1	Science	122	91.04%
2	Humanities and Social Science	8	5.97%
3	Paramedical Sciences	1	0.75%
4	Commerce & Management	2	1.49%
5	Engineering	1	0.75%
<b>Total</b>		<b>134</b>	<b>100%</b>

## SEMESTER WISE COURSE DISTRIBUTION

	SN	Course Code	Course Title	Course Category	Engagement							Maximum Marks for			
					L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
<b>Semester I</b>	1	22BSFS111R	Basics of Forensic Science	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22BSFS112R	Forensic Psychology	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSFS113R	Fundamentals of Forensic Biology	PC	3	0	2	0	0	0	4	40	60	100	200
	4	22BSFS114R	Fundamentals of Forensic Physics	PC	3	0	2	0	0	0	4	40	60	100	200
	5	22UBPD112R	PDP (Communicative English & Soft Skills)	UE	0	0	4	0	0	0	2	0	0	100	100
	6	22UBEC111R	Extra-curricular (non-CGPA)	UC	0	0	0	4	0	0	1	0	0	100	100
	<b>Total</b>					<b>12</b>	<b>0</b>	<b>12</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>19</b>	<b>160</b>	<b>240</b>	<b>600</b>
<b>Semester II</b>	1	22BSFS121R	Criminal Law	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22BSFS122R	Crime And Society	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSFS123R	Forensic Botany	PC	3	0	2	0	0	0	4	40	60	100	200
	4	22BSFS124R	Forensic Chemistry	PC	3	0	2	0	0	0	4	40	60	100	200
	5	22BSFS125R	Evaluation of Criminal Psychology (Techno-Professional Course)	PC	0	0	2	0	0	0	1	40	60	100	200
	6	22UBES101R	Environmental Science	UE	2	0	0	0	0	0	2	40	60	0	100
	7	22UBPD122R	Implicit English (Communicative English and Soft Skills)	UE	0	0	4	0	0	0	2	0	0	100	100
	8	22UBCC121	Co-Curricular (Non-CGPA)	UC	0	0	0	4	0	0	1	0	0	100	100
	9	22UBEC121	Extra-Curricular (Non CGPA)	UC	0	0	0	4	0	0	1	0	0	100	100
	10	22BSCE1201R	MOOCS- I	FE	0	0	2	0	0	0	1	0	0	100	100
	11	22UCDL102R	Digital Proficiency	UC	0	0	2	0	0	0	1	0	0	100	100
	<b>Total</b>					<b>14</b>	<b>0</b>	<b>18</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>25</b>	<b>240</b>	<b>360</b>	<b>1000</b>
<b>Semester III</b>	SN	Course Code	Course Title	Course Category	Engagement							Maximum Marks for			
					L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
	1	22BSFS211R	Forensic Dermatoglyphics	PC	3	0	2	0	0	0	4	40	60	100	200
2	22BSFS212R	Instrumental Techniques in Forensic Science	PC	3	0	2	0	0	0	4	40	60	100	200	

	3	22BSFS213R	Crime Scene Management and Forensic Physics	PC	3	0	2	0	0	0	4	40	60	100	200
	4	22BSFS214R	Questioned Documents and Handwriting Identification	PC	3	0	2	0	0	0	4	40	60	100	200
	5	22BSFS215R	Techno Professional Course- II	PC	0	0	4	0	0	0	2	0	0	100	100
	6	22UBPD212R	English Language for Excellence (Communicative English and Soft Skills)	UE	0	0	4	0	0	0	2	0	0	100	100
	7	22UBCC211	Co-Curricular (Non-CGPA)	UC	0	0	0	4	0	0	1	0	0	100	100
	8	22UBEC211	Extra- Curricular (Non CGPA)	UC	0	0	0	4	0	0	1	0	0	100	100
	9	22UUHV101R	UHV + PROFESSIONAL ETHICS	UC	1	0	2	0	0	0	2	40	60	0	100
	10	22BSFS2110R	Coursera	UE	2	0	0	0	0	0	2	40	60	0	100
	11	22UULS212R	Basic Life Saving Skills	UC	0	0	2	0	0	0	1	0	0	100	100
	12	22UUFL213R	Personal Finance Planning	UC	0	0	2	0	0	0	1	0	0	100	100
	<b>Total</b>				<b>15</b>	<b>0</b>	<b>22</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>28</b>	<b>240</b>	<b>360</b>	<b>1000</b>	<b>1600</b>
<b>Semester IV</b>	<b>SN</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Course Category</b>	<b>Engagement</b>							<b>Maximum Marks for</b>			
					<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O</b>	<b>C</b>	<b>IA*</b>	<b>SEE*</b>	<b>PE*</b>	<b>Total</b>
	1	22BSFS221R	Forensic Ballistics	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22BSFS222R	Forensic Chemistry	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSFS223R	Cyber & Digital Forensics	PC	3	0	2	0	0	0	4	40	60	100	200
	4	22BSFS224R	Forensic Accountancy & Statistics	PC	3	0	2	0	0	0	4	40	60	100	200
	5	22BSFS225R	Techno Professional Course- III	PC	0	0	2	0	0	0	1	0	0	100	100
	6	22UBPD222R	English For Employability (Communicative English & Soft Skills)	UC	0	0	4	0	0	0	2	0	0	100	100
	7	22UBCC221	Co-Curricular (None-CGPA)	UC	0	0	0	4	0	0	1	0	0	100	100
	8	22UBEC221	Extra-Curricular (None CGPA)	UC	0	0	0	4	0	0	1	0	0	100	100
	9	22BSFS2120R	General Elective	UE	2	0	0	0	0	0	2	40	60	0	100
	10	22BSCE222R	MOOCS II	FE	0	0	4	0	0	0	2	0	0	100	100
	11	22UULS221R	Basic Acclimatizing Skills	UE	0	0	2	0	0	0	1	0	0	100	100
	<b>Total</b>				<b>14</b>	<b>0</b>	<b>20</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>26</b>	<b>200</b>	<b>300</b>	<b>1000</b>	<b>1500</b>
<b>Semester V</b>	<b>SN</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Course Category</b>	<b>Engagement</b>							<b>Maximum Marks for</b>			
					<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O</b>	<b>C</b>	<b>IA*</b>	<b>SEE*</b>	<b>PE*</b>	<b>Total</b>

	1	22BSFS311R	Forensic Biology & Serology	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22BSFS312R	DNA Forensic	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSFS313R	Forensic Medicine	PC	3	0	2	0	0	0	4	40	60	100	200
	4	22BSFS314R	Wildlife and Environmental Forensic	PC	2	0	2	0	0	0	3	40	60	100	200
	5	22BSFS315R	Research project part I	PC	0	0	0	0	24	0	4	0	0	100	100
	6	22BSFS316R	Techno-professional course-IV	UC	0	0	2	0	0	0	1	0	0	100	100
	7	22BSCE313R	MOOCS- III	FE	0	0	4	0	0	0	2	0	0	100	100
	<b>Total</b>					<b>11</b>	<b>0</b>	<b>14</b>	<b>0</b>	<b>24</b>	<b>0</b>	<b>22</b>	<b>160</b>	<b>240</b>	<b>700</b>
<b>Semester VI</b>	<b>SN</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Course Category</b>	<b>Engagement</b>							<b>Maximum Marks for</b>			
					<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O</b>	<b>C</b>	<b>IA*</b>	<b>SEE*</b>	<b>PE*</b>	<b>Total</b>
	1	22BSFS321R	Forensic Toxicology	PC	3	0	2	0	0	0	4	40	60	100	200
	2	22BSFS322R	Forensic Anthropology	PC	3	0	2	0	0	0	4	40	60	100	200
	3	22BSFS323R	Research Project Part II	PC	0	0	0	0	36	0	6	0	0	100	100
<b>Total</b>					<b>6</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>36</b>	<b>0</b>	<b>14</b>	<b>80</b>	<b>120</b>	<b>300</b>	<b>500</b>

**\*IA: Internal Assessment, SEE: Semester End Examination, PE: Practical Examination**



SEMESTER – I									
Course Title	Introduction to Forensic Science								
Course code	22BSFS111R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Understand the definition, history, and scope of forensic science.</li> <li>2. Learn the basic principles, tools, and techniques used in forensic science.</li> <li>3. Comprehend the elements, characteristics, and causes of crime, and identify different types of criminal behavior.</li> <li>4. Explore criminological theories and understand the goals and objectives of criminology.</li> <li>5. Familiarize with various crime investigation agencies in India and their functions.</li> </ol>								
CO1	Understand fundamental concepts, history, and principles of forensic science, emphasizing ethics.								
CO2	Gain knowledge about forensic science branches and roles of labs and international bodies like INTERPOL and FBI.								
CO3	Comprehend the organizational structure of forensic science institutions in India								
CO4	Articulate the responsibilities, ethical standards, and qualifications of forensic scientists.								
CO5	Familiarize with police organizational structure and explain the collaboration between police and forensic scientists.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	Definitions and concepts in forensic science. Historical aspects of forensic science. Basic principles of forensic science. Need and Scope of forensic science. Ethics in Forensic Science.		7	Define and explain key concepts and historical developments in forensic science.				1,2	
II	Branches of forensic science. Forensic Science Laboratories, Teaching Institutes and Other Government and Private Bodies related to Forensic Science in India. Forensic science in international perspectives, including set up of INTERPOL and FBI.		10	Articulate the basic principles and ethical considerations guiding forensic investigations.				1,2	
III	Hierarchical set up of Central Forensic Science Laboratories, State Forensic Science Laboratories, Regional Forensic Science Laboratories, Mobile Forensic Unit, Government Examiners of Questioned Documents, Fingerprint Bureaus, National Crime Records Bureau, Police & Detective Training Schools, and Directorate of Forensic Science Services.		10	Identify tools and techniques used by forensic scientists and their applications.				1,2	
IV	Duties of forensic scientists. Code of conduct for forensic scientists in India. Eligibility and Qualifications of forensic scientist. Data depiction. Report writing.		8	Analyse various types of criminal behaviour and their sociological and psychological underpinnings				1,2	
V	Organizational Setup of POLICE at Central and State Levels. Organizational Setup of CBI, IB, CAPF, BSF, CRPF, ITBP, Assam Rifles, CISF, RAF, BPRnD and MHA. Relationship between POLICE and Forensic Scientist		10	Understand and describe the structure and functions of crime investigation agencies such as CFSL, CBI, and				1,2	

			NIA	
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. To study the history of crime cases from standpoint of forensic science.</li> <li>2. To compile reports on various types of criminal cases.</li> <li>3. To evaluate the organizational structure of several forensic science organizations and make suggestions for improvement.</li> <li>4. To compare the standards of conduct established by various organizations for forensic scientists.</li> <li>5. To examine criminal cases and clarify which hypothesis best explains the accused's illegal behavior</li> <li>6. To study at criminal situations where criminal profiling helped the police catch the suspect.</li> <li>7. To evaluate victimology in a heinous crime.</li> <li>8. To analyze an instance of juvenile misbehavior and recommend corrective action</li> </ol>	<b>30</b>		1,2,3,4

**TEXT BOOKS:**

**T1:** Encyclopaedia of Forensic Science by J.A. Saigal, Elsevier.

**T2:** Encyclopaedia of crime, criminology by Casper Davis, koros.

**T3:** Introduction to Forensic Science by Uttam K.S., Jnanada.

**REFERENCE BOOKS:**

**R1:** B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).

**R2:** B. S. Nabar, Forensic Science in Crime Investigation, 3rd Edition, Asia Law House (2019).

**R3:** B. R. Sharma, Forensic Science in Criminal Investigation and Trials, 4th Edition, Universal Law Publishing - An imprint of LexisNexis (2014).

**R4:** R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).

**OTHER LEARNING RESOURCES:** E-Pahala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand fundamental concepts, history, and principles of forensic science, emphasizing ethics.	<b>1, 6</b>
<b>2</b>	Gain knowledge about forensic science branches and roles of labs and international bodies like INTERPOL and FBI.	<b>1, 2</b>
<b>3</b>	Comprehend the organizational structure of forensic science institutions in India	<b>1</b>
<b>4</b>	Articulate the responsibilities, ethical standards, and qualifications of forensic scientists.	<b>1, 6</b>
<b>5</b>	Familiarize with police organizational structure and explain the collaboration between police and forensic scientists.	<b>1</b>

SEMESTER – I									
Course Title	Forensic Psychology								
Course code	22BSFS112R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Explore scope, ethics, and expert witness role.</li> <li>2. Analyze causes, impact, bystander effect, mental health.</li> <li>3. Study profiling, testimony, competence, treatment, special populations.</li> <li>4. Learn tests, detection methods, lie detection, applications.</li> <li>5. Develop competences, interviewing skills, legal role, and psychotherapy practices.</li> </ol>								
<b>CO1</b>	Understand the nature, history, and scope of forensic psychology, distinguishing its role from traditional psychology and law.								
<b>CO2</b>	Identify the causes and analyze their impact of crime on victims, exploring victimization and factors influencing it, such as the bystander effect.								
<b>CO3</b>	Access crime for criminal profiling, factors, eyewitness testimony, competence to stand trial, and explain the roles of correctional psychologists along with their practical aspects using real life criminal cases								
<b>CO4</b>	Discuss psychological tests and forensic methods for crime detection, including Brain Electrical Oscillation Signature Profiling (BEOS) and lie detection methods along with their practical aspects using real life criminal cases.								
<b>CO5</b>	Demonstrate forensic consultancy and supervision, emphasizing core competencies, cognitive interviewing techniques, and psychotherapy with criminal offenders.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
<b>I</b>	Introduction to forensic Psychology, Nature, History and its Scope. Fundamental distinctions between Psychology and Law, Police Psychology, Forensic Psychology in India and its sub-fields. Ethical and legal issues in Forensic Practice, Psychologist as Expert Witnesses.	7	Define forensic psychology and distinguish it from legal practice.				1,2		
<b>II</b>	Crime: Causes, impact of crime on victim, Victimization, Factors affecting victimization: Bystander Effect, Forensic Mental Health. Psychological explanations of specific crime types: Arson, terrorism, homicides, sexual offences, burglary, robbery, theft, white collar crimes.	10	Explain the causes and impacts of various types of crime.				1,2		
<b>III</b>	Criminal Profiling, Eyewitness Testimony, Competence to stand trial, Roles of correctional psychologist, Treatment and Rehabilitation in Correctional facilities, Risk Assessment, Treatment of Special population: Violent Offenders, Women Prisoners, Juvenile Justice.	10	Perform criminal profiling and evaluate eyewitness testimony.				1,2		
<b>IV</b>	Psychological Tests used in forensic psychology, Forensic methods in detection of crime: Brain Electrical Oscillation Signature Profiling (BEOS). Lie Detections: Polygraph, Brain Mapping, Narco-analysis.	8	Utilize psychological tests and forensic methods like BEOS and polygraph tests.				1,2		

<b>V</b>	Forensic consultancy and supervision, core competences, Cognitive interviewing techniques, psychologist as a consultant, Family law issues, custody and adoptions, Psychology and the legal process interaction, Presentation of evidences and providing feedback, Psychotherapy with Criminal Offenders.	<b>10</b>	Offer forensic consultancy and conduct psychotherapy with offenders.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. To review a crime case involving serial murders. Remark on the accused's psychological traits.</li> <li>2. To compile a report on the connection between forensic psychology and mental disorders.</li> <li>3. To examine a criminal case in which deception was found using hypnosis.</li> <li>4. To review a criminal case involving serial murder</li> <li>5. To cite a crime case involving a juvenile and argue for and against lowering the age for categorizing an individual as juvenile.</li> <li>6. To provide an example of a criminal case where narco analysis was employed to uncover deceit</li> </ol>	<b>30</b>		1,2, 3,4

**TEXT BOOKS:**

**T1:** Arrigo (2002): Introduction to forensic Psychology.

**REFERENCE BOOKS:**

**R1:** Cooke, G. (1980): The role of Forensic Psychologist. Channels C. Thomas.

**R2:** A.A. Monessen, J. Starrs, C.E. Henderson and F.E. Inbau, Scientific Evidence in Civil and Criminal Cases, 4th Edition, The Foundation Press, Inc., New York (1995).

**R3:** J.C. DeLaurenti and D.R. Sullivan, Criminal Investigation Standards, Harper & Row, New York (1980).

**R4:** E. Eliad in Encyclopaedia of Forensic Science, Volume 2, J.A. Siegel, P.J. Saukko and G.C

**R5:** J. Niehaus, Investigative Forensic Hypnosis, CRC Press, Boca Raton (1999).

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the nature, history, and scope of forensic psychology, distinguishing its role from traditional psychology and law.	<b>1, 3</b>
<b>2</b>	Identify the causes and analyze their impact of crime on victims, exploring victimization and factors influencing it, such as the bystander effect.	<b>1, 2</b>
<b>3</b>	Access crime for criminal profiling, factors, eyewitness testimony, competence to stand trial, and explain the roles of correctional psychologists along with their practical aspects using real life criminal cases	<b>1, 2, 3, 6</b>
<b>4</b>	Discuss psychological tests and forensic methods for crime detection, including Brain Electrical Oscillation Signature Profiling (BEOS) and lie detection methods along with their practical aspects using real life criminal cases.	<b>1, 3, 8</b>
<b>5</b>	Demonstrate forensic consultancy and supervision, emphasizing core competencies, cognitive interviewing techniques, and psychotherapy with criminal offenders.	<b>1, 3</b>

SEMESTER – I									
Course Title	Fundamentals of Forensic Biology								
Course code	22BSFS113R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Understand cell theory and compare the structures of prokaryotic and eukaryotic cells.</li> <li>2. Learn the structure and function of cellular components and organelles.</li> <li>3. Comprehend the basic features and significance of the cell cycle, mitosis, and meiosis.</li> <li>4. Explore the chemistry of living systems and the structural organization of biomolecules.</li> <li>5. Understand the applications of biotechnology, microbiology, and biochemistry in forensic science.</li> </ol>								
CO1	Explain the fundamental concepts of cell theory and differentiate between prokaryotic and eukaryotic cells.								
CO2	Describe the structure and functions of the plasma membrane, endomembrane system, cytoskeleton, and organelles.								
CO3	Analyze the processes of mitosis, meiosis, and their significance in cellular biology.								
CO4	Understand the properties and functions of biomolecules, enzymes, and nucleic acids.								
CO5	Apply biotechnological, microbiological, and biochemical techniques in forensic science.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	Introduction to cell theory, Comparison of a generalized pro- and eukaryotic cell, Methods in Cell Biology: Elementary idea of microscopy and cell fractionation.		7	Define and explain cell theory and the differences between prokaryotic and eukaryotic cells.				1,2	
II	Extranuclear, Elementary knowledge of structure and function of plasma membrane, Introduction to endomembrane system (endoplasmic reticulum, Golgi complex, lysosome), peroxisome, Introduction to cytoskeleton, Structure and functions of mitochondria, Nuclear, Nuclear envelope, nucleolus and biogenesis of ribosome, Interphase chromatin and its compaction into metaphase chromosome, Introduction to polytene and lamp brush chromosomes.		8	Describe the structure and function of key cellular components such as the plasma membrane, mitochondria, and nucleus.				1,2	
III	Basic features of cell cycle, Mitosis, mitotic spindle and chromosome movement, Process and phases of meiosis and its significance, Elementary idea of cell transformation and cancer, Introduction to the cellular basis of immunity.		7	Understand the cell cycle, including mitosis and meiosis, and their roles in cellular biology.				1,2	
IV	Chemistry of living system: its scope and importance, chemical bonds and energy, Biomolecules: configuration and conformation, Properties of water as biological solvent, Introduction to metabolism, Amino acids: Structure and classification, Properties of peptide bond, Proteins: Functions and diversity, Structural		8	Explain the structure, classification, and functions of biomolecules like proteins, carbohydrates, lipids, and nucleic acids.				1,2	

	organization and conformation.			
<b>V</b>	Enzymes: General properties, Major classes of enzymes, Mechanism of enzyme action (binding to substrate, lowering of energy of activation, Carbohydrates: Classification and nomenclature, Structure and conformation of monosaccharides, Reducing and non-reducing sugars, Oligosaccharides (disaccharides) and polysaccharides. Lipids: Biological significance and classification, Fatty acids Formation of lipid bi-layer, Nucleic acids, Bases, nucleosides and nucleotides, DNA structure: DNA double helix (Watson and Crick model), DNA and RNA as genetic material, DNA replication, Semi-conservative replication, Basic mechanism of replication (Prokaryotes) ,Types of RNA,Transcriptional unit and basic concept of transcription (Prokaryotes), Genetic code and basic mechanism of translation (Prokaryotes), Introduction to recombinant DNA techniques and their application.	<b>10</b>	Explain knowledge of enzymes, carbohydrates, fats and DNA.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. To perform microscopy and cell fractionation to study cellular components.</li> <li>2. To perform experiments to understand the structure and function of the plasma membrane.</li> <li>3. To perform the observation of mitosis and meiosis in plant and animal cells.</li> <li>4. To perform DNA extraction and analyze it using gel electrophoresis.</li> <li>5. To perform an enzyme kinetics study by measuring catalase activity.</li> <li>6. To perform carbohydrate identification and quantification tests.</li> <li>7. To perform the construction and study of a DNA structure and replication model</li> </ol>	<b>30</b>		1,2, 3,4

**TEXT BOOKS:**

**T1:** Gene IX by Benjamin Lewin (9th Edition). Jones and Barlett Publishers.

**T2:** Molecular biology of the gene by James D Watson (7th Editing). Pearson Education.

**T3:** Molecular biology of the gene by Watson. J. D. Hopkins, N. H. Roberts, J. W. ., Steitz, J. A. and Weiner, A.M. 1987, W.A. (4th Edition) Benjamin/Cummings Co., New York.



**REFERENCE BOOKS:**

R1. Alberts et al: Essential Cell Biology (1998, Garland).

R2. Alberts et al: Molecular Biology of the Cell (2008, Garland).

R3. Karp: Cell and Molecular Biology (2008, John Wiley).

**R4:** Lodish et al: Molecular Cell Biology (2008, Freeman)

**R5:** Boyer: Concepts in Biochemistry (3rd ed. 2006, Brooks/Cole).

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the fundamental concepts of cell theory and differentiate between prokaryotic and eukaryotic cells.	<b>1</b>
<b>2</b>	Describe the structure and functions of the plasma membrane, endomembrane system, cytoskeleton, and organelles.	<b>1</b>
<b>3</b>	Analyze the processes of mitosis, meiosis, and their significance in cellular biology.	<b>1,3</b>
<b>4</b>	Understand the properties and functions of biomolecules, enzymes, and nucleic acids.	<b>1,3</b>
<b>5</b>	Apply biotechnological, microbiological, and biochemical techniques in forensic science.	<b>1,3, 8</b>

SEMESTER – I									
Course Title	Fundamentals of Forensic Physics								
Course code	22BSFS114R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/ I semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Understand the fundamental principles of motion and the applications of Newton's laws.</li> <li>2. Comprehend the concepts of energy, work, and rotational dynamics.</li> <li>3. Explore wave mechanics, sound, and their applications, including ultrasonic technology.</li> <li>4. Study the characteristics and applications of lasers, optical fibers, and solar cells.</li> <li>5. Understand nuclear properties, radioactive decay, and the applications of radioisotopes.</li> <li>6. Learn the basic principles and applications of photography in forensic science.</li> </ol>								
CO1	Explain the concepts of motion, position, velocity, acceleration, and Newton's laws of motion.								
CO2	Understand and apply the principles of energy, work, and rotational dynamics.								
CO3	Describe the properties of waves, sound, and their practical forensic applications.								
CO4	Explain the characteristics of lasers, optical fibers, and their applications.								
CO5	Understand nuclear composition, radioactive decay, and the applications of radioisotopes and apply knowledge of photography and videography in forensic science.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Definition of motion, position and displacement, average velocity, average speed, acceleration, acceleration of freely falling body, projectile motion, uniform circular motion, relative motion in one dimension and two dimensions; Interpretation and applications of Newton's laws of motion, Pseudo forces, elastic properties of matter, elastic constants and their interrelations Fluid dynamics, equation of continuity, Bernoulli's equation, stream line and turbulent flow, lines of flow in air foil, Poiseuille's equation.	7	Define and explain motion, velocity, acceleration, Newton's laws, and fluid dynamics.				1,2		
II	Energy, kinetic energy, work, work done by gravitational force, work done by spring force, power, work and potential energy, work done on system by external force, conservation of energy. Rotation: The rotational variable, rotation with constant angular acceleration, relating linear and angular variables, kinetic energy of rotation.	8	Explain energy, work, conservation of energy, and rotational dynamics.				1,2		
III	Types of waves, transverse and longitudinal waves, wavelength and frequency, speed of travelling wave, the wave equation, sound waves, speed of sound, intensity and sound level, the	7	Describe wave types, sound properties, Doppler effect, acoustics, and ultrasonic applications.				1,2		

	<p>Doppler effect, shock waves.</p> <p>Velocity of sound, noise and sound intensity measurement, echo, reverberation, Sabine's Formula, absorption coefficient, acoustics of buildings and factors affecting acoustics of buildings.</p> <p>Sound distribution in an auditorium, introduction to ultrasonic, production of ultrasonic waves, applications of ultrasonic.</p>			
<b>IV</b>	<p>Laser Characteristics, Einstein's coefficient, Population Inversion and Pumping; types of Laser (Ruby laser, He-Ne, dye laser, semi-conductor lasers), Application of lasers: Industrial &amp; Medical, Holography: construction and reconstruction of images.</p> <p>Optical fibers, Propagation of light through optical fiber, Angle of acceptance and numerical aperture, losses, Solar cells.</p>	<b>8</b>	Understand laser characteristics, types, and applications; describe light propagation in optical fibers.	1,2
<b>V</b>	<p>Review of nuclear composition, nuclear properties and half-life, Radioactive decay Schemes, Applications of Radio Isotopes, Radiometric dating.</p>	<b>15</b>	Review nuclear composition, radioactive decay, and applications of radioisotopes.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. To perform the measurement of acceleration due to gravity using a freely falling body.</li> <li>2. To perform the verification of Newton's laws of motion using a simple pendulum or inclined plane.</li> <li>3. To perform the study of fluid dynamics using Bernoulli's equation and Poiseuille's law.</li> <li>4. To perform experiments to measure work done by different forces, including gravitational and spring forces.</li> <li>5. To perform the observation and analysis of rotational motion and calculate kinetic energy of rotation.</li> <li>6. To perform the measurement of the speed of sound and study the Doppler effect.</li> <li>7. To perform the study of laser characteristics and applications in holography and medical uses.</li> </ol>	<b>30</b>	Apply photography principles in forensic science, including 3D, infrared, and ultraviolet techniques	1,2,3,4

**TEXT BOOKS:**

**T1:** Halliday, Resnick and Walker, Fundamentals of Physics, John Wiley and sons' publication, sixth edition, 2004.

**T2:** Heat and Thermodynamics: Brijlal and N. Subramanyam.

**REFERENCE BOOKS:**

**R1:** Elements of Properties of matter, D S Mathur, S. Chand & company Ltd.

**R2:** New and simplified Physis, S L Arora, Dhanpati Rai & Co.

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the concepts of motion, position, velocity, acceleration, and Newton's laws of motion.	<b>1</b>
<b>2</b>	Understand and apply the principles of energy, work, and rotational dynamics.	<b>1</b>
<b>3</b>	Describe the properties of waves, sound, and their practical forensic applications.	<b>1,3</b>
<b>4</b>	Explain the characteristics of lasers, optical fibres, and their applications.	<b>1,3</b>
<b>5</b>	Understand nuclear composition, radioactive decay, and the applications of radioisotopes and apply knowledge of photography and videography in forensic science.	<b>1,3, 8</b>

SEMESTER – I									
Course Title	PDP (Communicative English & Soft Skills)								
Course code	22UBPD112R	Total credits: 2 Total hours: 60P	L	T	P	S	R	O/F	C
			0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/I Semester of First year of the programme								
Course Objectives	1. To recognize and identify parts of a sentence and their significance in a language. 2. To enhance listening and speaking/skills for self-development. 3. To give insight into English pronunciation and into central concepts in phonetics. 4. Introduction to the various modes of communication will enhance their knowledge of communication.								
CO1	It enables learners to recognize the structure of a sentence and its variations as they learn to understand, speak and write.								
CO2	Introduction to Phonetics and its importance will improve the learners' pronunciation.								
CO3	Students will be able to identify to pick and form different kinds of sentences.								
CO4	Knowledge of communication will be enhanced through practical examples.								
Unit-No.	Content								
I	Grammar Parts of Speech; Articles; Auxiliary Verbs; Affirmative and Negative Sentences								
II	Grammar Determiners; Sentence Construction; Types of Sentences (Assertive, Imperative etc.); Degree of Comparison; Comprehension Exercises								
III	Listening Skills What is listening? The Process of Listening; Factors that adversely affect Listening; Difference between Listening and Hearing; Purpose and Importance of Effective Listening; How to Improve Listening Process?								
IV	Speaking Skills Introducing yourself; Self-discovery; Basics of Phonetics and pronunciation; Extempore speech; Video Recording for Self Reflection								
V	Communication Skills Introduction to Communication; Importance of Communication Skills; Purpose of Communication; Types of Communication; Formal and informal communication; Importance of Communication; Barriers to Communication; How to improve/ tips to improve Communication skills? Responding to different questions in various situations (formal/informal)								

#### TEXT BOOKS:

**T1:** Chaturvedi, P.D., Chaturvedi Mukesh, 2011. Business Communication: Concepts, Cases and Applications, second edition, Pearson, Noida.

**T2:** Alex K., Chand, S, 2009. Soft Skills: Know Yourself and Know the World, first edition, S. Chand & Company Ltd.: New Delhi.

#### REFERENCE BOOKS:

**R1:** Quirk, Randolph. (2010) A Comprehensive Grammar of the English Language Randolph Quirk, Sidney Greenbaum, Pearson Education India.

**R2:** Marks, Jonathan. (2017) IELTS Advantage Speaking and Listening Skills: A step-by-step guide to a high IELTS speaking and listening score. Book + CD-ROM, Delta Publishing by Kle.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	It enables learners to recognize the structure of a sentence and its variations as they learn to understand, speak and write.	<b>5, 7, 9</b>
<b>2</b>	Introduction to Phonetics and its importance will improve the learners' pronunciation.	<b>5, 7, 9</b>
<b>3</b>	Students will be able to identify to pick and form different kinds of sentences.	<b>5, 7, 9</b>
<b>4</b>	Knowledge of communication will be enhanced through practical examples.	<b>5, 7, 9</b>

SEMESTER – II									
Course Title	Criminal Law								
Course code	22BSFS121R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Grasp offence forms, case classification, legislation components, judicial hierarchy.</li> <li>2. Differentiate cognizable and non-cognizable offences, bailable and non-bailable offences.</li> <li>3. Examine Sections related to offences against individuals and property.</li> <li>4. Explore constitutional articles and legal acts.</li> <li>5. Dive into specific legal areas and acts' intricacies.</li> </ol>								
<b>CO1</b>	Define offenses and their forms, compare and distinguish civil and criminal classifications along with their practical aspects in real cases.								
<b>CO2</b>	Interpret offenses against persons and property, including sexual offenses under relevant sections along with their practical aspects in real cases.								
<b>CO3</b>	Apply knowledge of evidence and rules of relevancy, including the examination of witnesses and expert testimony.								
<b>CO4</b>	Demonstrate an understanding of constitutional articles and acts, such as the Narcotic Drugs and Psychotropic Substances Act along with their practical aspects in real cases.								
<b>CO5</b>	Interpret various acts, including the Explosive Substances Act, Arms Act, Dowry Prohibition Act, and Wildlife Protection Act along with their practical aspects in real cases.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
<b>I</b>	Definition and forms of offence. Case classification: civil and criminal. The fundamental components of criminal legislation. Constitution and judicial system hierarchy. Cognizable and non-cognizable offences under the Criminal Procedure Code. Bailable and non-bailable offences under the Criminal Procedure Code. Bailable and non-bailable offences, as well as other pertinent laws. Sections 291 through 293	<b>7</b>	Define offences, understand case classification.				1,2		
<b>II</b>	Offences against person- Sections, 299, 300, 302, 304, 304A, 304B, 306, 307, 319, 320, 325, 359, 362, 363. Section 375 & 376 and their amendments. Offences against property- Sections 378, 383, 390, 391, 395, 415, 420, 441, 463, 489A, 497, 499, 503, 511. POSCO Act.	<b>10</b>	Distinguish and analyze specific offences.				1,2		
<b>III</b>	Evidence and rules of relevancy in brief. Expert witness. Cross examination and re-examination of witnesses. Examination in Chief. Sections 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, 138, 141.	<b>10</b>	Grasp evidence rules, witness examination.				1,2		
<b>IV</b>	Preamble, Fundamental Rights, Directive Principles of State Policy. – Articles 14, 15, 20, 21, 22, 51A.	<b>8</b>	Understand constitutional articles, rights				1,2		

<b>V</b>	Narcotic Drugs and Psychotropic Substances Act. Essential Commodity Act. Drugs and Cosmetics Act. Explosive Substances Act. Arms Act. Dowry Prohibition Act. Prevention of Food Adulteration Act. Prevention of Corruption Act. Wildlife Protection Act. I.T. Act. Environment Protection Act.	<b>10</b>	Explore specialized legal acts.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. To prepare a schedule of five cognizable and non-cognizable crimes.</li> <li>2. To study crime scene in which accused was punished under charges of section 302.</li> <li>3. To study crime scene in which accused was punished under charges of section 375.</li> <li>4. To cite a case under section 14 of the constitution of India where Right to equality before law was allegedly violated.</li> <li>5. To study a case in which Drugs and cosmetic act was invoked.</li> <li>6. To study a case in which arms act was invoked</li> </ol>	<b>3</b>		1,2,3,4

**TEXT BOOKS:**

**T1:** Constitution of India, Bare Act.

**REFERENCE BOOKS:**

**R1:** D.A. Bronstein, Law for the Expert Witness, CRC Press, Boca Raton (1999).

**R2:** Vipa P. Sarthi, Law of Evidence, 6th Edition, Eastern Book Co., Lucknow (2006).

**R3:** A.S. Pillia, Criminal Law, 6th Edition, N.M. Tripathi Pvt Ltd., Mumbai (1983).

**R4:** R.C. Nigam, Law of Crimes in India, Volume I, Asia Publishing House, New Delhi (1965)

**R5:** (Chief Justice) M. Monir, Law of Evidence, 6th Edition, Universal Law Publishing Co. Pvt. Ltd., New Delhi (2002).

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms.



**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Define offenses and their forms, compare and distinguish civil and criminal classifications along with their practical aspects in real cases.	<b>1</b>
<b>2</b>	Interpret offenses against persons and property, including sexual offenses under relevant sections along with their practical aspects in real cases.	<b>1</b>
<b>3</b>	Apply knowledge of evidence and rules of relevancy, including the examination of witnesses and expert testimony.	<b>1</b>
<b>4</b>	Demonstrate an understanding of constitutional articles and acts, such as the Narcotic Drugs and Psychotropic Substances Act along with their practical aspects in real cases.	<b>1, 2, 5</b>
<b>5</b>	Interpret various acts, including the Explosive Substances Act, Arms Act, Dowry Prohibition Act, and Wildlife Protection Act along with their practical aspects in real cases.	<b>1,2, 5</b>

SEMESTER – II									
Course Title	Crime and Society								
Course code	22BSFS122R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Define the field of criminology, outlining its aims and scope, and introduce theories of crime including classical, positivist, and sociological perspectives.</li> <li>2. Explore criminal anthropology and analyze the importance of modus operandi in criminal investigations and profiling.</li> <li>3. Investigate various investigative strategies and the role of criminal profiling in enhancing law enforcement and forensic practices.</li> <li>4. Examine the influence of media on public perception and understanding of crime and criminal behavior.</li> <li>5. Study the elements, causes, and consequences of different types of crime, including deviant behavior, hate crimes, and white-collar crimes.</li> </ol>								
CO1	Explain the foundational theories of crime, including classical, positivist, and sociological perspectives, and apply them to analyze criminal behavior.								
CO2	Evaluate the impact of criminal anthropology and modus operandi in criminal investigations and forensic profiling.								
CO3	Develop effective investigative strategies and utilize criminal profiling techniques to understand and predict criminal behavior.								
CO4	Analyze the role of media in shaping public perceptions and responses to crime and criminal justice issues.								
CO5	Understand the components of the criminal justice system, including police, courts, and corrections, and assess their roles in maintaining law and order.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Definition, aims and scope. Theories of Crime-classical, positivist, sociological, Criminal Anthropology, Understanding Modus Operandi, Investigative Strategy, Criminal Profiling, Role of Media.	7	Define criminology and discuss theories of crime such as classical, positivist, and sociological perspectives.	1,2					
II	Elements, nature, causes and consequences of crime, Deviant Behavior, Hate Crimes, Organized Crimes, Public Disorder, Domestic Violence and Workplace Violence, White Collar Crimes, Juvenile Delinquency, Victimology, Social Change and Crime, Psychological Disorders and Criminality, Situational Crime Prevention.	10	Explain the relevance of criminal anthropology and modus operandi in forensic investigations.	1,2					
III	Introduction to Criminal Behavior, Theories of Criminal Behavior: classical and non-classical theories, biological theories, psychological theories, social disorganization theory, labeling theory, conflict theory, anomie theory, routine activity theory, rational choice theory and differential association theory	10	Evaluate theories of criminal behavior, including classical, biological, psychological, and sociological theories	1,2					
IV	Crime Investigation Departments: Central Bureau of investigation, National Investigative	8	Analyze the roles and functions of crime	1,2					

	Agency, Anti-doping Agency, National Drug Testing Laboratory, Intelligence Bureau, Bureau of Police Research and Development, Fingerprint Bureau of Investigation, Central Police Organizations.		investigation departments and agencies in India.	
<b>V</b>	Components of Criminal Justice System: Police, Courts and Corrections, Types of Criminal Justice System, Filing of Criminal Charges, Community Policing, Correctional Measures and Rehabilitation of offenders, Human Rights and CJS in India.	<b>10</b>	Understand the components and functions of the criminal justice system, including police, courts, and corrections	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. To perform a case study analysis using different theories of crime.</li> <li>2. To perform the development of a criminal profile based on a given scenario.</li> <li>3. To perform an analysis of the role of media in influencing public perception of crime.</li> <li>4. To perform the study of different types of deviant behavior and their social implications.</li> <li>5. To perform a comparative study of various criminal investigation departments in India.</li> <li>6. To perform an analysis of the components of the Criminal Justice System and their roles in crime prevention.</li> <li>7. To perform a review of psychological theories in understanding criminal behavior.</li> </ol>	<b>30</b>		1,2,3,4

**TEXT BOOKS:**

**T1:** Ghosh & Rustamji, Encyclopedia of Police in India 1997 Vol, 3

**T2:** Vimala Veeraraghavan, Handbook of Forensic Psychology.

**REFERENCE BOOKS:**

**R1:** Ahuja, R., Criminology, Rawat Publications, ND, 2000.

R2. Paranjape, NV, Criminology, Penology and Victimology, Central Law Publications (CLP), 2017

R3. Ellis, L. and Walsh, Anthony, Criminology – A Global Perspective, Allyn and Bacon, Boston, 2000.

**R4:** Morris, E. K., and Braukman, C. J. (Eds.), Behavioural Approaches to Crime and Delinquency- A Hand book of Application, Research and Concepts, Plenum Press, New York, 1987

**R5:** Abaadinsky, H., Organized Crime (2ndEdn.), Nelson – Hall, Chicago, 1998.

**R6:** Adler, F., Mueller, G. O. W. and Laufer, W. S., Criminology, McGraw – Hill, Boston, 1991.

**R7:** Maguire, M.: Morgan, R and Reiner, R., The Oxford Handbook of Criminology (3rdEdn.), Oxford University Press, Oxford, 2002.

**R8:** Bajpai, G. S., Development without Disorders. Vishwavidyala, Prakashan, Sagar (M. P.), 2002.

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms.

### **RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Explain the foundational theories of crime, including classical, positivist, and sociological perspectives, and apply them to analyze criminal behavior.	<b>1, 5</b>
<b>2</b>	Evaluate the impact of criminal anthropology and modus operandi in criminal investigations and forensic profiling.	<b>1, 2</b>
<b>3</b>	Develop effective investigative strategies and utilize criminal profiling techniques to understand and predict criminal behavior.	<b>1,2, 5</b>
<b>4</b>	Analyze the role of media in shaping public perceptions and responses to crime and criminal justice issues.	<b>1, 2, 6</b>
<b>5</b>	Understand the components of the criminal justice system, including police, courts, and corrections, and assess their roles in maintaining law and order.	<b>1, 2, 6</b>

SEMESTER – II									
Course Title	Fundamentals of Forensic Botany								
Course code	22BSFS123R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce students to general plant classification schemes and the sub-specializations within forensic botany.</li> <li>2. Familiarize students with the morphology, anatomy, and systematic classification of plants relevant to forensic investigations.</li> <li>3. Explore the forensic significance of plant architecture, including roots, stems, flowers, and leaves.</li> <li>4. Enable students to identify and match various types of woods, timbers, seeds, and leaves crucial in forensic examinations.</li> <li>5. Analyze fibers for forensic purposes, considering properties such as fluorescence, optical characteristics, refractive index, birefringence, and dye analysis.</li> </ol>								
CO1	Understand general plant classification and forensic sub-specializations.								
CO2	Identify and match various types of woods, timbers, seeds, and leaves forensically.								
CO3	Recognize poisonous plants and their forensic significance.								
CO4	Comprehend the importance of wildlife, wildlife crimes, and relevant acts.								
CO5	Identify plants yielding drugs of abuse for forensic analysis.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	General plant classification schemes. Sub specialization of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology, Plant architecture- roots, stems, flowers, leaves.	7	Understand plant classification and forensic sub-specializations.				1,2		
II	Various types of woods, timbers, seeds and leaves and their forensic importance. . Identification and matching of various types of wood, timber varieties, seeds and leaves. Types of fibers – forensic aspects of fiber examination- fluorescent, optical properties, refractive index, birefringence, dye analysis etc.	10	Acquire skills in identifying and matching woods, timbers, seeds, and leaves				1,2		
III	Various types of poisonous plants-abrus precatorius, Aconitum, Anacardium occidentale, argemone Mexicana, calotropis, cannabis sativa, claviceps purpuria, cinchona, croton tiglium ,atropa belladonna, erythroxyllum coco, gloriosa superb,jatropha curcas, lathyrus sativus, manihot utilisissima, nerium indicum, nicotiana tabacum.	10	Recognize poisonous plants and assess their forensic relevance.				1,2		
IV	Introduction and importance of wild life.	8	Gain insights into wildlife				1,2		

	Protected and endangered species of animals and plants. Sanctuaries and their importance. Relevant provision of wild life and environmental act. Types of wildlife crimes, different methods of killing and poaching of wildlife animals.		protection laws and their enforcement.	
<b>V</b>	Types of plants yielding drugs of abuse – opium, cannabis, coco, tobacco, dhatura, Psilocybin mushrooms	<b>10</b>	Identify plants associated with drug abuse for forensic examination	1,2
<b>Practical</b>	1. Staining and microscopic observation of various stages of Mitosis of given sample(s). 2. Staining and microscopic observation of various stages in Meiosis of given sample(s).	<b>30</b>		1,2, 3,4

**TEXT BOOKS:**

**T1:** Agarwal, W.P. Forests in India. Oxford and I.B.H

**T2:** Arvind Kumar. Biodiversity and environment. A.P.M. Publishing Corporation, New Delhi.

**T3:** Kumar and Asija. Biodiversity – Principles and conservation. Updesh Purohit, Agrobios, Jodhpur.

**REFERENCE BOOKS:**

**R1:** Raghavendra AS. 1991. Physiology of Trees.

**R2:** John Wiley & Sons. Taiz, L. and Zeiger, E. 2007. Plant Physiology 4 th Ed. Sinauer Associates Inc. Publishers, Sunderland.

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand general plant classification and forensic sub-specializations.	<b>1</b>
<b>2</b>	Identify and match various types of woods, timbers, seeds, and leaves forensically.	<b>1</b>
<b>3</b>	Recognize poisonous plants and their forensic significance.	<b>1</b>
<b>4</b>	Comprehend the importance of wildlife, wildlife crimes, and relevant acts.	<b>1</b>
<b>5</b>	Identify plants yielding drugs of abuse for forensic analysis.	<b>1,3</b>

Course Title	Fundamentals of Forensic Chemistry								
Course code	22BSFS124R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/ II semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce periodic properties, including atomic and ionic radii, ionization energy, and electron affinity.</li> <li>2. Teach chemical bonding theories, valence bond, VSEPR, and molecular orbital theory.</li> <li>3. Explore the structure and bonding of organic compounds, emphasizing hybridization and reactivity.</li> <li>4. Discuss the mechanisms of organic reactions, covering bond fission and stability/reactivity.</li> <li>5. Examine the gaseous state, Boyle's law, kinetic gas equation, and van der Waals equation.</li> </ol>								
CO1	Understand the periodic properties of atomic size, radii, ionization energy, and electron affinity.								
CO2	Comprehend chemical bonding theories and their application in molecular structure.								
CO3	Analyze the structure and bonding in organic compounds, including hybrids and their formations								
CO4	Explore the mechanisms of organic reactions, focusing on bond fission and reactivity.								
CO5	Gain insights into the gaseous state, Boyle's law, and the behaviour of ideal and real gases.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Periodic Properties- Atomic Radii, factors on which atomic size depends, Vander Waal's radius, ionic radii, ionization energy, successive ionization energies, electron affinity, periodic trends.	7	Understand and apply periodic properties in the context of atomic and molecular behaviour.				1,2		
II	Chemical Bonding I-Valence bond theory and VSEPR theory, formation of oxygen, H <sub>2</sub> O and NH <sub>3</sub> molecules. Types of hybridization, molecular orbital Theory, electronic configuration and M.O diagrams of O <sub>2</sub> , N <sub>2</sub> , CO, HF molecules.	10	Apply chemical bonding theories to explain the structure of molecules.				1,2		
III	Structure and Bonding-Hybridisation, sp <sup>3</sup> hybridisation, Formation of methane, ethane, ethene, ethyne. Bond lengths, Bond Angles, Bond Energies, Naming, Preparation and Chemical reactions of Alkanes.	10	Analyze the structure and bonding of organic compounds, predicting reactivity.				1,2		
IV	Mechanism of Organic Reactions- Bond fission, Electrophilic and nucleophilic reagents, Types of organic reactions, Stability and reactivity of carbon ions, stability and reactivity of free radicals	8	Evaluate mechanisms of organic reactions, considering stability and reactivity.				1,2		
V	Gaseous State- Boyle's law, Nature of Gas Constant, Kinetic Gas Equation,	10	Comprehend the behaviour of gases, including ideal and real				1,2		

	Ideal or real gas, Volume correction due to molecular volume, Units for van der Waals constants, Limitation of van der Waals equation, Law of corresponding states		gas concepts.	
<b>Practical</b>	<ol style="list-style-type: none"> <li>To perform the determination of atomic radii and study periodic trends in atomic and ionic sizes.</li> <li>To perform the study of molecular shapes using VSEPR theory for molecules like H<sub>2</sub>O, NH<sub>3</sub>, and O<sub>2</sub>.</li> <li>To perform the analysis of hybridization in methane, ethane, ethene, and ethyne through molecular modeling.</li> <li>To perform the identification of electrophilic and nucleophilic reagents in organic reactions.</li> <li>To perform the study of bond energies, bond lengths, and bond angles in organic compounds.</li> <li>To perform experiments to verify Boyle's law and understand the behavior of gases.</li> <li>To perform the calculation of van der Waals constants and analyze deviations from ideal gas behavior.</li> </ol>	<b>30</b>		1,2,3,4

**TEXT BOOKS:**

**T1:** Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.

**REFERENCE BOOKS:**

R1. Inorganic Chemistry by Morrison & Boyd.

R2. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Comely University Press

**R3:** Physical Chemistry, P.W. Atkins, ELBS.

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms



**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the periodic properties of atomic size, radii, ionization energy, and electron affinity.	<b>1</b>
<b>2</b>	Comprehend chemical bonding theories and their application in molecular structure.	<b>1</b>
<b>3</b>	Analyze the structure and bonding in organic compounds, including hybrids and their formations	<b>1,3</b>
<b>4</b>	Explore the mechanisms of organic reactions, focusing on bond fission and reactivity.	<b>1</b>
<b>5</b>	Gain insights into the gaseous state, Boyle's law, and the behaviour of ideal and real gases.	<b>1</b>

<b>SEMESTER – II</b>									
<b>Course Title</b>	<b>Environmental Science</b>								
<b>Course code</b>	<b>22UBES101R</b>	<b>Total credits: 2</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
		<b>Total hours: 30T</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Co-requisite</b>	<b>Nil</b>						
<b>Programme</b>	<b>Bachelor of Science in Forensic Science</b>								
<b>Semester</b>	<b>Winter/II Semester of First year of the programme</b>								
<b>Course Objectives</b>	1. To prepare students for careers as leaders in understanding and addressing complex environmental issues from a problem-oriented, interdisciplinary perspective. 2. To develop a world population that is aware of and concerned about the environment and its associated problems and which has the knowledge, Skills, attitudes, motivations and commitment to work individually and collectively towards solutions of current problems and prevention of new ones..								
<b>CO1</b>	The students will be able to appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.								
<b>CO2</b>	Students will learn about natural resource, its importance and environmental impacts of Human activities on natural resource.								
<b>CO3</b>	Gain knowledge about environment and ecosystem, Students will be able to understand the concept of biodiversity and respect them								
<b>CO4</b>	Gain knowledge about the conservation of biodiversity and its importance. Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.								
<b>Unit-No.</b>	<b>Content</b>								<b>Contact Hour</b>
<b>I</b>	Multidisciplinary nature of environmental studies: Definition, scope and importance, Need for public awareness.								<b>2</b>
<b>II</b>	Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.								<b>7</b>
<b>III</b>	Ecosystems: Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the Following ecosystem: - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).								<b>6</b>
<b>IV</b>	Biodiversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity. Bio-geographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical,								<b>8</b>

	aesthetic and option values. Biodiversity at global, National and local levels. India as a mega- diversity nation• Hot-sports of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	
<b>V</b>	Environmental Pollution: Definition Cause, effects and control measures of:-Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste, Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides	<b>8</b>
<b>VI</b>	Social Issues and the Environment: From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case Studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Waste land reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness	<b>7</b>
<b>VII</b>	Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programme. Environment and human health. Human Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies	<b>6</b>
<b>VIII</b>	Field work: Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)	<b>5</b>

**TEXT BOOKS:**

**T1:** Bharucha. Textbook of Environmental Studies for Undergraduate Courses. 2nd edition. Orient Black swan Publishing; 2019.

**REFERENCE BOOKS:**

**R1:** Trivedi Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and II, Enviro Media(R). B.S. Publications; 2010.

**R2:** Trivedi, Goel. Introduction to air pollution. 1st publication. Techno-Science Publication (TB); 2003.

**R3:** Brunner. Hazardous Waste Incineration. 2nd edition. McGraw Hill Inc.; 1994

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	The students will be able to appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.	<b>1,6</b>
<b>2</b>	Students will learn about natural resource, its importance and environmental impacts of Human activities on natural resource.	<b>9</b>
<b>3</b>	Gain knowledge about environment and ecosystem, Students will be able to understand the concept of biodiversity and respect them	<b>1, 9</b>
<b>4</b>	Gain knowledge about the conservation of biodiversity and its importance. Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.	<b>1, 6, 9</b>

SEMESTER – II									
Course Title	Implicit English (Communicative English and Soft Skills)								
Course code	22UBPD122R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 60P	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/II Semester of First year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To introduce the types of sentences and their significance.</li> <li>To strengthen the vocabulary of the students to enhance student' vocabulary to enhance their speaking and writing skills it the importance of dress codes in various organisations. To introduce the 3P's (Planning, prioritizing &amp; performing) of Time Management.</li> </ol>								
CO1	This course will enable students to analysis and identify the different types of sentences.								
CO2	Learners will be able to integrate the skills of reading and speaking in professional communication								
CO3	Dress code Etiquette sessions will boost their confidence and morals.								
CO4	Students will learn about the effective and efficient utilization of time.								
Unit-No.	Content								
I	Grammar: Interchange of Interrogative and Assertive Sentences, Exclamatory and Assertive Sentences; Types of Tenses; Common Errors								
II	Vocabulary: Synonyms; Antonyms; Homonyms								
III	Reading Skills: Techniques of Effective Reading; Gathering ideas and information from a text; The SQ3R Technique; Interpret the text								
IV	Conflict Management: Definition; Type of Conflict Management; Effects of Conflict Management; Methods to deal with Conflicts (Negative)								
V	Time-Management Skills: Introduction to Time Management; Purpose and Importance of Time Management; Basic Tips to Maintain Time.								
Activity	Problem solving activity: A situation will be given to the students and they will have to tell us how to handle the situation or solve the problem								

#### TEXT BOOKS:

**T1:** Wren, P.C and Martin, H. 1995. High School English Grammar and Composition, S Chand Publishing.

**T2:** Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

#### REFERENCE BOOKS:

**R1:** McCarthy. (2008) English Vocabulary in Use Upper - Intermediate with CD ROM, Cambridge University Press.

**R2:** Tracy, Brian. (2018) Time Management: The Brian Tracy Success Library, Manjul Publishing House.

#### OTHER LEARNING RESOURCES:

<https://youtu.be/rl85jxktfms><https://www.betterteam.com/dress-codepolicy#:~:text=Everyone%20is%20expected%20to%20be,religion%20or%20ethnicity%20are%20exempt>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	This course will enable students to analysis and identify the different types of sentences.	<b>5, 7, 9</b>
<b>2</b>	Learners will be able to integrate the skills of reading and speaking in professional communication	<b>5, 7, 9</b>
<b>3</b>	Dress code Etiquette sessions will boost their confidence and morals.	<b>5, 7, 9</b>
<b>4</b>	Students will learn about the effective and efficient utilization of time.	<b>5, 7, 9</b>

SEMESTER – III									
Course Title	Forensic Dermatoglyphics								
Course code	22BSFS211R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/ III semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Understand the historical development and biological foundation of fingerprints.</li> <li>2. Analyze and interpret fingerprint patterns, ridge characters, and minutiae.</li> <li>3. Explore the classification and cataloging of fingerprint records, including the use of automated systems.</li> <li>4. Investigate the constituents of sweat residue and employ various methods for latent fingerprint detection.</li> <li>5. Investigate the constituents of sweat residue and employ various methods for latent fingerprint detection.</li> </ol>								
<b>CO1</b>	Understanding the historical facts and basic concepts of fingerprinting.								
<b>CO2</b>	Analyze various fingerprint patterns, including ridge characters/minutiae, and differentiate types of fingerprints found at crime scenes along with their practical aspects.								
<b>CO3</b>	Explain classification and cataloging of fingerprint records, including automated systems, and understand the significance of Poroscopy and edgeoscopy along with their practical aspects								
<b>CO4</b>	Analyze and interpret latent fingerprints through physical and chemical methods, preservation, and lifting, including digital imaging techniques along with their practical aspects.								
<b>CO5</b>	Illustrate the importance of footprints casting techniques, electrostatic lifting of latent footprints, and understand the historical significance of palm prints and lip prints along with their practical aspects.								
Unit-No.	Content	Contact Hour	Learning Outcome					KL	
<b>I</b>	Introduction and History. Biological basis of fingerprints. Formation of ridges. Fundamental principles of fingerprinting.	7	Understanding fingerprint history and formation.					1,2	
<b>II</b>	Fingerprint patterns. Ridge characters/minutiae. Plain and rolled fingerprints. Ridge Tracing and Ridge Counting. Types of Fingerprints found at Crime Scene.	10	Recognize fingerprint pattern and minutiae.					1,2	
<b>III</b>	Classification and cataloging of fingerprint record. Automated Fingerprint Identification System. Significance of Poroscopy and edgeoscopy. Ten Digit Classification. Single Digit Classification.	10	Classify fingerprints and use identification systems.					1,2	
<b>IV</b>	Constituents of sweat residue. Latent fingerprints' detection by physical and chemical methods. Preservation and lifting of developed fingerprints. Digital imaging for fingerprint enhancement. Fingerprinting the deceased	8	Detect, preserve, and enhance fingerprints.					1,2	

<b>V</b>	Importance of footprints. Casting of foot prints, Electrostatic lifting of latent foot prints. Palm prints and their historical importance. Lip prints - Nature, location, collection and examination of lip prints	<b>10</b>	Grasp footprints, palm prints, lip prints.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. To obtain plain fingerprints.</li> <li>2. To obtain rolled fingerprints.</li> <li>3. To identify core and delta in the given fingerprint sample</li> <li>4. To identify pattern types in the given fingerprint sample.</li> <li>5. To perform ridge counting in the given fingerprint sample</li> <li>6. To perform ridge tracing in the given fingerprint sample</li> <li>7. To identify ridge characteristics or minutiae in given fingerprint sample</li> <li>8. To develop latent fingerprint using powder method</li> <li>9. To develop and lift latent finger Prints with fuming and chemical methods.</li> <li>10. To compare two fingerprint samples</li> <li>11. To prepare cast of foot prints.</li> </ol>	<b>30</b>		1,2, 3,4

**TEXT BOOKS:**

**T1:** Lee and Gaenslen's, Advances in Fingerprint Technology, 3rd Edition, R.S. Ramotowski (Ed.), CRC Press, Boca Raton (2013)

**REFERENCE BOOKS:**

**R1:** J.E. Cowger, Friction Ridge Skin, CRC Press, Boca Raton (1983).

**R2:** D.A. Ashbaugh, Quantitative-Qualitative Friction Ridge Analysis, CRC Press, Boca Raton (2000).

**R3:** C. Cham pod, C. Lennard, P. Margot an M. Stolonice, Fingerprints and other Ridge Skin Impressions, CRC Press, Boca Raton (2004)

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms



**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understanding the historical facts and basic concepts of fingerprinting.	<b>1</b>
<b>2</b>	Analyze various fingerprint patterns, including ridge characters/minutiae, and differentiate types fingerprints found at crime scenes along with their practical aspects.	<b>1, 3</b>
<b>3</b>	Explain classification and cataloging of fingerprint records, including automated systems, and understand the significance of Poroscopy and edgeoscopy along with their practical aspects	<b>1,2, 8</b>
<b>4</b>	Analyze and interpret latent fingerprints through physical and chemical methods, preservation, and lifting, including digital imaging techniques along with their practical aspects.	<b>1, 2, 3, 8</b>
<b>5</b>	Illustrate the importance of footprints casting techniques, electrostatic lifting of latent footprints, and understand the historical significance of palm prints and lip prints along with their practical aspects.	<b>1, 3, 8</b>

SEMESTER – III									
Course Title	Instrumental techniques in Forensic Science								
Course code	22BSFS212R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/ III semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce students to the fundamental principles and forensic applications of Paper Chromatography, Thin Layer Chromatography (TLC), Gas Chromatography (GC), and Liquid Chromatography (LC).</li> <li>2. Familiarize students with the principles, instrumentation, and forensic applications of various spectroscopic techniques such as UV-Visible, Infrared, Atomic Absorption, Atomic Emission, Mass, X-ray, and Raman spectroscopy.</li> <li>3. Explore the principles, instrumentation, and forensic applications of optical and electron microscopes.</li> <li>4. Understand the principles, instrumentation, and forensic applications of electrophoresis and centrifugation techniques.</li> <li>5. Provide knowledge on the basic principles and forensic applications of photography, including crime scene documentation, 3D photography, and the use of DSLR cameras.</li> </ol>								
CO1	Understand and apply the principles and forensic applications of chromatography techniques.								
CO2	Utilize various spectroscopic techniques for forensic analysis and evidence evaluation.								
CO3	Operate and apply different types of microscopes in forensic examinations								
CO4	Employ electrophoresis and centrifugation techniques in forensic science for the separation and analysis of biological and chemical samples.								
CO5	Demonstrate proficiency in forensic photography techniques, including digital, 3D, infrared, and ultraviolet photography for crime scene documentation.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Fundamental principles, instrumentation and forensic application of Paper Chromatography, TLC, GC and LC.	7	Explain the principles and forensic uses of chromatography techniques.				1,2		
II	Fundamental principles, instrumentation and forensic applications of Ultraviolet-Visible spectroscopy, Infrared spectroscopy, Atomic Absorption spectroscopy, Atomic Emission spectroscopy and Mass spectroscopy. X-ray spectrometry. Raman spectroscopy.	10	Apply spectroscopic techniques in forensic analysis.				1,2		
III	Fundamental principles, Instrumentation and forensic application of different types of microscopes – Optical and Electron microscopes.	10	Use optical and electron microscopes in forensic examinations.				1,2		
IV	Fundamental principles, Instrumentation and forensic applications of Electrophoresis. Fundamental principles, Instrumentation and forensic applications of Centrifuge	8	Employ electrophoresis and centrifugation in forensic sample analysis.				1,2		

<b>V</b>	Basic principles and applications of photography in forensic science. 3D photography. Infrared and ultraviolet photography. Digital photography. Videography. Crime scene photography. Functioning of DSLR	<b>10</b>	Utilize various forensic photography methods for crime scene documentation.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>To separate and analyze the components of a mixture using Thin Layer Chromatography.</li> <li>To separate and quantify components of a volatile mixture using Gas Chromatography.</li> <li>To observe and analyze microscopic structures using light microscopy.</li> <li>To separate and analyze biomolecules based on their charge and size using electrophoresis</li> </ol>	<b>30</b>		1,2, 3,4

**TEXT BOOKS:**

**T1:** D.A. Skoog, D.M. West and F.J. Holler, Fundamentals of Analytical Chemistry, 6th Edition, Saunders College Publishing, Fort Worth (1992)

**REFERENCE BOOKS:**

**R1:** W. Kemp, Organic Spectroscopy, 3rd Edition, Macmillan, Hampshire (1991).

**R2:** J.W. Robinson, Undergraduate Instrumental Analysis, 5th Edition, Marcel Dekker, Inc., New York (1995)

**R3:** D.R. Red sicker, The Practical Methodology of Forensic Photography, 2nd Edition, CRC Press, Boca Raton (2000)

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand and apply the principles and forensic applications of chromatography techniques.	<b>1, 3, 8</b>
<b>2</b>	Utilize various spectroscopic techniques for forensic analysis and evidence evaluation.	<b>1, 3, 8</b>
<b>3</b>	Operate and apply different types of microscopes in forensic examinations	<b>1, 3, 8</b>
<b>4</b>	Employ electrophoresis and centrifugation techniques in forensic science for the separation and analysis of biological and chemical samples.	<b>1, 3, 8</b>
<b>5</b>	Demonstrate proficiency in forensic photography techniques, including digital, 3D, infrared, and ultraviolet photography for crime scene documentation.	<b>1, 3, 8</b>

SEMESTER – III									
Course Title	Crime Scene management and Forensic Physics								
Course code	22BSFS213R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/ III semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce students to the types of crime scenes and the methods for securing, isolating, and searching crime scenes.</li> <li>2. Familiarize students with the classification, collection, labelling, sealing, and preservation of physical, biological, and trace evidence.</li> <li>3. Explore the responsibilities of first responding officers and the coordination needed between police and forensic scientists.</li> <li>4. Provide knowledge on the forensic analysis of glass, paint, fibre, soil, and cloth evidence, including their collection and preservation.</li> <li>5. Educate students on the classification, collection, preservation, and forensic importance of tool marks, including the restoration of erased serial numbers and engraved marks.</li> </ol>								
CO1	Understand the procedures for managing different types of crime scenes and the legal considerations involved.								
CO2	Classify and handle various types of crime scene evidence, ensuring proper preservation and adherence to Locard's principle								
CO3	Evaluate the roles and coordination required during crime scene investigations, including the chain of custody and crime scene reconstruction.								
CO4	Conduct forensic analysis of glass, paint, fibre, soil, and cloth evidence, using both destructive and non-destructive methods.								
CO5	Analyze tool marks for forensic investigations and restore erased serial numbers and engraved marks.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Crime Scene Management: Types of crime scenes – indoor and outdoor, primary and secondary. Securing and isolating the crime scene. Crime scene search methods. Legal considerations at crime scenes. Documentation of crime scenes – photography, videography, sketching and recording notes	7	Manage and document crime scenes effectively, employing appropriate search methods and legal considerations.	1,2					
II	Crime Scene Evidence: Classification of crime scene evidence – physical, biological and trace evidence. Locard's principle. Collection, labelling, sealing of evidence. Hazardous evidence. Preservation of evidence	10	Classify, collect, and preserve different types of crime scene evidence.	1,2					
III	Investigation: Duties of first responding officer at crime scenes. Coordination between police personnel and forensic scientists at crime scenes. The evaluation of 5Ws (who? what?, when?, where?, why?) and 1H (how?). Chain of custody.	10	Perform investigative duties with a focus on coordination and crime scene reconstruction.	1,2					

	Reconstruction of crime scene			
<b>IV</b>	<p>Forensic Physics: Glass evidence – collection, packaging, analysis. Matching of glass samples by mechanical fit and refractive index measurements. Analysis by spectroscopic methods. Fracture analysis and direction of impact.</p> <p>Paint evidence – collection, packaging and preservation. Analysis by destructive and non- destructive methods. Importance of paint evidence in hit and run cases.</p> <p>Fiber evidence – artificial and natural fibres. Collection of fibre evidence. Identification and comparison of fibres.</p> <p>Soil evidence – importance, location, collection and comparison of soil samples.</p> <p>Cloth evidence – importance, collection, analysis of adhering material. Matching of pieces</p>	<b>8</b>	Analyze various types of forensic evidence, including glass, paint, fibre, soil, and cloth.	1,2
<b>V</b>	<p>Tool marks: Classification of tool marks. Forensic importance of tool marks. Collection, preservation and matching of tool marks. Restoration of erased serial numbers and engraved marks</p>	<b>10</b>	Evaluate tool marks and restore erased serial numbers for forensic purposes.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. To gather and analyze physical evidence and reconstruct events related to the crime.</li> <li>2. To identify and analyze the physical and chemical properties of hair to associate or disassociate it with individuals.</li> <li>3. To identify and analyze the physical and chemical properties of fibers to associate or disassociate them with individuals.</li> </ol>	<b>30</b>		1,2,3,4

**TEXT BOOKS:**

**T1:** M. Byrd, Crime Scene Evidence: A Guide to the Recovery and Collection of Physical Evidence, CRC Press, Boca Raton (2001).

**REFERENCE BOOKS:**

**R1:** T.J. Gardener and T.M. Anderson, Criminal Evidence, 4th Ed., Wadsworth, Belmont (2001).

**R2:** S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005)

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the procedures for managing different types of crime scenes and the legal considerations involved.	<b>1, 2, 3, 6</b>
<b>2</b>	Classify and handle various types of crime scene evidence, ensuring proper preservation and adherence to Locard's principle	<b>1, 2, 3</b>
<b>3</b>	Evaluate the roles and coordination required during crime scene investigations, including the chain of custody and crime scene reconstruction.	<b>1, 8</b>
<b>4</b>	Conduct forensic analysis of glass, paint, fibre, soil, and cloth evidence, using both destructive and non-destructive methods.	<b>1, 3, 8</b>
<b>5</b>	Analyze tool marks for forensic investigations and restore erased serial numbers and engraved marks.	<b>1, 8</b>

SEMESTER – III									
Course Title	Questioned Document & Handwriting Identification								
Course code	22BSFS213R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/ III semester of first year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce students to the types of questioned documents, forgery methods, and the characteristic features of genuine and forged handwriting/signatures.</li> <li>2. Familiarize students with the principles of handwriting identification, including class and individual characteristics, and the examination of tampered documents.</li> <li>3. Explore the analysis of disputed documents, such as wills, cheques, counterfeit currencies, and various types of fraud.</li> <li>4. Provide knowledge on the examination of security documents, printed matter, mechanical impressions, and paper analysis.</li> <li>5. Equip students with the skills to use advanced instrumentation and photographic techniques in the examination of questioned documents.</li> </ol>								
CO1	Understand the different types of questioned documents and forgery methods, and identify the features of genuine and forged handwriting/signatures.								
CO2	Apply principles of handwriting identification to analyze class and individual characteristics, and examine tampered documents.								
CO3	Evaluate disputed documents and identify various types of fraud involving documents.								
CO4	Analyze security features in documents and examine printed matter, mechanical impressions, and paper.								
CO5	Utilize advanced instrumentation and photographic techniques in the forensic examination of questioned documents.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Introduction to questioned documents, types, Forgery and its types, characteristic features of genuine handwriting/signatures, characteristic components of forged documents and their examination, procedure for collection of standards for comparison of documents, admitted/ genuine/documents/signature/writing	7	Identify and analyze various types of questioned documents and forgery methods.				1,2		
II	Principle of Handwriting Identification: introduction of handwriting, physiology, handwriting characteristics: class and individual characteristics, natural variations in handwriting, causes of variations, disguised writings, its examination, tampered documents: addition, alteration, erasure, obliteration, interlineation, page substitution, secret writing. examination of the documents for the ink, paper, photocopies/xerox, printouts and scanned documents.	10	Apply handwriting identification principles to examine handwriting characteristics and tampered documents.				1,2		
III	Disputed documents - wills, deeds, cheques, suicide letters, anonymous letters, threatening	10	Analyze disputed documents for evidence of				1,2		

	letters, stamps fraud, counterfeit currencies, fake paintings and printing, ATM and Credit card frauds, fake rubber stamps and seals, charred documents, torn documents, typed and photocopied documents.		fraud and identify types of counterfeit and fake documents.	
<b>IV</b>	Examination of security documents. examination of printed matter, examination of built-up documents, determination of sequence of strokes, identification of typist: use of forensic stylistics, examination of other mechanical impressions, examination of paper	<b>8</b>	Examine security features in documents and analyze printed and mechanical impressions.	1,2
<b>V</b>	Instrumentation in Questioned Documents Document photography using Camera, Colour filters, Various light sources/Transmitted light, Oblique light/UV/IR radiations), apparatus for specialized photographic techniques, magnifying glasses, illuminated torch, measuring equipment, geometrical requirements, compound microscope, Stereo microscope, Video Spectral Comparator, Docu-centre, Projectina, ESDA, TLC	<b>10</b>	Use advanced instrumentation and photographic techniques for the forensic analysis of questioned documents	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Handwriting analysis based on class and individual characteristics.</li> <li>2. Examination of documents under different light sources: transmitted, oblique, UV.</li> <li>3. Identification of genuine and fake currencies.</li> <li>4. To determine freehand forgery and traced forgery in a signature.</li> <li>5. Examination and comparison of disputed anonymous letters with specimens of suspect/suspects.</li> </ol>	<b>30</b>		1,2, 3,4

**TEXT BOOKS:**

**T1:** E. David, The Scientific Examination of Documents – Methods and Techniques, 2nd Edition, Taylor & Francis, Hants (1997).

**REFERENCE BOOKS:**

**R1:** B R Sharma, Handwriting Forensics, Universal Law Publishing - An imprint of Lexis Nexis.

**R2:** Wilson R Harrison, Suspect Documents: Their Scientific Examination, Burnham, Incorporated

**R3:** Albert S Osborn, Questioned Document, Nelson-Hall, Inc



**R4:** O. Hilton, Scientific Examination of Questioned Documents, CRC Press, Boca Raton (1982)

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the different types of questioned documents and forgery methods, and identify the features of genuine and forged handwriting/signatures.	<b>1, 3</b>
<b>2</b>	Apply principles of handwriting identification to analyze class and individual characteristics, and examine tampered documents.	<b>1, 3</b>
<b>3</b>	Evaluate disputed documents and identify various types of fraud involving documents.	<b>1, 3, 5</b>
<b>4</b>	Analyze security features in documents and examine printed matter, mechanical impressions, and paper.	<b>1, 3</b>
<b>5</b>	Utilize advanced instrumentation and photographic techniques in the forensic examination of questioned documents.	<b>1, 3, 8</b>

SEMESTER – III									
Course Title	Universal Human Value and Professional Ethics								
Course code	22UUHV101R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 15T + 30P	1	0	2	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/III Semester of First year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings</li> <li>To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way</li> <li>To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature</li> </ol>								
CO1	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence								
CO2	It is free from any dogma or value prescriptions								
CO3	It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.								
CO4	This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.								
CO5	This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs								
Unit-No.	Content								
I	<b>Course Introduction - Need, Basic Guidelines, Content and Process for Value Education</b> <ol style="list-style-type: none"> <li>Understanding the need, basic guidelines, content and process for Value Education</li> <li>Self-Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation-as the mechanism for self-exploration</li> <li>Continuous Happiness and Prosperity- A look at basic Human Aspirations</li> <li>Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority</li> <li>Understanding Happiness and Prosperity correctly-Acritical appraisal of the current scenario</li> <li>Method to fulfill the above human aspirations: understanding and living in harmony at various levels.</li> </ol>								
II	<b>Understanding Harmony in the Human Being - Harmony in Myself!</b> <ol style="list-style-type: none"> <li>Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body</li> <li>Understanding the needs of Self (‘I’) and ‘Body’ - Sukh and Suvidha</li> <li>Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)</li> <li>Understanding the characteristics and activities of ‘I’ and harmony in ‘I’</li> <li>Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physicalneeds, meaning of Prosperity in detail</li> <li>Programs to ensure Sanyam and Swasthya-Practice Exercises and Case Studies will be taken up inPractice Sessions.</li> </ol>								
III	<b>Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship</b> <ol style="list-style-type: none"> <li>Understanding Harmony in the family – the basic unit of human interaction</li> <li>Understanding values in human-human relationship; meaning of Nyaya and</li> </ol>								

	<p>program for its fulfilment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship</p> <ol style="list-style-type: none"> <li>3. Understanding the meaning of Vishwas; Difference between intention and competence</li> <li>4. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship</li> <li>5. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals</li> <li>6. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family!</li> </ol>
<b>IV</b>	<p><b>Understanding Harmony in the Nature and Existence - Whole existence as Co-existence</b></p> <ol style="list-style-type: none"> <li>1. Understanding the harmony in the Nature</li> <li>2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature</li> <li>3. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space</li> <li>4. Holistic perception of harmony at all levels of existence-Practice Exercises and Case Studies will be taken up in Practice Sessions.</li> </ol>
<b>V</b>	<p><b>Implications of the above Holistic Understanding of Harmony on Professional Ethics</b></p> <ol style="list-style-type: none"> <li>1. Natural acceptance of human values</li> <li>2. Definitiveness of Ethical Human Conduct</li> <li>3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order</li> <li>4. Competence in professional ethics: <ol style="list-style-type: none"> <li>a. Ability to utilize the professional competence for augmenting universal human order</li> <li>b. Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,</li> <li>c. Ability to identify and develop appropriate technologies and management patterns for above production systems.</li> </ol> </li> <li>5. Case studies of typical holistic technologies, management models and production systems</li> <li>6. Strategy for transition from the present state to Universal Human Order: <ol style="list-style-type: none"> <li>a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers</li> <li>b. At the level of society: as mutually enriching institutions and organizations</li> </ol> </li> </ol>
<b>VI</b>	<p><b>UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education</b></p> <p>PS 1: Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? How do you differentiate between right and wrong? What have been your achievements and shortcomings in your life? Observe and analyze them.</p> <p>Expected outcome: the students start exploring themselves; get comfortable to each other and to the teacher and start finding the need and relevance for the course.</p> <p>PS 2: Now-a-days, there is a lot of voice about many techno-genic maladies such as energy and natural resource depletion, environmental pollution, global warming, ozone depletion, deforestation, soil degradation, etc. – all these seem to be man-made problems threatening the survival of life on Earth – What is the root cause of these maladies &amp; what is the way out in your opinion?</p> <p>On the other hand, there is rapidly growing danger because of nuclear proliferation, arms race, terrorism, criminalization of politics, large scale corruption, scams, breakdown of relationships, generation gap, depression &amp; suicidal attempts, etc. – what do you think, is the root cause of these threats to human happiness and peace – what could be the way out in your opinion?</p>

Expected outcome: the students start finding that technical education without study of human values can generate more problems than solutions. They also start feeling that lack of understanding of human values is the root cause of all problems and the sustained solution could emerge only through understanding of human values and value-based living. Any solution brought out through fear, temptation or dogma will not be sustainable.

PS 3: Observe that each one of us has Natural Acceptance, based on which one can verify right or not right for him. Verify this in case of

- i) What is Naturally Acceptable to you in relationship- Feeling of respect or disrespect?
- ii) What is Naturally Acceptable to you – to nurture or to exploit others? Is your living the same as your natural acceptance or different?

Out of the three basic requirements for fulfilment of your aspirations- right understanding, relationship and physical facilities, observe how the problems in your family are related to each. Also observe how much time & effort you devote for each in your daily routine.

Expected outcome:

1. The students are able to see that verification on the basis of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity; it will only develop assumptions.
2. The students are able to see that their practice in living is not in harmony with their natural acceptance most of the time, and all they need to do is to refer to their natural acceptance to remove this disharmony.
3. The students are able to see that lack of right understanding leading to lack of relationship is the major cause of problems in their family and not the lack of physical facilities in most of the cases, while they have given higher priority to earning of physical facilities in their life ignoring relationships and not being aware that right understanding is the most important requirement for any human being.

## **UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!**

PS 4: List down all your desires. Observe whether the desire is related to Self (I) or Body. If it appears to be related to both, see which part of it is related to Self (I) and which part is related to Body.

Expected outcome: the students are able to see that they can enlist their desires and the desires are not vague. Also they are able to relate their desires to 'I' and 'Body' distinctly. If any desire appears related to both, they are able to see that the feeling is related to I while the physical facility is related to the body. They are also able to see that 'I' and 'Body' are two realities, and most of their desires are related to 'I' and not body, while their efforts are mostly centered on the fulfilment of the needs of the body assuming that it will meet the needs of 'I' too.

PS 5:

1. Observe that any physical facility you use, follows the given sequence with time: Necessary & tasteful → unnecessary & tasteful → unnecessary & tasteless intolerable
2. In contrast, observe that any feeling in you is either naturally acceptable or not acceptable at all. If naturally acceptable, you want it continuously and if not acceptable, you do not want it any moment!
3. List down all your activities. Observe whether the activity is of 'I' or of Body or with the participation of both 'I' and Body.
4. Observe the activities within 'I'. Identify the object of your attention for different moments (over a period of say 5 to 10 minutes) and draw a line diagram connecting these points. Try to observe the link between any two nodes.

Expected outcome:

1. The students are able to see that all physical facilities they use are required for a limited time in a limited quantity. Also, they are able to see that in case of feelings, they want continuity of the naturally acceptable feelings and they do not want feelings

which are not naturally acceptable even for a single moment.

2. the students are able to see that activities like understanding, desire, thought and selection are the activities of 'I' only, the activities like breathing, palpitation of different parts of the body are fully the activities of the body with the acceptance of 'I' while the activities they do with their sense organs like hearing through ears, seeing through eyes, sensing through touch, tasting through tongue and smelling through nose or the activities they do with their work organs like hands, legs etc. are such activities that require the participation of both 'I' and body.
3. The students become aware of their activities of 'I' and start finding their focus of attention at different moments. Also, they are able to see that most of their desires are coming from outside (through preconditioning or sensation) and are not based on their natural acceptance.

PS 6:

1. Chalk out programs to ensure that you are responsible to your body- for the nurturing, protection and right utilisation of the body.
2. Find out the plants and shrubs growing in and around your campus. Find out their use for curing different diseases.

Expected outcome: The students are able to list down activities related to proper upkeep of the body and practice them in their daily routine. They are also able to appreciate the plants wildly growing in and around the campus which can be beneficial in curing different diseases

#### **TEXT BOOKS:**

**T1:** 1.R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi,2010.

#### **REFERENCE BOOKS:**

**R1:** 1.B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted2008.

**R2:** PL Dhar, RR Gaur, 1990, Science and Humanism, Common wealth Publishers

**R3:** Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted1986,1991

**R4:** Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA.

**R5:** Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III,1972, limitsto Growth, Club of Rome's Report, Universe Books.

**R6:** Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh,Amravati.

**R7:** A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak

**R8:** E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond &Briggs, Britain

**R9:** A.N. Tripathy, 2003, Human Values, New Age International Publishers

#### **OTHER LEARNING RESOURCES:**

1. Value Education websites, <http://uhv.ac.in>,<http://www.uptu.ac.in>
2. Story of Stuff ,<http://www.storyofstuff.com>
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence	<b>5, 7, 9</b>
<b>2</b>	It is free from any dogma or value prescriptions	<b>5</b>
<b>3</b>	It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.	<b>9</b>
<b>4</b>	This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.	<b>9</b>
<b>5</b>	This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs	<b>9</b>

SEMESTER – III									
Course Title	English Language for excellence (Communicative English for soft skills)								
Course code	22UBPD212R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 60P	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/III Semester of First year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To enable students to learn, understand and practice transformation of sentences, uses of correct preposition.</li> <li>To augment the writing skills in different areas including CV and cover letter writing.</li> <li>To boost productivity and performance at work, which assists in the achievement of professional goals.</li> <li>To evaluate the required attributes in a candidate.</li> </ol>								
CO1	Practice of grammar will strengthen their speaking and writing skills.								
CO2	Learners will be able to use the skills in their professional communication.								
CO3	It will enable to deal with thoughts, and emotions in a productive way.								
CO4	The different attributes will develop the students' ability to cope up in professional environment.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Grammar: Use of preposition, tag questions, simple, complex and compound sentences.	3	Describe preposition, simple and complex sentences				1,2		
II	Grammar: Active and passive voice, direct and indirect speech.	3	Describe type of voices and type of speech				1, 2		
III	Self-Management Skills: SWOT analysis, self-regulation, personal hygiene.	3	Explain self-regulation and personal hygiene.				1, 2, 3		
IV	Non- Verbal Communication-Sciences of Body Language: What is Non-Verbal Communication & Body Language, Elements of Communication, Types of Body Language, Importance and Impact of Body Language, Types of Communication through Body Language, Body Language Do's and Don'ts, Doubt Clearing Session.	3	Explain nonverbal communication, body language				1, 2, 3,		
V	Group Discussion (Theory): Importance, Planning, elements ad skills assessed; effective disagreeing, summarizing and attaining the objective.	3	Develop knowledge on group discussion.				1,2,		

#### TEXT BOOKS:

**T1:** What Employers Want: The Work skills Handbook- Karen Holmes, 2011.

**T2:** English Grammar in Use, Raymond Murphy 4th edition, CUP.

#### REFERENCE BOOKS:

**R1:** Professional Communication, 2015, by Dr. Prachi Dr. S. K. Singh.

**R2:** Word Power Made Easy, Norman Lewis, 15 March 2015.

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Practice of grammar will strengthen their speaking and writing skills.	<b>5, 7</b>
<b>2</b>	Learners will be able to use the skills in their professional communication.	<b>5, 7</b>
<b>3</b>	It will enable to deal with thoughts, and emotions in a productive way.	<b>5, 7</b>
<b>4</b>	The different attributes will develop the students' ability to cope up in professional environment.	<b>5, 7, 9</b>



SEMESTER – IV									
Course Title	Forensic Ballistics								
Course code	22BSFS221R	Total credits: 4 Total hours: 45T+30P	L	T	P	S	R	O/F	C
			3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/IV Semester of Second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Understand the definition, scope, and significance of forensic ballistics, including the history and development of gunpowder and firearms.</li> <li>2. Explore improvised and country-made firearms, gunshot residues, and methods of analyzing residues on shooting hands and targets.</li> <li>3. Classify small firearms and ammunition, examining firing mechanisms, types of ammunition, and marks produced during the firing process.</li> <li>4. Delve into internal ballistics, covering propellant ignition, shape and size of propellants, and factors influencing internal ballistics.</li> <li>5. Study external ballistics, including vacuum trajectory, air resistance effects, projectile stability, and trajectory computation, as well as terminal ballistics, focusing on the impact of projectiles on targets, ricochet effects, and firearms injuries.</li> </ol>								
CO1	Understand the history and development of Gun powder firearms, IED, GSR and need and scope of forensic ballistics along with their practical aspects.								
CO2	Explain types of Firearms and ammunition and its composition along with their practical aspects								
CO3	Explain the type and mechanism of series of events that takes place after firing inside the firearm along with their practical aspects.								
CO4	Explain the series of events takes place after the bullet will leave the muzzle of the firearm and factor affecting its velocity along with their practical aspects.								
CO5	Examine the effect of bullets after terminating and different factors resulting it along with their practical aspects.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	Definition, Scope, and Significance of Forensic Ballistics; Gun powder – Definition, History and Development. Firearms – Definition according to Indian Arms Act. History and Development; Improvised & country made firearms; Formation of gunshot residues. Methods of analysis of gunshot residues from shooting hands and targets, with special reference to clothing.		8	Introduction to ballistic-need & scope. History and development of gun powder, firearms, ied, gsr-its collection and analysis.				1,2	
II	Weapon types and their operation. Firing mechanisms of different firearms. Types of ammunition. Constructional features and characteristics of different types of cartridges and bullets. Primers and priming compounds. Projectiles. Different types of marks produced during firing process on cartridge – firing pin marks, breech face marks, chamber marks, extractor and ejector marks		7	Classification of firearm as per their type and mechanism. Different parts of bullets and firearms.				1,2	
III	Definition, ignition of propellants, shape and size of propellants, manner of burning, and		10	Detailed study of internal ballistics- series of events				1,2	

	various factors affecting the internal ballistics		takes place after firing inside the firearm.	
<b>IV</b>	Vacuum trajectory, effect of air resistance on trajectory, base drag, drop, drift, yaw, shape of projectile and stability.	<b>10</b>	Detailed study of external ballistics- series of events takes place after the bullet will leave the muzzle of the firearm and factor affecting its velocity.	1,2
<b>V</b>	Terminal Ballistics, Wound ballistics, nature of injury, Effect of projectile on hitting the target, entry wound, exit wound, multiple entry and exit wound, ricochet and its effects.	<b>10</b>	Detailed study of terminal ballistics- what happens to the bullet and the target after hitting and different factors resulting it.	1,2
<b>Practical</b>	1) Identification of firearm for type, make & model 2) To identify ammunition for type, make & calibre 3) Matching of bullets by comparison microscope. 4) Matching of cartridge cases by comparison microscope. 5) To identify GSR/firearms discharge using chemical/colour test 6) To separate high explosives/ explosives residues using TLC 7) To identify explosives residues using UV-Vis spectroscopy 8) To identify explosives residues using FTIR	<b>30</b>		1,2,3,4

**TEXT BOOKS:**

**T1:** B.J. Heard, Handbook of Firearms and Ballistics, Wiley and Sons, Chichester (1997).

**REFERENCE BOOKS:**

**R1:** K Kumar, Forensic Ballistics in Criminal Justice, Eastern Book Company, Lucknow.

**R2:** W.F. Rowe, Firearms identification, Forensic Science Handbook, Vol. 2, R. Saferstein (Ed.), Prentice Hall, New Jersey (1988)

**R3:** A.J. Schwoebel and D.L. Exline, Current Methods in Forensic Gunshot Residue Analysis, CRC Press, Boca Raton (2000).

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the history and development of Gun powder firearms, IED, GSR and need and scope of forensic ballistics along with their practical aspects.	<b>1, 2, 3</b>
<b>2</b>	Explain types of Firearms and ammunition and its composition along with their practical aspects	<b>1, 8</b>
<b>3</b>	Explain the type and mechanism of series of events that takes place after firing inside the firearm along with their practical aspects.	<b>1, 2</b>
<b>4</b>	Explain the series of events takes place after the bullet will leave the muzzle of the firearm and factor affecting its velocity along with their practical aspects.	<b>2</b>
<b>5</b>	Examine the effect of bullets after terminating and different factors resulting it along with their practical aspects.	<b>2</b>

SEMESTER – IV									
Course Title	Forensic Chemistry								
Course code	22BSFS222R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/IV Semester of second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce students to designer drugs, narcotics, and psychotropic substances, including their effects on driving.</li> <li>2. Familiarize students with laboratory tests for drugs in blood, urine, and tissues, considering post-mortem changes and drug abuse in sports.</li> <li>3. Explore types and causes of fires, patterns, thermodynamics, accelerants, incendiary devices, and forensic analysis of fire debris and petroleum products.</li> <li>4. Provide knowledge on explosives, IEDs, explosion reconstruction, and systematic examination of explosive residues.</li> <li>5. Cover analysis of alcoholic beverages, country-made liquor, illicit liquor, and medicinal preparations containing alcohol, as well as examination of chemicals in bribe trap cases.</li> </ol>								
CO1	Identify and understand various drug categories, their impact, and their relevance in forensic investigations along with their practical aspects.								
CO2	Discuss various laboratory examination for drug detection in forensic contexts along with their practical aspects.								
CO3	Develop expertise in fire-related forensic analysis, allowing students to determine fire origin and causes along with their practical aspects.								
CO4	Analyze and interpret evidence related to explosives, contributing to forensic investigations.								
CO5	Conduct forensic analysis on beverages and identify relevant substances in forensic scenarios along with their practical aspects.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Designer drugs, Narcotics, depressants, stimulants, hallucinogens designer drugs, club drugs and date rape drugs, drugs and driving	8	Understand the classification, effects, and implications of various substances on driving, fostering a comprehensive understanding of their forensic significance				1,2		
II	Drugs detected in blood/urine/biological tissues, post-mortem changes affecting the analysis of clandestine drug laboratories, drug abuse in sports	7	Apply laboratory tests for detecting drugs in different biological samples, addressing post-mortem changes and issues related to drug abuse in sports.				1,2		
III	Types of Fires, and Causes of fire, Patterns of fire Thermodynamics of fire Accelerants and incendiary devices, Forensic Analysis of Fire Debris by Instrumental methods Forensic Analysis of petroleum products	10	Analyze fire incidents, identifying types, causes, and patterns, and conduct forensic analysis of fire debris and petroleum products, showcasing expertise in fire investigations.				1,2		
IV	Introduction, classification and chemistry of explosives, Various types of IEDs and their reconstruction Mechanism of explosion and their effects Systematic examination of explosive and explosion residues (organic and inorganic) by chemical and instrumental techniques and interpretation	10	Evaluate explosives, their classification, IED types, and conduct systematic examinations of explosive residues through chemical and instrumental techniques, fostering proficiency in explosive investigations.				1,2		

<b>V</b>	Analysis of alcoholic beverages, country made liquor, illicit liquor and medicinal preparations containing alcohol as constituents. Examination of chemicals used in bribe trap cases	<b>10</b>	Demonstrate skills in the analysis of alcoholic beverages, country-made liquor, illicit liquor, and chemicals used in bribe trap cases, showcasing expertise in beverage analysis and relevant forensic examinations.	1,2
<b>Practical</b>	1) Analysis of alcoholic liquors. 2) Determination of methanol and ethanol in alcoholic liquors. 3) Analysis of gasoline 4) Analysis of explosion residues 5) Systematic identification of (opiates, cannabis, barbiturates, benzodiazepines, amphetamines etc.) 6) Thin layer chromatographic analysis of drugs 7) UV/Vis spectrophotometric analysis of barbiturates, benzodiazepine and amphetamines.	<b>30</b>		1,2, 3,4

**TEXT BOOKS:**

**T1:** Forensic Chemistry by S bell (Pearson 2006)

**REFERENCE BOOKS:**

**R1:** Criminalistics by R. Safferstein published by Wiley

**R2:** V.V Pillay, Textbook of forensic medicine and Toxicology, 16th Edition, Paras publications

**R3:** Pascal Kintz, Toxicological Aspects of Drug-Facilitated Crimes, Academic Press, Elsevier

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Identify and understand various drug categories, their impact, and their relevance in forensic investigations along with their practical aspects.	<b>1, 3</b>
<b>2</b>	Discuss various laboratory examination for drug detection in forensic contexts along with their practical aspects.	<b>1, 3</b>
<b>3</b>	Develop expertise in fire-related forensic analysis, allowing students to determine fire origin and causes along with their practical aspects.	<b>1, 2, 3</b>
<b>4</b>	Analyze and interpret evidence related to explosives, contributing to forensic investigations.	<b>1, 2, 3, 8</b>
<b>5</b>	Conduct forensic analysis on beverages and identify relevant substances in forensic scenarios along with their practical aspects.	<b>1, 3, 8</b>

SEMESTER – IV									
Course Title	Cyber & Digital Forensics								
Course code	22BSFS223R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/ IV Semester of Second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Understand the fundamentals of computer hardware, including hard disk development, memory, processors, and operating systems.</li> <li>2. Explore the definition and various types of computer crimes, distinguishing them from conventional crimes.</li> <li>3. Examine malware, such as computer viruses, worms, Trojan horses, and their roles in computer crimes.</li> <li>4. Learn the principles and procedures of computer forensics investigations, including the seizure, preparation, and extraction of information from suspected computers.</li> <li>5. Address legal and privacy issues related to the collection and seizure of magnetic media, covering topics like file restoration, password cracking, encryption methods, and user tracking.</li> </ol>								
CO1	Understand the fundamentals of computer hardware, accessories and network connections along with their practical aspects								
CO2	Describe the various cyber and digital crimes along with their practical aspects.								
CO3	Explain various viruses, adware, malwares and their effect along with their practical aspects.								
CO4	Demonstrate the methods of collection restoration and decryption of data related to cybercrimes along with their practical aspects.								
CO5	Demonstrate analysis of media, files, folder etc. using various computer forensic software and hardware along with their practical aspects.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	Fundamentals and Concepts: Fundamentals of computers Hardware and accessories-development of hard disk, physical construction, CHS and LBA addressing, encoding methods and formats. Memory and processor. Methods of storing data. Operating system. Software. Introduction to network, LAN, WAN and MAN		8	Fundamentals of computer hardware and accessories and network connections & their uses.				1,2	
II	Computer Crimes: Definition and types of computer crimes. Distinction between computer crimes and conventional crimes. Reasons for commission of computer crimes. Breaching security and operation of digital systems		7	Definition and types of crime related to computer.				1,2	
III	Malware and Other Crimes: Computer virus, and computer worm – Trojan horse, trap door, super zapping, logic bombs. Types of computer crimes – computer stalking, pornography, hacking, crimes related to intellectual property rights, computer terrorism, hate speech, private and national security in cyber space. An overview of hacking, spamming, phishing and stalking		10	A brief idea about malwares and their effect, categories of crime involving computer and internet.				1,2	

<b>IV</b>	Computer Forensics Investigations: Seizure of suspected computer. Preparation required prior to seizure. Protocol to be taken at the scene. Extraction of information from the hard disk. Treatment of exhibits. Creating bitstream of the original media	<b>10</b>	Computer forensic information- preparation, seizure, analysis.	1,2
<b>V</b>	Collection and Seizure of Magnetic Media: Legal and privacy issues. Examining forensically sterile media. Restoration of deleted files. Password cracking and E-mail tracking. Encryption and decryption methods. Tracking users	<b>10</b>	Collection restoration and decryption of magnetic media data.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1) To identify, seize and preserve digital evidence from crime scenes.</li> <li>2) To detect deletions, obliterations and modifications of files using cyber forensic software.</li> <li>3) To identify the IP address of the sender of e-mails.</li> <li>4) To identify encrypted/hidden files</li> <li>5) To use digital signatures for securing e-mail and online transactions.</li> <li>6) To acquire data from PCs/laptops/HDDs/USBs, pen drives, memory cards and SIM cards cyber forensic software/hardware</li> <li>7) To carry out imaging of hard disks</li> </ol>	<b>30</b>		1,2,3,4

**TEXT BOOKS:**

**T1:** Verma M., Forensic Computer investigation

**REFERENCE BOOKS:**

**R1:** R.K. Tiwari, P.K. Sastry and K.V. Ravikumar, Computer Crimes and Computer Forensics, Select Publishers, New Delhi (2003)

**R2:** C.B. Leshin, Internet Investigations in Criminal Justice, Prentice Hall, New Jersey (1997)

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the fundamentals of computer hardware, accessories and network connections along with their practical aspects	<b>1, 8</b>
<b>2</b>	Describe the various cyber and digital crimes along with their practical aspects.	<b>1</b>
<b>3</b>	Explain various viruses, adware, malwares and their effect along with their practical aspects.	<b>1, 3</b>
<b>4</b>	Demonstrate the methods of collection restoration and decryption of data related to cybercrimes along with their practical aspects.	<b>1, 8</b>
<b>5</b>	Demonstrate analysis of media, files, folder etc. using various computer forensic software and hardware along with their practical aspects.	<b>1, 3, 8</b>



SEMESTER – IV									
Course Title	Forensic Accountancy & Statistics								
Course code	22BSFS224R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/ IV Semester of Second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce students to the role and importance of statistics in forensic science and the interpretation of forensic data.</li> <li>2. Familiarize students with methods of data collection, representation, and graphical depiction in forensic contexts.</li> <li>3. Explore measures of central tendency and dispersion to describe forensic data.</li> <li>4. Provide knowledge on probability distribution functions and their relevance in forensic science.</li> <li>5. Equip students with statistical tools and techniques, including hypothesis testing, correlation analysis, and analysis of variance, for forensic data interpretation.</li> </ol>								
CO1	Understand the significance of statistics in forensic science and data interpretation								
CO2	Collect, represent, and graphically depict forensic data for analysis.								
CO3	Apply measures of central tendency and dispersion to describe and analyze forensic data.								
CO4	Utilize probability distribution functions to interpret forensic data and understand their properties.								
CO5	Implement statistical tools and techniques for hypothesis testing, correlation analysis, and analysis of variance in forensic research.								
Unit-No.	Content		Contact Hour	Learning Outcome				KL	
I	Introduction to statistics: Introduction to why forensic science is a quantitative science Importance of statistics in interpreting forensic data in research work; Introduction to data and its types, Methods and sources of collecting data; Representation of raw data into tabular form, Graphical representation of frequency distribution, why graphs are important in Forensic Science; Population and Sample, Census and sample survey		8	Explain the importance of statistics in forensic science and interpret different types of data.				1,2	
II	Descriptive statistics: measures of central tendency and dispersion: Introduction to Measures of Central Tendency- Arithmetic mean, Median & Mode; Introduction to Measures of Dispersion- Range, Mean Deviation, Quartile deviation, Variance, Standard Deviation, Coefficient of variation		7	Collect and represent data using tabular and graphical methods relevant to forensic analysis.				1,2	
III	Introduction to probability distribution functions: Concept of probability, Definitions of probability, Concept of random variable - Discrete random variable, Continuous random variable; Concept of probability distribution, Binomial, Poisson, Normal distribution, Definitions, statements of properties of above		10	Apply measures of central tendency and dispersion to describe forensic data accurately.				1,2	

	distribution and examples			
<b>IV</b>	Correlation: Introduction to Correlation, Types of Correlation, Different measures of correlation-Karl Pearson's Rank Correlation Coefficient. Spearman's Rank Correlation Coefficient and its applications	<b>10</b>	Utilize probability distribution functions to analyze discrete and continuous random variables in forensic contexts.	1,2
<b>V</b>	Statistical tools and techniques: Introduction to hypothesis and its types, Types of errors, - Chi square test for goodness of fit and test for independence of attributes, Student's t-test, t-test for simple mean, Difference of means; F-test for equality of variance, Examples, Concept of analysis of variance	<b>10</b>	Use statistical tools and techniques for hypothesis testing, correlation analysis, and analysis of variance in forensic data interpretation.	1,2
<b>Practical</b>	<ol style="list-style-type: none"> <li>1. Construct histogram from the given data</li> <li>2. Represent data using pie chart and conclude the graphical representation</li> <li>3. Construct a frequency polygon from given data</li> <li>4. Calculate descriptive statistics using the data analysis tool in excel</li> <li>5. Generate 20 random Numbers between 100 and 1500 and arrange them in ascending order using MS Excel</li> <li>6. Calculate the correlation coefficient for data provided using MS Excel</li> <li>7. Calculate the correlation coefficient and also the estimated demand</li> </ol>	<b>30</b>		1.2. 3.4

**TEXT BOOKS:**

**T1:** Biostatistics, P. N. Arora and P.L. Malhan

**T2:** Mahajan's Methods in Biostatistics, Mahajan

**T3:** Introductory biostatistics, Chap T. Le. John Wiley, USA

**T4:** Introduction to Statistics for Forensic Science, David Lucey.

**T5:** Essential Mathematics and Statistics for Forensic Science, Craig Adam

**REFERENCE BOOKS:**

**R1:** Fundamentals of Statistics by S.C.Gupta

**R2:** Statistical Methods in Biology, N. T. J. Bailey

**R3:** Biostatistical Analysis, J. H. Zar

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the significance of statistics in forensic science and data interpretation	<b>1, 3</b>
<b>2</b>	Collect, represent, and graphically depict forensic data for analysis.	<b>1, 3</b>
<b>3</b>	Apply measures of central tendency and dispersion to describe and analyze forensic data.	<b>1, 3, 8</b>
<b>4</b>	Utilize probability distribution functions to interpret forensic data and understand their properties.	<b>1, 8</b>
<b>5</b>	Implement statistical tools and techniques for hypothesis testing, correlation analysis, and analysis of variance in forensic research.	<b>1, 8</b>

SEMESTER – IV									
Course Title	English for employability (Communicative English & Soft Skills)								
Course code	22UBPD222R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 60P	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/IV Semester of First year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>To acquaint students with the various tools of effective presentation.</li> <li>To acquire the speaking skill, instruct, influence, engage, educate, or appease the listeners.</li> <li>To increase proficiency, present ability and quality of resume and provide guidance for self-promotion and self-evaluation in social media.</li> <li>To prepare and train the students for the campus drives &amp; walking interviews.</li> </ol>								
CO1	It will prepare the learners to speak with greater control and charisma in front of others.								
CO2	It will have a positive impact on their thought process and problem-solving skills								
CO3	It will arm the students with all the necessary tools and skill sets to prepare a professional resume. They will learn and assess themselves in social media.								
CO4	It will impart them techniques to solve critical problems in interview, develop interviews, improve their communication skills, boost their confidence.								
Unit-No.	Content								
I	Presentation Skills: Introduction; Essential characteristics of a good presentation; Preparation of a good presentation								
II	Public Skills: Fear of Public Speaking; Understanding and Overcoming Fear of Public Speaking; Confidence and Control; Physiology and Stress-Control/Process; Tips for Presentations and Public Speaking; Tips for Using Visual Aids in Presentations; Process for Preparing and Creating Presentations; Delivering Presentations Successfully; Doubt Clearing and Summary of Main Points								
III	Practical session on Resume, Curriculum Vitae, Writing cover letter & LinkedIn Profile: Preparation, submission & screening of Resume; Practical session on cover letter screening session; Creating profile in LinkedIn; How to utilize it?								
IV	Leadership & Management Skills: Concepts of Leadership; Leadership Styles; Manager VS Leader; How to be an Effective Leader? Mock/Practice Session; Doubt Clearing Session								
V	Interview Skills & Dress code Ethics: Types of interview-telephonic, virtual & face to face; Online interview, personal interview; Panel interview; Group interview; JAM session; Types of interview questions- traditional/common interview questions; Case interview questions; General Strategies for answering questions; Marketing your skills and experiences; Preparation before the interview; How to dress up for an interview?; How to maintain eye contact and positive body language; How to be presentable?; Interview dos and don'ts?; Introduction to Dress Code Ethics; Purpose and Importance; How to Make FIRSTIMPRESSION; What to Wear During Interviews or Any Other Formal Meetings – Male & Female								
VI	Mock Interview: Practical Mock Interview; Feedback-Receiving Feedback; Giving Feedback; Advantages of Effective Feedback; How to deal with negative feedback?								

#### TEXT BOOKS:

**T1:** Barrett, Grant. 2016. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking, Zephyros Press.

**T2:** McDowell, Gayle Laakmann. 2008. Cracking the Coding Interview (Indian Edition).

#### REFERENCE BOOKS:

**R1:** Kannaiyan, S. 2002 Biotechnology of Biofertilizers. Narosa publishing house, New Delhi. Dubey, R.C. 2001.

**OTHER LEARNING RESOURCES:** <https://www.aplustopper.com/active-and-passive-voice-rules/><https://www.edudose.com/english/direct-and-indirect-speech-rules/>

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	It will prepare the learners to speak with greater control and charisma in front of others.	<b>5, 7</b>
<b>2</b>	It will have a positive impact on their thought process and problem-solving skills	<b>5, 7</b>
<b>3</b>	It will arm the students with all the necessary tools and skill sets to prepare a professional resume. They will learn and assess themselves in social media.	<b>5, 7, 9</b>
<b>4</b>	It will impart them techniques to solve critical problems in interview, develop interviews, improve their communication skills, boost their confidence.	<b>5, 7, 9</b>

SEMESTER – V									
Course Title	Forensic Biology & Serology								
Course code	22BSFS311R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/V Semester of Second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce the importance and forensic significance of biological evidence, including its nature, location, collection, and evaluation.</li> <li>2. Familiarize students with the forensic examination and identification of hair, fibres, and botanical evidence.</li> <li>3. Explore the composition, functions, and forensic analysis of blood, including species identification and blood group determination.</li> <li>4. Provide knowledge on the forensic significance, collection, and identification of semen and other body fluids.</li> <li>5. Educate students on the use of polymorphic enzymes and various methods for resolving paternity disputes, including serological and biochemical techniques.</li> </ol>								
CO1	Understand the forensic importance of evidence and methods for its collection and evaluation. Biological								
CO2	Identify and analyze hair, fibres, and botanical evidence in forensic investigations.								
CO3	Perform forensic analysis of blood, including species identification and blood group determination from various body fluids.								
CO4	Evaluate the forensic significance of semen and other body fluids, and apply appropriate tests for their identification.								
CO5	Utilize polymorphic enzymes and advanced techniques to resolve paternity disputes and calculate paternity indices.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Biological evidence: Importance, nature, location, collection and evaluation Hair and Fibres: Importance, nature, location, collection, evaluation and tests for their identification.	8	Collect and evaluate various types of biological evidence for forensic analysis.	1,2					
II	Blood: Composition and functions, collection and species identification. Human Blood groups: General Principles, theory of their inheritance, Blood group determination from fresh blood, titter, raulax formation and Bombay blood group. Definition of antigen and antibody, Various Antigen-antibody agglutination and precipitation reaction	7	Identify and analyze hair, fibres, and botanical evidence in forensic contexts.	1,2					
III	Blood grouping from stains of blood, semen, saliva and other body fluids by Absorption-inhibition, Absorption-elution and mixed agglutination techniques, determination of secretor/non-secretor status.Importance and identification of Botanical evidence as Pollen grains, wood, leaves and seeds	10	Perform blood analysis and determine species and blood groups using forensic techniques.	1,2					

<b>IV</b>	Semen: Forensic significance, location, collection, evaluation and tests for identification. Forensic significance of other body fluids as saliva, sweat, milk and urine, their collection and identification	<b>10</b>	Identify and analyze semen and other body fluids, applying forensic tests.	1,2
<b>V</b>	Polymorphic enzymes: Forensic significance, identification from fresh blood and stains. Paternity disputes: Causes, Various serological (ABO, Rh, MN, HLA) and biochemical (PGM, AK, GLO-1, EsD, Acid Phostase and DNA) methods, calculation of paternity index and probability for paternity and maternity	<b>10</b>	Resolve paternity disputes using serological and biochemical methods, and calculate paternity indices and probabilities.	1,2
<b>Practical</b>	1. To examine hair morphology and determine the species to which the hair belongs. 2. To carry out microscopic examination of pollen grains. 3. To determine blood group from fresh blood samples. 4. To carry out the crystal test on a blood sample 5. To identify blood samples by chemical tests. 6. To identify the given stain as saliva. 7. To identify the given stain as urine	<b>30</b>		1,2, 3,4

**TEXT BOOKS:**

**T1:** R. Saferstein, *Criminalistics*, 8<sup>th</sup> Edition, Prentice Hall, New Jersey (2004)

**REFERENCE BOOKS:**

**R1:** W.G. Eckert and S.H. James, *Interpretation of Bloodstain Evidence at Crime Scenes*, CRC Press, Boca Raton (1989)

**R2:** G.T. Duncan and M.I. Tracey in *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997)

**R3:** T. Bevel and R.M. Gardner, *Bloodstain Pattern Analysis*, 3rd Edition, CRC Press, Boca Raton (2008).

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the forensic importance of biological evidence and methods for its collection and evaluation.	<b>1</b>
<b>2</b>	Identify and analyze hair, fibres, and botanical evidence in forensic investigations..	<b>1, 3</b>
<b>3</b>	Perform forensic analysis of blood, including species identification and blood group determination from various body fluids.	<b>1, 3, 8</b>
<b>4</b>	Evaluate the forensic significance of semen and other body fluids, and apply appropriate tests for their identification.	<b>1, 3, 8</b>
<b>5</b>	Utilize polymorphic enzymes and advanced techniques to resolve paternity disputes and calculate paternity indices.	<b>1, 8</b>



SEMESTER – V									
Course Title	DNA Forensics								
Course code	22BSFS312R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/V Semester of Second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce students to DNA as the biological blueprint and methods for DNA extraction and quantitation in forensic analysis.</li> <li>2. Familiarize students with mitochondrial DNA sequence analysis and its application in forensic investigations.</li> <li>3. Explore forensic DNA typing techniques, including PCR, sequence polymorphisms, and the individualization of evidence using STR loci.</li> <li>4. Provide knowledge on RFLP techniques, genetic markers, typing procedures, and the interpretation of results in forensic DNA analysis.</li> <li>5. Educate students on the principles of parentage testing, including genetics of paternity, DNA testing methods, and the mathematical basis for identifying parentage in disputed cases.</li> </ol>								
CO1	Understand the principles of DNA analysis and methods for extraction, quantitation, and sequence analysis in forensic science.								
CO2	Perform PCR and analyze sequence polymorphisms to individualize forensic evidence using STR loci.								
CO3	Utilize RFLP techniques to analyze genetic markers and interpret results in forensic DNA profiling.								
CO4	Apply parentage testing principles and genetic laws to determine paternity and identify missing individuals using DNA databases.								
CO5	Write forensic reports integrating DNA profiling results and determine allele frequencies using Hardy-Weinberg law in population databases.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Basic Principles: DNA as biological blueprint of life. Extraction of DNA for analysis. Quantitation of DNA – yield gel quantitation and slot blot quantitation. Mitochondrial DNA – sequence analysis.	8	Explain the role of DNA in forensic science and apply methods for DNA extraction and quantitation.	1,2					
II	Forensic DNA Typing-I: Collection of specimens. Polymerase chain reaction – historical perspective, sequence polymorphisms, individualization of evidence. Short tandem repeats (STR) – role of fluorescent dyes, nature of STR loci.	7	Conduct mitochondrial DNA sequence analysis and apply it in forensic contexts.	1,2					
III	Forensic DNA Typing-II: Restriction fragment length polymorphism (RFLP) – genetic markers used in RFLP, typing procedure and interpretation of results. Touch DNA.	10	Perform PCR and analyze STR loci for forensic DNA typing.	1,2					
IV	Parentage Testing: Principles of heredity. Genetics of paternity. DNA testing in disputed paternity. Mendelian laws of	10	Utilize RFLP techniques to interpret genetic markers in forensic DNA profiling	1,2					

	parentage testing. Mathematical basis of parentage identification. Missing body cases. Reference populations and databases.			
<b>V</b>	Report Writing in DNA profiling cases: Role of DNA typing in identifying unrecognizable bodies. Allele frequency determination. Hardy-Weinberg law. Probability determination in a population database.	<b>10</b>	Apply parentage testing principles and write comprehensive forensic reports using DNA profiling results and population databases	1,2
<b>Practical</b>	1) Preparation of solutions for Molecular Biology experiments. 2) Isolation of chromosomal DNA from bacterial cells. 3) Isolation of Plasmid DNA by alkaline lysis method. 4) Agarose gel electrophoresis of genomic DNA & plasmid DNA. 5) Preparation of restriction enzyme digests of DNA samples.	<b>30</b>		1,2, 3,4

**TEXT BOOKS:**

**T1:** R. Saferstein, *Criminalistics*, 8<sup>th</sup> Edition, Prentice Hall, New Jersey (2004)

**REFERENCE BOOKS:**

**R1:** J.M. Butler, *Forensic DNA Typing*, Elsevier, Burlington (2005)

**R2:** K. Inman and N. Rudin, *An Introduction to Forensic DNA Analysis*, CRC Press, Boca Raton (1997)

**R3:** H. Coleman and E. Swenson, *DNA in the Courtroom: A Trial Watcher's Guide*, Gene Lex Corporation, Washington (1994).

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand the principles of DNA analysis and methods for extraction, quantitation, and sequence analysis in forensic science.	1, 3, 8
2	Perform PCR and analyze sequence polymorphisms to individualize forensic evidence using STR loci.	1, 3, 8
3	Utilize RFLP techniques to analyze genetic markers and interpret results in forensic DNA profiling.	1, 3, 8
4	Apply parentage testing principles and genetic laws to determine paternity and identify missing individuals using DNA databases.	1, 8
5	Write forensic reports integrating DNA profiling results and determine allele frequencies using Hardy-Weinberg law in population databases.	1, 3, 5, 8

SEMESTER – V									
Course Title	Forensic Medicine								
Course code	22BSFS313R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/V Semester of Second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce students to the fundamental aspects and scope of forensic medicine, including different types of inquests and the roles of oral evidence and dying declarations.</li> <li>2. Explore the medico-legal aspects of death, including the diagnosis, stages, and signs of death, as well as different types of fatal incidents.</li> <li>3. Provide knowledge on the autopsy process, including internal and external examinations, sample collection, and the investigation of sexual offences and suicidal cases.</li> <li>4. Educate students on the types and classification of injuries, including antemortem and post-mortem injuries, and specific injury types like bite marks and burn injuries.</li> <li>5. Familiarize students with forensic entomology, including the estimation of time since death and the factors affecting decomposition.</li> </ol>								
CO1	Understand the fundamental aspects and scope of forensic medicine and the different types of inquests and evidence in legal investigations.								
CO2	Diagnose the medico-legal aspects of death, recognizing the stages and signs of death and various causes of fatal incidents.								
CO3	Conduct thorough autopsies, including internal and external examinations, sample collection, and the investigation of specific cases like sexual offences and suicides.								
CO4	Identify and classify different types of injuries, distinguishing between antemortem and postmortem injuries.								
CO5	Apply forensic entomology techniques to estimate the time since death and understand the decomposition process.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Forensic medicine, pathology, police inquest, magistrate inquest, oral evidence, dying declaration, kind of witnesses, Fundamental aspects and scope of forensic medicine.	8	Describe the scope of forensic medicine and the roles of different types of inquests and evidence.				1,2		
II	Death & its medico legal aspects, diagnosis of death, stages of death, signs of death, asphyxial death, death due to Starvation, death due to drowning, death due to electrocution, Anaesthetics deaths.	7	Recognize the signs and stages of death and understand various causes of death from a medico-legal perspective.				1,2		
III	Autopsy: medico legal aspect of death, internal and external examination, Sample collecting, sampling techniques, preservation of samples, Causes of death. Investigation of sexual offences, exhumation (buried bodies), suicidal cases	10	Perform autopsies, collect and preserve samples, and investigate specific medico-legal cases				1,2		
IV	Injuries: Types and classification of injuries. Antemortem and post mortem	10	Identify and classify injuries, distinguishing between ante				1,2		

	injuries. Bite marks, burn injuries, head injury		mortem and post-mortem injuries	
<b>V</b>	Forensic entomology: Estimation of time since death, Stages of decomposition of corpse, geographical & seasonal effect on decomposition	<b>10</b>	Use forensic entomology to estimate the time since death and understand the factors affecting decomposition	1,2
<b>Practical</b>	1) To design a questionnaire for the first responder to the death scene. 2) To design a checklist for the forensic scientists at the death scene. 3) To analyze and preserve bite marks 4) To design a canvass form giving description of an unidentified victim.	<b>30</b>		1,2,3,4

**TEXT BOOKS:**

**T1:** J P Modi, A Textbook of Medical Jurisprudence and Toxicology, Lexis Nexis

**REFERENCE BOOKS:**

**R1:** Gautam Biswas, Review of Forensic Medicine and Toxicology, 4th Edition, Jaypee Brothers Medical Publishers

**R2:** K S Narayan Reddy, The Essentials of Forensic Medicine and Toxicology, 34th Edition, Jaypee Brothers Medical Publishers

**R3:** F.G. Hofmann, A Handbook on Drug and Alcohol Abuse, 2nd Edition, Oxford University Press, New York (1983).

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
<b>1</b>	Understand the fundamental aspects and scope of forensic medicine and the different types of inquests and evidence in legal investigations.	<b>1, 2, 6</b>
<b>2</b>	Diagnose the medico-legal aspects of death, recognizing the stages and signs of death and various causes of fatal incidents.	<b>1, 3</b>
<b>3</b>	Conduct thorough autopsies, including internal and external examinations, sample collection, and the investigation of specific cases like sexual offences and suicides.	<b>1, 3, 6</b>
<b>4</b>	Identify and classify different types of injuries, distinguishing between antemortem and postmortem injuries.	<b>1, 4, 8</b>
<b>5</b>	Apply forensic entomology techniques to estimate the time since death and understand the decomposition process.	<b>1, 3</b>

SEMESTER – V									
Course Title	Wildlife and Environmental Forensic								
Course code	22BSFS314R	Total credits: 3	L	T	P	S	R	O/F	C
		Total hours: 30T+30P	2	0	2	0	0	0	3
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/V Semester of Second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Understand the fundamental concepts of wildlife, protected species, and endangered species, and develop skills in the identification of wildlife materials.</li> <li>2. Apply knowledge of pug mark identification, wildlife population censuses, and forensic necropsy, and comprehend the legal aspects of wildlife protection.</li> <li>3. Gain proficiency in forensic entomology, including the identification of insects, collection of entomological evidence, and understanding insect succession in forensic investigations.</li> <li>4. Explore forensic botany, recognizing botanical evidence and diatoms, and understanding their forensic significance.</li> <li>5. Evaluate environmental standards, environmental protection laws, agencies, and waste treatment methods in the context of forensic investigations</li> </ol>								
CO1	Demonstrate a comprehensive understanding of the importance of wildlife, protected and endangered species, and proficiency in identifying wildlife materials through conventional and modern methods.								
CO2	Apply knowledge in the identification of pug marks, conducting wildlife population censuses, and performing forensic necropsy, while understanding the legal frameworks like the Wildlife Protection Act and Environment Protection Act.								
CO3	Exhibit a foundational understanding of forensic entomology, recognizing insects of forensic importance, collecting entomological evidence in death investigations, and applying insect succession to determine the time since death.								
CO4	Analyze various botanical evidence of forensic significance, including leaves and seeds, and demonstrate the isolation and forensic importance of diatoms from different samples.								
CO5	Evaluate environmental standards for air, water, and noise quality, and demonstrate knowledge of environmental laws, policies, protection agencies, waste treatment methods, and biodegradation processes.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Introduction and importance of wild life, Protected and endangered species of Animals and Plants. Identification of wild life materials such as skin, fur, bones, nails, horn, teeth, flowers and plants by conventional and modern methods.	6	Environmental Biology, ecosystem, biomarkers, biosensors ad toxicity.				1,2		
II	Pug marks of various animals, census of wild life population, forensic (medico-legal) necropsy of wildlife, wildlife protection act, environment protection act, significance of wildlife forensic.	6	Waste treatment strategies, nitrification and denitrification, anaerobic processes etc.				1,2		
III	Unit 3: Different insects of forensic importance, collection of entomological evidence during death investigations, Role of aquatic insects in forensic investigations, insect succession on	6	Application of forensic science in environmental science, forensic technique in environmental litigation				1,2		

	carrion and its relationship to determine time since death, factors influencing insect succession on carrion, its application to forensic entomology.			
<b>IV</b>	Unit 4: Different botanical evidences of forensic significance: Leaves, seeds, etc. Diatoms: Classification, basic structure and morphology, Isolation of diatoms from various samples and its forensic significance.	<b>6</b>	Biodegradation and bioremediation mechanism and process, use of plant for removal of organic and metallic pollutants, microbial interaction with metallic elements.	1,2
<b>V</b>	Unit 5: air, water and noise quality. Environment protection Act: environmental laws, policies, environmental protection agencies, waste treatment, aerobic/ anaerobic processes, biodegradation	<b>6</b>	Environmental protection and conversation.	1,2
<b>Practical</b>	1) To prepare a case report on problems of wildlife forensics. 2) To prepare report on techniques used in wildlife forensics 3) Analysis of pug marks 4) Analysis of diatoms 5) Visit to vet. hospital for postmortem study 6) Morphological identification of various wild life products 7) Chemical and investigative forensic methods presented within the context of environmental forensic case histories	<b>30</b>		1,2, 3,4

**TEXT BOOKS:**

**T1:** Introduction to Environmental Forensics, 2ndEdition - Robert D. Morrison, Academic Press, ISBN: 978-0123695222

**REFERENCE BOOKS:**

**R1:** Microbial Biotechnology: A. N. Glazer and H. Nikaidis

**R2:** Biotechnology: A Text Book of Industrial Microbiology, T. Brock

**R3:** Prescott & Dunn's Industrial Microbiology – G. Reed, CBS Publishers & Distributors, ISBN: 978-8123910017.

**R4:** Environmental Forensics: Contaminant Specific Guide- Robert D. Morrison

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Demonstrate a comprehensive understanding of the importance of wildlife, protected and endangered species, and proficiency in identifying wildlife materials through conventional and modern methods.	<b>1, 2</b>
<b>2</b>	Apply knowledge in the identification of pug marks, conducting wildlife population censuses, and performing forensic necropsy, while understanding the legal frameworks like the Wildlife Protection Act and Environment Protection Act.	<b>1, 2, 3</b>
<b>3</b>	Exhibit a foundational understanding of forensic entomology, recognizing insects of forensic importance, collecting entomological evidence in death investigations, and applying insect succession to determine the time since death.	<b>1, 2, 3</b>
<b>4</b>	Analyze various botanical evidence of forensic significance, including leaves and seeds, and demonstrate the isolation and forensic importance of diatoms from different samples.	<b>1, 3, 8</b>
<b>5</b>	Evaluate environmental standards for air, water, and noise quality, and demonstrate knowledge of environmental laws, policies, protection agencies, waste treatment methods, and biodegradation processes.	<b>1, 8</b>

SEMESTER – VI									
Course Title	Forensic Toxicology								
Course code	22BSFS321R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/VI Semester of third year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce students to poison classification, signs of drug addiction, drug toxicity, and methods for extracting poisons from biological specimens.</li> <li>2. Explore pharmacology and toxicology of psychotropic drugs, including sedatives, stimulants, opiates, and drugs of abuse.</li> <li>3. Cover the nature, administration, signs, symptoms, and detection of corrosive poisons, arsenic, mercury, and lead.</li> <li>4. Explore pesticides, their isolation, detection, and estimation, as well as volatile poisons like methyl alcohol and chloroform.</li> <li>5. Introduce students to animal and plant poisons, blood alcohol analysis, breath test instruments, and asphyxiants like cyanide and carbon monoxide.</li> </ol>								
CO1	Understand the foundational knowledge and practical skills to identify and analyze toxic substances in forensic contexts along with their practical aspects.								
CO2	Explain the effects of psychotropic drugs and their implications in forensic investigations along with their practical aspects.								
CO3	Interpret metallic poison analysis and their medico-legal aspects.								
CO4	Analyze non-volatile and volatile poisons, understanding their effects and contributing to forensic investigations along with their practical aspects.								
CO5	Analyze miscellaneous poisons contributing to forensic examination in complex and rare cases								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Classification of poisons, drug addiction and its signs and symptoms, drug toxicity. Extraction and isolation of poisons from viscera and other biological specimen	8	Proficiently identify, classify, and isolate poisons, demonstrating an understanding of drug addiction signs and symptoms				1,2		
II	Pharmacology and toxicology of Psychotropic Drugs: Sedatives, Stimulants, Opiates and drugs of abuse.	7	Apply knowledge of psychotropic drug effects, showcasing expertise in sedatives, stimulants, opiates, and drugs of abuse.				1,2		
III	Nature, administration, sign & symptoms, fatal dose, postmortem findings, detection and medicolegal aspects of-Corrosive poisons: acids and alkalis, Arsenic, Mercury, Lead.	10	Analyze metallic poisons with expertise in detection methods, postmortem findings, and medico-legal aspects.				1,2		
IV	Various pesticides, isolation, detection and estimation, Volatile Poisons: methyl alcohol, chloroform. symptoms, post-mortem findings, isolation, detection and estimation, medico-legal findings.	10	Showcase proficiency in identifying, detecting, and estimating non-volatile and volatile poisons, emphasizing toxicological analysis.				1,2		
V	Animal poisons, plant poisons, analysis of blood for alcohol, breath test instruments, Asphyxiants Cyanide, Carbon monoxide	10	Demonstrate expertise in analyzing various poisons, including animal and plant toxins, breath tests for alcohol, and detecting asphyxiants like cyanide and carbon monoxide,				1,2		



			showcasing proficiency in toxicological	
<b>Practical</b>	1) Isolation techniques of different toxic substances. 2) TLC of insecticides, Barbiturates and other drugs. 3) Analysis of volatile and non-volatile poisons. 4) Analysis of vegetable poisons. 5) Spot test of nitrates, nitrites, carbonates, sulphates, sulphites, chlorates. 6) Spot test of mercury, iron, copper, Aluminium and cadmium and zinc and other metallic poisons. 7) Determination of alcohol in blood and urine sample	<b>30</b>		1,2,3,4

**TEXT BOOKS:**

**T1:** The Toxicology is all about the studies drugs and poisons, their effect and analysis.

**REFERENCE BOOKS:**

**R1:** Gautam Biswas, Review of Forensic Medicine and Toxicology, 4th Edition, Jaypee Brothers Medical Publishers

**R2:** K S Narayan Reddy, The Essentials of Forensic Medicine and Toxicology, 34th Edition, Jaypee Brothers Medical Publishers

**R3:** F.G. Hofmann, A Handbook on Drug and Alcohol Abuse, 2nd Edition, Oxford University Press, New York (1983).

**R4:** S.B. Karch, The Pathology of Drug Abuse, CRC Press, Boca Raton (1996)

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand the foundational knowledge and practical skills to identify and analyze toxic substances in forensic contexts along with their practical aspects.	1, 3
2	Explain the effects of psychotropic drugs and their implications in forensic investigations along with their practical aspects.	1
3	Interpret metallic poison analysis and their medico-legal aspects.	1, 3, 8
4	Analyze non-volatile and volatile poisons, understanding their effects and contributing to forensic investigations along with their practical aspects.	1, 3, 8
5	Analyze miscellaneous poisons contributing to forensic examination in complex and rare cases	1, 3, 8

SEMESTER – VI									
Course Title	Forensic Anthropology								
Course code	22BSFS321R	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 45T+30P	3	0	2	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/VI Semester of Second year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Understand the definition, scope, and application of Forensic Anthropology, with a focus on the study of the human skeleton.</li> <li>2. Learn the nature, formation, and methods for identification of human bones, with an emphasis on estimating age, race, sex, and stature from skeletal material.</li> <li>3. Explore the importance and necessity of personal identification in forensic anthropology, particularly in cases requiring personal identification.</li> <li>4. Master Somatoscopy, focusing on the observation of various anatomical features and marks for personal identification purposes.</li> <li>5. Acquire knowledge of Somatometry and indices for measurements of different body parts, along with the study of burned bones and bone fragments in mass disasters.</li> </ol>								
CO1	Identify human skeleton for estimation of age, race, sex, and stature along with their practical aspects.								
CO2	Apply personal identification techniques, including somatoscopy, for observing and recording anatomical features, scars, occupational marks, and tattoos along with their practical aspects.								
CO3	Illustrate Somatometry measurements and interpret indices for various body parts, contributing to personal identification in forensic scenarios along with their practical aspects.								
CO4	Analyze burned bones and bone fragments in mass disasters.								
CO5	Utilize facial reconstruction techniques.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Definition, scope and application of Forensic Anthropology. Study of Human Skeleton. Nature, formation and identification of human bones. Estimation of age, race, sex and stature from skeletal material – skull, pelvis, long bones.	8	Proficiently apply the study of human bones to estimate age, race, sex, and stature, contributing to forensic investigations.				1,2		
II	Importance and need for personal identification, cases that will require personal identification. Somatoscopy – observation of hair on head, forehead, eyes, root of nose, nasal bridge, nasal tip, lips, chin, Darwin’s tubercle, ear lobes, supra-orbital ridges, physiognomic ear breadth, circumference of head, prognathism. Scar marks, occupational marks and tattoo marks.	7	Apply Somatoscopy techniques for the observation and recording of anatomical features, scars, and marks, addressing the need for personal identification				1,2		
III	Somatometry – measurements of head, face, nose, cheek, ear, hand and foot, body weight, height. Indices - cephalic index, nasal index, cranial index, upper facial index. Study of burned bones and bone fragments in mass disasters; Establishment of Partial and Complete	10	Conduct Somatometry measurements and interpret indices, contributing to personal identification, and study burned bones in mass disasters for identity establishment				1,2		

	identity of skeletal material and dead bodies			
<b>IV</b>	Facial superimposition techniques, Craniofacial superimposition techniques – photographic superimposition. Facial reconstruction and its importance. Importance of tissue depth in facial reconstruction. Use of somatoscopy and craniometric methods in reconstruction.	<b>10</b>	Utilize facial reconstruction techniques, including facial and craniofacial superimposition, emphasizing tissue depth for accurate reconstructions	1,2
<b>V</b>	Development, scope and role of forensic odontology in mass disaster and anthropology. Introduction to human dentition, structure of teeth, Types and functions of teeth and their comparative anatomy. Estimation of age from teeth. Bite Marks: Types of bite marks; collection and preservation and photography of bite mark evidence, forensic importance of bite marks.	<b>10</b>	Understand the role of forensic odontology, estimate age from teeth, and analyze bite marks, including their collection, preservation, and forensic importance...	1,2
<b>Practical</b>	1) To determine of age from skull and teeth. 2) To determine of sex from skull. 3) To determine sex from pelvis. 4) To study identification and description of bones and their measurements. 5) To investigate the differences between animal and human bones. 6) To perform somatometric measurements on living subjects. 7) To carry out craniometric measurements of human skull. 8) To estimate stature from long bone length.	<b>30</b>		1,2, 3,4

**TEXT BOOKS:**

**T1:** Boyd, C.C., Forensic Anthropology: Theoretical framework and scientific basis.

**REFERENCE BOOKS:**

**R1:** Kapoor, A.K., Anthropology and Forensic science

**R2:** Sehgal, S. Nath, Forensic Anthropology, Science and medicine

**OTHER LEARNING RESOURCES:** E-Pathsala- Online Learning Platforms

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Identify human skeleton for estimation of age, race, sex, and stature along with their practical aspects.	<b>1, 3</b>
<b>2</b>	Apply personal identification techniques, including somatoscopy, for observing and recording anatomical features, scars, occupational marks, and tattoos along with their practical aspects.	<b>1, 3</b>
<b>3</b>	Illustrate Somatometry measurements and interpret indices for various body parts, contributing to personal identification in forensic scenarios along with their practical aspects.	<b>1, 8</b>
<b>4</b>	Analyze burned bones and bone fragments in mass disasters.	<b>1, 3, 8</b>
<b>5</b>	Utilize facial reconstruction techniques.	<b>1, 3, 8</b>

### Techno-Professional Skill Courses

<b>SEMESTER – II</b>									
Course Title	<b>Evaluation of Criminal Psychology</b>								
Course code	<b>22BSFS125R</b>	Total credits: 1	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>R</b>	<b>O/F</b>	<b>C</b>
		Total hours: 30P	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
Pre-requisite	<b>Nil</b>	Co-requisite	<b>Nil</b>						
Programme	<b>Bachelor of Science in Forensic Science</b>								
Semester	<b>Winter/II Semester of First year of the programme</b>								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce the fundamental concepts of forensic psychology and the psychological explanations for specific crimes.</li> <li>2. Explore the relationship between criminality and mental illnesses such as necrophilia and schizophrenia, supported by case studies.</li> <li>3. Provide knowledge on the history, principles, procedures, and scope of narco-analysis, including detailed case studies.</li> <li>4. Educate students on the principles, instrumentation, procedures, and scope of BEOS, polygraph, and brain mapping, supported by detailed case studies.</li> <li>5. Discuss the acceptance and application of psychological study evidence in judicial systems.</li> </ol>								
CO1	Understand the basic concepts of forensic psychology and the psychological factors contributing to specific crimes.								
CO2	Analyze the relationship between criminality and mental illnesses, and apply this knowledge to case studies.								
CO3	Conduct narco-analysis by understanding its history, principles, procedures, and applications in forensic investigations.								
CO4	Utilize BEOS, polygraph, and brain mapping techniques, understanding their principles, procedures, and scope in forensic contexts.								
CO5	Evaluate the judicial acceptance and application of psychological evidence in court proceedings.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
<b>I</b>	Introduction: Introduction to forensic Psychology, Psychological explanations of specific crime, the relationship of criminality to mental illness: Necrophilia, Schizophrenia and their types, case studies:	<b>8</b>	Explain fundamental concepts of forensic psychology and the psychological factors behind specific crimes.				1,2		
<b>II</b>	Narco- Analysis: History, Principle, Procedure and its Scope. Detailed Case studies.	<b>7</b>	Perform narco-analysis, understanding its principles and applications in forensic investigations.				1,2		
<b>III</b>	BEOS, Polygraph, Brain mapping: History, Principle, Instrumentation, Procedure and its Scope. Detailed Case studies	<b>8</b>	Utilize BEOS, polygraph, and brain mapping techniques in forensic contexts, supported by understanding their principles and procedures				1,2		
<b>IV</b>	Aspects in judicial system: Aspects of acceptance of Psychology study evidences in Courts discussions.	<b>7</b>	Evaluate the acceptance and use of psychological evidence in judicial systems, understanding its impact on court proceedings				1,2		

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the basic concepts of forensic psychology and the psychological factors contributing to specific crimes.	<b>1, 3</b>
<b>2</b>	Analyze the relationship between criminality and mental illnesses, and apply this knowledge to case studies.	<b>1, 3</b>
<b>3</b>	Conduct narco-analysis by understanding its history, principles, procedures, and applications in forensic investigations.	<b>1,3</b>
<b>4</b>	Utilize BEOS, polygraph, and brain mapping techniques, understanding their principles, procedures, and scope in forensic contexts.	<b>1, 8</b>
<b>5</b>	Evaluate the judicial acceptance and application of psychological evidence in court proceedings.	<b>1, 5</b>

SEMESTER – III									
Course Title	Techno Professional Course- II								
Course code	22BSFS215R	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours: 60P	0	0	4	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Fall/III Semester of First year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce students to the fundamental theories of criminology, including classical, positivist, sociological, and criminal anthropology perspectives.</li> <li>2. Provide knowledge on understanding modus operandi, investigative strategies, and criminal profiling.</li> <li>3. Explore various types of crimes, including deviant behaviour, hate crimes, organized crimes, domestic violence, white-collar crimes, juvenile delinquency, and their social and psychological impacts.</li> <li>4. Analyze different sensational crime case studies to understand real-world applications of criminological concepts.</li> <li>5. Educate students on the structure and hierarchy of the justice system and Indian investigative agencies.</li> </ol>								
CO1	Understand and apply various theories of criminology to analyze criminal behaviour.								
CO2	Develop investigative strategies and criminal profiles based on modus operandi.								
CO3	Analyze different types of crimes and their social and psychological impacts.								
CO4	Evaluate sensational crime case studies to gain practical insights into criminology.								
CO5	Understand the structure and hierarchy of the justice system and Indian investigative agencies.								
Unit-No.	Content	Contact Hour	Learning Outcome	KL					
I	Basics of Criminology: Theories of Crime-classical, positivist, sociological, Criminal Anthropology, Understanding Modus Operandi, Investigative Strategy, Criminal Profiling, Role of Media.	15	Explain the fundamental theories of criminology and their application in analyzing criminal behaviour.	1,2					
II	Crime: Deviant Behaviour, Hate Crimes, Organized Crimes, Public Disorder, Domestic Violence and Workplace Violence, White Collar Crimes, Juvenile Delinquency, Victimology, Social Change and Crime, Psychological Disorders and Criminality.	15	Analyze the nature and impact of various types of crimes, including deviant behaviour and white-collar crimes.	1,2					
III	DIFFERENT SENSATIONAL CRIME CASE STUDIES: Murder & Killings, POSCO, Rape cases, bizarre identity crimes, criminal defamation, Scandal.	15	Evaluate and learn from sensational crime case studies	1,2					
IV	Justice System & Investigative agency: Types of court, Hierarchy of court & justice, Introduction to Indian investigative agency Hierarchy of Different Investigative agency.	15	Understand and describe the hierarchy and functions of the justice system and Indian investigative agencies	1,2					

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand and apply various theories of criminology to analyze criminal behaviour.	<b>1, 2, 6</b>
<b>2</b>	Develop investigative strategies and criminal profiles based on modus operandi.	<b>1, 5, 6</b>
<b>3</b>	Analyze different types of crimes and their social and psychological impacts.	<b>1, 3,</b>
<b>4</b>	Evaluate sensational crime case studies to gain practical insights into criminology.	<b>1, 6</b>
<b>5</b>	Understand the structure and hierarchy of the justice system and Indian investigative agencies.	<b>1, 6</b>



SEMESTER – IV									
Course Title	Techno Professional Course- III								
Course code	22BSFS225R	Total credits: 1 Total hours: 30P	L	T	P	S	R	O/F	C
			0	0	2	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Programme	Bachelor of Science in Forensic Science								
Semester	Winter/IV Semester of First year of the programme								
Course Objectives	<ol style="list-style-type: none"> <li>1. Introduce students to the instrumentation, principles, working mechanisms, and uses of tools in DNA laboratories.</li> <li>2. Educate students on the instrumentation and methodologies used in toxicology laboratories, emphasizing principles and applications.</li> <li>3. Familiarize with the equipment used in ballistics and photography laboratories and understand their applications.</li> <li>4. Acquire skills in using instrumentation for fingerprint analysis and questioned document examinations.</li> <li>5. Integrate theoretical knowledge with practical applications in forensic investigations using laboratory instruments.</li> </ol>								
CO1	Understand the instrumentation, principles, and applications of tools used in DNA laboratories.								
CO2	Gain comprehensive knowledge of the instruments and techniques employed in toxicology laboratories.								
CO3	Analyze different types of crimes and their social and psychological impacts.								
CO4	Evaluate sensational crime case studies to gain practical insights into criminology.								
CO5	Understand the structure and hierarchy of the justice system and Indian investigative agencies.								
Unit-No.	Content	Contact Hour	Learning Outcome				KL		
I	Instruments used in DNA Laboratory: Instrumentation, principle, working and uses.	8	Explain the fundamental theories of criminology and their application in analyzing criminal behaviour.				1,2		
II	Instruments used in Toxicology Laboratory: Instrumentation, principle, working and uses.	7	Analyze the nature and impact of various types of crimes, including deviant behaviour and white-collar crimes.				1,2		
III	Instruments used in Ballistics and Photography Laboratory: Instrumentation, principle, working and uses.	8	Evaluate and learn from sensational crime case studies				1,2		
IV	Instruments used in Fingerprint and Questioned document Laboratory: Instrumentation, principle, working and uses.	7	Understand and describe the hierarchy and functions of the justice system and Indian investigative agencies				1,2		

**RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES**

<b>CO PO Mapping</b>		
<b>SN</b>	<b>Course Outcome (CO)</b>	<b>Mapped Program Outcome</b>
<b>1</b>	Understand the instrumentation, principles, and applications of tools used in DNA laboratories.	<b>1, 8</b>
<b>2</b>	Gain comprehensive knowledge of the instruments and techniques employed in toxicology laboratories.	<b>1, 3, 8</b>
<b>3</b>	Analyze different types of crimes and their social and psychological impacts.	<b>1</b>
<b>4</b>	Evaluate sensational crime case studies to gain practical insights into criminology.	<b>1</b>
<b>5</b>	Understand the structure and hierarchy of the justice system and Indian investigative agencies.	<b>1, 6</b>