Assam down town University

Curriculum and Syllabus

Bachelor of Technology

in

Computer Science and Engineering

OUTCOME BASED EDUCATION FRAMEWORK

CHOICE BASED CREDIT SYSTEM

Version: 2.1

FACULTY OF COMPUTER TECHNOLOGY

July, 2023

PREAMBLE

Assam down town University is a premier higher educational institution which offers Bachelor, Master and Ph.D. degree Programs across various faculties. These Programs, 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 Board of Studies (BOS) meeting of the Faculty of Computer Technology Science held on dated 14/07/2023 and approved by the Emergent Academic Council (AC) meeting held on dated 28/07/2023.

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 Technology in Computer Science and Engineering is an Under Graduate Degree awarded for the Programme of Computer Science and Engineering. As one of the best computer engineering colleges, we intend to create a cohesive learning experience with the latest technological developments to that of industry demand.

I. Specific Features of the Curriculum

The B. Tech CSE curriculum, guided by the outlined Programme Specific Outcomes (PSOs), emphasizes a comprehensive educational framework. It prepares students for competitive exams through updated and focused syllabi. It integrates advanced research principles with sustainable technology applications, ensuring graduates possess the necessary engineering and management skills for societal impact. The curriculum fosters effective communication, teamwork, and project management in multidisciplinary settings. Additionally, it incorporates contemporary industrial and research trends, encouraging innovation and entrepreneurial proficiency. This holistic approach equips students to develop novel software engineering solutions, addressing real-world problems with cutting-edge techniques and strategies.

II. Eligibility Criteria:

Minimum 45% with English, Physics & Mathematics in HS.

III. Programme Educational Objectives (PEO):

PEO1 To produce graduates who have strong foundation of knowledge and skills in the field of Computer Science and Engineering.

PEO2 To produce graduates who can provide solutions to challenging problems in their profession by applying Computer Engineering theory and practices.

PEO3 To produce graduates who are employable in industries/public sector/research organizations or work as an entrepreneur, as well as can provide leadership and are effective in multidisciplinary environment.

IV. Programme Specific Outcomes (PSO):

PSO 1: Educational Advancement: Graduates will be prepared for state, national and international competitive examinations with focused and updated syllabi.

PSO 2: Advanced Research: Graduates will have a holistic comprehension of engineering and management principles required for application of sustainable technologies for societal development, and also will be able to communicate effectively in oral, written, visual and graphic modes as a member and leader in a team, to manage projects in multidisciplinary environments.

PSO 3: Entrepreneurial Proficiency: Graduates will be acquainted with the contemporary trends in industrial/research environments and also will capable of innovating novel solutions to prevailing problems by applying software engineering techniques and strategies.

V. Programme Outcome(PO):

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

VI. Total Credits to be Earned : 178

VII. Career Prospects:

A B. Tech in Computer Science and Engineering (CSE) offers diverse and promising career prospects. Graduates can pursue roles such as software developers, data scientists, cybersecurity analysts, and AI/ML engineers in top tech firms. They are well-suited for positions in research and development, working on cutting-edge technologies. The curriculum also prepares them for competitive exams, enabling careers in public sector and government organizations. Additionally, the strong emphasis on entrepreneurial skills allows graduates to innovate and launch their own start-ups. With rapid advancements in technology, CSE graduates remain in high demand across various industries, ensuring robust career opportunities.

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.

Table 1: Question paper pattern for End semester examination

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 Programme coordinators should upload the in-semester marks to the ERP and forward acknowledgement of all the courses of the Programme 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 2: Question paper pattern for End semester examination

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 Programme follow a unique pattern and the total marks is 60

Table 3: 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-Voice etc.:

i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.

ii) Viva-Voice, Oral examinations of the Project report, Dissertation etc. shall be undertaken by a Board of Examiners constituted by the respective Dean of Programme 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 x 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: 4) 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 4, 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 4, 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.

Table 4: 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 4.

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

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, Gi is the Grade Point secured in the i^{th} registered Course and Ci 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 enrolment in the Programme. In other words, taking into account all the Courses graded with 'O' to 'P' as given in Table 4, 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 enrolment.

(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, Gi is the Grade Point secured in the ith completed Course and Ci is the Credit (weight)of that Course.

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

(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 Summeren 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 watchvideo 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.

Breakdown of Credits

Sl. No	Category		Total number of Credits
1	University Core(UC)	Skill Enhancement Course (SEC)	3
		Ability Enhancement Course(AEC)	6
		Field Training	6
		Discipline Specific Elective (DSE)	0
		Value Added Course (VAC)	2
2	University Elective (UE)	Multidisciplinary Course (MDC)	7
		Value Added Course (VAC)	7
3	Programme Core(PC)	Discipline Specific Core(DSC)	111
		Field Training	0
		Research /Industry Internship	14
		Summer Internship	1
4	Programme Elective (PE)	Discipline Specific Elective (DSE)	13
		Value Added Course (VAC)	0
5	Faculty Core(FC)	Skill Enhancement Course (SEC)	0
		Ability Enhancement Course(AEC)	8
Total			178

Breakdown by categories of courses

SlNo	Category	Credits	%
1	Engineering	124	69%
2	Science	20	11%
3	Commerce and Management	34	20%
Total		178	100%

Semester I														
Sl.No	Course Code	Course Title	Course Category	Engagement						Credit	Maximum Marks			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1	23BTCS111R	Logic, Matrices and Calculus	DSC (Minor)	3	0	0	0	0	0	3	40	60	0	100
2	23BTCS112R	Problem Solving Using C	DSC (Major)	2	0	2	0	0	0	3	40	60	100	200
3	23BTCS113R	Engineering Physics	DSC (Minor)	2	0	2	0	0	0	3	40	60	100	200
4	23BTCS115R	Workshop for Engineers	DSC (Minor)	0	0	2	0	0	0	1	0	0	100	100
5	23BTCS116R	Field-based Training	Field Training	0	0	0	0	0	16	1	100	0	0	100
6	23MOCS111R / 23MOCS112R	MOOCS I	VAC	0	0	0	0	0	0	1	100	0	0	100
7	23UBEC111	Extra-curricular Activity	SEC	0	0	0	4	0	0	1	100	0	0	100
8	23UBPD113R	Introductory English for Engineers	AEC	0	0	4	0	0	0	2	0	0	100	100
Total Credit in 1st Semester				**7**	**0**	**10**	**4**	**0**	**16**	**15**	**420**	**180**	**400**	**1000**

Semester II														
Sl.No	Course Code	Course Title	Course Category	Engagement						Credit	Maximum Marks			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1	23BTCS121R	Ordinary Differential Equations and Differential Calculus	DSC (Minor)	3	0	0	0	0	0	3	40	60	0	100
2	23BTCS122R	Engineering Chemistry	DSC (Minor)	2	0	2	0	0	0	3	40	60	100	200
3	23BTCS123R	Basic Electrical and Electronics Engineering	DSC (Minor)	2	0	2	0	0	0	3	40	60	100	200
4	23BTCS124R	Object Oriented Programming	DSC (Major)	2	0	1	0	0	0	3	40	60	100	200
5	23BTCS125R	Field-based Training	Field Training	0	0	0	0	0	16	1	100	0	0	100
6	23MOCS121R / 23MOCS122R	MOOCS II	VAC	0	0	0	0	0	0	1	100	0	0	100
7	23UBEC121	Extra-curricular Activity	SEC	0	0	4	0	0	0	1	100	0	0	100
8	23UBES101R	Environmental Science	MDC	2	0	0	0	0	0	2	40	60	0	100
9	23UBPD123R	Effective English for Engineers	AEC	0	0	4	0	0	0	2	0	0	100	100
Total Credit in 2nd Semester				**11**	**0**	**13**	**0**	**0**	**16**	**19**	**500**	**300**	**400**	**1200**

Semester III														
Sl.No	Course Code	Course Title	Course Category	Engagement						Credit	Maximum Marks			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1	23BTCS211R	Digital Electronics	DSC (Minor)	3	0	2	0	0	0	4	40	60	100	200
2	23BTCS212R	Functional Programming in Python	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
3	23BTCS213R	Data Structure and Algorithms	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
4	23BTCS214R	Computer Organization and Architecture	DSC (Major)	3	0	0	0	0	0	3	40	60	0	100
5	23BTCS215R	Probability and Statistics	DSC (Minor)	3	0	0	0	0	0	3	40	60	0	100
6	23BTCS216R	Field-Based Training	Field Training	0	0	0	0	0	16	1	100	0	0	100
7	23BTCS217R	Mini Project I	Research /Industry Internship	0	0	0	4	0	0	1	100	0	0	100
8	23MOCS211R	MOOCS-Open Elective	MDC / CBCS	1	0	0	0	0	0	1	100	0	0	100
9	23MOCS212R	MOOCS III	VAC	1	0	0	0	0	0	1	100	0	0	100
10	23UBEC211	Co-Curricular Activities	AEC	0	0	0	4	0	0	1	100	0	0	100
11	23UBPD213R	English for Employability Skills	AEC	0	0	4	0	0	0	2	0	0	100	100
12	23UUFL211R	Personal Financial Planning	MDC	0	0	2	0	0	0	1	0	0	100	100
13	23UULS211R	Basic Life Saving Skills	AEC	0	0	2	0	0	0	1	0	0	100	100
Total Credit in 3rd Semester				**17**	**0**	**14**	**8**	**0**	**16**	**27**	**700**	**300**	**600**	**1600**

Semester IV														
Sl.No	Course Code	Course Title	Course Category	Engagement						Credit	Maximum Marks			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1	23BTCS221R	Discrete Mathematics and Graph Theory	DSC (Minor)	3	0	0	0	0	0	3	40	60	0	100
2	23BTCS222R	Database Management System	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
3	23BTCS223R	Operating Systems	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
4	23BTCS224R	Software Engineering	DSC (Major)	2	0	0	0	0	0	2	40	60	0	100
5	23BTCS225R	DE-I	DSE	3	0	0	0	0	0	3	40	60	0	100
6	23BTCS226R	PE-I	DSC (Minor)	3	0	0	0	0	0	3	40	60	0	100
7	23BTCS227R	Field-based Training	Field Training	0	0	0	0	0	16	1	100	0	0	100
8	23UBPD221R	PDP	AEC	0	0	2	0	0	0	1	0	0	100	100
9	23UCDL102R	Digital Literacy	VAC	0	0	2	0	0	0	1	0	0	100	100
10	23UULS221R	Basic Acclimitizing Skills	AEC	0	0	2	0	0	0	1	0	0	100	100
11	23MOCS221R	MOOCS-Open Elective	MDC	0	0	0	0	0	0	2	100	0	0	100
12	23MOCS222R	Indian Heritage	VAC	0	0	0	0	0	0	1	100	0	0	100
13	23BTCS228R	Mini Project II	Research /Industry Internship	0	0	0	4	0	0	1	100	0	0	100
Total Credit in 4th Semester				**17**	**0**	**10**	**4**	**0**	**16**	**27**	**640**	**360**	**500**	**1500**

Semester V														
Sl.No	Course Code	Course Title	Course Category	Engagement						Credit	Maximum Marks			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1	23BTCS311R	Computer Communication Network	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
2	23BTCS312R	Data Science & Statistical Modelling	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
3	23BTCS313R	DE-II	DSE	3	0	0	0	0	0	3	40	60	0	100
4	23BTCS314R	PE-II	DSC (Minor)	3	0	0	0	0	0	4	40	60	0	100
5	23BTCS315R	PE-III	DSC (Minor)	3	0	0	0	0	0	3	40	60	0	100
6	23MOCS311R / 23MOCS312R	MOOCS IV	VAC	0	0	0	0	0	0	1	100	0	0	100
7	23BTCS317R	Field-Based Training	Field Training	0	0	0	0	0	16	1	100	0	0	100
8	23BTCS318R	Summer Internship	Summer Internship	0	0	0	0	0	16	1	100	0	0	100
9	23UBPD314R	PDP	AEC	0	0	4	0	0	0	2	0	0	100	100
10	23MOCS312R	MOOCS-Open Elective	MDC	0	0	0	0	0	0	2	100	0	0	100
11	23UBEC311	Extra-curricular Activity	SEC	0	0	0	4	0	0	1	100	0	0	100
12	23BTCS316R	Mini Project III	Research /Industry Internship	0	0	0	4	0	0	1	100	0	0	100
Total Credit in 5th Semester				**12**	**0**	**6**	**8**	**0**	**32**	**27**	**760**	**240**	**200**	**1200**

Semester VI														
Sl.No	Course Code	Course Title	Course Category	Engagement						Credit	Maximum Marks			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1	23BTCS321R	Web Technologies	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
2	23BTCS322R	Formal Language and Automata Theory	DSC (Major)	3	0	0	0	0	0	3	40	60	0	100
3	23BTCS323R	DE-III	DSE	3	0	0	0	0	0	3	40	60	0	100
4	23BTCS324R	PE-IV	DSC (Minor)	3	0	2	0	0	0	4	40	60	100	100
5	23BTCS325R	PE-V	DSC (Minor)	3	0	2	0	0	0	4	40	60	100	100
6	23BTCS326R	PE-VI	DSC (Minor)	3	0	2	0	0	0	4	40	60	100	100
7	23MOCS321R / 23MOCS322R	MOOCS V	VAC	0	0	0	0	0	0	1	100	0	0	100
8	23BTCS327R	Field-Based Training	Field Training	0	0	0	0	0	16	1	100	0	0	100
9	23UBPD324R	PDP	AEC	0	0	4	0	0	0	2	0	0	100	100
10	23MOCS322R	MOOCS-Open Elective	MDC	0	0	0	0	0	0	1	100	0	0	100
12	23BTCS316R	Mini Project IV	Research /Industry Internship	0	0	0	4	0	0	1	100	0	0	100
Total Credit in 6th Semester				**18**	**0**	**12**	**4**	**0**	**16**	**28**	**640**	**360**	**500**	**1200**

Semester VII														
Sl.No	Course Code	Course Title	Course Category	Engagement						Credit	Maximum Marks			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1	23BTCS411R	Design and Analysis of Algorithm	DSC (Major)	3	0	2	0	0	0	4	40	60	0	100
2	23BTCS412R	Compiler Design	DSC (Major)	3	0	2	0	0	0	4	40	60	0	100
3	23BTCS413R	Elementary Statistical Analysis	DSC (Minor)	3	1	0	0	0	0	4	100	0	0	100
4	23BTCS414R	Project I	Research /Industry Internship	0	0	0	8	16	0	4	100	0	0	100
5	23MOCS411R / 23MOCS412R	MOOCS VI	VAC	0	0	0	0	0	0	1	100	0	0	100
6	23BTCS415R	Generative AI	DSC (Major)	2	0	0	4	0	0	3	100	0	100	100
Total Credit in 7th Semester				**11**	**1**	**4**	**12**	**16**	**0**	**20**	**480**	**120**	**100**	**600**

Semester VIII														
Sl.No	Course Code	Course Title	Course Category	Engagement						Credit	Maximum Marks			Total
				L	T	P	S	R	O		IA*	SEE*	PE*	
1	23BTCS421R	Cryptography & Network Security	DSC (Major)	3	0	2	0	0	0	4	40	60	0	100
2	23BTCS422R	Image Processing and Pattern Recognition	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
3	23BTCS423R	Project II	Research /Industry Internship	0	0	0	12	16	0	6	100	0	0	100
4	23MOCS421R / 23MOCS422R	MOOCS VII	VAC	0	0	0	0	0	0	1	100	0	0	100
Total Credit in 8th Semester				**6**	**0**	**4**	**12**	**16**	**0**	**15**	**280**	**120**	**100**	**500**

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

Discipline Specific Elective (DSE)		
Semester	Programme Electives No.	Electives Name
IV	DE-I	1. Design Thinking & Innovation 2. Entrepreneurship Development
V	DE-II	1. Organizational Behaviour 2. Principles of Management
VI	DE-III	1. Economics for Engineers 2. Positive Psychology

List of Programme Electives (PE)		
Semester	Programme Electives No.	Electives Name
IV	PE-I	1. Fundamentals Artificial Intelligence 2. Fundamentals of Cyber Security
V	PE-II	1. Data Mining and Analytics 2. Information Retrieval Systems
V	PE-III	1. Machine Learning 2. Cloud Computing
VI	PE-IV	1. Introduction to Internet of Things 2. Foundation of Data Science
VI	PE-V	1. Predictive Analysis 2. Wireless Sensor Network
VI	PE-VI	1. Neural Networks 2. Big Data Analytics

List of MOOCS				
Sl. No	**MOOCS Course No**	**Name of the Course**	**Course Code**	**Semester**
1	MOOCS I	Foundation Of Digital Marketing And E-Commerce	23MOCS111R	I
2		Introduction to Decision Science for Marketing	23MOSY112R	
1	MOOCS II	Introduction To Git And Github	23MOSY115R	II
2		Ethics, Technology And Engineering	23MOCS122R	
1	MOOCS III	Foundation Of Digital Marketing And E-Commerce	23MOCS211R	III
2		Linear Algebra for Data Science Using Python Specialization		
3	MOOCS OPEN ELECTIVE	International Leadership And Organizational Behaviour	23MOCS212R	
4		Organizational Analysis		
1	MOOCS IV	Introduction To SQL	23MOSY211R	IV
2		Introduction To Hardware And Operating Systems	23MOSY212R	
1	MOOCS V	Using Python To Interact With The Operating System	23MOSY311R	V
2		Mean Stack	23MOSY312R	
1	MOOCS VI	Java Full Stack Developer	23MOSY321R	VI
2		C# For .Net Developers	23MOSY322R	
1	MOOCS VII	Applied Data Science with Python Specialization		VII
2		Statistics and Machine Learning Specialization		
1	MOOCS VIII	Neural Networks and Deep Learning		VIII
2		Generative AI for Software Development		

SEMESTER – I										
Course Title	**Logic, Matrices and Calculus**									
Course code	**23BTCS111R**	**Total credits:3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 40T	**3**	**0**	**0**	**0**	**0**	**0**	**3**	
Pre-requisite	Mathematics	**Co-requisite**	**Nil**							
Programme	**Bachelor of Technology in Computer Science and Engineering**									
Semester	**Summer/ I semester of the first year of the Programme**									
Course Objectives	1. To make understand to evaluate definite and improper integrals. Apart from these some special functions like Beta and Gamma function must be introduced. 2. To provide the application of differential and integral calculus. 3. To make understand the convergence and divergence of sequence and series									
CO1	The students will be able to demonstrate the ability to understand the concepts of mathematics, logic, reasoning and coding									
CO2	Students will be able to apply of applications of concepts in other disciplines such as engineering, computer science, physics, etc.									
CO3	Solve and devise solutions to a range of elementary real-world problems in mathematics and Programming									
CO4	Explore and apply key concepts in logical thinking to business problems.									
CO5	Enable students to critically analyze information in order to evaluate evidence and construct reasoned arguments.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	***Calculus:*** Evaluates and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	**8**	Evaluate definite and improper integrals and understand their properties. Apply Beta and Gamma functions in various contexts. Use definite integrals to calculate surface areas and volumes of revolution.	**1,2, 3**
II	***Calculus:*** Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.	**12**	Understand and apply Rolle's Theorem and the Mean Value Theorem to determine properties of functions. Utilize Taylor and Maclaurin series expansions with remainders for function approximation. Evaluate indeterminate forms using L'Hospital's Rule, and identify and analyze local maxima and minima of functions.	**3,4**
III	***Sequences and series:*** Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series,	**8**	Analyze the convergence of sequences and series using various tests. Develop and utilize power series, including Taylor's series, to represent functions such as exponential, trigonometric, and logarithmic functions.	**3,4**

	Parseval's theorem.		Apply Fourier series to decompose functions into their sine and cosine components and understand Parseval's theorem in the context of these series.	
IV	***Multivariable Calculus (Differentiation):*** Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.	**6**	Understand and apply the concepts of limits, continuity, and partial derivatives, including directional and total derivatives. Analyze and solve problems involving tangent planes, normal lines, and optimization techniques such as maxima, minima, saddle points, and the method of Lagrange multipliers. Compute and interpret the gradient, curl, and divergence of vector fields.	**4**
V	***Matrices:*** Inverse and rank of a matrix, rank- nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley- Hamilton Theorem, and Orthogonal transformation.	**6**	Understand and calculate the inverse and rank of matrices, and apply the rank-nullity theorem.Solve systems of linear equations using matrix methods. Identify and work with symmetric and skew-symmetric matrices.	**4**

TEXT BOOKS:

T1:G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint,2002.
T2: Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley &Sons, 2006.
T3: Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11th Reprint, 2010

EFERENCE BOOKS:

R1:N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2008.
R2: B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010.

OTHER LEARNING RESOURCES:

O1: Coursera online platform for Mathematical learning
O2: Mathkind Quality *Math Education* portal

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Programme Outcome
1	The students will be able to demonstrate the ability to understand the concepts of mathematics, logic, reasoning and coding.	PO1,PO2,PO3,PO4,PO5,PO9,PO10,PO11,PO12
2	Students will be able to apply of applications of concepts in other disciplines such as engineering, computer science, physics, etc.	PO1,PO2,PO3,PO4,PO5,PO9,PO10,PO11,PO12
3	Solve and devise solutions to a range of elementary real-world problems in mathematics and Programming.	PO1,PO2,PO3,PO4,PO5,PO9,PO10,PO11,PO12
4	Explore and apply key concepts in logical thinking to business problems.	PO1,PO2,PO3,PO4,PO5,PO9,PO10,PO11,PO12
5	Enable students to critically analyze information in order to evaluate evidence and construct reasoned arguments.	PO1,PO2,PO3,PO4,PO5,PO9,PO10,PO11,PO12

SEMESTER – I										
Course Title	**Problem Solving Using C**									
Course code	**23BTCS112R**	**Total credits:3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:40T+30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/ I semester of the first year of the Programme**								
Course Objectives	1. To formulate simple algorithms for arithmetic and logical problems. 2. To test and execute the Programs and correct syntax and logical errors. **3.** Apply C in Real-World Applications.								
CO1	Understand the concept of computer system, analyze a given problem, develop an algorithm, fundamental Programming constructs, identify data representation formats, and describe operators and their precedence, associativity								
CO2	Apply branching and loop statements in problem solving.								
CO3	Apply the concepts of homogeneous derived data types, heterogeneous data types, strings and functions in Programming.								
CO4	Understand the concept of pointers and apply it in Programming.								
CO5	Apply the concept of file handling in C Programming.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Introduction to Programming Introduction to components of a computer system (disks, memory, processor, where a Programme is stored and executed, operating system, compilers etc.) Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to Programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.	**8**	Identify and describe the function of key components of a computer system, including disks, memory, processor, and how they interact with each other. Explain where and how a Programme is stored and executed within a computer system. Understand the role of an operating system in managing computer hardware and software resources.	**1,2,3**
II	Arithmetic expressions and precedence Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching, Iteration and loops Arrays: Arrays (1-D, 2-D), Character arrays and Strings Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example Programs (no formal definition required)	**12**	Understand and apply the rules of arithmetic operations and operator precedence to construct and evaluate expressions. Write and evaluate conditional statements and implement control flow through branching and iterative loops. Utilize 1-D and 2-D arrays, including character arrays and strings, for data storage and manipulation.	**3,4**

III	Function: Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference Recursion: Recursion, as a different way of solving problems. Example Programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.	**12**	Understand how to define functions, use built-in libraries, and pass parameters by value or reference. Explore recursion as a technique for solving problems, with examples like finding factorial, Fibonacci series, and Ackermann function. Learn about efficient sorting methods such as Quick sort or Mergesort, emphasizing their implementation and efficiency.	**3,4**
IV	Structure: Structures, Defining structures and Array of Structures Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)	**6**	Understand how to define and use structures to organize related data elements in a Programme, enhancing clarity and organization. Grasp the concept of pointers, their definition, and application in structures, especially in self-referential structures, laying the foundation for understanding dynamic data structures like linked lists. Comprehend how arrays of structures allow efficient storage and manipulation of multiple related data sets, enabling scalable and organized data management in Programs.	**4**
V	File handling (only if timeis available, otherwise should be done as part of the lab)	**6**	Students will grasp the concepts of reading from and writing to files, including different modes such as read, write, and append. They will learn how to manipulate file data, including searching, updating, and deleting records within a file. Students will practice error handling techniques	**4**

			and understand best practices for file handling to ensure data integrity and security.	
Practical Component				
Practical 1	a) Write a C Program to find sum and average of three numbers. b) Write a C Program to find the sum of individual digits of a given positive c) Write a C Program to generate the first n terms of the Fibonacci sequence	**2**	Understand basic input/output operations, arithmetic operations in C, and how to compute simple statistics.	1,2
Practical 2	a) Write a C Program to generate prime numbers between 1 to n. b) Write a C Program to Check whether given number is Armstrong Number or Not.	**2**	Learns to implement a basic algorithm using loops and conditional statements to identify prime numbers within a specified range.	1,3
Practical 3	a) Write a C Program to evaluate algebraic expression (ax)/ (ax-b). b) Write a C Program to check whethergiven number is perfect number or Not	**2**	Gains knowledge of iterative looping structures to sum proper divisors, use of conditional statements for validation, and understanding the concept of perfect numbers in number theory.	2,3
Practical 4	a). Write a C Program to check whether given number is strong number or not.	**2**	Understand the concept of strong numbers in Programming. Demonstrate proficiency in C Programming syntax and logic.	3
Practical 5	a) Write a C Program to find the roots of a quadratic equation. b) Write a C Program perform arithmetic operations using switch statement.	**2**	Learns to calculate roots using the quadratic formula, handling different cases (real, imaginary roots).	3,4
Practical 6	a) Write a C Program to find factorial of a given integer using non-recursive Function. b) Write a C Program to find factorial of a given integer using recursive function.	**2**	Students will demonstrate the ability to write a C Program that calculates the factorial of a given integer using iterative control structures and function calls, understanding fundamental concepts of loops, conditionals, and function definitions in C	3,5

			Programming.	
Practical 7	a) Write C Program to find GCD of two integers by using recursive function. b) Write C Program to find GCD of two integers using non-recursive function.	**2**	By implementing a C Program to find the GCD of two integers using recursion, learners understand recursion's application in solving mathematical problems efficiently, demonstrating proficiency in recursive function design and understanding of basic number theory concepts.	3,4
Practical 8	a) Write a C Program to find both the largest and smallest number in a list of Integers b) Write a C Program to Sort the Array in an Ascending Order. c) Write a C Program to find whether given matrix is symmetric or not.	**2**	Learn to iterate through an array, compare elements, and track both maximum and minimum values efficiently.	4,5
Practical 9	a) Write a C Program to perform addition of two matrices. b) Write a C Program that uses functions to perform Multiplication of Two Matrices.	**2**	Understands matrix representation in C, handling multidimensional arrays, and implementing basic arithmetic operations.	4,3
Practical 10	a) Write a C Program to use function to insert a sub-string in to given main string from a given position. b) Write a C Program that uses functions to delete n Characters from a give position in a given string.	**2**	Develop proficiency in C Programming by implementing a function that inserts a substring into a main string at a specified position, demonstrating effective use of string manipulation and function abstraction.	3,5
Practical 11	a) Write a C Program using user defined functions to determine whether the given string is palindrome or not. b) Write a C Program that displays the position or index in the main string S where the sub string T begins, or - 1 if S doesn't contain T	**2**	By writing a C Program using user-defined functions to check if a string is a palindrome, students will understand string manipulation, function definition, and logic implementation to verify symmetry in textual data.	2,3
Practical 12	a) Write C Program to count the number of lines, words and characters in a given text.	**2**	Developed proficiency in C Programming by implementing a	3,4

	b) Write a C Program to find the length of the string using Pointer		Programme to accurately count lines, words, and characters in a provided text using efficient file handling and string manipulation techniques.	
Practical 13	a) Write a C Program to Display array elements using cal oc ( ) function. b) Write a C Program to Calculate Total and Percentage marks of a student using structure.	**2**	Understand dynamic memory allocation in C using calloc() to allocate memory for arrays, and learn how to iterate through and display array elements	4,5
Practical 14	a) Write a C Program that uses functions and structures to perform the following operations: i) Reading a complex number ii) Writing a complex number iii) Addition of two complex numbers iv) Multiplication of two complex numbers b). Write a C Program to display the contents of a file	**2**	Utilize input functions to capture real and imaginary parts separately into a structure. Output the stored complex number using formatted printing with proper notation.	2,3
Practical 15	a) Write a C Program to copy the contents of one file to another. b) Write a C Program to merge two files into a third file. Write a C Program to reverse the first n characters in a file	**2**	Developed proficiency in handling file operations in C, demonstrating the ability to read from and write to files, ensuring accurate data transfer between file streams	3,4

TEXT BOOKS:

T1:E. Balaguruswamy, Programming in ANSI C, TataMcGraw-Hill.

T2: Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.

REFERENCE BOOKS:

R1: Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

OTHER LEARNING RESOURCES:

O1: Coursera online platform for Mathematical learning

O2: Mathkind Quality *Math Education* portal

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand the concept of computer system, analyze a given problem, develop an algorithm, fundamental Programming constructs, identify data representation formats, and describe operators and their precedence, associativity	PO1,PO2,PO3,PO4,PO5,PO11
2	Apply branching and loop statements in problem solving.	PO1,PO2,PO3,PO4,PO5,PO11
3	Apply the concepts of homogeneous derived data types, heterogeneous data types, strings and functions in Programming.	PO1,PO2,PO3,PO4,PO5,PO11
4	Understand the concept of pointers and apply it in Programming.	PO1,PO2,PO3,PO4,PO5,PO11
5	Apply the concept of file handling in C Programming.	PO1,PO2,PO3,PO4,PO5,PO11

SEMESTER – I										
Course Title	**Engineering Physics**									
Course code	**23BTCS113R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours:40T+30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**	
Pre-requisite	Basic knowledge of Physics	**Co-requisite**	**Mathematics**							
Programme	**Bachelor of Technology in Computer Science and Engineering**									
Semester	**Summer/ I semester of the first year of the Programme**									
Course Objectives	1. To understand the theories of physics 2. To apply the concepts in practical problems 3. To understand the physics of any process									
CO1	Apply electric field and potential calculations, Compute the vectors and scalar representation of forces and nature of forces.									
CO2	Analyze electrostatics in dielectric media, conservative and non-conservative forces, angular momentum and energy equations.									
CO3	Compute basics of non-inertial frames, harmonic oscillator and forced oscillations.									
CO4	Demonstrate understanding of magnetostatics in linear magnetic media, and the usage of common electrical measuring instruments.									
CO5	Understand the basic characteristics of transformers and electrical machines.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Electrostatics in vacuum	**8**	Understand and apply Coulomb's Law to calculate the electrostatic force between point charges in a vacuum. Analyze electric fields and potentials created by various charge distributions using principles of electrostatics.	**2**
II	Magneto statics	**8**	Magnetostatics studies magnetic fields in systems with steady currents, focusing on the behavior and interactions of magnetic fields in static conditions. It explains phenomena like the magnetic field produced by a current-carrying conductor and the forces between magnetic dipoles.	**3**
III	Faraday's law	**8**	Faraday's law of electromagnetic induction states that a change in magnetic flux through a circuit induces an electromotive force (EMF) in the circuit. This induced EMF is proportional to the	**3,5**

			rate of change of the magnetic flux.	
IV	Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations.	**8**	Understand the concept of displacement current as a term added to Ampere's law to account for the changing electric field in non-conductive regions. Recognize its role in ensuring the continuity of current in Maxwell's equations and the propagation of electromagnetic waves.	**3**
V	Electromagnetic waves	**8**	Electromagnetic waves are transverse waves composed of mutually perpendicular electric and magnetic fields oscillating perpendicular to the direction of wave propagation. They encompass a wide range of frequencies, from radio waves to gamma rays, each characterized by its wavelength and frequency.	**5**
Practical Component				
Practical 1	To verify the ohm's law and hence determine the unknown resistance of the given material of the wire.	**4**	Verification of Ohm's Law through experimental data to determine the resistance of a given wire material	3
Practical 2	To find the value of a given resistance by using meter bridge.	**5**	Understanding how to determine the resistance of a given resistor using a meter bridge based on null point detection	4
Practical 3	To convert the galvanometer in to voltmeter and hence calibrate it with a standard resistance and ammeter.	**5**	To convert a galvanometer into a voltmeter, learn to connect a high resistance in series with the galvanometer and calibrate it using a standard resistance and ammeter to measure the voltage accurately.	5
Practical 4	To determine the internal resistance of a cell by using potentiometer.	**6**	Understand and apply the principle of a potentiometer to accurately measure the internal resistance of a cell	3

Practical 5	To determine the frequency of a tuning fork by Melde's apparatus.	**5**	Determine the frequency of a tuning fork using Melde's apparatus by observing the formation of stationary waves on a stretched string and 2calculating it from the wave parameters.	2
Practical 6	To determine the moment of inertia of a body about an axis passing through its center of gravity and perpendicular to its length.	**2**	To determine the moment of inertia of a body about an axis passing through its center of gravity and perpendicular to its length, the learning outcome is: "Calculate the moment of inertia using integral calculus, considering the mass distribution and geometric properties of the body."	4
Practical 7	To determine the ECE of copper by using copper voltmeter and ammeter.	**3**	To determine the Electrochemical Equivalent (ECE) of copper using a copper voltmeter and ammeter, students will measure the mass of copper deposited during electrolysis and relate it to the charge passed through the solution to calculate the ECE.	5

TEXT BOOKS:

T1: Introduction to Electrodynamics. David Griffiths. Prentice Hall, Upper Saddle River, New Jersey, 07458
T2: Basic Laws of Electromagnetism. IE IRODOV

REFERENCE BOOKS:

R1: Principles of physics. Halliday Resnick OTHER LEARNING RESOURCES

OTHER LEARNING RESOURCES:

O1: Coursera Physics Courses
O2: edX Physics Courses
O3: MIT Open Course Ware Physics

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Apply electric field and potential calculations, Compute the vectors and scalar representation of forces and nature of forces.	PO1, PO2,PO3,PO4,PO5,PO10,PO12
2	Analyze electrostatics in dielectric media, conservative and non-conservative forces, angular momentum and energy equations.	PO1, PO2,PO3,PO4,PO5,PO10,PO12
3	Compute basics of non-inertial frames, harmonic oscillator and forced oscillations.	PO1, PO2,PO3,PO4,PO5,PO10,PO12
4	Demonstrate understanding of magnetostatics in linear magnetic media, and the usage of common electrical measuring instruments.	PO1, PO2,PO3,PO4,PO5,PO10,PO12
5	Understand the basic characteristics of transformers and electrical machines.	PO1, PO2,PO3,PO4,PO5,PO10,PO12

SEMESTER – I										
Course Title	**Workshop for Engineers**									
Course code	**23BTCS114R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 15T+ 30P	**0**	**0**	**2**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/I semester of the first year of the Programme**								
Course Objectives	1. Learning this course will lead you to understand basic concepts of workshop and manufacturing 2. Apply fundamental knowledge of workshop and manufacturing in day-to-day life 3. Recognize components using different materials.								
CO1	Introduction to various manufacturing methods like casting, Forming, machining etc.								
CO2	Application of computer coding in automation of Machines.								
CO3	Introduction to Carpentry & fitting operations and its application in industries.								
CO4	Different machining operations like turning, milling.								
CO5	Learning the different types of welding and its field of application.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Manufacturing Methods:** Casting, forming, machining, joining, advanced manufacturing methods	**3**	Manufacturing methods include casting, forming, machining, and joining, which involve shaping and assembling materials into final products. Advanced manufacturing methods leverage modern technologies such as additive manufacturing, laser machining, and automation to enhance efficiency, precision, and product quality.	**1,2,3**
II	**CNC machining, Additive Manufacturing: o**verview of CNC machining process, overview of additive manufacturing	**2**	CNC Machining: An automated manufacturing process that uses pre-Programmed computer software to control machinery and tools to shape, cut, and drill materials with high precision. Additive Manufacturing: A process of creating objects by adding material layer by layer, commonly known as 3D printing, allowing for complex geometries and reduced material waste.	**3,4**
III	**Carpentry & Fitting operations:** Carpentry tools, carpentry operations, fitting tools, fitting operations	**1**	Understand the use of various carpentry tools and perform fundamental carpentry operations. Gain proficiency in using fitting tools and executing essential fitting operations.	**3,4**
IV	**Machining operations:** Turning, milling, turning processes, milling processes	**2**	Understand the principles, equipment, and techniques involved in turning and milling operations. Gain proficiency in identifying and performing specific processes related to turning and milling, including tool selection, setup, and operation.	**4**
V	**Welding:** Arcwelding	**2**	Understand the principles, techniques,	**4**

	& gas welding, brazing		and applications of arc welding and gas welding. Develop skills in brazing, including proper material selection and joint preparation for effective metal joining.	
Practical Component				
Practical 1	**A brief introduction of workshop** Machine shop, Fitting shop, carpentry shop, welding shop	**5**	Gain practical skills and foundational knowledge in machine operations, fitting, carpentry, and welding techniques essential for manufacturing and construction industries.	1,2
Practical 2	**Machine shop** Plain turning, Taper turning, Step turning	**10**	Understand and execute the basic turning operations on a lathe, including plain turning, taper turning, and step turning, ensuring precision and adherence to specified dimensions. Develop skills in setting up and operating a lathe, selecting appropriate tools and parameters for each operation, and maintaining safety protocols throughout the machining process.	2,3
Practical 3	**Carpentry shop** Dovetail joint,T-lapjoint, Cross-lapjoint, Corner – lapjoint	**5**	Gain practical skills in creating dovetail, T-lap, cross-lap, and corner-lap joints, essential for woodworking projects. Understand the structural benefits and appropriate applications of each joint type in carpentry.	3,4
Practical 4	**Welding shop** Arcwelding (Buttjoint, T-joint, Lapjoint, Cornerjoint)	**5**	The welding shop training aims to develop skills in performing arc welding on various joint types, including butt joints, T-joints, lap joints, and corner joints. Trainees will learn proper techniques, safety practices, and quality control measures to produce strong, reliable welds in different configurations.	4
Practical 5	**Fittingshop** Angle fitting, squarefitting, cornerfitting	**5**	Participants will gain proficiency in identifying and selecting appropriate angle, square, and corner fittings for various construction needs. Participants will demonstrate competence in assembling and integrating angle, square, and corner fittings into structural frameworks effectively.	5

TEXT BOOKS:

T1: Elements of Workshop Technology, Vol. I 2008 and Vol. II 2010,
T2: Manufacturing Engineering and Technology

REFERENCE BOOKS:

R1: Principles Manufacturing Technology – I, Pearson Education, 2008

R2: Processes and Materials of Manufacture, Roy A. Lindberg 4th edition, Prentice Hall India, 1998

OTHER LEARNING RESOURCES:

O1: Coursera workshop & Manufacturing Courses
O2: edX manufacturing technology Courses

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Apply electric field and potential calculations, Compute the vectors and scalar representation of forces and nature of forces.	PO1,PO2,PO3,PO5,PO7
2	Analyze electrostatics in dielectric media, conservative and non-conservative forces, angular momentum and energy equations.	PO1,PO5,PO11,PO12
3	Compute basics of non-inertial frames, harmonic oscillator and forced oscillations.	PO1,PO3,PO9
4	Demonstrate understanding of magnetostatics in linear magnetic media, and the usage of common electrical measuring instruments.	PO1,PO2,PO5,PO9
5	Understand the basic characteristics of transformers and electrical machines.	PO1,PO2,PO3,PO5,PO6

SEMESTER – I									
Course Title	**MOOCS I: Foundation of Digital Marketing and E-Commerce**								
Course code	**23MOCS112R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 40T	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**BBachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/ I semester of the first year of the Programme**								
Course Objectives	1. Students will comprehend the foundational concepts, terminology, and strategies of digital marketing and e-commerce. 2. Students will be able to analyze market trends, consumer behavior, and competition to develop effective e-commerce strategies. 3. Students will gain hands-on experience with various digital marketing tools and platforms, including social media, search engine optimization (SEO), and email marketing. 4. Students will learn how to create and optimize digital content that engages and converts target audiences. 5. Students will develop skills to measure, analyze, and optimize the performance of digital marketing campaigns and e-commerce activities.								
CO1	Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.								
CO2	Analyze market trends, consumer behavior, and competition to develop effective e-commerce strategies.								
CO3	Gain hands-on experience with various digital marketing tools and platforms, including social media, search engine optimization (SEO), and email marketing.								
CO4	Create and optimize digital content that engages and converts target audiences.								
CO5	Develop skills to measure, analyze, and optimize the performance of digital marketing campaigns and e-commerce activities.								
Unit-No.	**Content**		**Contact Hour**	**Learning Outcome**					**KL**
I	Introduction to Digital Marketing and E-commerc :Overview of Digital Marketing and E-commerce, Evolution and Trends in Digital Marketing, Importance and Benefits of Digital Marketing and E-commerce, Role of Digital Marketing in Business Growth, Career Opportunities in Digital Marketing and E-commerce		**8**	Gain a comprehensive understanding of digital marketing and e-commerce, including their evolution, trends, and significant benefits to businesses. Explore the critical role of digital marketing in driving business growth and discover diverse career opportunities within the field.					**1,2,3**
II	Digital Marketing Fundamentals: Digital Marketing Channels and Platforms, Understanding Target Audience and Buyer Personas, Digital Marketing Strategy Development, Content Marketing and Storytelling, Branding and Positioning in Digital Marketing		**8**	Gain a comprehensive understanding of various digital marketing channels and platforms, and learn to identify and analyze target audiences and develop buyer personas. Develop effective digital marketing strategies, create compelling content through storytelling, and					**2,3**

			master branding and positioning techniques to enhance digital marketing efforts.	
III	E-commerce Principles and Strategies: Introduction to E-commerce Models (B2B, B2C, C2C, etc.), E-commerce Website Design and User Experience (UX), Payment Gateways and Security in E-commerce, E-commerce Marketing and Customer Acquisition, E-commerce Analytics and Conversion Optimization	**8**	Understand various e-commerce models (B2B, B2C, C2C, etc.) and their applications in digital business environments. Develop skills in designing user-friendly e-commerce websites, integrating secure payment gateways, and implementing effective marketing strategies for customer acquisition and retention.	**3,4**
IV	Digital Marketing Tools and Techniques : Social Media Marketing (SMM) Strategies and Platforms, Search Engine Optimization (SEO) Fundamentals, Pay-Per-Click (PPC) Advertising and Google Ads, Email Marketing Best Practices and Automation, Analytics Tools for Measuring Digital Marketing Performance	**8**	Master effective SMM strategies, understanding key platforms to engage audiences and drive brand awareness. Gain foundational knowledge of SEO principles to optimize website visibility and improve search engine rankings.	**4**
V	Content Creation and Optimization: Content Planning and Strategy Development, Writing Compelling Copy for Digital Channels, Visual Content Creation (Graphics, Videos, Infographics), Search Engine Optimization (SEO) for Content, Content Distribution and Promotion Strategies	**8**	Develop strategic content plans, create compelling written and visual content for digital channels, and implement SEO techniques to enhance content visibility. Utilize effective distribution and promotion strategies to maximize reach and engagement.	**5**

Text Books:

1. "Digital Marketing: Strategy, Implementation and Practice" by Dave Chaffey and Fiona Ellis-Chadwick.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.	PO1,PO9,PO10
2	Analyze market trends, consumer behaviour, and competition to develop effective e-commerce strategies.	PO1, PO2,PO3,PO12
3	Gain hands-on experience with various digital marketing tools and platforms, including social media, search engine optimization (SEO), and email marketing.	PO1, PO5,PO12
4	Create and optimize digital content that engages and converts target audiences.	PO1, PO3,PO10
5	Develop skills to measure, analyze, and optimize the performance of digital marketing campaigns and e-commerce activities.	PO4,PO5,PO11,PO12

SEMESTER – I									
Course Title	**Field-based Training**								
Course code	**23BTCS116R**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 16P	**0**	**0**	**0**	**0**	**0**	**16**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/ I semester of the first year of the Programme**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings. 4. To foster collaboration and communication skills through group projects and professional interactions. 5. To cultivate an appreciation for the complexities and challenges of professional practice in the field.								
CO1	Apply theoretical concepts to real-world situations.								
CO2	Conduct field-based research and gather data effectively.								
CO3	Analyze and interpret the university data to draw meaningful conclusions.								
CO4	Communicate findings clearly and effectively, both orally and in writing.								
CO5	Demonstrate professional behaviour and teamwork skills in field settings.								
Unit-No.	**Content**		**Contact Hour**	**Learning Outcome**					**KL**
I	Field-Based Learning is designed to provide students with hands-on, practical experience in real-world environments related to Networking. This course emphasizes experiential learning through site visits, fieldwork, projects, and interactions with professionals in the field. Students will apply theoretical knowledge to practice, develop critical thinking skills, and gain a deeper understanding of their discipline.		**16**	Field-Based Learning provides students with hands-on experience in real-world networking environments. It emphasizes experiential learning through site visits, fieldwork, projects, and professional interactions. Students will apply theoretical knowledge, develop critical thinking skills, and gain a deeper understanding of networking.					**1,2,3,4,5**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Apply theoretical concepts to real-world situations.	PO1,PO2,PO6
2	Conduct field-based research and gather data effectively.	PO1,PO4,PO9
3	Analyze and interpret the university data to draw meaningful conclusions.	PO4,PO10
4	Communicate findings clearly and effectively, both orally and in writing.	PO10,PO11
5	Demonstrate professional behaviour and teamwork skills in field settings.	PO9,PO10,PO12

SEMESTER – I									
Course Title	**Introductory English for Engineers**								
Course code	**23UBPD113R**	**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	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/ I semester of the first year of the Programme**								
Course Objectives	1. To capacitate the students with mastery over Basic English grammar. 2. To enable the students to communicate confidently with a focus on listening a speaking skills. 3. With the help of the basics of Phonetics, the students will be able to pronoun words correctly. 4. To interact successfully and with decorum.								
CO1	Analyze and apply the rules of Parts of Speech in constructing grammatically correct sentences.								
CO2	Evaluate sentence structures, employ varied sentence types, and demonstrate effective comprehension skills								
CO3	Assess listening skills, identify factors influencing listening, and implement strategies for improved listening.								
CO4	Demonstrate effective speaking skills, including self-introduction, pronunciation, and extempore speech delivery.								
CO5	Apply communication theories, recognize barriers, and enhance skills for diverse communication situations.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Grammar** 1. Parts of Speech 2. Articles 3. Auxiliary Verbs 4. Affirmative and Negative Sentences	**5**	You'll learn how different parts of speech function in sentences, including articles and auxiliary verbs, enabling you to construct both affirmative and negative sentences effectively.	**1**
II	**Grammar** 1. Determiners 2. Sentence Construction 3. Types of Sentences (Assertive, Imperative, etc.) 4. Degree of Comparison 5. Comprehension Exercises	**7**	Master determiners, sentence construction, and types of sentences (assertive, imperative, etc.), along with understanding degrees of comparison. Practice comprehension exercises to reinforce understanding and application of these concepts effectively.	**3**
III	**Listening Skills** 1. What is listening? 2. The Process of Listening 3. Factors that adversely affect Listening 4. Difference between Listening and Hearing,	**6**	By studying listening skills, you will understand the distinction between listening and hearing, recognize factors that hinder effective listening, appreciate the importance	**5**

	5. Purpose and Importance of Effective Listening 6. How to Improve Listening Process.		of active listening, and learn strategies to enhance the listening process	
IV	**Speaking Skills** 1. Introducing yourself 2. Self-discovery 3. Basics of Phonetics, pronunciation 4. Extempore speech 5. Video Recording for Self reflection	**6**	Developing speaking skills through self-introduction, phonetics, and extempore speaking, enhanced by video reflections for self-improvement and self-discovery.	**4**
V	**Communication Skills** 1. Introduction to Communication, 2. Importance of Communication Skills, 3. Purpose of Communication, 4. Types of Communication, 5. Formal and informal communication 6. Importance of Communication, 7. Barriers to Communication, 8. How to improve/ tips to improve Communication skills. 9. Responding to different questions in various situations(formal/informal)	**6**	By studying communication skills, learners gain a comprehensive understanding of its importance, types, barriers, and strategies for improvement, enabling effective interaction in various contexts.	**3**

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.: NewDelhi

REFERENCE BOOKS:

R1: Quirk, Randolp. (2010) A Comprehensive Grammar of the English Language by Randolph Quirk, Sidney Greenbaum, Pearson EducationIndia

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 Klett

OTHER LEARNING RESOURCES:
O1: Clapingoenglish Courses
O2: English partner India's Largest Online English Learning Platform

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Analyze and apply the rules of Parts of Speech in constructing grammatically correct sentences.	PO10
2	Evaluate sentence structures, employ varied sentence types, and demonstrate effective comprehension skills	PO2,PO10
3	Assess listening skills, identify factors influencing listening, and implement strategies for improved listening.	PO9,PO10
4	Demonstrate effective speaking skills, including self-introduction, pronunciation, and extempore speech delivery.	PO10
5	Apply communication theories, recognize barriers, and enhance skills for diverse communication situations.	PO6,PO10

SEMESTER – I									
Course Title	**Extra Curricular Activities**								
Course code	**23UBEC111**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/ I semester of the first year of the Programme**								
Course Objectives	1. It is to develop the social and soft skills and to promote a holistic development of the learners. 2. Participating in debate clubs, drama, or public speaking events enhances verbal and non-verbal communication skills. 3. Taking leadership roles in student organizations or event planning committees fosters leadership and teamwork abilities.								
CO1	Learn to a plan so that they can make meaningful contributions, maintain a commitment, and manage their time and priorities.								
CO2	Transform passionate students who demonstrate leadership and pursue interests beyond their academics.								
CO3	Learn to participate in various co-curricular activities leading to their multifaceted personality development.								
CO4	Express their ideas, views, In-depth evaluation and analysis clearly in the topic of their interest.								
CO5	Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.								
Unit-No.	**Content**		**Contact Hour**	**Learning Outcome**					**KL**
I	Discover the exciting world of engineering through hands-on projects and workshops. Gain practical skills in robotics, coding, and innovation, preparing for future STEM success.		30	Explore the dynamic field of engineering through interactive projects and workshops. Develop practical skills in robotics, coding, and innovation. Prepare for future success in STEM disciplines.					1,2,3,4,5

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Learn to a plan so that they can make meaningful contributions, maintain a commitment, and manage their time and priorities.	PO9
2	Transform passionate students who demonstrate leadership and pursue interests beyond their academics.	PO11,PO12
3	Learn to participate in various co-curricular activities leading to their multifaceted personality development.	PO12
4	Express their ideas, views, In-depth evaluation and analysis clearly in the topic of their interest.	PO10
5	Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.	PO9

SEMESTER – II									
Course Title	**Ordinary Differential Equations and Differential Calculus**								
Course code	**23BTCS121R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science & Engineering**								
Semester	**Winter/ II semester of the first year of the Programme**								
Course Objectives	1. To make students understand and solve first order and second order ordinary differential equations. 2. To help understand and solve higher order differential equations. 3. To provide the application on differential calculus. 4. To provide an overview of partial derivatives and the different notions attached to them. 5. To help understand the concept of multiple integrals and the ways to find the area of different types of curves.								
CO1	Enabling problem solving skills of ordinary differential equations of various order.								
CO2	Enable to find the partial order derivative of functions of two or more variables.								
CO3	Analyse the complex analysis and solutions.								
CO4	Solve problems related to differentiation under integral sign.								
CO5	Analyze and find the area of two curves using multiple integrals								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**First order ordinary differential equations:** Exact, linear and Bernoulli's equations- Euler's equations- Equations not of first degree: equations solvable for p- equations solvable for y- equations solvable for x and Clairaut's type.	**5**	Solve initial value problems and understand their significance in applications. Interpret the existence and uniqueness of solutions based on initial conditions.	**2,3**
II	**Ordinary differential equations of higher orders:** Second order linear differential equations with variable coefficients- method of variation of parameters, Cauchy-Euler equation- Power series solutions- Legendre polynomials- Bessel functions of the first kind and their properties.	**7**	Formulate real-world problems as first-order ODEs (e.g., population dynamics, cooling/heating problems, mixing problems). Interpret and analyze the solutions in the context of the modelled phenomena.	**2,3,4**
III	**Partial Differentiation-I** Introduction to partial derivatives- its meaning- standard rules of finding partial derivatives of functions of two or more variables- Introduction to homogeneous functions- To check whether a given function is homogeneous or not- Introduction to Euler's homogeneous function- application of Euler's homogeneous	**6**	Understand and interpret direction fields (slope fields). Analyze the behaviour of solutions without solving the equation explicitly.Determine the stability of equilibrium solutions.	**2,3,4,5**

	function.			
IV	**Partial differentiation-II** Jacobian- properties of Jacobian- Jacobian of Implicit Functions- Taylor's theorem for function of two variables- Maclaurin's series for function of two variables- Maxima and Minima of functions of two variables- Conditions for f(x, y) to be Maximum or Minimum of two variables without constraints and Lagrange's method- Differentiation under integral sign.	**6**	Solve first-order ODEs using separation of variables. Apply integrating factor methods to solve linear first-order ODEs. Utilize exact equations and understand the conditions for exactness.	**2,3,4,5**
V	**Multiple integrals** Double and Triple integrals – Change of order of integration in double integrals – Change of variables to polar, cylindrical and spherical coordinates.	**6**	Evaluate double integrals by iterated integration (Fubini's Theorem). Change the order of integration in double integrals. Compute double integrals in polar coordinates.	**2,3,4,5**

TEXT BOOKS:

T1: C Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley and Sons, 2006
T2: N. P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

REFERENCE BOOKS:
R1: S. L. Ross, Differential Equations, 3rd Ed. Wiley India, 1984.
R2: Dr. V. P. Mishra, Dr. Jyoti Sinha, Pratibha Mishra, Advanced Engineering Mathematics, Bhavya Books, Delhi.

OTHER LEARNING RESOURCES:
O1: Coursera: Platforms like Coursera offer courses such as "Mathematics for Engineers" which cover topics ranging from calculus to differential equations and linear algebra.
O2: edX: Courses like "Engineering Mathematics" provide an in-depth study of mathematical techniques important in engineering disciplines

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Enabling problem solving skills of ordinary differential equations of various order.	PO1,PO2,PO3,PO12
2	Enable to find the partial order derivative of functions of two or more variables.	PO1,PO2,PO3
3	Analyse the complex analysis and solutions.	PO1,PO2,PO3
4	Solve problems related to differentiation under integral sign.	PO1,PO2,PO3
5	Analyze and find the area of two curves using multiple integrals	PO1,PO2,PO3

SEMESTER – II										
Course Title	**Engineering Chemistry**									
Course code	**23BTCS122R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 42T+30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	Basic knowledge of Chemistry, Physics and Mathematics	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/ II semester of the first year of the Programme**								
Course Objectives	1. Identify scientific reasoning and quantitative analysis. 2. Revise the scope, content, and pedagogy for one of existing general chemistry course sequences 3. Produce the content of chemistry set in a current and relevant context for engineers.								
CO1	Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.								
CO2	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques								
CO3	Understand bulk properties and processes using thermodynamic considerations								
CO4	Understand periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity								
CO5	Analyse major chemical reactions that are used in the synthesis of molecules.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Atomic and molecular structure** Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentreorbitals .Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structure.	**12**	Comprehensive understanding of the organization of atoms, including the roles of protons, neutrons, and electrons within the nucleus and their distributions in electron orbitals. They should grasp the principles governing atomic spectra, electron configurations, and periodic trends.	**1,2,3,4,5**
II	**Spectroscopic techniques and applications** Principles of spectroscopy and selections rules. Electronic spectroscopy. Fluorescence and its applications in medicine.	**8**	Comprehensive understanding of the principles and methods used to analyze the interaction between matter and	**1,2,3,4,5**

	Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging. Surface characterization techniques. Diffraction and scattering.		electromagnetic radiation across different wavelengths. They should be able to describe and apply techniques such as UV-Vis spectroscopy, infrared spectroscopy (IR), nuclear magnetic resonance spectroscopy (NMR), and mass spectrometry (MS) for qualitative and quantitative analysis of compounds.	
III	**Intermolecular forces and potential energy surfaces** Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces oh H_3 ,H_2F and HCN and trajectories on these surfaces **Use of free energy in chemical equilibria** Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energies and emf. Cell potentials, the Nernst equations and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham Diagrams	**10**	grasp the fundamental interactions between molecules and their implications in physical properties and chemical behaviour. Intermolecular forces, including van der Waals forces, hydrogen bonding, and dipole-dipole interactions, dictate the stability of molecular aggregates and influence phenomena such as boiling points, solubility, and viscosity. Understanding the concept of free energy in chemical equilibria is essential for students to comprehend the spontaneity and directionality of chemical reactions. Free energy (G) represents the energy available to do work under constant temperature and pressure conditions	**1,2,3,4,5**
IV	**Periodic Properties** Effective nuclear charge. Penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the	**4**	Grasp the underlying principles governing these trends, such as effective nuclear charge	**1,2,3,4,5**

	periodic table, electronic configurations, atomic and ionic sizes. Ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries		and shielding effects, and how these influence the reactivity, chemical bonding, and physical properties of elements. Additionally, students should be able to predict and interpret periodic trends using periodic tables, understand the factors that affect these trends, and apply this knowledge to explain phenomena such as the formation of ions, trends in chemical reactivity, and the periodic classification of elements according to their properties.	
V	**Stereochemistry** Representations of 3 dimensional structures, structural isomers and stereo isomers. Configurations and symmetry and chirality, enantiomers, diastereomers, optical activity , absolute configurations and conformational analysis. Isomerism in transitional metal compounds. **Organic reactions and synthesis of a drug molecule** Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule	**8**	understand the fundamental concepts of chirality, stereoisomerism, and geometric isomerism, and be able to distinguish between different types of stereoisomers such as enantiomers and diastereomers. They should comprehend how stereochemistry influences molecular interactions, including biological recognition processes and drug efficacy. Moreover, students should apply stereochemical principles to predict the outcomes of reactions, particularly in organic chemistry, and recognize the importance of spatial arrangement in shaping the physical and chemical properties of molecules. Mastery of stereochemistry enables students to understand complex molecular structures and their	**1,2,3,4,5**

			behaviors, essential for fields such as pharmaceuticals, materials science, and biochemistry.	
Practical Component				
Practical 1	Qualitative Organic Analysis(Minimum 5 number of samples)	**5**	Learn to identify unknown organic compounds using a systematic approach involving several key techniques. They should be able to perform tests such as solubility tests, functional group tests (e.g., bromine water test for alkenes, silver nitrate test for halides), and spectroscopic methods including infrared (IR) and nuclear magnetic resonance (NMR) spectroscopy.	**1,2,3**
Practical 2	Estimation of Iron Using standard $KMnO_4$ solution	**5**	Estimating iron using a standard potassium permanganate (KMnO4) solution involves a titration method that students should master for analytical chemistry. Initially, students prepare an acidic solution containing iron ions, then titrate it with KMnO4 solution until a color change occurs, typically from purple to colorless.	**3,4**
Practical 3	Determination of Total Hardness of waterand Estimation of Ca	**5**	Determining the total hardness of water and estimating the calcium ion concentration involves titration techniques essential in environmental and analytical chemistry.	**3,4,5**
Practical 4	Determination of surface tension of given liquid	**5**	Determining the surface tension of a liquid involves several experimental methods that students should master in physical	**2,4,5**

			chemistry and fluid mechanics. One common method is the capillary rise method, where students measure the height to which the liquid rises in a capillary tube due to capillary action.	
Practical 5	Determination of viscosity of given liquid	**5**	Determining the viscosity of a liquid involves several experimental techniques that are fundamental in fluid mechanics and physical chemistry. One common method is the capillary viscometer technique, where students measure the time it takes for a liquid to flow through a narrow capillary tube under gravity.	**3,4,5**
Practical 6	Synthesis of a polymer drug	**5**	Synthesizing a polymer or drug involves a series of chemical reactions and processes aimed at creating a specific molecular structure with desired properties. For polymers, students typically learn methods such as polymerization reactions (e.g., condensation polymerization, addition polymerization) to link monomers into long chains.	**2,3,4,5,6**

TEXT BOOKS:

T1: University chemistry, by B. H. Mahan
T2: Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
T3: Fundamentals of Molecular Spectroscopy, by C. N. Banwell
T4: Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan

REFERENCE BOOKS:

R1: Physical Chemistry, by P. W. Atkins
R2: Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

OTHER LEARNING RESOURCES:

O1:Coursera: Offers courses on engineering chemistry topics such as materials science, environmental chemistry, and chemical engineering principles.

O2:edX: Provides courses from universities worldwide covering topics like nanotechnology, renewable energy, and chemical process design.

O3:MIT OpenCourseWare: Offers free lecture notes, exams, and videos from actual MIT courses in chemistry and chemical engineering.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.	PO1,PO2,PO3,PO4,PO5,PO10 ,PO12
2	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques	PO1,PO2,PO3,PO4,PO5,PO10 ,PO12
3	Understand bulk properties and processes using thermodynamic considerations	PO1,PO2,PO3,PO4,PO5,PO10 ,PO12
4	Understand periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity	PO1,PO2,PO3,PO4,PO5,PO10 ,PO12
5	Analyse major chemical reactions that are used in the synthesis of molecules.	PO1,PO2,PO3,PO4,PO5,PO10 ,PO12

SEMESTER – II										
Course Title	**Basic Electrical and Electronics Engineering**									
Course code	**23BTCS123R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 45T+30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**	
Pre-requisite	**Nil**	**Co-requisite**	**Nil**							
Programme	**Bachelor of Technology in Computer Science and Engineering**									
Semester	**Winter/ II semester of the first year of the Programme**									
Course Objectives	1. Recall basic concepts of Electrical Engineering 2. Illustrate basics of AC circuits 3. Explain operative principle of transformer with background of magnetic circuits 4. Classify and compare different types of Electrical machines**.**									
CO1	Understand Kirchoff's laws to solve complex DC circuits, employing Thevenin, Norton, and Superposition theorems effectively.									
CO2	Analyze single-phase AC circuits, applying phasor representation and power concepts with precision and understanding.									
CO3	Evaluate transformer performance, considering losses, regulation, and efficiency, and apply knowledge to three-phase transformer connections.									
CO4	Critically analyze three-phase induction motor operation, interpreting torque-slip characteristics, losses, and efficiency for practical applications.									
CO5	Understand the design of power converters and demonstrate expertise in electrical installations, including safety devices and battery types.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Dc circuits:** Electrical circuit elements(R,L,C),voltage and current source,Kirchoff‘scurrentandvoltagelaw,analysisofsimplecircuit,Thevenin,Nortonand Superposition theorem	**8**	Understand and explain voltage, current, resistance, power, and energy in the context of DC circuits. Apply Ohm’s Law to relate voltage, current, and resistance in simple DC circuits.Analyze and solve series, parallel, and series-parallel resistor networks.	**1,2,3,4**
II	**AC Circuit**: Representation of sinusoidal waveforms, peak and rms values, phasor representation,realpower,reactivepower,apparentpower,powerfactor, Analysis ofSinglephaseaccircuitsconsisting ofr,L,C.RL,RC,rlccombination(seriesand parallel), voltage and current relationship in star and delta connection.	**12**	Understand the nature of alternating current (AC) and how it differs from direct current (DC). Describe sinusoidal waveforms and understand key parameters such as amplitude, frequency, period, and phase angle.	**3,4**
III	**Transformer:** Magnetic materials, ideal and practical transformer, equivalent Circuit, losses in transformer,	**8**	Understand the fundamental principles of electromagnetic induction as they apply to transformers. Explain the concepts of	**2,3,4**

	regulation and efficiency, auto transformer, three phase transformer connection.		mutual inductance and magnetic coupling.	
IV	**Electrical machines:** Generation of rotating magnetic fields, construction and Working of three phase induction motor, torque-slip characteristics, losses and efficiency, Single phase induction motor, working of synchronous generator.	**6**	Understand the principles of electromechanical energy conversion. Describe the construction, components, and working principles of DC generators and motors.	**2,3,4 ,5**
V	**Power converter and electrical installation:** DC-DC buck and boost converter, singlephaseandthreephasevoltages ourceinverter,Fuse,MCB,ELCB,M CCB, Earthing, wires and cables, types of batteries	**5**	Understand the basic principles of power electronics and power conversion. Differentiate between various types of power converters (AC-DC, DC-DC, DC-AC, AC-AC) and their applications.	**2,3,4**
Practical Component				
Practical 1	To Study specification and uses of instruments	**2**	Explain the significance and interpretation of instrument specifications such as accuracy, precision, resolution, range, and sensitivity.	**1,2**
Practical 2	To Study Ohm's Law for DC Circuits	**2**	Apply Ohm's Law to calculate unknown quantities (voltage, current, resistance) in simple DC circuits.	**1,2**
Practical 3	To verify KCL and KVL Circuits	**3**	Explain Kirchhoff's Current Law and its application in electrical circuits, stating that the algebraic sum of currents entering a node (or junction) is zero.	**1,2**
Practical 4	To verify The venin's Theorem	**2**	Apply Thevenin's Theorem to analyze and solve DC and AC circuits with independent and dependent sources.	**1,2**
Practical 5	To verify Norton's Theorem	**2**	Construct the Norton equivalent circuit for a given network, comprising a current source (Norton current) in parallel with an impedance (Norton resistance).	**1,2**
Practical 6	To verify Maximum Power Transfer Theorem	**2**	Explain the principle behind the Maximum Power	**1,2**

			Transfer Theorem, stating that maximum power is transferred from a source to a load when the load resistance equals the Thevenin or Norton resistance of the source.	
Practical 7	To verify super position Theorem	**2**	Apply Superposition Theorem to analyze DC circuits containing multiple independent sources, including voltage sources and current sources.	**3,4**
Practical 8	To Study transformation	**2**	Define the transformation ratio of a single-phase transformer as the ratio of the number of turns in the primary winding to the number of turns in the secondary winding.	**3,4**
Practical 9	Mini-project	**13**	Define and articulate a clear problem or challenge to be addressed through the mini-project.	**3,4**

TEXT BOOKS:

T1: D.P. Kothari and I.J.Nagrath, Basic Electrical Engineering, TataMcGraw Hill, 2010

REFERENCE BOOKS:

R1:D.C.Kulshreshtha, Basic Electrical Engineering, McGrawHill,2009
R2:E.Hughes, ―ElectricalandElectronicsTechnology‖,Pearson,2010

OTHER LEARNING RESOURCES:

O1:Coursera: Courses such as "Programming for Everybody (Getting Started with C).
O2:edX: Introduction to C Programming" by Dartmouth College.
O3:Udemy: Various courses on C Programming, including "C Programming For Beginners - Master the C Language".

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand Kirchoff's laws to solve complex DC circuits, employing The venin, Norton, and Superposition theorems effectively.	PO1,PO2,PO3,PO4,PO5,PO6,PO9,PO 10,PO11,PO12
2	Analyze single-phase AC circuits, applying phasor representation and power concepts with precision and understanding.	PO1,PO2,PO3,PO4,PO5,PO6,PO9,PO 10,PO11,PO12
3	Evaluate transformer performance, considering losses, regulation, and efficiency, and apply knowledge to three-phase transformer connections.	PO1,PO2,PO3,PO4,PO5,PO6,PO9,PO 10,PO11,PO12
4	Critically analyze three-phase induction motor operation, interpreting torque-slip characteristics, losses, and efficiency for practical applications.	PO1,PO2,PO3,PO4,PO5,PO6,PO9,PO 10,PO11,PO12
5	Understand the design of power converters and demonstrate expertise in electrical installations, including safety devices and battery types.	PO1,PO2,PO3,PO4,PO5,PO6,PO9,PO 10,PO11,PO12

SEMESTER – II										
Course Title	**Object Oriented Programming**									
Course code	**23BTCS124R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 45T+30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**	
Pre-requisite	**Nil**	**Co-requisite**	**Nil**							
Programme	**Bachelor of Technology in Computer Science and Engineering**									
Semester	**Winter/ II semester of the first year of the Programme**									
Course Objectives	1.To enable students to understand the basic object oriented Programming concepts and apply them in problem solving. 2.Additionally, to illustrate among students the inheritance concepts for reusing the Programme and also to enable students. 3.To develop GUI-based applications using AWT, Swing and Event handling.									
CO1	Understand object-oriented Programming concepts and execute them proficiently in Java.									
CO2	Apply building blocks of OOPs language, including inheritance, packages, and interfaces, analysing real-world problems in their context.									
CO3	Utilize multithreading, exception handling, and other OOPs concepts effectively in object-oriented Programs.									
CO4	Apply various exception handling methods in Programming, demonstrating competence in error management.									
CO5	Develop interactive and GUI-based Java applications through project-based learning, showcasing practical application of Java Programming skills.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Java Overview:** Java Introduction, Platform Independence, JVM & JDK, Data types, Operators, If, else statement, Switch condition, while, do-while, for loop, break and continue statement. **Array and String:** Single Array & Multidimensional Array, Library Classes-String, String Buffer & Wrapper Class, Command line arguments and Various String Operations.	**5**	Describe the concept of platform independence in Java and how the Java Virtual Machine (JVM) enables it. Differentiate between the Java Virtual Machine (JVM) and the Java Development Kit (JDK), and understand their roles in Java application development. Define and declare single-dimensional arrays in Java, understanding array initialization, accessing elements, and iterating through array elements.	**1,2, 3**
II	**Classes, Objects and Methods:** Class and Object, Object reference, Constructor: Constructor Overloading, Method: Method Overloading, Recursion, Passing and Returning object form Method, new operator, this and static keyword, finalize () method, Import statement, Static import, Access control, Nested class, Inner class, Anonymous inner class.	**7**	Define classes and objects in Java, understanding the concept of encapsulation and how classes serve as blueprints for creating objects. Declare and define classes in Java, including instance variables, constructors, methods, and access modifiers (public, private, protected). Create objects of a class using constructors and understand the process of object initialization,	**3,4, 5,6**

			including default constructors and parameterized constructors.	
III	**Inheritance and Interfaces in Java:** Overview of Inheritance, inheritance in constructor, Inheriting Data members and Methods, Multilevel Inheritance – method overriding Handle multilevel constructors Explain super keyword, Stop Inheritance, Explain Final keywords, Creation and Implementation of an interface, Interface reference, instance of operator, Interface inheritance, Dynamic method dispatch, Abstract class, Comparison between Abstract Class and interface, inside of System.out.println – statements.	**6**	Differentiate between types of inheritance in Java, including single inheritance, multiple inheritance through interfaces, and hierarchical inheritance. Implement method overriding in subclasses to provide specialized implementations of methods inherited from superclasses, understanding runtime polymorphism.	**2,3, 4,5**
IV	**Exception Handling in Java:** Exception and Error, Use of try, catch, throw, throws and finally, Built in Exception, Custom exception, Throwable Class. JAVA File Handling: Overview of Different Stream (Byte Stream, Character stream), Readers and Writers class, FileClass, File Input Stream, File Output Stream, Input Stream Reader and Output Stream Writer class, File reader and writer class, File Writer, Buffered Reader class.	**6**	Define exceptions in Java and understand their role in handling runtime errors and abnormal conditions that may occur during Programme execution. Implement try-catch blocks to handle exceptions gracefully, preventing Programme termination and providing alternative behaviors or error messages.	**1,3, 4,5**
V	**Applet, AWT and Swing:** MVC Architecture, Applet: Applet Fundamental, Applet Architecture, Applet Skeleton, Requesting Repainting, Event Handling: various event handling mechanisms, Delegation Event Model, Events, Event Sources, Event Listeners, various classes related to event sources and event listeners, AWT: window fundamentals, creating frames, Adding removing various controls, Layout managers, Introduction To Swing,	**6**	Define what Java applets are and understand their role in web-based applications, particularly in the context of early web development. Describe the lifecycle of an applet, including initialization (init()), start (start()), stop (stop()), and destruction (destroy()), understanding how applets interact with web browsers. Implement event handling in Java applets to respond to user interactions such as mouse clicks, keyboard input, and	**4**

	Applications and Pluggable look and feel, Basic swing components: Text Fields, Buttons, Toggle Buttons, Checkboxes, and Radio Buttons.		window events, using event listeners and adapters.	
Practical Component				
Practical 1	Hands-on Introduction to Object-Oriented Programming: Practical exercises on creating classes and objects, Implementing encapsulation through practical examples, Coding exercises on constructors and destructors, Applying access modifiers (public, private, protected) in practical scenarios.	**6**	Define object-oriented Programming (OOP) concepts such as classes, objects, inheritance, polymorphism, and encapsulation, understanding their role in software development. Create classes in Java, defining attributes (fields) and behaviors (methods) that represent real-world entities or concepts, and instantiate objects from these classes.	**1,2,4,5**
Practical 2	Practical Inheritance and Polymorphism: Coding exercises on implementing different types of inheritance (single, multi-level, and multiple), Practical examples of method overriding, Creating and using abstract classes and interfaces, Implementing static and dynamic binding through practical examples.	**8**	Implement different types of inheritance in Java: single inheritance (one subclass inherits from one superclass), multi-level inheritance (a subclass extends another subclass), and multiple inheritance (a subclass inherits from multiple superclasses using interfaces).	**2,4,5**
Practical 3	Advanced OOP Concepts in Practice: Practical exercises on creating and using packages and namespaces, Implementing exception handling in real-world scenarios, Creating and managing multithreaded applications, Practical exercises on generics and collections.	**8**	Organize Java classes into packages to manage code structure and namespace, demonstrating how packages encapsulate related classes and provide access control. Develop practical exercises that involve creating, importing, and utilizing packages in Java applications, ensuring modularization, and facilitating code reuse and maintenance.	**1,2,3**
Practical 4	Software Design and Development in Action: Hands-on Object-Oriented Analysis and Design (OOAD) exercises, Implementing design patterns (e.g., Singleton, Factory, Observer) in practical scenarios, Software testing and debugging exercises, Code optimization and refactoring practical sessions.	**8**	Conduct hands-on exercises on OOAD principles, including identifying objects, defining classes, specifying relationships (inheritance, composition), and modeling behavior using UML diagrams (class diagrams, sequence diagrams, etc.). Implement commonly used design patterns (e.g., Singleton,	**2,3,4,5**

			Factory, Observer, Strategy) in practical scenarios, demonstrating their application to solve recurring design problems and improve code flexibility and maintainability.	

TEXT BOOKS:

T1: Herbert Schildt and Dale Skrien, ‖Java Fundamentals – A comprehensive Introduction‖, McGraw Hill.
T2: Herbert Schildt, ―Java the complete reference, McGraw Hill, Osborne.
T3: T. Budd, ―Understanding Object-Oriented Programming with Java‖, Pearson Education.

REFERENCE BOOKS:

R1: P.J. Dietel and H. M. Dietel,―Java How to Programme ‖,Prentice Hall.
R2: P. Radha Krishna, ―Object Oriented Programming through Java‖, CRC Press.

OTHER LEARNING RESOURCES:

O1:http://java.sun.com
O2:http://www.oracle.com/technetwork/java/index.html)
O3:http://java.sun.com/javase
O4:http://www.oracle.com/technetwork/java/javase/overview/index.html
O5:http://download.oracle.com/javase/7/docs/api/index.htmlE-Text Books:
O6:http://docs.oracle.com/javase/tutorial/

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand object-oriented Programming concepts and execute them proficiently in Java.	PO1,PO2,PO3,PO4,PO5,PO12
2	Apply building blocks of OOPs language, including inheritance, packages, and interfaces, analyzing real-world problems in their context.	PO1,PO2,PO3,PO4,PO5,PO12
3	Utilize multithreading, exception handling, and other OOPs concepts effectively in object-oriented Programs.	PO1,PO2,PO3,PO4,PO5,PO12
4	Apply various exception handling methods in Programming, demonstrating competence in error management.	PO1,PO2,PO3,PO4,PO5,PO12
5	Develop interactive and GUI-based Java applications through project-based learning, showcasing practical application of Java Programming skills.	PO1,PO2,PO3,PO4,PO5,PO12

SEMESTER – II									
Course Title	**Environmental Science**								
Course code	**23UBES121R**	**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 Technology in Computer Science and Engineering**								
Semester	**Winter/ II semester of the first year of the Programme**								
Course Objectives	1. Understanding Ecological Systems and Processes. 2. Analysing Environmental Issues and Solutions. 3. Promoting Environmental Stewardship and Sustainable Practices.								
CO1	Understand the relationships between natural and man-made systems.								
CO2	Develop critical thinking for shaping strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.								
CO3	Understand the consequences of human actions on the web of life, global economy, and quality of human life.								
CO4	Understand about Environment Pollution, Global Environment issues, Impact of Human Population and modern civilization on the Environment								
CO5	Analyse various aspects of human population, and the impact of the population growth on the environment.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Environment:** Definition and scope, components of environment, atmosphere, hydrosphere, lithosphere and biosphere, structure and composition, Life systems, pro and eukaryotic organizations, Metabolic principles; types of plants and animals. Producers, consumers and decomposers.	**6**	Identify and describe the major components of the environment: atmosphere (air), hydrosphere (water), lithosphere (earth's crust), and biosphere (living organisms), understanding their interactions and interdependencies. Define "environment" in the context of ecological and environmental sciences, exploring its scope as encompassing natural, built, and social environments.	**1,2,3,4**
II	**Ecology:** Terminology and approach, ecosystem, types of ecosystems; structure and function, mineral cycling, energy flow and trophic chains. Development and evolution.	**6**	Define key ecological terms such as ecosystem, community, population, niche, habitat, and biodiversity, understanding their roles in studying interactions between organisms and their environment. Explain the concept of an ecosystem as a functional unit consisting of biotic (living organisms) and	**1,2,3,4,5**

			abiotic (non-living environment) components interacting within a defined area.	
III	**Environmental Pollution:** Sources, causes, assessment, effect, prevention and control of water pollution, air pollution noise and land pollution. Strategies of management, concept of sustainability. Energy, e n v i r o n m e n t , and their relationship with human activities. Water Resources and utilization, forest resources.	**6**	Identify and categorize sources of pollution such as industrial emissions, agricultural runoff, urban waste, and vehicular emissions, understanding their contributions to environmental degradation. Conduct assessments of environmental pollution using scientific methods and tools, including monitoring techniques, data analysis, and environmental impact assessments (EIAs).	**1,2,3,4**
IV	**Global Environmental Problems:** Human health, settlements, management of rivers, lakes, forests, wild life and catchments. Role of society, NGO and Govt. agencies. Concept of urbanization and green cities Global Warming, greenhouse causes and effects, carbon Sequestration.	**6**	Analyze the impact of environmental pollution and degradation on human health, including respiratory diseases, waterborne illnesses, and exposure to hazardous substances. Discuss the challenges and opportunities of urbanization, including urban sprawl, infrastructure development, resource consumption patterns, and sustainable urban planning practices.	**1,3,4**
V	**International agreements and protocols**, National forest policy and Environmental laws and acts. EIA.	**6**	Explain the purpose and significance of international environmental agreements and protocols, such as the Kyoto Protocol, Paris Agreement, Convention on Biological Diversity (CBD), and Montreal Protocol, analyzing their goals, implementation mechanisms, and global impact.	**1,2,3,4**

TEXT BOOKS:

T1: Sudhir Andrews (2013) Food and Beverage Service: A Training Manual, Tata McGraw Hill, 2013.

REFERENCE BOOKS:

R1: PradipDey, ManasGhosh, "Programming in C", 2nd Edition, 2018, Oxford University

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand the relationships between natural and man-made systems.	PO1,PO2,PO3,PO4,PO7,PO12
2	Develop critical thinking for shaping strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.	PO1,PO2,PO3,PO4,PO7,PO12
3	Understand the consequences of human actions on the web of life, global economy, and quality of human life.	PO2,PO7,PO12
4	Understand about Environment Pollution, Global Environment issues, Impact of Human Population and modern civilization on the Environment	PO2,PO3,PO7
5	Analyse various aspects of human population, and the impact of the population growth on the environment.	PO1,PO2,PO3,PO4,PO7,PO12

SEMESTER – II										
Course Title	**MOOCS II: Ethics, Technology and Engineering**									
Course code	**23MOCS122R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 30T	**0**	**0**	**0**	**0**	**0**	**0**	**1**	
Pre-requisite	**Nil**	**Co-requisite**	**Nil**							
Programme	**Bachelor of Technology in Computer Science and Engineering**									
Semester	**Winter/II Semester of First Year of the Programme**									
Course Objectives	1. Gain a foundational understanding of major ethical theories and principles and their applications in technology and engineering contexts. 2. Recognize and analyze ethical issues and dilemmas arising from the development and use of technology in various engineering fields. 3. Assess the social, environmental, and cultural impacts of technology and engineering practices, considering both positive and negative consequences.									
CO1	Students will comprehend major ethical theories and frameworks and apply them to analyze ethical issues in technology and engineering.									
CO2	Students will be able to identify and evaluate ethical dilemmas that arise in the design, development, and implementation of engineering projects.									
CO3	Students will develop skills to make ethical decisions and resolve ethical conflicts in engineering practice, considering diverse perspectives and stakeholders.									
CO4	Students will assess the social, environmental, and cultural impact of technological innovations and propose strategies for ethical and sustainable engineering.									
CO5	Students will understand the importance of professional ethics in engineering and advocate for ethical practices within their organizations and communities.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Introduction to Ethics and Engineering: Overview of Ethics and Ethical Theories, Ethical Principles in Engineering Practice, Historical Perspectives on Ethics in Engineering, Ethical Decision-Making Models, Professional Codes of Ethics for Engineers	**6**	Define ethics and explore various ethical theories (e.g., deontology, utilitarianism, virtue ethics) that provide frameworks for ethical reasoning and decision-making in engineering contexts. Identify and analyze key ethical principles relevant to engineering practice, such as integrity, honesty, accountability, transparency, fairness, and respect for human rights and the environment.	**1,2,3**
II	Ethical Issues in Technological Innovation: Ethical Dimensions of Emerging Technologies (e.g., AI, Biotechnology, IoT), Privacy, Surveillance, and Data Ethics, Ethical Implications of Automation and Robotics, Intellectual Property Rights and Ethical Considerations, Ethical Challenges in Global Engineering Projects	**6**	Analyze ethical implications and societal impacts of emerging technologies such as Artificial Intelligence (AI), Biotechnology, Internet of Things (IoT), and Blockchain, addressing issues of fairness, accountability,	**3,4,5**

			transparency, and bias.	
III	Social and Environmental Justice in Engineering: Social Responsibility of Engineers, Environmental Ethics and Sustainable Engineering, Ethical Considerations in Urban Planning and Infrastructure Development, Technology and Social Justice: Bridging the Digital Divide, Case Studies: Ethical Responses to Environmental Disasters.	**6**	Define and articulate the ethical and social responsibilities of engineers to promote public safety, health, and well-being, while considering the needs and interests of diverse stakeholders. Discuss principles of environmental ethics and their application in engineering practice, emphasizing sustainable development, resource conservation, pollution prevention, and ecosystem protection.	**3,4,5, 6**
IV	Ethical Leadership and Professional Responsibility: Ethical Leadership in Engineering Organizations, Whistleblowing and Ethical Decision-Making in Engineering, Diversity, Equity, and Inclusion in Engineering Practice, Ethics of Engineering Research and Publication, Ethical Responsibility in the Use of Artificial Intelligence and Machine Learning	**6**	Define the concept of ethical leadership in the context of engineering organizations, exploring the characteristics, behaviors, and practices that promote integrity, accountability, and ethical culture within teams and organizations.	**3,4,5, 6**
V	Ethics in Design and Innovation: Design Thinking and Ethical Design Principles, User-Centered Design and Ethical User Experience (UX), Ethical Considerations in Product Development and Marketing, Human-Centered AI and Ethical AI Design, Ethical Innovation and Entrepreneurship in Engineering	**6**	Explore the principles of design thinking and their application to ethical design practices in engineering, emphasizing empathy, collaboration, creativity, and human-centeredsolutions. Apply ethical considerations in user experience (UX) design, ensuring usability, accessibility, transparency, and respect for user privacy and autonomy throughout the design process.	**4**

TEXT BOOKS:

T1: "Engineering Ethics: Concepts and Cases" by Charles E. Harris Jr., Michael S. Pritchard, and Michael J. Rabins.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Students will comprehend major ethical theories and frameworks and apply them to analyze ethical issues in technology and engineering.	PO2,PO6,PO7,PO8
2	Students will be able to identify and evaluate ethical dilemmas that arise in the design, development, and implementation of engineering projects.	PO2,PO6,PO8
3	Students will develop skills to make ethical decisions and resolve ethical conflicts in engineering practice, considering diverse perspectives and stakeholders.	PO3,PO6,PO7,PO8
4	Students will assess the social, environmental, and cultural impact of technological innovations and propose strategies for ethical and sustainable engineering.	PO3,PO6,PO7,PO8,
5	Students will understand the importance of professional ethics in engineering and advocate for ethical practices within their organizations and communities.	PO6,PO7,PO8

SEMESTER – II									
Course Title	**Field-based Training : Network Components and Management**								
Course code	**23BTCS125R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:	**0**	**0**	**0**	**0**	**0**	**16**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Networking Basics**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II Semester of First Year of the Programme**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings. 4. To foster collaboration and communication skills through group projects and professional interactions. 5. To cultivate an appreciation for the complexities and challenges of professional practice in the field.								
CO1	Expose students to real-world applications of theoretical knowledge.								
CO2	Enhance observational, analytical, and research skills through fieldwork.								
CO3	Develop problem-solving skills in practical settings.								
CO4	Foster collaboration and communication skills through group projects and professional interactions.								
CO5	Cultivate an appreciation for the complexities and challenges of professional practice in the field.								

Course Description:

Field-Based Learning is designed to provide students with hands-on, practical experience in real-world environments related to Networking. This course emphasizes experiential learning through site visits, fieldwork, projects, and interactions with professionals in the field. Students will apply theoretical knowledge to practice, develop critical thinking skills, and gain a deeper understanding of their discipline.

Course Contents:

The organization will provide the students one field visit for this Programme. The students will be taken to a specific blocks of the university for learning purposes. The students will visit all department block site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners of IT department of the university. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial fi

ELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Expose students to real-world applications of theoretical knowledge.	PO1,PO5,PO7
2	Enhance observational, analytical, and research skills through fieldwork.	PO2,PO4,PO5,PO6,PO7
3	Develop problem-solving skills in practical settings.	PO2,PO3,PO5,PO9,PO11
4	Foster collaboration and communication skills through group projects and professional interactions.	PO6,PO8,PO9,PO10
5	Cultivate an appreciation for the complexities and challenges of professional practice in the field.	PO6,PO7,PO8,PO11,PO12

SEMESTER – II									
Course Title	**Effective English for Engineers**								
Course code	**23UBPD123R**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 40T	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**NIL**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II Semester of First Year of the Programme**								
Course Objectives	1. This course will enable the students to acquire the important knowledge on grammar like the formation of sentences. 2. To enable the students to use vocabulary meaningfully for a successful conversation. 3. To establish Reputation and Rapport, a dress code session is much needed 4. The 3 P's (Planning, Prioritizing, and Performing) of Time Management will be taught to the students.								
CO1	Understand and identify common errors in English writing.								
CO2	Acquire skill of report writing.								
CO3	Develop the ability as critical readers and writers.								
CO4	Improve speaking ability in English both in terms of fluency and comprehensibility.								
CO5	Understand the correct usage of English grammar in writing and speaking.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Grammar** Interchange of Interrogative and Assertive Sentences, Interchange of Exclamatory and Assertive Sentences, Analysis of Sentences, Types of Tenses Exercises on Tense	**8**	Identify the structural differences between interrogative and assertive sentences. Convert assertive sentences into interrogative sentences and vice versa without altering the original meaning. Apply correct punctuation and syntax rules while transforming sentences from one form to another.	**1,2,3,4**
II	**Understanding Harmony in the Vocabulary** Synonyms, Antonyms, Homonyms	**12**	Define and understand what synonyms are and their role in language. Identify and provide examples of synonyms for given words. Use synonyms appropriately in various contexts to avoid repetition and enhance writing and speaking	**3,4**
III	**Reading Skills** Techniques of Effective Reading, Gathering ideas and information from a text,The SQ3RTechnique Interpret the text	**8**	Improve the ability to understand and interpret written texts across various genres and disciplines. Expand vocabulary by encountering and learning new words through	**1,3,4,5**

			reading diverse texts.	
IV	**Dress Code Ethics** Introduction to Dress Code Ethics, Purpose and Importance, How to Make first impression, What to Wear During Interviews or Any Other Formal Meetings.	**6**	Define dress code ethics and explain their relevance in various professional and social settings. Recognize how dress codes can vary across different cultures and the importance of being culturally sensitive in dress choices.	**1,2,4,5**
V	**Time-Management Skills** Introduction To Time Management, Purpose And Importance of Time Management,Basic Tips to Maintain Time.	**5**	Define time management and explain its key principles. Explore the historical development of time management concepts and techniques.	**1,2,4**

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 Indispensible Guide to Excellent Writing and Speaking, Zephyros Press

REFERENCE BOOKS:

R1: Carthy. (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:

O1:https://youtu.be/rl85jxktfms
O2:https://www.betterteam.com/dress-code-policy#:~:text=Everyone%20is%20expected%20to%20be,religion%20or%20ethnicity%20are%20exempt

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand and identify common errors in English writing.	PO1,PO2,PO3,PO4,PO5,PO10,PO12
2	Acquire skill of report writing.	PO1,PO2,PO3,PO4,PO5,PO10,PO12
3	Develop the ability as critical readers and writers.	PO1,PO2,PO3,PO4,PO5,PO10,PO12
4	Improve speaking ability in English both in terms of fluency and comprehensibility.	PO1,PO2,PO3,PO4,PO5,PO10,PO12
5	Understand the correct usage of English grammar in writing and speaking.	PO1,PO2,PO3,PO4,PO5,PO10,PO12

SEMESTER – II									
Course Title	**Extra Curricular Activities**								
Course code	**23UBEC121**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30P	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II Semester of First Year of the Programme**								
Course Objectives	1. It is to develop the social and soft skills and to promote a holistic development of the learners. 2. Participating in debate clubs, drama, or public speaking events enhances verbal and non-verbal communication skills. 3. Taking leadership roles in student organizations or event planning committees fosters leadership and teamwork abilities.								
CO1	Learn to a plan so that they can make meaningful contributions, maintain a commitment, and manage their time and priorities.								
CO2	Transform passionate students who demonstrate leadership and pursue interests beyond their academics.								
CO3	Learn to participate in various co-curricular activities leading to their multifaceted personality development.								
CO4	Express their ideas, views, In-depth evaluation and analysis clearly in the topic of their interest.								
CO5	Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Discover the exciting world of engineering through hands-on projects and workshops. Gain practical skills in robotics, coding, and innovation, preparing for future STEM success.	30	Explore the dynamic field of engineering through interactive projects and workshops. Develop practical skills in robotics, coding, and innovation. Prepare for future success in. STEM disciplines	1,2,3,4,5

Course Objectives: It is to develop the social and soft skills and to promote a holistic development of the learners

Course Outcomes:

CO 1: Learn to plan so that they can make meaningful contributions, maintain a commitment, and manage their time and priorities.

CO 2: Transform passionate students who demonstrate leadership and pursue interests beyond their academics.

CO 3: Learn to participate in various co-curricular activities leading to their multifaceted personality development.

CO 4: Express their ideas, views, In-depth evaluation and analysis clearly in the topic of their interest.

CO 5: Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.

Course Description: Discover the exciting world of engineering through hands-on projects and workshops. Gain practical skills in robotics, coding, and innovation, preparing for future STEM success.

Course 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 to 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 the platform to learn from experts in the respective fields.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand and identify common errors in English writing.	PO1,PO2,PO3,PO4,PO5,PO6,PO10,PO12
2	Acquire skill of report writing.	PO1,PO2,PO3,PO4,PO5,PO6,PO10,PO12
3	Develop the ability as critical readers and writers.	PO1,PO2,PO3,PO4,PO5,PO6,PO10,PO12
4	Improve speaking ability in English both in terms of fluency and comprehensibility.	PO1,PO2,PO3,PO4,PO5,PO6,PO10,PO12
5	Understand the correct usage of English grammar in writing and speaking.	PO1,PO2,PO3,PO4,PO5,PO6,PO10,PO12

SEMESTER – III										
Course Title	**Digital Electronics**									
Course code	**23BTCS211R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite		**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science & Engineering**								
Semester	**Summer/I Semester of Second Year of the Programme**								
Course Objectives	1. To familiarize with the different number systems, logic gates, and combinational and sequential circuits utilized in the different digital circuits and systems. 2. The course will help in design and analysis of the digital circuit and system.								
CO1	Understand Boolean algebra, analyze digital logic families, demonstrate IC interfacing.								
CO2	Design logic functions, implement digital circuits, showcase MSI chip expertise								
CO3	Analyze, design sequential circuits, demonstrate flip-flop and counter proficiency								
CO4	Evaluate digital-to-analog converters, understand quantization, A/D converter types.								
CO5	Analyze semiconductor memories, demonstrate proficiency in memory technology and PLDs.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Fundamentals of Digital Systems and logic families:** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.	**12**	Understand digital signals, circuits, logic gates, Boolean algebra, binary arithmetic, number systems, IC gates, logic families, and interfacing techniques.	**1,2,3**
II	**Combinational Digital Circuits:** Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.	**10**	Understanding digital logic fundamentals including Boolean algebra, K-maps, multiplexers, adders, ALUs, and MSI chips for designing and optimizing digital circuits.	**1,2,3**

III	**Sequential circuits and systems**: A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.	**8**	Mastering digital memory elements (latches, flip-flops), shift registers, counters, and their applications for sequential logic design in digital systems.	**1,2,3,4,6**
IV	**A/D and D/A Converters:** Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D	**7**	Gaining expertise in digital to analog and analog to digital converters, encompassing specifications, operational principles, and practical applications in digital systems design.	**1,2,3,4,5**
V	**Semiconductor memories and Programmable logic devices:** Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).	**8**	Developing comprehensive knowledge of memory organization, types (ROM, RAM, CAM), memory characteristics, and applications in digital systems and Programmable logic devices like PLDs and FPGAs.	**1,2,3,4,6**
Practical Component				
Practical 1	To study and verify the truth table of logic gates.	**2**	To effectively study and validate the truth tables of logic gates, ensuring proficiency in understanding their operational principles and applications in digital	**2,3**

			circuit design.	
Practical 2	To design and implementation using NAND gate & NOR gate as Universal Gate.	**2**	Designing and implementing circuits using NAND and NOR gates as universal gates, enhancing versatility in digital logic synthesis and problem-solving.	**3,4,5**
Practical 3	To study about Ex-OR gates and verify their Truth Table.	**2**	Studying XOR gates and verifying their truth table enhances understanding of their unique logic behavior critical for digital circuit design.	**2,3**
Practical 4	To study about adder circuits, half adder circuits and verify their truth table	**2**	Studying adder circuits, including half adders, and verifying their truth tables enhances proficiency in binary arithmetic fundamental to digital logic design.	**2,3**
Practical 5	To study about adder circuits, full adder circuits and verify their truth table.	**2**	Studying full adder circuits and verifying their truth tables strengthens understanding of binary addition, critical for designing complex arithmetic units in digital systems.	**2,3,4**
Practical 6	To study half subtractor using basic gates.	**2**	Studying half subtractors using basic gates enhances understanding of binary subtraction fundamentals, essential for digital logic design and arithmetic operations.	**2,3,4**
Practical 7	To study full subtractor using basic gates.	**2**	Studying full subtractors using basic gates enhances understanding of binary subtraction with borrow, crucial for designing efficient arithmetic circuits in digital systems.	**2,3,4**
Practical 8	To design and set up a 4:1 and 2:1 Multiplexer.	**2**	Designing and setting up 4:1 and 2:1 multiplexers enhances understanding of data selection and routing in digital circuits, critical for signal processing applications.	**2,3,4,5,6**

Practical 9	To design and set up a 1:4 Demultiplexer (DE-MUX) .	**2**	Designing and setting up a 1:4 demultiplexer enhances understanding of data distribution and signal routing, crucial for digital communication and control systems.	**2,3,4,5,6**
Practical 10	Implementation and verification of decoder and encoder using logic gates.	**2**	Implementing and verifying decoders and encoders using logic gates enhances understanding of signal decoding and encoding techniques crucial for digital communication and control systems.	**2,3,4,5,6**
Practical 11	Mini-Project			

TEXT BOOKS:

T1: J.B Gupta, Electronic Device and Circuits, 2nd Ed., Katson Books 6th edition 2018.
T2: Dr. Sanjay Sharma, Digital Electronics and Logic Design, 6th Ed., Katson Books 2010.

REFERENCE BOOKS:

R1: Floyd, Electronic Devices, Pearson Education, 2nd edition, 9th edition, 2012.
R2: RP Jain, Modern Digital Electronics, Tata Mc Graw Hill, 3rd Edition, 2007.
R3: Frenzel, Communication Electronics: Principles and Applications, Tata Mc Graw Hill, 3rd Edition, 2001.
R4: Kumar, Fundamentals of Digital Circuits, Prentice Hall India, 2016.

OTHER LEARNING RESOURCES:

O1:nptel: Platforms like nptel offer courses such as "Digital Circuits and Systems" which cover topics ranging from digital circuits to system design.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand Boolean algebra, analyze digital logic families, demonstrate IC interfacing.	PO1, PO2, PO3, PO10, PO12
2	Design logic functions, implement digital circuits, showcase MSI chip expertise	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Analyze, design sequential circuits, demonstrate flip-flop and counter proficiency	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Evaluate digital-to-analog converters, understand quantization, A/D converter types.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
5	Analyze semiconductor memories, demonstrate proficiency in memory technology and PLDs.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – III										
Course Title	**Functional Programming in Python**									
Course code	**23BTCS212R**	**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 Technology in Computer Science & Engineering**									
Semester	**Summer/I Semester of Second Year of the Programme**									
Course Objectives	The course "Problem Solving using Python" aims to provide students with a basic foundation in Python Programming and problem-solving skills. Students will learn to write efficient, structured, and modular code to solve a few basic real-world computational problems.									
CO1	Understand about the history of Programming Languages, types of Programming languages, Basic Syntax of a few Programming languages.									
CO2	Understand the fundamentals of Python Programming language and its syntax, enabling them to write basic to intermediate level Programs.									
CO3	Demonstrate proficiency in using data types and conditional statements to make simple Python Programs and manipulate data effectively.									
CO4	Understand about Loops, functions and various packages in Python.									
CO5	Understand Lambda and user defined functions in Python.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**History of Programming Languages** Overview of Programming Languages, Basic Syntax of a few Programming languages, Advantages and disadvantages of Python, Real-life examples of application of Python	**6**	Understanding Python's versatility through its syntax, advantages in ease of use, and real-world applications in diverse fields like data science and automation.	**1,2**
II	**Introduction to Python Programming** Introduction to Python Language, Writing and Compiling Python Programs, Basic Structure of a Python Programme, Data Types and Constants	**10**	Developing proficiency in Python basics: syntax, Programme structure, data types, constants, enabling effective Programming and problem-solving skills.	**2,3**
III	**Data types and Variables** Data types, Variable declaration and use, Typecasting in Python, Operators in Python: Assignment, Logical, Arithmetic, Conditional statements: If statement, If else statement, Python Collections: List, Tuple, Sets and Dictionary	**10**	Mastering Python essentials: data types, variables, typecasting, operators, conditional statements, and for robust Programming proficiency.	**1,2,3**
IV	**Loops and Functions** Loops in Python: For Loop, While Loop and Nested Loops, User Defined functions	**7**	Proficiency in Python loop and user-defined functions, enabling efficient problem-solving and scalable software development.	**1,2,3**
V	**Lambda Functions** Types of functions, Lambda functions	**7**	Understanding types of functions (built-in, user-defined) and lambda functions in Python for	**1,2,3**

			versatile Programming and concise code implementation.	
Practical Component				
Practical 1	**Introduction to Python** Overview of Python Programming ● Setting up Python environment a) Installing Python b) Installing an IDE (e.g., PyCharm, VS Code, Jupyter Notebook) ● Writing your first Python Programme ● Basic syntax, comments, and documentation	**3**	Develop foundational skills in Python: setup environment, write code, apply basic syntax, comments, and documentation for effective Programming.	**1,2,3**
Practical 2	**Basic Data Types and Variables** ● Variables and data types ○ Integers, floats, strings, and booleans ● Type casting ● Basic input and output	**3**	Mastering Python basics: variables (integers, floats, strings, booleans), type casting, and basic input/output operations for practical Programming proficiency.	**1,2,3**
Practical 3	**Operators and Expressions** ● Arithmetic operators ● Comparison operators ● Logical operators ● Assignment operators ● Bitwise operators	**3**	Understanding Python operators: arithmetic, comparison, logical, assignment, and bitwise, essential for comprehensive Programming and problem-solving in diverse applications.	**3,4**
Practical 4	**Control Structures** ● Conditional statements a) if, else if, else ● Loops a) for loops b) while loops ● Break and continue statements	**3**	Mastering control structures in Python: conditional statements, loops, break, and continue statements for efficient Programme flow and logic implementation.	**1,2,3**
Practical 5	**Functions** ● Defining functions ● Calling functions ● Parameters and arguments ● Return values ● Scope of variables ● Lambda functions	**3**	Proficiency in Python functions: defining, calling, handling parameters/arguments, return values, variable scope, and utilizing lambda functions for concise and efficient code implementation.	**1,2,3**
Practical 6	**Data Structures** ● Lists a) Creating and accessing elements	**3**	Proficiency in Python data structures: lists, tuples, dictionaries, and sets.	**1,2,3**

	b) List methods c) List comprehensions ● Tuples ● Dictionaries a) Creating and accessing elements b) Dictionary methods Sets			
Practical 7	**Strings** ● String operations ● String methods ● String formatting ● Regular expressions	**3**	Mastering string operations, methods, formatting, and regular expressions in Python for robust text processing and pattern matching capabilities.	**1,2,3**
Practical 8	**File Handling** ● Opening and closing files ● Reading and writing files ● Working with file modes ● Using with statement	**3**	Proficiency in file handling in Python: opening, closing, reading, writing files, understanding file modes, and utilizing the with statement for resource management.	**1,2,3**
Practical 9	**Exception Handling** ● Understanding exceptions ● try, except, finally blocks ● Handling multiple exceptions ● Custom exceptions	**3**	Mastering exception handling in Python: understanding exceptions, using try-except-finally blocks, managing multiple exceptions, and creating custom exceptions for robust error management in Programs.	**1,2,3**
Practical 10	**Modules and Packages** ● Importing modules ● Creating modules ● Using standard libraries o os, sys, math, datetime, etc.	**3**	Proficiency in module management in Python: importing modules, creating custom modules, and utilizing standard libraries like os, sys, math, datetime for enhanced functionality in applications.	**1,2,3**

TEXT BOOKS:

T1:BALAGURUSAMY, 1st Edition, Introduction To Computing And Problem-Solving Using Python, McGraw Hill, ISBN 9789352602582

REFERENCE BOOKS:

R1: Andrew Ngo, Introduction to Python Programming: Beginner to Advanced, Practical Guide, Tips and Tricks, Easy and Comprehensive, 1st Edition, 2017, Kindle Books
R2: Venugopal and Prasad, Python: The Complete Reference, 4th Edition, 2018, Tata McGraw Hill.

OTHER LEARNING RESOURCES:

O1: youtube: The youtube tutorial "Python Tutorial for Beginners" offers python Programming tutorials for beginners, including functional Programming principles.

O2: geeksforgeeks: Offers tutorials, including functional Programming principles.

O3: Coursera: the course "Programming for Everybody (Getting Started with Python)" offered helps Gain a foundational understanding and learn new concepts from industry experts

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand about the history of Programming Languages, types of Programming languages, Basic Syntax of a few Programming languages.	PO1, PO2, PO3, PO5, PO11
2	Understand the fundamentals of Python Programming language and its syntax, enabling them to write basic to intermediate level Programs.	PO1, PO2, PO3, PO5, PO11
3	Demonstrate proficiency in using data types and conditional statements to make simple Python Programs and manipulate data effectively.	PO1, PO2, PO3, PO5, PO11
4	Understand about Loops, functions and various packages in Python.	PO1, PO2, PO3, PO5, PO11
5	Understand Lambda and user defined functions in Python.	PO1, PO2, PO3, PO5, PO11

SEMESTER – III									
Course Title	**Data Structure & Algorithms**								
Course code	**23BTCS213R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Fundamentals of Programming logic**	**Co-requisite**	**C Programming**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/I Semester of Second Year of the Programme**								
Course Objectives	1. To impart the basic concepts of data structures and algorithms. 2. To understand basic concepts about stacks, queues, lists, trees and graphs. 3. To understand concepts about searching and sorting techniques								
CO1	Understand analysis of algorithms using asymptotic notations, and learn search technique								
CO2	Analyse algorithms on stacks and queues and their applications.								
CO3	Implement and analyse operations on linked lists and its variations and their applications.								
CO4	Apply tree terminologies and operations on different types of trees, with a focus on algorithmic analysis and practical applications.								
CO5	Evaluate and compare various sorting algorithms, hashing techniques, and graph theoretic concepts along with their complexity analysis.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction:** Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.	**8**	Understanding fundamental data structures, algorithm analysis, and search techniques, including complexities, for efficient problem-solving and resource management in computing.	**1,2,3**
II	**Stacks and Queues**: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	**10**	Learning outcomes: Mastery of stack and queue ADTs, including operations and complexities, and their practical applications in expression conversion, evaluation, and various queue types with corresponding algorithms and analyses.	**1,2,3**
III	**Linked Lists:** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.	**10**	Gain expertise in linked list structures: singly linked lists, doubly linked lists, circular linked lists, stack and queue implementations, and algorithmic complexities.	**2,3**

IV	**Trees:** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.	**6**	Learning outcomes: Proficiency in basic tree terminology, operations on binary, threaded, AVL trees, and B/B+ trees, including algorithms and complexity analysis, with applications in various domains.	**2,3**
V	**Sorting and Hashing:** Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. **Graph:** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	**6**	Master sorting (Selection, Bubble, Insertion, Quick, Merge, Heap), hashing principles, and graph operations (search, traversal) with complexity analyses.	**2,3**
Practical Component				
Practical 1	Array Operations- d) Programme to perform basic array operations (insertion, deletion, search, update).	**3**	Learning outcome: Proficiency in performing array operations (insertion, deletion, search, update) essential for efficient data manipulation and algorithm implementation in Programming.	**1,2,3**
Practical 2	Linked List Operations- Programme to implement singly linked list operations (insertion, deletion, traversal). Programme to implement doubly linked list operations (insertion, deletion, traversal). Circular Linked List- Programme to implement circular linked list operations (insertion, deletion, traversal).	**3**	Mastery of implementing and manipulating singly, doubly, and circular linked lists through operations like insertion, deletion, and traversal in Programming contexts.	**1,2,3**
Practical 3	Stacks and Queues- Stack Using Array- Programme to implement stack operations using arrays (push, pop, peek). Stack Using Linked List- Programme to implement stack operations using linked lists. Infix to Postfix Conversion Programme to convert infix expression to postfix expression using stack.	**3**	Proficiency in implementing stack operations using arrays and linked lists, and converting infix expressions to postfix using stacks, enhancing algorithmic understanding and Programming skills.	**1,2,3**

Practical 4	Queue Using Array- Programme to implement queue operations using arrays (enqueue, dequeue, front, rear). Queue Using Linked List- Programme to implement queue operations using linked lists. Circular Queue- Programme to implement circular queue using arrays.	**3**	Mastery in implementing queue operations using arrays and linked lists, including circular queue implementation, crucial for efficient data management and algorithmic proficiency in Programming.	**1,2,3**
Practical 5	Trees Binary Tree Creation Programme to create a binary tree and perform preorder, inorder, and postorder traversals. Binary Search Tree (BST) Operations c) Programme to implement BST operations (insertion, deletion, search).	**3**	Ability to create and traverse binary trees using preorder, inorder, and postorder methods, and proficiency in implementing BST operations (insertion, deletion, search) for efficient data organization and manipulation in Programming.	**1,2,3**
Practical 6	AVL Tree Implementation Programme to implement AVL tree operations (insertion with rotations). Heap Implementation c) Programme to implement a max-heap or min-heap and perform heap operations (insert, delete, heap if y).	**3**	Mastering AVL tree operations with rotations for balance and implementing heap structures with insertions, deletions, and maintenance in Programming contexts.	**1,2,3**
Practical 7	Sorting Programs- Merge Sort Implementation: Write a C Program to implement the merge sort algorithm to sort an array of integers. Quick Sort Implementation: Implement the quick sort algorithm in C to sort an array of integers. Heap Sort Implementation: Write a C Program to implement the heap sort algorithm to sort an array of integers.	**3**	Proficiency in implementing and understanding merge sort, quick sort, and heap sort algorithms for efficient array sorting in Programming.	**1,2,3**
Practical 8	Hash Table with Chaining: Implement a hash table using chaining for collision resolution in C. Include functions to insert, search, and display elements.	**3**	Learning to implement a hash table with chaining for collision resolution, including functions for insertion, searching, and displaying elements, crucial for efficient data management in C Programming.	**1,2,3**
Practical 9	Hash Table with Linear Probing: Write a C Program to implement a	**3**	Proficiency in implementing a hash table using linear probing for collision resolution,	**1,2,3**

	hash table using open addressing with linear probing for collision resolution. Include functions to insert, search, and display elements.		including functions for insertion, searching, and displaying elements in C Programming, essential for efficient data management and retrieval.	
Practical 10	Hash Table with Quadratic Probing: Implement a hash table using open addressing with quadratic probing for collision resolution in C. Include functions to insert, search, and display elements	**3**	Learning to implement hash tables with quadratic probing for collision resolution, including insert, search, and display functions in C.	**1,2,3**

TEXT BOOKS:

T1:"Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
T2: Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein**,** "Introduction to Algorithms" by Cormen et al.
T3: Seymour Lipschutz , "Data Structures, with C" by McGraw-Hill Education, Schaum's Outlines series.

REFERENCE BOOKS:
R1: Algorithms, "Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
R2: "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.

OTHER LEARNING RESOURCES:
O1:Coursera: "Data Structures and Algorithms" by UC San Diego and National Research University Higher School of Economics
O2:Udemy: "Master the Coding Interview: Data Structures + Algorithms" by Andrei Neagoie
O3: GeeksforGeeks: Offers tutorials, explanations, and problem-solving sessions on data structures and algorithms.
O4:Tutorialspoint: Provides comprehensive tutorials on data structures and algorithms.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand analysis of algorithms using asymptotic notations, and learn search technique	PO1, PO2, PO3, PO10, PO12
2	Analyse algorithms on stacks and queues and their applications.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Implement and analyse operations on linked lists and its variations and their applications.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Apply tree terminologies and operations on different types of trees, with a focus on algorithmic analysis and practical applications.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
5	Evaluate and compare various sorting algorithms, hashing techniques, and graph theoretic concepts along with their complexity analysis.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – III									
Course Title	**Computer Organization & Architecture**								
Course code	**23BTCS214R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Programming For Problem Solving**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/I Semester of Second Year of the Programme**								
Course Objectives	1. Discuss the organization and architecture of computer systems and electronic computers. 2. Analyse the basic components of computer systems besides the computer arithmetic. 3. Discuss input-output organization, memory organization and management, and pipelining.								
CO1	Understand the interaction of the components of a computer system with the instruction set architecture of a CPU and addressing modes.								
CO2	Analyse the various data representation techniques, perform computer arithmetic and discuss the various adders and multipliers.								
CO3	Analyse the control unit design approaches, memory design technologies and I/O transfers.								
CO4	Demonstrate the concepts of pipelining, parallel processing and concurrent access to memory.								
CO5	Summarize the concepts of memory organization with mapping functions and replacement algorithms.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Functional blocks of a computer:** CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.	**8**	Understanding computer architecture components: CPU, memory, I/O subsystems, control unit. Mastering CPU's instruction set architecture, addressing modes, and interpreting instructions for diverse applications.	**1,2,3**
II	**Data representation:** signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-andadd, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic. Introduction to x86 architecture.	**8**	Understanding data representation (signed numbers, fixed/floating-point, character encoding) and computer arithmetic (addition, multiplication, division techniques, floating-point operations) for comprehensive computer system understanding.	**1,2,3**
III	**CPU control unit design:** hardwired and micro-Programmed design approaches, Case study – design of a simple hypothetical	**10**	Understanding CPU control unit design (hardwired vs micro-Programmed), memory	**1,2**

	CPU. Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers – Programme controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCII, USB		system architecture, I/O subsystems, interfaces, interrupts, and exceptions for comprehensive computer system understanding and design.	
IV	**Pipelining:** Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.	**8**	Mastering pipelining fundamentals: concepts, throughput, speedup, and handling pipeline hazards. Understanding parallel processors, concurrent memory access, and cache coherency for advanced computational efficiency and performance.	**1,2**
V	**Memory organization:** Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.	**8**	Understanding memory organization: interleaving, hierarchical structure, cache memory, mapping techniques, replacement algorithms, and write policies for optimized memory access and performance in computer systems.	**1,2,3**

TEXT BOOKS:

T1: David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", 5th Edition, Elsevier.

REFERENCE BOOKS:

R1: "Computer Organization and Embedded Systems", 6th Edition by CarlHamacher, McGraw Hill Higher Education.

R2: "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill.

R3: "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.

OTHER LEARNING RESOURCES:

O1:javatpoint: the tutorial "Computer Architecture and Organization"

O2:nptel: "**Computer Organization and Architecture"** by Prof. Mainak Chaudhuri (IIT Kanpur)

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand the interaction of the components of a computer system with the instruction set architecture of a CPU and addressing modes.	PO1, PO2, PO3, PO10, PO12
2	Analyse the various data representation techniques, perform computer arithmetic and discuss the various adders and multipliers.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Analyse the control unit design approaches, memory design technologies and I/O transfers.	PO1, PO2, PO3, PO10, PO12
4	Demonstrate the concepts of pipelining, parallel processing and concurrent access to memory.	PO1, PO2, PO3, PO4, PO10, PO12
5	Summarize the concepts of memory organization with mapping functions and replacement algorithms.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – III									
Course Title	**Probability and Statistics**								
Course code	**23BTCS215R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Mathematics**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/ I semester of the second year of the Programme**								
Course Objectives	1. To make understand to solve first and second order ordinary differential equation. 2. To provide conceptual understanding on higher order ODE with constant coefficients. 3. To provide an overview of probability to engineers. 4. To understand the concept of basic statistical measurements. 5. To analyse the data by applying statistical methods.								
CO1	Enabling solving skills of ordinary differential equations of various order.								
CO2	Enabling solving skills of higher order ODE with constants coefficients.								
CO3	Enable to formulate and solve problems involving random variables.								
CO4	Enable to solve problems of various probability distribution.								
CO5	Analysing experimental data by applying statistical methods.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**First order ordinary differential equations:** Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.	**7**	Understanding first-order ODEs: exact, linear, Bernoulli's, Euler's equations, and equations solvable for p, y, x, and Clairaut's type.	**1,2**
II	**Ordinary differential equations of higher orders:** Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation, Higher order ODE with constant coefficients.	**9**	Understanding higher-order ODEs: second-order linear equations with variable coefficients, variation of parameters, Cauchy-Euler equation, and constant coefficient ODEs.	**2,3**
III	**Probability:** Basic definitions on Probability, conditional probability, independence; Discrete random variables, Independent random variables., Probability distributions: Binomial, Poisson and Normal, Poisson approximation to the binomial distribution.	**8**	Understanding probability basics: definitions, conditional probability, independence, discrete random variables, and distributions (Binomial, Poisson, Normal) including Poisson approximation.	**2,3,5**
IV	**Basic Statistics:** Measures of central tendency: Moments, skewness and Kurtosis, Correlation and regression.	**8**	Mastering basic statistics: measures of central tendency, moments, skewness, kurtosis, and understanding correlation and regression for data	**2,3,4**

			analysis.	
V	**Applied Statistics:** Test of significance: Large sample test for single proportion. Difference of proportions, single mean, difference of means and difference of standard deviations.	**8**	Understanding applied statistics: significance testing for large samples, including tests for single proportion, difference of proportions, means, and standard deviations.	**2,3**

TEXT BOOKS:

T1: Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

T2: N. P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

REFERENCE BOOKS:

R1: S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
R2: S. L. Ross, Differential Equations, 3rd Ed. Wiley India, 1984.

OTHER LEARNING RESOURCES:

O1:Tutorialspoint- offers a course "Statistics-Probability" for all beginners
O2: Youtube- Statistics and Probability full course.
O3: Nptel- a video lecture on "Probability and Statistics" full course by Prof. Somesh Kumar, IIT Kharagpur.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Enabling solving skills of ordinary differential equations of various order.	PO1, PO2, PO5, PO12
2	Enabling solving skills of higher order ODE with constants coefficients.	PO1, PO2, PO5, PO12
3	Enable to formulate and solve problems involving random variables.	PO1, PO2, PO4, PO6, PO12
4	Enable to solve problems of various probability distribution.	PO1, PO4, PO5, PO10, PO12
5	Analysing experimental data by applying statistical methods.	PO2, PO4, PO5, PO11, PO12

SEMESTER – III									
Course Title	**Field-Based Training**								
Course code	**23BTCS216R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 16hrs	**0**	**0**	**0**	**0**	**0**	**16**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/I Semester of Second Year of the Programme**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings. 4. To foster collaboration and communication skills through group projects and professional interactions. 5. To cultivate an appreciation for the complexities and challenges of professional practice in the field.								
CO1	Apply theoretical concepts to real-world situations.								
CO2	Conduct field-based research and gather data effectively.								
CO3	Analyze and interpret the university data to draw meaningful conclusions.								
CO4	Communicate findings clearly and effectively, both orally and in writing.								
CO5	Demonstrate professional behaviour and teamwork skills in field settings.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	The organization will provide the students one field visit for this Programme. The students will be taken to a specific blocks of the university for learning purposes. The students will visit all department block site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners of IT department of the university. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial findings.	**16**	Enhanced understanding through immersive field visits, interaction with IT professionals, and reflective journaling to integrate theoretical knowledge with practical insights effectively.	**1,2,3, 4,5,6**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Create effective written communication for professional scenarios, incorporating engineering terminology and conventions.	PO1, PO5, PO7, PO10, PO12
2	Demonstrate proficient verbal communication skills, applying engineering vocabulary and technical language appropriately.	PO2, PO4, PO5, PO6, PO12
3	Evaluate and apply effective teamwork strategies in engineering contexts, fostering collaboration and innovation.	PO2, PO3, PO4, PO9, PO11
4	Develop and deliver professional presentations using appropriate engineering language and communication techniques.	PO6, PO8, PO9, PO10, PO11
5	Analyse and adapt communication strategies for diverse engineering workplace scenarios, demonstrating cross-cultural competence.	PO6, PO7, PO8, PO11, PO12

SEMESTER – III									
Course Title	**English For Employability For Engineers**								
Course code	**23UBPD213R**	**Total credits: 1**	**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	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/I Semester of Second 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 organizations. 3. To overcome fear of Public Speaking 4. To understand the process of Effective Reading techniques and Listening skills.								
CO1	Create effective written communication for professional scenarios, incorporating engineering terminology and conventions.								
CO2	Demonstrate proficient verbal communication skills, applying engineering vocabulary and technical language appropriately.								
CO3	Evaluate and apply effective teamwork strategies in engineering contexts, fostering collaboration and innovation.								
CO4	Develop and deliver professional presentations using appropriate engineering language and communication techniques.								
CO5	Analyse and adapt communication strategies for diverse engineering workplace scenarios, demonstrating cross-cultural competence.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Reading Skills:** Exercise 1: Interpreting different texts Exercise 2: Importance and significance of Punctuation Exercise 3: Story -reading Exercise 4: News-reading Exercise 5: Comprehending texts of different genres	**6**	Enhancing reading skills: interpreting texts, understanding punctuation, reading stories and news, and comprehending various genres for improved literacy.	**1,2,3**
II	**Non-Verbal Communication:** i. Understanding Non-Verbal Communication & Body Language Types of Body Language ii. Importance and Impact of Body Language &Introduction to Haptics, Kinesics and Proxemics	**6**	Understanding non-verbal communication: types and impact of body language, and introduction to haptics, kinesics, and proxemics for effective interaction.	**1,2,3**
III	**Grammar (Flipped Classroom):** i. Types of Sentences (using Assertive, Imperative, exclamatory in respective contexts), ii. Degrees of Comparison	**4**	Understanding grammar through flipped classroom: identifying types of sentences (assertive, imperative, exclamatory) and mastering degrees of comparison in context.	**2,3**
IV	**Public Speaking Skills:** i. Introduction to public speaking Preparation for Public speaking	**7**	Developing public speaking skills: preparation (scripts, non-verbal cues),	**2,3**

	(scripts, non-verbal cues) ii. Understanding and overcoming Fear of Public Speaking Tips Public Speaking		overcoming fear, and applying effective public speaking tips for confident presentations.	
V	**Listening Skills:** i. Process of listening ii. Understanding listening barriers iii. Difference between Listening and Hearing, iv. Importance of Effective Listening Practice Session: Listening to podcasts, Lectures, Audio Books etc.	**5**	Enhancing listening skills: understanding the listening process, identifying barriers, distinguishing listening from hearing, and practicing with podcasts, lectures, and audiobooks.	**2,3,4**

TEXT BOOKS:

T1: Wren,P.C and Martin,H. 1995. High School English Grammar and Composition, S Chand Publishing.
T2: Barrett,Grant.2016.PerfectEnglishGrammar:TheIndispensibleGuidetoExcellent Writing and Speaking, ZephyrosPress

REFERENCE BOOKS:

R1: Carthy. (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
R3: Mccarthy. (2008) English Vocabulary in Use Upper - Intermediate with CD ROM, Cambridge University Press

OTHER LEARNING RESOURCES:

O1:nptel- the course "Technical English for Engineers" by Prof. Aysha Iqbal, IIT Madras
O2:youtube- "Your body language may shape who you are" Amy Cuddy ,TED
O3:Coursera- "Training and Practicing in English Public Speaking" by Shanghai Jiao Tong University

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOME

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Create effective written communication for professional scenarios, incorporating engineering terminology and conventions.	PO1, PO5, PO9, PO10
2	Demonstrate proficient verbal communication skills, applying engineering vocabulary and technical language appropriately.	PO6, PO9, PO10, PO12
3	Evaluate and apply effective teamwork strategies in engineering contexts, fostering collaboration and innovation.	PO6, PO9, PO10, PO11
4	Develop and deliver professional presentations using appropriate engineering language and communication techniques.	PO5, PO10, PO12
5	Analyse and adapt communication strategies for diverse engineering workplace scenarios, demonstrating cross-cultural competence.	PO6, PO8, PO10, PO12

SEMESTER – III									
Course Title	**Financial Literacy**								
Course code	**23UBPD211R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30P	**0**	**0**	**2**	**0**	**0**	**0**	**1**
Pre-requisite	Introduction to Financial Budgeting And Planning	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/I 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	Apply financial knowledge and skills to make informed decisions, ensuring long-term financial stability and security.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Fundamentals of Financial Planning - 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.	**8**	Fundamentals of Financial Planning covers understanding money's functions, inflation causes and control, financial planning processes, time value of money including simple and compound interest, Net Present Value (NPV) and Future Value (FV), compounding power, doubling periods, and the Rule of 72 for effective financial decision-making.	**1,2,3**
II	Income Tax Planning- 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.	**8**	Learning Outcome: Gain proficiency in understanding income, taxes (direct, indirect), taxable and non-taxable income, tax evasion, avoidance, GST, and effective tax planning strategies.	**3,4**

III	Entrepreneurial planning - 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.	**10**	Understand entrepreneurship fundamentals, support systems in India, institutional and financial support mechanisms (venture capital, business angels, government assistance, commercial bank loans), enabling effective entrepreneurial planning and implementation.	**3,4**
IV	Planning for investing in securities market - 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.	**10**	Gain knowledge of investment avenues in securities markets, primary and secondary markets, stock market functions (NSE, BSE), DEMAT trading, security repositories, stock brokers, operational aspects (order placement, contract notes, trading cycles), risks, financial intermediaries, stock indices, mutual funds (types, importance, drawbacks, investing in India), and advantages of Systematic Investment Plans (SIPs).	**4**
V	Planning for debts and Retirement 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.	**9**	Develop skills in consumer credit management, including choosing credit sources and evaluating costs. Understand consumer legal protections and factors influencing housing and vehicle decisions. Master retirement planning, including cost-of-living considerations, retirement needs analysis, retirement scheme evaluation, estate	**4**

			planning, pension, Medicare planning, and 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

REFERENCE BOOKS:

R1: Be Your Own Financial Advisor: Financial Planning, Investment Options, Risk Management, Tax Management, Succession Planning Kindle Edition y Sushil Bali
R2: The Dumb Things Smart People Do with Their Money: Thirteen Ways to Right Your Financial Wrongs Kindle Edition y Jill Schlesinger

OTHER LEARNING RESOURCES:

Financial Planning Association (FPA):Offers resources, workshops, and events for financial planners and individuals seeking financial advice.

1. **Local Community Resources**: Check local libraries, community centers, and universities for workshops or seminars on personal financial planning.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Develop a cash management strategy and a plan to facilitate the home or automobile buying process.	PO2, PO9, PO10, PO11
2	Design a diversified investment portfolio that addresses several different investment objectives.	PO2, PO5, PO11, PO12
3	Differentiate between open and closed-end mutual funds, exchange-traded funds, and direct or indirect real estate investments.	PO1, PO2, PO6, PO7
4	Create a financial plan that covers your income needs in retirement and helps protect you and your estate.	PO2, PO6, PO8, PO11, PO12
5	Apply financial knowledge and skills to make informed decisions, ensuring long-term financial stability and security.	PO2, PO6, PO8, PO11, PO12

SEMESTER – III									
Course Title	**Basic Life Saving Skills**								
Course code	**23UULS211R**	**Total credits: 2**	**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 Technology in Computer Science and Engineering**								
Semester	**Summer/I 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 2. To provide appropriate basic management and treatment for injuries.								
CO1	Basic Life Support (BLS) are the specific skills and knowledge that individuals should acquire and demonstrate after completing a BLS training course. These outcomes are essential for anyone who may encounter a medical emergency and need to provide immediate assistance before professional medical help arrives								
CO2	Soft skills are a set of personal attributes and abilities that enable students to interact effectively and harmoniously with others, both personally and professionally. These skills are highly valued and can lead to better communication, collaboration, and overall success in various aspects of life								
CO3	Focus on the knowledge and skills needed to effectively recognize, assess, and manage various types of traumatic injuries and emergencies. Essential for healthcare professionals, first responders, and anyone involved in emergency care								
CO4	Understand the principles and purpose of the Triage system in healthcare settings. Describe the different levels of triage (e.g., immediate ,delayed, minimal, expectant) and their significance in prioritizing patient care. Identify common medical conditions and injuries that require immediate attention and those that can be managed at a later stage. Recognize the importance of accurate and timely patient assessment during triage.								
CO5	Identify common medical emergency conditions: Learners should be able to recognize and differentiate between common medical emergencies, including myocardial infarction(heart attack),stroke, diabetic emergencies, anaphylaxis, respiratory distress, seizures, and allergic reactions.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Basic Life Support(BLS)** ● Introduction of BLS ● Chain of survival ● ABCs Assessment ● CPR and Ventilation Technique ● AED Choking for adult and children	5	Understanding chain of survival, ABCs assessment, CPR techniques, ventilation, AED usage, and choking management for adults and children.	**1,2,3**
II	**Soft skills** ● Introduction ● Communications Skills ● Situational Skills ● Team Work Other Soft Skills	5	Enhanced communication abilities, improved situational awareness, strengthened teamwork skills, and mastery of other interpersonal competencies crucial for professional success.	**3,4**
III	**Trauma emergencies**	10	Mastering scene safety	**3,4**

	• Introduction • Priorities of Initial approach in pre- hospital care a) Scene safety b) Primary assessment c) Bleeding control d) Helmet removal e) Care of amputated body part f) Extrication of victims and safe transfer g) Cervical spine stabilizatio n h) Cervical collar application i) Splinting of broken Limbs		assessment, prioritizing initial approaches in pre-hospital care such as primary assessment and bleeding control, and executing procedures like helmet removal, care of amputated body parts, extrication, cervical spine stabilization and collar application, and splinting of broken limbs for effective patient management and safety.	
IV	**Triage system** • Introduction • Flow chart approach of Triage • Triage of Multiple Casualties in Pre-Hospital setting • Triage of Single casualty	5	Understanding the introduction to triage, mastering the flowchart approach for triage, effectively triaging multiple casualties in a pre-hospital setting, and appropriately triaging a single casualty to optimize emergency response and patient care outcomes.	**1,2,3, 4**
V	**Medical emergencies** Introduction, Victim centred approach in medical emergency. Management of: • seizures • heart attack • asthma Diabetic emergencies	5	Learning victim-centered medical emergency approaches, managing seizures, heart attacks, asthma, diabetic emergencies, emergency childbirth, and stroke recovery positioning for effective patient care.	**2,3,4**

TEXT BOOKS:

T1: Nancy Caroline, Emergency Care in the streets, Seventh edition by Jones and Bartlett

T2: LC Gupta, First Aid book

REFERENCE BOOKS:

R1: Advance Emergency Care AmericanHeartAssociation

R2: Wikipedia - Basic life support

OTHER LEARNING RESOURCES:

O1:youtube- "Basic Life Support (BLS) CPR & AED Training" by the American Heart Association
O2: **youtube- "First Aid Training"** by St John Ambulance
O3: **Coursera- "Introduction to First Aid"** by the University of Michigan
O4: **Udemy- "Complete BLS Certification Course - Basic Life Support"** by First Aid For Free

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Basic Life Support (BLS) are the specific skills and knowledge that individuals should acquire and demonstrate after completing a BLS training course. These outcomes are essential for anyone who may encounter a medical emergency and need to provide immediate assistance before professional medical help arrives	PO1, PO6, PO8, PO10, PO12
2	Soft skills are a set of personal attributes and abilities that enable students to interact effectively and harmoniously with others, both personally and professionally. These skills are highly valued and can lead to better communication, collaboration, and overall success in various aspects of life	PO6, PO9, PO10, PO12
3	Focus on the knowledge and skills needed to effectively recognize, assess, and manage various types of traumatic injuries and emergencies. Essential for healthcare professionals, first responders, and anyone involved in emergency care	PO2, PO4, PO10, PO12
4	Understand the principles and purpose of the Triage system in healthcare settings. Describe the different levels of triage (e.g., immediate ,delayed, minimal, expectant) and their significance in prioritizing patient care. Identify common medical conditions and injuries that require immediate attention and those that can be managed at a later stage. Recognize the importance of accurate and timely patient assessment during triage.	PO2, PO6, PO10, PO12
5	Identify common medical emergency conditions: Learners should be able to recognize and differentiate between common medical emergencies, including myocardial infarction(heart attack),stroke, diabetic emergencies, anaphylaxis, respiratory distress, seizures, and allergic reactions.	PO1, PO2, PO6, PO8, PO12

SEMESTER – III										
Course Title	**Co-Curricular Activities**									
Course code	**23UBEC211**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60 Hrs	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programs	**All UG Programs**								
Semester	**Summer/I Semester of Second Year of the Programme**								
Course Objectives	1. It is to develop the social and soft skills and to promote a holistic development of the learners								
CO1	Connect and adapt cultural diversity among communities.								
CO2	Enhance team for working toward a shared vision								
CO3	Demonstrate and apply interdisciplinary connections and Cultivate spirit of creative thought and curiosity to achieve goals								
CO4	Learn to effectively communicate, delegate responsibilities and motivate team members.								
CO5	Develop strong teamwork and collaboration skills by engaging in group activities.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	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 the platform to learn from experts in the respective fields.	**60**	ADTU fosters holistic development through clubs participation in workshops and competitions. This course promotes promotes a holistic development of the learners.	

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Connect and adapt cultural diversity among communities.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
2	Enhance team for working toward a shared vision	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
3	Demonstrate and apply interdisciplinary connections and Cultivate spirit of creative thought and curiosity to achieve goals	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
4	Learn to effectively communicate, delegate responsibilities and motivate team members.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
5	Develop strong teamwork and collaboration skills by engaging in group activities.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12

SEMESTER – III										
Course Title	**Mini Project I**									
Course code	**23BTCS217R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60 hrs	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/I Semester of Second Year of the Programme**								
Course Objectives	1. To develop the knowledge, skills and attitudes of a professional Computer engineering professional. 2. To become confident in designing engineering solutions to complex software problems utilising a systems approach.								
CO1	Apply IT principles for real-world problem-solving using Programming languages and network solutions.								
CO2	Contribute to complex projects as a team member, demonstrating effective personal and team management.								
CO3	Develop Programming skills to create and assess software, hardware, and network solutions.								
CO4	Apply personal and team management skills as a professional software developer.								
CO5	Cultivate employability skills and uphold professionalism in software development.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: a) theoretical studies b) computer simulations c) hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project; 4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field; 5. Prepare a formal report describing the work undertaken and results obtained so far; and Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.	**60** **-**	Learning about independent research, technical expertise application, and effective communication through comprehensive project execution and presentation in specialized technical areas.	**1,2,3, 4,5,6**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Apply IT principles for real-world problem-solving using Programming languages and network solutions.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
2	Contribute to complex projects as a team member, demonstrating effective personal and team management.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
3	Develop Programming skills to create and assess software, hardware, and network solutions.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
4	Apply personal and team management skills as a professional software developer.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
5	Cultivate employability skills and uphold professionalism in software development.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12

SEMESTER – IV										
Course Title	**Discrete Mathematics and Graph Theory**									
Course code	**23BTCS221R**	**Total credits:3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 36	**3**	**0**	**0**	**0**	**0**	**0**	**3**	
Pre-requisite	**NIL**	**Co-requisite**	**NIL**							
Programme	**Bachelor of Technology in Computer Science and Engineering**									
Semester	**Winter/II semester of the second year of the Programme**									
Course Objectives	1. To provide students with a solid understanding of the fundamental concepts in discrete mathematics and graph theory. 2. To develop students' ability to solve problems related to discrete structures and graph algorithms. 3. To enable students to apply discrete mathematical concepts and graph theory techniques to computer science and related fields.									
CO1	Understand set operations, analyze relations, and demonstrate problem-solving in mathematics.									
CO2	Evaluate propositional logic, demonstrating analytical reasoning and deduction skills.									
CO3	Analyze algebraic structures, showcasing proficiency in groups, rings, and fields.									
CO4	Apply counting techniques, demonstrate problem-solving capabilities in mathematics.									
CO5	Analyze graph properties, apply graph theory concepts effectively in problem-solving.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Foundations of Discrete Mathematics** • Set Theory: Sets, subsets, operations on sets, Venn diagrams, Cartesian products. • Logic: Propositional logic, predicates, quantifiers, logical connectives, truth tables. • Proof Techniques: Direct proof, proof by contradiction, induction, contrapositive.	**4**	In Foundations of Discrete Mathematics, students will understand the basics of set theory, including sets, subsets, operations, Venn diagrams, and Cartesian products. They will learn propositional logic, predicates, quantifiers, logical connectives, and truth tables, along with mastering proof techniques such as direct proof, proof by contradiction, induction, and contrapositive.	**1,2,3**
II	**Combinatorics and Discrete Probability** • Combinatorics: Permutations, combinations, Pigeonhole principle, inclusion-exclusion principle. • Discrete Probability: Probability theory, conditional probability, Bayes' theorem, expected value.	**8**	Students will understand permutations, combinations, the Pigeonhole principle, and the inclusion-exclusion principle. They will also learn probability theory, conditional probability, Bayes' theorem, and how to calculate the expected value.	**2,5**
III	**Graph Theory Basics** • Graphs: Definitions, types	**10**	Students will learn the definitions and types of graphs, subgraphs, and	**1,2,3,4**

	of graphs, subgraphs, isomorphism. • Graph Representation: Adjacency matrix, adjacency list, incidence matrix. Trees: Properties, spanning trees, minimum spanning trees.		graph isomorphism. They will understand graph representation using adjacency matrices, adjacency lists, and incidence matrices, and explore tree properties, spanning trees, and minimum spanning trees.	
IV	**Advanced Graph Theory** • Graph Algorithms: Breadth-first search (BFS), depth-first search (DFS), Dijkstra's algorithm, Floyd-Warshall algorithm. • Planarity and Coloring: Planar graphs, Euler's formula, graph coloring, chromatic number. Network Flows: Max-flow min-cut theorem, Ford-Fulkerson algorithm.	**7**	In Advanced Graph Theory, students will master graph algorithms such as BFS, DFS, Dijkstra's, and Floyd-Warshall. They will understand planar graphs, Euler's formula, graph coloring, chromatic number, and network flows including the max-flow min-cut theorem and the Ford-Fulkerson algorithm.	**2,4,6**
V	**Applications of Discrete Mathematics** • Applications in Computer Science: Data structures, algorithms, complexity. • Applications in Network Theory: Internet graphs, social networks, communication networks. • Additional Applications: Cryptography, coding theory, combinatorial optimization.	**7**	In Applications of Discrete Mathematics, students will explore its use in computer science for data structures, algorithms, and complexity, and in network theory for internet graphs, social networks, and communication networks. They will also understand applications in cryptography, coding theory, and combinatorial optimization.	**2,3**

TEXT BOOKS:

T1: Discrete Mathematics and Its Applications" by Kenneth H. Rosen

REFERENCE BOOKS:

R1: "Introduction to Graph Theory" by Douglas B. West

OTHER LEARNING RESOURCES:

O1*:* *Discrete Mathematics for Computer Science Specialization* on Coursera: Offered by UC San Diego and National Research University Higher School of Economics.

O2: MIT Open Course Ware's lecture notes on Discrete Mathematics and Graph Theory.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand set operations, analyze relations, and demonstrate problem-solving in mathematics.	PO1, PO2,PO12
2	Evaluate propositional logic, demonstrating analytical reasoning and deduction skills.	PO1, PO2,PO12
3	Analyze algebraic structures, showcasing proficiency in groups, rings, and fields.	PO1, PO2,PO12
4	Apply counting techniques, demonstrate problem-solving capabilities in mathematics.	PO1, PO2,PO12
5	Analyze graph properties, apply graph theory concepts effectively in problem-solving.	PO1, PO2,PO12

SEMESTER – IV									
Course Title	**Database Management Systems**								
Course code	**23BTCS222R**	**Total credits:4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 35+30	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**File Systems**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the second year of the Programme**								
Course Objectives	1. To understand and use data manipulation language to query, update, and manage a database. 2. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency 3. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.								
CO1	Understand the fundamental concepts of database management systems with DBMS languages and data models.								
CO2	Apply the concepts of query languages such as DDL and DML for designing a relational database.								
CO3	Apply the ACID properties and concurrency control schemes to perform transaction processing with database recovery.								
CO4	Apply security to the database by checking for authentication and authorization								
CO5	Apply advanced topics of data warehousing and data mining, distributed databases and web databases.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Database system architecture:** Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). **Data models:** Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.	**6**	In studying Database System Architecture, students will understand data abstraction, data independence, and the roles of DDL and DML. They will also learn various data models, including entity-relationship, network, relational, and object-oriented models, and comprehend integrity constraints and data manipulation operations.	**1,2**
II	**Relational query languages:** Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. **Relational database design:** Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design.	**10**	Students will gain proficiency in relational query languages (relational algebra, tuple and domain relational calculus, SQL3), understand DDL and DML constructs across MySQL, Oracle, DB2, and SQL Server. They will also learn effective relational database design (domain and data dependency, Armstrong's	**2,3,4**

	Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.		axioms, normal forms, dependency preservation, lossless design) and optimize query processing through evaluation, equivalence, join strategies, and algorithms.	
III	**Transaction processing:** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic, Concurrency Control schemes, Database recovery.	**8**	Students will comprehend transaction processing concepts such as concurrency control, ACID properties, serializability of scheduling, and locking mechanisms in timestamp-based and multi-version concurrency control schemes. They will also master database recovery techniques essential for maintaining data integrity and availability.	**2,3,4, 5**
IV	**Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.	**6**	Students will understand database security fundamentals including authentication, authorization, DAC, MAC, and RBAC models, as well as techniques for intrusion detection and prevention of SQL injection attacks.	**2,3**
V	**Advanced topics:** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.	**5**	Students will explore advanced topics including object-oriented and object-relational databases, logical databases, web databases, distributed databases, and data warehousing, alongside principles and techniques of data mining for comprehensive data management solutions.	**1,2,3**
Practical Component				
Practical 1	**Designing and implementing a relational database schema** based on business requirements, ensuring normalization up to 3NF.	**2**	Students will achieve proficiency in designing and implementing relational database schemas tailored to business requirements, ensuring data organization adheres to normalization principles up to the third normal form (3NF).	2,3

Practical 2	**Writing and executing SQL queries** to retrieve, update, and delete data from a relational database, using DML commands such as SELECT, INSERT, UPDATE, DELETE.	**2**	Students will master the skill of writing and executing SQL queries to efficiently retrieve, update, and delete data from relational databases, employing DML commands (SELECT, INSERT, UPDATE, DELETE) to manipulate and manage data effectively.	3,5
Practical 3	**Implementing concurrency control mechanisms** like locking and timestamp-based protocols to manage simultaneous access to data in multi-user environments.	**2**	Students will develop the capability to implement concurrency control mechanisms such as locking and timestamp-based protocols, ensuring consistent and reliable management of data access in multi-user environments to prevent conflicts and maintain data integrity.	3
Practical 4	**Performing query optimization** by analyzing query plans, selecting appropriate join strategies, and applying optimization algorithms (e.g., cost-based optimization).	**2**	Students will learn to optimize query performance by analyzing query plans, selecting optimal join strategies, and applying algorithms such as cost-based optimization, enhancing database efficiency and responsiveness.	3
Practical 5	**Securing database access** through authentication mechanisms and defining authorization roles using RBAC models to enforce access controls.	**2**	Students will gain proficiency in securing database access through authentication mechanisms and implementing RBAC models to define and enforce granular authorization roles, ensuring data confidentiality and integrity in diverse organizational settings.	3
Practical 6	**Managing transactions** to ensure ACID properties (Atomicity, Consistency, Isolation, Durability) using transaction management techniques and protocols.	**2**	Students will develop expertise in managing transactions to guarantee ACID properties (Atomicity, Consistency, Isolation, Durability), employing robust transaction management	3

			techniques and protocols for reliable data operations in database systems.	
Practical 7	**Designing and deploying distributed database systems** to handle data across multiple nodes or locations while ensuring consistency and fault tolerance.	**2**	Students will learn to design and deploy distributed database systems, ensuring data consistency and fault tolerance across multiple nodes or locations, crucial for scalable and resilient data management in modern applications.	3
Practical 8	**Implementing data integrity constraints** such as primary keys, foreign keys, and check constraints to maintain data accuracy and reliability.	**2**	Students will gain proficiency in implementing data integrity constraints like primary keys, foreign keys, and check constraints, ensuring data accuracy and reliability in relational database systems.	3
Practical 9	**Designing and optimizing database indexes** to enhance query performance and facilitate efficient data retrieval.	**2**	Students will master designing and optimizing database indexes to improve query performance and streamline data retrieval operations, enhancing overall database efficiency.	3
Practical 10	**Implementing database recovery techniques** such as backup and restore procedures to ensure data availability and resilience against failures.	**2**	Students will learn to implement database recovery techniques, including backup and restore procedures, to ensure data availability and resilience against failures, maintaining database integrity and continuity.	3
Practical 11	**Exploring object-oriented and object-relational database features** for modeling complex data structures and relationships using inheritance and encapsulation.	**2**	Students will explore object-oriented and object-relational database features to effectively model complex data structures and relationships using inheritance and encapsulation, enhancing flexibility and scalability in database design.	3
Practical 12	**Utilizing data warehousing techniques** to integrate and consolidate data from heterogeneous sources for analytical processing and	**2**	Students will learn to utilize data warehousing techniques to integrate and consolidate data from	3

	decision support.		diverse sources, enabling effective analytical processing and decision support in organizational contexts.	
Practical 13	**Applying data mining algorithms** to extract patterns and insights from large datasets stored in databases, supporting business intelligence and predictive analytics.	**2**	Students will apply data mining algorithms to extract valuable patterns and insights from large databases, empowering business intelligence and facilitating predictive analytics for informed decision-making.	3
Practical 14	**Developing logical database designs** to map conceptual models (e.g., ER diagrams) to physical database schemas optimized for performance and storage.	**2**	Students will develop proficiency in translating conceptual models (e.g., ER diagrams) into optimized physical database schemas, ensuring efficient performance and storage in logical database designs.	3
Practical 15	**Managing and optimizing database performance** by monitoring resource usage, tuning database parameters, and analyzing execution plans for optimization opportunities.	**2**	Students will learn to manage and optimize database performance through effective monitoring of resource usage, tuning database parameters, and analyzing execution plans, ensuring efficient operation and responsiveness in database systems.	3

TEXT BOOKS:

T1:. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F.Korth, S. Sudarshan, McGraw-Hill.

REFERENCE BOOKS:

R1: "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.

OTHER LEARNING RESOURCES:

O1: https://www.jbiet.edu.in/coursefiles/cse/HO/cse2/DBMSI-III.pdf
O2: https://cs.ulb.ac.be/public/_media/teaching/infoh303/dbmsnotes.pdf

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand the fundamental concepts of database management systems with DBMS languages and data models.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
2	Apply the concepts of query languages such as DDL and DML for designing a relational database.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
3	Apply the ACID properties and concurrency control schemes to perform transaction processing with database recovery.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
4	Apply security to the database by checking for authentication and authorization	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
5	Apply advanced topics of data warehousing and data mining, distributed databases and web databases.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12

SEMESTER – IV									
Course Title	**Operating Systems**								
Course code	**23BTCS223R**	**Total credits:4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:39+30	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the second year of the Programme**								
Course Objectives	1. To learn the mechanisms of OS to handle processes and threads and their communication and the mechanisms involved in memory management in contemporary OS. 2. To gain knowledge on Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols 3. To know the components and management aspects of concurrency management.								
CO1	Understand operating system evolution, types, services, structures (UNIX, Windows).								
CO2	Analyse process, thread concepts, CPU scheduling, relationships, and states effectively.								
CO3	Evaluate IPC solutions, evaluate deadlock conditions, implement prevention, detection, recovery.								
CO4	Analyse memory management, mapping, allocation, paging, virtual memory, page replacement.								
CO5	Understand I/O hardware, controllers, DMA, secondary storage, disk scheduling, file management.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction:** Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.	**7**	Students will grasp the concepts of operating systems, including their generations, types, services, system calls, and structural architectures (layered, monolithic, microkernel), as well as understand the concept of virtual machines for efficient resource management and isolation.	**1,2**
II	**Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. **Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, **Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive	**8**	Students will understand processes and threads in operating systems, including their definitions, states, relationships, and management mechanisms like context switching and PCBs, alongside exploring process scheduling foundations, criteria, algorithms, and multiprocessor considerations for efficient resource utilization and system responsiveness.	**2,3,4**

	and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling.			
III	**Inter-process Communication:** Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution **Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	**8**	Students will master inter-process communication concepts including critical sections, race conditions, mutual exclusion, and hardware-based solutions, alongside understanding deadlocks, their conditions, prevention strategies like the Banker's algorithm, and techniques for detection and recovery in operating systems.	**2,3,4,5**
IV	**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging. **Virtual Memory**: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).	**8**	Students will comprehend memory management in operating systems, covering concepts like logical and physical address mapping, memory allocation strategies, including contiguous and paging methods, and virtual memory essentials such as locality of reference, demand paging, and page replacement algorithms like FIFO, LRU, and optimal for efficient resource utilization and system performance.	**2,3**
V	**I/O Hardware:** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure.. **File Management**: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management. **Disk Management:** Disk structure, Disk scheduling, Disk reliability, Disk formatting, Boot-block, Bad blocks.	**8**	Students will grasp I/O hardware principles including devices, controllers, and DMA, understand I/O software goals such as interrupt handling and device drivers, explore file management concepts like access methods, types, operations, and directory structures, and learn about disk management covering structure, scheduling, reliability, and formatting for efficient data storage and retrieval in operating systems.	**1,2,3**

Practical Component				
Practical 1	Basic Linux Commands and Overview.	**4**	Gain proficiency in fundamental Linux commands and system navigation.	2,3
Practical 2	Write Shell Script for followings a) To find the global complete path for any file. b) To broadcast a message to a specified user or a group of users logged on any terminal. c) To copy the file system from two directories to a new directory in such a way that only the latest file is copied in case there are common files in both the directories. d) To compare identically named files in two different directories and if they are same, copy one of them in a third directory e) To delete zero sized files from a given directory (and all its sub- directories). f) To display the name of those files (in the given directory) which are having multiple links. g) To display the name of all executable files in the given directory. h) Write a script to display the date, time and a welcome message (like Good Morning etc.). The time should be displayed with "a.m." or "p.m." and not in 24 hours notation. i) Write a script to display the directory in the descending order of the size of each file.	**10**	Develop proficiency in shell scripting through practical exercises in file management, system administration, and user interaction on Linux systems	2,3,5
Practical 3	Implementation of FCFS (First Come First Serve) CPU Scheduling.	**2**		3
Practical 4	Implementation of SJF (Shortest Job First) CPU Scheduling.	**2**	Implement SJF and CPU scheduling	3
Practical 5	Implementation of Round Robin (RR) CPU Scheduling.	**2**	Implement RR CPU scheduling	3
Practical 6	Implementation of Priority CPU Scheduling Algorithm.	**2**	Implement of Priority CPU Scheduling Algorithm.	3

Practical 7	Implementation of FIFO Replacement Algorithm.	**2**	Gain knowledge on FIFO	3
Practical 8	Implementation of Optimal Page Replacement Algorithm.	**2**	Able to implement Optimal Page Replacement Algorithm	3
Practical 9	Implementation of LRU Page Replacement Algorithm by Stack method	**2**	Able to implement LRU Page Replacement Algorithm by Stack method	3
Practical 10	Implement the producer-consumer problem using threads	**2**	Learn the producer-consumer problem using threads	3

TEXT BOOKS:

T1: Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
T2: Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

REFERENCE BOOKS:

R1: Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing.
R2: Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley

OTHER LEARNING RESOURCES:

O1: "Operating System Concepts" by Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne.
O2: "Modern Operating Systems" by Andrew S. Tanenbaum.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand operating system evolution, types, services, structures (UNIX, Windows).	PO1, PO2, PO3, PO4, PO5, PO10, PO12
2	Analyse process, thread concepts, CPU scheduling, relationships, and states effectively.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Evaluate IPC solutions, evaluate deadlock conditions, implement prevention, detection, recovery.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Analyse memory management, mapping, allocation, paging, virtual memory, page replacement.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
5	Understand I/O hardware, controllers, DMA, secondary storage, disk scheduling, file management.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – IV										
Course Title	**Software Engineering**									
Course code	**23BTCS224R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 36	**3**	**0**	**0**	**0**	**0**	**0**	**3**	
Pre-requisite	Basic Computer Science	**Co-requisite**	**NIL**							
Programme	**Bachelor of Technology in Computer Science and Engineering**									
Semester	**Winter/II semester of the second year of the Programme**									
Course Objectives	1. Master software development methodologies like Agile and WaterSummer. 2. Design scalable and maintainable software architectures. 3. Implement effective software testing and quality assurance practices.									
CO1	Demonstrate ethical software development practices.									
CO2	Apply systems development lifecycle phases effectively.									
CO3	Elicit, analyze, and specify software requirements collaboratively.									
CO4	Create and evaluate standard procedures and documentation.									
CO5	Collaborate productively in interdisciplinary software project teams.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Introduction: Lifecycle models Function-oriented software design: Structured analysis and structured design.	**7**	Students will gain proficiency in life cycle models and function-oriented software design through structured analysis and design methodologies, preparing for effective software development practices.	**1,2**
II	Software requirements, analysis, and specification: Informal and formal specification.	**8**	Develop skills in software requirements, analysis, and specification, encompassing both informal and formal specification methods to ensure comprehensive software development understanding and practice.	**1,2,3**
III	Object-Oriented Design: User interface design, GUI design primitives, Window management system, and the X Windows system. Coding and Testing: Coding standards and unit testing.	**7**	Master Object-Oriented Design principles including user interface and GUI design primitives, along with Window management systems like X Windows. Understand coding standards and practice effective unit testing methods to ensure robust software development.	**1,2,3**
IV	Project management: Estimation, scheduling, risk management, and configuration management.	**8**	Acquire proficiency in project management essentials such as estimation, scheduling, risk management, and configuration management, crucial for effective planning and execution of software projects.	**1,2,3**
V	Software reliability and quality assurance: Reliability metrics and growth modeling, ISO-	**6**	Explore software reliability and quality assurance, focusing on reliability metrics, growth	**1,2**

	9000, SEI, and CMM.		modeling, and standards like ISO-9000, SEI, and CMM to ensure high-quality software development practices and processes.	

TEXT BOOKS:

T1: An Integrated Approach to Software Engineering by Jalote. Narosa Publishing House.
T2: Software Engineering by R. Mall, PHI.

REFERENCE BOOKS:

R1: Software Engineering by R.S.Pressman, McGraw Hill

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Demonstrate ethical software development practices.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
2	Apply systems development lifecycle phases effectively.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
3	Elicit, analyze, and specify software requirements collaboratively.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
4	Create and evaluate standard procedures and documentation.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
5	Collaborate productively in interdisciplinary software project teams.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12

SEMESTER – IV									
Course Title	**DE-1: Biology For Engineers**								
Course code	**23BTCS225R**	**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**	**C Programming**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the first year of the Programme**								
Course Objectives	1. To introduce the students about the biological concepts from an engineering perspective. 2. To enable the students to have a strong knowledge of functioning of an ecosystem and identification of organisms. 3. To introduce with the concepts of genetics and mechanisms related to it.								
CO1	Analyze and differentiate between the fundamental principles of biology and engineering, emphasizing the significance of biological observations.								
CO2	Evaluate the importance of classification in biology, considering criteria such as cellularity, ultra structure, energy utilization, and molecular taxonomy.								
CO3	Examine the diversity of life through the study of biomolecules, emphasizing the common building blocks and diverse manifestations in sugars, proteins, nucleotides, and lipids.								
CO4	Explore the molecular basis of information transfer in genetics, understanding the hierarchy of DNA structure, the universality of the genetic code, and defining genes.								
CO5	Explore the fundamental principles of microbiology, including identification, classification, and ecological aspects of single-celled organisms.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction** ● Importance and scope of Biology as an important scientific discipline. ● Branches of biological sciences. ● Fundamental differences between science and engineering. ● Comparison between the working mechanism of eye and camera, Bird flying and aircraft. ● Biological observations of 18^{th} century that lead to major discoveries in the world ● Steps in scientific research works. ● Brownian motion in biological sciences.	**9**	Students will understand the significance, scope, and fundamental principles of biology, including its branches, historical observations, and the steps in scientific research.	**1,2**
II	**Classification & Ecology** ● Classification of organisms, Basis of classification: Morphological, biochemical or ecological, level of	**9**	Students will gain knowledge of organism classification, ecosystem dynamics, energy flow, excretion types, animal	**1,2,3**

	organization, symmetry, germ layer organization, segmentation, notochord. ● Concept of unicellular and multicellular organisms; prokaryotes and eukaryotes; Habitat & Adaptations. ● Concept of Ecosystem: Structure & Function. ● Energy flow in an ecosystem: Lindemann ten percent law. ● Types of excretion: Ammonotelism, Ureotelism and Uricotelism. ● Animal Kingdom: Characters of phylum with examples. ● Model organisms for the study of biology come from different groups. E. coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus.		kingdom characteristics, and the significance of model organisms in biological research.	
III	**Genetics & Biomolecules** ● Concept of Allele; Dominance & Recessive; Monohybrid, Dihybrid & Trihybrid cross; Mitosis & Meiosis. ● Mendel's laws, Concept of Segregation and Independent assortment. ● Concept of co-dominance and incomplete dominance with illustrations. ● Sex determination in human. ● Genetic disorders in human beings. ● DNA & RNA as genetic material. ● Enzymes: Classification; Mechanism of enzyme action.	**9**	Understand fundamental genetic concepts, inheritance patterns, genetic disorders, and the roles of DNA, RNA, and enzymes in biological processes.	**1,2,3**
IV	**Information Transfer & Metabolism** ● Genetic code: Properties ● Structure of DNA ● Concept of recombination and crossing over ● Proteins: Primary secondary,	**9**	Comprehend genetic code properties, DNA structure, protein structures, central dogma, ATP's role, and protein-ligand interactions.	**2,3**

	tertiary and quaternary structure. ● Concept of Central dogma ● ATP as an energy currency of cell. ● Concept of docking: Protein Ligand interaction			
V	**Physiology** ● Human Circulatory System: Heart and its working mechanism; Blood groups; Erythroblastosisfetalis. ● Neuroendocrine system of human: Endocrine glands and their functions. ● Human Excretory system: Structure of Kidney and Nephron ● Nervous system of human: Structure of neuron; Resting Membrane Potential; Origin and conduction of nerve impulse. ● Human Respiratory System: Structure of lungs and exchange of gases. ● Human digestive enzymes: Components and enzymes. Mechanism of muscle contraction	**9**	Students will understand the structure and function of human physiological systems, including circulatory, neuroendocrine, excretory, nervous, respiratory, and digestive systems, along with the mechanism of muscle contraction.	**1,2,3**

TEXT BOOKS:

T1: Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
T2: Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons.

REFERENCE BOOKS:

R1: Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
R2: Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C.

OTHER LEARNING RESOURCES: Nil

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Analyze and differentiate between the fundamental principles of biology and engineering, emphasizing the significance of biological observations.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
2	Evaluate the importance of classification in biology, considering criteria such as cellularity, ultra structure, energy utilization, and molecular taxonomy.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
3	Examine the diversity of life through the study of biomolecules, emphasizing the common building blocks and diverse manifestations in sugars, proteins, nucleotides, and lipids.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
4	Explore the molecular basis of information transfer in genetics, understanding the hierarchy of DNA structure, the universality of the genetic code, and defining genes.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
5	Explore the fundamental principles of microbiology, including identification, classification, and ecological aspects of single-celled organisms.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12

SEMESTER – IV									
Course Title	**DE-I: Design Thinking**								
Course code	**23BTCS225R**	**Total credits:3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 40	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/ II semester of the second year of the Programme**								
Course Objectives	1. The objective of the course is to equip students with the skills to apply design thinking methodologies for innovative problem-solving, develop sustainable business models, and effectively communicate and pitch entrepreneurial ideas. 2. Students will learn to empathize with users, ideate creatively, and prototype solutions. 3. The course aims to foster an entrepreneurial mindset that embraces risk-taking and adaptability.								
CO1	Compare and select problems suitable for DT projects and use techniques for empathetic research.								
CO2	Identify and document insights, user habits and identify user needs.								
CO3	Visualise solutions, evaluate solution concepts and able to create rough prototypes, gather feedback.								
CO4	Able to create high-fidelity prototypes. Able to test user experience								
CO5	Able to identify a business model for a solution concept. Able to estimate financial results2. Apply the various techniques of parsing to construct a syntax analyzer for a specific Programming language.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Design Thinking for Contextualized Problem-Solving and Empathetic Research.	**8**	Master design thinking for empathetic research and contextualized problem-solving, enhancing innovation and user-centered solutions.	**1,2**
II	Analysis of Research, Defining Needs	**8**	Gain proficiency in analyzing research data to accurately define needs, facilitating effective problem-solving and decision-making processes.	**2,3,4**
III	Brainstorming and Evaluation,	**8**	Develop skills in brainstorming and evaluating ideas to foster creativity and critical thinking for effective decision-making and problem-solving.	**2,5**
IV	Prototyping, Testing and testing to Launch.	**8**	Students will acquire proficiency in prototyping, testing, and launching processes to validate ideas and products efficiently, ensuring successful implementation and user satisfaction.	**1,2,3**
V	Entrepreneurial Innovation.	**8**	Develop entrepreneurial skills and strategies for fostering innovation, enabling effective identification, development, and implementation of business opportunities.	**1,2,3**

REFERENCE BOOKS:

R1: Van Der Pijl, P., Lokitz, J., & Solomon, L. K. (2016). Design a better business: New tools, skills, and mindset for strategy and innovation. John Wiley & Sons.

OTHER LEARNING RESOURCES:

O1: https://www.simplilearn.com/design-thinking-and-innovation-article
O2: https://online.hbs.edu/blog/post/what-is-design-thinking

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Compare and select problems suitable for DT projects and use techniques for empathetic research.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
2	Identify and document insights, user habits and identify user needs.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
3	Visualise solutions, evaluate solution concepts and able to create rough prototypes, gather feedback.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
4	Able to create high-fidelity prototypes. Able to test user experience	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
5	Able to identify a business model for a solution concept. Able to estimate financial results2. Apply the various techniques of parsing to construct a syntax analyzer for a specific Programming language.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12

SEMESTER – IV									
Course Title	**PE-I : Artificial Intelligence**								
Course code	**23BTCS226R**	**Total credits:3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:40	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	Basic Programming Skills, Data structures	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the second year of the Programme**								
Course Objectives	1. Describe the field of AI and its subfields machine learning, NLP and computer vision 2. Learn and implement key NLP algorithms and models, such as virtual agents, chatbots, sentiment classifiers, and language translators, to solve a variety of natural language understanding tasks. 3. Explore Practical Applications of Computer Vision**,**Investigate real-world applications of computer vision in various fields, including autonomous vehicles, surveillance systems, medical imaging, and augmented reality.								
CO1	Remember and understand relevance of AI in today's world.								
CO2	Gain an idea about Machine Learning application in real world problem.								
CO3	Develop an understanding deep learning concept in AI.								
CO4	Apply and Analyze data by applying various machine learning algorithms.								
CO5	Enhance problem-solving abilities with IBM Cloud service.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Artificial Intelligence:** Overview of Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL), Natural Language Processing(NLP), Computer Vision. Describe the types of AI,Explain what the main focus of AI is,List of practical applications of AI,Describe the eras of computing,Explain the difference between deterministic and probabilistic systems, Road Map of AI.	**8**	Gain a foundational understanding of Artificial Intelligence, its types, key focus areas, practical applications, historical development, and the differences between deterministic and probabilistic systems, along with an overview of the AI roadmap.	**1,2**
II	**Introduction to Machine Learning:** Introduction to Machine Learning, Supervised Learning & Unsupervised Learning. Supervised Learning Algorithms: Linear Regression, Logistic Regression, SupporVector Machine, Decision Tree,Random Forest, KNN. Unsupervised Learning Algorithms: K-Means Clustering,	**8**	Develop a fundamental understanding of Machine Learning, including supervised and unsupervised learning techniques, and gain practical experience with algorithms such as Linear Regression, Logistic Regression, SVM, Decision Trees,	**1,2,4**

	Hierarchical Clustering.		Random Forest, KNN, K-Means Clustering, and Hierarchical Clustering.	
III	**Introduction to Deep Learning:** Introduction to Deep Learning: Neural Networks, Layers, and Activation Functions, Back Propagation, Optimizers, Deep Learning Algorithm: ANN, CNN, RNN, LSTM with Tensorflow and Keras, Introduction to Autoencoders, Generative Adversarial Networks (GANs), Restricted Boltzmann Machines (RBMs) and Applications.	**8**	Students will gain a comprehensive introduction to Deep Learning, covering neural networks, activation functions, backpropagation, optimizers, and algorithms such as ANN, CNN, RNN, LSTM using TensorFlow and Keras, along with an understanding of Autoencoders, GANs, RBMs, and their applications in various domains.	**2,3,4,5**
IV	**Introduction to Natural Language Processing and Computer Vision:** Introduction to Natural Language Processing, NLP application in real world, components of NLP, Vartual Agents overview, Chatbot and its parts, Tokenization, Stemming & Lemmatization in NLP, BagofWords,TF-IDF,Word2Vec, Word Embedding in NLP. Introduction to Computer Vision, Image Classification and Object Recognition, Feature Detection and Description algorithms with OpenCV.	**8**	Acquire foundational knowledge in Natural Language Processing (NLP) including its applications, components, and techniques like tokenization, stemming, TF-IDF, and Word Embedding, as well as in Computer Vision covering image classification, object recognition, and feature detection using OpenCV.	**2,3**
V	**Evolution from DeepQA to Watson services on IBM Cloud:** Explain the DeepQA architecture was;Explain why IBM decided to commercialize Watson and Describe the evolution of Watson services from the original DeepQA architecture to the present. Introduction to IBM Watson: explore Watson Studio, IBM's integrated environment for data scientists, developers, and domain experts, to build and deploy ML models. Creating Chatbots using Watson	**8**	Understand the evolution of IBM Watson from DeepQA to its current services on IBM Cloud, including Watson Studio for ML model development, Watson Assistant for creating chatbots, and capabilities like Natural Language Understanding, Language Translator, Text to Speech, and Speech to Text on the IBM Cloud platform.	**1,2,3**

	Assistant: learn the basics of Watson Assistant, including intents, entities, dialog flows, and integration capabilities. Natural Language Understanding (NLU), Language Translator, Text to Speech, Speech to Text on IBM Cloud.			

TEXT BOOKS:

T1: Introduction to Data Science: B.UmaMaheswari& R. Sujata.
T2: Deep Learning with TensorFlow and Keras by Amita Kapoor, Antonio Gulli&Sujit pal

REFERENCE BOOKS:

R1: Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence" by Jon Krohn, Grant Beyleveld, and AglaéBassens.
R2: Artificial Intelligence: Foundations of Computational Agents" by David L. Poole and Alan K. Mackworth.

OTHER LEARNING RESOURCES:

O1: Python & Machine Learning -https://www.w3schools.com/python/python_ml_getting_started.asp

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Remember and understand relevance of AI in today's world.	PO1, PO2, PO3, PO4, PO10, PO12
2	Gain an idea about Machine Learning application in real world problem.	PO1, PO2, PO3, PO4, PO10, PO12
3	Develop an understanding deep learning concept in AI.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Apply and Analyze data by applying various machine learning algorithms.	PO1, PO2, PO3, PO4, PO10, PO12
5	Enhance problem-solving abilities with IBM Cloud service.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – IV									
Course Title	**PE-I: Introduction to Internet of Things**								
Course code	**23BTCS226R**	**Total credits: 3**	**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 Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1. To introduce the fundamental concepts and architectures of neural networks. 2. To develop an understanding of training algorithms, including back propagation and optimization techniques. 3. To explore advanced neural network models such as CNNs and RNNs. 4. To apply neural networks for solving real-world problems in areas like image processing and time series analysis. 5. To understand and implement techniques for regularization and improving model generalization.								
CO1	Understand the structure and functionality of basic and advanced neural network architectures.								
CO2	Implement training algorithms and optimization techniques for neural networks.								
CO3	Analyze and solve classification, regression, and sequential data problems using neural networks.								
CO4	Develop convolutional and recurrent neural networks for domain-specific applications.								
CO5	Apply techniques like regularization and dropout to enhance the performance and generalization of models.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Neural Networks:** • Basics of Neural Networks: Biological vs. Artificial Neural Networks • Perceptron Model: Single Layer Perceptron, Limitations of Perceptron • Activation Functions: Sigmoid, ReLU, Tanh, Softmax • Applications of Neural Networks in various domains	8	Understand the foundational concepts of neural networks and their applications.	**1,2,3**
II	**Multi-Layer Perceptron (MLP)** • Feedforward Neural Networks • Forward and Backpropagation Algorithm • Gradient Descent and Optimization Techniques • Role of Learning Rate and Hyperparameter Tuning	8	Analyze the working of multi-layer perceptrons and implement backpropagation for training neural networks.	**3,4**
III	**Regularization and Generalization:** • Overfitting and Underfitting in Neural Networks • Regularization Techniques: L1, L2 Regularization, Dropout • Batch Normalization • Early Stopping and Cross-Validation	8	Understand and apply techniques to improve the generalization of neural networks.	**3,4**
IV	**Convolutional Neural Networks (CNNs):** • Basics of Convolutional Neural Networks • Convolution and Pooling Operations • Architectures of CNNs: LeNet, AlexNet,	8	Develop convolutional neural network models for image-based tasks.	**4,5**

	VGG, ResNet • Applications of CNNs in Image Processing			
V	**Recurrent Neural Networks (RNNs) and Advanced Topics:** • Basics of Recurrent Neural Networks (RNNs) • Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) • Introduction to Generative Adversarial Networks (GANs) • Applications in Natural Language Processing and Time Series Prediction	8	Understand and implement RNNs for sequential data and explore advanced topics like GANs.	**3,4,5**
	Practical			
Practical 1	Create a single-layer perceptron using Python or a deep learning framework (e.g., TensorFlow/PyTorch) to classify linearly separable data.	3	Understand the working of a perceptron and its limitations.	1,2 ,3
Practical 2	Implement and visualize the effects of different activation functions (Sigmoid, ReLU, Tanh, Softmax) on a neural network's performance.	3	Understand how activation functions influence the output of neural networks.	3,4
Practical 3	Manually implement forward and backpropagation for a simple neural network and verify the weight updates.	3	Analyze how neural networks learn using forward and backpropagation.	4,5
Practical 4	Build and train a multi-layer perceptron to classify the MNIST handwritten digits dataset.	3	Learn to train a multi-layer perceptron for real-world classification tasks.	3,5
Practical 5	Implement L1, L2 regularization, and dropout on a neural network and compare their effects on overfitting.	3	Understand and apply regularization techniques to improve generalization.	4,5
Practical 6	Implement batch normalization and experiment with different learning rates to observe their impact on convergence speed.	3	Analyze how batch normalization and learning rates affect training stability and performance.	4,5
Practical 7	Design and train a CNN on a dataset like CIFAR-10 or Fashion-MNIST for image classification.	3	Understand the working of CNN layers and their application in image processing.	3,5
Practical 8	Visualize the feature maps learned by a CNN for different layers to understand hierarchical feature extraction.	3	Explore how CNNs extract features at different levels of abstraction.using IBM Watson.	4,5
Practical 9	Build an RNN to perform sentiment analysis on text data or time series prediction on a simple dataset.	3	Learn how RNNs handle sequential data and temporal dependencies.	3,4

Practical 10	Train an LSTM model for text generation or stock price prediction using a sequential dataset.	3	Understand the capabilities of LSTMs in handling long-term dependencies in sequential data.	3,5

Textbooks

T1: Simon Haykin - *"Neural Networks and Learning Machines",* Pearson.
T2: Ian Goodfellow, Yoshua Bengio, and Aaron Courville - *"Deep Learning",* MIT Press, 2016.

Reference Books

R1: Charu C. Aggarwal - *"Neural Networks and Deep Learning: A Textbook",* Springer, 2018.
R2: Christopher Bishop - *"Pattern Recognition and Machine Learning",* Springer, 2006.

Other Learning Resources

O1: *"Deep Learning Specialization"* by Andrew Ng on Coursera.
O2: *"Neural Networks and Deep Learning"* by Geoffrey Hinton on Coursera.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand the structure and functionality of basic and advanced neural network architectures.	PO1, PO2, PO3, PO4, PO10, PO12
2	Implement training algorithms and optimization techniques for neural networks.	PO1, PO2, PO3, PO4, PO10, PO12
3	Analyze and solve classification, regression, and sequential data problems using neural networks.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Develop convolutional and recurrent neural networks for domain-specific applications.	PO1, PO2, PO3, PO4, PO10, PO12
5	Apply techniques like regularization and dropout to enhance the performance and generalization of models.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – IV									
Course Title	**Field-based Training**								
Course code	**23BTCS227R**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:	**0**	**0**	**0**	**0**	**0**	**16**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**Networking Basics**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the second year of the Programme**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings.								
CO1	To expose students to real-world applications of theoretical knowledge.								
CO2	To enhance observational, analytical, and research skills through fieldwork.								
CO3	To develop problem-solving skills in practical settings.								
CO4	To foster collaboration and communication skills through group projects and professional interactions.								
CO5	To cultivate an appreciation for the complexities and challenges of professional practice in the field.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
	The organization will provide the students one field visit for this Programme. The students will be taken to a specific blocks of the university for learning purposes. The students will visit all department block site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners of IT department of the university. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial findings.		Develop practical insights and professional networking skills through guided field visits to university department blocks, facilitating firsthand observations, interactions with IT professionals, and reflective journaling to enhance learning and understanding in IT practices and environments.	**6**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	To expose students to real-world applications of theoretical knowledge.	PO1, PO5, PO7, PO10, PO12
2	To enhance observational, analytical, and research skills through fieldwork.	PO2, PO4, PO5, PO6, PO12
3	To develop problem-solving skills in practical settings.	PO2, PO3, PO4, PO9, PO11
4	To foster collaboration and communication skills through group projects and professional interactions.	PO6, PO8, PO9,PO10,PO11
5	To cultivate an appreciation for the complexities and challenges of professional practice in the field.	PO6, PO7, PO8, PO11, PO12

SEMESTER – IV										
Course Title	**Digital Literacy**									
Course code	**23UCDL102R**	**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**							
Programs	**All Degree / Diploma Programme of Engineering, Computer Technology, Management, Humanities, Science, and Agricultural Sciences**									
Semester	**Winter/II semester of the second 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 understand about the introduction to Social Media and E-Commerce and utility software. 3. Students will develop a solid foundation in computational thinking, which includes problem-solving, algorithmic design, and logical reasoning.									
CO1	Fundamentals of Computer Systems, Office Automation and Internet Search.									
CO2	Know more about the Internet & Cyber World									
CO3	Know Social Media, E-Commerce, and apply the same for digital branding									
CO4	Know to use the digital payments and digital transactions, and other utility software									
CO5										

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
Practical Component				
Practical 1	Disassemble and reassemble a desktop computer, identifying and explaining the function of each component. Discuss the importance of hardware compatibility.	**3**	By disassembling and reassembling a desktop computer, learners understand component functions, emphasize hardware compatibility for system stability, and gain practical troubleshooting skills.	3
Practical 2	Install an operating system (e.g., Windows or Linux) on a virtual machine. Configure essential settings, such as user accounts, network connections, and system updates.	**3**	Creating and configuring a virtual machine with an operating system develops skills in installation, setup of user accounts, network configurations, and system maintenance, enhancing proficiency in virtualized environments.	3
Practical 3	Use office software (e.g., Microsoft Office or Google Workspace) to create documents, spreadsheets, and presentations. Teach formatting, inserting images, and collaboration features.	**3**	Using office software for document creation, formatting, image insertion, and collaboration enhances proficiency in productivity tools, fostering effective communication and collaborative skills in professional settings.	3
Practical 4	Instruct students on effective internet searching, including the use of search engines, keywords, and advanced search operators.	**3**	Teaching effective internet searching covers using search engines proficiently, employing appropriate keywords, and leveraging advanced search	3

			operators to refine results, enhancing research skills and information retrieval efficiency.	
Practical 5	Set up email accounts, compose and send emails, attach files, and organize emails into folders. Discuss email etiquette and best practices.	**3**	Setting up email accounts, composing, sending emails, attaching files, organizing with folders, and understanding email etiquette enhances communication efficiency and professionalism, emphasizing clarity, conciseness, and proper etiquette in digital correspondence.	3
Practical 6	Use cloud storage services (e.g., Google Drive or Dropbox) to store and synchronize files. Create a backup of important data and discuss data recovery options.	**3**	Using cloud storage services for file storage and synchronization ensures accessibility and collaboration, while creating backups of important data safeguards against loss, with data recovery options providing security and continuity in digital operations.	3
Practical 7	Instruct students to create accounts on popular social media platforms (e.g., Facebook, Twitter, Instagram). Guide them through profile setup, privacy settings, and content posting.	**3**	Guiding students to create social media accounts, set up profiles, configure privacy settings, and post content fosters digital presence management, emphasizing responsible sharing, online safety, and personal branding awareness.	3
Practical 8	Have students create a content calendar for a fictional business or brand. Plan posts, including text, images, and hashtags, and use social media management tools to schedule posts.	**3**	Creating a content calendar for a fictional business includes planning posts with text, images, and hashtags, using social media management tools to schedule and optimize engagement, fostering skills in strategic content planning and digital marketing execution.	3
Practical 9	Guide students in building a basic e-commerce website using platforms like Shopify or WooCommerce. They should add products, set up payment gateways, and configure the online store.	**3**	Guiding students to build a basic e-commerce website involves adding products, setting up payment gateways, and configuring the online store using platforms like Shopify or WooCommerce, fostering skills in online retail setup and management for digital entrepreneurship.	3
Practical 10	Set up a payment gateway for the e-commerce website created in Experiment 3. Test payment transactions and discuss security	**3**	Setting up a payment gateway for the e-commerce website involves integrating services like PayPal, Stripe, or others, testing	3

	protocols such as SSL encryption.		transactions to ensure functionality, and emphasizing security protocols such as SSL encryption to protect customer data during online transactions, ensuring safe and secure e-commerce operations.	

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, E. 2014. *Fundamentals of Computer and Programming (Updated Ed Sem. I, Au)*. Tata McGraw-Hill Education.

OTHER LEARNING RESOURCES:

O1: https://www.w3schools.com
O2: https://edu.gcfglobal.org

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Students will have basic knowledge of cooking methods.	PO1, PO5, PO12
2	Students will gain the knowledge of organizing & Cleaning of Rooms.	PO1, PO5, PO12
3	Students will be able to gain the travel management concept.	PO1, PO5, PO12
4	Students will be able to acquire the knowledge of basic household's amenities for day- to-day use.	PO1, PO5, PO12

MESTER – IV									
Course Title	**Basic Acclimatizing Skills**								
Course code	**23UULS221R**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 36	**0**	**0**	**2**	**0**	**0**	**0**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**All the Under Graduate Programs**								
Semester	**Winter/II semester of the 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's amenities for day-to-day use.								
CO5	Students will be able to gain the hospitality management concept.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Accommodation Management** ● Telephone handling technique ● Organizing of Rooms. ● Cleaning equipment's and uses. ● Bed making Process.	**9**	Introduction to Accommodation Management covers telephone handling techniques, room organization, cleaning equipment usage, and bed making processes, ensuring comprehensive skills in guest service and room maintenance.	**1,2**
II	**Fundamental of Cooking** ● Uses of basic cooking equipment's ● Uses of fire & Fuel ● Different cuts of vegetables ● Uses of herbs & spices Regional Food Habits	**9**	Fundamentals of Cooking include mastering basic cooking equipment, understanding fire and fuel usage, learning various vegetable cuts, utilizing herbs and spices effectively, and exploring regional food habits for diverse culinary knowledge.	**2,3,4**
III	**- Food and Beverage skills** ● Introduction to catering industry ● Types menus and beverages ● Identifications of Cutlery, crockery & glassware ● Table etiquettes or manners ● Customer handling skills or Situation Handling	**9**	Food and Beverage skills encompass an introduction to the catering industry, knowledge of menu and beverage types, identification and use of cutlery, crockery, and glassware, understanding table etiquette, and developing customer handling and situational management abilities.	**2,3,5**

IV	**Travel management** ● Travel Documentation (Types) ● Application of passport & Visa ● Tourism products (UNESCO sites) ● Types of logistics in travel and tourism management	**4**	Travel Management involves understanding travel documentation types, applying passport and visa procedures, exploring tourism products such as UNESCO sites, and managing logistics in travel and tourism operations effectively.	**2,3**
V	**Basic Hospitality Skills** ● Various Egg Preparations ● Canapés preparations ● Mock tail & Shakes Preparations ● Butter Rice / Lemon Rice ● Various Lentils Preparations ● 1 non-veg preparation/ 1 veg preparation	**5**	Basic Hospitality Skills include mastering various egg preparations, creating canapés, preparing mocktails and shakes, making butter rice or lemon rice, mastering various lentil dishes, and preparing one non-vegetarian and one vegetarian dish to ensure a diverse culinary repertoire.	**1,2,3**

TEXT BOOKS:

T1: Arora K (2011). Theory of cookery, Frank brothers & company (pub) pvtltd-New Delhi.
T2: Bruce H. Axler, Carol A. Litrides (2010) Food and Beverage Service Volume 1 ofWiley Professional Restauranteur, Guides.

REFERENCE BOOKS:

R1: Mohammed Zulfikar (2010) - Introductions to Tourism and Hotel Industry Introduction to Tourism and Hotel Industry. Vikas Publishing.

OTHER LEARNING RESOURCES: Nil

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Students will have basic knowledge of cooking methods.	PO1, PO2, PO3, PO4, PO7, PO10,PO12
2	Students will gain the knowledge of organizing & Cleaning of Rooms.	PO1, PO2, PO3, PO4, PO7, PO10,PO12
3	Students will be able to gain the travel management concept.	PO1, PO2, PO3, PO4, PO7, PO10,PO12
4	Students will be able to acquire the knowledge of basic household's amenities for day- to-day use.	PO1, PO2, PO3, PO4, PO7, PO10,PO12
5	Students will be able to gain the hospitality management concept.	PO1, PO2, PO3, PO4, PO7, PO10,PO12

SEMESTER – IV										
Course Title	**Indian Heritage**									
Course code	**23MOCS222R**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours:30	**0**	**0**	**0**	**0**	**0**	**0**	**1**	
Pre-requisite	**NIL**	**Co-requisite**	**NIL**							
Programme	**Bachelor of Technology in Computer Science and Engineering**									
Semester	**Winter/II semester of the second year of the Programme**									
Course Objectives	1. To provide an in-depth understanding of India's rich cultural and historical heritage. 2. To explore the diverse traditions, practices, and contributions of India to world civilization. 3. To appreciate the evolution of Indian art, architecture, literature, and philosophy over the ages.									
CO1	Identify and describe key historical events and figures in Indian history.									
CO2	Analyze the influence of various cultural practices and traditions on Indian society.									
CO3	Evaluate the contributions of India to global heritage in terms of art, architecture, and literature.									
CO4	Discuss the philosophical and religious diversity of India.									
CO5	Develop a critical understanding of the changes and continuities in Indian heritage.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Ancient Indian Civilization** Indus Valley Civilization Vedic Age and Aryan Migration Mauryan and Gupta Empires Contributions in Science and Mathematics.	**5**	Students will understand the development and cultural achievements of the Indus Valley Civilization, Vedic Age, Aryan migration, Mauryan, and Gupta empires, focusing on their contributions to science and mathematics in ancient India.	**1,2**
II	**Medieval India** The Rise of Regional Kingdoms**,** The Delhi Sultanate and Mughal Empire Cultural Syncretism: Art, Architecture, and Music Bhakti and Sufi Movements	**6**	Explore the dynamics of medieval India, including the rise of regional kingdoms, the Delhi Sultanate, and the Mughal Empire, highlighting cultural syncretism in art, architecture, and music, as well as the impact of Bhakti and Sufi movements.	**2,3, 4**
III	**Indian Art and Architecture** Temple Architecture: Dravidian and Nagara Styles Mughal Architecture: Taj Mahal and Red Fort Painting Traditions: Ajanta, Ellora, and Miniature Paintings Modern Indian Art: Colonial and Post-Colonial Influences	**6**	Analyze Indian art and architecture across historical periods, including temple architecture in Dravidian and Nagara styles, Mughal architectural masterpieces like the Taj Mahal and Red Fort, diverse painting traditions such as Ajanta, Ellora, and miniature paintings, and the evolution of modern Indian art influenced by colonial and post-colonial eras.	**2,3, 4,5**
IV	**Indian Literature and Philosophy** Ancient Texts:	**6**	Explore Indian literature and philosophy through ancient texts	**2,3**

	Vedas, Upanishads, and EpicsClassical Literature: Kalidasa and Tamil Sangam LiteratureModern Literature: Rabindranath Tagore and Mahatma GandhiPhilosophical Schools: Advaita, Buddhism, and Jainism.		like the Vedas, Upanishads, and epics, classical works by Kalidasa and Tamil Sangam literature, modern contributions by Rabindranath Tagore and Mahatma Gandhi, and philosophical insights from schools such as Advaita Vedanta, Buddhism, and Jainism, fostering a deep understanding of India's cultural and intellectual heritage.	
V	**Contemporary Indian Heritage** India's Freedom Struggle and IndependenceInfluence of Globalization on Indian CulturePreservation of Heritage: UNESCO World Heritage Sites in IndiaContemporary Cultural Practices and Festivals	**7**	Examine contemporary Indian heritage, including the freedom struggle and independence movement, the impact of globalization on Indian culture, efforts in preserving UNESCO World Heritage Sites in India, and the significance of modern cultural practices and festivals, providing insights into India's evolving cultural identity and global influence.	**1,2, 3**

TEXT BOOKS:

T1:"The Discovery of India" by Jawaharlal Nehru

REFERENCE BOOKS:

R1: "India: A History" by John Keay

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Identify and describe key historical events and figures in Indian history.	PO6, PO12
2	Analyze the influence of various cultural practices and traditions on Indian society.	PO6, PO12
3	Evaluate the contributions of India to global heritage in terms of art, architecture, and literature.	PO6, PO12
4	Discuss the philosophical and religious diversity of India.	PO6, PO12
5	Develop a critical understanding of the changes and continuities in Indian heritage.	PO6, PO12

SEMESTER – IV									
Course Title	**Mini Project II**								
Course code	**23BTCS228R**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the second year of the Programme**								
Course Objectives	1. To develop the knowledge, skills and attitudes of a professional Computer engineering professional. 2. To become confident in designing engineering solutions to complex software problems utilising a systems approach. 3. Apply theoretical knowledge gained in earlier semesters to solve real-world problems through the development and implementation of a software project.								
CO1	Apply IT principles for real-world problem-solving using Programming languages and network solutions.								
CO2	Contribute to complex projects as a team member, demonstrating effective personal and team management.								
CO3	Develop Programming skills to create and assess software, hardware, and network solutions.								
CO4	Apply personal and team management skills as a professional software developer.								
CO5	Cultivate employability skills and uphold professionalism in software development.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: a) theoretical studies b) computer simulations c) hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project;		This course involves individual or small group projects supervised by academic staff, focusing on topics aligned with student and supervisor interests. Students will conduct extensive literature reviews to understand current developments in their chosen technical area. They will then engage in detailed technical work, employing theoretical studies, computer simulations, or hardware construction. Throughout the project, students will document their progress through regular reports or a professional journal, ensuring accountability and effective time management. They will present their findings and contributions in a seminar, preparing a formal report that outlines the project's scope,	**1,2,3, 4,5**

	4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field; 5. Prepare a formal report describing the work undertaken and results obtained so far; and Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.		methodologies, and results. The culmination will involve showcasing their work in a public forum, utilizing poster presentations and operational demonstrations of hardware and software. This comprehensive approach aims to enhance students' research, technical, communication, and presentation skills in a real-world project environment.	

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Apply IT principles for real-world problem-solving using Programming languages and network solutions.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
2	Contribute to complex projects as a team member, demonstrating effective personal and team management.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
3	Develop Programming skills to create and assess software, hardware, and network solutions.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
4	Apply personal and team management skills as a professional software developer.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
5	Cultivate employability skills and uphold professionalism in software development.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12

SEMESTER – V										
Course Title	**Computer Communication Network**									
Course code	**23BTCS311R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 41T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Programming Skills**	**Co-requisite**	**LINUX**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/I semester of the third year of the Programme**								
Course Objectives	3. Understand the fundamentals of data communications principles of media access, switching, routing and flow control. 4. Understand the basics of network protocol design and analysis. 5. Be familiar with the TCP/IP protocol suite and with application layer protocols. 6. Be able to write network-capable Programs using the socket libraries. 7. Understand the structure of client-server systems and be able to build client-server Programs.									
CO1	Understand the basics of data communication, networking, internet, physical layer techniques, and circuit switching.									
CO2	Analyze data link layer techniques, flow control, and error protocols.									
CO3	Analyze network layer protocols along with routing issues.									
CO4	Summarize transport and application layer operations and protocols along with QoS services.									
CO5	Design and execute computer network Programming projects, showcasing advanced skills in network application development.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Introduction to networks, internet, protocols and standards, the OSI model, layers in OSI model, TCP/IP suite, Addressing, Analog and digital signals. Physical Layer: digital transmission, multiplexing, transmission media, circuit switched networks, Datagram networks, virtual circuit networks, switch and Telephone network.	**8**	Understand networks, internet protocols, OSI and TCP/IP models, addressing, signal types, physical layer transmission, multiplexing, and various network types.	**1, 2, 3, 4,5**
II	Data link layer: Introduction, Block coding, cyclic codes, checksum, framing, flow and error control, Noiseless channels, noisy channels, HDLC, point to point protocols	**8**	Understand data link layer concepts: block coding, cyclic codes, checksum, framing, flow/error control, noiseless/noisy channels, HDLC, and point-to-point protocols.	**1, 2**
III	Network Layer: Logical addressing, internetworking, tunnelling, address mapping, ICMP, IGMP, forwarding, uni-cast routing protocols, multicast routing protocols.	**9**	Understand network layer concepts: logical addressing, internetworking, tunneling, address mapping, ICMP, IGMP, forwarding, unicast, and multicast routing protocols.	**1, 2**
IV	Transport Layer: Process to process delivery, UDP and TCP protocols,	**9**	Understand transport layer concepts: process delivery,	**1, 2, 3**

	SCTP, data traffic, congestion, congestion control, QoS, integrated services, differentiated services, QoS in switched networks.		UDP, TCP, SCTP, data traffic, congestion control, QoS, integrated /differentiated services, and QoS in switched networks.	
V	Application Layer – Domain name space, DNS in internet, electronic mail, FTP, WWW, HTTP, SNMP, multi-media, network security	**7**	Understand application layer concepts: domain name space, DNS, email, FTP, WWW, HTTP, SNMP, multimedia, and network security.	**1, 2**
Practical Component				
Practical 1	Create a diagram of the OSI model and describe the function of each layer.	**3**	Understand the OSI model layers and their functions, essential for network communication.	2
Practical 2	Configure IP addressing for a small network and verify connectivity using network commands.	**3**	Apply IP addressing schemes and verify network connectivity, fundamental for network setup.	3
Practical 3	Analyze and compare analog and digital signals using an oscilloscope.	**3**	Differentiate between analog and digital signals, crucial for understanding data transmission.	4
Practical 4	Implement and test a simple multiplexing scheme using digital signals.	**3**	Implement multiplexing techniques for efficient digital transmission, key in data communication.	3
Practical 5	Implement and test error detection and correction algorithms like CRC and checksum.	**3**	Analyze error detection and correction mechanisms, vital for reliable data communication.	4
Practical 6	Configure and test routing protocols in a simulated network environment.	**3**	Apply routing protocols and address mapping for effective data routing, critical for network layer understanding.	3
Practical 7	Compare the performance of UDP and TCP protocols in a network simulation.	**3**	Evaluate the performance of UDP and TCP protocols, important for transport layer knowledge.	5
Practical 8	Implement QoS mechanisms and analyze their impact on network performance.	**3**	Apply QoS and congestion control techniques for optimal network performance, essential in transport layer management.	3
Practical 9	Configure and test DNS, email, and FTP services on a network.	**3**	Implement application layer services like DNS and FTP, necessary for network functionality.	3

Practical 10	Implement basic network security measures such as firewalls and encryption.	**3**	Apply network security techniques to protect data transmission, crucial for maintaining secure networks.	3

TEXT BOOKS:

T1: Data Communications and Networking – Behrouz A. Forouzan, Fourth Edition TMH,2006.
T2: Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education.

REFERENCE BOOKS:

R1: An Engineering Approach to Computer Networks-S.Keshav,2nd Edition, Pearson Education
R2: Understanding communications and Networks,3rd Edition, W.A.Shay, Cengage Learning.
R3: Computer and Communication Networks,Nader F. Mir, Pearson Education
R4:.Computer Networking: A Top-Down Approach Featuring the Internet, James F.Kurose, K.W.Ross, 3rd Edition, Pearson Education.

OTHER LEARNING RESOURCES:

O1: Udemy: Platforms like Udemy offer courses such as " Cisco CCNA 200-301 " which cover topics like Cisco networking fundamentals, including OSI model, IP addressing, routing protocols, and network security.
O2: edX: Courses like "**Introduction to Computer Networking"** cover topics like fundamental networking concepts, protocols (including TCP/IP), network architecture, and security.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand the basics of data communication, networking, internet, physical layer techniques, and circuit switching.	PO1, PO2, PO3, PO4, PO5, PO12
2	Analyze data link layer techniques, flow control, and error protocols.	PO1, PO2, PO3, PO4, PO5, PO12
3	Analyse network layer protocols along with routing issues.	PO1, PO2, PO3, PO4, PO5, PO12
4	Summarize transport and application layer operations and protocols along with QoS services.	PO1, PO2, PO3, PO4, PO5, PO12
5	Design and execute computer network Programming projects, showcasing advanced skills in network application development.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V										
Course Title	**Data Science & Statistical Modelling**									
Course code	**23BTCS312R**	**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 Technology in Computer Science & Engineering**								
Semester	**Summer/I semester of the third year of the Programme**								
Course Objectives	1. To provide a solid foundation in data science principles and statistical modelling techniques. 2. To equip students with the skills to apply data science tools and statistical models to real-world problems. 3. To develop students' ability to critically analyze data and interpret the results of statistical analyses.								
CO1	Demonstrate the ability to apply data science methods to collect, process, and analyze data								
CO2	Construct and evaluate statistical models to make predictions and inform decision-making.								
CO3	Gain proficiency in using data science tools and software such as Python, R, and SQL.								
CO4	Develop the ability to critically evaluate data sources and statistical results.								
CO5	Effectively communicate data findings and insights through reports and visualizations.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Data Science and Data Handling** Definition and scope of data science Data science process and lifecycle Tools and technologies in data science Data types and sources Data collection methods Data cleaning and preprocessing techniques Handling missing data	**7**	Gain proficiency in data science fundamentals: scope, process, tools, data types, collection methods, cleaning techniques, and handling missing data effectively.	**2,3**
II	**Exploratory Data Analysis (EDA) and Visualization** Descriptive statistics Data visualization techniques using Python (Matplotlib, Seaborn) and R (ggplot2) Identifying patterns and insights Correlation analysis	**8**	Master exploratory data analysis (EDA) by employing descriptive statistics, Python (Matplotlib, Seaborn), and R (ggplot2) for effective data visualization and pattern identification.	**3,4**
III	**Statistical Modelling and Regression Analysis** Probability distributions Hypothesis testing Confidence intervals Simple and multiple linear regression Assumptions and diagnostics Polynomial and logistic regression	**10**	Achieve proficiency in statistical modeling and regression analysis, including probability distributions, hypothesis testing, confidence intervals, and various regression techniques like linear, polynomial, and logistic regression.	**3,4**
IV	**Machine Learning Techniques**	**12**	Develop proficiency in	**3,4**

	Classification techniques (Decision Trees, SVM, k-NN) Clustering techniques (K-means, Hierarchical Clustering) Association rule mining Ensemble methods (Random Forest, Gradient Boosting) Basics of neural networks and deep learning		machine learning techniques including classification (Decision Trees, SVM, k-NN), clustering (K-means, Hierarchical Clustering), association rule mining, and ensemble methods.	
V	**Advanced Topics and Ethics in Data Science** Time series analysis Principal Component Analysis (PCA) Model selection and validation Data privacy and security Ethical implications of data usage Responsible data science practices	**8**	Understand advanced data science topics including time series analysis, PCA, model selection/validation, data privacy/security, ethical implications, and responsible data science practices.	**2, 4**
Practical Component				
Practical 1	Define the scope and lifecycle of a data science project.	**2**	Understand the definition, scope, and lifecycle of data science, foundational for data-driven projects.	2
Practical 2	Install and configure data science tools (Python, R, Jupyter Notebooks).	**2**	Familiarize with essential tools for data science, critical for practical applications.	3
Practical 3	Identify and classify different types of data and sources.	**2**	Understand data types and sources, important for data collection and analysis.	2
Practical 4	Implement data collection from various sources (APIs, web scraping).	**2**	Apply data collection methods for gathering data, crucial for data analysis.	3
Practical 5	Clean and preprocess raw data using Python.	**2**	Perform data cleaning and preprocessing techniques, essential for data quality.	3
Practical 6	Implement techniques to handle missing data in datasets.	**2**	Manage missing data to maintain data integrity, key for accurate analysis.	**3**
Practical 7	Conduct EDA using descriptive statistics and visualization.	**2**	Perform EDA to discover patterns and insights, fundamental for data understanding.	**4**
Practical 8	Create data visualizations using Matplotlib and Seaborn.	**2**	Apply data visualization techniques for effective data presentation, important for analysis.	**3**
Practical 9	Create data visualizations using ggplot2.	**2**	Implement data visualization in R, enhancing data interpretation skills.	**3**
Practical 10	Conduct correlation analysis to identify relationships between variables.	**2**	Analyze variable relationships, essential for statistical analysis.	**4**

Practical 11	Perform simple and multiple linear regression analysis.	**2**	Apply regression techniques to model data relationships, important for predictive analysis.	**3**
Practical 12	Implement probability distributions and hypothesis tests on datasets.	**2**	Understand and apply statistical methods, crucial for data analysis.	**3**
Practical 13	Implement classification algorithms (Decision Trees, SVM, k-NN) on datasets.	**2**	Develop classification models, key for predictive analytics.	**3**
Practical 14	Perform clustering using K-means and Hierarchical Clustering.	**2**	Apply clustering methods to group data, important for unsupervised learning.	**3**
Practical 15	Implement ensemble methods (Random Forest, Gradient Boosting) and basics of neural networks.	**2**	Develop advanced machine learning models, essential for complex data tasks.	**3**

TEXT BOOKS:

T1:"Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani
T2:"Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" by Wes McKinney

REFERENCE BOOKS:

R1:"Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett
R2:"Applied Predictive Modeling" by Max Kuhn and Kjell Johnson

OTHER LEARNING RESOURCES:
O1:Coursera: Offers courses on topics such as Data Science Specialization, Advanced Statistics for Data Science Specialization, and Applied Data Science with Python Specialization.
O2: edX: Provides courses from universities worldwide covering topics like Statistical Learning, Introduction to Computational Thinking and Data Science.
O3: MIT Open Course Ware: Offers courses like Introduction to Probability and Statistics, Data Science and Big Data Analytics.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Demonstrate the ability to apply data science methods to collect, process, and analyze data	PO1, PO2, PO3, PO4, PO10, PO12
2	Construct and evaluate statistical models to make predictions and inform decision-making.	PO1, PO2, PO3, PO4, PO10, PO12
3	Gain proficiency in using data science tools and software such as Python, R, and SQL.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Develop the ability to critically evaluate data sources and statistical results.	PO1, PO2, PO3, PO4, PO10, PO12
5	Effectively communicate data findings and insights through reports and visualizations.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V										
Course Title	**DE-II: Organizational Behaviour**									
Course code	**23BTCS313R**	**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 Technology in Computer Science and Engineering**								
Semester	**Summer/I semester of the third year of the Programme**								
Course Objectives	1. Understand individual behavior in organizations, including diversity, attitudes, job satisfaction, emotions, moods, personality, values, perception, decision making, and motivational theories. 2. Understand group behavior in organizations, including communication, leadership, power and politics, conflict, and negotiations. 3. Understand the organizational system, including organizational structures, culture, human resources, and change.									
CO1	Understand the impact of environmental factors on Organizational Behavior, applying cognitive processes to enhance understanding.									
CO2	Evaluate environmental factors' impact on organizational behavior, employing cognitive processes.									
CO3	Analyze organizational communication, propose improvements, and apply positive behavior principles.									
CO4	Examine power dynamics, group interactions, and address group dysfunctions adeptly.									
CO5	Apply job design, leadership theories to effectively lead high-performance teams.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to OB** Definition, Nature and Scope– Environmental and organizational context– Impact of IT, globalization, Diversity, Ethics, culture, reward systems and organizational design on Organizational Behavior. Cognitive Processes-I: Perception and Attribution: Nature and importance of Perception – Perceptual selectivity and organization – Social perception – Attribution Theories – Locus of control –Attribution Errors – Impression Management.	**8**	Understand the definition, scope, and impact of environmental factors on organizational behavior, including perception, attribution, and impression management theories.	**1, 2**
II	**Cognitive Processes-II** Personality and Attitudes – Personality as a continuum – Meaning of personality- Johari Window and Transactional Analysis - Nature and Dimension of Attitudes – Jobsatisfactionandorganizationalcommitment-Motivationalneedsandprocesses-Work-MotivationApproachesTheoriesofMotivation-Motivationacrosscultures- Positive organizational behavior: Optimism – Emotional intelligence – Self- Efficacy.	**10**	Understand personality, attitudes, job satisfaction, motivation theories, and positive organizational behavior, including emotional intelligence, optimism, and self-efficacy.	**2,3**
III	**Dynamics of OB-**	**9**	Understand	**2,3**

	Dynamics of OB-I-Communication – types – interactive communication in organizations– barriers to communication and strategies to improve the follow of communication - Decision Making: Participative decision-making techniques – creativity and group decision making. Dynamics of OB –II Stress and Conflict: Meaningandtypesofstress– Meaningandtypesofconflict-Effectofstressand intra-individual conflict - strategies to cope with stress and conflict.		organizational communication, decision-making techniques, and dynamics of stress and conflict, including their types, effects, and coping strategies.	
IV	**Dynamics of OB–III** Power and Politics: Meaning and types of power–empowerment-Groups Vs. Teams – Nature of groups – dynamics of informal groups – dysfunctions of groups and teams – teams in modern work place.	**8**	Understand power, politics, empowerment, group dynamics, and team functions, including types of power, group nature, and modern workplace teams.	**2, 3**
V	**Leading High performance** Job design and Goal setting for High performance- Quality of Work Life-Socio technical Design and High-performance work practices – Behavioral performance management: reinforcement and punishment as principles of Learning –Process of Behavioral modification-Leadership theories-Styles, Activities and skills of Great leaders. Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations.	**10**	Achieve proficiency in job design, goal setting, quality of work life, leadership theories, styles, and communication skills in workplace contexts.	**3, 4**

TEXT BOOKS:

T1: Luthans, Fred: Organizational Behaviour10/e,McGraw-Hill,2009
T2: Nelson: Organizational Behaviour,3/e,Thomson, 2008

REFERENCE BOOKS:

R1: NewstromW.John & Davis Keith, OrganisationalBehaviour—Human Behaviourat Work, 12/e, TMH, New Delhi, 2009.
R2: Pierceand Gardner: Management and Organisational Behaviour: An Integrated perspective, Thomson, 2009.

OTHER LEARNING RESOURCES:

O1:Coursera: Courses such as " Managing the Organization: From Organizational Design to Execution"
O2: edX: Courses such as " Communication Skills and Teamwork"

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand the impact of environmental factors on Organizational Behavior, applying cognitive processes to enhance understanding.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
2	Evaluate environmental factors' impact on organizational behavior, employing cognitive processes.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Analyze organizational communication, propose improvements, and apply positive behavior principles.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Examine power dynamics, group interactions, and address group dysfunctions adeptly.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
5	Apply job design, leadership theories to effectively lead high-performance teams.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V										
Course Title	**DE-II: Principles of Management**									
Course code	**23BTCS313R**	**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 Technology in Computer Science & Engineering**								
Semester	**Summer/I semester of the third year of the Programme**								
Course Objectives	1. To provide students with a comprehensive understanding of the core principles and practices of management. 2. To develop practical management skills applicable to various business environments. 3. To cultivate the ability to critically analyze and solve management problems.								
CO1	Demonstrate a thorough understanding of the fundamental functions of management, including planning, organizing, leading, and controlling.								
CO2	Apply various management theories and concepts to real-world business scenarios.								
CO3	Develop effective decision-making and problem-solving skills.								
CO4	Exhibit strong leadership and communication abilities within a managerial context.								
CO5	Understand and apply ethical principles and social responsibility in management practices.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Management** Definition and significance of management Historical evolution of management theories The role of managers in organizations Managerial skills and competencies	**8**	Understand the definition, evolution, roles, skills, and competencies of management to effectively apply principles in organizational contexts for leadership and efficiency.	**1, 2**
II	**Planning** Nature and purpose of planning Types of plans (strategic, tactical, operational) Planning process and techniques Goal setting and management by objectives (MBO) Decision-making process	**9**	Develop proficiency in planning by understanding its nature, types, process, goal setting, management by objectives, and decision-making techniques for organizational effectiveness.	**3, 4**
III	**Organizing** Organizational structure and design Division of work and departmentalization Authority, responsibility, and delegation Coordination and communication within organizations Organizational culture and change	**9**	Effectively apply organizational theories by understanding structure, division of work, authority, coordination, communication, culture, and change for improved organizational effectiveness.	**3**
IV	**Leading** Leadership theories and styles Motivation theories and techniques Team building and group dynamics	**9**	Develop leadership proficiency by understanding theories, motivation techniques, team dynamics,	**3, 4**

	Communication skills for managers Conflict resolution and negotiation		managerial communication, conflict resolution, and negotiation for effective organizational leadership and management.	
V	**Controlling** The control process and its importance Types of control (feedforward, concurrent, feedback) Performance measurement and management Financial and non-financial controls Managing information and technology in control systems	**10**	Effectively implement control processes by understanding their types, performance measurement, financial and non-financial controls, and information management for organizational performance improvement.	**3, 4, 5**

TEXT BOOKS:

T1: Management: A Practical Introduction" by Angelo Kinicki and Brian Williams

REFERENCE BOOKS:

R1:"Principles of Management" by Charles W. L. Hill and Steven McShane

OTHER LEARNING RESOURCES:

O1:Coursera: Courses such as " Principles of Management" provides an introduction to management principles, covering topics such as planning, organizing, leading, and controlling
O2: edX: Courses such as " Principles of Management" introduces fundamental principles of management, including planning, organizing, leading, and controlling.

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Demonstrate a thorough understanding of the fundamental functions of management, including planning, organizing, leading, and controlling.	PO1, PO2, PO3, PO4, PO6, PO7, PO10, PO12
2	Apply various management theories and concepts to real-world business scenarios.	PO1, PO2, PO3, PO4, PO6, PO7, PO10, PO12
3	Develop effective decision-making and problem-solving skills.	PO1, PO2, PO3, PO4, PO6, PO7, PO10, PO12
4	Exhibit strong leadership and communication abilities within a managerial context.	PO1, PO2, PO3, PO4, PO6, PO7, PO10, PO12
5	Understand and apply ethical principles and social responsibility in management practices.	PO1, PO2, PO3, PO4, PO6, PO7, PO10, PO12

SEMESTER – V										
Course Title	**PE-II: Data Mining and Analytics**									
Course code	**23BTCS314R**	**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 Technology in Computer Science & Engineering**								
Semester	**Summer/I semester of the third year of the Programme**								
Course Objectives	This course is an introduction to data mining techniques, algorithms, and applications. Covers data pre-processing, pattern discovery, clustering, classification, and association rule mining. Emphasizes practical implementation and real-world data analysis.								
CO1	Understand diverse real-life data, mastering statistical foundations, and identifying challenges in data mining.								
CO2	Utilize Association Rule Mining to address practical problems, demonstrating understanding and proficiency in application.								
CO3	Apply Cluster analysis in unsupervised learning to real-world datasets, showcasing competence in data clustering techniques.								
CO4	Implement popular methodologies for prediction using Data Mining techniques, demonstrating practical application skills.								
CO5	Implement popular methodologies for prediction using Data Mining techniques, demonstrating practical application skills.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Data Mining:** What is data mining, applications of data mining, issues and challenges faced in data mining, types of data attributes – nominal, binary, ordinal, numeric, discrete and continuous, basic statistical descriptions of data – measures of central tendency and dispersion, major tasks in data pre-processing	**8**	Learning Outcome: Understand data mining concepts, applications, challenges, data attributes, statistical descriptions, and data pre-processing tasks for effective data analysis and decision-making.	**1, 2**
II	**Association Rule Mining:** Definitions of frequent itemset, maximal frequent itemset, closed frequent itemset, association rules, Frequent itemset generation – Apriori algorithm, DIC algorithm and FP-growth algorithm, Generating association rules from frequent item sets	**9**	Learning Outcome: Master association rule mining concepts including frequent itemsets, algorithms (Apriori, DIC, FP-growth), and generating association rules for data pattern discovery.	**3,4**
III	**DataClustering:** what is cluster analysis, need for cluster analysis, data matrix, dissimilarity matrix, proximity and dissimilarity measures for different data attribute types, partitioning based clustering methods, density-based clustering methods and hierarchical clustering methods,	**10**	Understand cluster analysis principles, dissimilarity measures, and various clustering methods for effective data segmentation and cluster quality evaluation.	**1, 2**

	measuring cluster quality			
IV	**Prediction**: What is prediction, application areas of prediction, Simple linear regression, Multiple linear regression, Predictor Error measures, Common techniques for assessing accuracy – holdout, random sampling, cross-validation, bootstrap	**8**	Master prediction concepts, including regression techniques, predictor error measures, and accuracy assessment methods for effective predictive modeling and decision-making.	**2, 3**
V	**Classification**: what is classification, differences between classification and prediction, applications of classification, Some classification algorithms - Decision Trees, Naïve Bayes Classification, Logistic Regression and K-nearest Neighbour Classification, Confusion matrix and metrics for evaluating classifier performance, Overview of ensemble methods – Bagging and Boosting, Ensemble-based classifier - Random Forest	**10**	Understand classification principles, algorithms (Decision Trees, Naïve Bayes, Logistic Regression, K-nearest Neighbor), evaluation metrics, and ensemble methods for effective data classification.	**2, 3, 4**
Practical Component				
Practical 1	Explore what data mining is and its applications.	**3**	Understand data mining and its applications, foundational for data analysis.	**2**
Practical 2	Identify and classify types of data attributes (nominal, binary, ordinal, numeric, discrete, continuous).	**3**	Recognize various data attributes, crucial for data preprocessing.	**2**
Practical 3	Calculate measures of central tendency and dispersion for a dataset.	**3**	Apply statistical measures to summarize data, essential for data analysis.	**3**
Practical 4	Perform major tasks in data preprocessing, including handling missing data and normalization.	**3**	Execute data preprocessing techniques, key for data quality improvement.	**3**
Practical 5	Implement the Apriori algorithm to generate frequent itemsets and association rules.	**3**	Apply Apriori algorithm for association rule mining, critical for pattern discovery.	**3**
Practical 6	Use FP-Growth algorithm to generate frequent itemsets.	**3**	Develop frequent itemsets using FP-Growth, important for efficient pattern mining.	**3**
Practical 7	Perform K-means clustering on a dataset and analyze clusters.	**3**	Apply K-means clustering, essential for grouping similar data points.	**3**
Practical 8	Implement hierarchical clustering and analyze the resulting dendrogram.	**3**	Utilize hierarchical clustering to understand data structure, crucial for unsupervised learning.	**3**

Practical 9	Implement simple and multiple linear regression models for prediction.	**3**	Develop predictive models using linear regression, fundamental for forecasting.	**3**
Practical 10	Build a decision tree classifier and evaluate its performance.	**3**	Create classification models with decision trees, key for categorical data analysis.	**3**

TEXT BOOKS:

T1: Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, India
T2: AK Pujari, Data Mining Techniques, University Press, India

REFERENCE BOOKS:

R1: Han, Manilla and Smyth, Principles of Data Mining, PHI, India
R2: Tan, Steinbach,Vipin Kumar, Introduction to Data Mining, Pearson Education Inc.

OTHER LEARNING RESOURCES:

O1: Coursera course like "Data Mining Specialization" covers fundamental data mining concepts, techniques, and applications.
O2:edX course like "Data Mining for Business Analytics" covers data mining techniques for business analytics, including data preprocessing, classification, prediction, clustering, association rules, and text mining.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand diverse real-life data, mastering statistical foundations, and identifying challenges in data mining.	PO1, PO2, PO3, PO4, PO10, PO12
2	Utilize Association Rule Mining to address practical problems, demonstrating understanding and proficiency in application.	PO1, PO2, PO3, PO4, PO10, PO12
3	Apply Cluster analysis in unsupervised learning to real-world datasets, showcasing competence in data clustering techniques.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Implement popular methodologies for prediction using Data Mining techniques, demonstrating practical application skills.	PO1, PO2, PO3, PO4, PO10, PO12
5	Implement popular methodologies for prediction using Data Mining techniques, demonstrating practical application skills.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – II										
Course Title	**PE-II: Information Retrieval Systems**									
Course code	**23BTCS314R**	**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 Technology in Computer Science & Engineering**								
Semester	**Summer/I semester of the third year of the Programme**								
Course Objectives	This course provides an in-depth introduction to the principles and practices of Information Retrieval (IR). Students will learn about the theory behind IR systems, the algorithms and techniques used to implement them, and the evaluation methods to measure their effectiveness. Topics covered include text processing, indexing, querying, ranking, and various IR models.									
CO1	Understand the fundamental concepts of Information Retrieval.									
CO2	Learn about various indexing and search techniques.									
CO3	Explore different IR models and their applications.									
CO4	Study the methods of evaluating IR systems.									
CO5	Gain hands-on experience with IR system implementation.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Information Retrieval** ● Course overview and objectives ● History of IR systems ● Applications of IR	**8**	Understand the fundamentals of information retrieval systems, including their history, applications, and objectives for effective information management and retrieval.	**1, 2**
II	**Text Processing and Indexing** ● Text preprocessing: tokenization, stemming, and lemmatization ● Stopword removal and handling special characters ● Inverted index and its construction ● Index compression techniques	**8**	Master text processing techniques including tokenization, stemming, lemmatization, stopwords removal, inverted index construction, and index compression for efficient information retrieval systems.	**2, 3, 4**
III	**Retrieval Models** ● Boolean retrieval model ● Vector space model ● Probabilistic retrieval models	**10**	Understand retrieval models including Boolean, vector space, and probabilistic models for efficient information retrieval and relevance ranking in various contexts.	**2, 3**
IV	**Relevance Feedback and Query Expansion** ● Relevance feedback mechanisms ● Pseudo-relevance feedback ● Query expansion techniques	**10**	Master relevance feedback mechanisms, pseudo-relevance feedback, and query expansion techniques to enhance information retrieval precision and relevance.	**3, 4, 5**

V	**Evaluation of IR Systems** ● Evaluation metrics: precision, recall, F-measure, MAP, NDCG ● Test collections: TREC, Cranfield paradigm ● User studies and A/B testing	**9**	Evaluate information retrieval systems using metrics like precision, recall, F-measure, MAP, NDCG, test collections, and user studies for system improvement.	**4, 5**
Practical Component				
Practical 1	Review course objectives and explore the history of Information Retrieval (IR) systems.	**3**	Understand the fundamentals and evolution of IR systems.	**2**
Practical 2	Investigate various applications of IR in different fields.	**3**	Recognize the diverse applications of IR systems.	**2**
Practical 3	Implement tokenization, stemming, and lemmatization on a text dataset.	**3**	Apply text preprocessing techniques to prepare data for indexing.	**3**
Practical 4	Remove stopwords and handle special characters in a text dataset.	**3**	Clean text data by removing irrelevant components.	**6**
Practical 5	Construct an inverted index for a given text corpus.	**3**	Develop an inverted index to facilitate efficient search and retrieval.	**3**
Practical 6	Implement basic index compression techniques on an inverted index.	**3**	Compress index data to optimize storage and retrieval efficiency.	**3**
Practical 7	Implement Boolean, Vector Space, and Probabilistic retrieval models.	**3**	Apply various retrieval models to query and retrieve relevant documents.	**3**
Practical 8	Implement relevance feedback mechanisms and query expansion techniques.	**3**	Enhance search results using relevance feedback and query expansion.	**3**
Practical 9	Calculate precision, recall, F-measure, MAP, and NDCG for an IR system.	**3**	Evaluate the performance of IR systems using standard metrics.	**5**
Practical 10	Conduct user studies and perform A/B testing for an IR system.	**3**	Assess IR system effectiveness through user studies and A/B testing.	**5**

TEXT BOOKS:

T1: "Introduction to Information Retrieval" by Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze.

REFERENCE BOOKS:

R1: "Modern Information Retrieval: The Concepts and Technology behind Search" by Ricardo Baeza-Yates and Berthier Ribeiro-Neto.

OTHER LEARNING RESOURCES:

O1:TREC (Text REtrieval Conference) datasets and proceedings

O2: Online tutorials and courses (e.g., Coursera, edX)

O3: Software tools and libraries (e.g., Apache Lucene, Solr, Elasticsearch)

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand the fundamental concepts of Information Retrieval.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
2	Learn about various indexing and search techniques.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Explore different IR models and their applications.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Study the methods of evaluating IR systems.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
5	Gain hands-on experience with IR system implementation.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V									
Course Title	**PE-III: Machine Learning**								
Course code	**23BTCS315R**	**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 Technology in Computer Science & Engineering**								
Semester	**Summer/I semester of the third year of the Programme**								
Course Objectives	1. To provide fundamental theoretical foundations knowledge of various learning algorithms 2. Apply suitable machine learning techniques for data handling and knowledge extraction 3. To gain the fundamental knowledge and understand the context of supervised and unsupervised learning through real-life examples 4. Evaluate the performance of algorithms based on corresponding metrics identified and to provide solutions for various real world applications								
CO1	Recognize the characteristics of machine learning strategies								
CO2	Demonstrate proficiency in data analytics and apply advanced tools to work on dimensionality reduction and mathematical operations								
CO3	Analyze and Apply the suitable supervised learning and unsupervised learning methods for real-world problems and for handling unknown patterns								
CO4	Understand the concept of ensemble learning and its applications								
CO5	Evaluate the performance of various algorithms								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Machine Learning** What is Machine Learning?, Types of Machine Learning: Supervised, Unsupervised, and Reinforcement Learning, Applications of Machine Learning in Various Fields	**7**	Gain knowledge of Machine Learning fundamentals, including types (supervised, unsupervised, reinforcement), and applications across diverse fields for practical implementation.	**1, 2**
II	**Data Preprocessing and Exploratory Data Analysis** Data Collection and Cleaning, Handling Missing Values, Feature Scaling and Normalization, Data Visualization Techniques, Exploratory Data Analysis (EDA), statistical measures, Basic tools (plots, graphs and summary statistics) of EDA	**8**	Master data pre processing techniques including collection, cleaning, handling missing values, feature scaling, normalization, visualization, and exploratory data analysis tools.	**3, 4**
III	**Supervised Learning and Unsupervised Learning** Linear and Non-Linear examples – Multi– Class & Multi-Label c basics (Partitioned, Hierarchical and Density based) - K- Means clustering – KMode clustering – Self organizing maps Expectation maximization – Principal Component Analysis	**12**	Demonstrate proficiency in supervised learning (regression, classification) and unsupervised learning (clustering, dimensionality reduction) algorithms for data analysis and modeling tasks.	**3, 4**

IV	**Ensemble Learning** Bagging-Committee Machines and Stacking-Boosting-Ranking based aggregation	**8**	Apply ensemble learning techniques such as bagging, boosting, stacking, and ranking for improving predictive model accuracy and robustness.	**3, 4, 5**
V	**Model Evaluation and Optimization** Model Validation Techniques: Train/Test Split, Cross-Validation, Performance Metrics, Confusion Matrix, Accuracy, Precision, Recall, F1-Score	**10**	Effectively evaluate machine learning models using validation techniques like train/test split, cross-validation, and performance metrics (accuracy, precision, recall, F1-score).	**3, 5**

TEXT BOOKS:

T1: S. Shalev-Shwartz, S.Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.

T2: Ethem Alpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India,

REFERENCE BOOKS:

R1: Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2nd Edition, 2018.

R2: Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.

R3: Data Mining: Concepts and Techniques", Third Edition, 2 Jiawei Han, Micheline Kamber and Jian Pei, ISBN 0123814790,(2011).

R4: Duda, Richard, Peter Hart, and David Stork, "Pattern Classification," 2 nd Edition, John Wiley & Sons, Hoboken, 2000.

OTHER LEARNING RESOURCES:

O1: Coursera provides course like "Machine Learning" that covers a broad introduction to machine learning, data mining, and statistical pattern recognition.

O2:edX provides course like "Machine Learning" that covers the essentials of machine learning, focusing on supervised and unsupervised learning, mathematical and heuristic aspects, and hands-on implementation of algorithms.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Recognize the characteristics of machine learning strategies	PO1, PO2, PO3, PO4, PO10, PO12
2	Demonstrate proficiency in data analytics and apply advanced tools to work on dimensionality reduction and mathematical operations	PO1, PO2, PO3, PO4, PO10, PO12
3	Analyze and Apply the suitable supervised learning and unsupervised learning methods for real-world problems and for handling unknown patterns	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Understand the concept of ensemble learning and its applications	PO1, PO2, PO3, PO4, PO10, PO12
5	Evaluate the performance of various algorithms	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V									
Course Title	**PE-III: Cloud Computing**								
Course code	**23BTCS315R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Basic Programming Skills**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science & Engineering**								
Semester	**Summer/I semester of the third year of the Programme**								
Course Objectives	1. To provide an overview of an exciting field of Cloud Computing 2. To introduce tools requires building, deploying, running and managing applications on a cloud platform. 3. To develop the cloud application development skills, such as Python, REST architecture, JSON, Cloud Foundry and DevOps services 4. To enable students to have skills that will help them to solve complex real-world problems in decision support.								
CO1	Understand fundamental cloud computing concepts and architectures.								
CO2	Analyze and implement RESTful APIs and data services on cloud platforms.								
CO3	Design and deploy cloud applications using IBM Cloud services, including Kubernetes.								
CO4	Develop and deploy applications using Python and related frameworks.								
CO5	Apply advanced cloud concepts and architectures to deploy applications on Kubernetes clusters.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Cloud Computing and IBM Cloud:** Defining cloud computing, Factors leading to cloud adoption, Types of cloud services (IaaS, PaaS, SaaS), Cloud deployment models (Public, Private, Hybrid) Overview of IBM Cloud Creating an IBM Cloud account, Navigating the IBM Cloud dashboard.	**8**	Understand cloud computing concepts, service models, deployment types, and IBM Cloud basics, including account creation and dashboard navigation.	**1, 2**
II	**IBM Cloud Core Services or data services on IBM Cloud:** Watson AI services on IBM Cloud, Introduction to DevOps, Implementing DevOps practices on IBM Cloud, Using IBM Cloud toolchains for DevOps, REST API, Types and capabilities of databases, Apis interaction with Cloudant database.	**8**	Develop proficiency in IBM Cloud core services, Watson AI, DevOps practices, and interacting with databases and APIs on IBM Cloud.	**1, 2, 3**
III	**Application Development on IBM Cloud:** Understanding business problems and goals, Functional and non-functional requirements, IBM Cloud App ID, Container orchestration (Kubernetes), Pods, Deployment, and Service, Cloud Foundry.	**9**	Develop skills in application development on IBM Cloud, including requirements analysis, App ID, Kubernetes, and Cloud Foundry deployment.	**3, 4**
IV	**Developing Python Applications for the Cloud:**		Develop proficiency in building scalable and	**2, 3**

	Building Python applications for cloud deployment Integrating popular Python frameworks (Django, Flask) with cloud services Leveraging cloud storage, databases, and AI services with Python Implementing scalability and high availability for Python applications on the cloud	**10**	high-availability Python applications using frameworks and cloud services.	
V	**Security and Compliance on IBM Cloud:** Overview of IBM Cloud security features, Implementing security best practices on IBM Cloud, Ensuring compliance on IBM Cloud, OAuth protocol.	**10**	Implement IBM Cloud security features, apply best practices, ensure compliance, and use OAuth protocol for secure cloud deployments.	**3, 4, 5**

TEXT BOOKS:

T1: Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood.
T2: Cloud Computing: A Hands-On Approach by Arshdeep Bahga and Vijay Madisetti.
T3: Cloud Native Architectures: Design High-availability and Cost-effective Applications for the Cloud by Tom Laszewski, Kamal Arora, and Erik Farr.

REFERENCE BOOKS:
R1: Cloud Computing Principles and Paradigms by Rajkumar Buyya, James Broberg, and Andrzej Goscinski.
R2: Cloud Computing: Principles, Systems and Applications by Nick Antonopoulos and Lee Gillam..
R3: Data Mining: Concepts and Techniques", Third Edition, 2 Jiawei Han, Micheline Kamber and Jian Pei, ISBN 0123814790,(2011).
R4: Cloud Computing: From Beginning to End by Ray J. Rafaels.

OTHER LEARNING RESOURCES:
O1: Coursera provides several courses like "Cloud Computing Specialization", "AWS Fundamentals Specialization" and "Google Cloud Platform Fundamentals: Core Infrastructure"
O2:NPTEL provides several courses like "Cloud Computing" and "Cloud Computing and Distributed Systems"

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand fundamental cloud computing concepts and architectures.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
2	Analyze and implement RESTful APIs and data services on cloud platforms.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Design and deploy cloud applications using IBM Cloud services, including Kubernetes.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Develop and deploy applications using Python and related frameworks.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
5	Apply advanced cloud concepts and architectures to deploy applications on Kubernetes clusters.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V									
Course Title	**Field-Based Training**								
Course code	**23BTCS317R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 16	**0**	**0**	**0**	**0**	**0**	**16**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/I semester of the third year of the Programme**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings. 4. To foster collaboration and communication skills through group projects and professional interactions. 5. To cultivate an appreciation for the complexities and challenges of professional practice in the field.								
CO1	Apply theoretical concepts to real-world situations.								
CO2	Conduct field-based research and gather data effectively.								
CO3	Analyze and interpret the university data to draw meaningful conclusions.								
CO4	Communicate findings clearly and effectively, both orally and in writing.								
CO5	Demonstrate professional behavior and teamwork skills in field settings.								
Unit-No.	**Content**		**Contact Hour**	**Learning Outcome**					**KL**
I	The organization will provide the students one field visit for this Programme. The students will be taken to a specific blocks of the university for learning purposes. The students will visit all department block site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners of IT department of the university. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial findings.		**16**	Gain practical insights and document observations through field visits, professional interactions, and reflective journaling for comprehensive learning.					**3, 4**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Apply theoretical concepts to real-world situations.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
2	Conduct field-based research and gather data effectively.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
3	Analyze and interpret the university data to draw meaningful conclusions.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
4	Communicate findings clearly and effectively, both orally and in writing.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
5	Demonstrate professional behavior and teamwork skills in field settings.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12

SEMESTER – V									
Course Title	**Summer Internship**								
Course code	**23BTCS318R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 90	**0**	**0**	**0**	**0**	**0**	**16**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science & Engineering**								
Semester	**Summer/I semester of the third year of the Programme**								
Course Objectives	1. Equip students with practical experience in their field of study, ensuring they are prepared to transition smoothly into industry roles by mastering modern tools, technologies, and industry-standard practices. 2. Enhance students' soft skills, including presentation, interpersonal communication, and documentation, as well as office etiquette, to ensure they can effectively navigate and contribute to professional environments. 3. Foster a deep understanding of professional and ethical responsibilities in engineering, encouraging students to adhere to industry best practices, processes, and regulations. 4. Promote the ability to work effectively in teams, especially within multidisciplinary contexts, emphasizing collaboration, communication, and the integration of diverse perspectives and expertise. 5. Cultivate a professional work ethic characterized by productivity, consistency, and punctuality, preparing students to meet the demands and expectations of the industry.								
CO1	Apply modern tools and technologies in real-world scenarios to solve complex engineering problems.								
CO2	Analyse industry-standard reporting methods to produce technical documents adhering to professional guidelines.								
CO3	Develop solutions using design, development, and testing practices aligned with current industry standards.								
CO4	Demonstrate effective communication, teamwork, and interpersonal skills in a multi-disciplinary team environment.								
CO5	Evaluate professional and ethical responsibilities to make informed decisions in engineering practices.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Method and Pedagogy: ● Summer internship shall be at least 90 hours during the summer vacation only. ● Department/Institute will help students to find an appropriate company/industry/organization for the summer internship. ● The student must fill up and get approved a Summer Internship Acceptance form by the company and provide it to the Coordinator of the department within the specified deadline. ● Students shall commence the internship after the approval of the department Coordinator. Summer internships in research centers is also allowed. ● During the entire period of internship,	**90**	Complete a 90-hour summer internship, submit an internship report, and demonstrate practical industry experience through documentation and evaluation.	**3, 4, 5**

	the student shall obey the rules and regulations of the company/industry/organization and also those of the University. ● Due to inevitable reasons, if the student will not able to attend the internship for few days with the permission of the supervisor, the department Coordinator should be informed via e-mail and these days should be compensated later. ● The student shall submit two documents to the Coordinator for the evaluation of the summer internship: a) Summer Internship Report b) Summer Internship Assessment Form ● Upon the completion of summer internship, a hard copy of "Summer Internship Report" must be submitted to the Coordinator by the first day of the new term. ● The report must outline the experience and observations gained through practical internship, in accordance with the required content and the format described in this guideline. Each report will be evaluated by a faculty member of the department on a satisfactory/unsatisfactory basis at the beginning of the semester. ● If the evaluation of the report is unsatisfactory, it shall be returned to the student for revision and/or rewriting. If the revised report is still unsatisfactory the student shall be requested to repeat the summer internship.			

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Apply modern tools and technologies in real-world scenarios to solve complex engineering problems.	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO12
2	Analyse industry-standard reporting methods to produce technical documents adhering to professional guidelines.	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO12
3	Develop solutions using design, development, and testing practices aligned with current industry standards.	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO12
4	Demonstrate effective communication, teamwork, and interpersonal skills in a multi-disciplinary team environment.	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO12
5	Evaluate professional and ethical responsibilities to make informed decisions in engineering practices.	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO10, PO12

SEMESTER – V									
Course Title	**Extra - Curricular Activities**								
Course code	**23UBEC311**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science & Engineering**								
Semester	**Summer/I semester of the third 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	Learn to a plan so that they can make meaningful contributions, maintain a commitment, and manage their time and priorities.								
CO2	Transform passionate students who demonstrate leadership and pursue interests beyond their academics.								
CO3	Learn to participate in various co-curricular activities leading to their multifaceted personality development.								
CO4	Express their ideas, views, In-depth evaluation and analysis clearly in the topic of their interest.								
CO5	Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	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 to the learners, Keeping in mind the3 60 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 the platform to learn from experts in the respective fields.		Engage in various extracurricular activities to develop social and soft skills, enhancing holistic development through club participation, workshops, and competitions.	**3, 5**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	It is to develop the social and soft skills and to promote a holistic development of the learners	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
2	Learn to a plan so that they can make meaningful contributions, maintain a commitment, and manage their time and priorities.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
3	Transform passionate students who demonstrate leadership and pursue interests beyond their academics.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
4	Learn to participate in various co-curricular activities leading to their multifaceted personality development.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
5	Express their ideas, views, In-depth evaluation and analysis clearly in the topic of their interest.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12

<table>
<tr><th colspan="10">SEMESTER – V</th></tr>
<tr><td>Course Title</td><td colspan="9">Mini Project III</td></tr>
<tr><td rowspan="2">Course code</td><td rowspan="2">23BTCS316R</td><td>Total credits: 1</td><td>L</td><td>T</td><td>P</td><td>S</td><td>R</td><td>O/F</td><td>C</td></tr>
<tr><td>Total hours: 45</td><td>0</td><td>0</td><td>0</td><td>4</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="2">Nil</td><td>Co-requisite</td><td colspan="6">Nil</td></tr>
<tr><td>Programme</td><td colspan="9">Bachelor of Technology in Computer Science & Engineering</td></tr>
<tr><td>Semester</td><td colspan="9">Summer/Isemester of the third year of the Programme</td></tr>
<tr><td>Course Objectives</td><td colspan="9">1. To develop the knowledge, skills and attitudes of a professional Computer engineering professional.
2. To become confident in designing engineering solutions to complex software problems utilising a systems approach.</td></tr>
<tr><td>CO1</td><td colspan="9">Apply IT principles for real-world problem-solving using Programming languages and network solutions.</td></tr>
<tr><td>CO2</td><td colspan="9">Contribute to complex projects as a team member, demonstrating effective personal and team management.</td></tr>
<tr><td>CO3</td><td colspan="9">Develop Programming skills to create and assess software, hardware, and network solutions.</td></tr>
<tr><td>CO4</td><td colspan="9">Apply personal and team management skills as a professional software developer.</td></tr>
<tr><td>CO5</td><td colspan="9">Cultivate employability skills and uphold professionalism in software development.</td></tr>
<tr><td>Unit-No.</td><td colspan="5">Content</td><td>Contact Hour</td><td>Learning Outcome</td><td>KL</td></tr>
<tr><td>I</td><td colspan="5">This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor.
Students will be required to:
1. Perform a literature search to review current knowledge and developments in the chosen technical area;
2. Undertake detailed technical work in the chosen area using one or more of:
o theoretical studies
o computer simulations
o hardware construction;
3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project;
4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field;
5. Prepare a formal report describing the work undertaken and results obtained so far; and
Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.</td><td>45</td><td>Conduct a research project involving literature review, technical work, progress reporting, seminar delivery, and formal presentation under academic supervision.</td><td>3, 4, 5, 6</td></tr>
</table>

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Apply IT principles for real-world problem-solving using Programming languages and network solutions.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
2	Contribute to complex projects as a team member, demonstrating effective personal and team management.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
3	Develop Programming skills to create and assess software, hardware, and network solutions.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
4	Apply personal and team management skills as a professional software developer.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
5	Cultivate employability skills and uphold professionalism in software development.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

SEMESTER – VI									
Course Title	**Web Technologies**								
Course code	**23BTCS321R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science & Engineering**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1. To make a student familiar with client server architecture. 2. To teach developing a web application using various technologies. 3. To make the students learn the skills and project-based experience needed for entry into web application and development careers..								
CO1	Learn about Internet and Web Page Design.								
CO2	Understand detailed concepts on Web Browsers, Markup Language Basics and XML.								
CO3	Learn basic concepts of client side Programming								
CO4	Learn detailed concepts on Web Server Side technologies.								
CO5	Understand few advanced Web Technologies and the Web Security.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**An Introduction to Web Technology** History of web Development, Time line, Motivation, Categories of Web Applications, Characteristics of Web Applications. Evolution and Need for Web Engineering, Web Engineering Models, Software Engineering v/s Web Engineering . World Wide Web: Introduction to TCP/IP and WAP, DNS, Email, TelNet, HTTP and FTP. Introduction to Browser and search engines, Search fundamentals, Search strategies, Directories search engines and Meta search engines, Working of the search engines , Miscellaneous Web Browser details, Introduction to Web Servers: Features of web servers, caching, case study-IIS, Apache, Configuring web servers	**8**	To understand web development basics, HTML, CSS, JavaScript, client-server architecture, and create simple web applications.	**1,2,3**
II	**Technologies for Web Applications** HTML and DHTML, HTML Basic Concepts, Static and dynamic HTML, Structure of HTML documents, HTML Elements, Linking in HTML, Anchor Attributes, Image Maps, Meta Information, Image Preliminaries, Layouts, Backgrounds, Colors and Text, Fonts, Tables, Frames and layers, Audio and Video Support with HTML Database integration, CSS, Positioning with Style sheets, Forms Control, Form. Elements. Introduction to CGI PERL, JAVA SCRIPT, ASP,	**10**	To master the advanced web technologies, frameworks, APIs, databases, and develop complex, scalable web applications with robust functionality.	**3,4**

	Cookies Creating and Reading Cookies. Introduction of XML, Validation of XML documents, DTD, Ways to use XML, XML for data files, HTML Vs XML, Embedding XML into HTML documents, Converting XML to HTML for Display, Displaying XML using CSS and XSL, Rewriting HTML as XML, Relationship between HTML, SGML and XML			
III	**Client Side Programming** Document Object Model (DOM),Overview of DOM, Jquery: ,Element Selector Document ready function, Events ,Ajax call ,plugins: Using JQuery UI ,Unobtrusive client validation ,JQuery templates ,Feature detection: Browser detection ,Feature detection ,Modernizer , polyfills. Introduction to AJAX, Overview of Traditional Web Communication Processes and Technologies, Interacting with the Web Server Using the XMLHttpRequest , Create an XMLHttpRequest Object Interact with the Web Server Working with PHP and AJAX: Introduction Process Client Requests Accessing Files Using PHP Applying Basic AJAX Techniques: Introduction Download Images Using AJAX Auto, Populate Select Boxes, Implementing Security and Accessibility in AJAX Applications: production, Secure AJAX Applications Accessible Rich Internet Applications	**10**	To learn JavaScript, DOM manipulation, event handling, form validation, AJAX, and create interactive, responsive web interfaces.	**3,4**
IV	**Server Side Programming** J2SE:Data Types, Arrays, Type Casting, Classes and Objects, Inheritance, Interfaces, Exception Handling, Multithreading,J2EE as a framework, Client Server Traditional model, Comparison amongst 2-tier, 3-tier and N-tier Architectures, Thin and Thick Clients. J2EE Servlet 2.x Specification, Writing small Servlet Programs, Deployment Descriptor, Inter Servlet Collaboration, Session: Definition, State on web, Different ways to track sessions,	**9**	To understand server-side scripting, databases, authentication, RESTful APIs, server deployment, and build dynamic, data-driven web applications.	**4**

	JSP Technology Introduction-JSP and Servlets- Running JSP Applications Basic JSP- JavaBeans Classes - Support for the Model- View-Controller Paradigm- Case Study- Related Technologies.			
V	**Advanced Web Technologies and Web Security** Exposure to Advanced Web Technologies: Distributed Object based models- DCOM, CORBA, EJB; Web services and Related Technologies- ISAPI, SOAP, UDDI, WSDL; Other Advanced Web Technologies- AJAX, ISAPI, .NET. Web Security: Firewalls- definition and uses, network layer firewalls and application layer firewalls; Proxy servers, HTPS for secure web communication.	**8**	To explore advanced web frameworks, progressive web apps, web security principles, encryption, and secure web application development practices.	**4**
Practical Component				
Practical 1	Identify common HTML tags and their functions.	2	Identify and label common HTML tags and understand their basic functions in web development.	**5**
Practical 2	Match CSS properties to their effects.	2	To match CSS properties to their corresponding effects, enhancing their understanding of CSS styling.	**5**
Practical 3	Create a concept map of basic JavaScript concepts.	2	To create a concept map, demonstrating their understanding of basic JavaScript concepts and their interrelationships.	**5**
Practical 4	Explain the structure of a basic web page.	2	analyze and explain the structure and purpose of different sections in a basic web page.	**5**
Practical 5	Use HTML and CSS to create a simple web page.	2	Use HTML and CSS to create a functional web page with various elements and styles.	**5**
Practical 6	Implement basic form validation using JavaScript.	2	implement JavaScript to perform basic form validation, ensuring proper data entry before submission.	**5**
Practical 7	Evaluate the responsiveness of a web page.	2	evaluate a web page's responsiveness, identifying	**5**

			areas for improvement using developer tools.	
Practical 8	Analyze the performance of a web page.	2	To analyze web page performance, using tools to identify and suggest solutions for performance bottlenecks..	**5**
Practical 9	Conduct a usability test on a web application..	2	Conduct and analyze usability tests, making recommendations to improve web application user experience.	**5**
Practical 10	Review and evaluate the quality of web code.	2	Review and evaluate web code quality for readability, efficiency, and best practices adherence.	5
Practical 11	Create a web application using HTML, CSS, and JavaScript.	2	Design and build a dynamic web application using HTML, CSS, and JavaScript.	6
Practical 12	Develop a custom CSS framework.	2	To develop a reusable custom CSS framework for use in various web development projects.	6
Practical 13	Develop a single page application using a JavaScript framework (e.g., React or Vue.js).	2	To create a SPA using a JavaScript framework, integrating dynamic content through API interactions.	6
Practical 14	Design and implement a RESTful API.	2	To design and implement a RESTful API using Node.js and Express, connecting it to a front-end..	6
Practical 15	Develop an interactive data dashboard.	2	develop interactive dashboards to visualize and explore data insights dynamically..	6

Text Book:

T1: Web Technologies: HTML, Javascript, PHP, Java, JSP, XML and AJAX, Black Book,Kogent Learning Solutions Inc., 1st Edition, 2009, Dreamtech Press.
T2: Web Technologies, Uttam K. Roy, 1st Edition, 2010, Oxford Publications.

Reference Books:

R1: N. P. Gopalan and J. Akilandeswari,Web Technology: A Developer's Perspective,1st Edition, 2014,Prentice-Hall of India Pvt. Ltd.
R2: Jeffrey C. Jackson,Web Technologies: A Computer Science Perspective, 1st Edition, 2008, Pearson Education India.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Learn about Internet and Web Page Design.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
2	Understand detailed concepts on Web Browsers, Markup Language Basics and XML.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
3	Learn basic concepts of client side Programming	CO1, CO2, CO3, CO4, CO5, CO10, CO12
4	Learn detailed concepts on Web Server Side technologies.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
5	Understand few advanced Web Technologies and the Web Security.	CO1, CO2, CO3, CO4, CO5, CO10, CO12

SEMESTER – VI									
Course Title	**Formal Language &Automata Theory**								
Course code	**23BTCS322R**	**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**	**Linux**						
Programme	**Bachelor of Technology in Computer Science & Engineering**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1. To gain a solid understanding of formal languages, grammars, automata, and their theoretical foundations in computer science. 2. Learn to design, analyze, and compare different computational models such as finite automata, pushdown automata, and Turing machines. 3. Develop skills to apply formal methods and automata theory concepts to solve complex problems in language processing, compiler design, and algorithm development.								
CO1	Understand the fundamental characteristics of formal languages and formal grammars, showcasing foundational linguistic knowledge.								
CO2	Recognize the similarity between deterministic and non-deterministic finite automata, demonstrating comparative analysis skills.								
CO3	Evaluate the minimization processes of both deterministic and non-deterministic finite automata, applying critical thinking skills.								
CO4	Analyze the resemblance between non-deterministic push-down automata and context-free grammars, demonstrating advanced understanding and synthesis of concepts.								
CO5	Examine the fundamental characteristics of Turing machines and their computational applications, showcasing analytical skills in computing theory.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction** Definitions: Language, Grammar, Automata, Relation between language, Grammar and automata, Importance of automata theory. **Finite Automata (FA)** Introduction of FA and its example. DFA: Definition, Processing strings, Transition functions, Language of a DFA, NDFA: Non-determinism, Definition, Processing strings, Extended transition functions, Language of a NFA, Kleene's theorem, Epsilon transitions, Applications of FA in text search.	**8**	To grasp finite automata theory, design deterministic/nondeterministic automata, understand regular languages, and apply these concepts to problem-solving.	**1, 2,3**
II	**Regular expressions and regular languages** Memory required to recognize a language, Regular expressions, Regular expression to finite automata & vice versa, Algebraic laws for regular expressions, Applications of regular expressions, Criterion for regularity, Regular languages, Properties of Regular languages	**8**	learn to construct and interpret regular expressions, understand regular languages, and apply these concepts to pattern matching.	**2,3**
III	**Context Free Grammars and Languages** Definition, Left most and right most grammars, Parse trees, Ambiguity: Ambiguous grammar, Removing ambiguity, Normal forms, Applications of context free grammars: Parsers	**10**	To comprehend context-free grammars, parse trees, Chomsky hierarchy, and apply these concepts to analyze	**2,4**

			and generate context-free languages.	
IV	**Pushdown automata (PDA) and context free languages (CFL)** Definition & representation of pushdown automata, Acceptance by PDA: By final state, By empty stack, Deterministic PDA, Equivalence of PDA and CFL, Pumping Lemma for CFL Closure properties of CFL, Testing membership of context free, Decision problems for CFLs.	**10**	To master pushdown automata theory, understand context-free languages, parse trees, and apply these concepts to language recognition and parsing.	**2,3**
V	**Turing machines** Definition, Language of a Turing machine, Programming Turing machines, The Church-Turing thesis, A simple Programming language, Extensions of the basic Turing machine. **Recursively enumerable languages & Undesirability** The halting problem, The post correspondence problem, Time and space complexity of Turing machines, Complexity classes	**9**	To grasp Turing machine theory, recursively enumerable languages, undecidability, and apply these concepts to analyze computability and algorithmic problems.	**2,3, 4**

Text Books:

1. John. E. Hopcroft, Rajeev Motwani, Jeffry Ullman,‖ Introduction to Automata Theory, Languages and Computation‖, Pearson Education.
2. John Martin,―Introduction to Languages and the Theory of Computation, Tata McGraw Hill

Reference Books:

1. Adesh K. Pandey,―An Introduction to Automata Theory & Formal Languages‖, Katson Books.
2. Peter Linz,―An Introduction to Formal Languages and Automata‖, Narosa.
3. Zvi Kohavi and Niraj K. Jha,―Switching and Finite Automata Theory‖, Tata McGraw Hill.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand the fundamental characteristics of formal languages and formal grammars, showcasing foundational linguistic knowledge.	CO1, CO2, CO3, CO10, CO12
2	Recognize the similarity between deterministic and non-deterministic finite automata, demonstrating comparative analysis skills.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
3	Evaluate the minimization processes of both deterministic and non-deterministic finite automata, applying critical thinking skills.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
4	Analyze the resemblance between non-deterministic push-down automata and context-free grammars, demonstrating advanced understanding and synthesis of concepts.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
5	Examine the fundamental characteristics of Turing machines and their computational applications, showcasing analytical skills in computing theory. .	CO1, CO2, CO3, CO4, CO5, CO10, CO12

SEMESTER – VI									
Course Title	**DE-III: Positive Psychology**								
Course code	**23BTCS323R**	**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 Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1. To introduce students to the core concepts, theories, and research findings in positive psychology. 2. To equip students with skills to apply positive psychology principles and interventions in personal and professional settings. 3. To foster an understanding of how positive psychology can contribute to enhancing individual and community well-being, resilience, and flourishing.								
CO1	Understand psychology's impact on personal and work success.								
CO2	Infer about hope, optimism, positive illusions, and playfulness.								
CO3	Summarize creativity, giftedness, judgment, wisdom, emotional intelligence.								
CO4	Discuss spirituality, love, kindness, gratitude, zest, modesty, forgiveness								
CO5	Generalize altruism, empathy, social intelligence, positive psychology at work								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Positive Psychology** Define positive psychology and its key concepts, understand the history and evolution of positive psychology, explore theories and research in positive psychology, analyze the role of positive emotions in well-being, apply positive psychology principles to personal and professional contexts.	**8**	To grasp positive psychology principles, apply interventions for well-being, cultivate strengths, foster relationships, and pursue meaningful, fulfilling lives.	**2**
II	**The Science of Happiness** Examine theories of happiness and subjective well-being, identify factors influencing happiness and life satisfaction, learn strategies for cultivating positive emotions, understand the importance of gratitude and resilience in happiness,apply happiness-boosting techniques to enhance well-being.	**8**	To comprehend happiness theories, identify factors influencing well-being, cultivate positive emotions, practice gratitude, and apply happiness-boosting strategies effectively.	**2,3**
III	**Resilience and Positive Coping** Define resilience and its significance in psychological well-being, explore resilience-building techniques and coping strategies, understand the role of optimism and growth mindset in resilience, identify personal strengths and resources for coping with adversity, apply resilience strategies to navigate challenges effectively.	**10**	Understand resilience concepts, develop coping strategies, foster optimism, leverage strengths, and effectively navigate challenges with resilience and adaptability.	**2,4**
IV	**Strengths and Virtues** Identify personal strengths using assessments like VIA Survey, understand the concept of character strengths and	**10**	To identify personal strengths, understand virtues, apply strengths-based	**2,3**

	virtues, explore the benefits of applying strengths-based approaches, learn to leverage strengths for personal development and goal attainment, apply strengths-based interventions to enhance performance and well-being.		approaches, leverage strengths for growth, and enhance well-being and performance.	
V	**Positive Relationships and Meaningful Living** Understand the importance of positive relationships in well-being, learn communication and conflict resolution skills for building positive relationships, explore research on meaning and purpose in life, identify sources of meaning and cultivate a sense of purpose, apply strategies for fostering positive connections and living a meaningful life.	**9**	To cultivate positive connections, develop communication skills, explore sources of meaning, foster purpose, and lead fulfilling lives through meaningful engagement.	**2,4**

Text Books:

1. Schultz, D.&Schultz, S. E. (2009). Psychology and Work Today (10thed.).New Jersey: Pearson/Prentice Hall.
2. Butcher, J. N., Mineka, S., & Hooley, J.M. (2010). Abnormal psychology(14thed.).

Reference Books:

1. New Aronson, E., Wilson, T. D., & Akert, R. M. (2010). Social Psychology (7thEd.). Upper Saddle River, NJ: Prentice Hall.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand psychology's impact on personal and work success.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO10, CO12.
2	Infer about hope, optimism, positive illusions, and playfulness.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO10, CO12.
3	Summarize creativity, giftedness, judgment, wisdom, emotional intelligence.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO10, CO12.
4	Discuss spirituality, love, kindness, gratitude, zest, modesty, forgiveness	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO10, CO12.
5	Generalize altruism, empathy, social intelligence, positive psychology at work	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO10, CO12.

SEMESTER – VI									
Course Title	**DE- III: Economics for Engineers**								
Course code	**23BTCS323R**	**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 Technology in Computer Science & Engineering**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1. Introduce engineering students to fundamental economic concepts, such as supply and demand, cost analysis, and market structures. 2. Equip engineering students with the skills to apply economic analysis techniques to engineering projects, resource allocation, and decision-making. 3. Facilitate the integration of engineering and economic perspectives to address real-world challenges and optimize engineering solutions.								
CO1	Understand the key distinctions between macroeconomics and microeconomics, applying the laws of demand and supply.								
CO2	Analyze economic indexes such as GNP, NNP, GDP, and NDP, along with cost concepts and break-even analysis.								
CO3	Apply statistical measures, probability distributions, and hypothesis testing in analyzing industrial data.								
CO4	Interpret and apply industrial laws related to industrial relations, disputes, health, safety, and compensation management.								
CO5	Evaluate challenges in the Indian economy, including poverty alleviation Programs, human capital formation, employment dynamics, and sustainable economic development.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introductory Macroeconomics**: What is Macroeconomics, Basic concepts in Macroeconomics: significance of economics, LPG meaning, demand and supply. Law of demand, law of supply. Difference of macroeconomics and microeconomics.	**8**	Understand macroeconomic principles, analyze economic indicators, evaluate policy impacts, comprehend global economic interdependencies, and make informed economic decisions.	**1,2**
II	**Economic Indexes**: Aggregates related to National Income: Gross National Product (GNP), Net National Product (NNP), Gross Domestic Product (GDP) and Net Domestic Product (NDP). Fixed, Variable, Marginal & Average Costs, Recurring and Nonrecurring Costs, Break Even Analysis, ROI, Payback period	**8**	Interpret economic indexes, analyze trends, assess economic health, predict market movements, and make informed decisions based on index data.	**2,3**
III	**Industrial Statistics**: Measures of central	**10**	To apply	**2,3**

	tendency, Relation between mean, median and mode, Measure of dispersion, moments, skewness, Kurtosis, Probability distribution, Binomial distribution, Poisson distribution, Test of hypothesis, Chi-square distribution, application of chi square test, ANOVA test, Level of confidence, Regression model, Simple linear regression analysis, coefficient of correlation, correlation coefficient, Mean absolute deviation (MAD), Mean squared error (MSE)		statistical methods in industrial settings, analyze production data, improve processes, ensure quality, and optimize resource utilization.	
IV	**Industrial laws:** Laws related to Industrial Relations and Industrial Disputes: Industrial disputes act, 1947: definition and authorities, awards, settlement, strike lockouts, lay off, retrenchment and closure. The Trade Union Act, 1926, Laws related to health, safety and welfare**:** The Workmen's Compensation Act, 1923 Provisions, and Social Legislation: Employee State Insurance Act 1948: Definition, employees' provident fund. Miscellaneous Provision Act 1948: Schemes, Administration and determination of dues, Laws related to compensation management: The payment of Wages Act 1948: Objectives, Definition,and Authorised Deductions.	**10**	Understand industrial regulations, employment laws, safety standards, resolve disputes, ensure compliance, and promote fair labor practices in workplaces.	**2,3**
V	**Challenges in Indian Economy:** Poverty-Main Programs for poverty alleviation, Human Capital Formation: How people become resource; Role of human capital in economic development; alternative farming - organic farming Employment: Growth and changes in work force participation rate in formal and informal sectors; Energy and Health: Sustainable Economic Development: Meaning, Effects of Economic Development on Resources and Environment, including global warming.	**9**	analyze structural issues, policy challenges, economic disparities, unemployment, inflation, and explore strategies for sustainable growth in the Indian economy.	**2,3, 4**

Text Books:

1. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia
2. V.Mote, S.Paul, G.Gupta(2004), Managerial Economics, Tata McGraw Hill

Reference Books:

1. M Chakravarty, Estimating, Costing Specifications & Valuation Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand the key distinctions between macroeconomics and microeconomics, applying the laws of demand and supply.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
2	Analyze economic indexes such as GNP, NNP, GDP, and NDP, along with cost concepts and break-even analysis.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
3	Apply statistical measures, probability distributions, and hypothesis testing in analysing industrial data.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
4	Interpret and apply industrial laws related to industrial relations, disputes, health, safety, and compensation management.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
5	Evaluate challenges in the Indian economy, including poverty alleviation Programs, human capital formation, employment dynamics, and sustainable economic development.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.

SEMESTER – VI										
Course Title	**PE IV: Foundations of Data Science**									
Course code	**23BTCS324R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+ 30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Mathematics and Statistics, Programming**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1. Develop Proficiency in Key Data Science Tools and Programming Languages. 2. Understand and Apply Fundamental Statistical and Machine Learning Methods. 3. Cultivate Critical Thinking and Problem-Solving Skills in a Data-Driven Context.									
CO1	Acquire foundational knowledge in data science.									
CO2	Understand and apply various data analytics techniques.									
CO3	Apply advanced tools to work on dimensionality reduction and mathematical operations.									
CO4	Manage diverse data types and employ Programming for knowledge representation through visualization.									
CO5	Demonstrate numerous open source data science tools to solve real-world problems through industrial case studies.									

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**Foundations of Data Science:** Overview of data science, its significance, and application across various sectors. Introduction to the data science workflow: data collection, cleaning, analysis, and visualization.	**8**	Grasp foundational concepts in data science, acquire Programming skills, analyze data, and communicate findings effectively using statistical methods.	**1, 2**
II	**Statistical Methods and DataManipulation:** Essential statistics for data science, probability theory, data summarization, and visualization techniques. Introduction to Programming with Python and R for data manipulation using Pandas, NumPy, and dplyr.	**8**	Understand statistical techniques, manipulate data using Programming languages, analyze datasets, interpret results, and communicate findings accurately.	**2,3**
III	**Machine Learning Techniques:** Supervised learning models (regression, decision trees, SVMs), unsupervised learning models (clustering, PCA), and model evaluation metrics. Introduction to machine learning algorithms implementation using scikit-learn.	**10**	Understand machine learning algorithms, apply techniques to analyze data, develop models, evaluate performance, and make predictions effectively.	**2,4**
IV	**Advanced Data Science Concepts:** Deep learning with TensorFlow, natural language processing basics, and introduction to big data technologies like Hadoop and	**10**	Explore advanced topics in data science such as deep learning, natural language processing, and big data analytics, applying them	**2,3**

	Spark. Real-world applications and case studies.		effectively.	
V	**Capstone Project in Data Science:** Application of data science processes to a real-world problem. Project phases include problem identification, data acquisition, preprocessing, modelling, analysis, and presentation of results.	**9**	Demonstrate proficiency in applying data science skills to solve real-world problems, presenting comprehensive solutions and insights effectively.	**2,5**
Practical Component				
Practical 1	Match basic data science terminology with their definitions.	2	Identify and understand key data science terms and definitions.	1
Practical 2	Identify different types of data (categorical, numerical, etc.).	2	Recognize and categorize different types of data in various data sets.	1
Practical 3	Interpret basic data visualizations (bar charts, histograms, scatter plots).	2	Interpret and explain information presented in basic data visualizations.	2
Practical 4	Explain the concept and importance of descriptive statistics.	2	Understand and explain the importance and application of descriptive statistics.	2
Practical 5	Perform basic data cleaning tasks.	2	Apply data cleaning techniques to prepare data sets for analysis.	3
Practical 6	Create data visualizations using software (e.g., Excel, Tableau, Python libraries).	2	Create accurate and effective data visualizations to represent data insights.	3
Practical 7	Analyze the correlation between variables.	2	Analyze and interpret the correlation between variables in data sets..	4
Practical 8	Perform and interpret hypothesis tests.	2	Perform hypothesis tests and interpret their significance in data analysis..	4
Practical 9	Evaluate the performance of machine learning models..	2	evaluate and interpret the performance of machine learning models using appropriate metrics.	5
Practical 10	Critically analyze the quality and reliability of data sources.	2	critically assess the quality and reliability of various data sources.	5
Practical 11	Build and test predictive models.	2	Build and test predictive models, demonstrating their understanding of model development.	6
Practical 12	Design a survey for data collection.	2	design effective surveys to collect relevant and unbiased data.	6
Practical 13	Implement a data processing pipeline.	2	Implement an ETL pipeline to process data efficiently.	6

Practical 14	Create a data-driven story.	2	Create and present a data-driven story, effectively communicating insights.	6
Practical 15	Develop an interactive data dashboard.	2	develop interactive dashboards to visualize and explore data insights dynamically..	6

Text Books:

1. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, Foster Provost and Tom Fawcett, 1st Edition, 2013.
2. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", Wes McKinney, 2nd Edition, 2017.
3. Pattern Recognition and Machine Learning", Christopher M. Bishop, 1st Edition, 2006.
4. Applied Predictive Modeling", Max Kuhn and Kjell Johnson, 1st Edition, 2013.

Reference Books:

1. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, 2nd Edition, 2021.
2. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, 1st Edition, 2012.
3. Data Mining: Practical Machine Learning Tools and Techniques, Ian H. Witten, Eibe Frank, Mark A. Hall, and Christopher J. Pal, 4th Edition, 2016.
4. Big Data: Principles and Best Practices of Scalable Realtime Data Systems, Nathan Marz and James Warren, 1st Edition, 2015.

Additional Resources:

- SKaggle - https://www.kaggle.com/
- DataCamp - https://www.datacamp.com/
- Google Colab - https://colab.research.google.com/

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Acquire foundational knowledge in data science.	CO1, CO2, CO3, CO4, CO10, CO12.
2	Understand and apply various data analytics techniques.	CO1, CO2, CO3, CO4, CO10, CO12.
3	Apply advanced tools to work on dimensionality reduction and mathematical operations.	CO1, CO2, CO3, CO4, CO10, CO12.
4	Manage diverse data types and employ Programming for knowledge representation through visualization.	CO1, CO2, CO3, CO4, CO10, CO12.
5	Demonstrate numerous open source data science tools to solve real-world problems through industrial case studies.	CO1, CO2, CO3, CO4, CO10, CO12.

Semester VI										
Course Title	**PE-IV: Cyber Security**									
Course code	**23BTCS324R**	**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 Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1.To provide students with a thorough understanding of the key principles and practices of cyber security. 2. To equip students with the technical skills necessary to identify, analyze, and mitigate cyber threats. 3. To foster an understanding of ethical considerations and legal implications in the field of cyber security.									
CO1	Demonstrate an understanding of various types of cyber threats and vulnerabilities.									
CO2	Apply risk management strategies to protect information systems.									
CO3	Develop technical skills in using tools and techniques for cyber defence.									
CO4	Formulate and implement effective incident response and recovery strategies.									
CO5	Recognize and apply ethical principles and legal regulations relevant to cyber security.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Cyber Security** Definition and importance of cyber security, Overview of cyber threats and attacks, Cyber security principles and practices, The role of cyber security professionals	**8**	Understand cybersecurity fundamentals, threats, vulnerabilities, defenses, and apply security best practices to protect digital assets effectively.	**1,2,3**
II	**Network Security** Fundamentals of network security Firewalls, VPNs, and intrusion detection/prevention systems Secure network design and architecture Network monitoring and analysis	**8**	Comprehend network security principles, protocols, encryption techniques, intrusion detection/prevention, and implement measures to safeguard network infrastructure effectively.	**2,4**
III	**Cryptography** Introduction to cryptography and its importance Symmetric and asymmetric encryption Digital signatures and certificates Cryptographic protocols and applications	**10**	Understand cryptographic algorithms, encryption/decryption methods, digital signatures, cryptographic protocols, and apply them to secure communication and data.	**2,4**
IV	**Risk Management and Incident Response** Risk assessment and management strategies ,Identifying and mitigating vulnerabilities, Incident response planning and execution Business continuity and disaster recovery	**10**	Analyze cybersecurity risks, develop risk management strategies, implement incident response plans, and mitigate security incidents effectively.	**2,3,4**
V	**Ethical and Legal Aspects of**	**9**	Comprehend ethical	**2,4**

	Cyber Security Ethical issues in cyber security Legal and regulatory frameworks Compliance requirements (e.g., GDPR, HIPAA) Case studies of cyber security breaches and legal implications Objectives:.		dilemmas, legal frameworks, regulations, and apply ethical principles to cybersecurity practices and decision-making processes.	
Practical Component				
Practical 1	Match key cybersecurity terms with their definitions.	2	Identify and understand key cyber security terms and definitions.	1
Practical 2	Identify different types of cyber threats.	2	Recognize and categorize different types of cyber threats.	1
Practical 3	Explain basic concepts of network security.	2	understand and explain the components and principles of network security.	2
Practical 4	Explain various encryption techniques.	2	Understand and explain different encryption techniques and their applications.	2
Practical 5	Configure a basic firewall.	2	Apply firewall configuration techniques to control network traffic.	3
Practical 6	Implement basic encryption for data protection.	2	Apply encryption techniques to protect data.	3
Practical 7	Conduct a vulnerability assessment on a system.	2	Analyze and identify vulnerabilities in systems using appropriate tools.	4
Practical 8	Analyze network traffic for suspicious activity.	2	Analyze network traffic to detect suspicious activities.	4
Practical 9	Evaluate the effectiveness of security policies.	2	Evaluate and suggest improvements for security policies.	5
Practical 10	Assess the robustness of an incident response plan.	2	Assess and critique the robustness of incident response plans.runtime environment.	5
Practical 11	Develop a security awareness Programme for an organization.	2	Create an effective security awareness Programme for organizational training.	6
Practical 12	Design a secure network architecture.	2	Design a secure network architecture to protect against cyber threats.	6
Practical 13	Implement an intrusion detection system (IDS).	2	Implement and configure an IDS to monitor and detect intrusions.	6
Practical 14	Develop a penetration testing plan.	2	Develop and document a comprehensive penetration	6

			testing plan.	
Practical 15	Create a detailed cyber security incident report.	2	Create acomprehensive incident report detailing their response and findings from a simulated cybersecurity incident.	6

Textbooks

1. “Cybersecurity Essentials" by Charles J. Brooks, Christopher Grow, Philip Craig, and Donald Short

Reference Books

1. "Network Security Essentials: Applications and Standards" by William Stallings

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Demonstrate an understanding of various types of cyber threats and vulnerabilities.	CO1, CO2, CO3, CO4, CO5, CO12.
2	Apply risk management strategies to protect information systems.	CO1, CO2, CO3, CO4, CO5, CO12.
3	Develop technical skills in using tools and techniques for cyber defence.	CO1, CO2, CO3, CO4, CO5, CO12.
4	Formulate and implement effective incident response and recovery strategies.	CO1, CO2, CO3, CO4, CO5, CO12.
5	Recognize and apply ethical principles and legal regulations relevant to cyber security.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.

SEMESTER – VI										
Course Title	**PE-V: Predictive Analysis**									
Course code	**23BTCS325R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Basic Programming knowledge**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1. To familiarize the students with various Statistical Data Analysis tools 2. Tools that can be used for effective decision making. 3. To make student handle data with various meters								
CO1	Understand and critically apply the concepts and methods of Predictive analytics.								
CO2	Understand and apply IBM SPSS Modeler in Data Mining, what kinds of data can be mined, what kinds of patterns can be mined.								
CO3	Applying and analysing how to use functions, deal with missing values, use advanced field operations, handle sequence data and improve efficiency.								
CO4	Get exposed to the testing of hypothesis and solving assumptions								
CO5	Understanding of IBM Watson Studio with Machine Learning Model.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**ANALYTICS OVERVIEW** What is Predictive Analysis, how predictive model works, why predictive modeling, what are the models in Predictive Analysis. How Predictive analytics: Transforming data into future insights, Analytics trends: Past, Present & Future, Towards a Predictive enterprise.	**8**	Understand predictive analysis principles, predictive models, and their application in transforming data into future insights.	1,2
II	**Statistical Analysis** Define Statistics and its types, Measures of Central Value; Mean, Median and Mode, Measures of Dispersion: Absolute and Relative measures of dispersion - Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation, Moments, Skewness, Kurtosis.	**8**	Define statistics, its types, and key measures such as mean, median, mode, and various measures of dispersion.	1,2
III	**DATA MINING** What is a Data Mining applications? Strategy for data mining: CRISP-DM, Steps of Data Mining, Stages and tasks in CRISP-DM, Life Cycle of a Data Mining Project, Skills Needed for Data Mining. Identify nodes and streams, The framework of a Data – mining project, Brief the unit of analysis,	**8**	Explain data mining applications, strategy using CRISP-DM, stages in a data mining project, and required skills.	2,3

	Explain the type of dialog box.			
IV	**UNIT OF ANALYSIS** Concepts of Unit of analysis (Distinct, Aggregate, SetToFlag), Integrate data, CLEM Expression, Role of Relationship between two fields, Identifying the modeling objective.	**8**	Define unit of analysis concepts (distinct, aggregate, SetToFlag), integrate data using CLEM Expression, and identify modeling objectives.	2,3
V	**PREDICTIVE ANALYTICS WITH IBM WATSON STUDIO** Understanding of IBM Cloud, IBM Watson Studio, Watson studio Components, Creating a Machine Learning Model, Data preparation, Watson Machine learning, Data Refinery, Watson Studio Neural Network Modeler, IBM Watson Studio jobs, Use case with AutoAI.	**8**	Utilize IBM Watson Studio for machine learning model creation, data preparation, Watson Machine Learning, Data Refinery, Neural Network Modeler, and AutoAI use cases.	1,2,5,6
Practical Component				
Practical 1	Match key predictive analysis terms with their definitions.	2	Identify and understand key predictive analysis terms and definitions..	1
Practical 2	Identify different types of predictive models.	2	Recognize and categorize different types of predictive models.	1
Practical 3	Explain the steps in the predictive modeling process.	2	Understand and explain the steps involved in the predictive modeling process.	2
Practical 4	Explain various model evaluation metrics.	2	Understand and explain different model evaluation metrics and their applications.	2
Practical 5	Implement a linear regression model.	2	Apply linear regression techniques to train and evaluate a predictive model.	3
Practical 6	Perform data preprocessing tasks for predictive analysis.	2	Apply data preprocessing techniques to prepare data for predictive analysis.	3
Practical 7	Analyze the importance of features in a predictive model.	2	Analyze and identify the most important features in a predictive model.	4
Practical 8	Analyze the performance of different predictive models.	2	Analyze and compare the performance of various predictive models.	4
Practical 9	Evaluate the impact of overfitting and underfitting on model performance.	2	Evaluate and understand the effects of overfitting and underfitting on model performance.	5
Practical 10	Assess the generalizability of a	2	Students will assess and	5

	predictive model.		understand the generalizability of predictive models.	
Practical 11	Build and evaluate a classification model.	2	Build and evaluate a classification model to make predictions.	6
Practical 12	Develop a time series forecasting model.	2	develop and evaluate a time series forecasting model.	6
Practical 13	Implement a clustering algorithm for data segmentation.	2	Implement and analyze the results of a clustering algorithm.	6
Practical 14	Design a predictive maintenance model for machinery or equipment..	2	Design and evaluate a predictive maintenance model.	6
Practical 15	Create an end-to-end predictive analytics pipeline..	2	Create and implement an end-to-end predictive analytics pipeline for real-world applications.	6

TEXT BOOKS:

1. Predictive Analytics Mesmerizing & fascinating by ERIC SIEGEL

REFERENCE BOOKS:

1. "Applied Predictive Modeling" by Max Kuhn and Kjell JohnsonDatabase Management Systems
2. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy
3. "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die" by Eric Siegel

OTHER LEARNING RESOURCES:

1. https://www.ibm.com/topics/predictive-analytics
2. https://www.simplilearn.com/what-is-predictive-analytics-article
3. https://www.ibm.com/products/watson-studio

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand and critically apply the concepts and methods of Predictive analytics.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
2	Understand and apply IBM SPSS Modeler in Data Mining, what kinds of data can be mined, what kinds of patterns can be mined.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
3	Applying and analysing how to use functions, deal with missing values, use advanced field operations, handle sequence data and improve efficiency.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
4	Get exposed to the testing of hypothesis and solving assumptions	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
5	Understanding of IBM Watson Studio with Machine Learning Model.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.

SEMESTER – VI										
Course Title	**PE-V: Wireless Sensor Networks**									
Course code	**23BTCS325R**	**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 Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1. To understand the fundamental concepts of wireless sensor networks, their architecture, and applications. 2. To explore various protocols and algorithms used in WSN for data collection, routing, and energy efficiency. 3. To analyze the challenges and solutions for deploying WSNs in real-world scenarios. 4. To develop skills in designing, simulating, and implementing WSN applications. 5. To evaluate the performance and reliability of WSN systems									
CO1	Explain the basic concepts, architecture, and applications of wireless sensor networks.									
CO2	Demonstrate knowledge of various WSN protocols and their functions.									
CO3	Identify and address the challenges in WSN deployment, including energy management and network scalability.									
CO4	Design and simulate WSN applications using appropriate tools and methodologies.									
CO5	Assess the performance, reliability, and security aspects of WSNs.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Wireless Sensor Networks:** Overview of Wireless Sensor Networks Sensor nodes and their architecture Types of sensors and sensor networks Applications of WSN in various fields (environmental monitoring, healthcare, military, etc.) Basic WSN concepts: sensing, communication, and computation	**8**	understand wireless sensor network (WSN) principles, protocols, design considerations, and apply them to develop and deploy WSN solutions effectively..	**1,2, 3**
II	**WSN Protocols and Architectures:** Network architectures (flat, hierarchical, and location-based) Medium Access Control (MAC) protocols for WSN Routing protocols: data-centric, hierarchical, and location-based Data dissemination and aggregation techniques	**8**	Comprehend WSN protocols, network architectures, routing algorithms, energy-efficient techniques, and apply them to design scalable and robust WSNs.	**2,3, 4**
III	**Energy Management in WSN:** Energy consumption in sensor nodes Energy-efficient MAC and routing protocols	**10**	Understand energy consumption patterns, optimization techniques, power-efficient protocols, and apply strategies to prolong	**2**

	Power management and energy harvesting techniques Sleep scheduling and duty cycling Case studies of energy management in WSN		battery life in wireless sensor networks.	
IV	**Challenges and Solutions in WSN Deployment:** Scalability and network topology control Localization and positioning techniques Time synchronization methods Security issues and countermeasures in WSN Case studies of WSN deployments in real-world scenarios	**10**	Identify challenges in WSN deployment, such as coverage, connectivity, security, and propose effective solutions to overcome deployment obstacles.	**2,3, 4**
V	**WSN Design, Simulation, and Performance Evaluation:** Tools and platforms for WSN simulation (e.g., NS-2/3, TOSSIM, Cooja) Designing and implementing WSN applications Simulation-based performance analysis Real-world implementation and testing of WSN Future trends and research directions in WSN	**9**	Design WSN architectures, simulate network behavior, evaluate performance metrics, and optimize system parameters for enhanced network efficiency.	**3,5, 6**
Practical Component				
Practical 1	Match key IoT terms with their definitions.	2	Identify and understand key IoT terms and definitions.	1
Practical 2	Identify different types of IoT devices.	2	Recognize and categorize different types of IoT devices.	1
Practical 3	Explain the architecture of IoT systems.	2	Understand and explain the components and roles in an IoT architecture.	2
Practical 4	Explain various IoT communication protocols.	2	understand and explain different IoT communication protocols and their applications.	2
Practical 5	Set up a basic IoT device.	2	apply IoT setup techniques to configure a basic IoT device.	3
Practical 6	Collect and analyze data from an IoT device.	2	Apply data collection and analysis techniques to interpret IoT data.	3
Practical 7	Analyze network traffic in an IoT system.	2	Analyze network traffic to identify patterns and potential issues.	4
Practical 8	Analyze security vulnerabilities in IoT devices.	2	Analyze and identify security vulnerabilities in IoT devices.	4

Practical 9	Evaluate methods for managing IoT data.	2	Evaluate and understand different methods for managing IoT data.	5
Practical 10	Assess the performance of an IoT device.	2	Assess and interpret the performance metrics of IoT devices.	5
Practical 11	Build a working IoT prototype.	2	Students will build and test an IoT prototype, demonstrating practical IoT skills.	6
Practical 12	Develop an application for IoT device control.	2	Develop and implement an application for managing IoT devices.	6
Practical 13	Implement a security solution for an IoT system.	2	Implement and evaluate security solutions for IoT systems.generation.	6
Practical 14	Design a smart home system using IoT devices.	2	Design and implement a smart home system using IoT technology.	6
Practical 15	Create an interactive dashboard for IoT data visualization.	2	Create and use an interactive dashboard to monitor and analyze IoT data.	6

Text Books:

1. Wireless Sensor Networks: Technology, Protocols, and Applications by Kazem Sohraby, Daniel Minoli, and TaiebZnati.
2. Protocols and Architectures for Wireless Sensor Networks by Holger Karl and Andreas Willig.

Reference Books:

1. Wireless Sensor Networks: An Information Processing Approach" by Feng Zhao and Leonidas Guibas.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Explain the basic concepts, architecture, and applications of wireless sensor networks.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
2	Demonstrate knowledge of various WSN protocols and their functions.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
3	Identify and address the challenges in WSN deployment, including energy management and network scalability.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
4	Design and simulate WSN applications using appropriate tools and methodologies.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
5	Assess the performance, reliability, and security aspects of WSNs.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.

SEMESTER – VI										
Course Title	**PE-VI: Big Data Analytics**									
Course code	**23BTCS326R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+30 P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**DBMS**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1. Gain foundational knowledge of Big Data, including its characteristics, technologies, and real-world applications across various domains. 2. Learn the architecture and components of Hadoop and Spark, and develop practical skills in data ingestion, processing, and management. 3. Develop the ability to perform analytics on Big Data, apply machine learning techniques, and utilize visualization tools for insightful data representation.								
CO1	Understand the characteristics and real-world applications of Big Data, differentiating it from traditional data.								
CO2	Demonstrate the use of Hadoop and Spark frameworks by executing basic data processing tasks.								
CO3	Analyze and compare various NoSQL databases and their suitability for different types of Big Data storage requirements.								
CO4	Evaluate different data pre-processing techniques and machine learning tools for effective Big Data analytics.								
CO5	Design a real-time Big Data analytics pipeline using cloud-based solutions and ensuring data security and privacy.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Big Data:** Overview of Big Data: Definition and characteristics of Big Data (Volume, Velocity, Variety, Veracity, and Value), Differences between traditional data and Big Data. Big Data in the Real World: Applications in various domains (healthcare, finance, social media, e-commerce, etc.), Case studies of Big Data applications. Big Data Technologies: Introduction to Hadoop ecosystem, NoSQL databases overview (e.g., MongoDB, Cassandra). Big Data Challenges: Data storage and management issues, Privacy and ethical considerations in Big Data. Data Generation Sources: Structured vs. Unstructured data, Data from sensors, social media, and other digital platforms.	**8**	Understand the definition, characteristics, and real-world applications of Big Data, as well as the technologies and challenges associated with it.	**2,4**
II	**Big Data Processing Frameworks:** Hadoop Fundamentals: Architecture of Hadoop, Hadoop Distributed File System (HDFS), MapReduce	**8**	Grasp the fundamentals of Hadoop ecosystem, including HDFS, MapReduce, and related	**2,3**

	Programming model. Hadoop Ecosystem Components: Introduction to Pig, Hive, HBase, and other related tools, Use cases and applications of each component. Data Ingestion Tools: Overview of Sqoop and Flume, Real-time data processing with Apache Kafka. Spark Framework: Introduction to Apache Spark, Spark vs. Hadoop MapReduce, Spark RDDs (Resilient Distributed Datasets). Hands-On Exercises: Basic HDFS commands, Writing and running a simple MapReduce Programme.		tools, as well as Spark framework and its comparison with Hadoop.	
III	**Data Storage and Management:** NoSQL Databases: Types of NoSQL databases: Document, Key-Value, Column Family, Graph, CAP theorem and BASE properties. MongoDB: Features and architecture of MongoDB, CRUD operations in MongoDB, Indexing and aggregation. Cassandra: Features and architecture of Cassandra, Data modeling in Cassandra, Querying in Cassandra using CQL. HBase: Introduction to HBase and its architecture, HBase data model and operations, Integration of HBase with Hadoop. Data Warehousing Solutions: Introduction to Big Data warehousing solutions like Amazon Redshift and Google BigQuery.	**10**	Gain knowledge of NoSQL databases, focusing on MongoDB, Cassandra, HBase, and Big Data warehousing solutions, and their features, architecture, and operations.	**2,3**
IV	**Big Data Analytics and Tools:** Introduction to Big Data Analytics: Importance of analytics in Big Data, Types of analytics: Descriptive, Diagnostic, Predictive, Prescriptive. Data Pre-processing Techniques: Data cleaning, transformation, and reduction, Handling missing data and outliers. Machine Learning with Big Data: Overview of machine learning algorithms used in Big Data, Introduction to scalable machine learning tools like MLlib. Big Data Visualization: Importance of data visualization, Tools for Big Data	**10**	Understand the importance of analytics in Big Data, pre-processing techniques, machine learning algorithms, and data visualization tools.	**2,3,5**

	visualization (e.g., Tableau, D3.js).			
V	**Advanced Topics in Big Data Analytics:** Real-Time Big Data Analytics: Stream processing with Apache Storm and Spark Streaming, Real-time data pipelines and architectures. Big Data Security and Privacy: Security challenges in Big Data, Techniques and tools for securing Big Data, Cloud-Based Big Data Solutions: Overview of Big Data solutions on AWS, Azure, and Google Cloud, Case studies on cloud-based Big Data implementations. Future Trends in Big Data: Emerging technologies and trends in Big Data, The impact of AI and IoT on Big Data.	**9**	Explore real-time Big Data analytics, security and privacy challenges, cloud-based Big Data solutions, and future trends in Big Data technologies.	**2,4,5**
Practical Component				
Practical 1	Match big data terms with their definitions.	2	Identify and understand key big data analytics terms and definitions.	1
Practical 2	Identify different big data technologies and tools.	2	Recognize and categorize different big data technologies and their primary uses.	1
Practical 3	Explain the architecture of big data systems.	2	Understand and explain the components and roles in a big data architecture.	2
Practical 4	Explain different data storage models.	2	Understand and explain various data storage models and their differences.	2
Practical 5	Perform data ingestion using Hadoop.	2	Apply data ingestion techniques using Hadoop.	3
Practical 6	Process data using Apache Spark.	2	Apply data processing techniques using Apache Spark.	3
Practical 7	Analyze large data sets using big data tools.	2	Analyze large data sets to extract insights using big data tools.	4
Practical 8	Analyze the efficiency of MapReduce jobs.	2	Analyze and interpret the efficiency of MapReduce jobs.	4
Practical 9	Evaluate the performance of big data systems.	2	Evaluate and interpret the performance of various big data systems using appropriate metrics.	5
Practical 10	Assess the quality of big data	2	Critically assess the	5

	sources.		quality and reliability of big data sources.	
Practical 11	Build and implement a big data processing pipeline.	2	design and implement a data processing pipeline for big data.	6
Practical 12	Develop a real-time data analytics application.	2	Develop real-time analytics applications to process streaming data.	6
Practical 13	Implement machine learning models on big data platforms.	2	Implement and test machine learning models on big data platforms.	6
Practical 14	Design and set up a data lake.	2	Design and implement a data lake for scalable data storage and processing.	6
Practical 15	Develop an interactive big data analytics dashboard.	2	Develop interactive dashboards to visualize and explore big data insights dynamically.	6

TEXT BOOKS:

1. "Big Data: Principles and Best Practices of Scalable Realtime Data Systems" by Nathan Marz, James Warren, Manning Publications.
2. "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost, Tom Fawcett, O'Reilly Media.
3. "Big Data: A Revolution That Will Transform How We Live, Work, and Think" by Viktor Mayer-Schönberger, Kenneth Cukier, Eamon Dolan/Mariner Books.

REFERENCE BOOKS:

1. "Hadoop: The Definitive Guide" by Tom White, O'Reilly Media.

2. "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems" by Martin Kleppmann, O'Reilly Media.

3. "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence" by Pramod J. Sadalage, Martin Fowler, Addison-Wesley.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand the characteristics and real-world applications of Big Data, differentiating it from traditional data.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
2	Demonstrate the use of Hadoop and Spark frameworks by executing basic data processing tasks.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
3	Analyze and compare various NoSQL databases and their suitability for different types of Big Data storage requirements.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
4	Evaluate different data preprocessing techniques and machine learning tools for effective Big Data analytics.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
5	Design a real-time Big Data analytics pipeline using cloud-based solutions and ensuring data security and privacy.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.

SEMESTER – VI									
Course Title	**PE-VI: Internet of Things**								
Course code	**23BTCS326R**	**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 Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1. To introduce the different terminology, technology of IoT and its applications 2. To introduce the concept of M2M (machine to machine) with necessary protocols 3. To introduce the Python Scripting Language which is used in many IoT devices 4. To introduce the Raspberry PI platform, that is widely used in IoT applications 5. To introduce the implementation of web-based services on IoT devices								
CO1	Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules.								
CO2	Understand IoT value chain structure (device, data cloud), application areas and technologies involved.								
CO3	Market forecast for IoT devices with a focus on sensors								
CO4	Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi								
CO5	Apply database knowledge to a real-world data analytics project.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Internet of Things-** Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.	**8**	Understand IoT concepts, architecture, communication protocols, sensor integration, and design basic IoT applications for various domains..	**1,2**
II	**IoT Physical Devices and Endpoints-** Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors.	**8**	comprehend IoT device hardware, sensors, actuators, communication interfaces, and configure/manage physical endpoints for IoT applications effectively.	**2,4**
III	**IOT Data Communication:** Transfer data by Wireless / Wired connectivity, Ipv4/Ipv6, 2g ,3g ,4g & 5g IEEE 802.15.4, IEEE 802.15.4e, 802.11ah, Relay Access Point (AP) Grouping of station Target Wake Time (TWT), Software defined networks, network function virtualization, difference between SDN and NFV for IoT.	**10**	Understand IoT communication protocols, data formats, transmission techniques, and implement efficient data communication solutions for IoT networks.	**2,3**
IV	**IOT Data Storage & Retrieval:** Overview	**10**	Comprehend IoT data	**2,3,4**

	and Role of Storage in Cloud / Server /Inhouse Storage, Databases Connectivity with IOT devices and users, Case Study over Mysql / NoSql / NewSql, Cloud Services and Administration, Case Study Of Big Data & Hadoop Platforms.		storage architectures, database systems, retrieval methods, and implement scalable and efficient data storage solutions for IoT applications.	
V	**IoT Data Analysis:** An Introduction to Data Science and Analytics Data Analysis Using NumPy , Pandas Data Cleaning, Missing Data, Feature extraction, Data Visualization – Static, Dynamic & Geographical Visualization. Linear Regression, Supervised Learning (Classification) and Unsupervised Learning (Clustering) algorithms, Time Series Analysis	**9**	Analyze IoT data using statistical techniques, machine learning algorithms, and extract actionable insights to optimize IoT system performance.	**2,3,4**

Text Books:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
3. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759
4. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895

Reference Books:

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan
2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
2	Understand IoT value chain structure (device, data cloud), application areas and technologies involved.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
3	Market forecast for IoT devices with a focus on sensors	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
4	Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
5	Apply database knowledge to a real-world data analytics project.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.

SEMESTER – VI									
Course Title	**Field-based Training**								
Course code	**23BTCS327R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30 P	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**All UG Programs**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings. 4. To foster collaboration and communication skills through group projects and professional interactions. 5. To cultivate an appreciation for the complexities and challenges of professional practice in the field.								
CO1	Apply theoretical concepts to real-world situations.								
CO2	Conduct field-based research and gather data effectively.								
CO3	Analyze and interpret the university data to draw meaningful conclusions.								
CO4	Communicate findings clearly and effectively, both orally and in writing.								
CO5	Demonstrate professional behavior and teamwork skills in field settings.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	The organization will provide the students one field visit for this Programme. The students will be taken to a specific blocks of the university for learning purposes. The students will visit all department block site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners of IT department of the university. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial findings.	**30**	Gain practical experience in real-world settings relevant to the field of study or profession. Also apply theoretical knowledge to practical scenarios, enhancing skill proficiency and problem-solving abilities.	**2,3**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Apply theoretical concepts to real-world situations.	CO1, CO2, CO3, CO4, CO5, CO6, CO10, CO12.
2	Conduct field-based research and gather data effectively.	CO1, CO2, CO3, CO4, CO5, CO6, CO10, CO12
3	Analyze and interpret the university data to draw meaningful conclusions.	CO1, CO2, CO3, CO4, CO5, CO6, CO10, CO12
4	Communicate findings clearly and effectively, both orally and in writing.	CO1, CO2, CO3, CO4, CO5, CO6, CO10, CO12
5	Demonstrate professional behaviour and teamwork skills in field settings.	CO1, CO2, CO3, CO4, CO5, CO6, CO10, CO12

SEMESTER – VI									
Course Title	**Mini Project IV**								
Course code	**23BTCS316R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30P	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the third year of the Programme**								
Course Objectives	1. Develop advanced technical skills through individual or group project work in engineering domains. 2. Enhance project management abilities, including workload management and meeting project deadlines effectively. 3. Improve presentation skills through seminar presentations and public demonstrations of project outcomes.								
CO1	Apply IT principles to solve real-world problems.								
CO2	Contribute to complex projects as a team member.								
CO3	Apply Programming languages and platforms to develop software and hardware solutions.								
CO4	Demonstrate personal and team management skills in software development.								
CO5	Cultivate employability skills and professionalism commitment.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: a. theoretical studies b. computer simulations c. hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project; 4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field;	**30**	Demonstrate proficiency in conducting literature reviews, performing technical work, maintaining progress reports, delivering seminars, preparing formal reports, and presenting project outcomes effectively.	**2,3,4,5,6**

	5. Prepare a formal report describing the work undertaken and results obtained so far; and 6. Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.			

REFERENCE BOOKS:

1. "The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams

2. "Doing Your Research Project: A Guide for First-Time Researchers" by Judith Bell and Stephen Waters

3. "How to Write a Thesis" by Umberto Eco

4. "Effective Project Management: Traditional, Agile, Extreme" by Robert K. Wysocki

5. "Writing for Computer Science" by Justin Zobel

6. "The Elements of Style" by William Strunk Jr. and E.B. White

7. "Python Crash Course" by Eric Matthes (if applicable for coding projects)

8. "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett (if applicable for data science projects).

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Apply IT principles to solve real-world problems.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10, CO11, CO12.
2	Contribute to complex projects as a team member.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10,CO11, CO12.
3	Apply Programming languages and platforms to develop software and hardware solutions.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10, CO11, CO12.
4	Demonstrate personal and team management skills in software development.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10, CO11, CO12.
5	Cultivate employability skills and professionalism commitment.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10,CO11, CO12.

SEMESTER – VII										
Course Title	**Design & Analysis of Algorithms**									
Course code	**23BTCS411R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Data Structures**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/ I semester of the fourth year of the Programme**								
Course Objectives	1. Analyse the asymptotic performance of algorithms. 2. Demonstrate a familiarity with major algorithms and data structures. 3. Apply important algorithmic design paradigms and methods of analysis.								
CO1	Understand analysis of algorithms using asymptotic notations for advanced problem-solving.								
CO2	Implement sorting, searching, matrix multiplication algorithms with varied strategies.								
CO3	Apply greedy approaches and dynamic Programming to optimize problem-solving, for advanced algorithm design.								
CO4	Apply problem-solving strategies to complex scenarios, solving N-Queen, knapsack, and TSP, etc.								
CO5	Evaluate decision tree bounds, interpret complexity classes P, NP, NP-Complete proficiently.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction: Characteristics of algorithm.** Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.	**8**	Understand and analyze the best, average, and worst-case complexities of algorithms.	**2,4**
II	**Fundamental Algorithmic Strategies:** Brute-Force, Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics –characteristics and their application domains.	**8**	Apply different algorithmic strategies such as Brute-Force, Greedy, and Dynamic Programming to solve problems.	**3,4,5**
III	**Graph and Tree Algorithms:** Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow	**10**	Implement traversal algorithms and determine the shortest paths in graphs.	**3,4**

	Algorithm.			
IV	**Tractable and Intractable Problems:** Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques	**10**	Differentiate between P, NP, NP-complete, and NP-hard classes and understand the significance of Cook's theorem.	**2,4,5**
V	**Advanced Topics:** Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE	**9**	Develop and analyze approximation and randomized algorithms for complex problems.	**3,4,6**
Practical Component				
Practical 1	Implement and analyze the time complexity of Bubble Sort, Selection Sort, and Insertion Sort.	**2**	Compare the time complexities of different sorting algorithms in best, average, and worst cases.	**4**
Practical 2	Use the substitution method to solve simple recurrence relations.	**2**	Apply the substitution method to determine the time complexity of recursive algorithms.	**3**
Practical 3	Implement a recursive algorithm and analyze its performance using the recursion tree method.	**2**	Visualize and analyze the time complexity of recursive algorithms using recursion trees.	**4**
Practical 4	Solve the 0/1 Knapsack problem using dynamic Programming.	**2**	Develop and apply dynamic Programming to solve optimization problems.	**3,6**
Practical 5	Implement a solution to the Traveling Salesman Problem using the branch and bound technique.	**2**	Apply branch and bound to solve combinatorial optimization problems.	**3,4**
Practical 6	Design and implement a greedy algorithm for the Fractional Knapsack problem.	**2**	Understand and apply the greedy strategy to solve optimization problems.	**2,3**
Practical 7	Implement backtracking to solve the N-Queens problem.	**2**	Apply backtracking techniques to solve constraint satisfaction problems.	**3,4**
Practical 8	Implement a brute-force solution for the Bin Packing problem and evaluate its efficiency.	**2**	Evaluate the efficiency of brute-force algorithms for combinatorial problems.	**5**
Practical 9	Implement Depth First Search (DFS) and Breadth First Search (BFS) for graph traversal.	**2**	Implement and compare DFS and BFS traversal techniques.	**3,4**
Practical 10	Implement Dijkstra's algorithm to find the shortest path in a weighted graph.	**2**	Apply shortest path algorithms to find the minimum distance between nodes in a graph.	**3**
Practical 11	Implement Kruskal's and Prim's algorithms to find the Minimum Spanning Tree (MST).	**2**	Compare and apply different algorithms to find MST in a graph.	**3,4**
Practical 12	Perform topological sorting on a	**2**	Understand and implement	**2,3**

	directed acyclic graph (DAG).		topological sorting on DAGs.	
Practical 13	Implement the reduction technique to show that a problem is NP-complete.	**2**	Demonstrate the reduction technique to classify problems within NP-complete.	**3,4**
Practical 14	Solve an NP-hard problem using approximation algorithms.	**2**	Apply approximation techniques to find near-optimal solutions to NP-hard problems.	**3,5**
Practical 15	Implement a randomized algorithm for the Minimum Cut problem.	**2**	Understand and apply randomized algorithms to solve complex problems.	**2,3**

TEXT BOOKS:

T1: Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
T2: Fundamentals of Algorithms – E. Horowitz et al.

REFERENCE BOOKS:

R1: Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
R2: Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition,
R3: Michael T Goodrich and Roberto Tamassia, Wiley.
R4: Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

OTHER LEARNING RESOURCES:

1. https://ocw.mit.edu/courses/6-006-introduction-to-algorithms-Summer-2011/pages/lecture-notes/
2. https://www.vssut.ac.in/lecture_notes/lecture1428551222.pdf

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand analysis of algorithms using asymptotic notations for advanced problem-solving.	CO1, CO2, CO3, CO4, CO11, CO12
2	Implement sorting, searching, matrix multiplication algorithms with varied strategies.	CO1, CO2, CO3, CO4, CO11, CO12
3	Apply greedy approaches and dynamic Programming to optimize problem-solving, for advanced algorithm design.	CO1, CO2, CO3, CO4, CO9, CO10, CO11, CO12
4	Apply problem-solving strategies to complex scenarios, solving N-Queen, knapsack, and TSP, etc.	CO1, CO2, CO3, CO4, CO9, CO10, CO11, CO12
5	Evaluate decision tree bounds, interpret complexity classes P, NP, NP-Complete proficiently.	CO1, CO2, CO3, CO4, CO9, CO10, CO11, CO12

SEMESTER – VII										
Course Title	**Compiler Design**									
Course code	**23BTCS412R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Theory of Computation**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/ I semester of the fourth year of the Programme**								
Course Objectives	1. Discuss the process of translating a high-level language to machine code required for compiler construction. 2. Analyze the software tools and techniques used in compiler construction such as lexical analyser and parser generators 3. Discuss the data structures used in compiler construction such as abstract syntax trees, symbol tables, three address code and stack machines.									
CO1	Understand different phases of a compiler and explain lexical analysis principles.									
CO2	Apply parsing techniques to build a language-specific syntax analyser.									
CO3	Analyse syntax-directed translations, evaluation order, and type checking.									
CO4	Understand the association of runtime storage allocation with control flow and procedure calls.									
CO5	Apply code optimization on intermediate code for target code generation.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Compiler structure:** Analysis-synthesis model of compilation, Various phases of a compiler, Tool based approach to compiler construction. Lexical analysis: Interface with input, Parser and symbol table, Token, Lexeme and patterns, Regular definition, Transition diagrams, LEX.	**8**	Understand the analysis-synthesis model of compilation and the role of lexical analysis in converting source code into tokens using tools like LEX.	**1,2,3**
II	**Syntax analysis:** CFG's, Ambiguity, Associativity, Precedence, Top-down parsing, Recursive descend parsing, Transformation on the grammars, Predictive parsing, Bottom-up parsing, Operator precedence grammars, LR parsers (SLR, Canonical, LALR), YACC	**8**	Grasp the concepts of context-free grammars (CFGs) and develop skills in various parsing techniques including top-down and bottom-up parsing methods, utilizing tools like YACC.	**3,4**
III	**Syntax directed translation:** Inherited and synthesized attributes, Dependency graph, Evaluation order, Bottom up evaluation of S-attributed definitions L- attributed definitions and top down translation of attributes Type checking: Type system, Type expressions, Structural and name equivalence of types, Type conversion.	**10**	Learn to design and implement syntax-directed translation schemes, focusing on attribute grammars and type checking mechanisms, and understand the differences between structural and name equivalence of types.	**3,4**
IV	**Run time environments:**	**10**	Comprehend the	**4**

	Storage organization, Storage-allocation strategies, Access to nonlocal names, Activation tree, Activation record, Parameter passing, Symbol table and dynamic storage allocation Intermediate code generation: Intermediate representations, Translation of declarations, Assignments, Control flow, Boolean expressions and procedure calls.		organization and management of run-time storage, including activation records and parameter passing techniques, and learn the principles of intermediate code generation.	
V	**Code generation:** Issues in the design of a code generator, Basic blocks and flow graphs, Next use information, Register allocation, Code generation algorithm, Dag representation of Programs, Code generation from dags, Peephole optimization and code generator generators.	**9**	Acquire knowledge on the design and implementation of a code generator, emphasizing optimization techniques, basic blocks, flow graphs, and register allocation strategies.	**4**
Practical Component				
Practical 1	Design a lexical analyser for a simple Programming language using LEX.	2	Understand the basics of lexical analysis and the use of tools like LEX to create lexical analysers.	3
Practical 2	Implement a Programme to identify different tokens, lexemes, and patterns in a given source code.	2	Ability to recognize and classify tokens, lexemes, and patterns within a source code.	2
Practical 3	Create a transition diagram for a given regular expression and simulate its working.	2	Comprehend the conversion of regular expressions to transition diagrams and their usage in lexical analysis.	2
Practical 4	Write a recursive descent parser for a given context-free grammar (CFG).	2	Develop and implement top-down parsing techniques using recursive descent methodology.	3
Practical 5	Implement an SLR parser for a specified grammar and test it with various input strings.	2	Understand and apply bottom-up parsing techniques, specifically SLR parsing.	3
Practical 6	Using YACC, create a parser for a small language and demonstrate its usage with sample inputs.	2	Gain practical experience with parser generators like YACC and their integration with lexical analysers.	3
Practical 7	Construct a dependency graph for a given annotated parse tree and determine the order of attribute evaluation.	2	Understand the relationship between parse trees and attribute evaluation orders.	4
Practical 8	Develop an attribute grammar for a simple language construct and	2	Understand and implement syntax-directed translation	3

	implement its evaluation using synthesized and inherited attributes.		using attribute grammars.	
Practical 9	Write a type checker for a language that includes basic types, type expressions, and type conversions.	2	Implement type checking mechanisms and understand type systems and conversions.	3
Practical 10	Simulate the activation record creation and management for a simple recursive function.	2	Understand the structure and management of activation records in a runtime environment.	3
Practical 11	Implement intermediate code generation for a given set of language constructs (e.g., if-else, loops).	2	Develop skills in generating intermediate representations of high-level language constructs.	3
Practical 12	Create a symbol table management system that handles scope and lifetime of variables.	2	Design and implement a symbol table for managing variable scopes and lifetimes.	3
Practical 13	Design and implement a basic block and flow graph generator for a given intermediate code.	2	Understand the concepts of basic blocks and control flow graphs in code generation.	3
Practical 14	Develop a register allocation algorithm using graph coloring techniques.	2	Apply graph coloring techniques for efficient register allocation during code generation.	3
Practical 15	Implement a peephole optimization technique for a given intermediate code and demonstrate its effectiveness.	2	Understand and apply optimization techniques at the code generation level.	3

TEXT BOOKS:

T1: A.V. Aho, R. Sethi, J.D. Ullman, "Compilers: Principles, Techniques and Tools", Addison – Wesley.
T2: Steven S. Muchnick, "Advanced Compiler Design and Implementation", Elsevier

REFERENCE BOOKS:

R1: W. Appel, "Modern Compiler Implementation in C: Basic design", Cambridge Press
R2: Fraser and Hanson, "A Retargetable C Compiler: Design and Implementation", Addison-Wesley
R3: Dhamdhere, "Compiler Construction", McMillan

OTHER LEARNING RESOURCES:

1. www.vssut.ac.in/lecture_notes/lecture1422914957.pdf
2. 2.http://csenote.weebly.com/principles-of-compiler-design.html
3. http://www.faadooengineers.com/threads/32857,Compiler-Design-Notes-full-book-pdf-download
4. https://www.vidyarthiplus.com/vp/thread,37033.html#.WF0PhlMrLDc

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand different phases of a compiler and explain lexical analysis principles.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
2	Apply parsing techniques to build a language-specific syntax analyser.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
3	Analyse syntax-directed translations, evaluation order, and type checking.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
4	Understand the association of runtime storage allocation with control flow and procedure calls.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
5	Apply code optimization on intermediate code for target code generation.	CO1, CO2, CO3, CO4, CO5, CO10, CO12

SEMESTER – VII									
Course Title	**Elementary Statistical Analysis**								
Course code	**23BTCS413R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**3**	**1**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/ I semester of the fourth year of the Programme**								
Course Objectives	1. To familiarize students with the fundamental concepts and terminology used in statistics, including descriptive and inferential statistics. 2. To enhance students' ability to collect, organize, analyze, and interpret data using appropriate statistical methods. 3. To enable students to apply statistical techniques to real-world problems, ensuring they can effectively use statistical software and interpret the results.								
CO1	Distinguish between different sampling methods and identify sampling and non-sampling errors in data collection.								
CO2	Apply probability theorems to solve problems involving binomial, Poisson, exponential, beta, and normal distributions.								
CO3	Conduct hypothesis tests and determine the significance for attributes and variables in large and small samples.								
CO4	Analyze relationships using multiple regression and correlation techniques; apply control charts in quality control.								
CO5	Perform non-parametric tests and analysis of variance (ANOVA) to evaluate data distributions.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Sampling and Sample Design** Introduction and Types of Sampling, Sampling Methods. Point Estimation and Interval Estimation. Sampling and Non-Sampling Errors	**8**	Distinguish between different sampling methods and their applicability in various research contexts.	**2,4**
II	**Probability and Theoretical Distribution** Approaches to Probability. Theorems of Probability. Binomial and Poisson Distribution. Exponential, Beta & Normal Distribution	**8**	Apply probability theorems to solve problems involving binomial, Poisson, and normal distributions.	**3,4**
III	**Hypothesis Testing and Significance Tests in Attributes & Variables** Procedure of Testing a Hypothesis. Significance Test in Attributes. Significance Test in Variables (Large Samples). Significance Test in Variables (Small Samples)	**10**	Conduct hypothesis tests for attributes and variables using large and small sample techniques.	**3,5**
IV	**Regression, Correlation and Statistical Quality Control** Partial & Multiple Correlation Multiple Regression Analysis Types and Techniques of Statistical Quality Control. Control Charts for Attributes and Variables.	**10**	Perform multiple regression analysis and interpret the results for statistical quality control.	**3,4**

V	**Non Parametric Tests and Analysis of Variance** Chi-Square Test. Sign Test & Median Test. F Test / Multivariate Analysis Technique Analysis of Variance (ANNOVA)	**9**	Conduct ANOVA and non-parametric tests like Chi-Square to analyze data.	**3,5**

TEXT BOOKS:

T1: S. P. Gupta, Statistical Methods, Sultan Chand & Sons.

T2: C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa Prakashan.

REFERENCE BOOKS:

R1: Bendat and Piersol, Random data: Analysis and Measurement Procedures, Wiley InterScience
R2: D.C. Sancheti, V.K. Kapoor, Statistics, Theory methods and Application, Sultan Chand & Sons.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Distinguish between different sampling methods and identify sampling and non-sampling errors in data collection.	CO1, CO2, CO3, CO4, CO5, CO10
2	Apply probability theorems to solve problems involving binomial, Poisson, exponential, beta, and normal distributions.	CO1, CO2, CO3, CO4, CO5, CO10
3	Conduct hypothesis tests and determine the significance for attributes and variables in large and small samples.	CO1, CO2, CO3, CO4, CO5, CO10
4	Analyze relationships using multiple regression and correlation techniques; apply control charts in quality control.	CO1, CO2, CO3, CO4, CO5, CO10
5	Perform non-parametric tests and analysis of variance (ANOVA) to evaluate data distributions.	CO1, CO2, CO3, CO4, CO5, CO10

SEMESTER – VII										
Course Title	**Project-I**									
Course code	**23BTCS414R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 120S+240R	**0**	**0**	**0**	**8**	**16**	**0**	**4**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/ I semester of the fourth year of the Programme**								
Course Objectives	1. To enable students to perform comprehensive literature searches, critically review current knowledge, and synthesize information on advanced technical topics. 2. To provide students with hands-on experience in conducting detailed technical work, including theoretical studies, computer simulations, or hardware construction. 3. To improve students' ability to communicate their research findings and technical work effectively through progress reports, seminars, formal reports, and presentations.									
CO1	Apply IT principles for real-world problem-solving using Programming languages and network solutions.									
CO2	Contribute to complex projects as a team member, demonstrating effective personal and team management.									
CO3	Develop Programming skills to create and assess software, hardware, and network solutions.									
CO4	Apply personal and team management skills as a professional software developer.									
CO5	Cultivate employability skills and uphold professionalism in software development.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: a) theoretical studies b) computer simulations c) hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project; 4. Deliver a seminar on the general area of work being undertaken		Develop and Demonstrate comprehensive research, technical, and communication skills through literature review, technical implementation, progress documentation, and presentation.	**3,4,5,6**

	and specific contributions to that field; 5. Prepare a formal report describing the work undertaken and results obtained so far; and Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.			

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Distinguish between different sampling methods and identify sampling and non-sampling errors in data collection.	CO1,CO2,CO3, CO4,CO5,CO6,CO7,CO8,CO9,CO10,CO11, CO12
2	Apply probability theorems to solve problems involving binomial, Poisson, exponential, beta, and normal distributions.	CO1,CO2,CO3, CO4,CO5,CO6,CO7,CO8,CO9,CO10,CO11, CO12
3	Conduct hypothesis tests and determine the significance for attributes and variables in large and small samples.	CO1,CO2,CO3, CO4,CO5,CO6,CO7,CO8,CO9,CO10,CO11, CO12
4	Analyze relationships using multiple regression and correlation techniques; apply control charts in quality control.	CO1,CO2,CO3, CO4,CO5,CO6,CO7,CO8,CO9,CO10,CO11, CO12
5	Perform non-parametric tests and analysis of variance (ANOVA) to evaluate data distributions.	CO1,CO2,CO3, CO4,CO5,CO6,CO7,CO8,CO9,CO10,CO11, CO12

SEMESTER – VII										
Course Title	**Generative AI**									
Course code	**23BTCS415R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30L+60S	**2**	**0**	**0**	**4**	**0**	**0**	**3**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Summer/ I semester of the fourth year of the Programme**								
Course Objectives	1. To provide students with a comprehensive understanding of generative AI concepts and techniques. 2. To equip students with the skills to develop and implement generative AI models. 3. To foster creativity and innovation by leveraging generative AI for various applications.								
CO1	Develop proficiency in using generative AI frameworks and tools to create, train, and optimize models.								
CO2	Design, implement, and evaluate various generative AI models such as GANs, VAEs, and autoregressive models.								
CO3	Apply generative AI techniques to solve real-world problems and create innovative solutions across different domains.								
CO4	Understand the ethical implications of generative AI and integrate responsible practices into their work.								
CO5	Critically analyze the strengths and limitations of different generative AI approaches and stay informed about current research and future trends.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Generative AI:** Definition and significance of generative AI. Historical context and evolution of generative models. Fundamental concepts: probability distributions, latent spaces, and learning paradigms. Overview of applications in various domains.	**5**	Explain the fundamental concepts and historical evolution of generative AI and its applications across various domains.	**1,2**
II	**Generative Adversarial Networks (GANs):** GAN architecture and working principles. Training GANs: challenges and solutions. Variants of GANs (e.g., DCGAN, WGAN, CycleGAN). Applications: image generation, style transfer, data augmentation.	**6**	Describe GAN architecture, training challenges, and their variants, including applications in image generation and style transfer.	**2,3**
III	**Variational Autoencoders (VAEs):** VAE architecture and mathematical foundations. Training and optimizing VAEs. Applications: data generation, anomaly detection, latent space exploration Objectives: 1. Understand the principles	**6**	Implement and optimize VAE models, understanding their architecture and applications in data generation and anomaly detection.	**3,4**

	and architecture of VAEs 2. Gain proficiency in training and optimizing VAE models 3. Explore various applications of VAEs			
IV	**Autoregressive Models and Transformers** Overview of autoregressive models (e.g., PixelRNN, PixelCNN). Transformer-based models (e.g., GPT, BERT) and their significance. Sequence generation and modeling	**7**	Compare autoregressive models and transformer-based models, explaining their significance in sequence generation and modeling.	**2,4**
V	**Ethical and Practical Considerations in Generative AI** Ethical implications of generative AI. Addressing bias and fairness in generative models. Security concerns and potential misuse. Future trends and research directions in generative AI.	**6**	Evaluate the ethical implications, bias, and security concerns of generative AI, and discuss future trends and research directions.	**2,5**
Practical Component				
Practical 1	Implementing a Simple GAN	3	Understand the basic architecture of GANs and implement a simple GAN model for image generation.	3
Practical 2	Training a DCGAN on CIFAR-10 Dataset	3	Gain proficiency in training Deep Convolutional GANs and understand the nuances of training on a standard dataset.	4
Practical 3	Exploring Latent Spaces with VAEs	3	Visualize and explore the latent space of a trained VAE, and understand how latent space manipulation affects generated outputs.	3
Practical 4	Anomaly Detection using VAEs	3	Implement a VAE for anomaly detection in a dataset and evaluate its performance.	5
Practical 5	Style Transfer using Cycle GAN	3	Apply CycleGAN for style transfer tasks and understand the underlying mechanics.	4
Practical 6	Training PixelCNN for Image Generation	3	Implement and train an autoregressive PixelCNN model for image generation.	4
Practical 7	Fine-tuning a Pre-trained Transformer Model (e.g., GPT-2)		Gain proficiency in fine-tuning a pre-trained transformer model for specific text generation tasks.	4
	Sequence Modeling with		Implement a transformer	5

Practical 8	Transformer Models		model for sequence modeling tasks and evaluate its performance.	
Practical 9	Addressing Bias in Generative Models		Identify and mitigate bias in generative models through data pre-processing and model adjustments.	6
Practical 10	Assessing Security Concerns in Generative AI		Evaluate the potential security risks associated with generative AI models and propose mitigation strategies.	5

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Develop proficiency in using generative AI frameworks and tools to create, train, and optimize models.	CO1, CO2, CO3, CO4, CO10, CO12
2	Design, implement, and evaluate various generative AI models such as GANs, VAEs, and autoregressive models.	CO1, CO2, CO3, CO4, CO10, CO12
3	Apply generative AI techniques to solve real-world problems and create innovative solutions across different domains.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
4	Understand the ethical implications of generative AI and integrate responsible practices into their work.	CO1, CO2, CO3, CO4, CO10, CO12
5	Critically analyze the strengths and limitations of different generative AI approaches and stay informed about current research and future trends.	CO1, CO2, CO3, CO4, CO5, CO10, CO12

SEMESTER – VIII									
Course Title	**Cryptography & Network Security**								
Course code	**23BTCS421R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the fourth year of the Programme**								
Course Objectives	1. To provide deeper understanding into cryptography, its application to network security, threats/vulnerabilities to networks and countermeasures. 2. To explain various approaches to Encryption techniques, strengths of Traffic Confidentiality, Message Authentication Codes. 3. To familiarize Digital Signature Standard and provide solutions for their issues.								
CO1	Identify basic security attacks and services.								
CO2	Use symmetric and asymmetric key algorithms for cryptography.								
CO3	Design a security solution for a given application.								
CO4	Analyze Key Management techniques and the importance of number Theory.								
CO5	Understanding of Authentication functions how Message Authentication Codes and Hash Functions work.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**INTRODUCTION**: Security trends, The OSI Security Architecture, Security Attacks, Security Services, and Security Mechanisms, A model for Network security. CLASSICAL ENCRYPTION TECHNIQUES: Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques, Rotor Machines, Stenography.	**10**	To understand different security services and security mechanisms and different classical encryption techniques	1,2
II	**BLOCK CIPHER AND DATA ENCRYPTION STANDARDS:** Block Cipher Principles, Data Encryption Standards, the Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles. ADVANCED ENCRYPTION STANDARDS: Evaluation Criteria for AES, the AES Cipher. MORE ON SYMMETRIC CIPHERS: Multiple Encryption, Triple DES, Block Cipher Modes of Operation, Stream Cipher and RC4.	**10**	Understanding block cipher and data encryption standards	1,2
III	**PUBLIC KEY CRYPTOGRAPHY AND RSA:** Principles Public key crypto Systems, Diffie Hellman Key Exchange, the RSA algorithm, Key Management, Elliptic Curve Arithmetic, Elliptic Curve Cryptography. MESSAGE AUTHENTICATION AND HASH FUNCTIONS: Authentication	**15**	Analyzing the concepts of Public key cryptography and RSA.	1,2

	Requirement, Authentication Function, Message Authentication Code, Hash Function, Security of Hash Function and MACs. HASH AND MAC ALGORITHM: Secure Hash Algorithm, Whirlpool, HMAC, CMAC. DIGITAL SIGNATURE: Digital Signature, Authentication Protocol, Digital Signature Standard.			
IV	**AUTHENTICATION APPLICATION:** Kerberos, X.509Authentication Service, Public Key Infrastructure. EMAILSECURITY: Pretty Good Privacy (PGP) and S/MIME. IPSECURITY: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Pay load, Combining Security Associations and Key Management.	**15**	Analyzation of the concepts of Authentication Application, Email Security and IP Security.	1,2
V	**WEB SECURITY:** Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET), Intruders, Viruses and related threats. FIREWALL: Firewall Design principles, Trusted Systems	**10**	Analyzation of Web Security and firewall.	1,2
Practical	**1. Cryptographic Implementations**: • Implement classical ciphers (Caesar, Vigenère) and modern ciphers (AES, RSA) using Programming languages like Python or Java.	**6**	Describe, illustrate, and explain the basic components of Cryptographic Implementations.	1,2, 3,4
	2. Network Security Tools: • Configure and use firewalls (e.g., pfSense) • Set up and analyze VPNs (e.g., OpenVPN)	**6**	Describe, illustrate, and explain the Network Security Tools.	1,2, 3,4
	3. Security Protocols and Applications: • Implement and test SSL/TLS for secure communication • Develop secure email systems using PGP or S/MIME	**6**	Describe, illustrate, and explain the Security Protocols and Applications.	1,2, 3,4
	4. Security Analysis and Testing: • Use network security tools like Wireshark for traffic analysis • Perform penetration testing with tools like Metasploit	**6**	Describe, illustrate, and explain the Security Analysis and Testing.	1,2, 3,4
	5. Emerging Technologies: • Explore blockchain development using platforms like Ethereum • Implement basic post-quantum	**6**	Describe, illustrate, explain, and explore blockchain development using	1,2,

	cryptographic algorithms		platforms like Ethereum.	3,4

TEXT BOOKS:

T1: William Stallings (2006), Cryptography and Network Security: Principles and Practice,4th edition, Pearson Education, India.

T2: William Stallings (2000), Network Security Essentials (Applications and Standards), Pearson Education, India.

REFERENCE BOOKS:

R1: Charlie Kaufman (2002), Network Security: Private Communication in a Public World, 2nd edition, Prentice Hall of India, New Delhi.

R2: Atul Kahate (2008), Cryptography andNetworkSecurity,2nd edition, Tata McGraw hill, India.

R3: Robert Bragg, Mark Rhodes (2004), Network Security: The complete reference, Tata McGraw-Hill, India.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Identify basic security attacks and services.	CO1,CO2,CO3,CO4,CO5,CO10,CO12
2	Use symmetric and asymmetric key algorithms for cryptography.	CO1,CO2,CO3,CO4,CO5,CO10,CO12
3	Design a security solution for a given application.	CO1,CO2,CO3,CO4,CO5,CO10,CO12
4	Analyze Key Management techniques and the importance of number Theory.	CO1,CO2,CO3,CO4,CO5,CO10,CO12
5	Understanding of Authentication functions the manner in which Message Authentication Codes and Hash Functions work.	CO1,CO2,CO3,CO4,CO5,CO10,CO12

SEMESTER – VIII										
Course Title	**Image Processing and Pattern Recognition**									
Course code	**23BTCS422R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the fourth year of the Programme**								
Course Objectives	4. To provide a comprehensive study of digital image processing fundamentals, techniques, and applications. 5. To explain various approaches to image enhancement, restoration, segmentation, feature extraction, and pattern recognition. 6. To familiarize Emphasizes theoretical understanding and practical implementation.									
CO1	Understand spatial filtering techniques to enhance digital images in the spatial domain effectively.									
CO2	Evaluate the impact of Fourier Transform properties on image enhancement in the frequency domain.									
CO3	Compare and contrast error-free and lossy image compression models for efficient data storage.									
CO4	Implement adaptive thresholding techniques for image segmentation and edge detection in practice.									
CO5	Understand the core concepts and principles of pattern recognition.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction** Digital image representation, Fundamentals steps in Image Processing, Elements of DIP systems. **Digital Image Fundamentals** Elements of Visual Perception, Sampling and Quantization, Relationships between pixels, Linear and Nonlinear operations.	**10**	To understand digital image fundamentals.	1,2
II	**Image Enhancement in Spatial domain** Enhancement by Point Processing, Histogram Processing, Spatial Filtering.. **Image Enhancement in Frequency Domain** Introduction to the Fourier Transform, The discrete Fourier Transform, Properties of the two- dimensional Fourier Transform, Smoothing Frequency-domain filters, Sharpening Frequency domain filters.	**10**	Understanding Image Enhancement in Spatial domain and Frequency Domain.	1,2
III	Image Compression Fundamentals, Image Compression Models, Error Free Compression, Lossy Compression.	**15**	Analyzing the concepts of Image Compression Fundamentals.	1,2
IV	Image Segmentation Threshold Techniques: Global, Adaptive and Optimum thresholding,	**15**	Analyzation of the concepts of Image	1,2

	Edge detection, Region Growing.		Segmentation Threshold Techniques.	
V	**Pattern Recognition** Definition and scope of pattern recognition History and applications of pattern recognition Basic concepts: patterns, features, and classifiers Overview of different approaches: statistical, syntactic, and neural Pattern recognition system design cycle	**10**	Analyzation of Pattern Recognition.	1,2
Practical	**1. Basic Image Processing**: • Implement image enhancement techniques (contrast stretching, histogram equalization) using Python/OpenCV • Apply spatial and frequency domain filters to images	**6**	Describe, illustrate, and explain the basic image processing components.	1,2, 3,4
	2. Advanced Image Processing: • Implement edge detection and morphological operations • Perform image segmentation using thresholding and region-based methods	**6**	Describe, illustrate, and explain the advanced image processing components.	1,2, 3,4
	3. Feature Extraction and Pattern Recognition: • Extract features (shape, texture, color) from images • Implement PCA and LDA for dimensionality reduction • Develop and evaluate classifiers (SVM, k-NN) for pattern recognition tasks	**6**	Describe, illustrate, and explain the basic components of feature extraction and pattern recognition.	1,2, 3,4
	4. Machine Learning and Deep Learning: • Train and test machine learning models for image classification • Implement CNNs for image classification using frameworks like TensorFlow/Keras • Apply transfer learning using pre-trained models (e.g., VGG16, ResNet)	**6**	Describe, illustrate, and explain basic components of Machine Learning and Deep Learning.	1,2, 3,4
	5. Application Development: • Develop an object detection system using YOLO or Faster R-CNN • Implement a face recognition system using deep learning techniques • Create a project focused on medical image analysis or real-time image processing	**6**	Describe, illustrate, and explain basic components of application development.	1,2, 3,4

TEXT BOOKS:

T1: Rafael C Gonzalez, Richard E Woods,—Digital Image Processing, Pearson Education Publications.

T2: RajjanShinghal,—Pattern Recognition, Oxford Publications.

T3: Chanda and Majumder,—Digital Image Processing and Analysis, Prentice Hall Publications.

REFERENCEBOOKS:

R1: Rafael C Gonzalez, Richard E Woods,—Digital Image Processing with Matlab, Pearson Education Publications.

R2: S.Sridhar,—Digital Image Processing, Oxford University Press.

R3: Jayaraman,—Digital Image Processing, McGraw Hill.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Understand spatial filtering techniques to enhance digital images in the spatial domain effectively.	CO1,CO2,CO3, CO5,CO10,CO12
2	Evaluate the impact of Fourier Transform properties on image enhancement in the frequency domain.	CO1,CO2,CO3, CO5,CO10,CO12
3	Compare and contrast error-free and lossy image compression models for efficient data storage.	CO1,CO2,CO3, CO5,CO10,CO12
4	Implement adaptive thresholding techniques for image segmentation and edge detection in practice.	CO1,CO2,CO3, CO4, CO5,CO10,CO12
5	Understand the core concepts and principles of pattern recognition.	CO1,CO2,CO3, CO4, CO5,CO10,CO12

SEMESTER – VIII									
Course Title	**Project II**								
Course code	**23BTCS423R**	**Total credits: 6**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 90	**0**	**0**	**0**	**12**	**16**	**0**	**6**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering**								
Semester	**Winter/II semester of the fourth year of the Programme**								
Course Objectives	1. To equip students with the IT principles and Programming skills. 2. To equip students with team management abilities necessary to develop and implement software, hardware, and network solutions effectively. 3. To cultivate employability skills and professionalism in software development.								
CO1	Apply IT principles for real-world problem-solving using Programming languages and network solutions.								
CO2	Manage complex projects as a team member, demonstrating effective personal and team management skills.								
CO3	Develop Programming skills to create and assess software, hardware, and network solutions.								
CO4	Apply personal and team management skills as a professional software developer.								
CO5	Cultivate employability skills and uphold professionalism in software development.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: a) theoretical studies b) computer simulations c) hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project; 4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field; 5. Prepare a formal report	**156**	To understand, analyze, manage, develop and cultivate Programming skills to create and assess software, hardware, and network solutions.	1,2,3, 4,5

	describing the work undertaken and results obtained so far; and Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.			

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	Apply IT principles for real-world problem-solving using Programming languages and network solutions.	CO1,CO2,CO3, CO4, CO5,CO6, CO 7, CO8, CO9, CO10, CO12
2	Manage complex projects as a team member, demonstrating effective personal and team management skills.	CO1,CO2,CO3, CO4, CO5,CO6, CO 7, CO8, CO9, CO10, CO12
3	Develop Programming skills to create and assess software, hardware, and network solutions.	CO1,CO2,CO3, CO4, CO5,CO6, CO 7, CO8, CO9, CO10, CO12
4	Apply personal and team management skills as a professional software developer.	CO1,CO2,CO3, CO4, CO5,CO6, CO 7, CO8, CO9, CO10, CO12
5	Cultivate employability skills and uphold professionalism in software development.	CO1,CO2,CO3, CO4, CO5,CO6, CO 7, CO8, CO9, CO10, CO12

Assam down town University

Curriculum and Syllabus

Bachelor of Technology
in
Computer Science and Engineering
On Data Science and Artificial Intelligence

OUTCOME BASED EDUCATION FRAMEWORK

CHOICE BASED CREDIT SYSTEM

Version: 1.1

FACULTY OF COMPUTER TECHNOLOGY

July, 2023

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 Board of Studies (BOS) meeting of the Faculty of Computer Technology held on dated 14/07/2023 and approved by the Emergent Academic Council (AC) meeting held on dated 28/07/2023.

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 Technology in Computer Science and Engineering (DS and AI) is an Under Graduate Degree awarded for the programme of Computer Science and Engineering. As one of the best computer engineering colleges, we intend to create a cohesive learning experience with the latest technological developments to that of industry demand.

I. Specific Features of the Curriculum

The B. Tech CSE curriculum, guided by the outlined Program Specific Outcomes (PSOs), emphasizes a comprehensive educational framework. It prepares students for competitive exams through updated and focused syllabi. It integrates advanced research principles with sustainable technology applications, ensuring graduates possess the necessary engineering and management skills for societal impact. The curriculum fosters effective communication, teamwork, and project management in multidisciplinary settings. Additionally, it incorporates contemporary industrial and research trends, encouraging innovation and entrepreneurial proficiency. This holistic approach equips students to develop novel software engineering solutions, addressing real-world problems with cutting-edge techniques and strategies.

II. Eligibility Criteria:

Minimum 45% with English, Physics & Mathematics in HS.

III. Programme Educational Objectives (PEO):

PEO1 : To produce graduates who have strong foundation of knowledge and skills in the field of Computer Science and Engineering.

PEO2: To produce graduates who can provide solutions to challenging problems in their profession by applying Computer Engineering theory and practices.

PEO3: To produce graduates who are employable in industries/public sector/research organizations or work as an entrepreneur, as well as can provide leadership and are effective in multidisciplinary environment.

IV. Programme Specific Outcomes (PSO):

PSO 1: Educational Advancement: Graduates will be prepared for state, national and international competitive examinations with focused and updated syllabi.

PSO 2: Advanced Research: Graduates will have a holistic comprehension of engineering and management principles required for application of sustainable technologies for societal development, and also will be able to communicate effectively in oral, written, visual and graphic modes as a member and leader in a team, to manage projects in multidisciplinary environments.

PSO 3: Entrepreneurial Proficiency: Graduates will be acquainted with the contemporary trends in industrial/research environments and also will capable of innovating novel solutions to prevailing problems by applying software engineering techniques and strategies.

V. Programme Outcome (PO):

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change**.**

VI. Total Credits to be Earned: 193

VII. Career Prospects:

A B. Tech in Computer Science and Engineering (CSE) offers diverse and promising career prospects. Graduates can pursue roles such as software developers, data scientists, cybersecurity analysts, and AI/ML engineers in top tech firms. They are well-suited for positions in research and development, working on cutting-edge technologies. The curriculum also prepares them for competitive exams, enabling careers in public sector and government organizations. Additionally, the strong emphasis on entrepreneurial skills allows graduates to innovate and launch their own start-ups. With rapid advancements in technology, CSE graduates remain in high demand across various industries, ensuring robust career opportunities.

EVALUATION METHODS

The student performance shall be evaluated through In-semester (Sessional) and semester-end examinations. A weight age 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.

Table 1: Question paper pattern for End semester examination

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 2: Question paper pattern for End semester examination

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 3: 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-Voice etc.:

i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.

ii) Viva-Voice, 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 x 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: 4) 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 4, 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 4, 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.

Table 4: 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 4.

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

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, Gi is the Grade Point secured in the i^{th} registered Course and Ci 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 enrolment in the Programme. In other words, taking into account all the Courses graded with 'O' to 'P' as given in Table 4, 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 enrolment.

(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, Gi is the Grade Point secured in the ith completed Course and Ci is the Credit (weight)of that Course.

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

(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 Summeren 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.

Breakdown of Credits

Sl. No	Category		Total number of Credits
1	University Core(UC)	Skill Enhancement Course (SEC)	3
		Ability Enhancement Course(AEC)	6
		Field Training	6
		Discipline Specific Elective (DSE)	0
		Value Added Course (VAC)	2
2	University Elective (UE)	Multidisciplinary Course (MDC)	9
		Value Added Course (VAC)	7
3	Program Core(PC)	Discipline Specific Core(DSC)	125
		Field Training	0
		Research /Industry Internship	14
		Summer Internship	1
4	Program Elective (PE)	Discipline Specific Elective (DSE)	12
		Value Added Course (VAC)	0
5	Faculty Core(FC)	Skill Enhancement Course (SEC)	0
		Ability Enhancement Course(AEC)	8
		Total	**193**

Breakdown by categories of courses

Sl No	Category	Credits	%
1	Engineering	139	72%
2	Science	20	11%
3	Commerce and Management	34	17%
Total		**193**	**100%**

Semester I														
Sl.No	**Course Code**	**Course Title**	**Course Category**	**Engagement**						**Credit**	**Maximum Marks**			**Total**
				L	**T**	**P**	**S**	**R**	**O**		**IA***	**SEE***	**PE***	
1	23BTCS111R	Logic, Matrices and Calculus	DSC (Minor)	3	0	0	0	0	0	3	40	60	0	100
2	23BTCS112R	Problem Solving Using C	DSC (Major)	2	0	2	0	0	0	3	40	60	100	200
3	23BTCS113R	Engineering Physics	DSC (Minor)	2	0	2	0	0	0	3	40	60	100	200
4	23BTCS115R	Workshop for Engineers	DSC (Minor)	0	0	2	0	0	0	1	0	0	100	100
5	23BTCS116R	Field-based Training : Networking Basics	Field Training	0	0	0	0	0	16	1	100	0	0	100
6	23MOCS111R / 23MOCS112R	MOOCS I	VAC	0	0	0	0	0	0	1	100	0	0	100
7	23UBEC111	Extra-curricular Activity	SEC	0	0	0	4	0	0	1	100	0	0	100
8	23UBPD113R	Introductory English for Engineers	AEC	0	0	4	0	0	0	2	0	0	100	100
Total Credit in 1st Semester				**7**	**0**	**10**	**4**	**0**	**16**	**15**	**420**	**180**	**400**	**1000**

Semester II														
Sl.No	**Course Code**	**Course Title**	**Course Category**	**Engagement**						**Credit**	**Maximum Marks**			**Total**
				L	**T**	**P**	**S**	**R**	**O**		**IA***	**SEE***	**PE***	
1	23BTCS121R	Ordinary Differential Equations and Differential Calculus	DSC (Minor)	3	0	0	0	0	0	3	40	60	0	100
2	23BTCS122R	Engineering Chemistry	DSC (Minor)	2	0	2	0	0	0	3	40	60	100	200
3	23BTCS123R	Basic Electrical and Electronics Engineering	DSC (Minor)	2	0	2	0	0	0	3	40	60	100	200
4	23BTCS124R	Object Oriented Programming	DSC (Major)	2	0	1	0	0	0	3	40	60	100	200
5	23BTCS125R	Field-based Training : Network Components and Managment	Field Training	0	0	0	0	0	16	1	100	0	0	100
6	23MOCS121R / 23MOCS122R	MOOCS II	VAC	0	0	0	0	0	0	1	100	0	0	100
7	23UBEC121	EXTRA-CURRICULAR	SEC	0	0	4	0	0	0	1	100	0	0	100
8	23UBES101R	Environmental Science	MDC	2	0	0	0	0	0	2	40	60	0	100
9	23UBPD123R	Effective English for Engineers	AEC	0	0	4	0	0	0	2	0	0	100	100
Total Credit in 2nd Semester				**11**	**0**	**13**	**0**	**0**	**16**	**19**	**500**	**300**	**400**	**1200**

Semester III														
Sl.No	**Course Code**	**Course Title**	**Course Category**	**Engagement**						**Credit**	**Maximum Marks**			**Total**
				L	**T**	**P**	**S**	**R**	**O**		**IA***	**SEE***	**PE***	
1	23BTCS211R	Digital Electronics	DSC (Minor)	3	0	2	0	0	0	4	40	60	100	200
2	23BTCS212R	Functional Programming in Python	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
3	23BTCS213R	Data Structure and Algorithms	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
4	23BTCS214R	Computer Organization and Architecture	DSC (Major)	3	0	0	0	0	0	3	40	60	0	100
5	23BTCS215R	Probability and Statistics	DSC (Minor)	3	0	0	0	0	0	3	40	60	0	100
6	23BTCS216R	Field-Based Training	Field Training	0	0	0	0	0	16	1	100	0	0	100
7	23BTCS217R	Mini Project I	Research /Industry Internship	0	0	0	4	0	0	1	100	0	0	100
8	23MOCS211R	MOOCS-Open Elective	MDC / CBCS	1	0	0	0	0	0	1	100	0	0	100
9	23MOCS212R	MOOCS III	VAC	1	0	0	0	0	0	1	100	0	0	100
10	23UBEC211	Co-Curricular Activities	AEC	0	0	0	4	0	0	1	100	0	0	100
11	23UBPD213R	English for Employability Skills	AEC	0	0	4	0	0	0	2	0	0	100	100
12	23UUFL211R	Personal Financial Planning	MDC	0	0	2	0	0	0	1	0	0	100	100
13	23UULS211R	Basic Life Saving Skills	AEC	0	0	2	0	0	0	1	0	0	100	100
14	23BTCS218R	Cloud Fundamentals	DSC (Major)	2	0	2	0	0	0	3	40	60	100	200
Total Credit in 3rd Semester				**19**	**0**	**16**	**8**	**0**	**16**	**30**	**740**	**360**	**700**	**1800**

Semester IV														
Sl.No	**Course Code**	**Course Title**	**Course Category**	**Engagement**						**Credit**	**Maximum Marks**			**Total**
				L	**T**	**P**	**S**	**R**	**O**		**IA***	**SEE***	**PE***	
1	23BTCS221R	Discrete Mathematics and Graph Theory	DSC (Minor)	3	0	0	0	0	0	3	40	60	0	100
2	23BTCS222R	Database Management System	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
3	23BTCS223R	Operating Systems	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
4	23BTCS224R	Software Engineering	DSC (Major)	2	0	0	0	0	0	2	40	60	0	100
5	23BTCS225R	DE-I	DSE	3	0	0	0	0	0	3	40	60	0	100
6	23BTCS226R	PE-I	DSC (Minor)	3	0	0	0	0	0	3	40	60	0	100
7	23BTCS227R	Field-based Training	Field Training	0	0	0	0	0	16	1	100	0	0	100
8	23UBPD221R	PDP	AEC	0	0	2	0	0	0	1	0	0	100	100
9	23UCDL102R	Digital Literacy	VAC	0	0	2	0	0	0	1	0	0	100	100
10	23UULS221R	Basic Acclimatizing Skills	AEC	0	0	2	0	0	0	1	0	0	100	100
11	23MOCS221R	MOOCS-Open Elective	MDC	0	0	0	0	0	0	2	100	0	0	100
12	23MOCS222R	Indian Heritage	VAC	0	0	0	0	0	0	1	100	0	0	100
13	23BTCS228R	Mini Project II	Research /Industry Internship	0	0	0	4	0	0	1	100	0	0	100
14	23BTCS229R	Data Visualization	DSC (Major)	2	0	2	0	0	0	3	40	60	100	200
Total Credit in 4th Semester				**19**	**0**	**12**	**4**	**0**	**16**	**30**	**680**	**420**	**600**	**1700**

Semester V														
Sl.No	**Course Code**	**Course Title**	**Course Category**	**Engagement**						**Credit**	**Maximum Marks**			**Total**
				L	**T**	**P**	**S**	**R**	**O**		**IA***	**SEE***	**PE***	
1	23BTCS311R	Computer Communication Network	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
2	23BTCS312R	Data Science & Statistical Modelling	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
3	23BTCS313R	DE-II	DSE	3	0	0	0	0	0	3	40	60	0	100
4	23BTCS314R	PE-II	DSC (Minor)	3	0	2	0	0	0	4	40	60	0	100
5	23BTCS315R	PE-III	DSC (Minor)	3	0	0	0	0	0	3	40	60	0	100
6	23MOCS311R / 23MOCS312R	MOOCS IV	VAC	0	0	0	0	0	0	1	100	0	0	100
7	23BTCS317R	Field-Based Training	Field Training	0	0	0	0	0	16	1	100	0	0	100
8	23BTCS318R	Summer Internship	Summer Internship	0	0	0	0	0	16	1	100	0	0	100
9	23UBPD314R	PDP	AEC	0	0	4	0	0	0	2	0	0	100	100
10	23MOCS312R	MOOCS-Open Elective	MDC	0	0	0	0	0	0	2	100	0	0	100
11	23UBEC311	Extra - Curricular Activities	SEC	0	0	0	4	0	0	1	100	0	0	100
12	23BTCS316R	Mini Project III	Research /Industry Internship	0	0	0	4	0	0	1	100	0	0	100
13	23BTCS317R	Predictive Analysis	IBM Course	2	0	2	0	0	0	3	40	60	100	200
Total Credit in 5th Semester				**17**	**0**	**12**	**8**	**0**	**32**	**30**	**840**	**360**	**400**	**1600**

Semester VI														
Sl.No	**Course Code**	**Course Title**	**Course Category**	**Engagement**						**Credit**	**Maximum Marks**			**Total**
				L	**T**	**P**	**S**	**R**	**O**		**IA***	**SEE***	**PE***	
1	23BTCS321R	Web Technologies	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
2	23BTCS322R	Formal Language and Automata Theory	DSC (Major)	3	0	0	0	0	0	3	40	60	0	100
3	23BTCS323R	DE-III	DSE	3	0	0	0	0	0	3	40	60	0	100
4	23BTCS324R	PE-IV	DSC (Minor)	3	0	2	0	0	0	4	40	60	100	100
5	23BTCS325R	PE-V	DSC (Minor)	3	0	2	0	0	0	4	40	60	100	100
6	23BTCS326R	PE-VI	DSC (Minor)	3	0	2	0	0	0	4	40	60	100	100
7	23MOCS321R / 23MOCS322R	MOOCS V	VAC	0	0	0	0	0	0	1	100	0	0	100
8	23BTCS327R	Field-Based Training	Field Training	0	0	0	0	0	16	1	100	0	0	100
9	23UBPD324R	PDP	AEC	0	0	4	0	0	0	2	0	0	100	100
10	23MOCS322R	MOOCS-Open Elective	MDC	0	0	0	0	0	0	1	100	0	0	100
12	23BTCS316R	Mini Project IV	Research /Industry Internship	0	0	0	4	0	0	1	100	0	0	100
13	23BTCS317R	Data Science	DSC (Major)	2	0	2	0	0	0	3	40	60	100	200
Total Credit in 6th Semester				**20**	**0**	**14**	**4**	**0**	**16**	**31**	**680**	**420**	**600**	**1400**

Semester VII														
Sl.No	**Course Code**	**Course Title**	**Course Category**	**Engagement**						**Credit**	**Maximum Marks**			**Total**
				L	**T**	**P**	**S**	**R**	**O**		**IA***	**SEE***	**PE***	
1	23BTCS411R	Design and Analysis of Algorithm	DSC (Major)	3	0	2	0	0	0	4	40	60	0	100
2	23BTCS412R	Compiler Design	DSC (Major)	3	0	2	0	0	0	4	40	60	0	100
3	23BTCS413R	Elementary Statistical Analysis	DSC (Minor)	3	1	0	0	0	0	4	100	0	0	100
4	23BTCS414R	Project I	Research /Industry Internship	0	0	0	8	16	0	4	100	0	0	100
5	23MOCS411R / 23MOCS412R	MOOCS VI	VAC	0	0	0	0	0	0	1	100	0	0	100
6	23BTCS415R	Generative AI	DSC (Major)	2	0	0	4	0	0	3	100	0	100	100
7	23BTCS416R	Artificial Intelligence	DSC (Major)	2	0	2	0	0	0	3	40	60	100	200
Total Credit in 7th Semester				**13**	**1**	**6**	**12**	**16**	**0**	**23**	**520**	**180**	**200**	**800**

Semester VIII														
Sl.No	**Course Code**	**Course Title**	**Course Category**	**Engagement**						**Credit**	**Maximum Marks**			**Total**
				L	**T**	**P**	**S**	**R**	**O**		**IA***	**SEE***	**PE***	
1	23BTCS421R	Cryptography & Network Security	DSC (Major)	3	0	2	0	0	0	4	40	60	0	100
2	23BTCS422R	Image Processing and Pattern Recognition	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
3	23BTCS423R	Project II	Research /Industry Internship	0	0	0	12	16	0	6	100	0	0	100
4	23MOCS421R / 23MOCS422R	MOOCS VII	VAC	0	0	0	0	0	0	1	100	0	0	100
Total Credit in 8th Semester				**6**	**0**	**4**	**12**	**16**	**0**	**15**	**280**	**120**	**100**	**500**

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

Discipline Specific Elective (DSE)		
Semester	Program Electives No.	Electives Name
IV	DE-I	1. Design Thinking & Innovation 2. Entrepreneurship Development
V	DE-II	1. Organizational Behaviour 2. Principles of Management
VI	DE-III	1. Economics for Engineers 2. Positive Psychology

List of Programme Electives (PE)		
Semester	Programme Electives No.	Electives Name
IV	PE-I	1. Fundamentals Artificial Intelligence 2. Fundamentals of Cyber Security
V	PE-II	1. Data Mining and Analytics 2. Information Retrieval Systems
V	PE-III	1. Machine Learning 2. Cloud Computing
VI	PE-IV	1. Introduction to Internet of Things 2. Foundation of Data Science
VI	PE-V	1. Predictive Analysis 2. Wireless Sensor Network
VI	PE-VI	1. Neural Networks 2. Big Data Analytics

List of MOOCS				
Sl. No	**MOOCS Course No**	**Name of the Course**	**Course Code**	**Semester**
1	MOOCS I	Foundation Of Digital Marketing And E-Commerce	23MOCS111R	I
2		Introduction to Decision Science for Marketing	23MOSY112R	
1	MOOCS II	Introduction To Git And GitHub	23MOSY115R	II
2		Ethics, Technology And Engineering	23MOCS122R	
1	MOOCS III	Foundation Of Digital Marketing And E-Commerce	23MOCS211R	III
2		Linear Algebra for Data Science Using Python Specialization		
3	MOOCS OPEN ELECTIVE	International Leadership And Organizational Behaviour	23MOCS212R	
4		Organizational Analysis		
1	MOOCS IV	Introduction To SQL	23MOSY211R	IV
2		Introduction To Hardware And Operating Systems	23MOSY212R	
1	MOOCS V	Using Python To Interact With The Operating System	23MOSY311R	V
2		Mean Stack	23MOSY312R	
1	MOOCS VI	Java Full Stack Developer	23MOSY321R	VI
2		C# For .Net Developers	23MOSY322R	
1	MOOCS VII	Applied Data Science with Python Specialization		VII
2		Statistics and Machine Learning Specialization		
1	MOOCS VIII	Neural Networks and Deep Learning		VIII
2		Generative AI for Software Development		

SEMESTER – I									
Course Title	**Logic, Matrices and Calculus**								
Course code	**23BTCS111R**	**Total credits:3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 40T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	Mathematics	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the first year of the programme**								
Course Objectives	1. To make understand to evaluate definite and improper integrals. Apart from these some special functions like Beta and Gamma function must be introduced. 2. To provide the application of differential and integral calculus. 3. To make understand the convergence and divergence of sequence and series								
CO1	The students will be able to demonstrate the ability to understand the concepts of mathematics, logic, reasoning and coding								
CO2	Students will be able to apply of applications of concepts in other disciplines such as engineering, computer science, physics, etc.								
CO3	Solve and devise solutions to a range of elementary real-world problems in mathematics and programming								
CO4	Explore and apply key concepts in logical thinking to business problems.								
CO5	Enable students to critically analyze information in order to evaluate evidence and construct reasoned arguments.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Calculus:** Evaluates and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	**8**	Evaluate definite and improper integrals and understand their properties. Apply Beta and Gamma functions in various contexts. Use definite integrals to calculate surface areas and volumes of revolution.	**1,2,3**
II	**Calculus:** Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.	**12**	Understand and apply Rolle's Theorem and the Mean Value Theorem to determine properties of functions. Utilize Taylor and Maclaurin series expansions with remainders for function approximation. Evaluate indeterminate forms using L'Hospital's Rule, and identify and analyze local maxima and minima of functions.	**3,4**
III	**Sequences and series:** Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential,	**8**	Analyze the convergence of sequences and series using various tests. Develop and utilize	**3,4**

	trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.		power series, including Taylor's series, to represent functions such as exponential, trigonometric, and logarithmic functions. Apply Fourier series to decompose functions into their sine and cosine components and understand Parseval's theorem in the context of these series.	
IV	**Multivariable Calculus (Differentiation):** Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.	**6**	Understand and apply the concepts of limits, continuity, and partial derivatives, including directional and total derivatives. Analyze and solve problems involving tangent planes, normal lines, and optimization techniques such as maxima, minima, saddle points, and the method of Lagrange multipliers. Compute and interpret the gradient, curl, and divergence of vector fields.	**4**
V	**Matrices:** Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley- Hamilton Theorem, and Orthogonal transformation.	**6**	Understand and calculate the inverse and rank of matrices, and apply the rank-nullity theorem.Solve systems of linear equations using matrix methods. Identify and work with symmetric and skew-symmetric matrices.	**4**

TEXT BOOKS:

T1:G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint,2002.

T2: Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley &Sons, 2006.

T3: Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11th Reprint, 2010

EFERENCE BOOKS:

R1:N.P. Bali and Manish Goyal, A text book of Engineering Mathematics,Laxmi Publications, Reprint,2008.
R2: B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010.

OTHER LEARNING RESOURCES:

O1: Coursera online platform for Mathematical learning
O2: Mathkind Quality *Math Education* portal

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAMME OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome**
1	The students will be able to demonstrate the ability to understand the concepts of mathematics, logic, reasoning and coding.	PO1,PO2,PO3,PO4,PO5,PO9,PO10,PO11,PO12
2	Students will be able to apply of applications of concepts in other disciplines such as engineering, computer science, physics, etc.	PO1,PO2,PO3,PO4,PO5,PO9,PO10,PO11,PO12
3	Solve and devise solutions to a range of elementary real-world problems in mathematics and programming.	PO1,PO2,PO3,PO4,PO5,PO9,PO10,PO11,PO12
4	Explore and apply key concepts in logical thinking to business problems.	PO1,PO2,PO3,PO4,PO5,PO9,PO10,PO11,PO12
5	Enable students to critically analyze information in order to evaluate evidence and construct reasoned arguments.	PO1,PO2,PO3,PO4,PO5,PO9,PO10,PO11,PO12

SEMESTER – I										
Course Title	**Problem Solving Using C**									
Course code	**23BTCS112R**	**Total credits:3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:40T+30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the first year of the programme**								
Course Objectives	1. To formulate simple algorithms for arithmetic and logical problems. 2. To test and execute the programs and correct syntax and logical errors. **3.** Apply C in Real-World Applications.								
CO1	Understand the concept of computer system, analyze a given problem, develop an algorithm, fundamental programming constructs, identify data representation formats, and describe operators and their precedence, associativity								
CO2	Apply branching and loop statements in problem solving.								
CO3	Apply the concepts of homogeneous derived data types, heterogeneous data types, strings and functions in programming.								
CO4	Understand the concept of pointers and apply it in programming.								
CO5	Apply the concept of file handling in C programming.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Introduction to Programming Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.	**8**	Identify and describe the function of key components of a computer system, including disks, memory, processor, and how they interact with each other. Explain where and how a program is stored and executed within a computer system. Understand the role of an operating system in managing computer hardware and software resources.	**1,2,3**
II	Arithmetic expressions and precedence Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching, Iteration and loops Arrays: Arrays (1-D, 2-D), Character arrays and Strings Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)	**12**	Understand and apply the rules of arithmetic operations and operator precedence to construct and evaluate expressions. Write and evaluate conditional statements and implement control flow through branching and iterative loops. Utilize 1-D and 2-D arrays, including character arrays and strings, for data storage and manipulation.	**3,4**

III	Function: Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.	**12**	Understand how to define functions, use built-in libraries, and pass parameters by value or reference. Explore recursion as a technique for solving problems, with examples like finding factorial, Fibonacci series, and Ackermann function. Learn about efficient sorting methods such as Quick sort or Mergesort, emphasizing their implementation and efficiency.	**3,4**
IV	Structure: Structures, Defining structures and Array of Structures Pointers: Idea of pointers, Defining pointers, Use of Pointers in self- referential structures, notion of linked list (no implementation)	**6**	Understand how to define and use structures to organize related data elements in a program, enhancing clarity and organization. Grasp the concept of pointers, their definition, and application in structures, especially in self-referential structures, laying the foundation for understanding dynamic data structures like linked lists. Comprehend how arrays of structures allow efficient storage and manipulation of multiple related data sets, enabling scalable and organized data management in programs.	**4**
V	File handling (only if timeis available, otherwise should be done as part of the lab)	**6**	Students will grasp the concepts of reading from and writing to files, including different modes such as read, write, and append. They will learn how to manipulate file data, including searching, updating, and deleting records within a file. Students will practice error handling techniques and understand best practices for file handling to ensure data integrity and security.	**4**
Practical Component				

Practical 1	a) Write a C program to find sum and average of three numbers. b) Write a C program to find the sum of individual digits of a given positive c) Write a C program to generate the first n terms of the Fibonacci sequence	**2**	Understand basic input/output operations, arithmetic operations in C, and how to compute simple statistics.	1,2
Practical 2	a) Write a C program to generate prime numbers between 1 to n. b) Write a C program to Check whether given number is Armstrong Number or Not.	**2**	Learns to implement a basic algorithm using loops and conditional statements to identify prime numbers within a specified range.	1,3
Practical 3	a) Write a C program to evaluate algebraic expression (ax)/ (ax-b). b) Write a C program to check whethergiven number is perfect number or Not	**2**	Gains knowledge of iterative looping structures to sum proper divisors, use of conditional statements for validation, and understanding the concept of perfect numbers in number theory.	2,3
Practical 4	a). Write a C program to check whether given number is strong number or not.	**2**	Understand the concept of strong numbers in programming. Demonstrate proficiency in C programming syntax and logic.	3
Practical 5	a) Write a C program to find the roots of a quadratic equation. b) Write a C program perform arithmetic operations using switch statement.	**2**	Learns to calculate roots using the quadratic formula, handling different cases (real, imaginary roots).	3,4
Practical 6	a) Write a C program to find factorial of a given integer using non-recursive Function. b) Write a C program to find factorial of a given integer using recursive function.	**2**	Students will demonstrate the ability to write a C program that calculates the factorial of a given integer using iterative control structures and function calls, understanding fundamental concepts of loops, conditionals, and function definitions in C programming.	3,5
Practical 7	a) Write C program to find GCD of two integers by using recursive function. b) Write C program to find	**2**	By implementing a C program to find the GCD of two integers using recursion, learners	3,4

	GCD of two integers using non-recursive function.		understand recursion's application in solving mathematical problems efficiently, demonstrating proficiency in recursive function design and understanding of basic number theory concepts.	
Practical 8	a) Write a C program to find both the largest and smallest number in a list of Integers b) Write a C Program to Sort the Array in an Ascending Order. c) Write a C Program to find whether given matrix is symmetric or not.	**2**	Learn to iterate through an array, compare elements, and track both maximum and minimum values efficiently.	4,5
Practical 9	a) Write a C program to perform addition of two matrices. b) Write a C program that uses functions to perform Multiplication of Two Matrices.	**2**	Understands matrix representation in C, handling multidimensional arrays, and implementing basic arithmetic operations.	4,3
Practical 10	a) Write a C program to use function to insert a sub-string in to given main string from a given position. b) Write a C program that uses functions to delete n Characters from a give position in a given string.	**2**	Develop proficiency in C programming by implementing a function that inserts a substring into a main string at a specified position, demonstrating effective use of string manipulation and function abstraction.	3,5
Practical 11	a) Write a C program using user defined functions to determine whether the given string is palindrome or not. b) Write a C program that displays the position or index in the main string S where the sub string T begins, or - 1 if S doesn't contain T	**2**	By writing a C program using user-defined functions to check if a string is a palindrome, students will understand string manipulation, function definition, and logic implementation to verify symmetry in textual data.	2,3
Practical 12	a) Write C program to count the number of lines, words and characters in a given text. b) Write a C program to find	**2**	Developed proficiency in C programming by implementing a program to accurately count lines, words, and characters in a	3,4

	the length of the string using Pointer		provided text using efficient file handling and string manipulation techniques.	
Practical 13	a) Write a C program to Display array elements usingcalloc( ) function. b) Write a C Program to Calculate Total and Percentage marks of a student using structure.	**2**	Understand dynamic memory allocation in C using calloc() to allocate memory for arrays, and learn how to iterate through and display array elements	4,5
Practical 14	a) Write a C program that uses functions and structures to perform the following operations: i) Reading a complex number ii) Writing a complex number iii) Addition of two complex numbers iv) Multiplication of two complex numbers b). Write a C program to display the contents of a file	**2**	Utilize input functions to capture real and imaginary parts separately into a structure. Output the stored complex number using formatted printing with proper notation.	2,3
Practical 15	a) Write a C program to copy the contents of one file to another. b) Write a C program to merge two files into a third file. Write a C program to reverse the first n characters in a file	**2**	Developed proficiency in handling file operations in C, demonstrating the ability to read from and write to files, ensuring accurate data transfer between file streams	3,4

TEXT BOOKS:

T1:E. Balaguruswamy, Programming in ANSI C, TataMcGraw-Hill.

T2: Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.

REFERENCE BOOKS:

R1: Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

OTHER LEARNING RESOURCES:

O1: Coursera online platform for Mathematical learning

O2: Mathkind Quality *Math Education* portal

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the concept of computer system, analyze a given problem, develop an algorithm, fundamental programming constructs, identify data representation formats, and describe operators and their precedence, associativity	PO1,PO2,PO3,PO4,PO5,PO11
2	Apply branching and loop statements in problem solving.	PO1,PO2,PO3,PO4,PO5,PO11
3	Apply the concepts of homogeneous derived data types, heterogeneous data types, strings and functions in programming.	PO1,PO2,PO3,PO4,PO5,PO11
4	Understand the concept of pointers and apply it in programming.	PO1,PO2,PO3,PO4,PO5,PO11
5	Apply the concept of file handling in C programming.	PO1,PO2,PO3,PO4,PO5,PO11

SEMESTER – I										
Course Title	**Engineering Physics**									
Course code	**23BTCS113R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:40T+30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	Basic knowledge of Physics	**Co-requisite**	**Mathematics**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the first year of the programme**								
Course Objectives	1. To understand the theories of physics 2. To apply the concepts in practical problems 3. To understand the physics of any process								
CO1	Apply electric field and potential calculations, Compute the vectors and scalar representation of forces and nature of forces.								
CO2	Analyze electrostatics in dielectric media, conservative and non-conservative forces, angular momentum and energy equations.								
CO3	Compute basics of non-inertial frames, harmonic oscillator and forced oscillations.								
CO4	Demonstrate understanding of magnetostatics in linear magnetic media, and the usage of common electrical measuring instruments.								
CO5	Understand the basic characteristics of transformers and electrical machines.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Electrostatics in vacuum	**8**	Understand and apply Coulomb's Law to calculate the electrostatic force between point charges in a vacuum. Analyze electric fields and potentials created by various charge distributions using principles of electrostatics.	**2**
II	Magneto statics	**8**	Magnetostatics studies magnetic fields in systems with steady currents, focusing on the behavior and interactions of magnetic fields in static conditions. It explains phenomena like the magnetic field produced by a current-carrying conductor and the forces between magnetic dipoles.	**3**
III	Faraday's law	**8**	Faraday's law of electromagnetic induction states that a change in magnetic flux through a circuit induces an electromotive force (EMF) in the circuit. This induced EMF is proportional to the rate of change of the magnetic flux.	**3,5**
IV	Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations.	**8**	Understand the concept of displacement current as a term added to Ampere's law to account for the changing electric field in non-conductive regions. Recognize its role in ensuring the	**3**

			continuity of current in Maxwell's equations and the propagation of electromagnetic waves.	
V	Electromagnetic waves	**8**	Electromagnetic waves are transverse waves composed of mutually perpendicular electric and magnetic fields oscillating perpendicular to the direction of wave propagation. They encompass a wide range of frequencies, from radio waves to gamma rays, each characterized by its wavelength and frequency.	**5**
Practical Component				
Practical 1	To verify the ohm's law and hence determine the unknown resistance of the given material of the wire.	**4**	Verification of Ohm's Law through experimental data to determine the resistance of a given wire material	3
Practical 2	To find the value of a given resistance by using meter bridge.	**5**	Understanding how to determine the resistance of a given resistor using a meter bridge based on null point detection	4
Practical 3	To convert the galvanometer in to voltmeter and hence calibrate it with a standard resistance and ammeter.	**5**	To convert a galvanometer into a voltmeter, learn to connect a high resistance in series with the galvanometer and calibrate it using a standard resistance and ammeter to measure the voltage accurately.	5
Practical 4	To determine the internal resistance of a cell by using potentiometer.	**6**	Understand and apply the principle of a potentiometer to accurately measure the internal resistance of a cell	3
Practical 5	To determine the frequency of a tuning fork by Melde's apparatus.	**5**	Determine the frequency of a tuning fork using Melde's apparatus by observing the formation of stationary waves on a stretched string and 2calculating it from the wave parameters.	2
Practical 6	To determine the moment of inertia of a body about an axis passing through its center of gravity and perpendicular to its length.	**2**	To determine the moment of inertia of a body about an axis passing through its center of gravity and perpendicular to its length, the learning outcome is: "Calculate the moment of inertia using integral calculus, considering the mass distribution and geometric properties of the body."	4
Practical 7	To determine the ECE of copper by using copper	**3**	To determine the Electrochemical Equivalent (ECE) of copper using	5

	voltmeter and ammeter.		a copper voltmeter and ammeter, students will measure the mass of copper deposited during electrolysis and relate it to the charge passed through the solution to calculate the ECE.	

TEXT BOOKS:

T1: Introduction to Electrodynamics. David Griffiths. Prentice Hall, Upper Saddle River, New Jersey, 07458
T2: Basic Laws of Electromagnetism. IE IRODOV

REFERENCE BOOKS:

R1: Principles of physics. Halliday Resnick OTHER LEARNING RESOURCES

OTHER LEARNING RESOURCES:

O1: Coursera Physics Courses
O2: edX Physics Courses
O3: MIT OpenCourseWare Physics

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply electric field and potential calculations, Compute the vectors and scalar representation of forces and nature of forces.	PO1, PO2,PO3,PO4,PO5,PO10,PO12
2	Analyze electrostatics in dielectric media, conservative and non-conservative forces, angular momentum and energy equations.	PO1, PO2,PO3,PO4,PO5,PO10,PO12
3	Compute basics of non-inertial frames, harmonic oscillator and forced oscillations.	PO1, PO2,PO3,PO4,PO5,PO10,PO12
4	Demonstrate understanding of magnetostatics in linear magnetic media, and the usage of common electrical measuring instruments.	PO1, PO2,PO3,PO4,PO5,PO10,PO12
5	Understand the basic characteristics of transformers and electrical machines.	PO1, PO2,PO3,PO4,PO5,PO10,PO12

SEMESTER – I										
Course Title	**Workshop for Engineers**									
Course code	**23BTCS114R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 15T+30P	**0**	**0**	**2**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the first year of the programme**								
Course Objectives	1. Learning this course will lead you to understand basic concepts of workshop and manufacturing 2. Apply fundamental knowledge of workshop and manufacturing in day-to-day life 3. Recognize components using different materials.								
CO1	Introduction to various manufacturing methods like casting, Forming, machining etc.								
CO2	Application of computer coding in automation of Machines.								
CO3	Introduction to Carpentry & fitting operations and its application in industries.								
CO4	Different machining operations like turning, milling.								
CO5	Learning the different types of welding and its field of application.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Manufacturing Methods:** Casting, forming, machining, joining, advanced manufacturing methods	**3**	Manufacturing methods include casting, forming, machining, and joining, which involve shaping and assembling materials into final products. Advanced manufacturing methods leverage modern technologies such as additive manufacturing, laser machining, and automation to enhance efficiency, precision, and product quality.	**1,2,3**
II	**CNCmachining, Additive Manufacturing:** **o**verview of CNC machining process, overview of additive manufacturing	**2**	CNC Machining: An automated manufacturing process that uses pre-programmed computer software to control machinery and tools to shape, cut, and drill materials with high precision. Additive Manufacturing: A process of creating objects by adding material layer by layer, commonly known as 3D printing, allowing for complex geometries and reduced material waste.	**3,4**
III	**Carpentry & Fitting operations:** Carpentry tools, carpentryoperations, fitting tools, fitting operations	**1**	Understand the use of various carpentry tools and perform fundamental carpentry operations. Gain proficiency in using fitting tools and executing essential fitting operations.	**3,4**
IV	**Machining operations:** Turning, milling, turning processes, milling processes	**2**	Understand the principles, equipment, and techniques involved in turning and milling operations. Gain proficiency in identifying and performing specific processes related to turning and milling, including tool selection,	**4**

			setup, and operation.	
V	**Welding:** Arcwelding & gas welding, brazing	**2**	Understand the principles, techniques, and applications of arc welding and gas welding. Develop skills in brazing, including proper material selection and joint preparation for effective metal joining.	**4**
Practical Component				
Practical 1	**A brief introduction of workshop** Machine shop, Fitting shop, carpentry shop, welding shop	**5**	Gain practical skills and foundational knowledge in machine operations, fitting, carpentry, and welding techniques essential for manufacturing and construction industries.	1,2
Practical 2	**Machine shop** Plain turning, Taper turning, Step turning	**10**	Understand and execute the basic turning operations on a lathe, including plain turning, taper turning, and step turning, ensuring precision and adherence to specified dimensions. Develop skills in setting up and operating a lathe, selecting appropriate tools and parameters for each operation, and maintaining safety protocols throughout the machining process.	2,3
Practical 3	**Carpentry shop** Dovetail joint, T-lapjoint, Cross-lapjoint, Corner – lapjoint	**5**	Gain practical skills in creating dovetail, T-lap, cross-lap, and corner-lap joints, essential for woodworking projects. Understand the structural benefits and appropriate applications of each joint type in carpentry.	3,4
Practical 4	**Welding shop** Arcwelding (Buttjoint,T-joint, Lapjoint, Cornerjoint)	**5**	The welding shop training aims to develop skills in performing arc welding on various joint types, including butt joints, T-joints, lap joints, and corner joints. Trainees will learn proper techniques, safety practices, and quality control measures to produce strong, reliable welds in different configurations.	4
Practical 5	**Fittingshop** Angle fitting, squarefitting, cornerfitting	**5**	Participants will gain proficiency in identifying and selecting appropriate angle, square, and corner fittings for various construction needs. Participants will demonstrate competence in assembling and integrating angle, square, and corner fittings into structural frameworks effectively.	5

TEXT BOOKS:

T1: Elements of Workshop Technology, Vol. I 2008 and Vol. II 2010,

T2: Manufacturing Engineering and Technology

REFERENCE BOOKS:

R1: Principles Manufacturing Technology – I, Pearson Education, 2008

R2: Processes and Materials of Manufacture, Roy A. Lindberg 4th edition, Prentice Hall India, 1998

OTHER LEARNING RESOURCES:

O1: Coursera workshop & Manufacturing Courses

O2: edX manufacturing technology Courses

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply electric field and potential calculations, Compute the vectors and scalar representation of forces and nature of forces.	PO1,PO2,PO3,PO5,PO7
2	Analyze electrostatics in dielectric media, conservative and non-conservative forces, angular momentum and energy equations.	PO1,PO5,PO11,PO12
3	Compute basics of non-inertial frames, harmonic oscillator and forced oscillations.	PO1,PO3,PO9
4	Demonstrate understanding of magnetostatics in linear magnetic media, and the usage of common electrical measuring instruments.	PO1,PO2,PO5,PO9
5	Understand the basic characteristics of transformers and electrical machines.	PO1,PO2,PO3,PO5,PO6

SEMESTER – I									
Course Title	**MOOCS I: Foundation of Digital Marketing and E-Commerce**								
Course code	**23MOCS112R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 15T	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**BBachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the first year of the program**								
Course Objectives	1. Students will comprehend the foundational concepts, terminology, and strategies of digital marketing and e-commerce. 2. Students will be able to analyze market trends, consumer behavior, and competition to develop effective e-commerce strategies. 3. Students will gain hands-on experience with various digital marketing tools and platforms, including social media, search engine optimization (SEO), and email marketing. 4. Students will learn how to create and optimize digital content that engages and converts target audiences. 5. Students will develop skills to measure, analyze, and optimize the performance of digital marketing campaigns and e-commerce activities.								
CO1	Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.								
CO2	Analyze market trends, consumer behavior, and competition to develop effective e-commerce strategies.								
CO3	Gain hands-on experience with various digital marketing tools and platforms, including social media, search engine optimization (SEO), and email marketing.								
CO4	Create and optimize digital content that engages and converts target audiences.								
CO5	Develop skills to measure, analyze, and optimize the performance of digital marketing campaigns and e-commerce activities.								
Unit-No.	**Content**		**Contact Hour**		**Learning Outcome**				**KL**
I	Introduction to Digital Marketing and E-commerce: Overview of Digital Marketing and E-commerce, Evolution and Trends in Digital Marketing, Importance and Benefits of Digital Marketing and E-commerce, Role of Digital Marketing in Business Growth, Career Opportunities in Digital Marketing and E-commerce		**8**		Gain a comprehensive understanding of digital marketing and e-commerce, including their evolution, trends, and significant benefits to businesses. Explore the critical role of digital marketing in driving business growth and discover diverse career opportunities within the field.				**1,2,3**
II	Digital Marketing Fundamentals: Digital Marketing Channels and Platforms, Understanding Target Audience and Buyer Personas, Digital Marketing Strategy Development, Content Marketing and Storytelling, Branding and Positioning in Digital Marketing		**8**		Gain a comprehensive understanding of various digital marketing channels and platforms, and learn to identify and analyze target audiences and develop buyer personas. Develop effective digital marketing strategies, create				**2,3**

			compelling content through storytelling, and master branding and positioning techniques to enhance digital marketing efforts.	
III	E-commerce Principles and Strategies: Introduction to E-commerce Models (B2B, B2C, C2C, etc.), E-commerce Website Design and User Experience (UX), Payment Gateways and Security in E-commerce, E-commerce Marketing and Customer Acquisition, E-commerce Analytics and Conversion Optimization	**8**	Understand various e-commerce models (B2B, B2C, C2C, etc.) and their applications in digital business environments. Develop skills in designing user-friendly e-commerce websites, integrating secure payment gateways, and implementing effective marketing strategies for customer acquisition and retention.	**3,4**
IV	Digital Marketing Tools and Techniques : Social Media Marketing (SMM) Strategies and Platforms, Search Engine Optimization (SEO) Fundamentals, Pay-Per-Click (PPC) Advertising and Google Ads, Email Marketing Best Practices and Automation, Analytics Tools for Measuring Digital Marketing Performance	**8**	Master effective SMM strategies, understanding key platforms to engage audiences and drive brand awareness. Gain foundational knowledge of SEO principles to optimize website visibility and improve search engine rankings.	**4**
V	Content Creation and Optimization: Content Planning and Strategy Development, Writing Compelling Copy for Digital Channels, Visual Content Creation (Graphics, Videos, Infographics), Search Engine Optimization (SEO) for Content, Content Distribution and Promotion Strategies	**8**	Develop strategic content plans, create compelling written and visual content for digital channels, and implement SEO techniques to enhance content visibility. Utilize effective distribution and promotion strategies to maximize reach and engagement.	**5**

Text Books:

1. "Digital Marketing: Strategy, Implementation and Practice" by Dave Chaffey and Fiona Ellis-Chadwick.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.	PO1,PO9,PO10
2	Analyze market trends, consumer behaviour, and competition to develop effective e-commerce strategies.	PO1, PO2,PO3,PO12
3	Gain hands-on experience with various digital marketing tools and platforms, including social media, search engine optimization (SEO), and email marketing.	PO1, PO5,PO12
4	Create and optimize digital content that engages and converts target audiences.	PO1, PO3,PO10
5	Develop skills to measure, analyze, and optimize the performance of digital marketing campaigns and e-commerce activities.	PO4,PO5,PO11,PO12

SEMESTER – I									
Course Title	**Field-based Training**								
Course code	**23BTCS116R**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 16P	**0**	**0**	**0**	**0**	**0**	**16**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the first year of the program**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings. 4. To foster collaboration and communication skills through group projects and professional interactions. 5. To cultivate an appreciation for the complexities and challenges of professional practice in the field.								
CO1	Apply theoretical concepts to real-world situations.								
CO2	Conduct field-based research and gather data effectively.								
CO3	Analyze and interpret the university data to draw meaningful conclusions.								
CO4	Communicate findings clearly and effectively, both orally and in writing.								
CO5	Demonstrate professional behaviour and teamwork skills in field settings.								
Unit-No.	**Content**		**Contact Hour**	**Learning Outcome**					**KL**
I	Field-Based Learning is designed to provide students with hands-on, practical experience in real-world environments related to Networking. This course emphasizes experiential learning through site visits, fieldwork, projects, and interactions with professionals in the field. Students will apply theoretical knowledge to practice, develop critical thinking skills, and gain a deeper understanding of their discipline.		**16**	Field-Based Learning provides students with hands-on experience in real-world networking environments. It emphasizes experiential learning through site visits, fieldwork, projects, and professional interactions. Students will apply theoretical knowledge, develop critical thinking skills, and gain a deeper understanding of networking.					**1,2,3,4,5**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply theoretical concepts to real-world situations.	PO1,PO2,PO6
2	Conduct field-based research and gather data effectively.	PO1,PO4,PO9
3	Analyze and interpret the university data to draw meaningful conclusions.	PO4,PO10
4	Communicate findings clearly and effectively, both orally and in writing.	PO10,PO11
5	Demonstrate professional behaviour and teamwork skills in field settings.	PO9,PO10,PO12

SEMESTER – I									
Course Title	**Introductory English for Engineers**								
Course code	**23UBPD113R**	**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	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the first year of the program**								
Course Objectives	1. To capacitate the students with mastery over Basic English grammar. 2. To enable the students to communicate confidently with a focus on listening a speaking skills. 3. With the help of the basics of Phonetics, the students will be able to pronoun words correctly. 4. To interact successfully and with decorum.								
CO1	Analyze and apply the rules of Parts of Speech in constructing grammatically correct sentences.								
CO2	Evaluate sentence structures, employ varied sentence types, and demonstrate effective comprehension skills								
CO3	Assess listening skills, identify factors influencing listening, and implement strategies for improved listening.								
CO4	Demonstrate effective speaking skills, including self-introduction, pronunciation, and extempore speech delivery.								
CO5	Apply communication theories, recognize barriers, and enhance skills for diverse communication situations.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Grammar** 1. Parts of Speech 2. Articles 3. Auxiliary Verbs 4. Affirmative and Negative Sentences	**5**	You'll learn how different parts of speech function in sentences, including articles and auxiliary verbs, enabling you to construct both affirmative and negative sentences effectively.	**1**
II	**Grammar** 1. Determiners 2. Sentence Construction 3. Types of Sentences (Assertive, Imperative, etc.) 4. Degree of Comparison 5. Comprehension Exercises	**7**	Master determiners, sentence construction, and types of sentences (assertive, imperative, etc.), along with understanding degrees of comparison. Practice comprehension exercises to reinforce understanding and application of these concepts effectively.	**3**
III	**Listening Skills** 1. What is listening? 2. The Process ofListening 3. Factors that adversely affectListening 4. Difference between Listening andHearing,	**6**	By studying listening skills, you will understand the distinction between listening and hearing, recognize factors that hinder effective listening, appreciate the importance	**5**

	5. Purpose and Importance of EffectiveListening 6. How to Improve ListeningProcess.		of active listening, and learn strategies to enhance the listening process	
IV	**Speaking Skills** 1. Introducing yourself 2. Self-discovery 3. Basics of Phonetics, pronunciation 4. Extempore speech 5. Video Recording for Self reflection	**6**	Developing speaking skills through self-introduction, phonetics, and extempore speaking, enhanced by video reflections for self-improvement and self-discovery.	**4**
V	**Communication Skills** 1. Introduction to Communication, 2. Importance of Communication Skills, 3. Purpose of Communication, 4. Types of Communication, 5. Formal and informal communication 6. Importance of Communication, 7. Barriers to Communication, 8. How to improve/ tips to improve Communication skills. 9. Responding to different questions in various situations(formal/informal)	**6**	By studying communication skills, learners gain a comprehensive understanding of its importance, types, barriers, and strategies for improvement, enabling effective interaction in various contexts.	**3**

TEXT BOOKS:

T1: Chaturvedi, P.D., ChaturvediMukesh, 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.: NewDelhi

REFERENCE BOOKS:

R1: Quirk, Randolp. (2010) A Comprehensive Grammar of the English Language by Randolph Quirk, Sidney Greenbaum, Pearson EducationIndia

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 Klett

OTHER LEARNING RESOURCES:
O1: Clapingo english Courses
O2: English partner India's Largest Online English Learning Platform

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Analyze and apply the rules of Parts of Speech in constructing grammatically correct sentences.	PO10
2	Evaluate sentence structures, employ varied sentence types, and demonstrate effective comprehension skills	PO2,PO10
3	Assess listening skills, identify factors influencing listening, and implement strategies for improved listening.	PO9,PO10
4	Demonstrate effective speaking skills, including self-introduction, pronunciation, and extempore speech delivery.	PO10
5	Apply communication theories, recognize barriers, and enhance skills for diverse communication situations.	PO6,PO10

SEMESTER – I									
Course Title	**Extra-Curricular Activities**								
Course code	**23UBEC111**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T	0	0	0	4	0	0	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the first year of the program**								
Course Objectives	1. It is to develop the social and soft skills and to promote a holistic development of the learners. 2. Participating in debate clubs, drama, or public speaking events enhances verbal and non-verbal communication skills. 3. Taking leadership roles in student organizations or event planning committees fosters leadership and teamwork abilities.								
CO1	Learn to a plan so that they can make meaningful contributions, maintain a commitment, and manage their time and priorities.								
CO2	Transform passionate students who demonstrate leadership and pursue interests beyond their academics.								
CO3	Learn to participate in various co-curricular activities leading to their multifaceted personality development.								
CO4	Express their ideas, views, In-depth evaluation and analysis clearly in the topic of their interest.								
CO5	Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Discover the exciting world of engineering through hands-on projects and workshops. Gain practical skills in robotics, coding, and innovation, preparing for future STEM success.	30	Explore the dynamic field of engineering through interactive projects and workshops. Develop practical skills in robotics, coding, and innovation. Prepare for future success in. STEM disciplines	1,2,3,4,5

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Learn to a plan so that they can make meaningful contributions, maintain a commitment, and manage their time and priorities.	PO9
2	Transform passionate students who demonstrate leadership and pursue interests beyond their academics.	PO11,PO12
3	Learn to participate in various co-curricular activities leading to their multifaceted personality development.	PO12
4	Express their ideas, views, In-depth evaluation and analysis clearly in the topic of their interest.	PO10
5	Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.	PO9

SEMESTER – II									
Course Title	**Ordinary Differential Equations and Differential Calculus**								
Course code	**23BTCS121R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the first year of the program**								
Course Objectives	1. To make students understand and solve first order and second order ordinary differential equations. 2. To help understand and solve higher order differential equations. 3. To provide the application on differential calculus. 4. To provide an overview of partial derivatives and the different notions attached to them. 5. To help understand the concept of multiple integrals and the ways to find the area of different types of curves.								
CO1	Enabling problem solving skills of ordinary differential equations of various order.								
CO2	Enable to find the partial order derivative of functions of two or more variables.								
CO3	Analyse the complex analysis and solutions.								
CO4	Solve problems related to differentiation under integral sign.								
CO5	Analyze and find the area of two curves using multiple integrals								
Unit-No.	**Content**		**Contact Hour**	**Learning Outcome**					**BL**
I	**First order ordinary differential equations:** Exact, linear and Bernoulli's equations- Euler's equations- Equations not of first degree: equations solvable for p- equations solvable for y- equations solvable for x and Clairaut's type.		**5**	Solve initial value problems and understand their significance in applications. Interpret the existence and uniqueness of solutions based on initial conditions.					**2,3**
II	**Ordinary differential equations of higher orders:** Second order linear differential equations with variable coefficients- method of variation of parameters, Cauchy-Euler equation- Power series solutions- Legendre polynomials- Bessel functions of the first kind and their properties.		**7**	Formulate real-world problems as first-order ODEs (e.g., population dynamics, cooling/heating problems, mixing problems). Interpret and analyze the solutions in the context of the modelled phenomena.					**2,3,4**
III	**Partial Differentiation-I** Introduction to partial derivatives- its meaning- standard rules of finding partial derivatives of functions of two or more variables- Introduction to homogeneous functions- To check whether a given function is homogeneous or not- Introduction to Euler's homogeneous function- application of Euler's homogeneous		**6**	Understand and interpret direction fields (slope fields). Analyze the behaviour of solutions without solving the equation explicitly. Determine the stability of equilibrium solutions.					**2,3,4,5**

	function.			
IV	**Partial differentiation-II** Jacobian- properties of Jacobian- Jacobian of Implicit Functions- Taylor's theorem for function of two variables- Maclaurin's series for function of two variables- Maxima and Minima of functions of two variables- Conditions for f(x, y) to be Maximum or Minimum of two variables without constraints and Lagrange's method- Differentiation under integral sign.	**6**	Solve first-order ODEs using separation of variables. Apply integrating factor methods to solve linear first-order ODEs. Utilize exact equations and understand the conditions for exactness.	**2,3,4,5**
V	**Multiple integrals** Double and Triple integrals – Change of order of integration in double integrals – Change of variables to polar, cylindrical and spherical coordinates.	**6**	Evaluate double integrals by iterated integration (Fubini's Theorem). Change the order of integration in double integrals. Compute double integrals in polar coordinates.	**2, 3,4,5**

TEXT BOOKS:

T1: C Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley and Sons, 2006

T2: N. P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

REFERENCE BOOKS:

R1: S. L. Ross, Differential Equations, 3rd Ed. Wiley India, 1984.
R2: Dr. V. P. Mishra, Dr. Jyoti Sinha, Pratibha Mishra, Advanced Engineering Mathematics, Bhavya Books, Delhi.

OTHER LEARNING RESOURCES:

O1: Coursera: Platforms like Coursera offer courses such as "Mathematics for Engineers" which cover topics ranging from calculus to differential equations and linear algebra.
O2: edX: Courses like "Engineering Mathematics" provide an in-depth study of mathematical techniques important in engineering disciplines

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Enabling problem solving skills of ordinary differential equations of various order.	PO1,PO2,PO3,PO12
2	Enable to find the partial order derivative of functions of two or more variables.	PO1,PO2,PO3
3	Analyse the complex analysis and solutions.	PO1,PO2,PO3
4	Solve problems related to differentiation under integral sign.	PO1,PO2,PO3
5	Analyze and find the area of two curves using multiple integrals	PO1,PO2,PO3

SEMESTER – II										
Course Title	**Engineering Chemistry**									
Course code	**23BTCS122R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 42T+30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	Basic knowledge of Chemistry, Physics and Mathematics	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the first year of the program**								
Course Objectives	1. Identify scientific reasoning and quantitative analysis. 2. Revise the scope, content, and pedagogy for one of existing general chemistry course sequences 3. Produce the content of chemistry set in a current and relevant context for engineers.								
CO1	Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.								
CO2	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques								
CO3	Understand bulk properties and processes using thermodynamic considerations								
CO4	Understand periodic properties such as ionization potential, electronegativity, oxidation states and electro negativity								
CO5	Analyse major chemical reactions that are used in the synthesis of molecules.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Atomic and molecular structure** Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals .Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structure.	**12**	Comprehensive understanding of the organization of atoms, including the roles of protons, neutrons, and electrons within the nucleus and their distributions in electron orbitals. They should grasp the principles governing atomic spectra, electron configurations, and periodic trends.	**1,2,3,4,5**
II	**Spectroscopic techniques and applications** Principles of spectroscopy and selections rules. Electronic spectroscopy. Fluorescence and its applications in medicine.	**8**	Comprehensive understanding of the principles and methods used to analyze the interaction between matter and electromagnetic	**1,2,3,4,5**

	Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging. Surface characterization techniques. Diffraction and scattering.		radiation across different wavelengths. They should be able to describe and apply techniques such as UV-Vis spectroscopy, infrared spectroscopy (IR), nuclear magnetic resonance spectroscopy (NMR), and mass spectrometry (MS) for qualitative and quantitative analysis of compounds.	
III	**Intermolecular forces and potential energy surfaces** Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces oh H_3 ,H_2F and HCN and trajectories on these surfaces **Use of free energy in chemical equilibria** Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energies and emf. Cell potentials, the Nernst equations and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham Diagrams	**10**	grasp the fundamental interactions between molecules and their implications in physical properties and chemical behaviour. Intermolecular forces, including van der Waals forces, hydrogen bonding, and dipole-dipole interactions, dictate the stability of molecular aggregates and influence phenomena such as boiling points, solubility, and viscosity. Understanding the concept of free energy in chemical equilibria is essential for students to comprehend the spontaneity and directionality of chemical reactions. Free energy (G) represents the energy available to do work under constant temperature and pressure conditions	**1,2,3,4,5**
IV	**Periodic Properties** Effective nuclear charge. Penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes. Ionization energies, electron affinity and electronegativity, polarizability,	**4**	Grasp the underlying principles governing these trends, such as effective nuclear charge and shielding effects, and how these influence the reactivity, chemical bonding, and physical properties of elements.	**1,2,3,4,5**

	oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries		Additionally, students should be able to predict and interpret periodic trends using periodic tables, understand the factors that affect these trends, and apply this knowledge to explain phenomena such as the formation of ions, trends in chemical reactivity, and the periodic classification of elements according to their properties.	
V	**Stereochemistry** Representations of 3 dimensional structures, structural isomers and stereo isomers. Configurations and symmetry and chirality, enantiomers, diastereomers, optical activity , absolute configurations and conformational analysis. Isomerism in transitional metal compounds. **Organic reactions and synthesis of a drug molecule** Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule	**8**	understand the fundamental concepts of chirality, stereoisomerism, and geometric isomerism, and be able to distinguish between different types of stereoisomers such as enantiomers and diastereomers. They should comprehend how stereochemistry influences molecular interactions, including biological recognition processes and drug efficacy. Moreover, students should apply stereo chemical principles to predict the outcomes of reactions, particularly in organic chemistry, and recognize the importance of spatial arrangement in shaping the physical and chemical properties of molecules. Mastery of stereochemistry enables students to understand complex molecular structures and their behaviors, essential for fields such as pharmaceuticals, materials science, and biochemistry.	**1,2,3,4,5**
Practical Component				
Practical 1	Qualitative Organic Analysis(Minimum 5 number of samples)	**5**	Learn to identify unknown organic compounds using a systematic approach	**1,2,3**

			involving several key techniques. They should be able to perform tests such as solubility tests, functional group tests (e.g., bromine water test for alkenes, silver nitrate test for halides), and spectroscopic methods including infrared (IR) and nuclear magnetic resonance (NMR) spectroscopy.	
Practical 2	Estimation of Iron Using standard $KMnO_4$ solution	**5**	Estimating iron using a standard potassium permanganate (KMnO4) solution involves a titration method that students should master for analytical chemistry. Initially, students prepare an acidic solution containing iron ions, then titrate it with KMnO4 solution until a color change occurs, typically from purple to colorless.	**3,4**
Practical 3	Determination of Total Hardness of waterand Estimation of Ca	**5**	Determining the total hardness of water and estimating the calcium ion concentration involves titration techniques essential in environmental and analytical chemistry.	**3,4,5**
Practical 4	Determination of surface tension of given liquid	**5**	Determining the surface tension of a liquid involves several experimental methods that students should master in physical chemistry and fluid mechanics. One common method is the capillary rise method, where students measure the height to which the liquid rises in a capillary tube due to capillary action.	**2,4,5**
Practical 5	Determination of viscosity of given liquid	**5**	Determining the viscosity of a liquid involves several experimental	**3,4,5**

			techniques that are fundamental in fluid mechanics and physical chemistry. One common method is the capillary viscometer technique, where students measure the time it takes for a liquid to flow through a narrow capillary tube under gravity.	
Practical 6	Synthesis of a polymer drug	**5**	Synthesizing a polymer or drug involves a series of chemical reactions and processes aimed at creating a specific molecular structure with desired properties. For polymers, students typically learn methods such as polymerization reactions (e.g., condensation polymerization, addition polymerization) to link monomers into long chains.	**2,3,4,5,6**

TEXT BOOKS:

T1: University chemistry, by B. H. Mahan
T2: Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
T3: Fundamentals of Molecular Spectroscopy, by C. N. Banwell
T4: Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan

REFERENCE BOOKS:

R1: Physical Chemistry, by P. W. Atkins
R2: Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

OTHER LEARNING RESOURCES:

O1:Coursera: Offers courses on engineering chemistry topics such as materials science, environmental chemistry, and chemical engineering principles.
O2:edX: Provides courses from universities worldwide covering topics like nanotechnology, renewable energy, and chemical process design.
O3:MIT OpenCourseWare: Offers free lecture notes, exams, and videos from actual MIT courses in chemistry and chemical engineering.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.	PO1,PO2,PO3,PO4,PO5,PO10,PO12
2	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques	PO1,PO2,PO3,PO4,PO5,PO10,PO12
3	Understand bulk properties and processes using thermodynamic considerations	PO1,PO2,PO3,PO4,PO5,PO10,PO12
4	Understand periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity	PO1,PO2,PO3,PO4,PO5,PO10,PO12
5	Analyse major chemical reactions that are used in the synthesis of molecules.	PO1,PO2,PO3,PO4,PO5,PO10,PO12

SEMESTER – II										
Course Title	**Basic Electrical and Electronics Engineering**									
Course code	**23BTCS123R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 45T+30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**	
Pre-requisite	**Nil**	**Co-requisite**	**Nil**							
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**									
Semester	**Winter/ II semester of the first year of the program**									
Course Objectives	1. Recall basic concepts of Electrical Engineering 2. Illustrate basics of AC circuits 3. Explain operative principle of transformer with background of magnetic circuits 4. Classify and compare different types of Electrical machines**.**									
CO1	Understand Kirchoff's laws to solve complex DC circuits, employing Thevenin, Norton, and Superposition theorems effectively.									
CO2	Analyze single-phase AC circuits, applying phasor representation and power concepts with precision and understanding.									
CO3	Evaluate transformer performance, considering losses, regulation, and efficiency, and apply knowledge to three-phase transformer connections.									
CO4	Critically analyze three-phase induction motor operation, interpreting torque-slip characteristics, losses, and efficiency for practical applications.									
CO5	Understand the design of power converters and demonstrate expertise in electrical installations, including safety devices and battery types.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Dc circuits:** Electrical circuit elements(R,L,C),voltage and current source,Kirchoff‘scurrentand voltagelaw,analysisofsimple circuit,Thevenin,Nortonand Superposition theorem	**8**	Understand and explain voltage, current, resistance, power, and energy in the context of DCcircuits.Apply Ohm’s Law to relate voltage, current, and resistance in simple DC circuits.Analyze and solve series, parallel, and series-parallel resistor networks.	**1,2,3, 4**
II	**AC Circuit**: Representation of sinusoidal waveforms, peak and rms values, phasor representation,realpower,rea ctivepower,apparentpower,p owerfactor,Analysis ofSinglephaseaccircuitsconsi stingofr,L,C.RL,RC,rlccomb ination(seriesand parallel), voltage and current relationship in star and delta connection.	**12**	Understand the nature of alternating current (AC) and how it differs from direct current (DC). Describe sinusoidal waveforms and understand key parameters such as amplitude, frequency, period, and phase angle.	**3,4**
III	**Transformer:** Magnetic materials, ideal and practical transformer, equivalent Circuit, losses in transformer,	**8**	Understand the fundamental principles of electromagnetic induction as they apply to transformers. Explain the concepts of mutual	**2,3,4**

	regulation and efficiency, auto transformer, three phase transformer connection.		inductance and magnetic coupling.	
IV	**Electrical machines:** Generation of rotating magnetic fields, construction and Working of three phase induction motor, torque-slip characteristics, losses and efficiency, Single phase induction motor, working of synchronous generator.	**6**	Understand the principles of electromechanical energy conversion. Describe the construction, components, and working principles of DC generators and motors.	**2,3,4, 5**
V	**Power converter and electrical installation:** DC-DC buck and boost converter, singlephaseandthreephasevoltagesourceinverter,Fuse,MCB,ELCB,MCCB, Earthing, wires and cables, types of batteries	**5**	Understand the basic principles of power electronics and power conversion. Differentiate between various types of power converters (AC-DC, DC-DC, DC-AC, AC-AC) and their applications.	**2,3,4**
Practical Component				
Practical 1	To Study specification and uses of instruments	**2**	Explain the significance and interpretation of instrument specifications such as accuracy, precision, resolution, range, and sensitivity.	**1,2**
Practical 2	To Study Ohm's Law for DC Circuits	**2**	Apply Ohm's Law to calculate unknown quantities (voltage, current, resistance) in simple DC circuits.	**1,2**
Practical 3	To verify KCL and KVL Circuits	**3**	Explain Kirchhoff's Current Law and its application in electrical circuits, stating that the algebraic sum of currents entering a node (or junction) is zero.	**1,2**
Practical 4	To verify Thevenin's Theorem	**2**	Apply Thevenin's Theorem to analyze and solve DC and AC circuits with independent and dependent sources.	**1,2**
Practical 5	To verify Norton's Theorem	**2**	Construct the Norton equivalent circuit for a given network, comprising a current source (Norton current) in parallel with an impedance (Norton resistance).	**1,2**
Practical 6	To verify Maximum Power Transfer Theorem	**2**	Explain the principle behind the Maximum Power Transfer Theorem, stating that maximum power is transferred from a source to a load when the load resistance	**1,2**

			equals the Thevenin or Norton resistance of the source.	
Practical 7	To verify super position Theorem	**2**	Apply Superposition Theorem to analyze DC circuits containing multiple independent sources, including voltage sources and current sources.	**3,4**
Practical 8	To Study transformation	**2**	Define the transformation ratio of a single-phase transformer as the ratio of the number of turns in the primary winding to the number of turns in the secondary winding.	**3,4**
Practical 9	Mini-project	**13**	Define and articulate a clear problem or challenge to be addressed through the mini-project.	**3,4**

TEXT BOOKS:

T1: D.P. KothariandI.J.Nagrath, Basic Electrical Engineering, TataMcGraw Hill, 2010

REFERENCE BOOKS:

R1:D.C.Kulshreshtha, Basic Electrical Engineering, McGrawHill,2009
R2:E.Hughes, ―ElectricalandElectronicsTechnology‖,Pearson,2010

OTHER LEARNING RESOURCES:

O1:Coursera: Courses such as "Programming for Everybody (Getting Started with C).
O2:edX: Introduction to C Programming" by Dartmouth College.
O3:Udemy: Various courses on C programming, including "C Programming For Beginners - Master the C Language".

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand Kirchoff's laws to solve complex DC circuits, employing Thevenin, Norton, and Superposition theorems effectively.	PO1,PO2,PO3,PO4,PO5,PO6,PO9, PO10,PO11,PO12
2	Analyze single-phase AC circuits, applying phasor representation and power concepts with precision and understanding.	PO1,PO2,PO3,PO4,PO5,PO6,PO9, PO10,PO11,PO12
3	Evaluate transformer performance, considering losses, regulation, and efficiency, and apply knowledge to three-phase transformer connections.	PO1,PO2,PO3,PO4,PO5,PO6,PO9, PO10,PO11,PO12
4	Critically analyze three-phase induction motor operation, interpreting torque-slip characteristics, losses, and efficiency for practical applications.	PO1,PO2,PO3,PO4,PO5,PO6,PO9, PO10,PO11,PO12
5	Understand the design of power converters and demonstrate expertise in electrical installations, including safety devices and battery types.	PO1,PO2,PO3,PO4,PO5,PO6,PO9, PO10,PO11,PO12

SEMESTER – II										
Course Title	**Object Oriented Programming**									
Course code	**23BTCS124R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the first year of the program**								
Course Objectives	1.To enable students to understand the basic object oriented programming concepts and apply them in problem solving. 2.Additionally, to illustrate among students the inheritance concepts for reusing the program and also to enable students. 3.To develop GUI-based applications using AWT, Swing and Event handling.									
CO1	Understand object-oriented programming concepts and execute them proficiently in Java.									
CO2	Apply building blocks of OOPs language, including inheritance, packages, and interfaces, analysing real-world problems in their context.									
CO3	Utilize multithreading, exception handling, and other OOPs concepts effectively in object-oriented programs.									
CO4	Apply various exception handling methods in programming, demonstrating competence in error management.									
CO5	Develop interactive and GUI-based Java applications through project-based learning, showcasing practical application of Java programming skills.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Java Overview:** Java Introduction, Platform Independence, JVM & JDK, Data types, Operators, If, else statement, Switch condition, while, do-while, for loop, break and continue statement. **Array and String:** Single Array & Multidimensional Array, Library Classes-String, String Buffer & Wrapper Class, Command line arguments and Various String Operations.	**5**	Describe the concept of platform independence in Java and how the Java Virtual Machine (JVM) enables it. Differentiate between the Java Virtual Machine (JVM) and the Java Development Kit (JDK), and understand their roles in Java application development. Define and declare single-dimensional arrays in Java, understanding array initialization, accessing elements, and iterating through array elements.	**1,2,3**
II	**Classes, Objects and Methods:** Class and Object, Object reference, Constructor: Constructor Overloading, Method: Method Overloading, Recursion, Passing and Returning object form Method, new operator, this and static keyword, finalize () method, Import statement, Static import, Access control, Nested class, Inner class, Anonymous inner	**7**	Define classes and objects in Java, understanding the concept of encapsulation and how classes serve as blueprints for creating objects. Declare and define classes in Java, including instance variables, constructors, methods, and access modifiers (public, private, protected). Create objects of a class using constructors and understand the process of object initialization,	**3,4,5,6**

	class.		including default constructors and parameterized constructors.	
III	**Inheritance and Interfaces in Java:** Overview of Inheritance, inheritance in constructor, Inheriting Data members and Methods, Multilevel Inheritance – method overriding Handle multilevel constructors Explain super keyword, Stop Inheritance, Explain Final keywords, Creation and Implementation of an interface, Interface reference, instance of operator, Interface inheritance, Dynamic method dispatch, Abstract class, Comparison between Abstract Class and interface, inside of System.out.println – statements.	**6**	Differentiate between types of inheritance in Java, including single inheritance, multiple inheritance through interfaces, and hierarchical inheritance. Implement method overriding in subclasses to provide specialized implementations of methods inherited from superclasses, understanding runtime polymorphism.	**2,3,4 ,5**
IV	**Exception Handling in Java:** Exception and Error, Use of try, catch, throw, throws and finally, Built in Exception, Custom exception, Throwable Class. JAVA File Handling: Overview of Different Stream (Byte Stream, Character stream), Readers and Writers class, FileClass, File Input Stream, File Output Stream, Input Stream Reader and Output Stream Writer class, File reader and writer class, File Writer, Buffered Reader class.	**6**	Define exceptions in Java and understand their role in handling runtime errors and abnormal conditions that may occur during program execution. Implement try-catch blocks to handle exceptions gracefully, preventing program termination and providing alternative behaviors or error messages.	**1,3,4 ,5**
V	**Applet, AWT and Swing:** MVC Architecture, Applet: Applet Fundamental, Applet Architecture, Applet Skeleton, Requesting Repainting, Event Handling: various event handling mechanisms, Delegation Event Model, Events, Event Sources, Event Listeners, various classes related to event sources and event listeners, AWT: window fundamentals, creating frames, Adding removing various	**6**	Define what Java applets are and understand their role in web-based applications, particularly in the context of early web development. Describe the lifecycle of an applet, including initialization (init()), start (start()), stop (stop()), and destruction (destroy()), understanding how applets interact with web browsers. Implement event handling in Java applets to respond to user	**4**

	controls, Layout managers, Introduction To Swing, Applications and Pluggable look and feel, Basic swing components: Text Fields, Buttons, Toggle Buttons, Checkboxes, and Radio Buttons.		interactions such as mouse clicks, keyboard input, and window events, using event listeners and adapters.	
Practical Component				
Practical 1	Hands-on Introduction to Object-Oriented Programming: Practical exercises on creating classes and objects, Implementing encapsulation through practical examples, Coding exercises on constructors and destructors, Applying access modifiers (public, private, protected) in practical scenarios.	**6**	Define object-oriented programming (OOP) concepts such as classes, objects, inheritance, polymorphism, and encapsulation, understanding their role in software development. Create classes in Java, defining attributes (fields) and behaviors (methods) that represent real-world entities or concepts, and instantiate objects from these classes.	**1,2,4,5**
Practical 2	Practical Inheritance and Polymorphism: Coding exercises on implementing different types of inheritance (single, multi-level, and multiple), Practical examples of method overriding, Creating and using abstract classes and interfaces, Implementing static and dynamic binding through practical examples.	**8**	Implement different types of inheritance in Java: single inheritance (one subclass inherits from one superclass), multi-level inheritance (a subclass extends another subclass), and multiple inheritance (a subclass inherits from multiple super classes using interfaces).	**2,4,5**
Practical 3	Advanced OOP Concepts in Practice: Practical exercises on creating and using packages and namespaces, Implementing exception handling in real-world scenarios, Creating and managing multithreaded applications, Practical exercises on generics and collections.	**8**	Organize Java classes into packages to manage code structure and namespace, demonstrating how packages encapsulate related classes and provide access control. Develop practical exercises that involve creating, importing, and utilizing packages in Java applications, ensuring modularization, and facilitating code reuse and maintenance.	**1,2,3**
Practical 4	Software Design and Development in Action: Hands-on Object-Oriented Analysis and Design (OOAD) exercises, Implementing design patterns (e.g., Singleton, Factory, Observer) in practical scenarios,	**8**	Conduct hands-on exercises on OOAD principles, including identifying objects, defining classes, specifying relationships (inheritance, composition), and modeling behavior using UML diagrams (class diagrams,	**2,3,4,5**

	Software testing and debugging exercises, Code optimization and refactoring practical sessions.		sequence diagrams, etc.). Implement commonly used design patterns (e.g., Singleton, Factory, Observer, Strategy) in practical scenarios, demonstrating their application to solve recurring design problems and improve code flexibility and maintainability.	

TEXT BOOKS:

T1: Herbert Schildt and Dale Skrien, ‖Java Fundamentals – A comprehensive Introduction‖, McGraw Hill.
T2: Herbert Schildt, ―Java the complete reference, McGraw Hill, Osborne.
T3: T. Budd, ―Understanding Object-Oriented Programming with Java‖, Pearson Education.

REFERENCE BOOKS:

R1: P.J. Dietel and H. M. Dietel,―Java How to program ‖,Prentice Hall.
R2: P. Radha Krishna, ―Object Oriented programming through Java‖, CRC Press.

OTHER LEARNING RESOURCES:

O1:http://java.sun.com
O2:http://www.oracle.com/technetwork/java/index.html)
O3:http://java.sun.com/javase
O4:http://www.oracle.com/technetwork/java/javase/overview/index.html
O5:http://download.oracle.com/javase/7/docs/api/index.htmlE-Text Books:
O6:http://docs.oracle.com/javase/tutorial/

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand object-oriented programming concepts and execute them proficiently in Java.	PO1,PO2,PO3,PO4,PO5,PO12
2	Apply building blocks of OOPs language, including inheritance, packages, and interfaces, analyzing real-world problems in their context.	PO1,PO2,PO3,PO4,PO5,PO12
3	Utilize multithreading, exception handling, and other OOPs concepts effectively in object-oriented programs.	PO1,PO2,PO3,PO4,PO5,PO12
4	Apply various exception handling methods in programming, demonstrating competence in error management.	PO1,PO2,PO3,PO4,PO5,PO12
5	Develop interactive and GUI-based Java applications through project-based learning, showcasing practical application of Java programming skills.	PO1,PO2,PO3,PO4,PO5,PO12

SEMESTER – II									
Course Title	**Environmental Science**								
Course code	**23UBES121R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the first year of the program**								
Course Objectives	1. Understanding Ecological Systems and Processes. 2. Analysing Environmental Issues and Solutions. 3. Promoting Environmental Stewardship and Sustainable Practices.								
CO1	Understand the relationships between natural and man-made systems.								
CO2	Develop critical thinking for shaping strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.								
CO3	Understand the consequences of human actions on the web of life, global economy, and quality of human life.								
CO4	Understand about Environment Pollution, Global Environment issues, Impact of Human Population and modern civilization on the Environment								
CO5	Analyse various aspects of human population, and the impact of the population growth on the environment.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**Introduction to Environment:** Definition and scope, components of environment, atmosphere, hydrosphere, lithosphere and biosphere, structure and composition, Life systems, pro and eukaryotic organizations, Metabolic principles; types of plants and animals. Producers, consumers and decomposers.	**6**	Identify and describe the major components of the environment: atmosphere (air), hydrosphere (water), lithosphere (earth's crust), and biosphere (living organisms), understanding their interactions and interdependencies. Define "environment" in the context of ecological and environmental sciences, exploring its scope as encompassing natural, built, and social environments.	**1,2,3, 4**
II	**Ecology:** Terminology and approach, ecosystem, types of ecosystems; structure and function, mineral cycling, energy flow and trophic chains. Development and evolution.	**6**	Define key ecological terms such as ecosystem, community, population, niche, habitat, and biodiversity, understanding their roles in studying interactions between organisms and their environment. Explain the concept of an ecosystem as a functional unit consisting of biotic (living organisms) and abiotic (non-living environment) components interacting within a defined area.	**1,2,3, 4,5**
III	**Environmental Pollution:** Sources, causes, assessment, effect, prevention and control of water pollution, air	**6**	Identify and categorize sources of pollution such as industrial emissions, agricultural runoff, urban waste, and vehicular	**1,2,3, 4**

	pollution noise and land pollution. Strategies of management, concept of sustainability. Energy, e n v i r o n m e n t , and their relationship with human activities. Water Resources and utilization, forest resources.		emissions, understanding their contributions to environmental degradation. Conduct assessments of environmental pollution using scientific methods and tools, including monitoring techniques, data analysis, and environmental impact assessments (EIAs).	
IV	**Global Environmental Problems:** Human health, settlements, management of rivers, lakes, forests, wild life and catchments. Role of society, NGO and Govt. agencies. Concept of urbanization and green cities Global Warming, greenhouse causes and effects, carbon Sequestration.	**6**	Analyze the impact of environmental pollution and degradation on human health, including respiratory diseases, waterborne illnesses, and exposure to hazardous substances. Discuss the challenges and opportunities of urbanization, including urban sprawl, infrastructure development, resource consumption patterns, and sustainable urban planning practices.	**1,3,4**
V	**International agreements and protocols**, National forest policy and Environmental laws and acts. EIA.	**6**	Explain the purpose and significance of international environmental agreements and protocols, such as the Kyoto Protocol, Paris Agreement, Convention on Biological Diversity (CBD), and Montreal Protocol, analyzing their goals, implementation mechanisms, and global impact.	**1,2,3, 4**

TEXT BOOKS:

T1: Sudhir Andrews (2013) Food and Beverage Service: A Training Manual, Tata McGraw Hill, 2013.

REFERENCE BOOKS:

R1: PradipDey, ManasGhosh, “Programming in C”, 2nd Edition, 2018, Oxford University

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the relationships between natural and man-made systems.	PO1,PO2,PO3,PO4,PO7,PO12
2	Develop critical thinking for shaping strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.	PO1,PO2,PO3,PO4,PO7,PO12
3	Understand the consequences of human actions on the web of life, global economy, and quality of human life.	PO2,PO7,PO12
4	Understand about Environment Pollution, Global Environment issues, Impact of Human Population and modern civilization on the Environment	PO2,PO3,PO7
5	Analyse various aspects of human population, and the impact of the population growth on the environment.	PO1,PO2,PO3,PO4,PO7,PO12

SEMESTER – II									
Course Title	**MOOCS II: Ethics, Technology and Engineering**								
Course code	**23MOCS122R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II Semester of First Year of the Programme**								
Course Objectives	1. Gain a foundational understanding of major ethical theories and principles and their applications in technology and engineering contexts. 2. Recognize and analyze ethical issues and dilemmas arising from the development and use of technology in various engineering fields. 3. Assess the social, environmental, and cultural impacts of technology and engineering practices, considering both positive and negative consequences.								
CO1	Students will comprehend major ethical theories and frameworks and apply them to analyze ethical issues in technology and engineering.								
CO2	Students will be able to identify and evaluate ethical dilemmas that arise in the design, development, and implementation of engineering projects.								
CO3	Students will develop skills to make ethical decisions and resolve ethical conflicts in engineering practice, considering diverse perspectives and stakeholders.								
CO4	Students will assess the social, environmental, and cultural impact of technological innovations and propose strategies for ethical and sustainable engineering.								
CO5	Students will understand the importance of professional ethics in engineering and advocate for ethical practices within their organizations and communities.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Introduction to Ethics and Engineering: Overview of Ethics and Ethical Theories, Ethical Principles in Engineering Practice, Historical Perspectives on Ethics in Engineering, Ethical Decision-Making Models, Professional Codes of Ethics for Engineers	**6**	Define ethics and explore various ethical theories (e.g., deontology, utilitarianism, virtue ethics) that provide frameworks for ethical reasoning and decision-making in engineering contexts. Identify and analyze key ethical principles relevant to engineering practice, such as integrity, honesty, accountability, transparency, fairness, and respect for human rights and the environment.	**1,2, 3**
II	Ethical Issues in Technological Innovation: Ethical Dimensions of Emerging Technologies (e.g., AI, Biotechnology, IoT), Privacy, Surveillance, and Data Ethics, Ethical Implications of Automation and Robotics, Intellectual Property Rights and Ethical Considerations, Ethical Challenges in Global Engineering Projects	**6**	Analyze ethical implications and societal impacts of emerging technologies such as Artificial Intelligence (AI), Biotechnology, Internet of Things (IoT), and Blockchain, addressing issues of fairness, accountability, transparency, and bias.	**3,4, 5**
III	Social and Environmental Justice in Engineering: Social Responsibility	**6**	Define and articulate the ethical and social	**3,4, 5,6**

	of Engineers, Environmental Ethics and Sustainable Engineering, Ethical Considerations in Urban Planning and Infrastructure Development, Technology and Social Justice: Bridging the Digital Divide, Case Studies: Ethical Responses to Environmental Disasters.		responsibilities of engineers to promote public safety, health, and well-being, while considering the needs and interests of diverse stakeholders. Discuss principles of environmental ethics and their application in engineering practice, emphasizing sustainable development, resource conservation, pollution prevention, and ecosystem protection.	
IV	Ethical Leadership and Professional Responsibility: Ethical Leadership in Engineering Organizations, Whistleblowing and Ethical Decision-Making in Engineering, Diversity, Equity, and Inclusion in Engineering Practice, Ethics of Engineering Research and Publication, Ethical Responsibility in the Use of Artificial Intelligence and Machine Learning	**6**	Define the concept of ethical leadership in the context of engineering organizations, exploring the characteristics, behaviors, and practices that promote integrity, accountability, and ethical culture within teams and organizations.	**3,4, 5,6**
V	Ethics in Design and Innovation: Design Thinking and Ethical Design Principles, User-Centered Design and Ethical User Experience (UX), Ethical Considerations in Product Development and Marketing, Human-Centered AI and Ethical AI Design, Ethical Innovation and Entrepreneurship in Engineering	**6**	Explore the principles of design thinking and their application to ethical design practices in engineering, emphasizing empathy, collaboration, creativity, and human-centered solutions.Apply ethical considerations in user experience (UX) design, ensuring usability, accessibility, transparency, and respect for user privacy and autonomy throughout the design process.	**4**

TEXT BOOKS:

T1: "Engineering Ethics: Concepts and Cases" by Charles E. Harris Jr., Michael S. Pritchard, and Michael J. Rabins.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Students will comprehend major ethical theories and frameworks and apply them to analyze ethical issues in technology and engineering.	PO2,PO6,PO7,PO8
2	Students will be able to identify and evaluate ethical dilemmas that arise in the design, development, and implementation of engineering projects.	PO2,PO6,PO8
3	Students will develop skills to make ethical decisions and resolve ethical conflicts in engineering practice, considering diverse perspectives and stakeholders.	PO3,PO6,PO7,PO8
4	Students will assess the social, environmental, and cultural impact of technological innovations and propose strategies for ethical and sustainable engineering.	PO3,PO6,PO7,PO8,
5	Students will understand the importance of professional ethics in engineering and advocate for ethical practices within their organizations and communities.	PO6,PO7,PO8

SEMESTER – II									
Course Title	**Field-based Training : Network Components and Management**								
Course code	**23BTCS125R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: NA	**0**	**0**	**0**	**0**	**0**	**16**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Networking Basics**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II Semester of First Year of the Programme**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings. 4. To foster collaboration and communication skills through group projects and professional interactions. 5. To cultivate an appreciation for the complexities and challenges of professional practice in the field.								
CO1	Expose students to real-world applications of theoretical knowledge.								
CO2	Enhance observational, analytical, and research skills through fieldwork.								
CO3	Develop problem-solving skills in practical settings.								
CO4	Foster collaboration and communication skills through group projects and professional interactions.								
CO5	Cultivate an appreciation for the complexities and challenges of professional practice in the field.								

Course Description:

Field-Based Learning is designed to provide students with hands-on, practical experience in real-world environments related to Networking. This course emphasizes experiential learning through site visits, fieldwork, projects, and interactions with professionals in the field. Students will apply theoretical knowledge to practice, develop critical thinking skills, and gain a deeper understanding of their discipline.

Course Contents:

The organization will provide the students one field visit for this program. The students will be taken to a specific blocks of the university for learning purposes. The students will visit all department block site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners of IT department of the university. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial fi

ELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Expose students to real-world applications of theoretical knowledge.	PO1,PO5,PO7
2	Enhance observational, analytical, and research skills through fieldwork.	PO2,PO4,PO5,PO6,PO7
3	Develop problem-solving skills in practical settings.	PO2,PO3,PO5,PO9,PO11
4	Foster collaboration and communication skills through group projects and professional interactions.	PO6,PO8,PO9,PO10
5	Cultivate an appreciation for the complexities and challenges of professional practice in the field.	PO6,PO7,PO8,PO11,PO12

SEMESTER – II										
Course Title	**Effective English for Engineers**									
Course code	**23UBPD123R**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 40T	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**NIL**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II Semester of First Year of the Programme**								
Course Objectives	1. This course will enable the students to acquire the important knowledge on grammar like the formation of sentences. 2. To enable the students to use vocabulary meaningfully for a successful conversation. 3. To establish Reputation and Rapport, a dress code session is much needed 4. The 3 P's (Planning, Prioritizing, and Performing) of Time Management will be taught to the students.									
CO1	Understand and identify common errors in English writing.									
CO2	Acquire skill of report writing.									
CO3	Develop the ability as critical readers and writers.									
CO4	Improve speaking ability in English both in terms of fluency and comprehensibility.									
CO5	Understand the correct usage of English grammar in writing and speaking.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Grammar** Interchange of Interrogative and Assertive Sentences, Interchange of Exclamatory and Assertive Sentences, Analysis of Sentences, Types of Tenses Exercises on Tense	**8**	Identify the structural differences between interrogative and assertive sentences. Convert assertive sentences into interrogative sentences and vice versa without altering the original meaning. Apply correct punctuation and syntax rules while transforming sentences from one form to another.	**1,2,3,4**
II	**Understanding Harmony in the Vocabulary** Synonyms, Antonyms, Homonyms	**12**	Define and understand what synonyms are and their role in language. Identify and provide examples of synonyms for given words. Use synonyms appropriately in various contexts to avoid repetition and enhance writing and speaking	**3,4**
III	**Reading Skills** Techniques of Effective Reading, Gathering ideas and information from a text,The SQ3RTechnique Interpret the text	**8**	Improve the ability to understand and interpret written texts across various genres and disciplines. Expand vocabulary by encountering and learning new words through reading diverse texts.	**1,3,4,5**
IV	**Dress Code Ethics** Introduction to Dress Code	**6**	Define dress code ethics and explain their relevance in	**1,2,4,5**

	Ethics, Purpose and Importance, How to Make first impression, What to Wear During Interviews or Any Other Formal Meetings.		various professional and social settings. Recognize how dress codes can vary across different cultures and the importance of being culturally sensitive in dress choices.	
V	**Time-Management Skills** Introduction To Time Management, Purpose And Importance of Time Management,Basic Tips to Maintain Time.	**5**	Define time management and explain its key principles. Explore the historical development of time management concepts and techniques.	**1,2,4**

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 Indispensible Guide to Excellent Writing and Speaking, Zephyros Press

REFERENCE BOOKS:

R1: Carthy. (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:

O1:https://youtu.be/rl85jxktfms
O2:https://www.betterteam.com/dress-code-policy#:~:text=Everyone%20is%20expected%20to%20be,religion%20or%20ethnicity%20are%20exempt

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand and identify common errors in English writing.	PO1,PO2,PO3,PO4,PO5,PO10,PO12
2	Acquire skill of report writing.	PO1,PO2,PO3,PO4,PO5,PO10,PO12
3	Develop the ability as critical readers and writers.	PO1,PO2,PO3,PO4,PO5,PO10,PO12
4	Improve speaking ability in English both in terms of fluency and comprehensibility.	PO1,PO2,PO3,PO4,PO5,PO10,PO12
5	Understand the correct usage of English grammar in writing and speaking.	PO1,PO2,PO3,PO4,PO5,PO10,PO12

SEMESTER – II									
Course Title	**Extra Curricular Activities**								
Course code	**23UBEC121**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30P	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II Semester of First Year of the Programme**								
Course Objectives	1. It is to develop the social and soft skills and to promote a holistic development of the learners. 2. Participating in debate clubs, drama, or public speaking events enhances verbal and non-verbal communication skills. 3. Taking leadership roles in student organizations or event planning committees fosters leadership and teamwork abilities.								
CO1	Learn to a plan so that they can make meaningful contributions, maintain a commitment, and manage their time and priorities.								
CO2	Transform passionate students who demonstrate leadership and pursue interests beyond their academics.								
CO3	Learn to participate in various co-curricular activities leading to their multifaceted personality development.								
CO4	Express their ideas, views, In-depth evaluation and analysis clearly in the topic of their interest.								
CO5	Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Discover the exciting world of engineering through hands-on projects and workshops. Gain practical skills in robotics, coding, and innovation, preparing for future STEM success.	30	Explore the dynamic field of engineering through interactive projects and workshops. Develop practical skills in robotics, coding, and innovation. Prepare for future success in. STEM disciplines	1,2,3,4,5

Course Objectives: It is to develop the social and soft skills and to promote a holistic development of the learners

Course Outcomes:

CO 1: Learn to plan so that they can make meaningful contributions, maintain a commitment, and manage their time and priorities.
CO 2: Transform passionate students who demonstrate leadership and pursue interests beyond their academics.
CO 3: Learn to participate in various co-curricular activities leading to their multifaceted personality development.
CO 4: Express their ideas, views, In-depth evaluation and analysis clearly in the topic of their interest.
CO 5: Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.

Course Description: Discover the exciting world of engineering through hands-on projects and workshops. Gain practical skills in robotics, coding, and innovation, preparing for future STEM success.

Course 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 to 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 the platform to learn from experts in the respective fields.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand and identify common errors in English writing.	PO1,PO2,PO3,PO4,PO5,PO6,PO10,PO12
2	Acquire skill of report writing.	PO1,PO2,PO3,PO4,PO5,PO6,PO10,PO12
3	Develop the ability as critical readers and writers.	PO1,PO2,PO3,PO4,PO5,PO6,PO10,PO12
4	Improve speaking ability in English both in terms of fluency and comprehensibility.	PO1,PO2,PO3,PO4,PO5,PO6,PO10,PO12
5	Understand the correct usage of English grammar in writing and speaking.	PO1,PO2,PO3,PO4,PO5,PO6,PO10,PO12

SEMESTER – III										
Course Title	**Digital Electronics**									
Course code	**23BTCS211R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 45T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**	
Pre-requisite		**Co-requisite**	**Nil**							
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**									
Semester	**Summer/I Semester of Second Year of the Programme**									
Course Objectives	1. To familiarize with the different number systems, logic gates, and combinational and sequential circuits utilized in the different digital circuits and systems. 2. The course will help in design and analysis of the digital circuit and system.									
CO1	Understand Boolean algebra, analyze digital logic families, demonstrate IC interfacing.									
CO2	Design logic functions, implement digital circuits, showcase MSI chip expertise									
CO3	Analyze, design sequential circuits, demonstrate flip-flop and counter proficiency									
CO4	Evaluate digital-to-analog converters, understand quantization, A/D converter types.									
CO5	Analyze semiconductor memories, demonstrate proficiency in memory technology and PLDs.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Fundamentals of Digital Systems and logic families:** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.	**12**	Understand digital signals, circuits, logic gates, Boolean algebra, binary arithmetic, number systems, IC gates, logic families, and interfacing techniques.	**1,2,3**
II	**Combinational Digital Circuits:** Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.	**10**	Understanding digital logic fundamentals including Boolean algebra, K-maps, multiplexers, adders, ALUs, and MSI chips for designing and optimizing digital circuits.	**1,2,3**

III	**Sequential circuits and systems**: A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.	**8**	Mastering digital memory elements (latches, flip-flops), shift registers, counters, and their applications for sequential logic design in digital systems.	**1,2,3, 4,6**
IV	**A/D and D/A Converters:** Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D	**7**	Gaining expertise in digital to analog and analog to digital converters, encompassing specifications, operational principles, and practical applications in digital systems design.	**1,2,3, 4,5**
V	**Semiconductor memories and Programmable logic devices:** Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).	**8**	Developing comprehensive knowledge of memory organization, types (ROM, RAM, CAM), memory characteristics, and applications in digital systems and programmable logic devices like PLDs and FPGAs.	**1,2,3, 4,6**
Practical Component				
Practical 1	To study and verify the truth table of logic gates.	**2**	To effectively study and validate the truth tables of logic gates, ensuring proficiency in understanding their operational principles and applications in digital circuit design.	**2,3**

Practical 2	To design and implementation using NAND gate & NOR gate as Universal Gate.	**2**	Designing and implementing circuits using NAND and NOR gates as universal gates, enhancing versatility in digital logic synthesis and problem-solving.	**3,4,5**
Practical 3	To study about Ex-OR gates and verify their Truth Table.	**2**	Studying XOR gates and verifying their truth table enhances understanding of their unique logic behavior critical for digital circuit design.	**2,3**
Practical 4	To study about adder circuits, half adder circuits and verify their truth table	**2**	Studying adder circuits, including half adders, and verifying their truth tables enhances proficiency in binary arithmetic fundamental to digital logic design.	**2,3**
Practical 5	To study about adder circuits, full adder circuits and verify their truth table.	**2**	Studying full adder circuits and verifying their truth tables strengthens understanding of binary addition, critical for designing complex arithmetic units in digital systems.	**2,3,4**
Practical 6	To study half subtractor using basic gates.	**2**	Studying half subtractors using basic gates enhances understanding of binary subtraction fundamentals, essential for digital logic design and arithmetic operations.	**2,3,4**
Practical 7	To study full subtractor using basic gates.	**2**	Studying full subtractors using basic gates enhances understanding of binary subtraction with borrow, crucial for designing efficient arithmetic circuits in digital systems.	**2,3,4**
Practical 8	To design and set up a 4:1 and 2:1 Multiplexer.	**2**	Designing and setting up 4:1 and 2:1 multiplexers enhances understanding of data selection and routing in digital circuits, critical for signal processing applications.	**2,3,4, 5,6**
Practical 9	To design and set up a 1:4 Demultiplexer (DE-MUX) .	**2**	Designing and setting up a 1:4 demultiplexer enhances understanding of data	**2,3,4, 5,6**

			distribution and signal routing, crucial for digital communication and control systems.	
Practical 10	Implementation and verification of decoder and encoder using logic gates.	**2**	Implementing and verifying decoders and encoders using logic gates enhances understanding of signal decoding and encoding techniques crucial for digital communication and control systems.	**2,3,4, 5,6**
Practical 11	Mini-Project			

TEXT BOOKS:

T1: J.B Gupta, Electronic Device and Circuits, 2nd Ed., Katson Books 6th edition 2018.

T2: Dr. Sanjay Sharma, Digital Electronics and Logic Design, 6th Ed., Katson Books 2010.

REFERENCE BOOKS:

R1: Floyd, Electronic Devices, Pearson Education, 2nd edition, 9th edition, 2012.

R2: RP Jain, Modern Digital Electronics, Tata Mc Graw Hill, 3rd Edition, 2007.

R3: Frenzel, Communication Electronics: Principles and Applications, Tata Mc Graw Hill, 3rd Edition, 2001.

R4: Kumar, Fundamentals of Digital Circuits, Prentice Hall India, 2016.

OTHER LEARNING RESOURCES:

O1: nptel: Platforms like nptel offer courses such as "Digital Circuits and Systems" which cover topics ranging from digital circuits to system design.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand Boolean algebra, analyze digital logic families, demonstrate IC interfacing.	PO1, PO2, PO3, PO10, PO12
2	Design logic functions, implement digital circuits, showcase MSI chip expertise	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Analyze, design sequential circuits, demonstrate flip-flop and counter proficiency	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Evaluate digital-to-analog converters, understand quantization, A/D converter types.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
5	Analyze semiconductor memories, demonstrate proficiency in memory technology and PLDs.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – III										
Course Title	**Functional Programming in Python**									
Course code	**23BTCS212R**	**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 Technology in Computer Science and Engineering (DS and AI)**									
Semester	**Summer/I Semester of Second Year of the Programme**									
Course Objectives	The course "Problem Solving using Python" aims to provide students with a basic foundation in Python programming and problem-solving skills. Students will learn to write efficient, structured, and modular code to solve a few basic real-world computational problems.									
CO1	Understand about the history of Programming Languages, types of programming languages, Basic Syntax of a few programming languages.									
CO2	Understand the fundamentals of Python programming language and its syntax, enabling them to write basic to intermediate level programs.									
CO3	Demonstrate proficiency in using data types and conditional statements to make simple Python programs and manipulate data effectively.									
CO4	Understand about Loops, functions and various packages in Python.									
CO5	Understand Lambda and user defined functions in Python.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**History of Programming Languages** Overview of Programming Languages, Basic Syntax of a few programming languages, Advantages and disadvantages of Python, Real-life examples of application of Python	**6**	Understanding Python's versatility through its syntax, advantages in ease of use, and real-world applications in diverse fields like data science and automation.	**1,2**
II	**Introduction to Python Programming** Introduction to Python Language, Writing and Compiling Python Programs, Basic Structure of a Python Program, Data Types and Constants	**10**	Developing proficiency in Python basics: syntax, program structure, data types, constants, enabling effective programming and problem-solving skills.	**2,3**
III	**Data types and Variables** Data types, Variable declaration and use, Typecasting in Python, Operators in Python: Assignment, Logical, Arithmetic, Conditional statements: If statement, If else statement, Python Collections: List, Tuple, Sets and Dictionary	**10**	Mastering Python essentials: data types, variables, typecasting, operators, conditional statements, and for robust programming proficiency.	**1,2,3**
IV	**Loops and Functions** Loops in Python: For Loop, While Loop and Nested Loops, User Defined functions	**7**	Proficiency in Python loop and user-defined functions, enabling efficient problem-solving and scalable software development.	**1,2,3**
V	**Lambda Functions** Types of functions, Lambda	**7**	Understanding types of functions (built-in, user-	**1,2,3**

	functions		defined) and lambda functions in Python for versatile programming and concise code implementation.	
Practical Component				
Practical 1	**Introduction to Python** Overview of Python Programming ● Setting up Python environment a) Installing Python b) Installing an IDE (e.g., PyCharm, VS Code, Jupyter Notebook) ● Writing your first Python program ● Basic syntax, comments, and documentation	**3**	Develop foundational skills in Python: setup environment, write code, apply basic syntax, comments, and documentation for effective programming.	**1,2, 3**
Practical 2	**Basic Data Types and Variables** ● Variables and data types o Integers, floats, strings, and booleans ● Type casting ● Basic input and output	**3**	Mastering Python basics: variables (integers, floats, strings, booleans), type casting, and basic input/output operations for practical programming proficiency.	**1,2, 3**
Practical 3	**Operators and Expressions** ● Arithmetic operators ● Comparison operators ● Logical operators ● Assignment operators ● Bitwise operators	**3**	Understanding Python operators: arithmetic, comparison, logical, assignment, and bitwise, essential for comprehensive programming and problem-solving in diverse applications.	**3,4**
Practical 4	**Control Structures** ● Conditional statements a) if, else if, else ● Loops a) for loops b) while loops ● Break and continue statements	**3**	Mastering control structures in Python: conditional statements, loops, break, and continue statements for efficient program flow and logic implementation.	**1,2, 3**
Practical 5	**Functions** ● Defining functions ● Calling functions ● Parameters and arguments ● Return values ● Scope of variables ● Lambda functions	**3**	Proficiency in Python functions: defining, calling, handling parameters/arguments, return values, variable scope, and utilizing lambda functions for concise and efficient code implementation.	**1,2, 3**
Practical 6	**Data Structures**	**3**	Proficiency in Python data	**1,2,**

	• Lists a) Creating and accessing elements b) List methods c) List comprehensions • Tuples • Dictionaries a) Creating and accessing elements **b)** Dictionary methods Sets		structures: lists, tuples, dictionaries, and sets.	**3**
Practical 7	**Strings** • String operations • String methods • String formatting • Regular expressions	**3**	Mastering string operations, methods, formatting, and regular expressions in Python for robust text processing and pattern matching capabilities.	**1,2, 3**
Practical 8	**File Handling** • Opening and closing files • Reading and writing files • Working with file modes • Using with statement	**3**	Proficiency in file handling in Python: opening, closing, reading, writing files, understanding file modes, and utilizing the with statement for resource management.	**1,2, 3**
Practical 9	**Exception Handling** • Understanding exceptions • try, except, finally blocks • Handling multiple exceptions • Custom exceptions	**3**	Mastering exception handling in Python: understanding exceptions, using try-except-finally blocks, managing multiple exceptions, and creating custom exceptions for robust error management in programs.	**1,2, 3**
Practical 10	**Modules and Packages** • Importing modules • Creating modules • Using standard libraries ○ os, sys, math, datetime, etc.	**3**	Proficiency in module management in Python: importing modules, creating custom modules, and utilizing standard libraries like os, sys, math, datetime for enhanced functionality in applications.	**1,2, 3**

TEXT BOOKS:

T1:BALAGURUSAMY, 1st Edition, Introduction To Computing And Problem-Solving Using Python, McGraw Hill, ISBN 9789352602582

REFERENCE BOOKS:

R1: Andrew Ngo, Introduction to Python Programming: Beginner to Advanced, Practical Guide, Tips and Tricks, Easy and Comprehensive, 1st Edition, 2017, Kindle Books
R2: Venugopal and Prasad, Python: The Complete Reference, 4th Edition, 2018, Tata McGraw Hill.

OTHER LEARNING RESOURCES:

O1: youtube: The youtube tutorial "Python Tutorial for Beginners" offers python programming tutorials for beginners, including functional programming principles.

O2: geeksforgeeks: Offers tutorials, including functional programming principles.

O3: Coursera: the course "Programming for Everybody (Getting Started with Python)" offered helps Gain a foundational understanding and learn new concepts from industry experts

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand about the history of Programming Languages, types of programming languages, Basic Syntax of a few programming languages.	PO1, PO2, PO3, PO5, PO11
2	Understand the fundamentals of Python programming language and its syntax, enabling them to write basic to intermediate level programs.	PO1, PO2, PO3, PO5, PO11
3	Demonstrate proficiency in using data types and conditional statements to make simple Python programs and manipulate data effectively.	PO1, PO2, PO3, PO5, PO11
4	Understand about Loops, functions and various packages in Python.	PO1, PO2, PO3, PO5, PO11
5	Understand Lambda and user defined functions in Python.	PO1, PO2, PO3, PO5, PO11

SEMESTER – III									
Course Title	**Data Structure & Algorithms**								
Course code	**23BTCS213R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Fundamentals of programming logic**	**Co-requisite**	**C Programming**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I Semester of Second Year of the Programme**								
Course Objectives	1. To impart the basic concepts of data structures and algorithms. 2. To understand basic concepts about stacks, queues, lists, trees and graphs. 3. To understand concepts about searching and sorting techniques								
CO1	Understand analysis of algorithms using asymptotic notations, and learn search technique								
CO2	Analyse algorithms on stacks and queues and their applications.								
CO3	Implement and analyse operations on linked lists and its variations and their applications.								
CO4	Apply tree terminologies and operations on different types of trees, with a focus on algorithmic analysis and practical applications.								
CO5	Evaluate and compare various sorting algorithms, hashing techniques, and graph theoretic concepts along with their complexity analysis.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction:** Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.	**8**	Understanding fundamental data structures, algorithm analysis, and search techniques, including complexities, for efficient problem-solving and resource management in computing.	**1,2,3**
II	**Stacks and Queues**: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	**10**	Learning outcomes: Mastery of stack and queue ADTs, including operations and complexities, and their practical applications in expression conversion, evaluation, and various queue types with corresponding algorithms and analyses.	**1,2,3**
III	**Linked Lists:** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all	**10**	Gain expertise in linked list structures: singly linked lists, doubly linked lists, circular linked lists, stack and queue implementations, and algorithmic complexities.	**2,3**

	operations their algorithms and the complexity analysis.			
IV	**Trees:** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.	**6**	Learning outcomes: Proficiency in basic tree terminology, operations on binary, threaded, AVL trees, and B/B+ trees, including algorithms and complexity analysis, with applications in various domains.	**2,3**
V	**Sorting and Hashing:** Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. **Graph:** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	**6**	Master sorting (Selection, Bubble, Insertion, Quick, Merge, Heap), hashing principles, and graph operations (search, traversal) with complexity analyses.	**2,3**
Practical Component				
Practical 1	Array Operations- d) Program to perform basic array operations (insertion, deletion, search, update).	**3**	Learning outcome: Proficiency in performing array operations (insertion, deletion, search, update) essential for efficient data manipulation and algorithm implementation in programming.	**1,2,3**
Practical 2	Linked List Operations- Program to implement singly linked list operations (insertion, deletion, traversal). Program to implement doubly linked list operations (insertion, deletion, traversal). Circular Linked List- Program to implement circular linked list operations (insertion, deletion, traversal).	**3**	Mastery of implementing and manipulating singly, doubly, and circular linked lists through operations like insertion, deletion, and traversal in programming contexts.	**1,2,3**
Practical 3	Stacks and Queues- Stack Using Array- Program to implement stack operations using arrays (push, pop, peek). Stack Using Linked List- Program to implement stack operations using linked lists. Infix to Postfix Conversion Program to convert infix expression	**3**	Proficiency in implementing stack operations using arrays and linked lists, and converting infix expressions to postfix using stacks, enhancing algorithmic understanding and programming skills.	**1,2,3**

	to postfix expression using stack.			
Practical 4	Queue Using Array- Program to implement queue operations using arrays (enqueue, dequeue, front, rear). Queue Using Linked List- Program to implement queue operations using linked lists. Circular Queue- Program to implement circular queue using arrays.	**3**	Mastery in implementing queue operations using arrays and linked lists, including circular queue implementation, crucial for efficient data management and algorithmic proficiency in programming.	**1,2,3**
Practical 5	Trees Binary Tree Creation Program to create a binary tree and perform preorder, inorder, and postorder traversals. Binary Search Tree (BST) Operations c) Program to implement BST operations (insertion, deletion, search).	**3**	Ability to create and traverse binary trees using preorder, inorder, and postorder methods, and proficiency in implementing BST operations (insertion, deletion, search) for efficient data organization and manipulation in programming.	**1,2,3**
Practical 6	AVL Tree Implementation Program to implement AVL tree operations (insertion with rotations). Heap Implementation c) Program to implement a max-heap or min-heap and perform heap operations (insert, delete, heap if y).	**3**	Mastering AVL tree operations with rotations for balance and implementing heap structures with insertions, deletions, and maintenance in programming contexts.	**1,2,3**
Practical 7	Sorting Programs- Merge Sort Implementation: Write a C program to implement the merge sort algorithm to sort an array of integers. Quick Sort Implementation: Implement the quick sort algorithm in C to sort an array of integers. Heap Sort Implementation: Write a C program to implement the heap sort algorithm to sort an array of integers.	**3**	Proficiency in implementing and understanding merge sort, quick sort, and heap sort algorithms for efficient array sorting in programming.	**1,2,3**
Practical 8	Hash Table with Chaining: Implement a hash table using chaining for collision resolution in C. Include functions to insert, search, and display elements.	**3**	Learning to implement a hash table with chaining for collision resolution, including functions for insertion, searching, and displaying elements, crucial for efficient data management in C programming.	**1,2,3**
Practical 9	Hash Table with Linear Probing:	**3**	Proficiency in implementing a hash table using linear probing	**1,2,3**

	Write a C program to implement a hash table using open addressing with linear probing for collision resolution. Include functions to insert, search, and display elements.		for collision resolution, including functions for insertion, searching, and displaying elements in C programming, essential for efficient data management and retrieval.	
Practical 10	Hash Table with Quadratic Probing: Implement a hash table using open addressing with quadratic probing for collision resolution in C. Include functions to insert, search, and display elements	**3**	Learning to implement hash tables with quadratic probing for collision resolution, including insert, search, and display functions in C.	**1,2,3**

TEXT BOOKS:

T1:"Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
T2: Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein**,** "Introduction to Algorithms" by Cormen et al.
T3: Seymour Lipschutz , "Data Structures, with C" by McGraw-Hill Education, Schaum's Outlines series.

REFERENCE BOOKS:
R1: Algorithms, "Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
R2: "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.

OTHER LEARNING RESOURCES:
O1:Coursera: "Data Structures and Algorithms" by UC San Diego and National Research University Higher School of Economics
O2:Udemy: "Master the Coding Interview: Data Structures + Algorithms" by Andrei Neagoie
O3: GeeksforGeeks: Offers tutorials, explanations, and problem-solving sessions on data structures and algorithms.
O4:Tutorialspoint: Provides comprehensive tutorials on data structures and algorithms.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand analysis of algorithms using asymptotic notations, and learn search technique	PO1, PO2, PO3, PO10, PO12
2	Analyse algorithms on stacks and queues and their applications.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Implement and analyse operations on linked lists and its variations and their applications.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Apply tree terminologies and operations on different types of trees, with a focus on algorithmic analysis and practical applications.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
5	Evaluate and compare various sorting algorithms, hashing techniques, and graph theoretic concepts along with their complexity analysis.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – III										
Course Title	**Computer Organization & Architecture**									
Course code	**23BTCS214R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Programming For Problem Solving**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I Semester of Second Year of the Programme**								
Course Objectives	1. Discuss the organization and architecture of computer systems and electronic computers. 2. Analyse the basic components of computer systems besides the computer arithmetic. 3. Discuss input-output organization, memory organization and management, and pipelining.								
CO1	Understand the interaction of the components of a computer system with the instruction set architecture of a CPU and addressing modes.								
CO2	Analyse the various data representation techniques, perform computer arithmetic and discuss the various adders and multipliers.								
CO3	Analyse the control unit design approaches, memory design technologies and I/O transfers.								
CO4	Demonstrate the concepts of pipelining, parallel processing and concurrent access to memory.								
CO5	Summarize the concepts of memory organization with mapping functions and replacement algorithms.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Functional blocks of a computer:** CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.	**8**	Understanding computer architecture components: CPU, memory, I/O subsystems, control unit. Mastering CPU's instruction set architecture, addressing modes, and interpreting instructions for diverse applications.	**1,2,3**
II	**Data representation:** signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic. Introduction to x86 architecture.	**8**	Understanding data representation (signed numbers, fixed/floating-point, character encoding) and computer arithmetic (addition, multiplication, division techniques, floating-point operations) for comprehensive computer system understanding.	**1,2,3**
III	**CPU control unit design:** hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical	**10**	Understanding CPU control unit design (hardwired vs micro-programmed), memory	**1,2**

	CPU. Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCII, USB		system architecture, I/O subsystems, interfaces, interrupts, and exceptions for comprehensive computer system understanding and design.	
IV	**Pipelining:** Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.	**8**	Mastering pipelining fundamentals: concepts, throughput, speedup, and handling pipeline hazards. Understanding parallel processors, concurrent memory access, and cache coherency for advanced computational efficiency and performance.	**1,2**
V	**Memory organization:** Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.	**8**	Understanding memory organization: interleaving, hierarchical structure, cache memory, mapping techniques, replacement algorithms, and write policies for optimized memory access and performance in computer systems.	**1,2,3**

TEXT BOOKS:

T1: David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", 5th Edition, Elsevier.

REFERENCE BOOKS:

R1: "Computer Organization and Embedded Systems", 6th Edition by CarlHamacher, McGraw Hill Higher Education.
R2: "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill.
R3: "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.

OTHER LEARNING RESOURCES:

O1:javatpoint: the tutorial "Computer Architecture and Organization"
O2:nptel: "**Computer Organization and Architecture"** by Prof. Mainak Chaudhuri (IIT Kanpur)

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the interaction of the components of a computer system with the instruction set architecture of a CPU and addressing modes.	PO1, PO2, PO3, PO10, PO12
2	Analyse the various data representation techniques, perform computer arithmetic and discuss the various adders and multipliers.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Analyse the control unit design approaches, memory design technologies and I/O transfers.	PO1, PO2, PO3, PO10, PO12
4	Demonstrate the concepts of pipelining, parallel processing and concurrent access to memory.	PO1, PO2, PO3, PO4, PO10, PO12
5	Summarize the concepts of memory organization with mapping functions and replacement algorithms.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – III									
Course Title	**Probability and Statistics**								
Course code	**23BTCS215R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Mathematics**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the second year of the program**								
Course Objectives	1. To make understand to solve first and second order ordinary differential equation. 2. To provide conceptual understanding on higher order ODE with constant coefficients. 3. To provide an overview of probability to engineers. 4. To understand the concept of basic statistical measurements. 5. To analyse the data by applying statistical methods.								
CO1	Enabling solving skills of ordinary differential equations of various order.								
CO2	Enabling solving skills of higher order ODE with constants coefficients.								
CO3	Enable to formulate and solve problems involving random variables.								
CO4	Enable to solve problems of various probability distribution.								
CO5	Analysing experimental data by applying statistical methods.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**First order ordinary differential equations:** Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.	**7**	Understanding first-order ODEs: exact, linear, Bernoulli's, Euler's equations, and equations solvable for p, y, x, and Clairaut's type.	**1,2**
II	**Ordinary differential equations of higher orders:** Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation, Higher order ODE with constant coefficients.	**9**	Understanding higher-order ODEs: second-order linear equations with variable coefficients, variation of parameters, Cauchy-Euler equation, and constant coefficient ODEs.	**2,3**
III	**Probability:** Basic definitions on Probability, conditional probability, independence; Discrete random variables, Independent random variables., Probability distributions: Binomial, Poisson and Normal, Poisson approximation to the binomial distribution.	**8**	Understanding probability basics: definitions, conditional probability, independence, discrete random variables, and distributions (Binomial, Poisson, Normal) including Poisson approximation.	**2,3,5**
IV	**Basic Statistics:** Measures of central tendency: Moments, skewness and Kurtosis, Correlation and regression.	**8**	Mastering basic statistics: measures of central tendency, moments, skewness, kurtosis, and understanding correlation and regression for data	**2,3,4**

			analysis.	
V	**Applied Statistics:** Test of significance: Large sample test for single proportion. Difference of proportions, single mean, difference of means and difference of standard deviations.	**8**	Understanding applied statistics: significance testing for large samples, including tests for single proportion, difference of proportions, means, and standard deviations.	**2,3**

TEXT BOOKS:

T1: Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

T2: N. P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

REFERENCE BOOKS:

R1: S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
R2: S. L. Ross, Differential Equations, 3rd Ed. Wiley India, 1984.

OTHER LEARNING RESOURCES:

O1:Tutorialspoint- offers a course "Statistics-Probability" for all beginners
O2: Youtube- Statistics and Probability full course.
O3: Nptel- a video lecture on "Probability and Statistics" full course by Prof. Somesh Kumar, IIT Kharagpur.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Enabling solving skills of ordinary differential equations of various order.	PO1, PO2, PO5, PO12
2	Enabling solving skills of higher order ODE with constants coefficients.	PO1, PO2, PO5, PO12
3	Enable to formulate and solve problems involving random variables.	PO1, PO2, PO4, PO6, PO12
4	Enable to solve problems of various probability distribution.	PO1, PO4, PO5, PO10, PO12
5	Analysing experimental data by applying statistical methods.	PO2, PO4, PO5, PO11, PO12

SEMESTER – III									
Course Title	**Field-Based Training**								
Course code	**23BTCS216R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: NA	**0**	**0**	**0**	**0**	**0**	**16**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I Semester of Second Year of the Programme**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings. 4. To foster collaboration and communication skills through group projects and professional interactions. 5. To cultivate an appreciation for the complexities and challenges of professional practice in the field.								
CO1	Apply theoretical concepts to real-world situations.								
CO2	Conduct field-based research and gather data effectively.								
CO3	Analyze and interpret the university data to draw meaningful conclusions.								
CO4	Communicate findings clearly and effectively, both orally and in writing.								
CO5	Demonstrate professional behaviour and teamwork skills in field settings.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	The organization will provide the students one field visit for this program. The students will be taken to a specific blocks of the university for learning purposes. The students will visit all department block site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners of IT department of the university. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial findings.	**16**	Enhanced understanding through immersive field visits, interaction with IT professionals, and reflective journaling to integrate theoretical knowledge with practical insights effectively.	**1,2,3,4,5,6**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Create effective written communication for professional scenarios, incorporating engineering terminology and conventions.	PO1, PO5, PO7, PO10, PO12
2	Demonstrate proficient verbal communication skills, applying engineering vocabulary and technical language appropriately.	PO2, PO4, PO5, PO6, PO12
3	Evaluate and apply effective teamwork strategies in engineering contexts, fostering collaboration and innovation.	PO2, PO3, PO4, PO9, PO11
4	Develop and deliver professional presentations using appropriate engineering language and communication techniques.	PO6, PO8, PO9, PO10, PO11
5	Analyse and adapt communication strategies for diverse engineering workplace scenarios, demonstrating cross-cultural competence.	PO6, PO7, PO8, PO11, PO12

SEMESTER – III									
Course Title	**English For Employability For Engineers**								
Course code	**23UBPD213R**	**Total credits: 1**	**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	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I Semester of Second 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 organizations. 3. To overcome fear of Public Speaking 4. To understand the process of Effective Reading techniques and Listening skills.								
CO1	Create effective written communication for professional scenarios, incorporating engineering terminology and conventions.								
CO2	Demonstrate proficient verbal communication skills, applying engineering vocabulary and technical language appropriately.								
CO3	Evaluate and apply effective teamwork strategies in engineering contexts, fostering collaboration and innovation.								
CO4	Develop and deliver professional presentations using appropriate engineering language and communication techniques.								
CO5	Analyse and adapt communication strategies for diverse engineering workplace scenarios, demonstrating cross-cultural competence.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Reading Skills:** Exercise 1: Interpreting different texts Exercise 2: Importance and significance of Punctuation Exercise 3: Story -reading Exercise 4: News-reading Exercise 5: Comprehending texts of different genres	**6**	Enhancing reading skills: interpreting texts, understanding punctuation, reading stories and news, and comprehending various genres for improved literacy.	**1,2,3**
II	**Non-Verbal Communication:** i. Understanding Non-Verbal Communication & Body Language Types of Body Language ii. Importance and Impact of Body Language &Introduction to Haptics, Kinesics and Proxemics	**6**	Understanding non-verbal communication: types and impact of body language, and introduction to haptics, kinesics, and proxemics for effective interaction.	**1,2,3**
III	**Grammar (Flipped Classroom):** i. Types of Sentences (using Assertive, Imperative, exclamatory in respective contexts), ii. Degrees of Comparison	**4**	Understanding grammar through flipped classroom: identifying types of sentences (assertive, imperative, exclamatory) and mastering degrees of comparison in context.	**2,3**
IV	**Public Speaking Skills:** i. Introduction to public speaking Preparation for Public speaking	**7**	Developing public speaking skills: preparation (scripts, non-verbal cues),	**2,3**

	(scripts, non-verbal cues) ii. Understanding and overcoming Fear of Public Speaking Tips Public Speaking		overcoming fear, and applying effective public speaking tips for confident presentations.	
V	**Listening Skills:** i. Process of listening ii. Understanding listening barriers iii. Difference between Listening and Hearing, iv. Importance of Effective Listening Practice Session: Listening to podcasts, Lectures, Audio Books etc.	**5**	Enhancing listening skills: understanding the listening process, identifying barriers, distinguishing listening from hearing, and practicing with podcasts, lectures, and audiobooks.	**2,3,4**

TEXT BOOKS:

T1: Wren,P.C and Martin,H. 1995. High School English Grammar and Composition, S Chand Publishing.
T2: Barrett,Grant.2016.PerfectEnglishGrammar:TheIndispensibleGuidetoExcellent Writing and Speaking, ZephyrosPress

REFERENCE BOOKS:

R1: Carthy. (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
R3: Mccarthy. (2008) English Vocabulary in Use Upper - Intermediate with CD ROM, Cambridge University Press

OTHER LEARNING RESOURCES:

O1:nptel- the course "Technical English for Engineers" by Prof. Aysha Iqbal, IIT Madras
O2:youtube- "Your body language may shape who you are" Amy Cuddy ,TED
O3:Coursera- "Training and Practicing in English Public Speaking" by Shanghai Jiao Tong University

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Create effective written communication for professional scenarios, incorporating engineering terminology and conventions.	PO1, PO5, PO9, PO10
2	Demonstrate proficient verbal communication skills, applying engineering vocabulary and technical language appropriately.	PO6, PO9, PO10, PO12
3	Evaluate and apply effective teamwork strategies in engineering contexts, fostering collaboration and innovation.	PO6, PO9, PO10, PO11
4	Develop and deliver professional presentations using appropriate engineering language and communication techniques.	PO5, PO10, PO12
5	Analyse and adapt communication strategies for diverse engineering workplace scenarios, demonstrating cross-cultural competence.	PO6, PO8, PO10, PO12

SEMESTER – III									
Course Title	**Personal Financial Planning**								
Course code	**23UBPD211R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30P	**0**	**0**	**2**	**0**	**0**	**0**	**1**
Pre-requisite	Introduction to Financial Budgeting And Planning	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I 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	Apply financial knowledge and skills to make informed decisions, ensuring long-term financial stability and security.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Fundamentals of Financial Planning - 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.	**8**	Fundamentals of Financial Planning covers understanding money's functions, inflation causes and control, financial planning processes, time value of money including simple and compound interest, Net Present Value (NPV) and Future Value (FV), compounding power, doubling periods, and the Rule of 72 for effective financial decision-making.	**1,2,3**
II	Income Tax Planning- 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.	**8**	Learning Outcome: Gain proficiency in understanding income, taxes (direct, indirect), taxable and non-taxable income, tax evasion, avoidance, GST, and effective tax planning strategies.	**3,4**
III	Entrepreneurial planning - i. Meaning of Entrepreneurship, prerequisites for becoming an	**10**	Understand entrepreneurship fundamentals, support systems in India, institutional and	**3,4**

	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.		financial support mechanisms (venture capital, business angels, government assistance, commercial bank loans), enabling effective entrepreneurial planning and implementation.	
IV	Planning for investing in securities market - 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.	**10**	Gain knowledge of investment avenues in securities markets, primary and secondary markets, stock market functions (NSE, BSE), DEMAT trading, security repositories, stock brokers, operational aspects (order placement, contract notes, trading cycles), risks, financial intermediaries, stock indices, mutual funds (types, importance, drawbacks, investing in India), and advantages of Systematic Investment Plans (SIPs).	**4**
V	Planning for debts and Retirement 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.	**9**	Develop skills in consumer credit management, including choosing credit sources and evaluating costs. Understand consumer legal protections and factors influencing housing and vehicle decisions. Master retirement planning, including cost-of-living considerations, retirement needs analysis, retirement scheme evaluation, estate planning, pension, Medicare planning, and wills.	**4**

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

REFERENCE BOOKS:

R1: Be Your Own Financial Advisor: Financial Planning, Investment Options, Risk Management, Tax Management, Succession Planning Kindle Edition y Sushil Bali

R2: The Dumb Things Smart People Do with Their Money: Thirteen Ways to Right Your Financial Wrongs Kindle Edition y Jill Schlesinger

OTHER LEARNING RESOURCES:

Financial Planning Association (FPA):Offers resources, workshops, and events for financial planners and individuals seeking financial advice.

1. **Local Community Resources**: Check local libraries, community centers, and universities for workshops or seminars on personal financial planning.

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.	PO2, PO9, PO10, PO11
2	Design a diversified investment portfolio that addresses several different investment objectives.	PO2, PO5, PO11, PO12
3	Differentiate between open and closed-end mutual funds, exchange-traded funds, and direct or indirect real estate investments.	PO1, PO2, PO6, PO7
4	Create a financial plan that covers your income needs in retirement and helps protect you and your estate.	PO2, PO6, PO8, PO11, PO12
5	Apply financial knowledge and skills to make informed decisions, ensuring long-term financial stability and security.	PO2, PO6, PO8, PO11, PO12

SEMESTER – III									
Course Title	**Basic Life Saving Skills**								
Course code	**23UULS211R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I 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 2. To provide appropriate basic management and treatment for injuries.								
CO1	Basic Life Support (BLS) are the specific skills and knowledge that individuals should acquire and demonstrate after completing a BLS training course. These outcomes are essential for anyone who may encounter a medical emergency and need to provide immediate assistance before professional medical help arrives								
CO2	Soft skills are a set of personal attributes and abilities that enable students to interact effectively and harmoniously with others, both personally and professionally. These skills are highly valued and can lead to better communication, collaboration, and overall success in various aspects of life								
CO3	Focus on the knowledge and skills needed to effectively recognize, assess, and manage various types of traumatic injuries and emergencies. Essential for healthcare professionals, first responders, and anyone involved in emergency care								
CO4	Understand the principles and purpose of the Triage system in healthcare settings. Describe the different levels of triage (e.g., immediate ,delayed, minimal, expectant) and their significance in prioritizing patient care. Identify common medical conditions and injuries that require immediate attention and those that can be managed at a later stage. Recognize the importance of accurate and timely patient assessment during triage.								
CO5	Identify common medical emergency conditions: Learners should be able to recognize and differentiate between common medical emergencies, including myocardial infarction(heart attack),stroke, diabetic emergencies, anaphylaxis, respiratory distress, seizures, and allergic reactions.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Basic Life Support(BLS)** ● Introduction of BLS ● Chain of survival ● ABCs Assessment ● CPR and Ventilation Technique ● AED Choking for adult and children	5	Understanding chain of survival, ABCs assessment, CPR techniques, ventilation, AED usage, and choking management for adults and children.	**1,2,3**
II	**Soft skills** ● Introduction ● Communications Skills ● Situational Skills ● Team Work Other Soft Skills	5	Enhanced communication abilities, improved situational awareness, strengthened teamwork skills, and mastery of other interpersonal competencies crucial for professional success.	**3,4**
III	**Trauma emergencies** ● Introduction ● Priorities of Initial approach in pre-	10	Mastering scene safety assessment, prioritizing initial approaches in pre-hospital care such as primary assessment and	**3,4**

	hospital care a) Scene safety b) Primary assessment c) Bleeding control d) Helmet removal e) Care of amputated body part f) Extrication of victims and safe transfer g) Cervical spine stabilizatio n h) Cervical collar application i) Splinting of broken Limbs		bleeding control, and executing procedures like helmet removal, care of amputated body parts, extrication, cervical spine stabilization and collar application, and splinting of broken limbs for effective patient management and safety.	
IV	**Triage system** ● Introduction ● Flow chart approach of Triage ● Triage of Multiple Casualties in Pre-Hospital setting ● Triage of Single casualty	5	Understanding the introduction to triage, mastering the flowchart approach for triage, effectively triaging multiple casualties in a pre-hospital setting, and appropriately triaging a single casualty to optimize emergency response and patient care outcomes.	**1,2,3, 4**
V	**Medical emergencies** Introduction, Victim centred approach in medical emergency. Management of: • seizures • heart attack • asthma Diabetic emergencies	5	Learning victim-centered medical emergency approaches, managing seizures, heart attacks, asthma, diabetic emergencies, emergency childbirth, and stroke recovery positioning for effective patient care.	**2,3,4**

TEXT BOOKS:

T1: Nancy Caroline, Emergency Care in the streets, Seventh edition by Jones and Bartlett

T2: LC Gupta, First Aid book

REFERENCE BOOKS:

R1: Advance Emergency Care American Heart Association

R2: Wikipedia - Basic life support

OTHER LEARNING RESOURCES:

O1:youtube- "Basic Life Support (BLS) CPR & AED Training" by the American Heart Association
O2: **youtube- "First Aid Training"** by St John Ambulance
O3: **Coursera- "Introduction to First Aid"** by the University of Michigan
O4: **Udemy- "Complete BLS Certification Course - Basic Life Support"** by First Aid For Free

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Basic Life Support (BLS) are the specific skills and knowledge that individuals should acquire and demonstrate after completing a BLS training course. These outcomes are essential for anyone who may encounter a medical emergency and need to provide immediate assistance before professional medical help arrives	PO1, PO6, PO8, PO10, PO12
2	Soft skills are a set of personal attributes and abilities that enable students to interact effectively and harmoniously with others, both personally and professionally. These skills are highly valued and can lead to better communication, collaboration, and overall success in various aspects of life	PO6, PO9, PO10, PO12
3	Focus on the knowledge and skills needed to effectively recognize, assess, and manage various types of traumatic injuries and emergencies. Essential for healthcare professionals, first responders, and anyone involved in emergency care	PO2, PO4, PO10, PO12
4	Understand the principles and purpose of the Triage system in healthcare settings. Describe the different levels of triage (e.g., immediate ,delayed, minimal, expectant) and their significance in prioritizing patient care. Identify common medical conditions and injuries that require immediate attention and those that can be managed at a later stage. Recognize the importance of accurate and timely patient assessment during triage.	PO2, PO6, PO10, PO12
5	Identify common medical emergency conditions: Learners should be able to recognize and differentiate between common medical emergencies, including myocardial infarction(heart attack),stroke, diabetic emergencies, anaphylaxis, respiratory distress, seizures, and allergic reactions.	PO1, PO2, PO6, PO8, PO12

SEMESTER – III									
Course Title	**Co-Curricular Activities**								
Course code	**23UBEC211**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60 Hrs	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programmes	**All UG Programmes**								
Semester	**Summer/I Semester of Second Year of the Programme**								
Course Objectives	1. It is to develop the social and soft skills and to promote a holistic development of the learners								
CO1	Connect and adapt cultural diversity among communities.								
CO2	Enhance team for working toward a shared vision								
CO3	Demonstrate and apply interdisciplinary connections and Cultivate spirit of creative thought and curiosity to achieve goals								
CO4	Learn to effectively communicate, delegate responsibilities and motivate team members.								
CO5	Develop strong teamwork and collaboration skills by engaging in group activities.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	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 the platform to learn from experts in the respective fields.	**60**	ADTU fosters holistic development through clubs participation in workshops and competitions. This course promotes promotes a holistic development of the learners.	

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Connect and adapt cultural diversity among communities.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
2	Enhance team for working toward a shared vision	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
3	Demonstrate and apply interdisciplinary connections and Cultivate spirit of creative thought and curiosity to achieve goals	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
4	Learn to effectively communicate, delegate responsibilities and motivate team members.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
5	Develop strong teamwork and collaboration skills by engaging in group activities.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12

SEMESTER – III									
Course Title	**Mini Project I**								
Course code	**23BTCS217R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60 hrs	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I Semester of Second Year of the Programme**								
Course Objectives	1. To develop the knowledge, skills and attitudes of a professional Computer engineering professional. 2. To become confident in designing engineering solutions to complex software problems utilising a systems approach.								
CO1	Apply IT principles for real-world problem-solving using programming languages and network solutions.								
CO2	Contribute to complex projects as a team member, demonstrating effective personal and team management.								
CO3	Develop programming skills to create and assess software, hardware, and network solutions.								
CO4	Apply personal and team management skills as a professional software developer.								
CO5	Cultivate employability skills and uphold professionalism in software development.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: a) theoretical studies b) computer simulations c) hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project; 4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field; 5. Prepare a formal report describing the work undertaken and results obtained so far; and Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.	**60** **-**	Learning about independent research, technical expertise application, and effective communication through comprehensive project execution and presentation in specialized technical areas.	**1,2,3,4, 5,6**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply IT principles for real-world problem-solving using programming languages and network solutions.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
2	Contribute to complex projects as a team member, demonstrating effective personal and team management.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
3	Develop programming skills to create and assess software, hardware, and network solutions.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
4	Apply personal and team management skills as a professional software developer.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
5	Cultivate employability skills and uphold professionalism in software development.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12

SEMESTER – III										
Course Title	**Cloud Fundamentals**									
Course code	**23BTCS218R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 30T+30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**	
Pre-requisite	**Basic Programming Skills**	**Co-requisite**	**NIL**							
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**									
Semester	**Summer/ I semester of the Second year of the program**									
Course Objectives	1. To provide an overview of an exciting field of Cloud Computing 2. To introduce tools requires building, deploying, running and managing applications on a cloud platform. 3. To develop the cloud application development skills, such as Python, REST architecture, JSON, Cloud Foundry and DevOps services 4. To enable students to have skills that will help them to solve complex real-world problems in decision support.									
CO1	Understand fundamental cloud computing concepts and architectures.									
CO2	Analyze and implement RESTful APIs and data services on cloud platforms.									
CO3	Design and deploy cloud applications using IBM Cloud services, including Kubernetes.									
CO4	Develop and deploy applications using Python and related frameworks.									
CO5	Apply advanced cloud concepts and architectures to deploy applications on Kubernetes clusters.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Cloud Computing and IBM Cloud:** Defining cloud computing, Factors leading to cloud adoption, Types of cloud services (IaaS, PaaS, SaaS), Cloud deployment models (Public, Private, Hybrid) Overview of IBM Cloud Creating an IBM Cloud account, Navigating the IBM Cloud dashboard.	**5**	Understand the basics of cloud computing and identify the factors driving cloud adoption, different cloud services, and deployment models.	**1,2**
II	**IBM Cloud Core Services or data services on IBM Cloud:** Watson AI services on IBM Cloud, Introduction to DevOps, Implementing DevOps practices on IBM Cloud, Using IBM Cloud toolchains for DevOps, REST API, Types and capabilities of databases, Apis interaction with Cloudant database.	**6**	Explore IBM Cloud's Watson AI services, DevOps practices, and various databases, and interact with Cloudant using REST APIs.	**2,3**
III	**Application Development on IBM Cloud:** Understanding business problems and goals, Functional and non-functional requirements, IBM Cloud App ID, Container orchestration (Kubernetes), Pods, Deployment, and Service, Cloud	**6**	Analyze business problems and goals, define requirements, and develop applications using IBM Cloud App ID, Kubernetes, and Cloud Foundry.	**4,6**

	Foundry.			
IV	**Developing Python Applications for the Cloud:** Building Python applications for cloud deployment. Integrating popular Python frameworks (Django, Flask) with cloud services. Leveraging cloud storage, databases, and AI services with Python. Implementing scalability and high availability for Python applications on the cloud	**7**	Develop and deploy scalable Python applications using Django or Flask, leveraging cloud storage, databases, and AI services.	**3,6**
V	**Security and Compliance on IBM Cloud:** Overview of IBM Cloud security features, Implementing security best practices on IBM Cloud, Ensuring compliance on IBM Cloud, OAuth protocol.	**6**	Implement security best practices and ensure compliance on IBM Cloud using its security features and OAuth protocol.	**3,5**
Practical 1	Create and configure an IBM Cloud account, navigate the dashboard, and explore different services available.	**2**	Understand basic cloud account setup and navigation of IBM Cloud services.	**2,3**
Practical 2	Deploy a Watson AI service on IBM Cloud and create a simple chatbot.	**2**	Gain practical experience in using AI services on the cloud.	**3,4**
Practical 3	Implement a basic DevOps pipeline using IBM Cloud toolchains.	**2**	Learn to integrate DevOps practices with IBM Cloud.	**3,4**
Practical 4	Create and interact with a Cloud database using REST APIs.	**2**	Understand database operations and API integration.	**3,4**
Practical 5	Develop a simple cloud-based application using IBM Cloud Foundry.	**2**	Learn the basics of cloud application development.	**3,4**
Practical 6	Deploy a containerized application using Kubernetes on IBM Cloud.	**2**	Understand container orchestration and management.	**3,4**
Practical 7	Set up IBM Cloud App ID for authentication in an application.	**2**	Learn to implement authentication in cloud applications.	**3,4**
Practical 8	Build and deploy a Python web application using Flask on IBM Cloud.	**2**	Learn to develop and deploy Python applications on the cloud.	**3,4**
Practical 9	Integrate IBM Cloud AI services with a Django application.	**2**	Understand how to leverage cloud AI services in Python applications.	**3,4**
Practical 10	Implement cloud storage integration in a Python application.	**2**	Learn to integrate cloud storage solutions with Python applications.	**3,4**
Practical 11	Scale a Python application on IBM	**2**	Understand scalability and	**4,5**

	Cloud to handle increased load.		high availability in cloud applications.	
Practical 12	Implement OAuth protocol for securing a cloud application on IBM Cloud.	**2**	Understand how to secure cloud applications using OAuth.	**3,4**
Practical 13	Configure IBM Cloud security features for an application.	**2**	Learn to apply security best practices on IBM Cloud.	**3,4**
Practical 14	Ensure compliance for a cloud application using IBM Cloud tools.	**2**	Understand compliance requirements and tools on IBM Cloud.	**3,4**
Practical 15	Deploy a multi-tier web application on IBM Cloud using various services.	**2**	Learn to integrate multiple IBM Cloud services for complex applications.	**4,5,6**

TEXT BOOKS:

T1: Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood.

T2: Cloud Computing: A Hands-On Approach by Arshdeep Bahga and Vijay Madisetti.

T3: Cloud Native Architectures: Design High-availability and Cost-effective Applications for the Cloud by Tom Laszewski, Kamal Arora, and Erik Farr.

REFERENCE BOOKS:

R1: Cloud Computing Principles and Paradigms by Rajkumar Buyya, James Broberg, and Andrzej Goscinski.

R2: Cloud Computing: Principles, Systems and Applications by Nick Antonopoulos and Lee Gillam.

R3: Cloud Computing: From Beginning to End by Ray J. Rafaels.

ADDITIONAL RESOURCES:

1. Cloud Essentials: CompTIA Authorized Courseware for Exam CLO-001 by Kalani Kirk Hausman and Susan L. Cook.
2. Cloud Computing: A Practical Approach by Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter.
3. IBM Cloud Essentials: V3 Certification Study Guide by William Rothwell.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Understand fundamental cloud computing concepts and architectures.	1, 2, 3, 4, 10, 12
2	Analyze and implement RESTful APIs and data services on cloud platforms.	1, 2, 3, 4, 10, 12
3	Design and deploy cloud applications using IBM Cloud services, including Kubernetes.	1, 2, 3, 4, 10, 12
4	Develop and deploy applications using Python and related frameworks.	1, 2, 3, 4, 5, 10, 12
5	Apply advanced cloud concepts and architectures to deploy applications on Kubernetes clusters.	1, 2, 3, 4, 5, 10, 12

SEMESTER – IV										
Course Title	**Discrete Mathematics and Graph Theory**									
Course code	**23BTCS221R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 36	**3**	**0**	**0**	**0**	**0**	**0**	**3**	
Pre-requisite	**NIL**	**Co-requisite**	**NIL**							
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**									
Semester	**Winter/ II semester of the second year of the program**									
Course Objectives	1. To provide students with a solid understanding of the fundamental concepts in discrete mathematics and graph theory. 2. To develop students' ability to solve problems related to discrete structures and graph algorithms. 3. To enable students to apply discrete mathematical concepts and graph theory techniques to computer science and related fields.									
CO1	Understand set operations, analyze relations, and demonstrate problem-solving in mathematics.									
CO2	Evaluate propositional logic, demonstrating analytical reasoning and deduction skills.									
CO3	Analyze algebraic structures, showcasing proficiency in groups, rings, and fields.									
CO4	Apply counting techniques, demonstrate problem-solving capabilities in mathematics.									
CO5	Analyze graph properties, apply graph theory concepts effectively in problem-solving.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Foundations of Discrete Mathematics** • Set Theory: Sets, subsets, operations on sets, Venn diagrams, Cartesian products. • Logic: Propositional logic, predicates, quantifiers, logical connectives, truth tables. • Proof Techniques: Direct proof, proof by contradiction, induction, contrapositive.	**4**	In Foundations of Discrete Mathematics, students will understand the basics of set theory, including sets, subsets, operations, Venn diagrams, and Cartesian products. They will learn propositional logic, predicates, quantifiers, logical connectives, and truth tables, along with mastering proof techniques such as direct proof, proof by contradiction, induction, and contrapositive.	**1,2, 3**
II	**Combinatorics and Discrete Probability** • Combinatorics: Permutations, combinations, Pigeonhole principle, inclusion-exclusion principle. • Discrete Probability: Probability theory, conditional probability, Bayes' theorem, expected value.	**8**	Students will understand permutations, combinations, the Pigeonhole principle, and the inclusion-exclusion principle. They will also learn probability theory, conditional probability, Bayes' theorem, and how to calculate the expected value.	**2,5**
III	**Graph Theory Basics** • Graphs: Definitions, types of graphs, subgraphs,	**10**	Students will learn the definitions and types of graphs, subgraphs, and graph	**1,2, 3,4**

	isomorphism. • Graph Representation: Adjacency matrix, adjacency list, incidence matrix. Trees: Properties, spanning trees, minimum spanning trees.		isomorphism. They will understand graph representation using adjacency matrices, adjacency lists, and incidence matrices, and explore tree properties, spanning trees, and minimum spanning trees.	
IV	**Advanced Graph Theory** • Graph Algorithms: Breadth-first search (BFS), depth-first search (DFS), Dijkstra's algorithm, Floyd-Warshall algorithm. • Planarity and Coloring: Planar graphs, Euler's formula, graph coloring, chromatic number. Network Flows: Max-flow min-cut theorem, Ford-Fulkerson algorithm.	**7**	In Advanced Graph Theory, students will master graph algorithms such as BFS, DFS, Dijkstra's, and Floyd-Warshall. They will understand planar graphs, Euler's formula, graph coloring, chromatic number, and network flows including the max-flow min-cut theorem and the Ford-Fulkerson algorithm.	**2,4, 6**
V	**Applications of Discrete Mathematics** • Applications in Computer Science: Data structures, algorithms, complexity. • Applications in Network Theory: Internet graphs, social networks, communication networks. • Additional Applications: Cryptography, coding theory, combinatorial optimization.	**7**	In Applications of Discrete Mathematics, students will explore its use in computer science for data structures, algorithms, and complexity, and in network theory for internet graphs, social networks, and communication networks. They will also understand applications in cryptography, coding theory, and combinatorial optimization.	**2,3**

TEXT BOOKS:

T1: Discrete Mathematics and Its Applications" by Kenneth H. Rosen

REFERENCE BOOKS:

R1: "Introduction to Graph Theory" by Douglas B. West

OTHER LEARNING RESOURCES:

O1*: Discrete Mathematics for Computer Science Specialization* on Coursera: Offered by UC San Diego and National Research University Higher School of Economics.

O2: MIT OpenCourseWare's lecture notes on Discrete Mathematics and Graph Theory.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand set operations, analyze relations, and demonstrate problem-solving in mathematics.	PO1, PO2,PO12
2	Evaluate propositional logic, demonstrating analytical reasoning and deduction skills.	PO1, PO2,PO12
3	Analyze algebraic structures, showcasing proficiency in groups, rings, and fields.	PO1, PO2,PO12
4	Apply counting techniques, demonstrate problem-solving capabilities in mathematics.	PO1, PO2,PO12
5	Analyze graph properties, apply graph theory concepts effectively in problem-solving.	PO1, PO2,PO12

SEMESTER – IV									
Course Title	**Database Management Systems**								
Course code	**23BTCS222R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T + 30p	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**File Systems**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the second year of the program**								
Course Objectives	1. To understand and use data manipulation language to query, update, and manage a database. 2. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency 3. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.								
CO1	Understand the fundamental concepts of database management systems with DBMS languages and data models.								
CO2	Apply the concepts of query languages such as DDL and DML for designing a relational database.								
CO3	Apply the ACID properties and concurrency control schemes to perform transaction processing with database recovery.								
CO4	Apply security to the database by checking for authentication and authorization								
CO5	Apply advanced topics of data warehousing and data mining, distributed databases and web databases.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**Database system architecture:** Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). **Data models:** Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.	**6**	In studying Database System Architecture, students will understand data abstraction, data independence, and the roles of DDL and DML. They will also learn various data models, including entity-relationship, network, relational, and object-oriented models, and comprehend integrity constraints and data manipulation operations.	**1,2**
II	**Relational query languages:** Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. **Relational database design:** Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. **Query processing and**	**10**	Students will gain proficiency in relational query languages (relational algebra, tuple and domain relational calculus, SQL3), understand DDL and DML constructs across MySQL, Oracle, DB2, and SQL Server. They will also learn effective relational database design (domain and data dependency, Armstrong's axioms, normal forms, dependency preservation, lossless design) and optimize	**2,3, 4**

	optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.		query processing through evaluation, equivalence, join strategies, and algorithms.	
III	**Transaction processing:** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic, Concurrency Control schemes, Database recovery.	**8**	Students will comprehend transaction processing concepts such as concurrency control, ACID properties, serializability of scheduling, and locking mechanisms in timestamp-based and multi-version concurrency control schemes. They will also master database recovery techniques essential for maintaining data integrity and availability.	**2,3, 4,5**
IV	**Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.	**6**	Students will understand database security fundamentals including authentication, authorization, DAC, MAC, and RBAC models, as well as techniques for intrusion detection and prevention of SQL injection attacks.	**2,3**
V	**Advanced topics:** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.	**5**	Students will explore advanced topics including object-oriented and object-relational databases, logical databases, web databases, distributed databases, and data warehousing, alongside principles and techniques of data mining for comprehensive data management solutions.	**1,2, 3**
Practical Component				
Practical 1	**Designing and implementing a relational database schema** based on business requirements, ensuring normalization up to 3NF.	**2**	Students will achieve proficiency in designing and implementing relational database schemas tailored to business requirements, ensuring data organization adheres to normalization principles up to the third normal form (3NF).	2,3
Practical 2	**Writing and executing SQL queries** to retrieve, update, and delete data from a relational database, using DML commands such as SELECT, INSERT, UPDATE, DELETE.	**2**	Students will master the skill of writing and executing SQL queries to efficiently retrieve, update, and delete data from relational databases, employing DML commands (SELECT, INSERT, UPDATE, DELETE) to manipulate and manage data effectively.	3,5

Practical 3	**Implementing concurrency control mechanisms**like locking and timestamp-based protocols to manage simultaneous access to data in multi-user environments.	**2**	Students will develop the capability to implement concurrency control mechanisms such as locking and timestamp-based protocols, ensuring consistent and reliable management of data access in multi-user environments to prevent conflicts and maintain data integrity.	3
Practical 4	**Performing query optimization** by analyzing query plans, selecting appropriate join strategies, and applying optimization algorithms (e.g., cost-based optimization).	**2**	Students will learn to optimize query performance by analyzing query plans, selecting optimal join strategies, and applying algorithms such as cost-based optimization, enhancing database efficiency and responsiveness.	3
Practical 5	**Securing database access** through authentication mechanisms and defining authorization roles using RBAC models to enforce access controls.	**2**	Students will gain proficiency in securing database access through authentication mechanisms and implementing RBAC models to define and enforce granular authorization roles, ensuring data confidentiality and integrity in diverse organizational settings.	3
Practical 6	**Managing transactions** to ensure ACID properties (Atomicity, Consistency, Isolation, Durability) using transaction management techniques and protocols.	**2**	Students will develop expertise in managing transactions to guarantee ACID properties (Atomicity, Consistency, Isolation, Durability), employing robust transaction management techniques and protocols for reliable data operations in database systems.	3
Practical 7	**Designing and deploying distributed database systems** to handle data across multiple nodes or locations while ensuring consistency and fault tolerance.	**2**	Students will learn to design and deploy distributed database systems, ensuring data consistency and fault tolerance across multiple nodes or locations, crucial for scalable and resilient data management in modern applications.	3
Practical 8	**Implementing data integrity constraints** such as primary keys, foreign keys, and check constraints to maintain data accuracy and reliability.	**2**	Students will gain proficiency in implementing data integrity constraints like primary keys, foreign keys, and check constraints, ensuring data accuracy and reliability in relational database systems.	3
Practical 9	**Designing and optimizing database indexes** to enhance query	**2**	Students will master designing and optimizing database indexes	3

	performance and facilitate efficient data retrieval.		to improve query performance and streamline data retrieval operations, enhancing overall database efficiency.	
Practical 10	**Implementing database recovery techniques** such as backup and restore procedures to ensure data availability and resilience against failures.	**2**	Students will learn to implement database recovery techniques, including backup and restore procedures, to ensure data availability and resilience against failures, maintaining database integrity and continuity.	3
Practical 11	**Exploring object-oriented and object-relational database features** for modeling complex data structures and relationships using inheritance and encapsulation.	**2**	Students will explore object-oriented and object-relational database features to effectively model complex data structures and relationships using inheritance and encapsulation, enhancing flexibility and scalability in database design.	3
Practical 12	**Utilizing data warehousing techniques** to integrate and consolidate data from heterogeneous sources for analytical processing and decision support.	**2**	Students will learn to utilize data warehousing techniques to integrate and consolidate data from diverse sources, enabling effective analytical processing and decision support in organizational contexts.	3
Practical 13	**Applying data mining algorithms** to extract patterns and insights from large datasets stored in databases, supporting business intelligence and predictive analytics.	**2**	Students will apply data mining algorithms to extract valuable patterns and insights from large databases, empowering business intelligence and facilitating predictive analytics for informed decision-making.	3
Practical 14	**Developing logical database designs** to map conceptual models (e.g., ER diagrams) to physical database schemas optimized for performance and storage.	**2**	Students will develop proficiency in translating conceptual models (e.g., ER diagrams) into optimized physical database schemas, ensuring efficient performance and storage in logical database designs.	3
Practical 15	**Managing and optimizing database performance** by monitoring resource usage, tuning database parameters, and analyzing execution plans for optimization opportunities.	**2**	Students will learn to manage and optimize database performance through effective monitoring of resource usage, tuning database parameters, and analyzing execution plans, ensuring efficient operation and responsiveness in database systems.	3

TEXT BOOKS:

T1:. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F.Korth, S. Sudarshan, McGraw-Hill.

REFERENCE BOOKS:

R1: "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.

OTHER LEARNING RESOURCES:

O1: https://www.jbiet.edu.in/coursefiles/cse/HO/cse2/DBMSI-III.pdf
O2: https://cs.ulb.ac.be/public/_media/teaching/infoh303/dbmsnotes.pdf

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the fundamental concepts of database management systems with DBMS languages and data models.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
2	Apply the concepts of query languages such as DDL and DML for designing a relational database.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
3	Apply the ACID properties and concurrency control schemes to perform transaction processing with database recovery.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
4	Apply security to the database by checking for authentication and authorization	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
5	Apply advanced topics of data warehousing and data mining, distributed databases and web databases.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12

SEMESTER – IV									
Course Title	**Operating Systems**								
Course code	**23BTCS223R**	**Total credits:4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:39+30	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the second year of the programme**								
Course Objectives	1. To learn the mechanisms of OS to handle processes and threads and their communication and the mechanisms involved in memory management in contemporary OS. 2. To gain knowledge on Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols 3. To know the components and management aspects of concurrency management.								
CO1	Understand operating system evolution, types, services, structures (UNIX, Windows).								
CO2	Analyse process, thread concepts, CPU scheduling, relationships, and states effectively.								
CO3	Evaluate IPC solutions, evaluate deadlock conditions, implement prevention, detection, recovery.								
CO4	Analyse memory management, mapping, allocation, paging, virtual memory, page replacement.								
CO5	Understand I/O hardware, controllers, DMA, secondary storage, disk scheduling, file management.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction:** Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.	**7**	Students will grasp the concepts of operating systems, including their generations, types, services, system calls, and structural architectures (layered, monolithic, microkernel), as well as understand the concept of virtual machines for efficient resource management and isolation.	**1,2**
II	**Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. **Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, **Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time;	**8**	Students will understand processes and threads in operating systems, including their definitions, states, relationships, and management mechanisms like context switching and PCBs, alongside exploring process scheduling foundations, criteria, algorithms, and multiprocessor considerations for efficient resource utilization and system responsiveness.	**2,3, 4**

	Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling.			
III	**Inter-process Communication:** Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution **Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker‘s algorithm, Deadlock detection and Recovery.	**8**	Students will master inter-process communication concepts including critical sections, race conditions, mutual exclusion, and hardware-based solutions, alongside understanding deadlocks, their conditions, prevention strategies like the Banker's algorithm, and techniques for detection and recovery in operating systems.	**2,3, 4,5**
IV	**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging. **Virtual Memory**: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).	**8**	Students will comprehend memory management in operating systems, covering concepts like logical and physical address mapping, memory allocation strategies, including contiguous and paging methods, and virtual memory essentials such as locality of reference, demand paging, and page replacement algorithms like FIFO, LRU, and optimal for efficient resource utilization and system performance.	**2,3**
V	**I/O Hardware:** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure.. **File Management**: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management. **Disk Management:** Disk structure, Disk scheduling, Disk reliability, Disk formatting, Boot-block, Bad blocks.	**8**	Students will grasp I/O hardware principles including devices, controllers, and DMA, understand I/O software goals such as interrupt handling and device drivers, explore file management concepts like access methods, types, operations, and directory structures, and learn about disk management covering structure, scheduling, reliability, and formatting for efficient data storage and retrieval in operating systems.	**1,2, 3**

Practical Component				
Practical 1	Basic Linux Commands and Overview.	**4**	Gain proficiency in fundamental Linux commands and system navigation.	2,3
Practical 2	Write Shell Script for followings a) To find the global complete path for any file. b) To broadcast a message to a specified user or a group of users logged on any terminal. c) To copy the file system from two directories to a new directory in such a way that only the latest file is copied in case there are common files in both the directories. d) To compare identically named files in two different directories and if they are same, copy one of them in a third directory e) To delete zero sized files from a given directory (and all its sub- directories). f) To display the name of those files (in the given directory) which are having multiple links. g) To display the name of all executable files in the given directory. h) Write a script to display the date, time and a welcome message (like Good Morning etc.). The time should be displayed with "a.m." or "p.m." and not in 24 hours notation. i) Write a script to display the directory in the descending order of the size of each file.	**10**	Develop proficiency in shell scripting through practical exercises in file management, system administration, and user interaction on Linux systems	2,3, 5
Practical 3	Implementation of FCFS (First Come First Serve) CPU Scheduling.	**2**		3
Practical 4	Implementation of SJF (Shortest Job First) CPU Scheduling.	**2**		3
Practical 5	Implementation of Round Robin (RR) CPU Scheduling.	**2**		3
Practical 6	Implementation of Priority CPU Scheduling Algorithm.	**2**		3

Practical 7	Implementation of FIFO Replacement Algorithm.	**2**		3
Practical 8	Implementation of Optimal Page Replacement Algorithm.	**2**		3
Practical 9	Implementation of LRU Page Replacement Algorithm by Stack method	**2**		3
Practical 10	Implement the producer-consumer problem using threads	**2**		3

TEXT BOOKS:

T1: Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia
Student Edition.
T2: Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

REFERENCE BOOKS:

R1: Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing.
R2: Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley

OTHER LEARNING RESOURCES:

O1: "Operating System Concepts" by Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne.
O2: "Modern Operating Systems" by Andrew S. Tanenbaum.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand operating system evolution, types, services, structures (UNIX, Windows).	PO1, PO2, PO3, PO4, PO5, PO10, PO12
2	Analyse process, thread concepts, CPU scheduling, relationships, and states effectively.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Evaluate IPC solutions, evaluate deadlock conditions, implement prevention, detection, recovery.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Analyse memory management, mapping, allocation, paging, virtual memory, page replacement.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
5	Understand I/O hardware, controllers, DMA, secondary storage, disk scheduling, file management.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – IV									
Course Title	**Software Engineering**								
Course code	**23BTCS224R**	**Total credits:2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:36	**2**	**0**	**0**	**0**	**0**	**0**	**2**
Pre-requisite	Basic Computer Science	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the second year of the programme**								
Course Objectives	1. Master software development methodologies like Agile and WaterSummer. 2. Design scalable and maintainable software architectures. 3. Implement effective software testing and quality assurance practices.								
CO1	Demonstrate ethical software development practices.								
CO2	Apply systems development lifecycle phases effectively.								
CO3	Elicit, analyze, and specify software requirements collaboratively.								
CO4	Create and evaluate standard procedures and documentation.								
CO5	Collaborate productively in interdisciplinary software project teams.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	Introduction: Lifecycle models Function-oriented software design: Structured analysis and structured design.	**7**	Students will gain proficiency in life cycle models and function-oriented software design through structured analysis and design methodologies, preparing for effective software development practices.	**1,2**
II	Software requirements, analysis, and specification: Informal and formal specification.	**8**	Develop skills in software requirements, analysis, and specification, encompassing both informal and formal specification methods to ensure comprehensive software development understanding and practice.	**1,2, 3**
III	Object-Oriented Design: User interface design, GUI design primitives, Window management system, and the X Windows system. Coding and Testing: Coding standards and unit testing.	**7**	Master Object-Oriented Design principles including user interface and GUI design primitives, along with Window management systems like X Windows. Understand coding standards and practice effective unit testing methods to ensure robust software development.	**1,2, 3**
IV	Project management: Estimation, scheduling, risk management, and configuration management.	**8**	Acquire proficiency in project management essentials such as estimation, scheduling, risk management, and configuration management, crucial for effective planning and execution of software projects.	**1,2, 3**
V	Software reliability and quality assurance: Reliability metrics and growth modeling, ISO-9000, SEI, and CMM.	**6**	Explore software reliability and quality assurance, focusing on reliability metrics, growth modeling, and standards like ISO-9000, SEI, and CMM to ensure high-quality software development practices and processes.	**1,2**

TEXT BOOKS:

T1: An Integrated Approach to Software Engineering by Jalote. Narosa Publishing House.
T2: Software Engineering by R. Mall, PHI.

REFERENCE BOOKS:

R1: Software Engineering by R.S.Pressman, McGraw Hill

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate ethical software development practices.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
2	Apply systems development lifecycle phases effectively.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
3	Elicit, analyze, and specify software requirements collaboratively.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
4	Create and evaluate standard procedures and documentation.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
5	Collaborate productively in interdisciplinary software project teams.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12

SEMESTER – IV									
Course Title	**DE-1: Biology For Engineers**								
Course code	**23BTCS225R**	**Total credits:3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 36T	**3**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**NIL**	**Co-requisite**	**C Programming**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the first year of the programme**								
Course Objectives	1. To introduce the students about the biological concepts from an engineering perspective. 2. To enable the students to have a strong knowledge of functioning of an ecosystem and identification of organisms. 3. To introduce with the concepts of genetics and mechanisms related to it.								
CO1	Analyze and differentiate between the fundamental principles of biology and engineering, emphasizing the significance of biological observations.								
CO2	Evaluate the importance of classification in biology, considering criteria such as cellularity, ultra structure, energy utilization, and molecular taxonomy.								
CO3	Examine the diversity of life through the study of biomolecules, emphasizing the common building blocks and diverse manifestations in sugars, proteins, nucleotides, and lipids.								
CO4	Explore the molecular basis of information transfer in genetics, understanding the hierarchy of DNA structure, the universality of the genetic code, and defining genes.								
CO5	Explore the fundamental principles of microbiology, including identification, classification, and ecological aspects of single-celled organisms.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction** ● Importance and scope of Biology as an important scientific discipline. ● Branches of biological sciences. ● Fundamental differences between science and engineering. ● Comparison between the working mechanism of eye and camera, Bird flying and aircraft. ● Biological observations of 18^{th} century that lead to major discoveries in the world ● Steps in scientific research works. ● Brownian motion in biological sciences.	**6**	Students will understand the significance, scope, and fundamental principles of biology, including its branches, historical observations, and the steps in scientific research.	**1,2**
II	**Classification & Ecology** ● Classification of organisms, Basis of classification: Morphological, biochemical or ecological, level of	**6**	Students will gain knowledge of organism classification, ecosystem dynamics, energy flow, excretion types, animal	**1,2,3**

	organization, symmetry, germ layer organization, segmentation, notochord. ● Concept of unicellular and multicellular organisms; prokaryotes and eukaryotes; Habitat & Adaptations. ● Concept of Ecosystem: Structure & Function. ● Energy flow in an ecosystem: Lindemann ten percent law. ● Types of excretion: Ammonotelism, Ureotelism and Uricotelism. ● Animal Kingdom: Characters of phylum with examples. ● Model organisms for the study of biology come from different groups. E. coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus.		kingdom characteristics, and the significance of model organisms in biological research.	
III	**Genetics & Biomolecules** ● Concept of Allele; Dominance & Recessive; Monohybrid, Dihybrid & Trihybrid cross; Mitosis & Meiosis. ● Mendel's laws, Concept of Segregation and Independent assortment. ● Concept of co-dominance and incomplete dominance with illustrations. ● Sex determination in human. ● Genetic disorders in human beings. ● DNA & RNA as genetic material. ● Enzymes: Classification; Mechanism of enzyme action.	**5**	Understand fundamental genetic concepts, inheritance patterns, genetic disorders, and the roles of DNA, RNA, and enzymes in biological processes.	**1,2,3**
IV	**Information Transfer & Metabolism** ● Genetic code: Properties ● Structure of DNA ● Concept of recombination and crossing over ● Proteins: Primary secondary,	**5**	Comprehend genetic code properties, DNA structure, protein structures, central dogma, ATP's role, and protein-ligand interactions.	**2,3**

	tertiary and quaternary structure. ● Concept of Central dogma ● ATP as an energy currency of cell. ● Concept of docking: Protein Ligand interaction			
V	**Physiology** ● Human Circulatory System: Heart and its working mechanism; Blood groups; Erythroblastosisfetalis. ● Neuroendocrine system of human: Endocrine glands and their functions. ● Human Excretory system: Structure of Kidney and Nephron ● Nervous system of human: Structure of neuron; Resting Membrane Potential; Origin and conduction of nerve impulse. ● Human Respiratory System: Structure of lungs and exchange of gases. ● Human digestive enzymes: Components and enzymes. Mechanism of muscle contraction	**5**	Students will understand the structure and function of human physiological systems, including circulatory, neuroendocrine, excretory, nervous, respiratory, and digestive systems, along with the mechanism of muscle contraction.	**1,2,3**

TEXT BOOKS:

T1: Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
T2: Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons.

REFERENCE BOOKS:

R1: Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
R2: Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C.

OTHER LEARNING RESOURCES: Nil

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Analyze and differentiate between the fundamental principles of biology and engineering, emphasizing the significance of biological observations.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
2	Evaluate the importance of classification in biology, considering criteria such as cellularity, ultrastructure, energy utilization, and molecular taxonomy.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
3	Examine the diversity of life through the study of biomolecules, emphasizing the common building blocks and diverse manifestations in sugars, proteins, nucleotides, and lipids.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
4	Explore the molecular basis of information transfer in genetics, understanding the hierarchy of DNA structure, the universality of the genetic code, and defining genes.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
5	Explore the fundamental principles of microbiology, including identification, classification, and ecological aspects of single-celled organisms.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12

SEMESTER – IV									
Course Title	**DE-I: Design Thinking**								
Course code	**23BTCS225R**	**Total credits:3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 40	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the second year of the programme**								
Course Objectives	1. The objective of the course is to equip students with the skills to apply design thinking methodologies for innovative problem-solving, develop sustainable business models, and effectively communicate and pitch entrepreneurial ideas. 2. Students will learn to empathize with users, ideate creatively, and prototype solutions. 3. The course aims to foster an entrepreneurial mindset that embraces risk-taking and adaptability.								
CO1	Compare and select problems suitable for DT projects and use techniques for empathetic research.								
CO2	Identify and document insights, user habits and identify user needs.								
CO3	Visualise solutions, evaluate solution concepts and able to create rough prototypes, gather feedback.								
CO4	Able to create high-fidelity prototypes. Able to test user experience								
CO5	Able to identify a business model for a solution concept. Able to estimate financial results2. Apply the various techniques of parsing to construct a syntax analyzer for a specific programming language.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Design Thinking for Contextualized Problem-Solving and Empathetic Research.	**8**	Master design thinking for empathetic research and contextualized problem-solving, enhancing innovation and user-centered solutions.	**1,2**
II	Analysis of Research, Defining Needs	**8**	Gain proficiency in analyzing research data to accurately define needs, facilitating effective problem-solving and decision-making processes.	**2,3,4**
III	Brainstorming and Evaluation,	**8**	Develop skills in brainstorming and evaluating ideas to foster creativity and critical thinking for effective decision-making and problem-solving.	**2,5**
IV	Prototyping, Testing and testing to Launch.	**8**	Students will acquire proficiency in prototyping, testing, and launching processes to validate ideas and products efficiently, ensuring successful implementation and user satisfaction.	**1,2,3**
V	Entrepreneurial Innovation.	**8**	Develop entrepreneurial skills and strategies for fostering innovation, enabling effective identification, development, and implementation of business opportunities.	**1,2,3**

REFERENCE BOOKS:

R1: Van Der Pijl, P., Lokitz, J., & Solomon, L. K. (2016). Design a better business: New tools, skills, and mindset for strategy and innovation. John Wiley & Sons.

OTHER LEARNING RESOURCES:

O1: https://www.simplilearn.com/design-thinking-and-innovation-article

O2: https://online.hbs.edu/blog/post/what-is-design-thinking

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Compare and select problems suitable for DT projects and use techniques for empathetic research.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
2	Identify and document insights, user habits and identify user needs.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
3	Visualise solutions, evaluate solution concepts and able to create rough prototypes, gather feedback.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
4	Able to create high-fidelity prototypes. Able to test user experience	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12
5	Able to identify a business model for a solution concept. Able to estimate financial results2. Apply the various techniques of parsing to construct a syntax analyzer for a specific programming language.	PO2,PO3,PO4,PO6,PO8,PO9PO10,PO12

SEMESTER – IV										
Course Title	**PE-I : Artificial Intelligence**									
Course code	**23BTCS226R**	**Total credits:3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours:40T	**3**	**0**	**0**	**0**	**0**	**0**	**3**	
Pre-requisite	Basic Programming Skills, Data structures	**Co-requisite**	**NIL**							
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**									
Semester	**Winter/ II semester of the second year of the program**									
Course Objectives	1. Describe the field of AI and its subfields machine learning, NLP and computer vision 2. Learn and implement key NLP algorithms and models, such as virtual agents, chatbots, sentiment classifiers, and language translators, to solve a variety of natural language understanding tasks. 3. Explore Practical Applications of Computer Vision**,**Investigate real-world applications of computer vision in various fields, including autonomous vehicles, surveillance systems, medical imaging, and augmented reality.									
CO1	Remember and understand relevance of AI in today's world.									
CO2	Gain an idea about Machine Learning application in real world problem.									
CO3	Develop an understanding deep learning concept in AI.									
CO4	Apply and Analyze data by applying various machine learning algorithms.									
CO5	Enhance problem-solving abilities with IBM Cloud service.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Artificial Intelligence:**Overview of Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL), Natural Language Processing(NLP), Computer Vision. Describe the types of AI,Explain what the main focus of AI is,List of practical applications of AI,Describe the eras of computing,Explain the difference between deterministic and probabilistic systems, Road Map of AI.	**8**	Gain a foundational understanding of Artificial Intelligence, its types, key focus areas, practical applications, historical development, and the differences between deterministic and probabilistic systems, along with an overview of the AI roadmap.	**1,2**
II	**Introduction to Machine Learning:** Introduction to Machine Learning, Supervised Learning & Unsupervised Learning. Supervised Learning Algorithms:	**8**	Develop a fundamental understanding of Machine Learning, including supervised and unsupervised learning techniques, and gain practical experience with algorithms such as Linear Regression, Logistic Regression, SVM, Decision Trees,	**1,2,4**

	Linear Regression, Logistic Regression, Suppor Vector Machine, Decision Tree,Random Forest, KNN. Unsupervised Learning Algorithms: K-Means Clustering, Hierarchical Clustering.		Random Forest, KNN, K-Means Clustering, and Hierarchical Clustering.	
III	**Introduction to Deep Learning:** Introduction to Deep Learning: Neural Networks, Layers, and Activation Functions, Back Propagation, Optimizers, Deep Learning Algorithm: ANN, CNN, RNN, LSTM with Tensorflow and Keras, Introduction to Autoencoders, Generative Adversarial Networks (GANs), Restricted Boltzmann Machines (RBMs) and Applications.	**8**	Students will gain a comprehensive introduction to Deep Learning, covering neural networks, activation functions, backpropagation, optimizers, and algorithms such as ANN, CNN, RNN, LSTM using TensorFlow and Keras, along with an understanding of Autoencoders, GANs, RBMs, and their applications in various domains.	**2,3,4,5**
IV	**Introduction to Natural Language Processing and Computer Vision:** Introduction to Natural Language Processing, NLP application in real world, components of NLP, Vartual Agents overview, Chatbot and its parts, Tokenization, Stemming & Lemmatization in NLP, BagofWords,TF-IDF,Word2Vec, Word Embedding in NLP. Introduction to Computer Vision, Image Classification and Object Recognition, Feature Detection and Description algorithms with OpenCV.	**8**	Acquire foundational knowledge in Natural Language Processing (NLP) including its applications, components, and techniques like tokenization, stemming, TF-IDF, and Word Embedding, as well as in Computer Vision covering image classification, object recognition, and feature detection using OpenCV.	**2,3**
V	**Evolution from DeepQA to Watson services on**	**8**	Understand the evolution of IBM Watson from DeepQA to its current	**1,2,3**

	IBM Cloud: Explain the DeepQA architecture was;Explain why IBM decided to commercialize Watson and Describe the evolution of Watson services from the original DeepQA architecture to the present. Introduction to IBM Watson: explore Watson Studio, IBM's integrated environment for data scientists, developers, and domain experts, to build and deploy ML models. Creating Chatbots using Watson Assistant: learn the basics of Watson Assistant, including intents, entities, dialog flows, and integration capabilities. Natural Language Understanding (NLU), Language Translator, Text to Speech, Speech to Text on IBM Cloud.		services on IBM Cloud, including Watson Studio for ML model development, Watson Assistant for creating chatbots, and capabilities like Natural Language Understanding, Language Translator, Text to Speech, and Speech to Text on the IBM Cloud platform.	

TEXT BOOKS:

T1: Introduction to Data Science: B.UmaMaheswari& R. Sujata.
T2: Deep Learning with TensorFlow and Keras by Amita Kapoor, Antonio Gulli&Sujit pal

REFERENCE BOOKS:

R1: Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence" by Jon Krohn, Grant Beyleveld, and AglaéBassens.
R2: Artificial Intelligence: Foundations of Computational Agents" by David L. Poole and Alan K. Mackworth.

OTHER LEARNING RESOURCES:

O1: Python & Machine Learning - https://www.w3schools.com/python/python_ml_getting_started.asp

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Remember and understand relevance of AI in today's world.	PO1, PO2, PO3, PO4, PO10, PO12
2	Gain an idea about Machine Learning application in real world problem.	PO1, PO2, PO3, PO4, PO10, PO12
3	Develop an understanding deep learning concept in AI.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Apply and Analyze data by applying various machine learning algorithms.	PO1, PO2, PO3, PO4, PO10, PO12
5	Enhance problem-solving abilities with IBM Cloud service.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – IV									
Course Title	**PE-I: Introduction to Internet of Things**								
Course code	**23BTCS226R**	**Total credits: 3**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the second year of the programme**								
Course Objectives	1. To introduce the different terminology, technology of IoT and its applications 2. To introduce the concept of M2M (machine to machine) with necessary protocols 3. To introduce the Python Scripting Language which is used in many IoT devices 4. To introduce the Raspberry PI platform, that is widely used in IoT applications 5. To introduce the implementation of web-based services on IoT devices								
CO1	Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules.								
CO2	Understand IoT value chain structure (device, data cloud), application areas and technologies involved.								
CO3	Market forecast for IoT devices with a focus on sensors								
CO4	Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi								
CO5	Apply database knowledge to a real-world data analytics project.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Internet of Things-** Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.	**8**	Understand IoT concepts, architecture, communication protocols, sensor integration, and design basic IoT applications for various domains..	**1,2**
II	**IoT Physical Devices and Endpoints-** Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors.	**8**	comprehend IoT device hardware, sensors, actuators, communication interfaces, and configure/manage physical endpoints for IoT applications effectively.	**2,4**
III	**IOT Data Communication:** Transfer data by Wireless / Wired connectivity, Ipv4/Ipv6, 2g ,3g ,4g & 5g IEEE 802.15.4, IEEE 802.15.4e, 802.11ah, Relay Access Point (AP) Grouping of station Target Wake Time (TWT), Software defined networks, network function virtualization, difference between SDN and NFV for IoT.	**10**	Understand IoT communication protocols, data formats, transmission techniques, and implement efficient data communication solutions for IoT networks.	**2,3**
IV	**IOT Data Storage & Retrieval:** Overview	**10**	Comprehend IoT data	**2,3,4**

	and Role of Storage in Cloud / Server /Inhouse Storage, Databases Connectivity with IOT devices and users, Case Study over Mysql / NoSql / NewSql, Cloud Services and Administration, Case Study Of Big Data & Hadoop Platforms.		storage architectures, database systems, retrieval methods, and implement scalable and efficient data storage solutions for IoT applications	
V	**IoT Data Analysis:** An Introduction to Data Science and Analytics Data Analysis Using NumPy , Pandas Data Cleaning, Missing Data, Feature extraction, Data Visualization – Static, Dynamic & Geographical Visualization. Linear Regression, Supervised Learning (Classification) and Unsupervised Learning (Clustering) algorithms, Time Series Analysis	**9**	Analyze IoT data using statistical techniques, machine learning algorithms, and extract actionable insights to optimize IoT system performance.	**2,3,4**

Text Books:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
3. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759
4. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895

Reference Books:

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan
2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
2	Understand IoT value chain structure (device, data cloud), application areas and technologies involved.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
3	Market forecast for IoT devices with a focus on sensors	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
4	Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
5	Apply database knowledge to a real-world data analytics project.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.

SEMESTER – IV									
Course Title	**Field-based Training**								
Course code	**23BTCS227R**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: NA	**0**	**0**	**0**	**0**	**0**	**16**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**Networking Basics**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the second year of the programme**								
Course Objectives	6. To expose students to real-world applications of theoretical knowledge. 7. To enhance observational, analytical, and research skills through fieldwork. 8. To develop problem-solving skills in practical settings.								
CO1	To expose students to real-world applications of theoretical knowledge.								
CO2	To enhance observational, analytical, and research skills through fieldwork.								
CO3	To develop problem-solving skills in practical settings.								
CO4	To foster collaboration and communication skills through group projects and professional interactions.								
CO5	To cultivate an appreciation for the complexities and challenges of professional practice in the field.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
	The organization will provide the students one field visit for this program. The students will be taken to a specific blocks of the university for learning purposes. The students will visit all department block site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners of IT department of the university. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial findings.		Develop practical insights and professional networking skills through guided field visits to university department blocks, facilitating firsthand observations, interactions with IT professionals, and reflective journaling to enhance learning and understanding in IT practices and environments.	**6**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	To expose students to real-world applications of theoretical knowledge.	PO1, PO5, PO7, PO10, PO12
2	To enhance observational, analytical, and research skills through fieldwork.	PO2, PO4, PO5, PO6, PO12
3	To develop problem-solving skills in practical settings.	PO2, PO3, PO4, PO9, PO11
4	To foster collaboration and communication skills through group projects and professional interactions.	PO6, PO8, PO9,PO10,PO11
5	To cultivate an appreciation for the complexities and challenges of professional practice in the field.	PO6, PO7, PO8, PO11, PO12

SEMESTER – IV									
Course Title	**Digital Literacy**								
Course code	**23UCDL102R**	**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**						
Programmes	**All Degree / Diploma programme of Engineering, Computer Technology, Management, Humanities, Science, and Agricultural Sciences**								
Semester	**Winter/ II semester of the second 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 understand about the introduction to Social Media and E-Commerce and utility software. 3. Students will develop a solid foundation in computational thinking, which includes problem-solving, algorithmic design, and logical reasoning.								
CO1	Fundamentals of Computer Systems, Office Automation and Internet Search.								
CO2	Know more about the Internet & Cyber World								
CO3	Know Social Media, E-Commerce, and apply the same for digital branding								
CO4	Know to use the digital payments and digital transactions, and other utility software								
CO5									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
Practical Component				
Practical 1	Disassemble and reassemble a desktop computer, identifying and explaining the function of each component. Discuss the importance of hardware compatibility.	**3**	By disassembling and reassembling a desktop computer, learners understand component functions, emphasize hardware compatibility for system stability, and gain practical troubleshooting skills.	3
Practical 2	Install an operating system (e.g., Windows or Linux) on a virtual machine. Configure essential settings, such as user accounts, network connections, and system updates.	**3**	Creating and configuring a virtual machine with an operating system develops skills in installation, setup of user accounts, network configurations, and system maintenance, enhancing proficiency in virtualized environments.	3
Practical 3	Use office software (e.g., Microsoft Office or Google Workspace) to create documents, spreadsheets, and presentations. Teach formatting, inserting images, and collaboration features.	**3**	Using office software for document creation, formatting, image insertion, and collaboration enhances proficiency in productivity tools, fostering effective communication and collaborative skills in professional settings.	3
Practical 4	Instruct students on effective internet searching, including the use	**3**	Teaching effective internet searching covers using search	3

	of search engines, keywords, and advanced search operators.		engines proficiently, employing appropriate keywords, and leveraging advanced search operators to refine results, enhancing research skills and information retrieval efficiency.	
Practical 5	Set up email accounts, compose and send emails, attach files, and organize emails into folders. Discuss email etiquette and best practices.	**3**	Setting up email accounts, composing, sending emails, attaching files, organizing with folders, and understanding email etiquette enhances communication efficiency and professionalism, emphasizing clarity, conciseness, and proper etiquette in digital correspondence.	3
Practical 6	Use cloud storage services (e.g., Google Drive or Dropbox) to store and synchronize files. Create a backup of important data and discuss data recovery options.	**3**	Using cloud storage services for file storage and synchronization ensures accessibility and collaboration, while creating backups of important data safeguards against loss, with data recovery options providing security and continuity in digital operations.	3
Practical 7	Instruct students to create accounts on popular social media platforms (e.g., Facebook, Twitter, Instagram). Guide them through profile setup, privacy settings, and content posting.	**3**	Guiding students to create social media accounts, set up profiles, configure privacy settings, and post content fosters digital presence management, emphasizing responsible sharing, online safety, and personal branding awareness.	3
Practical 8	Have students create a content calendar for a fictional business or brand. Plan posts, including text, images, and hashtags, and use social media management tools to schedule posts.	**3**	Creating a content calendar for a fictional business includes planning posts with text, images, and hashtags, using social media management tools to schedule and optimize engagement, fostering skills in strategic content planning and digital marketing execution.	3
Practical 9	Guide students in building a basic e-commerce website using platforms	**3**	Guiding students to build a basic e-commerce website	3

	like Shopify or WooCommerce. They should add products, set up payment gateways, and configure the online store.		involves adding products, setting up payment gateways, and configuring the online store using platforms like Shopify or WooCommerce, fostering skills in online retail setup and management for digital entrepreneurship.	
Practical 10	Set up a payment gateway for the e-commerce website created in Experiment 3. Test payment transactions and discuss security protocols such as SSL encryption.	**3**	Setting up a payment gateway for the e-commerce website involves integrating services like PayPal, Stripe, or others, testing transactions to ensure functionality, and emphasizing security protocols such as SSL encryption to protect customer data during online transactions, ensuring safe and secure e-commerce operations.	3

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, E. 2014. *Fundamentals of Computer and Programming (Updated Ed Sem. I, Au)*. Tata McGraw-Hill Education.

OTHER LEARNING RESOURCES:

O1: https://www.w3schools.com

O2: https://edu.gcfglobal.org

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 methods.	PO1, PO5, PO12
2	Students will gain the knowledge of organizing & Cleaning of Rooms.	PO1, PO5, PO12
3	Students will be able to gain the travel management concept.	PO1, PO5, PO12
4	Students will be able to acquire the knowledge of basic household's amenities for day- to-day use.	PO1, PO5, PO12

SEMESTER – IV									
Course Title	**Basic Acclimatizing Skills**								
Course code	**23UULS221R**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 52	**0**	**0**	**2**	**0**	**0**	**0**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**All the Under Graduate Programmes**								
Semester	**Winter/ II semester of the second year of the program**								
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's amenities for day-to-day use.								
CO5	Students will be able to gain the hospitality management concept.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Accommodation Management** ● Telephone handling technique ● Organizing of Rooms. ● Cleaning equipment's and uses. ● Bed making Process.	**12**	Introduction to Accommodation Management covers telephone handling techniques, room organization, cleaning equipment usage, and bed making processes, ensuring comprehensive skills in guest service and room maintenance.	**1,2**
II	**Fundamental of Cooking** ● Uses of basic cooking equipment's ● Uses of fire & Fuel ● Different cuts of vegetables ● Uses of herbs & spices Regional Food Habits	**10**	Fundamentals of Cooking include mastering basic cooking equipment, understanding fire and fuel usage, learning various vegetable cuts, utilizing herbs and spices effectively, and exploring regional food habits for diverse culinary knowledge.	**2,3,4**
III	**- Food and Beverage skills** ● Introduction to catering industry ● Types menus and beverages ● Identifications of Cutlery, crockery & glassware ● Table etiquettes or manners ● Customer handling skills or Situation Handling	**12**	Food and Beverage skills encompass an introduction to the catering industry, knowledge of menu and beverage types, identification and use of cutlery, crockery, and glassware, understanding table etiquette, and developing customer handling and situational	**2,3,5**

			management abilities.	
IV	**Travel management** ● Travel Documentation (Types) ● Application of passport & Visa ● Tourism products (UNESCO sites) ● Types of logistics in travel and tourism management	**10**	Travel Management involves understanding travel documentation types, applying passport and visa procedures, exploring tourism products such as UNESCO sites, and managing logistics in travel and tourism operations effectively.	**2,3**
V	**Basic Hospitality Skills** ● Various Egg Preparations ● Canapés preparations ● Mock tail & Shakes Preparations ● Butter Rice / Lemon Rice ● Various Lentils Preparations ● 1 non-veg preparation/ 1 veg preparation	**8**	Basic Hospitality Skills include mastering various egg preparations, creating canapés, preparing mocktails and shakes, making butter rice or lemon rice, mastering various lentil dishes, and preparing one non-vegetarian and one vegetarian dish to ensure a diverse culinary repertoire.	**1,2,3**

TEXT BOOKS:

T1: Arora K (2011). Theory of cookery, Frank brothers & company (pub) pvtltd-New Delhi.
T2: Bruce H. Axler, Carol A. Litrides (2010) Food and Beverage Service Volume 1 ofWiley Professional Restauranteur, Guides.

REFERENCE BOOKS:
R1: Mohammed Zulfikar (2010) - Introductions to Tourism and Hotel Industry Introduction to Tourism and Hotel Industry. Vikas Publishing.

OTHER LEARNING RESOURCES: Nil

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 methods.	PO1, PO2, PO3, PO4, PO7, PO10,PO12
2	Students will gain the knowledge of organizing & Cleaning of Rooms.	PO1, PO2, PO3, PO4, PO7, PO10,PO12
3	Students will be able to gain the travel management concept.	PO1, PO2, PO3, PO4, PO7, PO10,PO12
4	Students will be able to acquire the knowledge of basic household's amenities for day- to-day use.	PO1, PO2, PO3, PO4, PO7, PO10,PO12
5	Students will be able to gain the hospitality management concept.	PO1, PO2, PO3, PO4, PO7, PO10,PO12

SEMESTER – IV									
Course Title	**Indian Heritage**								
Course code	**23MOCS222R**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:30	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the second year of the programme**								
Course Objectives	1. To provide an in-depth understanding of India's rich cultural and historical heritage. 2. To explore the diverse traditions, practices, and contributions of India to world civilization. 3. To appreciate the evolution of Indian art, architecture, literature, and philosophy over the ages.								
CO1	Identify and describe key historical events and figures in Indian history.								
CO2	Analyze the influence of various cultural practices and traditions on Indian society.								
CO3	Evaluate the contributions of India to global heritage in terms of art, architecture, and literature.								
CO4	Discuss the philosophical and religious diversity of India.								
CO5	Develop a critical understanding of the changes and continuities in Indian heritage.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Ancient Indian Civilization** Indus Valley CivilizationVedic Age and Aryan MigrationMauryan and Gupta EmpiresContributions in Science and Mathematics.	**5**	Students will understand the development and cultural achievements of the Indus Valley Civilization, Vedic Age, Aryan migration, Mauryan, and Gupta empires, focusing on their contributions to science and mathematics in ancient India.	**1,2**
II	**Medieval India** The Rise of Regional Kingdoms**,** The Delhi Sultanate and Mughal EmpireCultural Syncretism: Art, Architecture, and MusicBhakti and Sufi Movements	**6**	Explore the dynamics of medieval India, including the rise of regional kingdoms, the Delhi Sultanate, and the Mughal Empire, highlighting cultural syncretism in art, architecture, and music, as well as the impact of Bhakti and Sufi movements.	**2,3,4**
III	**Indian Art and Architecture** Temple Architecture: Dravidian and Nagara StylesMughal Architecture: Taj Mahal and Red FortPainting Traditions: Ajanta, Ellora, and Miniature PaintingsModern Indian Art: Colonial and Post-Colonial	**6**	Analyze Indian art and architecture across historical periods, including temple architecture in Dravidian and Nagara styles, Mughal architectural masterpieces	**2,3,4,5**

	Influences		like the Taj Mahal and Red Fort, diverse painting traditions such as Ajanta, Ellora, and miniature paintings, and the evolution of modern Indian art influenced by colonial and post-colonial eras.	
IV	**Indian Literature and Philosophy** Ancient Texts: Vedas, Upanishads, and EpicsClassical Literature: Kalidasa and Tamil Sangam LiteratureModern Literature: Rabindranath Tagore and Mahatma GandhiPhilosophical Schools: Advaita, Buddhism, and Jainism.	**6**	Explore Indian literature and philosophy through ancient texts like the Vedas, Upanishads, and epics, classical works by Kalidasa and Tamil Sangam literature, modern contributions by Rabindranath Tagore and Mahatma Gandhi, and philosophical insights from schools such as Advaita Vedanta, Buddhism, and Jainism, fostering a deep understanding of India's cultural and intellectual heritage.	**2,3**
V	**Contemporary Indian Heritage** India's Freedom Struggle and IndependenceInfluence of Globalization on Indian CulturePreservation of Heritage: UNESCO World Heritage Sites in IndiaContemporary Cultural Practices and Festivals	**7**	Examine contemporary Indian heritage, including the freedom struggle and independence movement, the impact of globalization on Indian culture, efforts in preserving UNESCO World Heritage Sites in India, and the significance of modern cultural practices and festivals, providing insights into India's evolving cultural identity and global influence.	**1,2,3**

TEXT BOOKS:

T1:"The Discovery of India" by Jawaharlal Nehru

REFERENCE BOOKS:

R1: "India: A History" by John Keay

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Identify and describe key historical events and figures in Indian history.	PO6, PO12
2	Analyze the influence of various cultural practices and traditions on Indian society.	PO6, PO12
3	Evaluate the contributions of India to global heritage in terms of art, architecture, and literature.	PO6, PO12
4	Discuss the philosophical and religious diversity of India.	PO6, PO12
5	Develop a critical understanding of the changes and continuities in Indian heritage.	PO6, PO12

SEMESTER – IV									
Course Title	**Mini Project II**								
Course code	**23BTCS228R**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:NA	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/ II semester of the second year of the programme**								
Course Objectives	1. To develop the knowledge, skills and attitudes of a professional Computer engineering professional. 2. To become confident in designing engineering solutions to complex software problems utilising a systems approach. 3. Apply theoretical knowledge gained in earlier semesters to solve real-world problems through the development and implementation of a software project.								
CO1	Apply IT principles for real-world problem-solving using programming languages and network solutions.								
CO2	Contribute to complex projects as a team member, demonstrating effective personal and team management.								
CO3	Develop programming skills to create and assess software, hardware, and network solutions.								
CO4	Apply personal and team management skills as a professional software developer.								
CO5	Cultivate employability skills and uphold professionalism in software development.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: a) theoretical studies b) computer simulations c) hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project;		This course involves individual or small group projects supervised by academic staff, focusing on topics aligned with student and supervisor interests. Students will conduct extensive literature reviews to understand current developments in their chosen technical area. They will then engage in detailed technical work, employing theoretical studies, computer simulations, or hardware construction. Throughout the project, students will document their progress through regular reports or a professional journal, ensuring accountability and effective time management. They will present their findings and contributions in a seminar, preparing a formal report that outlines the project's scope, methodologies, and results. The culmination will involve	**1,2, 3,4, 5**

	4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field; 5. Prepare a formal report describing the work undertaken and results obtained so far; and Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.		showcasing their work in a public forum, utilizing poster presentations and operational demonstrations of hardware and software. This comprehensive approach aims to enhance students' research, technical, communication, and presentation skills in a real-world project environment.	

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply IT principles for real-world problem-solving using programming languages and network solutions.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
2	Contribute to complex projects as a team member, demonstrating effective personal and team management.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
3	Develop programming skills to create and assess software, hardware, and network solutions.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
4	Apply personal and team management skills as a professional software developer.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
5	Cultivate employability skills and uphold professionalism in software development.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12

SEMESTER – IV									
Course Title	**Data Visualization**								
Course code	**23BTCS229R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T+30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Basic Programming Skills**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ II semester of the Second year of the program**								
Course Objectives	1. Gain a deep understanding of the significance of data visualization in IT applications and its impact on decision-making and communication. 2. Develop proficiency in using R programming and Python for data analysis and visualization, including mastery of libraries such as ggplot2 (R) and Matplotlib (Python). 3. Apply data analysis techniques and visualization tools, including interactive tools like Tableau or Cognos, to solve real-world IT problems.								
CO1	Explain the significance of data visualization in IT applications and demonstrate basic plotting techniques using ggplot2 and Matplotlib.								
CO2	Develop advanced customized plots using ggplot2 and create interactive visualizations with Cognos.								
CO3	Create and export various types of geospatial visualizations using Folium and implement hypothesis and gradient descent in Python.								
CO4	Construct and customize diverse plots using Seaborn library for relational, categorical, distribution, and regression data.								
CO5	Apply data visualization techniques to real-world datasets and create dashboards for comprehensive data analysis in engineering applications.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Data Visualization and R Programming:** Understanding the importance of data visualization in IT applications. Overview of R programming for data analysis and visualization. Introduction to data visualization libraries: ggplot2 (R) and Matplotlib (Python). Basic plotting techniques and data representation in R and Python. Hands-on exercises with simple plots and data visualization examples.	**5**	Understand the importance of data visualization in IT applications and learn basic plotting techniques in R and Python.	**1,2,3**
II	**Advanced Data Visualization Techniques:** Advanced Features of ggplot2 for Customized Plots in R. Customizing Plot Aesthetics and Themes in ggplot2.. Introduction to Interactive Data Visualization Tools: Cognos. Creating Interactive Visualizations using Cognos. Hands-on Exercises:	**6**	Gain proficiency in advanced plotting with ggplot2 and create interactive visualizations using Cognos.	**3,4,5**

	Advanced Plotting Techniques and Interactive Visualizations.			
III	**Maps, Geospatial Data Visualization, Export Features:** Introduction to Folium. Maps with Markers, Choropleth Maps. Export Feature – Data Visualization. Generating a PNG picture. Generating PDF documents Multiple graphs plotting and export. Inserting subfigure Hypothesis and Gradient Descent. Understanding Hypothesis. Implementation of hypothesis in Python. Gradient Descent Implementation	**6**	Learn to create and export geospatial visualizations using Folium and implement hypothesis testing and gradient descent in Python.	**2,34**
IV	**Visualization by using Seaborn Library:** Relational plot: Dist Plot, Line Plot, Lmplot . Categorical plot: Stripplot, Swarmplot,Barplot, Countplot, Boxplot, Violinplot, Stripplot Distribution plot: Joinplot, Distpot, Pairplot, Rugplot. Regression plot: Simple Linear plot with additional parameters (hue and markers), Setting size and color of the plot, Displaying multiple plots, Size and aspect ratio of plots. Matrix plot: Heatmaps, Cluster Maps. Style and Color: Set the background to be white, Set the background to be ticks, Set the background to be darkgrid, Set the background to be whitegrid. Remove axes spine: Despine Size and aspect: Non grid plot, Grid type plot Scale and Context: Poster, paper, notebook and talk	**7**	Master various plotting techniques in Seaborn for relational, categorical, distribution, regression, and matrix plots, including customizing styles and contexts.	**3,4,5**
V	**Application of Data Visualization in Engineering:** Case studies demonstrating data visualization . Visualizing datasets & Creating dashboards for analysis Real-world applications and projects.	**6**	Apply data visualization techniques to real-world engineering problems, creating dashboards and analyzing datasets through case studies.	**4,5,6**
Practical				

Practical 1	Generate simple scatter, line, and bar plots using ggplot2 in R. Generate simple scatter, line, and bar plots using Matplotlib in Python.	**2**	**C**reate basic visual representations of data in R and Python.	**3,4**
Practical 2	Compare and contrast ggplot2 and Matplotlib for basic plotting tasks.	**2**	**U**nderstand the strengths and weaknesses of different visualization libraries.	**2,4**
Practical 3	Apply advanced features of ggplot2 to customize plot aesthetics and themes.	**2**	**E**nhance the appearance of their plots using advanced customization techniques.	**3,5**
Practical 4	Implement advanced plotting techniques such as faceting and combining multiple plots.	**2**	**C**reate complex and informative visualizations.	**4,5**
Practical 5	Generate interactive maps with markers and choropleth maps using Folium.	**2**	**V**isualize geospatial data effectively.	**3,4**
Practical 6	Export data visualizations to PNG and PDF formats.	**2**	**S**ave and share their visualizations in different formats.	**3,4**
Practical 7	Create and export multiple graphs in a single 2layout, including subfigures.	**2**	**C**ombine multiple plots into a cohesive visual presentation.	**4,5**
Practical 8	Perform hypothesis testing and implement gradient descent for data analysis.	**2**	**A**pply statistical methods to analyze data.	**3,4**
Practical 9	Generate relational plots such as dist plots, line plots, and lmplot.	**2**	Visualize relationships between variables.	**3,4**
Practical 10	Generate categorical plots such as strip plots, swarm plots, and bar plots.	**2**	Compare categories within the data.	**3,4**
Practical 11	Generate distribution plots such as join plots, dist plots, and pair plots.	**2**	Visualize data distributions and relationships.	**3,4**
Practical 12	Generate regression plots and matrix plots like heatmaps and cluster maps.	**2**	Visualize regression relationships and matrix data.	**3,4**
Practical 13	Customize plot styles, colors, and contexts for various presentation needs.	**2**	Tailor the appearance of their plots for different contexts.	**3,5**
Practical 14	Develop and present interactive dashboards for analyzing datasets.	**2**	Create comprehensive dashboards to analyze and present data.	**4,5,6**
Practical 15	Conduct a case study to demonstrate the application of data visualization techniques to solve an engineering problem.	**2**	Apply visualization techniques to real-world problems.	**4,5,6**

TEXT BOOKS:

T1: Data Visualization with R" by Carson Sievert and Chris Parmer

T2: Python Data Visualization Cookbook" by Igor Milovanović

REFERENCE BOOKS:

R1: Interactive Data Visualization for the Web" by Scott Murray

R2: Storytelling with Data: A Data Visualization Guide for Business Professionals" by Cole Nussbaumer Knaflic.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the significance of data visualization in IT applications and demonstrate basic plotting techniques using ggplot2 and Matplotlib.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
2	Develop advanced customized plots using ggplot2 and create interactive visualizations with Cognos.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
3	Create and export various types of geospatial visualizations using Folium and implement hypothesis and gradient descent in Python.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
4	Construct and customize diverse plots using Seaborn library for relational, categorical, distribution, and regression data.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12
5	Apply data visualization techniques to real-world datasets and create dashboards for comprehensive data analysis in engineering applications.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12

SEMESTER – V									
Course Title	**Computer Communication Network**								
Course code	**23BTCS311R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 41T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Programming Skills**	**Co-requisite**	**LINUX**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the third year of the programme**								
Course Objectives	1. Understand the fundamentals of data communications principles of media access, switching, routing and flow control. 2. Understand the basics of network protocol design and analysis. 3. Be familiar with the TCP/IP protocol suite and with application layer protocols. 4. Be able to write network-capable programs using the socket libraries. 5. Understand the structure of client-server systems and be able to build client-server programs.								
CO1	Understand the basics of data communication, networking, internet, physical layer techniques, and circuit switching.								
CO2	Analyze data link layer techniques, flow control, and error protocols.								
CO3	Analyze network layer protocols along with routing issues.								
CO4	Summarize transport and application layer operations and protocols along with QoS services.								
CO5	Design and execute computer network programming projects, showcasing advanced skills in network application development.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Introduction to networks, internet, protocols and standards, the OSI model, layers in OSI model, TCP/IP suite, Addressing, Analog and digital signals. Physical Layer: digital transmission, multiplexing, transmission media, circuit switched networks, Datagram networks, virtual circuit networks, switch and Telephone network.	**8**	Understand networks, internet protocols, OSI and TCP/IP models, addressing, signal types, physical layer transmission, multiplexing, and various network types.	**1, 2, 3, 4,5**
II	Data link layer: Introduction, Block coding, cyclic codes, checksum, framing, flow and error control, Noiseless channels, noisy channels, HDLC, point to point protocols	**8**	Understand data link layer concepts: block coding, cyclic codes, checksum, framing, flow/error control, noiseless/noisy channels, HDLC, and point-to-point protocols.	**1, 2**
III	Network Layer: Logical addressing, internetworking, tunnelling, address mapping, ICMP, IGMP, forwarding, uni-cast routing protocols, multicast routing protocols.	**9**	Understand network layer concepts: logical addressing, internetworking, tunneling, address mapping, ICMP, IGMP, forwarding, unicast, and multicast routing protocols.	**1, 2**

IV	Transport Layer: Process to process delivery, UDP and TCP protocols, SCTP, data traffic, congestion, congestion control, QoS, integrated services, differentiated services, QoS in switched networks.	**9**	Understand transport layer concepts: process delivery, UDP, TCP, SCTP, data traffic, congestion control, QoS, integrated/differentiated services, and QoS in switched networks.	**1, 2, 3**
V	Application Layer – Domain name space, DNS in internet, electronic mail, FTP, WWW, HTTP, SNMP, multi-media, network security	**7**	Understand application layer concepts: domain name space, DNS, email, FTP, WWW, HTTP, SNMP, multimedia, and network security.	**1, 2**
Practical Component				
Practical 1	Create a diagram of the OSI model and describe the function of each layer.	**3**	Understand the OSI model layers and their functions, essential for network communication.	2
Practical 2	Configure IP addressing for a small network and verify connectivity using network commands.	**3**	Apply IP addressing schemes and verify network connectivity, fundamental for network setup.	3
Practical 3	Analyze and compare analog and digital signals using an oscilloscope.	**3**	Differentiate between analog and digital signals, crucial for understanding data transmission.	4
Practical 4	Implement and test a simple multiplexing scheme using digital signals.	**3**	Implement multiplexing techniques for efficient digital transmission, key in data communication.	3
Practical 5	Implement and test error detection and correction algorithms like CRC and checksum.	**3**	Analyze error detection and correction mechanisms, vital for reliable data communication.	4
Practical 6	Configure and test routing protocols in a simulated network environment.	**3**	Apply routing protocols and address mapping for effective data routing, critical for network layer understanding.	3
Practical 7	Compare the performance of UDP and TCP protocols in a network simulation.	**3**	Evaluate the performance of UDP and TCP protocols, important for transport layer knowledge.	5
Practical 8	Implement QoS mechanisms and analyze their impact on network performance.	**3**	Apply QoS and congestion control techniques for optimal network performance, essential in transport layer	3

			management.	
Practical 9	Configure and test DNS, email, and FTP services on a network.	**3**	Implement application layer services like DNS and FTP, necessary for network functionality.	3
Practical 10	Implement basic network security measures such as firewalls and encryption.	**3**	Apply network security techniques to protect data transmission, crucial for maintaining secure networks.	3

TEXT BOOKS:

T1: Data Communications and Networking – Behrouz A. Forouzan, Fourth Edition TMH,2006.

T2: Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education.

REFERENCE BOOKS:

R1: An Engineering Approach to Computer Networks-S.Keshav,2nd Edition, Pearson Education

R2: Understanding communications and Networks,3rd Edition, W.A.Shay, Cengage Learning.

R3: Computer and Communication Networks,Nader F. Mir, Pearson Education

R4:.Computer Networking: A Top-Down Approach Featuring the Internet, James F.Kurose, K.W.Ross, 3rd Edition, Pearson Education.

OTHER LEARNING RESOURCES:

O1: Udemy: Platforms like Udemy offer courses such as " Cisco CCNA 200-301 " which cover topics like Cisco networking fundamentals, including OSI model, IP addressing, routing protocols, and network security.

O2: edX: Courses like "**Introduction to Computer Networking"** cover topics like fundamental networking concepts, protocols (including TCP/IP), network architecture, and security.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basics of data communication, networking, internet, physical layer techniques, and circuit switching.	PO1, PO2, PO3, PO4, PO5, PO12
2	Analyze data link layer techniques, flow control, and error protocols.	PO1, PO2, PO3, PO4, PO5, PO12
3	Analyse network layer protocols along with routing issues.	PO1, PO2, PO3, PO4, PO5, PO12
4	Summarize transport and application layer operations and protocols along with QoS services.	PO1, PO2, PO3, PO4, PO5, PO12
5	Design and execute computer network programming projects, showcasing advanced skills in network application development.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V										
Course Title	**Data Science & Statistical Modelling**									
Course code	**23BTCS312R**	**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 Technology in Computer Science and Engineering (DS and AI)**									
Semester	**Summer/I semester of the third year of the programme**									
Course Objectives	1. To provide a solid foundation in data science principles and statistical modelling techniques. 2. To equip students with the skills to apply data science tools and statistical models to real-world problems. 3. To develop students' ability to critically analyze data and interpret the results of statistical analyses.									
CO1	Demonstrate the ability to apply data science methods to collect, process, and analyze data									
CO2	Construct and evaluate statistical models to make predictions and inform decision-making.									
CO3	Gain proficiency in using data science tools and software such as Python, R, and SQL.									
CO4	Develop the ability to critically evaluate data sources and statistical results.									
CO5	Effectively communicate data findings and insights through reports and visualizations.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Data Science and Data Handling** Definition and scope of data science Data science process and lifecycle Tools and technologies in data science Data types and sources Data collection methods Data cleaning and preprocessing techniques Handling missing data	**7**	Gain proficiency in data science fundamentals: scope, process, tools, data types, collection methods, cleaning techniques, and handling missing data effectively.	**2,3**
II	**Exploratory Data Analysis (EDA) and Visualization** Descriptive statistics Data visualization techniques using Python (Matplotlib, Seaborn) and R (ggplot2) Identifying patterns and insights Correlation analysis	**8**	Master exploratory data analysis (EDA) by employing descriptive statistics, Python (Matplotlib, Seaborn), and R (ggplot2) for effective data visualization and pattern identification.	**3,4**
III	**Statistical Modelling and Regression Analysis** Probability distributions Hypothesis testing Confidence intervals Simple and multiple linear regression Assumptions and diagnostics Polynomial and logistic regression	**10**	Achieve proficiency in statistical modeling and regression analysis, including probability distributions, hypothesis testing, confidence intervals, and various regression techniques like linear, polynomial, and logistic regression.	**3,4**
IV	**Machine Learning Techniques**	**12**	Develop proficiency in	**3,4**

	Classification techniques (Decision Trees, SVM, k-NN) Clustering techniques (K-means, Hierarchical Clustering) Association rule mining Ensemble methods (Random Forest, Gradient Boosting) Basics of neural networks and deep learning		machine learning techniques including classification (Decision Trees, SVM, k-NN), clustering (K-means, Hierarchical Clustering), association rule mining, and ensemble methods.	
V	**Advanced Topics and Ethics in Data Science** Time series analysis Principal Component Analysis (PCA) Model selection and validation Data privacy and security Ethical implications of data usage Responsible data science practices	**8**	Understand advanced data science topics including time series analysis, PCA, model selection/validation, data privacy/security, ethical implications, and responsible data science practices.	**2, 4**
Practical Component				
Practical 1	Define the scope and lifecycle of a data science project.	**2**	Understand the definition, scope, and lifecycle of data science, foundational for data-driven projects.	2
Practical 2	Install and configure data science tools (Python, R, Jupyter Notebooks).	**2**	Familiarize with essential tools for data science, critical for practical applications.	3
Practical 3	Identify and classify different types of data and sources.	**2**	Understand data types and sources, important for data collection and analysis.	2
Practical 4	Implement data collection from various sources (APIs, web scraping).	**2**	Apply data collection methods for gathering data, crucial for data analysis.	3
Practical 5	Clean and preprocess raw data using Python.	**2**	Perform data cleaning and preprocessing techniques, essential for data quality.	3
Practical 6	Implement techniques to handle missing data in datasets.	**2**	Manage missing data to maintain data integrity, key for accurate analysis.	**3**
Practical 7	Conduct EDA using descriptive statistics and visualization.	**2**	Perform EDA to discover patterns and insights, fundamental for data understanding.	**4**
Practical 8	Create data visualizations using Matplotlib and Seaborn.	**2**	Apply data visualization techniques for effective data presentation, important for analysis.	**3**
Practical 9	Create data visualizations using ggplot2.	**2**	Implement data visualization in R, enhancing data interpretation skills.	**3**
Practical 10	Conduct correlation analysis to identify relationships between	**2**	Analyze variable relationships, essential for statistical analysis.	**4**

	variables.			
Practical 11	Perform simple and multiple linear regression analysis.	**2**	Apply regression techniques to model data relationships, important for predictive analysis.	**3**
Practical 12	Implement probability distributions and hypothesis tests on datasets.	**2**	Understand and apply statistical methods, crucial for data analysis.	**3**
Practical 13	Implement classification algorithms (Decision Trees, SVM, k-NN) on datasets.	**2**	Develop classification models, key for predictive analytics.	**3**
Practical 14	Perform clustering using K-means and Hierarchical Clustering.	**2**	Apply clustering methods to group data, important for unsupervised learning.	**3**
Practical 15	Implement ensemble methods (Random Forest, Gradient Boosting) and basics of neural networks.	**2**	Develop advanced machine learning models, essential for complex data tasks.	**3**

TEXT BOOKS:

T1:"Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani

T2:"Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" by Wes McKinney

REFERENCE BOOKS:

R1:"Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett

R2:"Applied Predictive Modeling" by Max Kuhn and Kjell Johnson

OTHER LEARNING RESOURCES:

O1:Coursera: Offers courses on topics such as Data Science Specialization, Advanced Statistics for Data Science Specialization, and Applied Data Science with Python Specialization.

O2: edX: Provides courses from universities worldwide covering topics like Statistical Learning, Introduction to Computational Thinking and Data Science.

O3: MIT Open Course Ware: Offers courses like Introduction to Probability and Statistics, Data Science and Big Data Analytics.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate the ability to apply data science methods to collect, process, and analyze data	PO1, PO2, PO3, PO4, PO10, PO12
2	Construct and evaluate statistical models to make predictions and inform decision-making.	PO1, PO2, PO3, PO4, PO10, PO12
3	Gain proficiency in using data science tools and software such as Python, R, and SQL.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Develop the ability to critically evaluate data sources and statistical results.	PO1, PO2, PO3, PO4, PO10, PO12
5	Effectively communicate data findings and insights through reports and visualizations.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V									
Course Title	**DE-II: Organizational Behaviour**								
Course code	**23BTCS313R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the third year of the programme**								
Course Objectives	1. Understand individual behaviour in organizations, including diversity, attitudes, job satisfaction, emotions, moods, personality, values, perception, decision making, and motivational theories. 2. Understand group behaviour in organizations, including communication, leadership, power and politics, conflict, and negotiations. 3. Understand the organizational system, including organizational structures, culture, human resources, and change.								
CO1	Understand the impact of environmental factors on Organizational Behavior, applying cognitive processes to enhance understanding.								
CO2	Evaluate environmental factors' impact on organizational behavior, employing cognitive processes.								
CO3	Analyze organizational communication, propose improvements, and apply positive behavior principles.								
CO4	Examine power dynamics, group interactions, and address group dysfunctions adeptly.								
CO5	Apply job design, leadership theories to effectively lead high-performance teams.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to OB** Definition, Nature and Scope– Environmental and organizational context–Impact of IT, globalization, Diversity, Ethics, culture, reward systems and organizational design on Organizational Behavior. Cognitive Processes-I: Perception and Attribution: Nature and importance of Perception – Perceptual selectivity and organization – Social perception – Attribution Theories – Locus of control –Attribution Errors – Impression Management.	**8**	Understand the definition, scope, and impact of environmental factors on organizational behavior, including perception, attribution, and impression management theories.	**1, 2**
II	**Cognitive Processes-II** Personality and Attitudes – Personality as a continuum – Meaning of personality- Johari Window and Transactional Analysis - Nature and Dimension of Attitudes – Jobsatisfactionandorganizationalcommitment- Motivationalneedsandprocesses- Work-MotivationApproachesTheoriesof	**10**	Understand personality, attitudes, job satisfaction, motivation theories, and positive organizational behavior, including emotional intelligence, optimism, and self-efficacy.	**2,3**

	Motivation-Motivationacrosscultures-Positive organizational behavior: Optimism – Emotional intelligence – Self- Efficacy.			
III	**Dynamics of OB-** Dynamics of OB-I-Communication – types – interactive communication in organizations–barriers to communication and strategies to improve the follow of communication - Decision Making: Participative decision-making techniques – creativity and group decision making. Dynamics of OB –II Stress and Conflict: Meaningandtypesofstress–Meaningandtypesofconflict-Effectofstressand intra-individual conflict - strategies to cope with stress and conflict.	**9**	Understand organizational communication, decision-making techniques, and dynamics of stress and conflict, including their types, effects, and coping strategies.	**2,3**
IV	**Dynamics of OB–III** Power and Politics: Meaning and types of power–empowerment-Groups Vs. Teams – Nature of groups – dynamics of informal groups – dysfunctions of groups and teams – teams in modern work place.	**8**	Understand power, politics, empowerment, group dynamics, and team functions, including types of power, group nature, and modern workplace teams.	**2, 3**
V	**Leading High performance** Job design and Goal setting for High performance- Quality of Work Life-Socio technical Design and High-performance work practices – Behavioral performance management: reinforcement and punishment as principles of Learning –Process of Behavioral modification-Leadership theories-Styles, Activities and skills of Great leaders. Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations.	**10**	Achieve proficiency in job design, goal setting, quality of work life, leadership theories, styles, and communication skills in workplace contexts.	**3, 4**

TEXT BOOKS:

T1: Luthans, Fred: Organizational Behaviour10/e,McGraw-Hill,2009
T2: Nelson: Organizational Behaviour,3/e,Thomson, 2008

REFERENCE BOOKS:

R1: NewstromW.John & Davis Keith, Organisational Behaviour—Human Behaviourat Work, 12/e, TMH, New Delhi, 2009.
R2: Pierceand Gardner: Management and Organisational Behaviour: An Integrated perspective, Thomson, 2009.

OTHER LEARNING RESOURCES:

O1:Coursera: Courses such as " Managing the Organization: From Organizational Design to Execution"
O2: edX: Courses such as " Communication Skills and Teamwork"

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the impact of environmental factors on Organizational Behavior, applying cognitive processes to enhance understanding.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
2	Evaluate environmental factors' impact on organizational behavior, employing cognitive processes.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Analyze organizational communication, propose improvements, and apply positive behavior principles.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Examine power dynamics, group interactions, and address group dysfunctions adeptly.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
5	Apply job design, leadership theories to effectively lead high-performance teams.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V										
Course Title	**DE-II: Principles of Management**									
Course code	**23BTCS313R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the third year of the programme**								
Course Objectives	1. To provide students with a comprehensive understanding of the core principles and practices of management. 2. To develop practical management skills applicable to various business environments. 3. To cultivate the ability to critically analyze and solve management problems.								
CO1	Demonstrate a thorough understanding of the fundamental functions of management, including planning, organizing, leading, and controlling.								
CO2	Apply various management theories and concepts to real-world business scenarios.								
CO3	Develop effective decision-making and problem-solving skills.								
CO4	Exhibit strong leadership and communication abilities within a managerial context.								
CO5	Understand and apply ethical principles and social responsibility in management practices.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Management** Definition and significance of management Historical evolution of management theories The role of managers in organizations Managerial skills and competencies	**8**	Understand the definition, evolution, roles, skills, and competencies of management to effectively apply principles in organizational contexts for leadership and efficiency.	**1, 2**
II	**Planning** Nature and purpose of planning Types of plans (strategic, tactical, operational) Planning process and techniques Goal setting and management by objectives (MBO) Decision-making process	**9**	Develop proficiency in planning by understanding its nature, types, process, goal setting, management by objectives, and decision-making techniques for organizational effectiveness.	**3, 4**
III	**Organizing** Organizational structure and design Division of work and departmentalization Authority, responsibility, and delegation Coordination and communication within organizations Organizational culture and change	**9**	Effectively apply organizational theories by understanding structure, division of work, authority, coordination, communication, culture, and change for improved organizational effectiveness.	**3**
IV	**Leading** Leadership theories and styles Motivation theories and techniques	**9**	Develop leadership proficiency by understanding theories, motivation techniques, team	**3, 4**

	Team building and group dynamics Communication skills for managers Conflict resolution and negotiation		dynamics, managerial communication, conflict resolution, and negotiation for effective organizational leadership and management.	
V	**Controlling** The control process and its importance Types of control (feedforward, concurrent, feedback) Performance measurement and management Financial and non-financial controls Managing information and technology in control systems	**10**	Effectively implement control processes by understanding their types, performance measurement, financial and non-financial controls, and information management for organizational performance improvement.	**3, 4, 5**

TEXT BOOKS:

T1: Management: A Practical Introduction" by Angelo Kinicki and Brian Williams

REFERENCE BOOKS:

R1:"Principles of Management" by Charles W. L. Hill and Steven McShane

OTHER LEARNING RESOURCES:

O1:Coursera: Courses such as " Principles of Management" provides an introduction to management principles, covering topics such as planning, organizing, leading, and controlling

O2: edX: Courses such as " Principles of Management" introduces fundamental principles of management, including planning, organizing, leading, and controlling.

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate a thorough understanding of the fundamental functions of management, including planning, organizing, leading, and controlling.	PO1, PO2, PO3, PO4, PO6, PO7, PO10, PO12
2	Apply various management theories and concepts to real-world business scenarios.	PO1, PO2, PO3, PO4, PO6, PO7, PO10, PO12
3	Develop effective decision-making and problem-solving skills.	PO1, PO2, PO3, PO4, PO6, PO7, PO10, PO12
4	Exhibit strong leadership and communication abilities within a managerial context.	PO1, PO2, PO3, PO4, PO6, PO7, PO10, PO12
5	Understand and apply ethical principles and social responsibility in management practices.	PO1, PO2, PO3, PO4, PO6, PO7, PO10, PO12

SEMESTER – V										
Course Title	**PE-II: Data Mining and Analytics**									
Course code	**23BTCS314R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the third year of the programme**								
Course Objectives	This course is an introduction to data mining techniques, algorithms, and applications. Covers data pre-processing, pattern discovery, clustering, classification, and association rule mining. Emphasizes practical implementation and real-world data analysis.								
CO1	Understand diverse real-life data, mastering statistical foundations, and identifying challenges in data mining.								
CO2	Utilize Association Rule Mining to address practical problems, demonstrating understanding and proficiency in application.								
CO3	Apply Cluster analysis in unsupervised learning to real-world datasets, showcasing competence in data clustering techniques.								
CO4	Implement popular methodologies for prediction using Data Mining techniques, demonstrating practical application skills.								
CO5	Implement popular methodologies for prediction using Data Mining techniques, demonstrating practical application skills.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Data Mining:** What is data mining, applications of data mining, issues and challenges faced in data mining, types of data attributes – nominal, binary, ordinal, numeric, discrete and continuous, basic statistical descriptions of data – measures of central tendency and dispersion, major tasks in data pre-processing	**8**	Learning Outcome: Understand data mining concepts, applications, challenges, data attributes, statistical descriptions, and data pre-processing tasks for effective data analysis and decision-making.	**1, 2**
II	**Association Rule Mining:** Definitions of frequent itemset, maximal frequent itemset, closed frequent itemset, association rules, Frequent itemset generation – Apriori algorithm, DIC algorithm and FP-growth algorithm, Generating association rules from frequent item sets	**9**	Learning Outcome: Master association rule mining concepts including frequent itemsets, algorithms (Apriori, DIC, FP-growth), and generating association rules for data pattern discovery.	**3,4**
III	**DataClustering:** what is cluster analysis, need for cluster analysis, data matrix, dissimilarity matrix, proximity and dissimilarity measures for different data attribute types, partitioning based clustering methods, density-based clustering methods and hierarchical clustering methods, measuring cluster quality	**10**	Understand cluster analysis principles, dissimilarity measures, and various clustering methods for effective data segmentation and cluster quality evaluation.	**1, 2**

IV	**Prediction**: What is prediction, application areas of prediction, Simple linear regression, Multiple linear regression, Predictor Error measures, Common techniques for assessing accuracy – holdout, random sampling, cross-validation, bootstrap	**8**	Master prediction concepts, including regression techniques, predictor error measures, and accuracy assessment methods for effective predictive modeling and decision-making.	**2, 3**
V	**Classification**: what is classification, differences between classification and prediction, applications of classification, Some classification algorithms - Decision Trees, Naïve Bayes Classification, Logistic Regression and K-nearest Neighbour Classification, Confusion matrix and metrics for evaluating classifier performance, Overview of ensemble methods – Bagging and Boosting, Ensemble-based classifier - Random Forest	**10**	Understand classification principles, algorithms (Decision Trees, Naïve Bayes, Logistic Regression, K-nearest Neighbor), evaluation metrics, and ensemble methods for effective data classification.	**2, 3, 4**
Practical Component				
Practical 1	Explore what data mining is and its applications.	**3**	Understand data mining and its applications, foundational for data analysis.	**2**
Practical 2	Identify and classify types of data attributes (nominal, binary, ordinal, numeric, discrete, continuous).	**3**	Recognize various data attributes, crucial for data preprocessing.	**2**
Practical 3	Calculate measures of central tendency and dispersion for a dataset.	**3**	Apply statistical measures to summarize data, essential for data analysis.	**3**
Practical 4	Perform major tasks in data preprocessing, including handling missing data and normalization.	**3**	Execute data preprocessing techniques, key for data quality improvement.	**3**
Practical 5	Implement the Apriori algorithm to generate frequent itemsets and association rules.	**3**	Apply Apriori algorithm for association rule mining, critical for pattern discovery.	**3**
Practical 6	Use FP-Growth algorithm to generate frequent itemsets.	**3**	Develop frequent itemsets using FP-Growth, important for efficient pattern mining.	**3**
Practical 7	Perform K-means clustering on a dataset and analyze clusters.	**3**	Apply K-means clustering, essential for grouping similar data points.	**3**
Practical 8	Implement hierarchical clustering and analyze the resulting	**3**	Utilize hierarchical clustering to understand	**3**

	dendrogram.		data structure, crucial for unsupervised learning.	
Practical 9	Implement simple and multiple linear regression models for prediction.	**3**	Develop predictive models using linear regression, fundamental for forecasting.	**3**
Practical 10	Build a decision tree classifier and evaluate its performance.	**3**	Create classification models with decision trees, key for categorical data analysis.	**3**

TEXT BOOKS:

T1: Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, India
T2: AK Pujari, Data Mining Techniques, University Press, India

REFERENCE BOOKS:

R1: Han, Manilla and Smyth, Principles of Data Mining, PHI, India
R2: Tan, Steinbach,Vipin Kumar, Introduction to Data Mining, Pearson Education Inc.

OTHER LEARNING RESOURCES:

O1: Coursera course like "Data Mining Specialization" covers fundamental data mining concepts, techniques, and applications.
O2:edX course like "Data Mining for Business Analytics" covers data mining techniques for business analytics, including data preprocessing, classification, prediction, clustering, association rules, and text mining.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand diverse real-life data, mastering statistical foundations, and identifying challenges in data mining.	PO1, PO2, PO3, PO4, PO10, PO12
2	Utilize Association Rule Mining to address practical problems, demonstrating understanding and proficiency in application.	PO1, PO2, PO3, PO4, PO10, PO12
3	Apply Cluster analysis in unsupervised learning to real-world datasets, showcasing competence in data clustering techniques.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Implement popular methodologies for prediction using Data Mining techniques, demonstrating practical application skills.	PO1, PO2, PO3, PO4, PO10, PO12
5	Implement popular methodologies for prediction using Data Mining techniques, demonstrating practical application skills.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V									
Course Title	**PE-II: Information Retrieval Systems**								
Course code	**23BTCS314R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the third year of the programme**								
Course Objectives	This course provides an in-depth introduction to the principles and practices of Information Retrieval (IR). Students will learn about the theory behind IR systems, the algorithms and techniques used to implement them, and the evaluation methods to measure their effectiveness. Topics covered include text processing, indexing, querying, ranking, and various IR models.								
CO1	Understand the fundamental concepts of Information Retrieval.								
CO2	Learn about various indexing and search techniques.								
CO3	Explore different IR models and their applications.								
CO4	Study the methods of evaluating IR systems.								
CO5	Gain hands-on experience with IR system implementation.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**Introduction to Information Retrieval** ● Course overview and objectives ● History of IR systems ● Applications of IR	**8**	Understand the fundamentals of information retrieval systems, including their history, applications, and objectives for effective information management and retrieval.	**1, 2**
II	**Text Processing and Indexing** ● Text preprocessing: tokenization, stemming, and lemmatization ● Stopword removal and handling special characters ● Inverted index and its construction ● Index compression techniques	**8**	Master text processing techniques including tokenization, stemming, lemmatization, stopwords removal, inverted index construction, and index compression for efficient information retrieval systems.	**2, 3, 4**
III	**Retrieval Models** ● Boolean retrieval model ● Vector space model ● Probabilistic retrieval models	**10**	Understand retrieval models including Boolean, vector space, and probabilistic models for efficient information retrieval and relevance ranking in various contexts.	**2, 3**
IV	**Relevance Feedback and Query Expansion** ● Relevance feedback mechanisms ● Pseudo-relevance feedback	**10**	Master relevance feedback mechanisms, pseudo-relevance feedback, and query expansion techniques to enhance	**3, 4, 5**

	• Query expansion techniques		information retrieval precision and relevance.	
V	**Evaluation of IR Systems** • Evaluation metrics: precision, recall, F-measure, MAP, NDCG • Test collections: TREC, Cranfield paradigm • User studies and A/B testing	**9**	Evaluate information retrieval systems using metrics like precision, recall, F-measure, MAP, NDCG, test collections, and user studies for system improvement.	**4, 5**
Practical Component				
Practical 1	Review course objectives and explore the history of Information Retrieval (IR) systems.	**3**	Understand the fundamentals and evolution of IR systems.	**2**
Practical 2	Investigate various applications of IR in different fields.	**3**	Recognize the diverse applications of IR systems.	**2**
Practical 3	Implement tokenization, stemming, and lemmatization on a text dataset.	**3**	Apply text preprocessing techniques to prepare data for indexing.	**3**
Practical 4	Remove stopwords and handle special characters in a text dataset.	**3**	Clean text data by removing irrelevant components.	**6**
Practical 5	Construct an inverted index for a given text corpus.	**3**	Develop an inverted index to facilitate efficient search and retrieval.	**3**
Practical 6	Implement basic index compression techniques on an inverted index.	**3**	Compress index data to optimize storage and retrieval efficiency.	**3**
Practical 7	Implement Boolean, Vector Space, and Probabilistic retrieval models.	**3**	Apply various retrieval models to query and retrieve relevant documents.	**3**
Practical 8	Implement relevance feedback mechanisms and query expansion techniques.	**3**	Enhance search results using relevance feedback and query expansion.	**3**
Practical 9	Calculate precision, recall, F-measure, MAP, and NDCG for an IR system.	**3**	Evaluate the performance of IR systems using standard metrics.	**5**
Practical 10	Conduct user studies and perform A/B testing for an IR system.	**3**	Assess IR system effectiveness through user studies and A/B testing.	**5**

TEXT BOOKS:

T1: "Introduction to Information Retrieval" by Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze.

REFERENCE BOOKS:

R1: "Modern Information Retrieval: The Concepts and Technology behind Search" by Ricardo Baeza-Yates and Berthier Ribeiro-Neto.

OTHER LEARNING RESOURCES:

O1:TREC (Text REtrieval Conference) datasets and proceedings

O2: Online tutorials and courses (e.g., Coursera, edX)

O3: Software tools and libraries (e.g., Apache Lucene, Solr, Elasticsearch)

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the fundamental concepts of Information Retrieval.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
2	Learn about various indexing and search techniques.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Explore different IR models and their applications.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Study the methods of evaluating IR systems.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
5	Gain hands-on experience with IR system implementation.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V									
Course Title	**PE-III: Machine Learning**								
Course code	**23BTCS315R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the third year of the programme**								
Course Objectives	1. To provide fundamental theoretical foundations knowledge of various learning algorithms 2. Apply suitable machine learning techniques for data handling and knowledge extraction 3. To gain the fundamental knowledge and understand the context of supervised and unsupervised learning through real-life examples 4. Evaluate the performance of algorithms based on corresponding metrics identified and to provide solutions for various real world applications								
CO1	Recognize the characteristics of machine learning strategies								
CO2	Demonstrate proficiency in data analytics and apply advanced tools to work on dimensionality reduction and mathematical operations								
CO3	Analyze and Apply the suitable supervised learning and unsupervised learning methods for real-world problems and for handling unknown patterns								
CO4	Understand the concept of ensemble learning and its applications								
CO5	Evaluate the performance of various algorithms								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Machine Learning** What is Machine Learning?, Types of Machine Learning: Supervised, Unsupervised, and Reinforcement Learning, Applications of Machine Learning in Various Fields	**7**	Gain knowledge of Machine Learning fundamentals, including types (supervised, unsupervised, reinforcement), and applications across diverse fields for practical implementation.	**1, 2**
II	**Data Preprocessing and Exploratory Data Analysis** Data Collection and Cleaning, Handling Missing Values, Feature Scaling and Normalization, Data Visualization Techniques, Exploratory Data Analysis (EDA), statistical measures, Basic tools (plots, graphs and summary statistics) of EDA	**8**	Master data pre processing techniques including collection, cleaning, handling missing values, feature scaling, normalization, visualization, and exploratory data analysis tools.	**3, 4**
III	**Supervised Learning and Unsupervised Learning** Linear and Non-Linear examples – Multi– Class & Multi-Label classification – Linear Density based) - K- Means clustering – KMode clustering –	**12**	Demonstrate proficiency in supervised learning (regression, classification) and unsupervised learning (clustering, dimensionality reduction) algorithms for data analysis and modeling tasks.	**3, 4**

	Self organizing maps – Expectation maximization – Principal Component Analysis			
IV	**Ensemble Learning** Bagging-Committee Machines and Stacking-Boosting-Ranking based aggregation	**8**	Apply ensemble learning techniques such as bagging, boosting, stacking, and ranking for improving predictive model accuracy and robustness.	**3, 4, 5**
V	**Model Evaluation and Optimization** Model Validation Techniques: Train/Test Split, Cross-Validation, Performance Metrics, Confusion Matrix, Accuracy, Precision, Recall, F1-Score	**10**	Effectively evaluate machine learning models using validation techniques like train/test split, cross-validation, and performance metrics (accuracy, precision, recall, F1-score).	**3, 5**

TEXT BOOKS:

T1: S. Shalev-Shwartz, S.Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
T2: Ethem Alpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India,

REFERENCE BOOKS:
R1: Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2nd Edition, 2018.
R2: Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
R3: Data Mining: Concepts and Techniques", Third Edition, 2 Jiawei Han, Micheline Kamber and Jian Pei, ISBN 0123814790,(2011).
R4: Duda, Richard, Peter Hart, and David Stork, "Pattern Classification," 2 nd Edition, John Wiley & Sons, Hoboken, 2000.

OTHER LEARNING RESOURCES:

O1: Coursera provides course like "Machine Learning" that covers a broad introduction to machine learning, data mining, and statistical pattern recognition.
O2:edX provides course like "Machine Learning" that covers the essentials of machine learning, focusing on supervised and unsupervised learning, mathematical and heuristic aspects, and hands-on implementation of algorithms.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recognize the characteristics of machine learning strategies	PO1, PO2, PO3, PO4, PO10, PO12
2	Demonstrate proficiency in data analytics and apply advanced tools to work on dimensionality reduction and mathematical operations	PO1, PO2, PO3, PO4, PO10, PO12
3	Analyze and Apply the suitable supervised learning and unsupervised learning methods for real-world problems and for handling unknown patterns	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Understand the concept of ensemble learning and its applications	PO1, PO2, PO3, PO4, PO10, PO12
5	Evaluate the performance of various algorithms	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V									
Course Title	**PE-III: Cloud Computing**								
Course code	**23BTCS315R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Basic Programming Skills**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the third year of the programme**								
Course Objectives	1. To provide an overview of an exciting field of Cloud Computing 2. To introduce tools requires building, deploying, running and managing applications on a cloud platform. 3. To develop the cloud application development skills, such as Python, REST architecture, JSON, Cloud Foundry and DevOps services 4. To enable students to have skills that will help them to solve complex real-world problems in decision support.								
CO1	Understand fundamental cloud computing concepts and architectures.								
CO2	Analyze and implement RESTful APIs and data services on cloud platforms.								
CO3	Design and deploy cloud applications using IBM Cloud services, including Kubernetes.								
CO4	Develop and deploy applications using Python and related frameworks.								
CO5	Apply advanced cloud concepts and architectures to deploy applications on Kubernetes clusters.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Cloud Computing and IBM Cloud:** Defining cloud computing, Factors leading to cloud adoption, Types of cloud services (IaaS, PaaS, SaaS), Cloud deployment models (Public, Private, Hybrid) Overview of IBM Cloud Creating an IBM Cloud account, Navigating the IBM Cloud dashboard.	**8**	Understand cloud computing concepts, service models, deployment types, and IBM Cloud basics, including account creation and dashboard navigation.	**1, 2**
II	**IBM Cloud Core Services or data services on IBM Cloud:** Watson AI services on IBM Cloud, Introduction to DevOps, Implementing DevOps practices on IBM Cloud, Using IBM Cloud toolchains for DevOps, REST API, Types and capabilities of databases, Apis interaction with Cloudant database.	**8**	Develop proficiency in IBM Cloud core services, Watson AI, DevOps practices, and interacting with databases and APIs on IBM Cloud.	**1, 2, 3**
III	**Application Development on IBM Cloud:** Understanding business problems and goals, Functional and non-functional requirements, IBM		Develop skills in application development on IBM Cloud, including requirements analysis, App ID,	**3, 4**

	Cloud App ID, Container orchestration (Kubernetes), Pods, Deployment, and Service, Cloud Foundry.	**9**	Kubernetes, and Cloud Foundry deployment.	
IV	**Developing Python Applications for the Cloud:** Building Python applications for cloud deployment Integrating popular Python frameworks (Django, Flask) with cloud services Leveraging cloud storage, databases, and AI services with Python Implementing scalability and high availability for Python applications on the cloud	**10**	Develop proficiency in building scalable and high-availability Python applications using frameworks and cloud services.	**2, 3**
V	**Security and Compliance on IBM Cloud:** Overview of IBM Cloud security features, Implementing security best practices on IBM Cloud, Ensuring compliance on IBM Cloud, OAuth protocol.	**10**	Implement IBM Cloud security features, apply best practices, ensure compliance, and use OAuth protocol for secure cloud deployments.	**3, 4, 5**

TEXT BOOKS:

T1: Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood.
T2: Cloud Computing: A Hands-On Approach by Arshdeep Bahga and Vijay Madisetti.
T3: Cloud Native Architectures: Design High-availability and Cost-effective Applications for the Cloud by Tom Laszewski, Kamal Arora, and Erik Farr.

REFERENCE BOOKS:
R1: Cloud Computing Principles and Paradigms by Rajkumar Buyya, James Broberg, and Andrzej Goscinski.
R2: Cloud Computing: Principles, Systems and Applications by Nick Antonopoulos and Lee Gillam..
R3: Data Mining: Concepts and Techniques", Third Edition, 2 Jiawei Han, Micheline Kamber and Jian Pei, ISBN 0123814790,(2011).
R4: Cloud Computing: From Beginning to End by Ray J. Rafaels.

OTHER LEARNING RESOURCES:
O1: Coursera provides several courses like "Cloud Computing Specialization", "AWS Fundamentals Specialization" and "Google Cloud Platform Fundamentals: Core Infrastructure"
O2:NPTEL provides several courses like "Cloud Computing" and "Cloud Computing and Distributed Systems"

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand fundamental cloud computing concepts and architectures.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
2	Analyze and implement RESTful APIs and data services on cloud platforms.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
3	Design and deploy cloud applications using IBM Cloud services, including Kubernetes.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Develop and deploy applications using Python and related frameworks.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
5	Apply advanced cloud concepts and architectures to deploy applications on Kubernetes clusters.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – V									
Course Title	**Field-Based Training**								
Course code	**23BTCS317R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: NA	**0**	**0**	**0**	**0**	**0**	**16**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the third year of the programme**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings. 4. To foster collaboration and communication skills through group projects and professional interactions. 5. To cultivate an appreciation for the complexities and challenges of professional practice in the field.								
CO1	Apply theoretical concepts to real-world situations.								
CO2	Conduct field-based research and gather data effectively.								
CO3	Analyze and interpret the university data to draw meaningful conclusions.								
CO4	Communicate findings clearly and effectively, both orally and in writing.								
CO5	Demonstrate professional behavior and teamwork skills in field settings.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	The organization will provide the students one field visit for this program. The students will be taken to a specific blocks of the university for learning purposes. The students will visit all department block site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners of IT department of the university. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial findings.	**16**	Gain practical insights and document observations through field visits, professional interactions, and reflective journaling for comprehensive learning.	**3, 4**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply theoretical concepts to real-world situations.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
2	Conduct field-based research and gather data effectively.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
3	Analyze and interpret the university data to draw meaningful conclusions.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
4	Communicate findings clearly and effectively, both orally and in writing.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
5	Demonstrate professional behavior and teamwork skills in field settings.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12

SEMESTER – V									
Course Title	**Summer Internship**								
Course code	**23BTCS318R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: NA	**0**	**0**	**0**	**0**	**0**	**16**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the third year of the program**								
Course Objectives	1. Equip students with practical experience in their field of study, ensuring they are prepared to transition smoothly into industry roles by mastering modern tools, technologies, and industry-standard practices. 2. Enhance students' soft skills, including presentation, interpersonal communication, and documentation, as well as office etiquette, to ensure they can effectively navigate and contribute to professional environments. 3. Foster a deep understanding of professional and ethical responsibilities in engineering, encouraging students to adhere to industry best practices, processes, and regulations. 4. Promote the ability to work effectively in teams, especially within multidisciplinary contexts, emphasizing collaboration, communication, and the integration of diverse perspectives and expertise. 5. Cultivate a professional work ethic characterized by productivity, consistency, and punctuality, preparing students to meet the demands and expectations of the industry.								
CO1	Apply modern tools and technologies in real-world scenarios to solve complex engineering problems.								
CO2	Analyse industry-standard reporting methods to produce technical documents adhering to professional guidelines.								
CO3	Develop solutions using design, development, and testing practices aligned with current industry standards.								
CO4	Demonstrate effective communication, teamwork, and interpersonal skills in a multi-disciplinary team environment.								
CO5	Evaluate professional and ethical responsibilities to make informed decisions in engineering practices.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Method and Pedagogy: ● Summer internship shall be at least 90 hours during the Summer vacation only. ● Department/Institute will help students to find an appropriate company/industry/organization for the Summer internship. ● The student must fill up and get approved a Summer Internship Acceptance form by the company and provide it to the Coordinator of the department within the specified deadline. ● Students shall commence the internship after the approval of the department Coordinator.	**90**	Complete a 90-hour Summer internship, submit an internship report, and demonstrate practical industry experience through documentation and evaluation.	**3, 4, 5**

	Summer internships in research centers is also allowed. ● During the entire period of internship, the student shall obey the rules and regulations of the company/industry/organization and also those of the University. ● Due to inevitable reasons, if the student will not able to attend the internship for few days with the permission of the supervisor, the department Coordinator should be informed via e-mail and these days should be compensated later. ● The student shall submit two documents to the Coordinator for the evaluation of the Summer internship: a) Summer Internship Report b) Summer Internship Assessment Form ● Upon the completion of Summer internship, a hard copy of "Summer Internship Report" must be submitted to the Coordinator by the first day of the new term. ● The report must outline the experience and observations gained through practical internship, in accordance with the required content and the format described in this guideline. Each report will be evaluated by a faculty member of the department on a satisfactory/unsatisfactory basis at the beginning of the semester. ● If the evaluation of the report is unsatisfactory, it shall be returned to the student for revision and/or rewriting. If the revised report is still unsatisfactory the student shall be requested to repeat the Summer internship.			

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply modern tools and technologies in real-world scenarios to solve complex engineering problems.	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO12
2	Analyse industry-standard reporting methods to produce technical documents adhering to professional guidelines.	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO12
3	Develop solutions using design, development, and testing practices aligned with current industry standards.	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO12
4	Demonstrate effective communication, teamwork, and interpersonal skills in a multi-disciplinary team environment.	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO12
5	Evaluate professional and ethical responsibilities to make informed decisions in engineering practices.	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO10, PO12

SEMESTER – V									
Course Title	**Extra - Curricular Activities**								
Course code	**23UBEC311**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 36	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the third year of the program**								
Course Objectives	It is to develop the social and soft skills and to promote a holistic development of the learners								
CO1	Learn to a plan so that they can make meaningful contributions, maintain a commitment, and manage their time and priorities.								
CO2	Transform passionate students who demonstrate leadership and pursue interests beyond their academics.								
CO3	Learn to participate in various co-curricular activities leading to their multifaceted personality development.								
CO4	Express their ideas, views, In-depth evaluation and analysis clearly in the topic of their interest.								
CO5	Demonstrate and practices different activities, by Integrating learning experiences by demonstrating transferable skills.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	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 to the learners, Keeping in mind the3 60 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 the platform to learn from experts in the respective fields.	**36**	Engage in various extracurricular activities to develop social and soft skills, enhancing holistic development through club participation, workshops, and competitions.	**3, 5**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	It is to develop the social and soft skills and to promote a holistic development of the learners	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
2	Learn to a plan so that they can make meaningful contributions, maintain a commitment, and manage their time and priorities.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
3	Transform passionate students who demonstrate leadership and pursue interests beyond their academics.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
4	Learn to participate in various co-curricular activities leading to their multifaceted personality development.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12
5	Express their ideas, views, In-depth evaluation and analysis clearly in the topic of their interest.	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO12

SEMESTER – V									
Course Title	**Mini Project III**								
Course code	**23BTCS316R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: NA	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the third year of the programme**								
Course Objectives	1. To develop the knowledge, skills and attitudes of a professional Computer engineering professional. 2. To become confident in designing engineering solutions to complex software problems utilising a systems approach.								
CO1	Apply IT principles for real-world problem-solving using programming languages and network solutions.								
CO2	Contribute to complex projects as a team member, demonstrating effective personal and team management.								
CO3	Develop programming skills to create and assess software, hardware, and network solutions.								
CO4	Apply personal and team management skills as a professional software developer								
CO5	Cultivate employability skills and uphold professionalism in software development.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: o theoretical studies o computer simulations o hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project; 4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field; 5. Prepare a formal report describing the work undertaken and results obtained so far; and Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.		Conduct a research project involving literature review, technical work, progress reporting, seminar delivery, and formal presentation under academic supervision.	**3, 4, 5, 6**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply IT principles for real-world problem-solving using programming languages and network solutions.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
2	Contribute to complex projects as a team member, demonstrating effective personal and team management.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
3	Develop programming skills to create and assess software, hardware, and network solutions.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
4	Apply personal and team management skills as a professional software developer.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
5	Cultivate employability skills and uphold professionalism in software development.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

SEMESTER – V									
Course Title	**Predictive Analysis**								
Course code	**22BTCS317R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45P + 30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the third year of the program**								
Course Objectives	1. To familiarize the students with various Statistical Data Analysis tools 2. Tools that can be used for effective decision making. 3. Provide students with the knowledge to apply predictive analytics techniques to solve practical business problems and improve decision-making processes.								
CO1	Understand and critically apply the concepts and methods of Predictive analytics.								
CO2	Understand and apply IBM SPSS Modeller in Data Mining, what kinds of data can be mined, what kinds of patterns can be mined.								
CO3	Applying and analysing how to use functions, deal with missing values, use advanced field operations, handle sequence data and improve efficiency.								
CO4	Get exposed to the testing of hypothesis and solving assumptions								
CO5	Understanding of IBM Watson Studio with Machine Learning Model.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**ANALYTICS OVERVIEW** What is Predictive Analysis, how predictive model works, why predictive modeling, what are the models in Predictive Analysis. How Predictive analytics: Transforming data into future insights, Analytics trends: Past, Present & Future, Towards a Predictive enterprise.	**7**	Understand basic analytics concepts and applications in business contexts.	1,2,3
II	**Statistical Analysis** Define Statistics and its types, Measures of Central Value; Mean, Median and Mode, Measures of Dispersion: Absolute and Relative measures of dispersion - Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation, Moments, Skewness, Kurtosis.	**8**	Understand fundamental statistical concepts, techniques, and their applications in data analysis to derive insights and support decision-making.	2,3,4
III	**DATA MINING** What is a Data Mining applications? Strategy for data mining: CRISP-DM, Steps of Data Mining, Stages and tasks in CRISP-DM, Life Cycle of a Data Mining Project, Skills Needed for Data Mining. Identify nodes and streams, The framework of a Data – mining project, Brief the unit of analysis, Explain the type of dialog box.	**10**	Understand data mining concepts, algorithms, and their applications to extract patterns and knowledge from large data sets.	2, 3, 4

IV	**UNIT OF ANALYSIS** Concepts of Unit of analysis (Distinct, Aggregate, SetToFlag), Integrate data, CLEM Expression, Role of Relationship between two fields, Identifying the modeling objective.	**12**	Understand the concept and importance of the unit of analysis in research and data analysis.	2,3, 4
V	**PREDICTIVE ANALYTICS WITH IBM WATSON STUDIO** Understanding of IBM Cloud, IBM Watson Studio, Watson studio Components, Creating a Machine Learning Model, Data preparation, Watson Machine learning, Data Refinery, Watson Studio Neural Network Modeler, IBM Watson Studio jobs, Use case with AutoAI.	**8**	Understand predictive analytics concepts and IBM Watson Studio features for building predictive models. (2 - Understand). Apply IBM Watson Studio tools to develop and deploy predictive models effectively	2, 3, 4
Practical Component				
Practical 1	Introduction to Predictive Analysis	3	Explain the concept of predictive analysis and its importance in decision-making.	2
Practical 2	Predictive Modeling	**3**	Describe how predictive models work and their applications in various domains.	2
Practical 3	Analytics Trends Over Time	3	Analyze past, present, and future trends in analytics and their impact on business strategies.	4
Practical 4	Measures of Central Tendency	**3**	Compute and interpret mean, median, and mode for a dataset.	3
Practical 5	Measures of Dispersion	3	Calculate and compare measures of dispersion such as range, standard deviation, and coefficient of variation.	4
Practical 6	Skewness and Kurtosis Analysis	**3**	Evaluate skewness and kurtosis to understand the shape and distribution of data.	3
Practical 7	CRISP-DM Framework Overview	3	Outline the stages and tasks in the CRISP-DM framework for data mining projects.	3
Practical 8	Experiment: Data Mining Project Life Cycle	**3**	Apply the stages of a data mining project life cycle to a practical case study.	4
Practical 9	Data Preparation Using Watson Studio	3	Utilize IBM Watson Studio's Data Refinery for	3

			data preparation tasks like cleaning and feature engineering.	
Practical 10	Utilize IBM Watson Studio's Data Refinery for data preparation tasks like cleaning and feature engineering.	**3**	Differentiate between distinct, aggregate, and SetToFlag units of analysis in data mining contexts.	4

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand and critically apply the concepts and methods of Predictive analytics.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
2	Understand and apply IBM SPSS Modeller in Data Mining, what kinds of data can be mined, what kinds of patterns can be mined.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
3	Applying and analysing how to use functions, deal with missing values, use advanced field operations, handle sequence data and improve efficiency.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
4	Get exposed to the testing of hypothesis and solving assumptions	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
5	Understanding of IBM Watson Studio with Machine Learning Model.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12

SEMESTER – VI										
Course Title	**Web Technologies**									
Course code	**23BTCS321R**	**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 Technology in Computer Science and Engineering (DS and AI)**									
Semester	**Winter/ II semester of the third year of the programme**									
Course Objectives	1. To make a student familiar with client server architecture. 2. To teach developing a web application using various technologies. 3. To make the students learn the skills and project-based experience needed for entry into web application and development careers..									
CO1	Learn about Internet and Web Page Design.									
CO2	Understand detailed concepts on Web Browsers, Markup Language Basics and XML.									
CO3	Learn basic concepts of client side programming									
CO4	Learn detailed concepts on Web Server Side technologies.									
CO5	Understand few advanced Web Technologies and the Web Security.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**An Introduction to Web Technology** History of web Development, Time line, Motivation, Categories of Web Applications, Characteristics of Web Applications. Evolution and Need for Web Engineering, Web Engineering Models, Software Engineering v/s Web Engineering . World Wide Web: Introduction to TCP/IP and WAP, DNS, Email, TelNet, HTTP and FTP. Introduction to Browser and search engines, Search fundamentals, Search strategies, Directories search engines and Meta search engines, Working of the search engines , Miscellaneous Web Browser details, Introduction to Web Servers: Features of web servers, caching, case study-IIS, Apache,Configuring web servers	**8**	To understand web development basics, HTML, CSS, JavaScript, client-server architecture, and create simple web applications.	**1,2,3**
II	**Technologies for Web Applications** HTML and DHTML, HTML Basic Concepts, Static and dynamic HTML, Structure of HTML documents, HTML Elements, Linking in HTML, Anchor Attributes, Image Maps, Meta Information, Image Preliminaries, Layouts, Backgrounds, Colors and Text, Fonts, Tables, Frames and layers, Audio and Video Support with HTML Database integration, CSS, Positioning with Style sheets, Forms Control, Form. Elements. Introduction to CGI PERL, JAVA SCRIPT, ASP,	**10**	To master the advanced web technologies, frameworks, APIs, databases, and develop complex, scalable web applications with robust functionality.	**3,4**

	Cookies Creating and Reading Cookies. Introduction of XML, Validation of XML documents, DTD, Ways to use XML, XML for data files, HTML Vs XML, Embedding XML into HTML documents, Converting XML to HTML for Display, Displaying XML using CSS and XSL, Rewriting HTML as XML, Relationship between HTML, SGML and XML			
III	**Client Side Programming** Document Object Model (DOM),Overview of DOM, Jquery: ,Element Selector Document ready function, Events ,Ajax call ,plugins: Using JQuery UI ,Unobtrusive client validation ,JQuery templates ,Feature detection: Browser detection ,Feature detection ,Modernizer , polyfills. Introduction to AJAX, Overview of Traditional Web Communication Processes and Technologies, Interacting with the Web Server Using the XMLHttpRequest , Create an XMLHttpRequest Object Interact with the Web Server Working with PHP and AJAX: Introduction Process Client Requests Accessing Files Using PHP Applying Basic AJAX Techniques: Introduction Download Images Using AJAX Auto, Populate Select Boxes, Implementing Security and Accessibility in AJAX Applications: production, Secure AJAX Applications Accessible Rich Internet Applications	**10**	To learn JavaScript, DOM manipulation, event handling, form validation, AJAX, and create interactive, responsive web interfaces.	**3,4**
IV	**Server Side Programming** J2SE:Data Types, Arrays, Type Casting, Classes and Objects, Inheritance, Interfaces, Exception Handling, Multithreading,J2EE as a framework, Client Server Traditional model, Comparison amongst 2-tier, 3-tier and N-tier Architectures, Thin and Thick Clients. J2EE Servlet 2.x Specification, Writing small Servlet Programs, Deployment Descriptor, Inter Servlet Collaboration, Session: Definition, State on web, Different ways to track sessions,	**9**	To understand server-side scripting, databases, authentication, RESTful APIs, server deployment, and build dynamic, data-driven web applications.	**4**

	JSP Technology Introduction-JSP and Servlets- Running JSP Applications Basic JSP- JavaBeans Classes - Support for the Model- View-Controller Paradigm- Case Study- Related Technologies.			
V	**Advanced Web Technologies and Web Security** Exposure to Advanced Web Technologies: Distributed Object based models- DCOM, CORBA, EJB; Web services and Related Technologies- ISAPI, SOAP, UDDI, WSDL; Other Advanced Web Technologies- AJAX, ISAPI, .NET. Web Security: Firewalls- definition and uses, network layer firewalls and application layer firewalls; Proxy servers, HTPS for secure web communication.	**8**	To explore advanced web frameworks, progressive web apps, web security principles, encryption, and secure web application development practices.	**4**
Practical Component				
Practical 1	Identify common HTML tags and their functions.	2	Identify and label common HTML tags and understand their basic functions in web development.	**5**
Practical 2	Match CSS properties to their effects.	2	To match CSS properties to their corresponding effects, enhancing their understanding of CSS styling.	**5**
Practical 3	Create a concept map of basic JavaScript concepts.	2	To create a concept map, demonstrating their understanding of basic JavaScript concepts and their interrelationships.	**5**
Practical 4	Explain the structure of a basic web page.	2	analyze and explain the structure and purpose of different sections in a basic web page.	**5**
Practical 5	Use HTML and CSS to create a simple web page.	2	Use HTML and CSS to create a functional web page with various elements and styles.	**5**
Practical 6	Implement basic form validation using JavaScript.	2	implement JavaScript to perform basic form validation, ensuring proper data entry before submission.	**5**
Practical 7	Evaluate the responsiveness of a web page.	2	evaluate a web page's responsiveness, identifying areas for improvement	**5**

			using developer tools.	
Practical 8	Analyze the performance of a web page.	2	To analyze web page performance, using tools to identify and suggest solutions for performance bottlenecks..	**5**
Practical 9	Conduct a usability test on a web application..	2	Conduct and analyze usability tests, making recommendations to improve web application user experience.	**5**
Practical 10	Review and evaluate the quality of web code.	2	Review and evaluate web code quality for readability, efficiency, and best practices adherence.	5
Practical 11	Create a web application using HTML, CSS, and JavaScript.	2	Design and build a dynamic web application using HTML, CSS, and JavaScript.	6
Practical 12	Develop a custom CSS framework.	2	To develop a reusable custom CSS framework for use in various web development projects.	6
Practical 13	Develop a single page application using a JavaScript framework (e.g., React or Vue.js).	2	To create a SPA using a JavaScript framework, integrating dynamic content through API interactions.	6
Practical 14	Design and implement a RESTful API.	2	To design and implement a RESTful API using Node.js and Express, connecting it to a front-end..	6
Practical 15	Develop an interactive data dashboard.	2	develop interactive dashboards to visualize and explore data insights dynamically..	6

Text Book:

T1: Web Technologies: HTML, Javascript, PHP, Java, JSP, XML and AJAX, Black Book,Kogent Learning Solutions Inc., 1st Edition, 2009, Dreamtech Press.

T2: Web Technologies, Uttam K. Roy, 1st Edition, 2010, Oxford Publications.

Reference Books:

R1: N. P. Gopalan and J. Akilandeswari,Web Technology: A Developer's Perspective,1st Edition, 2014,Prentice-Hall of India Pvt. Ltd.

R2: Jeffrey C. Jackson,Web Technologies: A Computer Science Perspective, 1st Edition, 2008, Pearson Education India.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Learn about Internet and Web Page Design.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
2	Understand detailed concepts on Web Browsers, Markup Language Basics and XML.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
3	Learn basic concepts of client side programming	CO1, CO2, CO3, CO4, CO5, CO10, CO12
4	Learn detailed concepts on Web Server Side technologies.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
5	Understand few advanced Web Technologies and the Web Security.	CO1, CO2, CO3, CO4, CO5, CO10, CO12

SEMESTER – VI									
Course Title	**Formal Language &Automata Theory**								
Course code	**23BTCS322R**	**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**	**Linux**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the third year of the programme**								
Course Objectives	1. To gain a solid understanding of formal languages, grammars, automata, and their theoretical foundations in computer science. 2. Learn to design, analyze, and compare different computational models such as finite automata, pushdown automata, and Turing machines. 3. Develop skills to apply formal methods and automata theory concepts to solve complex problems in language processing, compiler design, and algorithm development.								
CO1	Understand the fundamental characteristics of formal languages and formal grammars, showcasing foundational linguistic knowledge.								
CO2	Recognize the similarity between deterministic and non-deterministic finite automata, demonstrating comparative analysis skills.								
CO3	Evaluate the minimization processes of both deterministic and non-deterministic finite automata, applying critical thinking skills.								
CO4	Analyze the resemblance between non-deterministic push-down automata and context-free grammars, demonstrating advanced understanding and synthesis of concepts.								
CO5	Examine the fundamental characteristics of Turing machines and their computational applications, showcasing analytical skills in computing theory.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction** Definitions: Language, Grammar, Automata, Relation between language, Grammar and automata, Importance of automata theory. **Finite Automata (FA)** Introduction of FA and its example. DFA: Definition, Processing strings, Transition functions, Language of a DFA, NDFA: Non-determinism, Definition, Processing strings, Extended transition functions, Language of a NFA, Kleene's theorem, Epsilon transitions, Applications of FA in text search.	**8**	To grasp finite automata theory, design deterministic/nondeterministic automata, understand regular languages, and apply these concepts to problem-solving.	**1, 2,3**
II	**Regular expressions and regular languages** Memory required to recognize a language, Regular expressions, Regular expression to finite automata & vice versa, Algebraic laws for regular expressions, Applications of regular expressions, Criterion for regularity, Regular languages, Properties of	**8**	learn to construct and interpret regular expressions, understand regular languages, and apply these concepts to pattern matching.	**2,3**

	Regular languages			
III	**Context Free Grammars and Languages** Definition, Left most and right most grammars, Parse trees, Ambiguity: Ambiguous grammar, Removing ambiguity, Normal forms, Applications of context free grammars: Parsers	**10**	To comprehend context-free grammars, parse trees, Chomsky hierarchy, and apply these concepts to analyze and generate context-free languages.	**2,4**
IV	**Pushdown automata (PDA) and context free languages (CFL)** Definition & representation of pushdown automata, Acceptance by PDA: By final state, By empty stack, Deterministic PDA, Equivalence of PDA and CFL, Pumping Lemma for CFL Closure properties of CFL, Testing membership of context free, Decision problems for CFLs.	**10**	To master pushdown automata theory, understand context-free languages, parse trees, and apply these concepts to language recognition and parsing.	**2,3**
V	**Turing machines** Definition, Language of a Turing machine, Programming Turing machines, The Church-Turing thesis, A simple programming language, Extensions of the basic Turing machine. **Recursively enumerable languages & Undesirability** The halting problem, The post correspondence problem, Time and space complexity of Turing machines, Complexity classes	**9**	To grasp Turing machine theory, recursively enumerable languages, undecidability, and apply these concepts to analyze computability and algorithmic problems.	**2,3,4**

Text Books:

1. John. E. Hopcroft, Rajeev Motwani, Jeffry Ullman,‖ Introduction to Automata Theory, Languages and Computation‖, Pearson Education.
2. John Martin,―Introduction to Languages and the Theory of Computation, Tata McGraw Hill

Reference Books:

1. Adesh K. Pandey,―An Introduction to Automata Theory & Formal Languages‖, Katson Books.
2. Peter Linz,―An Introduction to Formal Languages and Automata‖, Narosa.
3. Zvi Kohavi and Niraj K. Jha,―Switching and Finite Automata Theory‖, Tata McGraw Hill.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the fundamental characteristics of formal languages and formal grammars, showcasing foundational linguistic knowledge.	CO1, CO2, CO3, CO10, CO12
2	Recognize the similarity between deterministic and non-deterministic finite automata, demonstrating comparative analysis skills.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
3	Evaluate the minimization processes of both deterministic and non-deterministic finite automata, applying critical thinking skills.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
4	Analyze the resemblance between non-deterministic push-down automata and context-free grammars, demonstrating advanced understanding and synthesis of concepts.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
5	Examine the fundamental characteristics of Turing machines and their computational applications, showcasing analytical skills in computing theory. .	CO1, CO2, CO3, CO4, CO5, CO10, CO12

SEMESTER – VI									
Course Title	**DE-III: Positive Psychology**								
Course code	**23BTCS323R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the third year of the programme**								
Course Objectives	1. To introduce students to the core concepts, theories, and research findings in positive psychology. 2. To equip students with skills to apply positive psychology principles and interventions in personal and professional settings. 3. To foster an understanding of how positive psychology can contribute to enhancing individual and community well-being, resilience, and flourishing.								
CO1	Understand psychology's impact on personal and work success.								
CO2	Infer about hope, optimism, positive illusions, and playfulness.								
CO3	Summarize creativity, giftedness, judgment, wisdom, emotional intelligence.								
CO4	Discuss spirituality, love, kindness, gratitude, zest, modesty, forgiveness								
CO5	Generalize altruism, empathy, social intelligence, positive psychology at work								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Positive Psychology** Define positive psychology and its key concepts, understand the history and evolution of positive psychology, explore theories and research in positive psychology, analyze the role of positive emotions in well-being, apply positive psychology principles to personal and professional contexts.	**8**	To grasp positive psychology principles, apply interventions for well-being, cultivate strengths, foster relationships, and pursue meaningful, fulfilling lives.	**2**
II	**The Science of Happiness** Examine theories of happiness and subjective well-being, identify factors influencing happiness and life satisfaction, learn strategies for cultivating positive emotions, understand the importance of gratitude and resilience in happiness,apply happiness-boosting techniques to enhance well-being.	**8**	To comprehend happiness theories, identify factors influencing well-being, cultivate positive emotions, practice gratitude, and apply happiness-boosting strategies effectively.	**2,3**
III	**Resilience and Positive Coping** Define resilience and its significance in psychological well-being, explore resilience-building techniques and coping strategies, understand the role of optimism and growth mindset in resilience, identify personal strengths and resources for coping with adversity, apply resilience strategies to navigate challenges effectively.	**10**	Understand resilience concepts, develop coping strategies, foster optimism, leverage strengths, and effectively navigate challenges with resilience and adaptability.	**2,4**
IV	**Strengths and Virtues** Identify personal strengths using	**10**	To identify personal strengths, understand	**2,3**

	assessments like VIA Survey, understand the concept of character strengths and virtues, explore the benefits of applying strengths-based approaches, learn to leverage strengths for personal development and goal attainment, apply strengths-based interventions to enhance performance and well-being.		virtues, apply strengths-based approaches, leverage strengths for growth, and enhance well-being and performance.	
V	**Positive Relationships and Meaningful Living** Understand the importance of positive relationships in well-being, learn communication and conflict resolution skills for building positive relationships, explore research on meaning and purpose in life, identify sources of meaning and cultivate a sense of purpose, apply strategies for fostering positive connections and living a meaningful life.	**9**	To cultivate positive connections, develop communication skills, explore sources of meaning, foster purpose, and lead fulfilling lives through meaningful engagement.	**2,4**

Text Books:

1. Schultz, D.&Schultz, S. E. (2009). Psychology and Work Today (10thed.).New Jersey: Pearson/Prentice Hall.
2. Butcher, J. N., Mineka, S., & Hooley, J.M. (2010). Abnormal psychology(14thed.).

Reference Books:

1. New Aronson, E., Wilson, T. D., & Akert, R. M. (2010). Social Psychology (7thEd.). Upper Saddle River, NJ: Prentice Hall.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand psychology's impact on personal and work success.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO10, CO12.
2	Infer about hope, optimism, positive illusions, and playfulness.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO10, CO12.
3	Summarize creativity, giftedness, judgment, wisdom, emotional intelligence.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO10, CO12.
4	Discuss spirituality, love, kindness, gratitude, zest, modesty, forgiveness	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO10, CO12.
5	Generalize altruism, empathy, social intelligence, positive psychology at work	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO10, CO12.

SEMESTER – VI									
Course Title	**DE- III: Economics for Engineers**								
Course code	**23BTCS323R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the third year of the programme**								
Course Objectives	1. Introduce engineering students to fundamental economic concepts, such as supply and demand, cost analysis, and market structures. 2. Equip engineering students with the skills to apply economic analysis techniques to engineering projects, resource allocation, and decision-making. 3. Facilitate the integration of engineering and economic perspectives to address real-world challenges and optimize engineering solutions.								
CO1	Understand the key distinctions between macroeconomics and microeconomics, applying the laws of demand and supply.								
CO2	Analyze economic indexes such as GNP, NNP, GDP, and NDP, along with cost concepts and break-even analysis.								
CO3	Apply statistical measures, probability distributions, and hypothesis testing in analyzing industrial data.								
CO4	Interpret and apply industrial laws related to industrial relations, disputes, health, safety, and compensation management.								
CO5	Evaluate challenges in the Indian economy, including poverty alleviation programs, human capital formation, employment dynamics, and sustainable economic development.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introductory Macroeconomics**: What is Macroeconomics, Basic concepts in Macroeconomics: significance of economics, LPG meaning, demand and supply. Law of demand, law of supply. Difference of macroeconomics and microeconomics.	**8**	Understand macroeconomic principles, analyze economic indicators, evaluate policy impacts, comprehend global economic interdependencies, and make informed economic decisions.	**1,2**
II	**Economic Indexes**: Aggregates related to National Income: Gross National Product (GNP), Net National Product (NNP), Gross Domestic Product (GDP) and Net Domestic Product (NDP). Fixed, Variable, Marginal & Average Costs, Recurring and Nonrecurring Costs, Break Even Analysis, ROI, Payback period	**8**	Interpret economic indexes, analyze trends, assess economic health, predict market movements, and make informed decisions based on index data.	**2,3**
III	**Industrial Statistics**: Measures of central tendency, Relation between mean, median and mode, Measure of dispersion, moments, skewness, Kurtosis, Probability distribution,	**10**	To apply statistical methods in industrial settings, analyze production data, improve processes, ensure quality,	**2,3**

	Binomial distribution, Poisson distribution, Test of hypothesis, Chi-square distribution, application of chi square test, ANOVA test, Level of confidence, Regression model, Simple linear regression analysis, coefficient of correlation, correlation coefficient, Mean absolute deviation (MAD), Mean squared error (MSE)		and optimize resource utilization.	
IV	**Industrial laws:** Laws related to Industrial Relations and Industrial Disputes: Industrial disputes act, 1947: definition and authorities, awards, settlement, strike lockouts, lay off, retrenchment and closure. The Trade Union Act, 1926, Laws related to health, safety and welfare**:** The Workmen's Compensation Act, 1923 Provisions, and Social Legislation: Employee State Insurance Act 1948: Definition, employees' provident fund. Miscellaneous Provision Act 1948: Schemes, Administration and determination of dues, Laws related to compensation management: The payment of Wages Act 1948: Objectives, Definition,and Authorised Deductions.	**10**	Understand industrial regulations, employment laws, safety standards, resolve disputes, ensure compliance, and promote fair labor practices in workplaces.	**2,3**
V	**Challenges in Indian Economy:** Poverty- Main programmes for poverty alleviation, Human Capital Formation: How people become resource; Role of human capital in economic development; alternative farming - organic farming Employment: Growth and changes in work force participation rate in formal and informal sectors; Energy and Health: Sustainable Economic Development: Meaning, Effects of Economic Development on Resources and Environment, including global warming.	**9**	analyze structural issues, policy challenges, economic disparities, unemployment, inflation, and explore strategies for sustainable growth in the Indian economy.	**2,3, 4**

Text Books:

1. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia
2. V.Mote, S.Paul, G.Gupta(2004), Managerial Economics, Tata McGraw Hill

Reference Books:

1. M Chakravarty, Estimating, Costing Specifications & Valuation Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the key distinctions between macroeconomics and microeconomics, applying the laws of demand and supply.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
2	Analyze economic indexes such as GNP, NNP, GDP, and NDP, along with cost concepts and break-even analysis.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
3	Apply statistical measures, probability distributions, and hypothesis testing in analysing industrial data.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
4	Interpret and apply industrial laws related to industrial relations, disputes, health, safety, and compensation management.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
5	Evaluate challenges in the Indian economy, including poverty alleviation programs, human capital formation, employment dynamics, and sustainable economic development.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.

SEMESTER – VI										
Course Title	**PE-IV: Foundations of Data Science**									
Course code	**23BTCS324R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+ 30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Mathematics and Statistics, Programming**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the third year of the programme**								
Course Objectives	1. Develop Proficiency in Key Data Science Tools and Programming Languages. 2. Understand and Apply Fundamental Statistical and Machine Learning Methods. 3. Cultivate Critical Thinking and Problem-Solving Skills in a Data-Driven Context.									
CO1	Acquire foundational knowledge in data science.									
CO2	Understand and apply various data analytics techniques.									
CO3	Apply advanced tools to work on dimensionality reduction and mathematical operations.									
CO4	Manage diverse data types and employ programming for knowledge representation through visualization.									
CO5	Demonstrate numerous open source data science tools to solve real-world problems through industrial case studies.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Foundations of Data Science:** Overview of data science, its significance, and application across various sectors. Introduction to the data science workflow: data collection, cleaning, analysis, and visualization.	**8**	Grasp foundational concepts in data science, acquire programming skills, analyze data, and communicate findings effectively using statistical methods.	**1, 2**
II	**Statistical Methods and DataManipulation:** Essential statistics for data science, probability theory, data summarization, and visualization techniques. Introduction to programming with Python and R for data manipulation using Pandas, NumPy, and dplyr.	**8**	Understand statistical techniques, manipulate data using programming languages, analyze datasets, interpret results, and communicate findings accurately.	**2,3**
III	**Machine Learning Techniques:** Supervised learning models (regression, decision trees, SVMs), unsupervised learning models (clustering, PCA), and model evaluation metrics. Introduction to machine learning algorithms implementation using scikit-learn.	**10**	Understand machine learning algorithms, apply techniques to analyze data, develop models, evaluate performance, and make predictions effectively.	**2,4**
IV	**Advanced Data Science Concepts:** Deep learning with TensorFlow, natural language processing basics, and introduction to big data technologies like Hadoop and Spark. Real-world applications and case	**10**	Explore advanced topics in data science such as deep learning, natural language processing, and big data analytics, applying them effectively.	**2,3**

	studies.			
V	**Capstone Project in Data Science:** Application of data science processes to a real-world problem. Project phases include problem identification, data acquisition, preprocessing, modelling, analysis, and presentation of results.	**9**	Demonstrate proficiency in applying data science skills to solve real-world problems, presenting comprehensive solutions and insights effectively.	**2,5**
Practical Component				
Practical 1	Match basic data science terminology with their definitions.	2	Identify and understand key data science terms and definitions.	1
Practical 2	Identify different types of data (categorical, numerical, etc.).	2	Recognize and categorize different types of data in various data sets.	1
Practical 3	Interpret basic data visualizations (bar charts, histograms, scatter plots).	2	Interpret and explain information presented in basic data visualizations.	2
Practical 4	Explain the concept and importance of descriptive statistics.	2	Understand and explain the importance and application of descriptive statistics.	2
Practical 5	Perform basic data cleaning tasks.	2	Apply data cleaning techniques to prepare data sets for analysis.	3
Practical 6	Create data visualizations using software (e.g., Excel, Tableau, Python libraries).	2	Create accurate and effective data visualizations to represent data insights.	3
Practical 7	Analyze the correlation between variables.	2	Analyze and interpret the correlation between variables in data sets..	4
Practical 8	Perform and interpret hypothesis tests.	2	Perform hypothesis tests and interpret their significance in data analysis..	4
Practical 9	Evaluate the performance of machine learning models..	2	evaluate and interpret the performance of machine learning models using appropriate metrics.	5
Practical 10	Critically analyze the quality and reliability of data sources.	2	critically assess the quality and reliability of various data sources.	5
Practical 11	Build and test predictive models.	2	Build and test predictive models, demonstrating their understanding of model development.	6
Practical 12	Design a survey for data collection.	2	design effective surveys to collect relevant and unbiased data.	6

Practical 13	Implement a data processing pipeline.	2	Implement an ETL pipeline to process data efficiently.	6
Practical 14	Create a data-driven story.	2	Create and present a data-driven story, effectively communicating insights.	6
Practical 15	Develop an interactive data dashboard.	2	develop interactive dashboards to visualize and explore data insights dynamically..	6

Text Books:

1. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, Foster Provost and Tom Fawcett, 1st Edition, 2013.
2. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", Wes McKinney, 2nd Edition, 2017.
3. Pattern Recognition and Machine Learning", Christopher M. Bishop, 1st Edition, 2006.
4. Applied Predictive Modeling", Max Kuhn and Kjell Johnson, 1st Edition, 2013.

Reference Books:

1. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, 2nd Edition, 2021.
2. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, 1st Edition, 2012.
3. Data Mining: Practical Machine Learning Tools and Techniques, Ian H. Witten, Eibe Frank, Mark A. Hall, and Christopher J. Pal, 4th Edition, 2016.
4. Big Data: Principles and Best Practices of Scalable Realtime Data Systems, Nathan Marz and James Warren, 1st Edition, 2015.

Additional Resources:

- SKaggle - https://www.kaggle.com/
- DataCamp - https://www.datacamp.com/
- Google Colab - https://colab.research.google.com/

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Acquire foundational knowledge in data science.	CO1, CO2, CO3, CO4, CO10, CO12.
2	Understand and apply various data analytics techniques.	CO1, CO2, CO3, CO4, CO10, CO12.
3	Apply advanced tools to work on dimensionality reduction and mathematical operations.	CO1, CO2, CO3, CO4, CO10, CO12.
4	Manage diverse data types and employ programming for knowledge representation through visualization.	CO1, CO2, CO3, CO4, CO10, CO12.
5	Demonstrate numerous open source data science tools to solve real-world problems through industrial case studies.	CO1, CO2, CO3, CO4, CO10, CO12.

Semester VI										
Course Title	**PE-IV: Cyber Security**									
Course code	**23BTCS324R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the third year of the programme**								
Course Objectives	1. To provide students with a thorough understanding of the key principles and practices of cyber security. 2. To equip students with the technical skills necessary to identify, analyze, and mitigate cyber threats. 3. To foster an understanding of ethical considerations and legal implications in the field of cyber security.									
CO1	Demonstrate an understanding of various types of cyber threats and vulnerabilities.									
CO2	Apply risk management strategies to protect information systems.									
CO3	Develop technical skills in using tools and techniques for cyber defence.									
CO4	Formulate and implement effective incident response and recovery strategies.									
CO5	Recognize and apply ethical principles and legal regulations relevant to cyber security.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Cyber Security** Definition and importance of cyber security, Overview of cyber threats and attacks, Cyber security principles and practices, The role of cyber security professionals	**8**	Understand cybersecurity fundamentals, threats, vulnerabilities, defenses, and apply security best practices to protect digital assets effectively.	**1,2,3**
II	**Network Security** Fundamentals of network security Firewalls, VPNs, and intrusion detection/prevention systems Secure network design and architecture Network monitoring and analysis	**8**	Comprehend network security principles, protocols, encryption techniques, intrusion detection/prevention, and implement measures to safeguard network infrastructure effectively.	**2,4**
III	**Cryptography** Introduction to cryptography and its importance Symmetric and asymmetric encryption Digital signatures and certificates Cryptographic protocols and applications	**10**	Understand cryptographic algorithms, encryption/decryption methods, digital signatures, cryptographic protocols, and apply them to secure communication and data.	**2,4**
IV	**Risk Management and Incident Response** Risk assessment and management strategies ,Identifying and mitigating vulnerabilities, Incident response planning and execution Business continuity and disaster recovery	**10**	Analyze cybersecurity risks, develop risk management strategies, implement incident response plans, and mitigate security incidents effectively.	**2,3,4**
V	**Ethical and Legal Aspects of**	**9**	Comprehend ethical dilemmas,	**2,4**

	Cyber Security Ethical issues in cyber security Legal and regulatory frameworks Compliance requirements (e.g., GDPR, HIPAA) Case studies of cyber security breaches and legal implications Objectives:.		legal frameworks, regulations, and apply ethical principles to cybersecurity practices and decision-making processes.	
Practical Component				
Practical 1	Match key cybersecurity terms with their definitions.	2	Identify and understand key cyber security terms and definitions.	1
Practical 2	Identify different types of cyber threats.	2	Recognize and categorize different types of cyber threats.	1
Practical 3	Explain basic concepts of network security.	2	understand and explain the components and principles of network security.	2
Practical 4	Explain various encryption techniques.	2	Understand and explain different encryption techniques and their applications.	2
Practical 5	Configure a basic firewall.	2	Apply firewall configuration techniques to control network traffic.	3
Practical 6	Implement basic encryption for data protection.	2	Apply encryption techniques to protect data.	3
Practical 7	Conduct a vulnerability assessment on a system.	2	Analyze and identify vulnerabilities in systems using appropriate tools.	4
Practical 8	Analyze network traffic for suspicious activity.	2	Analyze network traffic to detect suspicious activities.	4
Practical 9	Evaluate the effectiveness of security policies.	2	Evaluate and suggest improvements for security policies.	5
Practical 10	Assess the robustness of an incident response plan.	2	Assess and critique the robustness of incident response plans.runtime environment.	5
Practical 11	Develop a security awareness program for an organization.	2	Create an effective security awareness program for organizational training.	6
Practical 12	Design a secure network architecture.	2	Design a secure network architecture to protect against cyber threats.	6
Practical 13	Implement an intrusion detection system (IDS).	2	Implement and configure an IDS to monitor and detect intrusions.	6
Practical 14	Develop a penetration testing plan.	2	Develop and document a comprehensive penetration testing plan.	6
Practical 15	Create a detailed cyber security incident report.	2	Create acomprehensive incident report detailing their	6

			response and findings from a simulated cybersecurity incident.	

Textbooks

1. "Cybersecurity Essentials" by Charles J. Brooks, Christopher Grow, Philip Craig, and Donald Short

Reference Books

1. "Network Security Essentials: Applications and Standards" by William Stallings

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate an understanding of various types of cyber threats and vulnerabilities.	CO1, CO2, CO3, CO4, CO5, CO12.
2	Apply risk management strategies to protect information systems.	CO1, CO2, CO3, CO4, CO5, CO12.
3	Develop technical skills in using tools and techniques for cyber defence.	CO1, CO2, CO3, CO4, CO5, CO12.
4	Formulate and implement effective incident response and recovery strategies.	CO1, CO2, CO3, CO4, CO5, CO12.
5	Recognize and apply ethical principles and legal regulations relevant to cyber security.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.

SEMESTER – VI										
Course Title	**PE-V: Predictive Analysis**									
Course code	**23BTCS325R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 45T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**	
Pre-requisite	**Basic Programming knowledge**	**Co-requisite**	**Nil**							
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**									
Semester	**Winter/II semester of the third year of the programme**									
Course Objectives	1. To familiarize the students with various Statistical Data Analysis tools 2. Tools that can be used for effective decision making. 3. To make student handle data with various meters									
CO1	Understand and critically apply the concepts and methods of Predictive analytics.									
CO2	Understand and apply IBM SPSS Modeler in Data Mining, what kinds of data can be mined, what kinds of patterns can be mined.									
CO3	Applying and analysing how to use functions, deal with missing values, use advanced field operations, handle sequence data and improve efficiency.									
CO4	Get exposed to the testing of hypothesis and solving assumptions									
CO5	Understanding of IBM Watson Studio with Machine Learning Model.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**ANALYTICS OVERVIEW** What is Predictive Analysis, how predictive model works, why predictive modeling, what are the models in Predictive Analysis. How Predictive analytics: Transforming data into future insights, Analytics trends: Past, Present & Future, Towards a Predictive enterprise.	**8**	Understand predictive analysis principles, predictive models, and their application in transforming data into future insights.	1,2
II	**Statistical Analysis** Define Statistics and its types, Measures of Central Value; Mean, Median and Mode, Measures of Dispersion: Absolute and Relative measures of dispersion - Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation, Moments, Skewness, Kurtosis.	**8**	Define statistics, its types, and key measures such as mean, median, mode, and various measures of dispersion.	1,2
III	**DATA MINING** What is a Data Mining applications? Strategy for data mining: CRISP-DM, Steps of Data Mining, Stages and tasks in CRISP-DM, Life Cycle of a Data Mining Project, Skills Needed for Data Mining. Identify nodes and streams, The framework of a Data – mining project, Brief the unit of analysis,	**8**	Explain data mining applications, strategy using CRISP-DM, stages in a data mining project, and required skills.	2,3

	Explain the type of dialog box.			
IV	**UNIT OF ANALYSIS** Concepts of Unit of analysis (Distinct, Aggregate, SetToFlag), Integrate data, CLEM Expression, Role of Relationship between two fields, Identifying the modeling objective.	**8**	Define unit of analysis concepts (distinct, aggregate, SetToFlag), integrate data using CLEM Expression, and identify modeling objectives.	2,3
V	**PREDICTIVE ANALYTICS WITH IBM WATSON STUDIO** Understanding of IBM Cloud, IBM Watson Studio, Watson studio Components, Creating a Machine Learning Model, Data preparation, Watson Machine learning, Data Refinery, Watson Studio Neural Network Modeler, IBM Watson Studio jobs, Use case with AutoAI.	**8**	Utilize IBM Watson Studio for machine learning model creation, data preparation, Watson Machine Learning, Data Refinery, Neural Network Modeler, and AutoAI use cases.	1,2,5,6
Practical Component				
Practical 1	Match key predictive analysis terms with their definitions.	2	Identify and understand key predictive analysis terms and definitions..	1
Practical 2	Identify different types of predictive models.	2	Recognize and categorize different types of predictive models.	1
Practical 3	Explain the steps in the predictive modeling process.	2	Understand and explain the steps involved in the predictive modeling process.	2
Practical 4	Explain various model evaluation metrics.	2	Understand and explain different model evaluation metrics and their applications.	2
Practical 5	Implement a linear regression model.	2	Apply linear regression techniques to train and evaluate a predictive model.	3
Practical 6	Perform data preprocessing tasks for predictive analysis.	2	Apply data preprocessing techniques to prepare data for predictive analysis.	3
Practical 7	Analyze the importance of features in a predictive model.	2	Analyze and identify the most important features in a predictive model.	4
Practical 8	Analyze the performance of different predictive models.	2	Analyze and compare the performance of various predictive models.	4
Practical 9	Evaluate the impact of overfitting and underfitting on model performance.	2	Evaluate and understand the effects of overfitting and underfitting on model performance.	5
Practical 10	Assess the generalizability of a	2	Students will assess and	5

	predictive model.		understand the generalizability of predictive models.	
Practical 11	Build and evaluate a classification model.	2	Build and evaluate a classification model to make predictions.	6
Practical 12	Develop a time series forecasting model.	2	develop and evaluate a time series forecasting model.	6
Practical 13	Implement a clustering algorithm for data segmentation.	2	Implement and analyze the results of a clustering algorithm.	6
Practical 14	Design a predictive maintenance model for machinery or equipment..	2	Design and evaluate a predictive maintenance model.	6
Practical 15	Create an end-to-end predictive analytics pipeline..	2	Create and implement an end-to-end predictive analytics pipeline for real-world applications.	6

TEXT BOOKS:

1. Predictive Analytics Mesmerizing & fascinating by ERIC SIEGEL

REFERENCE BOOKS:

1. "Applied Predictive Modeling" by Max Kuhn and Kjell JohnsonDatabase Management Systems
2. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy
3. "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die" by Eric Siegel

OTHER LEARNING RESOURCES:

1. https://www.ibm.com/topics/predictive-analytics
2. https://www.simplilearn.com/what-is-predictive-analytics-article
3. https://www.ibm.com/products/watson-studio

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand and critically apply the concepts and methods of Predictive analytics.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
2	Understand and apply IBM SPSS Modeler in Data Mining, what kinds of data can be mined, what kinds of patterns can be mined.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
3	Applying and analysing how to use functions, deal with missing values, use advanced field operations, handle sequence data and improve efficiency.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
4	Get exposed to the testing of hypothesis and solving assumptions	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
5	Understanding of IBM Watson Studio with Machine Learning Model.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.

SEMESTER – VI										
Course Title	**PE-V- Wireless Sensor Networks**									
Course code	**23BTCS325R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the third year of the programme**								
Course Objectives	1. To understand the fundamental concepts of wireless sensor networks, their architecture, and applications. 2. To explore various protocols and algorithms used in WSN for data collection, routing, and energy efficiency. 3. To analyze the challenges and solutions for deploying WSNs in real-world scenarios. 4. To develop skills in designing, simulating, and implementing WSN applications. 5. To evaluate the performance and reliability of WSN systems									
CO1	Explain the basic concepts, architecture, and applications of wireless sensor networks.									
CO2	Demonstrate knowledge of various WSN protocols and their functions.									
CO3	Identify and address the challenges in WSN deployment, including energy management and network scalability.									
CO4	Design and simulate WSN applications using appropriate tools and methodologies.									
CO5	Assess the performance, reliability, and security aspects of WSNs.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Wireless Sensor Networks:** Overview of Wireless Sensor Networks Sensor nodes and their architecture Types of sensors and sensor networks Applications of WSN in various fields (environmental monitoring, healthcare, military, etc.) Basic WSN concepts: sensing, communication, and computation	**8**	understand wireless sensor network (WSN) principles, protocols, design considerations, and apply them to develop and deploy WSN solutions effectively..	**1,2,3**
II	**WSN Protocols and Architectures:** Network architectures (flat, hierarchical, and location-based) Medium Access Control (MAC) protocols for WSN Routing protocols: data-centric, hierarchical, and location-based Data dissemination and aggregation techniques	**8**	Comprehend WSN protocols, network architectures, routing algorithms, energy-efficient techniques, and apply them to design scalable and robust WSNs.	**2,3,4**
III	**Energy Management in WSN:** Energy consumption in sensor nodes Energy-efficient MAC and routing protocols	**10**	Understand energy consumption patterns, optimization techniques, power-efficient protocols, and apply strategies to	**2**

	Power management and energy harvesting techniques Sleep scheduling and duty cycling Case studies of energy management in WSN		prolong battery life in wireless sensor networks.	
IV	**Challenges and Solutions in WSN Deployment:** Scalability and network topology control Localization and positioning techniques Time synchronization methods Security issues and countermeasures in WSN Case studies of WSN deployments in real-world scenarios	**10**	Identify challenges in WSN deployment, such as coverage, connectivity, security, and propose effective solutions to overcome deployment obstacles.	**2,3,4**
V	**WSN Design, Simulation, and Performance Evaluation:** Tools and platforms for WSN simulation (e.g., NS-2/3, TOSSIM, Cooja) Designing and implementing WSN applications Simulation-based performance analysis Real-world implementation and testing of WSN Future trends and research directions in WSN	**9**	Design WSN architectures, simulate network behavior, evaluate performance metrics, and optimize system parameters for enhanced network efficiency.	**3,5,6**
Practical Component				
Practical 1	Match key IoT terms with their definitions.	2	Identify and understand key IoT terms and definitions.	1
Practical 2	Identify different types of IoT devices.	2	Recognize and categorize different types of IoT devices.	1
Practical 3	Explain the architecture of IoT systems.	2	Understand and explain the components and roles in an IoT architecture.	2
Practical 4	Explain various IoT communication protocols.	2	understand and explain different IoT communication protocols and their applications.	2
Practical 5	Set up a basic IoT device.	2	apply IoT setup techniques to configure a basic IoT device.	3
Practical 6	Collect and analyze data from an IoT device.	2	Apply data collection and analysis techniques to interpret IoT data.	3
Practical 7	Analyze network traffic in an IoT system.	2	Analyze network traffic to identify patterns and potential issues.	4

Practical 8	Analyze security vulnerabilities in IoT devices.	2	Analyze and identify security vulnerabilities in IoT devices.	4
Practical 9	Evaluate methods for managing IoT data.	2	Evaluate and understand different methods for managing IoT data.	5
Practical 10	Assess the performance of an IoT device.	2	Assess and interpret the performance metrics of IoT devices.	5
Practical 11	Build a working IoT prototype.	2	Students will build and test an IoT prototype, demonstrating practical IoT skills.	6
Practical 12	Develop an application for IoT device control.	2	Develop and implement an application for managing IoT devices.	6
Practical 13	Implement a security solution for an IoT system.	2	Implement and evaluate security solutions for IoT systems.generation.	6
Practical 14	Design a smart home system using IoT devices.	2	Design and implement a smart home system using IoT technology.	6
Practical 15	Create an interactive dashboard for IoT data visualization.	2	Create and use an interactive dashboard to monitor and analyze IoT data.	6

Text Books:

1. Wireless Sensor Networks: Technology, Protocols, and Applications by Kazem Sohraby, Daniel Minoli, and Taieb Znati.
2. Protocols and Architectures for Wireless Sensor Networks by Holger Karl and Andreas Willig.

Reference Books:

1. Wireless Sensor Networks: An Information Processing Approach" by Feng Zhao and Leonidas Guibas.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the basic concepts, architecture, and applications of wireless sensor networks.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
2	Demonstrate knowledge of various WSN protocols and their functions.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
3	Identify and address the challenges in WSN deployment, including energy management and network scalability.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
4	Design and simulate WSN applications using appropriate tools and methodologies.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
5	Assess the performance, reliability, and security aspects of WSNs.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.

SEMESTER – VI										
Course Title	**PE-VI: Big Data Analytics**									
Course code	**23BTCS326R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+30 P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**DBMS**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the third year of the programme**								
Course Objectives	1. Gain foundational knowledge of Big Data, including its characteristics, technologies, and real-world applications across various domains. 2. Learn the architecture and components of Hadoop and Spark, and develop practical skills in data ingestion, processing, and management. 3. Develop the ability to perform analytics on Big Data, apply machine learning techniques, and utilize visualization tools for insightful data representation.									
CO1	Understand the characteristics and real-world applications of Big Data, differentiating it from traditional data.									
CO2	Demonstrate the use of Hadoop and Spark frameworks by executing basic data processing tasks.									
CO3	Analyze and compare various NoSQL databases and their suitability for different types of Big Data storage requirements.									
CO4	Evaluate different data pre-processing techniques and machine learning tools for effective Big Data analytics.									
CO5	Design a real-time Big Data analytics pipeline using cloud-based solutions and ensuring data security and privacy.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Big Data:** Overview of Big Data: Definition and characteristics of Big Data (Volume, Velocity, Variety, Veracity, and Value), Differences between traditional data and Big Data. Big Data in the Real World: Applications in various domains (healthcare, finance, social media, e-commerce, etc.), Case studies of Big Data applications. Big Data Technologies: Introduction to Hadoop ecosystem, NoSQL databases overview (e.g., MongoDB, Cassandra). Big Data Challenges: Data storage and management issues, Privacy and ethical considerations in Big Data. Data Generation Sources: Structured vs. Unstructured data, Data from sensors, social media, and other digital platforms.	**8**	Understand the definition, characteristics, and real-world applications of Big Data, as well as the technologies and challenges associated with it.	**2,4**
II	**Big Data Processing Frameworks:** Hadoop Fundamentals: Architecture of Hadoop, Hadoop Distributed File System (HDFS), MapReduce programming model.	**8**	Grasp the fundamentals of Hadoop ecosystem, including HDFS, MapReduce, and related tools, as well as Spark	**2,3**

	Hadoop Ecosystem Components: Introduction to Pig, Hive, HBase, and other related tools, Use cases and applications of each component. Data Ingestion Tools: Overview of Sqoop and Flume, Real-time data processing with Apache Kafka. Spark Framework: Introduction to Apache Spark, Spark vs. Hadoop MapReduce, Spark RDDs (Resilient Distributed Datasets). Hands-On Exercises: Basic HDFS commands, Writing and running a simple MapReduce program.		framework and its comparison with Hadoop.	
III	**Data Storage and Management:** NoSQL Databases: Types of NoSQL databases: Document, Key-Value, Column Family, Graph, CAP theorem and BASE properties. MongoDB: Features and architecture of MongoDB, CRUD operations in MongoDB, Indexing and aggregation. Cassandra: Features and architecture of Cassandra, Data modeling in Cassandra, Querying in Cassandra using CQL. HBase: Introduction to HBase and its architecture, HBase data model and operations, Integration of HBase with Hadoop. Data Warehousing Solutions: Introduction to Big Data warehousing solutions like Amazon Redshift and Google BigQuery.	**10**	Gain knowledge of NoSQL databases, focusing on MongoDB, Cassandra, HBase, and Big Data warehousing solutions, and their features, architecture, and operations.	**2,3**
IV	**Big Data Analytics and Tools:** Introduction to Big Data Analytics: Importance of analytics in Big Data, Types of analytics: Descriptive, Diagnostic, Predictive, Prescriptive. Data Pre-processing Techniques: Data cleaning, transformation, and reduction, Handling missing data and outliers. Machine Learning with Big Data: Overview of machine learning algorithms used in Big Data, Introduction to scalable machine learning tools like MLlib. Big Data Visualization: Importance of data visualization, Tools for Big Data visualization (e.g., Tableau, D3.js).	**10**	Understand the importance of analytics in Big Data, pre-processing techniques, machine learning algorithms, and data visualization tools.	**2,3,5**
V	**Advanced Topics in Big Data Analytics:**	**9**	Explore real-time Big Data analytics, security	**2,4,5**

	Real-Time Big Data Analytics: Stream processing with Apache Storm and Spark Streaming, Real-time data pipelines and architectures. Big Data Security and Privacy: Security challenges in Big Data, Techniques and tools for securing Big Data, Cloud-Based Big Data Solutions: Overview of Big Data solutions on AWS, Azure, and Google Cloud, Case studies on cloud-based Big Data implementations. Future Trends in Big Data: Emerging technologies and trends in Big Data, The impact of AI and IoT on Big Data.		and privacy challenges, cloud-based Big Data solutions, and future trends in Big Data technologies.	
Practical Component				
Practical 1	Match big data terms with their definitions.	2	Identify and understand key big data analytics terms and definitions.	1
Practical 2	Identify different big data technologies and tools.	2	Recognize and categorize different big data technologies and their primary uses.	1
Practical 3	Explain the architecture of big data systems.	2	Understand and explain the components and roles in a big data architecture.	2
Practical 4	Explain different data storage models.	2	Understand and explain various data storage models and their differences.	2
Practical 5	Perform data ingestion using Hadoop.	2	Apply data ingestion techniques using Hadoop.	3
Practical 6	Process data using Apache Spark.	2	Apply data processing techniques using Apache Spark.	3
Practical 7	Analyze large data sets using big data tools.	2	Analyze large data sets to extract insights using big data tools.	4
Practical 8	Analyze the efficiency of MapReduce jobs.	2	Analyze and interpret the efficiency of MapReduce jobs.	4
Practical 9	Evaluate the performance of big data systems.	2	Evaluate and interpret the performance of various big data systems using appropriate metrics.	5
Practical 10	Assess the quality of big data sources.	2	Critically assess the quality and reliability of big data sources.	5

Practical 11	Build and implement a big data processing pipeline.	2	design and implement a data processing pipeline for big data.	6
Practical 12	Develop a real-time data analytics application.	2	Develop real-time analytics applications to process streaming data.	6
Practical 13	Implement machine learning models on big data platforms.	2	Implement and test machine learning models on big data platforms.	6
Practical 14	Design and set up a data lake.	2	Design and implement a data lake for scalable data storage and processing.	6
Practical 15	Develop an interactive big data analytics dashboard.	2	Develop interactive dashboards to visualize and explore big data insights dynamically.	6

TEXT BOOKS:

1. "Big Data: Principles and Best Practices of Scalable Realtime Data Systems" by Nathan Marz, James Warren, Manning Publications.
2. "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost, Tom Fawcett, O'Reilly Media.
3. "Big Data: A Revolution That Will Transform How We Live, Work, and Think" by Viktor Mayer-Schönberger, Kenneth Cukier, Eamon Dolan/Mariner Books.

REFERENCE BOOKS:

1. "Hadoop: The Definitive Guide" by Tom White, O'Reilly Media.

2. "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems" by Martin Kleppmann, O'Reilly Media.

3. "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence" by Pramod J. Sadalage, Martin Fowler, Addison-Wesley.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the characteristics and real-world applications of Big Data, differentiating it from traditional data.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
2	Demonstrate the use of Hadoop and Spark frameworks by executing basic data processing tasks.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
3	Analyze and compare various NoSQL databases and their suitability for different types of Big Data storage requirements.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
4	Evaluate different data preprocessing techniques and machine learning tools for effective Big Data analytics.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.
5	Design a real-time Big Data analytics pipeline using cloud-based solutions and ensuring data security and privacy.	CO1, CO2, CO3, CO4, CO5, CO10, CO12.

SEMESTER – VI									
Course Title	**PE-VI : Neural Networks**								
Course code	**23BTCS326R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the third year of the programme**								
Course Objectives	1. To introduce the fundamental concepts and architectures of neural networks. 2. To develop an understanding of training algorithms, including backpropagation and optimization techniques. 3. To explore advanced neural network models such as CNNs and RNNs. 4. To apply neural networks for solving real-world problems in areas like image processing and time series analysis. 5. To understand and implement techniques for regularization and improving model generalization.								
CO1	Understand the structure and functionality of basic and advanced neural network architectures.								
CO2	Implement training algorithms and optimization techniques for neural networks.								
CO3	Analyze and solve classification, regression, and sequential data problems using neural networks.								
CO4	Develop convolutional and recurrent neural networks for domain-specific applications.								
CO5	Apply techniques like regularization and dropout to enhance the performance and generalization of models.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Neural Networks:** • Basics of Neural Networks: Biological vs. Artificial Neural Networks • Perceptron Model: Single Layer Perceptron, Limitations of Perceptron • Activation Functions: Sigmoid, ReLU, Tanh, Softmax • Applications of Neural Networks in various domains	8	Understand the foundational concepts of neural networks and their applications.	**1,2,3**
II	**Multi-Layer Perceptron (MLP)** • Feedforward Neural Networks • Forward and Backpropagation Algorithm • Gradient Descent and Optimization Techniques • Role of Learning Rate and Hyperparameter Tuning	8	Analyze the working of multi-layer perceptrons and implement backpropagation for training neural networks.	**3,4**
III	**Regularization and Generalization:** • Overfitting and Underfitting in Neural Networks • Regularization Techniques: L1, L2 Regularization, Dropout • Batch Normalization • Early Stopping and Cross-Validation	8	Understand and apply techniques to improve the generalization of neural networks.	**3,4**
IV	**Convolutional Neural Networks**	8	Develop convolutional	**4,5**

	(CNNs): • Basics of Convolutional Neural Networks • Convolution and Pooling Operations • Architectures of CNNs: LeNet, AlexNet, VGG, ResNet • Applications of CNNs in Image Processing		neural network models for image-based tasks.	
V	**Recurrent Neural Networks (RNNs) and Advanced Topics:** • Basics of Recurrent Neural Networks (RNNs) • Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) • Introduction to Generative Adversarial Networks (GANs) • Applications in Natural Language Processing and Time Series Prediction	8	Understand and implement RNNs for sequential data and explore advanced topics like GANs.	**3,4,5**
Practical 1	Create a single-layer perceptron using Python or a deep learning framework (e.g., TensorFlow/PyTorch) to classify linearly separable data.	3	Understand the working of a perceptron and its limitations.	1,2 ,3
Practical 2	Implement and visualize the effects of different activation functions (Sigmoid, ReLU, Tanh, Softmax) on a neural network's performance.	3	Understand how activation functions influence the output of neural networks.	3,4
Practical 3	Manually implement forward and backpropagation for a simple neural network and verify the weight updates.	3	Analyze how neural networks learn using forward and backpropagation.	4,5
Practical 4	Build and train a multi-layer perceptron to classify the MNIST handwritten digits dataset.	3	Learn to train a multi-layer perceptron for real-world classification tasks.	3,5
Practical 5	Implement L1, L2 regularization, and dropout on a neural network and compare their effects on overfitting.	3	Understand and apply regularization techniques to improve generalization.	4,5
Practical 6	Implement batch normalization and experiment with different learning rates to observe their impact on convergence speed.	3	Analyze how batch normalization and learning rates affect training stability and performance.	4,5
Practical 7	Design and train a CNN on a dataset like CIFAR-10 or Fashion-MNIST for image classification.	3	Understand the working of CNN layers and their application in image processing.	3,5
Practical 8	Visualize the feature maps learned by a	3	Explore how CNNs	4,5

	CNN for different layers to understand hierarchical feature extraction.		extract features at different levels of abstraction.using IBM Watson.	
Practical 9	Build an RNN to perform sentiment analysis on text data or time series prediction on a simple dataset.	3	Learn how RNNs handle sequential data and temporal dependencies.	3,4
Practical 10	Train an LSTM model for text generation or stock price prediction using a sequential dataset.	3	Understand the capabilities of LSTMs in handling long-term dependencies in sequential data.	3,5

Text Books

T1: Simon Haykin - *"Neural Networks and Learning Machines",* Pearson.
T2: Ian Goodfellow, Yoshua Bengio, and Aaron Courville - *"Deep Learning",* MIT Press, 2016.

Reference Books

R1: Charu C. Aggarwal - *"Neural Networks and Deep Learning: A Textbook",* Winterer, 2018.
R2: Christopher Bishop - *"Pattern Recognition and Machine Learning",* Winterer, 2006.

Other Learning Resources

O1: *"Deep Learning Specialization"* by Andrew Ng on Coursera.
O2: *"Neural Networks and Deep Learning"* by Geoffrey Hinton on Coursera.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the structure and functionality of basic and advanced neural network architectures.	PO1, PO2, PO3, PO4, PO10, PO12
2	Implement training algorithms and optimization techniques for neural networks.	PO1, PO2, PO3, PO4, PO10, PO12
3	Analyze and solve classification, regression, and sequential data problems using neural networks.	PO1, PO2, PO3, PO4, PO5, PO10, PO12
4	Develop convolutional and recurrent neural networks for domain-specific applications.	PO1, PO2, PO3, PO4, PO10, PO12
5	Apply techniques like regularization and dropout to enhance the performance and generalization of models.	PO1, PO2, PO3, PO4, PO5, PO10, PO12

SEMESTER – VI									
Course Title	**Field-based Training**								
Course code	**23BTCS327R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: NA	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**All UG Programmes**								
Semester	**Winter/II semester of the third year of the programme**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings. 4. To foster collaboration and communication skills through group projects and professional interactions. 5. To cultivate an appreciation for the complexities and challenges of professional practice in the field.								
CO1	Apply theoretical concepts to real-world situations.								
CO2	Conduct field-based research and gather data effectively.								
CO3	Analyze and interpret the university data to draw meaningful conclusions.								
CO4	Communicate findings clearly and effectively, both orally and in writing.								
CO5	Demonstrate professional behavior and teamwork skills in field settings.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	The organization will provide the students one field visit for this program. The students will be taken to a specific blocks of the university for learning purposes. The students will visit all department block site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners of IT department of the university. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial findings.	**30**	Gain practical experience in real-world settings relevant to the field of study or profession. Also apply theoretical knowledge to practical scenarios, enhancing skill proficiency and problem-solving abilities.	**2,3**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply theoretical concepts to real-world situations.	CO1, CO2, CO3, CO4, CO5, CO6, CO10, CO12.
2	Conduct field-based research and gather data effectively.	CO1, CO2, CO3, CO4, CO5, CO6, CO10, CO12
3	Analyze and interpret the university data to draw meaningful conclusions.	CO1, CO2, CO3, CO4, CO5, CO6, CO10, CO12
4	Communicate findings clearly and effectively, both orally and in writing.	CO1, CO2, CO3, CO4, CO5, CO6, CO10, CO12
5	Demonstrate professional behaviour and teamwork skills in field settings.	CO1, CO2, CO3, CO4, CO5, CO6, CO10, CO12

SEMESTER – VI									
Course Title	**Mini Project IV**								
Course code	**23BTCS316R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: NA	**0**	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the third year of the programme**								
Course Objectives	1. Develop advanced technical skills through individual or group project work in engineering domains. 2. Enhance project management abilities, including workload management and meeting project deadlines effectively. 3. Improve presentation skills through seminar presentations and public demonstrations of project outcomes.								
CO1	Apply IT principles to solve real-world problems.								
CO2	Contribute to complex projects as a team member.								
CO3	Apply programming languages and platforms to develop software and hardware solutions.								
CO4	Demonstrate personal and team management skills in software development.								
CO5	Cultivate employability skills and professionalism commitment.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: a. theoretical studies b. computer simulations c. hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project; 4. Deliver a seminar on the general area of work being undertaken and specific	**30**	Demonstrate proficiency in conducting literature reviews, performing technical work, maintaining progress reports, delivering seminars, preparing formal reports, and presenting project outcomes effectively.	**2,3,4,5,6**

	contributions to that field; 5. Prepare a formal report describing the work undertaken and results obtained so far; and 6. Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.			

REFERENCE BOOKS:

1. "The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams

2. "Doing Your Research Project: A Guide for First-Time Researchers" by Judith Bell and Stephen Waters

3. "How to Write a Thesis" by Umberto Eco

4. "Effective Project Management: Traditional, Agile, Extreme" by Robert K. Wysocki

5. "Writing for Computer Science" by Justin Zobel

6. "The Elements of Style" by William Strunk Jr. and E.B. White

7. "Python Crash Course" by Eric Matthes (if applicable for coding projects)

8. "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett (if applicable for data science projects).

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply IT principles to solve real-world problems.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10, CO11, CO12.
2	Contribute to complex projects as a team member.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10,CO11, CO12.
3	Apply programming languages and platforms to develop software and hardware solutions.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10, CO11, CO12.
4	Demonstrate personal and team management skills in software development.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10, CO11, CO12.
5	Cultivate employability skills and professionalism commitment.	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10,CO11, CO12.

SEMESTER – VI										
Course Title	**Data Science**									
Course code	**23BTCS317R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T + 30P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the third year of the program**								
Course Objectives	1. Develop Proficiency in Key Data Science Tools and Programming Languages. 2. Understand and apply Fundamental Statistical and Machine Learning Methods. 3. Cultivate Critical Thinking and Problem-Solving Skills in a Data-Driven Context.									
CO1	Master Core Data Science Concepts and Techniques.									
CO2	Develop Proficiency in Programming for Data Science.									
CO3	Apply Machine Learning and Predictive Analytics.									
CO4	Enhance Skills in Data Wrangling and Visualization.									
CO5	Execute a Capstone Data Science Project.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Foundations of Data Science:** Overview of data science, its significance, and application across various sectors. Introduction to the data science workflow: data collection, cleaning, analysis, and visualization.	**7**	Apply data analysis techniques to interpret, visualize, and make data-driven decisions	3, 4, 5, 6
II	**Statistical Methods and Data Manipulation:** Essential statistics for data science, probability theory, data summarization, and visualization techniques. Introduction to programming with Python and R for data manipulation using Pandas, NumPy, and dplyr.	**8**	Analyze and manipulate datasets using statistical methods to derive meaningful insights and inform decision-making.	4, 5, 6
III	**Machine Learning Techniques:** Supervised learning models (regression, decision trees, SVMs), unsupervised learning models (clustering, PCA), and model evaluation metrics. Introduction to machine learning algorithms implementation using scikit-learn.	**10**	Develop, implement, and evaluate machine learning models to solve real-world problems.	4, 5, 6
IV	**Advanced Data Science Concepts:** Deep learning with TensorFlow, natural language processing basics, and introduction to big data technologies like Hadoop and Spark. Real-world applications and case studies.	**12**	Master advanced techniques for analysing complex data, optimizing models, and deriving actionable insights.	5, 6
V	**Capstone Project in Data Science:** Application of data science processes to a real-world problem. Project phases include problem	**8**	Design, execute, and present a comprehensive data science project addressing a real-world	5, 6

	identification, data acquisition, pre-processing, modeling, analysis, and presentation of results.		problem.	
Practical Component				
Practical 1	Data Collection and Cleaning	3	Apply techniques to gather and pre-process data for analysis.	3
Practical 2	Data Visualization	**3**	Create visual representations to explore and present data insights.	3
Practical 3	Introduction to Data Science Workflow	3	Understand and apply the steps in the data science workflow.	3
Practical 4	Descriptive Statistics and Visualization	**3**	Compute summary statistics and visualize data distributions.	3
Practical 5	Probability Theory and Hypothesis Testing	3	Apply probability concepts and conduct hypothesis tests.	4
Practical 6	Data Manipulation with Pandas and NumPy	**3**	Use Pandas and NumPy for data manipulation and analysis.	3
Practical 7	Linear Regression	3	Implement and evaluate linear regression models.	4
Practical 8	Clustering with K-Means	**3**	Apply K-Means clustering for unsupervised learning tasks.	4
Practical 9	Decision Trees and Random Forest	3	Construct and compare decision tree and random forest models.	4
Practical 10	Deep Learning with TensorFlow	**3**	Develop and evaluate deep learning models using TensorFlow.	4

SEMESTER – VII									
Course Title	**Design &Analysis of Algorithms**								
Course code	**23BTCS411R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Data Structures**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the fourth year of the programme**								
Course Objectives	1. Analyse the asymptotic performance of algorithms. 2. Demonstrate a familiarity with major algorithms and data structures. 3. Apply important algorithmic design paradigms and methods of analysis.								
CO1	Understand analysis of algorithms using asymptotic notations for advanced problem-solving.								
CO2	Implement sorting, searching, matrix multiplication algorithms with varied strategies.								
CO3	Apply greedy approaches and dynamic programming to optimize problem-solving, for advanced algorithm design.								
CO4	Apply problem-solving strategies to complex scenarios, solving N-Queen, knapsack, and TSP, etc.								
CO5	Evaluate decision tree bounds, interpret complexity classes P, NP, NP-Complete proficiently.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction: Characteristics of algorithm.** Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.	**8**	Understand and analyze the best, average, and worst-case complexities of algorithms.	**2,4**
II	**Fundamental Algorithmic Strategies:** Brute-Force, Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics –characteristics and their application domains.	**8**	Apply different algorithmic strategies such as Brute-Force, Greedy, and Dynamic Programming to solve problems.	**3,4,5**
III	**Graph and Tree Algorithms:** Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow	**10**	Implement traversal algorithms and determine the shortest paths in graphs.	**3,4**

	Algorithm.			
IV	**Tractable and Intractable Problems:** Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques	**10**	Differentiate between P, NP, NP-complete, and NP-hard classes and understand the significance of Cook's theorem.	**2,4,5**
V	**Advanced Topics:** Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE	**9**	Develop and analyze approximation and randomized algorithms for complex problems.	**3,4,6**
Practical Component				
Practical 1	Implement and analyze the time complexity of Bubble Sort, Selection Sort, and Insertion Sort.	**2**	Compare the time complexities of different sorting algorithms in best, average, and worst cases.	**4**
Practical 2	Use the substitution method to solve simple recurrence relations.	**2**	Apply the substitution method to determine the time complexity of recursive algorithms.	**3**
Practical 3	Implement a recursive algorithm and analyze its performance using the recursion tree method.	**2**	Visualize and analyze the time complexity of recursive algorithms using recursion trees.	**4**
Practical 4	Solve the 0/1 Knapsack problem using dynamic programming.	**2**	Develop and apply dynamic programming to solve optimization problems.	**3,6**
Practical 5	Implement a solution to the Traveling Salesman Problem using the branch and bound technique.	**2**	Apply branch and bound to solve combinatorial optimization problems.	**3,4**
Practical 6	Design and implement a greedy algorithm for the Fractional Knapsack problem.	**2**	Understand and apply the greedy strategy to solve optimization problems.	**2,3**
Practical 7	Implement backtracking to solve the N-Queens problem.	**2**	Apply backtracking techniques to solve constraint satisfaction problems.	**3,4**
Practical 8	Implement a brute-force solution for the Bin Packing problem and evaluate its efficiency.	**2**	Evaluate the efficiency of brute-force algorithms for combinatorial problems.	**5**
Practical 9	Implement Depth First Search (DFS) and Breadth First Search (BFS) for graph traversal.	**2**	Implement and compare DFS and BFS traversal techniques.	**3,4**
Practical 10	Implement Dijkstra's algorithm to find the shortest path in a weighted graph.	**2**	Apply shortest path algorithms to find the minimum distance between nodes in a graph.	**3**
Practical 11	Implement Kruskal's and Prim's	**2**	Compare and apply	**3,4**

	algorithms to find the Minimum Spanning Tree (MST).		different algorithms to find MST in a graph.	
Practical 12	Perform topological sorting on a directed acyclic graph (DAG).	**2**	Understand and implement topological sorting on DAGs.	**2,3**
Practical 13	Implement the reduction technique to show that a problem is NP-complete.	**2**	Demonstrate the reduction technique to classify problems within NP-complete.	**3,4**
Practical 14	Solve an NP-hard problem using approximation algorithms.	**2**	Apply approximation techniques to find near-optimal solutions to NP-hard problems.	**3,5**
Practical 15	Implement a randomized algorithm for the Minimum Cut problem.	**2**	Understand and apply randomized algorithms to solve complex problems.	**2,3**

TEXT BOOKS:

T1: Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
T2: Fundamentals of Algorithms – E. Horowitz et al.

REFERENCE BOOKS:

R1: Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
R2: Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition,
R3: Michael T Goodrich and Roberto Tamassia, Wiley.
R4: Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

OTHER LEARNING RESOURCES:

1. https://ocw.mit.edu/courses/6-006-introduction-to-algorithms-Summer-2011/pages/lecture-notes/
2. https://www.vssut.ac.in/lecture_notes/lecture1428551222.pdf

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand analysis of algorithms using asymptotic notations for advanced problem-solving.	CO1, CO2, CO3, CO4, CO11, CO12
2	Implement sorting, searching, matrix multiplication algorithms with varied strategies.	CO1, CO2, CO3, CO4, CO11, CO12
3	Apply greedy approaches and dynamic programming to optimize problem-solving, for advanced algorithm design.	CO1, CO2, CO3, CO4, CO9, CO10, CO11, CO12
4	Apply problem-solving strategies to complex scenarios, solving N-Queen, knapsack, and TSP, etc.	CO1, CO2, CO3, CO4, CO9, CO10, CO11, CO12
5	Evaluate decision tree bounds, interpret complexity classes P, NP, NP-Complete proficiently.	CO1, CO2, CO3, CO4, CO9, CO10, CO11, CO12

SEMESTER – VII										
Course Title	**Compiler Design**									
Course code	**23BTCS412R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Theory of Computation**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the fourth year of the program**								
Course Objectives	1. Discuss the process of translating a high-level language to machine code required for compiler construction. 2. Analyze the software tools and techniques used in compiler construction such as lexical analyser and parser generators 3. Discuss the data structures used in compiler construction such as abstract syntax trees, symbol tables, three address code and stack machines.									
CO1	Understand different phases of a compiler and explain lexical analysis principles.									
CO2	Apply parsing techniques to build a language-specific syntax analyser.									
CO3	Analyse syntax-directed translations, evaluation order, and type checking.									
CO4	Understand the association of runtime storage allocation with control flow and procedure calls.									
CO5	Apply code optimization on intermediate code for target code generation.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Compiler structure:** Analysis-synthesis model of compilation, Various phases of a compiler, Tool based approach to compiler construction. Lexical analysis: Interface with input, Parser and symbol table, Token, Lexeme and patterns, Regular definition, Transition diagrams, LEX.	**8**	Understand the analysis-synthesis model of compilation and the role of lexical analysis in converting source code into tokens using tools like LEX.	**1,2,3**
II	**Syntax analysis:** CFG's, Ambiguity, Associativity, Precedence, Top-down parsing, Recursive descend parsing, Transformation on the grammars, Predictive parsing, Bottom-up parsing, Operator precedence grammars, LR parsers (SLR, Canonical, LALR), YACC	**8**	Grasp the concepts of context-free grammars (CFGs) and develop skills in various parsing techniques including top-down and bottom-up parsing methods, utilizing tools like YACC.	**3,4**
III	**Syntax directed translation:** Inherited and synthesized attributes, Dependency graph, Evaluation order, Bottom up evaluation of S-attributed definitions L- attributed definitions and top down translation of attributes Type checking: Type system, Type expressions, Structural and name equivalence of types, Type conversion.	**10**	Learn to design and implement syntax-directed translation schemes, focusing on attribute grammars and type checking mechanisms, and understand the differences between structural and name equivalence of types.	**3,4**
IV	**Run time environments:**	**10**	Comprehend the	**4**

	Storage organization, Storage-allocation strategies, Access to nonlocal names, Activation tree, Activation record, Parameter passing, Symbol table and dynamic storage allocation Intermediate code generation: Intermediate representations, Translation of declarations, Assignments, Control flow, Boolean expressions and procedure calls.		organization and management of run-time storage, including activation records and parameter passing techniques, and learn the principles of intermediate code generation.	
V	**Code generation:** Issues in the design of a code generator, Basic blocks and flow graphs, Next use information, Register allocation, Code generation algorithm, Dag representation of programs, Code generation from dags, Peephole optimization and code generator generators.	**9**	Acquire knowledge on the design and implementation of a code generator, emphasizing optimization techniques, basic blocks, flow graphs, and register allocation strategies.	**4**
Practical Component				
Practical 1	Design a lexical analyser for a simple programming language using LEX.	2	Understand the basics of lexical analysis and the use of tools like LEX to create lexical analysers.	3
Practical 2	Implement a program to identify different tokens, lexemes, and patterns in a given source code.	2	Ability to recognize and classify tokens, lexemes, and patterns within a source code.	2
Practical 3	Create a transition diagram for a given regular expression and simulate its working.	2	Comprehend the conversion of regular expressions to transition diagrams and their usage in lexical analysis.	2
Practical 4	Write a recursive descent parser for a given context-free grammar (CFG).	2	Develop and implement top-down parsing techniques using recursive descent methodology.	3
Practical 5	Implement an SLR parser for a specified grammar and test it with various input strings.	2	Understand and apply bottom-up parsing techniques, specifically SLR parsing.	3
Practical 6	Using YACC, create a parser for a small language and demonstrate its usage with sample inputs.	2	Gain practical experience with parser generators like YACC and their integration with lexical analysers.	3
Practical 7	Construct a dependency graph for a given annotated parse tree and determine the order of attribute evaluation.	2	Understand the relationship between parse trees and attribute evaluation orders.	4

Practical 8	Develop an attribute grammar for a simple language construct and implement its evaluation using synthesized and inherited attributes.	2	Understand and implement syntax-directed translation using attribute grammars.	3
Practical 9	Write a type checker for a language that includes basic types, type expressions, and type conversions.	2	Implement type checking mechanisms and understand type systems and conversions.	3
Practical 10	Simulate the activation record creation and management for a simple recursive function.	2	Understand the structure and management of activation records in a runtime environment.	3
Practical 11	Implement intermediate code generation for a given set of language constructs (e.g., if-else, loops).	2	Develop skills in generating intermediate representations of high-level language constructs.	3
Practical 12	Create a symbol table management system that handles scope and lifetime of variables.	2	Design and implement a symbol table for managing variable scopes and lifetimes.	3
Practical 13	Design and implement a basic block and flow graph generator for a given intermediate code.	2	Understand the concepts of basic blocks and control flow graphs in code generation.	3
Practical 14	Develop a register allocation algorithm using graph coloring techniques.	2	Apply graph coloring techniques for efficient register allocation during code generation.	3
Practical 15	Implement a peephole optimization technique for a given intermediate code and demonstrate its effectiveness.	2	Understand and apply optimization techniques at the code generation level.	3

TEXT BOOKS:

T1: A.V. Aho, R. Sethi, J.D. Ullman, “Compilers: Principles, Techniques and Tools”, Addison – Wesley.
T2: Steven S. Muchnick, “Advanced Compiler Design and Implementation”, Elsevier

REFERENCE BOOKS:

R1: W. Appel, “Modern Compiler Implementation in C: Basic design”, Cambridge Press
R2: Fraser and Hanson, “A Retargetable C Compiler: Design and Implementation”, Addison-Wesley
R3: Dhamdhere, “Compiler Construction”, McMillan

OTHER LEARNING RESOURCES:

1. www.vssut.ac.in/lecture_notes/lecture1422914957.pdf
2. 2.http://csenote.weebly.com/principles-of-compiler-design.html
3. http://www.faadooengineers.com/threads/32857,Compiler-Design-Notes-full-book-pdf-download
4. https://www.vidyarthiplus.com/vp/thread,37033.html#.WF0PhlMrLDc

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand different phases of a compiler and explain lexical analysis principles.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
2	Apply parsing techniques to build a language-specific syntax analyser.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
3	Analyse syntax-directed translations, evaluation order, and type checking.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
4	Understand the association of runtime storage allocation with control flow and procedure calls.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
5	Apply code optimization on intermediate code for target code generation.	CO1, CO2, CO3, CO4, CO5, CO10, CO12

SEMESTER – VII									
Course Title	**Elementary Statistical Analysis**								
Course code	**23BTCS413R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**3**	**1**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the fourth year of the program**								
Course Objectives	1. To familiarize students with the fundamental concepts and terminology used in statistics, including descriptive and inferential statistics. 2. To enhance students' ability to collect, organize, analyze, and interpret data using appropriate statistical methods. 3. To enable students to apply statistical techniques to real-world problems, ensuring they can effectively use statistical software and interpret the results.								
CO1	Distinguish between different sampling methods and identify sampling and non-sampling errors in data collection.								
CO2	Apply probability theorems to solve problems involving binomial, Poisson, exponential, beta, and normal distributions.								
CO3	Conduct hypothesis tests and determine the significance for attributes and variables in large and small samples.								
CO4	Analyze relationships using multiple regression and correlation techniques; apply control charts in quality control.								
CO5	Perform non-parametric tests and analysis of variance (ANOVA) to evaluate data distributions.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Sampling and Sample Design** Introduction and Types of Sampling, Sampling Methods. Point Estimation and Interval Estimation. Sampling and Non-Sampling Errors	**8**	Distinguish between different sampling methods and their applicability in various research contexts.	**2,4**
II	**Probability and Theoretical Distribution** Approaches to Probability. Theorems of Probability. Binomial and Poisson Distribution. Exponential, Beta & Normal Distribution	**8**	Apply probability theorems to solve problems involving binomial, Poisson, and normal distributions.	**3,4**
III	**Hypothesis Testing and Significance Tests in Attributes & Variables** Procedure of Testing a Hypothesis. Significance Test in Attributes. Significance Test in Variables (Large Samples). Significance Test in Variables (Small Samples)	**10**	Conduct hypothesis tests for attributes and variables using large and small sample techniques.	**3,5**
IV	**Regression, Correlation and Statistical Quality Control** Partial & Multiple Correlation Multiple Regression Analysis Types and Techniques of Statistical Quality Control. Control Charts for	**10**	Perform multiple regression analysis and interpret the results for statistical quality control.	**3,4**

	Attributes and Variables.			
V	**Non Parametric Tests and Analysis of Variance** Chi-Square Test. Sign Test & Median Test. F Test / Multivariate Analysis Technique Analysis of Variance (ANNOVA)	**9**	Conduct ANOVA and non-parametric tests like Chi-Square to analyze data.	**3,5**

TEXT BOOKS:

T1: S. P. Gupta, Statistical Methods, Sultan Chand & Sons.
T2: C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa Prakashan.

REFERENCE BOOKS:

R1: Bendat and Piersol, Random data: Analysis and Measurement Procedures, Wiley InterScience
R2: D.C. Sancheti, V.K. Kapoor, Statistics, Theory methods and Application, Sultan Chand & Sons.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Distinguish between different sampling methods and identify sampling and non-sampling errors in data collection.	CO1, CO2, CO3, CO4, CO5, CO10
2	Apply probability theorems to solve problems involving binomial, Poisson, exponential, beta, and normal distributions.	CO1, CO2, CO3, CO4, CO5, CO10
3	Conduct hypothesis tests and determine the significance for attributes and variables in large and small samples.	CO1, CO2, CO3, CO4, CO5, CO10
4	Analyze relationships using multiple regression and correlation techniques; apply control charts in quality control.	CO1, CO2, CO3, CO4, CO5, CO10
5	Perform non-parametric tests and analysis of variance (ANOVA) to evaluate data distributions.	CO1, CO2, CO3, CO4, CO5, CO10

SEMESTER – VII										
Course Title	**Project-I**									
Course code	**23BTCS414R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 120S+240R	**0**	**0**	**0**	**8**	**16**	**0**	**4**	
Pre-requisite	**NIL**	**Co-requisite**	**NIL**							
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**									
Semester	**Summer/ I semester of the fourth year of the programme**									
Course Objectives	1. To enable students to perform comprehensive literature searches, critically review current knowledge, and synthesize information on advanced technical topics. 2. To provide students with hands-on experience in conducting detailed technical work, including theoretical studies, computer simulations, or hardware construction. 3. To improve students' ability to communicate their research findings and technical work effectively through progress reports, seminars, formal reports, and presentations.									
CO1	Apply IT principles for real-world problem-solving using programming languages and network solutions.									
CO2	Contribute to complex projects as a team member, demonstrating effective personal and team management.									
CO3	Develop programming skills to create and assess software, hardware, and network solutions.									
CO4	Apply personal and team management skills as a professional software developer.									
CO5	Cultivate employability skills and uphold professionalism in software development.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: a) theoretical studies b) computer simulations c) hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project; 4. Deliver a seminar on the general area of work being undertaken		Develop and Demonstrate comprehensive research, technical, and communication skills through literature review, technical implementation, progress documentation, and presentation.	**3,4,5,6**

	and specific contributions to that field; 5. Prepare a formal report describing the work undertaken and results obtained so far; and Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.			

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Distinguish between different sampling methods and identify sampling and non-sampling errors in data collection.	CO1,CO2,CO3, CO4,CO5,CO6,CO7,CO8,CO9,CO10,CO11, CO12
2	Apply probability theorems to solve problems involving binomial, Poisson, exponential, beta, and normal distributions.	CO1,CO2,CO3, CO4,CO5,CO6,CO7,CO8,CO9,CO10,CO11, CO12
3	Conduct hypothesis tests and determine the significance for attributes and variables in large and small samples.	CO1,CO2,CO3, CO4,CO5,CO6,CO7,CO8,CO9,CO10,CO11, CO12
4	Analyze relationships using multiple regression and correlation techniques; apply control charts in quality control.	CO1,CO2,CO3, CO4,CO5,CO6,CO7,CO8,CO9,CO10,CO11, CO12
5	Perform non-parametric tests and analysis of variance (ANOVA) to evaluate data distributions.	CO1,CO2,CO3, CO4,CO5,CO6,CO7,CO8,CO9,CO10,CO11, CO12

SEMESTER – VII									
Course Title	**Generative AI**								
Course code	**23BTCS415R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 36T + 30S	**2**	**0**	**0**	**4**	**0**	**0**	**3**
Pre-requisite	**NIL**	**Co-requisite**	**NIL**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/ I semester of the fourth year of the programme**								
Course Objectives	1. To provide students with a comprehensive understanding of generative AI concepts and techniques. 2. To equip students with the skills to develop and implement generative AI models. 3. To foster creativity and innovation by leveraging generative AI for various applications.								
CO1	Develop proficiency in using generative AI frameworks and tools to create, train, and optimize models.								
CO2	Design, implement, and evaluate various generative AI models such as GANs, VAEs, and autoregressive models.								
CO3	Apply generative AI techniques to solve real-world problems and create innovative solutions across different domains.								
CO4	Understand the ethical implications of generative AI and integrate responsible practices into their work.								
CO5	Critically analyze the strengths and limitations of different generative AI approaches and stay informed about current research and future trends.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Generative AI:** Definition and significance of generative AI. Historical context and evolution of generative models. Fundamental concepts: probability distributions, latent spaces, and learning paradigms. Overview of applications in various domains.	**5**	Explain the fundamental concepts and historical evolution of generative AI and its applications across various domains.	**1,2**
II	**Generative Adversarial Networks (GANs):** GAN architecture and working principles. Training GANs: challenges and solutions. Variants of GANs (e.g., DCGAN, WGAN, CycleGAN). Applications: image generation, style transfer, data augmentation.	**6**	Describe GAN architecture, training challenges, and their variants, including applications in image generation and style transfer.	**2,3**
III	**Variational Autoencoders (VAEs):** VAE architecture and mathematical foundations. Training and optimizing VAEs. Applications: data generation, anomaly detection, latent space exploration Objectives: 1. Understand the principles	**6**	Implement and optimize VAE models, understanding their architecture and applications in data generation and anomaly detection.	**3,4**

	and architecture of VAEs 2. Gain proficiency in training and optimizing VAE models 3. Explore various applications of VAEs			
IV	**Autoregressive Models and Transformers** Overview of autoregressive models (e.g., PixelRNN, PixelCNN). Transformer-based models (e.g., GPT, BERT) and their significance. Sequence generation and modeling	**7**	Compare autoregressive models and transformer-based models, explaining their significance in sequence generation and modeling.	**2,4**
V	**Ethical and Practical Considerations in Generative AI** Ethical implications of generative AI. Addressing bias and fairness in generative models. Security concerns and potential misuse. Future trends and research directions in generative AI.	**6**	Evaluate the ethical implications, bias, and security concerns of generative AI, and discuss future trends and research directions.	**2,5**
Practical Component				
Practical 1	Implementing a Simple GAN	3	Understand the basic architecture of GANs and implement a simple GAN model for image generation.	3
Practical 2	Training a DCGAN on CIFAR-10 Dataset	3	Gain proficiency in training Deep Convolutional GANs and understand the nuances of training on a standard dataset.	4
Practical 3	Exploring Latent Spaces with VAEs	3	Visualize and explore the latent space of a trained VAE, and understand how latent space manipulation affects generated outputs.	3
Practical 4	Anomaly Detection using VAEs	3	Implement a VAE for anomaly detection in a dataset and evaluate its performance.	5
Practical 5	Style Transfer using Cycle GAN	3	Apply CycleGAN for style transfer tasks and understand the underlying mechanics.	4
Practical 6	Training PixelCNN for Image Generation	3	Implement and train an autoregressive PixelCNN model for image generation.	4
Practical 7	Fine-tuning a Pre-trained Transformer Model (e.g., GPT-2)	3	Gain proficiency in fine-tuning a pre-trained transformer model for specific text generation tasks.	4
	Sequence Modeling with	3	Implement a transformer	5

Practical 8	Transformer Models		model for sequence modeling tasks and evaluate its performance.	
Practical 9	Addressing Bias in Generative Models	3	Identify and mitigate bias in generative models through data pre-processing and model adjustments.	6
Practical 10	Assessing Security Concerns in Generative AI	3	Evaluate the potential security risks associated with generative AI models and propose mitigation strategies.	5

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Develop proficiency in using generative AI frameworks and tools to create, train, and optimize models.	CO1, CO2, CO3, CO4, CO10, CO12
2	Design, implement, and evaluate various generative AI models such as GANs, VAEs, and autoregressive models.	CO1, CO2, CO3, CO4, CO10, CO12
3	Apply generative AI techniques to solve real-world problems and create innovative solutions across different domains.	CO1, CO2, CO3, CO4, CO5, CO10, CO12
4	Understand the ethical implications of generative AI and integrate responsible practices into their work.	CO1, CO2, CO3, CO4, CO10, CO12
5	Critically analyze the strengths and limitations of different generative AI approaches and stay informed about current research and future trends.	CO1, CO2, CO3, CO4, CO5, CO10, CO12

SEMESTER – VII									
Course Title	**Artificial Intelligence**								
Course code	**23BTCS416R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Summer/I semester of the fourth year of the program**								
Course Objectives	1.Understand the fundamentals of artificial intelligence, including machine learning, neural networks, and natural language processing. 2.Explore real-world applications such as computer vision, autonomous vehicles, virtual assistants, and healthcare diagnostics. 3.Discuss the ethical implications of AI technologies, including bias in algorithms, privacy concerns, and the impact on employment and society.								
CO1	Understand key AI concepts, including machine learning and neural networks.								
CO2	Apply AI techniques to solve real-world problems effectively.								
CO3	Develop chatbot using IBM Watson service.								
CO4	Enhance problem-solving abilities with IBM Cloud service.								
CO5	Apply EDA to real-world data.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to AI:** fundamental concepts of Artificial Intelligence (AI). define AI and trace its historical evolution, highlighting its profound impact on various societal domains, exploring the different types of AI, distinguishing between Narrow AI, tailored for specific tasks, and General AI, which aims to mimic human intelligence.	**7**	Understand basic AI concepts, algorithms, and applications to solve simple problems.	2,3, 4
II	**Advanced Python and Data Visualization:** Introducing Numpy: learn the NumPy attribute and method Pandas: Introducing Pandas for data manipulation and analysis, explore Series, data frames, and operations like cleaning, filtering, and merging datasets efficiently. Matplotlib: create diverse plots, customize visualizations, and depict data trends, distributions, and relationships effectively.	**8**	Develop advanced Python skills to create complex data visualizations for effective communication of insights.	4, 5, 6
III	**Introduction to Machine Learning and Algorithms:** Understanding Machine Learning: exploring its definition and basic principles and learning about the types of machine learning tasks, including supervised, unsupervised,	**10**	Understand and apply basic machine learning algorithms to analyze data and solve problems.	2, 3, 4

	and reinforcement learning. Supervised Learning: Linear Regression, Logistic Regression: Unsupervised Learning: K-Means Clustering Additional Algorithms: Decision Trees, k-nearest Neighbors (kNN), Random Forest			
IV	**IBM Watson for Machine Learning and Bot Creation:** Introduction to IBM Watson: explore Watson Studio, IBM's integrated environment for data scientists, developers, and domain experts, to build and deploy ML models. Creating Bots using Watson Assistant: learn the basics of Watson Assistant, including intents, entities, dialog flows, and integration capabilities.	**12**	Utilize IBM Watson to develop machine learning models and create intelligent bots for various applications.	3, 4, 5
V	**IBM Natural Language Processing (NLP):** Introduction to NLP: learn the basics of natural language processing, and IBM's NLP services, such as Watson Natural Language Understanding (NLU) and Watson Discovery, for extracting insights from unstructured text data.	**8**	Apply IBM NLP techniques to analyze, interpret, and extract insights from textual data.	3, 4, 5
Practical Component				
Practical 1	Introduction to NumPy	3	Apply NumPy arrays and operations for efficient numerical computing.	3
Practical 2	Data Manipulation with Pandas	**3**	Use Pandas to manipulate and analyze datasets, including cleaning, filtering, and merging.	3
Practical 3	Data Visualization with Matplotlib	3	Create customized plots to visualize data trends, distributions, and relationships.	4
Practical 4	Linear Regression with Supervised Learning	**3**	Implement and evaluate linear regression models for predictive analytics.	4
Practical 5	Logistic Regression with Supervised Learning	3	Apply logistic regression for binary classification tasks.	4
Practical 6	K-Means Clustering with Unsupervised Learning	**3**	Perform clustering analysis to group data points based on similarities.	4

Practical 7	Decision Trees for Classification	3	Construct decision trees and interpret results for decision-making.	4
Practical 8	Perform clustering analysis to group data points based on similarities.	**3**	k-Nearest Neighbors (kNN) Algorithm	4
Practical 9	Random Forest for Ensemble Learning	3	Build and assess random forest models for improved predictive accuracy.	4
Practical 10	Building a Chatbot with Watson Assistant	**3**	Create a functional chatbot using Watson Assistant, integrating intents, entities, and dialog flows.	4

SEMESTER – VIII									
Course Title	**Cryptography & Network Security**								
Course code	**23BTCS421R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the fourth year of the programme**								
Course Objectives	1. To provide deeper understanding into cryptography, its application to network security, threats/vulnerabilities to networks and countermeasures. 2. To explain various approaches to Encryption techniques, strengths of Traffic Confidentiality, Message Authentication Codes. 3. To familiarize Digital Signature Standard and provide solutions for their issues.								
CO1	Identify basic security attacks and services.								
CO2	Use symmetric and asymmetric key algorithms for cryptography.								
CO3	Design a security solution for a given application.								
CO4	Analyze Key Management techniques and the importance of number Theory.								
CO5	Understanding of Authentication functions how Message Authentication Codes and Hash Functions work.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**INTRODUCTION**: Security trends, The OSI Security Architecture, Security Attacks, Security Services, and Security Mechanisms, A model for Network security. CLASSICAL ENCRYPTION TECHNIQUES: Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques, Rotor Machines, Stenography.	**10**	To understand different security services and security mechanisms and different classical encryption techniques	1,2
II	**BLOCK CIPHER AND DATA ENCRYPTION STANDARDS:** Block Cipher Principles, Data Encryption Standards, the Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles. ADVANCED ENCRYPTION STANDARDS: Evaluation Criteria for AES, the AES Cipher. MORE ON SYMMETRIC CIPHERS: Multiple Encryption, Triple DES, Block Cipher Modes of Operation, Stream Cipher and RC4.	**10**	Understanding block cipher and data encryption standards	1,2
III	**PUBLIC KEY CRYPTOGRAPHY AND RSA:** Principles Public key crypto Systems, Diffie Hellman Key Exchange, the RSA algorithm, Key Management, Elliptic Curve Arithmetic, Elliptic Curve	**15**	Analyzing the concepts of Public key cryptography and RSA.	1,2

	Cryptography. MESSAGE AUTHENTICATION AND HASH FUNCTIONS: Authentication Requirement, Authentication Function, Message Authentication Code, Hash Function, Security of Hash Function and MACs. HASH AND MAC ALGORITHM: Secure Hash Algorithm, Whirlpool, HMAC, CMAC. DIGITAL SIGNATURE: Digital Signature, Authentication Protocol, Digital Signature Standard.			
IV	**AUTHENTICATION APPLICATION:** Kerberos, X.509Authentication Service, Public Key Infrastructure. EMAILSECURITY: Pretty Good Privacy (PGP) and S/MIME. IPSECURITY: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Pay load, Combining Security Associations and Key Management.	**15**	Analyzation of the concepts of Authentication Application, Email Security and IP Security.	1,2
V	**WEB SECURITY:** Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET), Intruders, Viruses and related threats. FIREWALL: Firewall Design principles, Trusted Systems	**10**	Analyzation of Web Security and firewall.	1,2
Practical	**1. Cryptographic Implementations**: • Implement classical ciphers (Caesar, Vigenère) and modern ciphers (AES, RSA) using programming languages like Python or Java.	**6**	Describe, illustrate, and explain the basic components of Cryptographic Implementations.	1,2,3,4
	2. Network Security Tools: • Configure and use firewalls (e.g., pfSense) • Set up and analyze VPNs (e.g., OpenVPN)	**6**	Describe, illustrate, and explain the Network Security Tools.	1,2,3,4
	3. Security Protocols and Applications: • Implement and test SSL/TLS for secure communication • Develop secure email systems using PGP or S/MIME	**6**	Describe, illustrate, and explain the Security Protocols and Applications.	1,2,3,4
	4. Security Analysis and	**6**	Describe, illustrate, and	

	Testing: • Use network security tools like Wireshark for traffic analysis • Perform penetration testing with tools like Metasploit		explain the Security Analysis and Testing.	1,2,3,4
	5. Emerging Technologies: • Explore blockchain development using platforms like Ethereum • Implement basic post-quantum cryptographic algorithms	**6**	Describe, illustrate, explain, and explore blockchain development using platforms like Ethereum.	1,2,3,4

TEXT BOOKS:

T1: William Stallings (2006), Cryptography and Network Security: Principles and Practice,4th edition, Pearson Education, India.

T2: William Stallings (2000), Network Security Essentials (Applications and Standards), Pearson Education, India.

REFERENCE BOOKS:

R1: Charlie Kaufman (2002), Network Security: Private Communication in a Public World, 2nd edition, Prentice Hall of India, New Delhi.

R2: Atul Kahate (2008), Cryptography andNetworkSecurity,2nd edition, Tata McGraw hill, India.

R3: Robert Bragg, Mark Rhodes (2004), Network Security: The complete reference, Tata McGraw-Hill, India.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Identify basic security attacks and services.	CO1,CO2,CO3,CO4,CO5,CO10,CO12
2	Use symmetric and asymmetric key algorithms for cryptography.	CO1,CO2,CO3,CO4,CO5,CO10,CO12
3	Design a security solution for a given application.	CO1,CO2,CO3,CO4,CO5,CO10,CO12
4	Analyze Key Management techniques and the importance of number Theory.	CO1,CO2,CO3,CO4,CO5,CO10,CO12
5	Understanding of Authentication functions the manner in which Message Authentication Codes and Hash Functions work.	CO1,CO2,CO3,CO4,CO5,CO10,CO12

SEMESTER – VIII									
Course Title	**Image Processing and Pattern Recognition**								
Course code	**23BTCS422R**	**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 Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the fourth year of the programme**								
Course Objectives	1. To provide a comprehensive study of digital image processing fundamentals, techniques, and applications. 2. To explain various approaches to image enhancement, restoration, segmentation, feature extraction, and pattern recognition. 3. To familiarize Emphasizes theoretical understanding and practical implementation.								
CO1	Understand spatial filtering techniques to enhance digital images in the spatial domain effectively.								
CO2	Evaluate the impact of Fourier Transform properties on image enhancement in the frequency domain.								
CO3	Compare and contrast error-free and lossy image compression models for efficient data storage.								
CO4	Implement adaptive thresholding techniques for image segmentation and edge detection in practice.								
CO5	Understand the core concepts and principles of pattern recognition.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction** Digital image representation, Fundamentals steps in Image Processing, Elements of DIP systems. **Digital Image Fundamentals** Elements of Visual Perception, Sampling and Quantization, Relationships between pixels, Linear and Nonlinear operations.	**10**	To understand digital image fundamentals.	1,2
II	**Image Enhancement in Spatial domain** Enhancement by Point Processing, Histogram Processing, Spatial Filtering.. **Image Enhancement in Frequency Domain** Introduction to the Fourier Transform, The discrete Fourier Transform, Properties of the two-dimensional Fourier Transform, Smoothing Frequency-domain filters, Sharpening Frequency domain filters.	**10**	Understanding Image Enhancement in Spatial domain and Frequency Domain.	1,2
III	Image Compression Fundamentals, Image Compression Models, Error Free Compression, Lossy Compression.	**15**	Analyzing the concepts of Image Compression Fundamentals.	1,2
IV	Image Segmentation Threshold Techniques: Global, Adaptive and Optimum thresholding, Edge detection, Region	**15**	Analyzation of the concepts of Image Segmentation	1,2

	Growing.		Threshold Techniques.	
V	**Pattern Recognition** Definition and scope of pattern recognition History and applications of pattern recognition Basic concepts: patterns, features, and classifiers Overview of different approaches: statistical, syntactic, and neural Pattern recognition system design cycle	**10**	Analyzation of Pattern Recognition.	1,2
Practical	**1. Basic Image Processing**: • Implement image enhancement techniques (contrast stretching, histogram equalization) using Python/OpenCV • Apply spatial and frequency domain filters to images	**6**	Describe, illustrate, and explain the basic image processing components.	1,2, 3,4
	2. Advanced Image Processing: • Implement edge detection and morphological operations • Perform image segmentation using thresholding and region-based methods	**6**	Describe, illustrate, and explain the advanced image processing components.	1,2, 3,4
	3. Feature Extraction and Pattern Recognition: • Extract features (shape, texture, color) from images • Implement PCA and LDA for dimensionality reduction • Develop and evaluate classifiers (SVM, k-NN) for pattern recognition tasks	**6**	Describe, illustrate, and explain the basic components of feature extraction and pattern recognition.	1,2, 3,4
	4. Machine Learning and Deep Learning: • Train and test machine learning models for image classification • Implement CNNs for image classification using frameworks like TensorFlow/Keras • Apply transfer learning using pre-trained models (e.g., VGG16, ResNet)	**6**	Describe, illustrate, and explain basic components of Machine Learning and Deep Learning.	1,2, 3,4
	5. Application Development: • Develop an object detection system using YOLO or Faster R-CNN • Implement a face recognition system using deep learning techniques • Create a project focused on medical image analysis or real-time image processing	**6**	Describe, illustrate, and explain basic components of application development.	1,2, 3,4

TEXT BOOKS:

T1: Rafael C Gonzalez, Richard E Woods,—Digital Image Processing, Pearson Education Publications.

T2: Rajjan Shinghal,—Pattern Recognition, Oxford Publications.

T3: Chanda and Majumder,—Digital Image Processing and Analysis, Prentice Hall Publications.

REFERENCEBOOKS:

R1: Rafael C Gonzalez, Richard E Woods,—Digital Image Processing with Matlab, Pearson Education Publications.

R2: S.Sridhar,—Digital Image Processing, Oxford University Press.

R3: Jayaraman,—Digital Image Processing, McGraw Hill.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand spatial filtering techniques to enhance digital images in the spatial domain effectively.	CO1,CO2,CO3, CO5,CO10,CO12
2	Evaluate the impact of Fourier Transform properties on image enhancement in the frequency domain.	CO1,CO2,CO3, CO5,CO10,CO12
3	Compare and contrast error-free and lossy image compression models for efficient data storage.	CO1,CO2,CO3, CO5,CO10,CO12
4	Implement adaptive thresholding techniques for image segmentation and edge detection in practice.	CO1,CO2,CO3, CO4, CO5,CO10,CO12
5	Understand the core concepts and principles of pattern recognition.	CO1,CO2,CO3, CO4, CO5,CO10,CO12

SEMESTER – VIII										
Course Title	**Project II**									
Course code	**23BTCS423R**	**Total credits: 6** **Total hours: 72**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**12**	**16**	**0**	**6**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Technology in Computer Science and Engineering (DS and AI)**								
Semester	**Winter/II semester of the fourth year of the programme**								
Course Objectives	1. To equip students with the IT principles and programming skills. 2. To equip students with team management abilities necessary to develop and implement software, hardware, and network solutions effectively. 3. To cultivate employability skills and professionalism in software development.								
CO1	Apply IT principles for real-world problem-solving using programming languages and network solutions.								
CO2	Manage complex projects as a team member, demonstrating effective personal and team management skills.								
CO3	Develop programming skills to create and assess software, hardware, and network solutions.								
CO4	Apply personal and team management skills as a professional software developer.								
CO5	Cultivate employability skills and uphold professionalism in software development.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: a) theoretical studies b) computer simulations c) hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project;	**72**	To understand, analyze, manage, develop and cultivate programming skills to create and assess software, hardware, and network solutions.	1,2,3,4,5

	4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field; 5. Prepare a formal report describing the work undertaken and results obtained so far; and Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.			

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply IT principles for real-world problem-solving using programming languages and network solutions.	CO1,CO2,CO3, CO4, CO5,CO6, CO 7, CO8, CO9, CO10, CO12
2	Manage complex projects as a team member, demonstrating effective personal and team management skills.	CO1,CO2,CO3, CO4, CO5,CO6, CO 7, CO8, CO9, CO10, CO12
3	Develop programming skills to create and assess software, hardware, and network solutions.	CO1,CO2,CO3, CO4, CO5,CO6, CO 7, CO8, CO9, CO10, CO12
4	Apply personal and team management skills as a professional software developer.	CO1,CO2,CO3, CO4, CO5,CO6, CO 7, CO8, CO9, CO10, CO12
5	Cultivate employability skills and uphold professionalism in software development.	CO1,CO2,CO3, CO4, CO5,CO6, CO 7, CO8, CO9, CO10, CO12

ASSAM DOWN TOWN UNIVERSITY

Curriculum and Syllabus

Bachelor of Computer Application

OUTCOME BASED EDUCATION FRAMEWORK

CHOICE BASED CREDIT SYSTEM

Version: 2.1

FACULTY OF COMPUTER TECHNOLOGY

July, 2023

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 Board of Studies (BOS) meeting of the Faculty of Computer Technology held on dated 14/07/2023 and approved by the Emergent Academic Council (AC) meeting held on dated 28/07/2023.

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 multi disciplinary 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 conflict-free global society.

6. To be renowned for creating new knowledge through high quality inter disciplinary research for betterment of society.

7. Become a key hub for the growth and excellence of AdtU's stake holders 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

Understanding the fundamentals of computer programming languages and databases is of utmost importance in the field of computer science and information technology. The Bachelor of Computer Application (BCA) Programme has been designed in sync with the latest industry demands. This programme enriches the students with the necessary skills to build a successful career in the Information Technology sector. Through this programme, we intend to create a skilled workforce to take up future challenges in the industry. It aims at educating the students as expert programmers and computer professionals for the future.

I. Specific Features of the Curriculum

The Bachelor of Computer Application (BCA) programme is meticulously designed to align with current industry demands. It focuses on imparting a strong foundation in programming languages and database management. Students gain practical skills essential for the IT sector, preparing them for successful careers. The curriculum emphasizes hands-on experience, ensuring students are ready to tackle real-world challenges. By integrating the latest technological trends, the programme ensures relevance in a rapidly evolving field. It aims to produce expert programmers and computer professionals. Graduates are equipped to meet future industry challenges. Continuous updates keep the curriculum effective. The programme builds a skilled workforce for the future.

II. Eligibility Criteria:

Students should be secured 45 % in 10+2 in Arts/Science/Commerce from AHSEC or any other equivalent Examination recognized as such by the University with preferably Mathematics as one of the subjects in HS (Pass Marks).

Note: Candidate having (10+2) without mathematics/computer Science has to undertake additional bridge courses.

III. Program Educational Objectives (PEO):

PEO1: To produce graduates who have a strong foundation of knowledge and skills in the field of Computer Applications.

PEO2: To produce graduates who can provide solutions to challenging problems in their profession by applying Computer Science theory and practices.

PEO3: To produce graduates who are employable in industries/public sector/Govt. organizations or work as an entrepreneur, as well as can provide leadership and are effective in a multidisciplinary environment

IV. Program Specific Outcomes (PSO):

PSO 1: Advance the graduates with the contemporary trends in industrial/Computer Application environments and also will be capable of innovating novel solutions to prevailing problems by applying software engineering techniques and strategies.

PSO 2: Develop a holistic comprehension of Computer Science and management principles required for the application of sustainable technologies for societal development, and also will be able to communicate effectively in oral, written, visual, and graphic modes as a member and leader in a team, to manage projects in multidisciplinary environments.

PSO 3: Prepare the graduates for the state, national, and international competitive examinations with focused and updated syllabi.

V. Program Outcome (PO):

PO1 Basic Mathematical Knowledge: Apply knowledge of Mathematics & Statistics to the solution of ICT problems.

PO2 Problem Analysis, Design/Development of Solutions: Analysis the IT problem and then design/develop the solutions using Software Engineering principles that meet specified needs with appropriate consideration for cultural, societal, and environmental considerations.

PO3 Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern ICT tools including prediction and modelling with an understanding of the limitations.

PO4 Environment and Sustainability: Understand the impact of professional IT solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

PO5 Ethics: Apply ethical principles and commit to professional ethics, responsibilities, and norms.

PO6 Communication: Communicate effectively with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO7 Project Management and Finance: Demonstrate knowledge and understanding of Software Engineering and Project management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO8 Life-long Learning: Recognize the need for and have the preparation and ability to Engage in independent and life-long learning in the broadest context of technological Change.

Total Credits to be Earned: 140

VI. Career Prospects:

After completing a degree in one of the most desirable professions in the current times, Computer Application graduates have a wide array of options at their disposal. There is no one single career option but several after Computer Application -

a. Higher Studies in Technical Field: From there one could go into the research field or complete PhD and work as a Faculty. In order to pursue M. Tech. in India, one will need to clear the GATE Examination, which will open a lot of opportunities to study Master's as well as work in PSUs. From here you can work in Government owned companies like DRDO, BARC, CSIR, ISRO, AAI, ONGC etc.
b. Technical Job: Graduates can work at a good company in various fields like Data science and Analysis, Machine Learning Engineer, Software Developer, Blockchain Developer and Engineer, Computer Network Architect, Database Administration and Management, Security Analyst, Game Development, Digital Marketing, etc.
c. Government Services: Along with pursuing technical government jobs after appearing for GATE, engineering graduates could also work in non technical fields by applying and studying for various government exams like UPSC, SSC, Banking exams, Defence or IAS. These are very rewarding jobs as they are well paid, and very secure.

Entrepreneurship: If someone is filled with ideas with a need to create a change in the society, and like being one's own boss, one can even commence own start-up. For an entrepreneur, "opportunity" equates to something that solves a problem and addresses a need in a way that the entrepreneurs can profit from or further a cause.

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-Voice etc.:

i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.

ii) Viva-Voice, 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 x 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.

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

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, Gi is the Grade Point secured in the i^{th} registered Course and Ci 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, Gi is the Grade Point secured in the ith completed Course and Ci is the Credit (weight)of that Course.

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

(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 class room teaching through series of lectures delivering concepts using ITC facilities, white or black board. Notes may also be circulated to the students however; the students are to be involved in preparation of the notes. The teacher will be responsible in selecting the best note for circulation. The teacher- centric methodology has recently fallen out of favor because this strategy for teaching is seen to favor 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 student for studying by themselves, prepare presentations, notes etc., and present at respective class time after consultation and discussion with the course teachers. The teacher facilitate 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 behavior 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 visit to the laboratory for experiments or field and survey. 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 a 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 with problems. During the library hours the student along with the teacher visits library search probable solution for the assigned problem. The same has to be done in group 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, Student present and deliver lectures in presence of teacher and supervised by teacher	60%
Student visit fields or perform experiments or teacher perform demonstration	05%
Flipped Classroom approach	10%
Cooperative learning approach	05%

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

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

Breakdown of Credits

Sl. No	Category		Total number of Credits
1	University Core(UC)	Skill Enhancement Course (SEC)	4
		Ability Enhancement Course(AEC)	-
		Field Training	3
		Discipline Specific Elective (DSE)	-
		Value Added Course (VAC)	-
2	University Elective (UE)	Multidisciplinary Course (MDC)	13
		Value Added Course (VAC)	3
3	Program Core(PC)	Discipline Specific Core(DSC)	83
		Field Training	-
		Research /Industry Internship	16
		Summer Internship	3
4	Program Elective (PE)	Discipline Specific Elective (DSE)	11
		Value Added Course (VAC)	4
5	Faculty Core(FC)	Skill Enhancement Course (SEC)	-
		Ability Enhancement Course(AEC)	-
Total			**140**

Breakdown by categories of courses

Sl no	Category	Credits	%
1	Science	7	5
2	Engineering	132	94.29
3	Commerce and Management	1	0.71
Total		**140**	**100%**

SEMESTER WISE COURSE DISTRIBUTION

	Sl. No	Course Code	Course Title	Category I	Engagement							Maximum Marks for			TOTAL Marks
					L	T	P	S	R	O/F	C	IA*	SEE*	PE*	
Semester I	1	23BCAO111R	DIGITAL ELECTRONICS	DSC (MINOR)	2	0	0	0	0	0	2	40	60	0	100
	2	23BCAO112R	PROGRAMMING FOR PROBLEM SOLVING	DSC (MAJOR)	2	0	4	0	0	0	4	40	60	100	200
	3	23BCAO113R	MATHEMATICS	DSC (MINOR)	3	0	0	0	0	0	3	40	60	0	100
	4	23BCAO114R	FUNDAMENTALS OF COMPUTER APPLICATIONS	DSC (MAJOR)	3	0	2	0	0	0	4	40	60	100	200
	5	23UBPD112R	ELEMENTARY ENGLISH	AEC	0	0	2	0	0	0	2	0	0	100	100
	6	23UBCC111	CO-CURRICULAR ACTIVITY	VAC	0	0	0	4	0	0	1	0	0	100	100
	7	23MOSY113R 23MOSY114R 23MOSY115R	MOOCS I	SEC	0	0	0	0	0	0	1	0	0	100	100
	8	23BCAO115R	FIELD BASED LEARNING (2 VISIT PER SEMESTER)	Field Training	0	0	0	0	0	8	1	0	0	100	100
				Total	**10**	**0**	**8**	**4**	**0**	**8**	**18**	**160**	**240**	**600**	**1000**

	Sl. No	Course Code	Course Title	Category I	Engagement						Credit	Maximum Marks for			TOTAL Marks
					L	T	P	S	R	O/F		IA*	SEE*	PE*	
Semester II	1	23BCAO121R	DATA STRUCTURE USING C	DSC (MAJOR)	3	0	2	0	0	0	4	40	60	100	200
	2	23BCAO122R	COMPUTER ORGANIZATION AND ARCHITECTURE	DSC (MAJOR)	3	0	2	0	0	0	4	40	60	100	200
	3	23BCAO123R	INTRODUCTION TO WEB TECHNOLOGY	DSC (MAJOR)	3	0	2	0	0	0	4	40	60	100	200
	4	23BCAO124R	FIELD BASED LEARNING	Field Training	0	0	0	0	0	8	1	0	0	100	100
	5	23UBES101R	ENVIRONMENTAL STUDIES	VAC	2	0	0	0	0	0	2	40	60	0	100
	6	23UBPD124R	ADVANCED IMPLICIT ENGLISH	AEC	0	0	4	0	0	0	2	0	0	100	100
	7	23MOSY121R/ 23MOSY122R/ 23MOSY123R	MOOCS II	SEC	0	0	0	0	0	0	1	0	0	100	100
	8	23UBEC121	EXTRA CURRICULAR ACTIVITY	VAC	0	0	0	4	0	0	1	0	0	100	100
		Credit Without Brdge Course			**11**	**0**	**10**	**4**	**0**	**8**	**19**	**160**	**240**	**700**	**1100**
	9	23BCAO125R	BRIDGE COURSE I (ALGORITHM FOR PROBLEM SOLVING)	BRIDGE COURSE	3	0	0	0	0	0	3	40	60	0	100
	10	23BCAO126R	BRIDGE COURSE II (FUNDAMENTAL OF STATISTICS)	BRIDGE COURSE	3	0	0	0	0	0	3	40	60	0	100
	Total				**17**	**0**	**10**	**4**	**0**	**8**	**25**	**240**	**360**	**700**	**1300**

	Sl. No	Course Code	Course Title	Category I	Engagement							Maximum Marks for			TOTAL Marks
					L	T	P	S	R	O/F	Credit	IA*	SEE*	PE*	
Semester III	1	23BCAO211R	DATABASE MANAGEMENT SYSTEMS	DSC (MAJOR)	3	0	2	0	0	0	4	40	60	100	200
	2	23BCAO212R	OPERATING SYSTEMS	DSC (MAJOR)	3	0	2	0	0	0	4	40	60	100	100
	3	23BCAO213R	OBJECT ORIENTED PROGRAMMING PARADIGM IN JAVA	DSC (MAJOR)	3	0	2	0	0	0	4	40	60	100	200
	4	23BCAO214R	WEB AND MOBILE PROGRAMMING TECHNOLOGIES	DSC (MAJOR)	3	0	2	0	0	0	4	40	60	100	200
	5	23BCAO215R/ 23BCAO216R/ 23BCAO217R	PE I	DSC (MAJOR)	3	0	0	0	0	0	3	40	60	0	100
	6	23MOSY211R 23MOSY212R 23MOSY213R	MOOCS III	SEC	0	0	0	0	0	0	1	0	0	100	100
	7	23BCAO218R	FIELD BASED LEARNING	Field Training	0	0	0	0	0	8	1	0	0	100	100
	8	23UULS212R	BLSS	VAC	0	0	2	0	0	0	1	0	0	100	100
	9	23UBPD212R	PDP	AEC	0	0	4	0	0	0	2	0	0	100	100
	10	23UUFL213R	FL	VAC	0	0	2	0	0	0	1	0	0	100	100
	11	23BCAO001R	GENERIC ELECTIVE I	MDC	0	0	0	0	0	0	1	0	0	100	100
	12	23UBCC121 / 23UBEC121	CO-CURRICULAR ACTIVITIES / EXTRA-CURRICULAR ACTIVITIES	VAC	0	0	0	4	0	0	1	0	0	100	100
	13	23BCAO219R	MINI PROJECT I	DSC	0	0	0	4	0	0	1	0	0	0	100
	Credit Without Brdge Course				**15**	**0**	**16**	**8**	**0**	**8**	**28**	**200**	**300**	**1100**	**1600**
	14	23BCAO2110R	BRIDGE COURSE III (INTERNET CONCEPT AND WEB DESIGN)	BRIDGE COURSE	3	0	0	0	0	0	3	40	60	0	100
	15	23BCAO2111R	BRIDGE COURSE IV (COMPUTER APPLICATION TECHNIQUES)	BRIDGE COURSE	3	0	0	0	0	0	3	40	60	0	100
	Credit With Brdge Course				**21**	**0**	**16**	**12**	**0**	**0**	**34**	**280**	**420**	**1100**	**1800**

	Sl. No	Course Code	Course Title	Category I	Engagement						Credit	Maximum Marks for			TOTAL Marks
					L	T	P	S	R	O/F		IA*	SEE*	PE*	
Semester IV	1	23BCAO221R	DESIGN AND ANALYSIS OF ALGORITHMS	DSC (MAJOR)	3	0	0	0	0	0	3	40	60	0	100
	2	23BCAO222R	BASICS OF PYTHON PROGRAMMING	DSC (MAJOR)	2	1	4	0	0	0	5	40	60	100	200
	3	23BCAO223R	COMPUTER NETWORKS	DSC (MAJOR)	3	0	0	0	0	0	3	40	60	0	100
	4	23BCAO224R	INTRODUCTION TO LINUX	DSC (MAJOR)	2	0	2	0	0	0	3	40	60	100	200
	5	23BCAO225R/ 23BCAO228R	PE II	DSC (MAJOR)	2	0	2	0	0	0	3	40	60	100	200
	6	23BCAO226R/ 23BCAO229R	PE III	DSC (MAJOR)	2	0	2	0	0	0	3	40	60	100	200
	7	23UULS221R	BAS	VAC	0	0	2	0	0	0	1	0	0	100	100
	8	23BCAO002R	GENERIC ELECTIVE II	MDC	0	0	0	0	0	0	2	0	0	100	100
	9	23MOSY221R 23MOSY222R 23MOSY223R	MOOCS IV	VAC	0	0	0	0	0	0	1	0	0	100	100
	10	23UBPD222R	PDP	AEC	0	0	4	0	0	0	2	0	0	100	100
	11	23UCDL221R	COMPUTATIONAL SYSTEMS AND DIGITAL WORLD	VAC	0	0	2	0	0	0	1	0	0	100	100
	12	23UBCC221 / 23UBEC221	CO-CURRICULAR ACTIVITIES / EXTRA-CURRICULAR ACTIVITIES	VAC	0	0	0	4	0	0	1	0	0	100	100
	13	23BCAO227R	MINI PROJECT II	DSC (MAJOR)	0	0	0	4	0	0	1	0	0	100	100
	Total Credit				**14**	**1**	**18**	**8**	**0**	**0**	**29**	**240**	**360**	**1100**	**1700**

	Sl. No	Course Code	Course Title	Category I	Engagement						Credit	Maximum Marks for			TOTAL Marks
					L	T	P	S	R	O/F		IA*	SEE*	PE*	
Semester V	1	23BCAO311R	ADVANCE APPLICATION DEVELOPMENT	DSC (MAJOR)	2	0	2	0	0	0	3	40	60	100	200
	2	23BCAO312R	CLOUD COMPUTING AND VIRTUALIZATION	DSC (MAJOR)	3	0	2	0	0	0	4	40	60	100	200
	3	23BCAO313R	PROJECT - I	DSC (MAJOR)	0	0	4	0	6	0	3	0	0	100	100
	4	23BCAO314R	UI/UX DESIGN	DSC (MAJOR)	1	0	4	0	6	0	4	40	60	100	200
	5	23MOSY311R 23MOSY312R 23MOSY313R	MOOCS V	SEC	0	0	0	0	0	0	1	0	0	100	100
	6	23BCAO315R 23BCAO316R	RESEARCH INTERNSHIP / INDUSTRY INTERNSHIP	Research/ Industry Internship	0	0	0	16	0	0	4	0	0	100	100
	7	23BCAO317R	SUMMER INTERNSHIP	Summer Internship	0	0	0	12	0	0	3	0	0	100	100
	8	23MOSY314R 23MOSY315R 23MOSY316R	MOOC VI	SEC	0	0	0	0	0	0	1	0	0	100	100
	9	23BCAO003R	GENERIC ELECTIVE III	MDC	0	0	0	0	0	0	2	0	0	100	100
	Total Credit				**6**	**0**	**12**	**28**	**12**	**0**	**25**	**120**	**180**	**900**	**1200**

	Sl. No	Course Code	Course Title	Category I	Engagement						Credit	Maximum Marks for			TOTAL Marks
					L	T	P	S	R	O/F		IA*	SEE*	PE*	
Semester VI	1	23BCAO321R	COMPUTER VISION	DSC (MAJOR)	2	1	2	0	0	0	4	40	60	100	200
	2	23BCAO322R	INTRODUCTION TO CYBER SECURITY	DSC (MAJOR)	3	0	2	0	0	0	4	40	60	100	200
	3	23BCAO323R	PROJECT - II	DSC (MAJOR)	0	0	8	0	12	0	6	0	0	100	100
	4	23MOSY321R 23MOSY322R 23MOSY323R	MOOC VII	SEC	0	0	0	0	0	0	1	0	0	100	100
	5	23BCAO324R 23BCAO325R	RESEARCH INTERNSHIP / INDUSTRY INTERNSHIP	Research/ Industry Internship	0	0	2	4	12	0	4	0	0	100	100
	6	23BCAO004R	GENERIC ELECTIVE IV	MDC	0	0	0	0	0	0	1	0	0	100	100
	7	23MOSY314R 23MOSY315R 23MOSY316R	MOOC VIII	SEC	0	0	0	0	0	0	1	0	0	100	100
	Total Credit				**5**	**1**	**14**	**4**	**24**	**0**	**21**	**80**	**120**	**700**	**900**

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

SEMESTER – I									
Course Title	**Digital Electronics**								
Course code	**23BCAO111R**	**Total credits: 2** **Total hours: 30**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			2	**0**	**0**	**0**	**0**	**0**	**2**
Pre- requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ I semester of the first year of the program**								
Course Objectives	1. To familiarize with the different number systems, logic gates, and combinational and sequential circuits utilized in the different digital circuits and systems. 2. The course will help in design and analysis of the digital circuit and system. 3. To impart how to design Digital Circuits.								
CO1	Interpret different number systems, binary codes and Boolean algebra to minimize logic expressions								
CO2	Develop K-maps to minimize and optimize logic functions up to 5 variables								
CO3	Infer the knowledge about various logic gates and logic families and analyze basic circuits of these families								
CO4	Design and implement Combinational and Sequential logic circuits.								
CO5	Describe and compare various memory systems, shift registers and analog to digital and digital to analog conversion circuits								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	**Fundamentals of Digital Systems and logic families:** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic	**10**	Remembering and understanding the different logic gates and applying them for different circuit.	1,2,3
II	**Combinational Digital Circuits:** Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical Faculty of Engineering& Technology| Assam down town University functions. Don't care conditions, Multiplexer, DeMultiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry lookahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, QM method of function realization	**12**	Applying and analyzing different digital circuits.	3,4
III	**Sequential circuits and systems:** A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.	**10**	Applying and analyzing different sequential circuits	3,4
IV	**A/D and D/A Converters:** Digital to analog	**7**	Describe, Differentiate,	2,4

	converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs		and analyzing A/D and D/A converters	
V	**Semiconductor memories and Programmable logic devices:** Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).	**6**	Understanding, analyzing and explaining different memories and logic.	1,2,4

TEXT BOOKS:

T1: Modern Digital Electronics, R. P. Jain, McGraw Hill Education, 2009.

REFERENCE BOOKS:

R1: Digital logic and Computer design, M. M. Mano, Pearson Education India, 2016.
R2: Fundamentals of Digital Circuits, A. Kumar, Prentice Hall India, 2016.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Interpret different number systems, binary codes and Boolean algebra to minimize logic expressions	**1 and 3**
2	Develop K-maps to minimize and optimize logic functions up to 5 variables	**2,3, and 4**
3	Infer the knowledge about various logic gates and logic families and analyze basic circuits of these families	**1,2, and 7**
4	Design and implement Combinational and Sequential logic circuits.	**1,2,4, and 7**
5	Describe and compare various memory systems, shift registers and analog to digital and digital to analog conversion circuits	**1,2,5, and 7**

SEMESTER – I										
Course Title	**PROGRAMMING FOR PROBLEM SOLVING**									
Course code	**23BCAO112R**	**Total credits: 4** **Total hours: 30T+30P**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
			2	**0**	**4**	**0**	**0**	**0**	**4**	
Pre-requisite	**Nil**	**Co-requisite**	**Nil**							
Programme	**Bachelor of Computer Application**									
Semester	**Fall/ I semester of the first year of the program**									
Course Objectives	1. To formulate simple algorithms for arithmetic and logical problems. 2. To test and execute the programs and correct syntax and logical errors. 3. To solve real-time problems using programming									
CO1	Explain the basic terminology used in computer programming to write, compile and debug programs in C programming language.									
CO2	Examine the syntax and semantics and be fluent in the use of various Operators of C Programming.									
CO3	Demonstrate the concept of Searching and Sorting in programming.									
CO4	Develop programs to describe the applications of derived data types such as arrays and strings etc.									
CO5	Illustarte the dynamics of memory by the use of pointers and Structures									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	Introduction to C Programming: Introduction, History, Features, Advantages and Disadvantages, Structure of C program, Compiling Process, C Pre-processor and Header Files, Library Function, Character Set, Comments, Tokens and its types. Data types, Escape Sequences, Pre-processors Directives.	**7**	Describe, illustrate, and explain computer, algorithms, flowchart	1,2
II	Operators and Expressions Arithmetic Operator, Relational Operator, Logical Operator, Assignment Operator, Increment/decrement Operator, Conditional Operator, Bitwise Operator, Comma Operator, Sizeof Operator, Operator Precedence and Associativity.	**10**	Describe, illustrate, and explain different operators	1,2
III	Function: Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.	**10**	Describe, illustrate, and explain function, recursive function.	1,2
IV	Structure: Structures, Defining structures and Array of Structures Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)	**8**	Describe, illustrate, and explain structure, linked-list	1,2
V	File handling (only if time is available, otherwise should be done as part of the lab)	**10**	Describe, illustrate, and explain file handling	1,2
Practical				
Practical 1	C program to display "hello world".	1	Creating a first program to display hello world in C	3, 5
Practical 2	Create a simple program where we will Print Integer in C where variable value is pre-defined.	1	Creating and displaying a value of a variable in C	3, 5

Practical 3	Program where we will Print the Integer in C where the value of the variable is entered by the user.	1	Creating and displaying the value variable from user input.	3, 5
Practical 4	Input integer, float and character values using one scanf() statement in C.	1	Creating and displaying different types of data types.	3, 5
Practical 5	C Program to Find the Size of int, float, double and char.	1	Creating and finding the size of different data types.	3, 5
Practical 6	Perform addition, subtraction, multiplication and division of two numbers.	1	Creating and displaying the different types of calculation program using C	3, 5
Practical 7	C Program to Calculate Percentage of 5 Subjects.	1	Creating and calculating the percentage of five subject in C	3, 5
Practical 8	C Program to Calculate Simple interest.	1	Creating and calculating the simple interest.	3, 5
Practical 9	C Program to Calculate Compound interest.	1	Creating and finding the compound interest.	3, 5
Practical 10	C Program to Find Area and Perimeter of Rectangle.	1	Creating and finding the area and perimeter of the rectangle.	3, 5
Practical 11	Radius and Area of Circle program in C.	1	Creating and finding the radius and area of a circle.	3, 5
Practical 12	Swap numbers using temporary variable.	1	Creating a program to swap two numbers with the help of a temporary variable.	3, 5
Practical 13	Swap numbers without using temporary variable.	1	Creating a program to swap two numbers without using the temporary variable.	3, 5
Practical 14	C example to print "hello world" using if statement and without using semicolon.	1	Creating a C program for implementing the *if* statement.	3, 5
Practical 15	C Program to find the largest number among three numbers using the if statement.	1	Creating a C program to find the largest number among the three numbers.	3, 5
Practical 16	C Program to find the largest number among three numbers using the if else ladder.	1	Creating a C program to find the largest number among the three numbers using if-else statement	3, 5
Practical 17	C Program to find the largest number among three numbers using nested if-else statement.	1	Creating a C program to find the largest number	3, 5

			among the three numbers using the nested if-else.	
Practical 18	C Program to check whether a number is even or odd.	1	Creating a C program to check whether the given number is odd or even.	3, 5
Practical 19	C Program to check whether a character is a Vowel or a Consonant.	1	Creating a program to check whether a character is a vowel or consonant.	3, 5
Practical 20	C program to check whether a number is Positive or Negative or Zero.	1	Creating a C program to check if the given number is positive or negative.	3, 5
Practical 21	C program to find the factorial of a number.	1	Creating a program to find the factorial of a number.	3, 5
Practical 22	C example to print "hello world" using switch statement and without using semicolon.	1	Creating a C program to display hello world using switch statement.	3, 5
Practical 23	C Program to Find Largest of Two Numbers using Switch Case.	1	Creating and finding the largest of two numbers using switch case statement.	3, 5
Practical 24	C Program to Find Largest of Two Numbers using Conditional Operator.	1	Creating a program to find the largest of two using conditional operators.	3, 5
Practical 25	C Program to print first 10 natural numbers using a for loop	1	Creating a C program to display the first 10 natural numbers using a for loop.	3, 5
Practical 26	C Program to calculate the sum of first n natural numbers using a for loop	1	Creating a C program to display the first n natural numbers using a for loop.	3, 5
Practical 27	C program to print all natural numbers in reverse in a given range using a for loop.	1	Creating a program to print all natural numbers in reverse	3, 5
Practical 28	C Program to print even and odd natural numbers using a for loop	1	Creating a program to print even and odd numbers using a for loop.	3, 5
Practical 29	C Program to check whether a number is a prime number or not.	1	Creating and displaying whether a given number is a prime number or not.	3, 5
Practical 30	Print prime numbers between 1 to n in c language using a for loop.	1	Creating a C program to check the prime numbers between 1-10 using a for loop.	3, 5
Practical 31	Write a c program to print Fibonacci series using a for loop.	1	Creating a C program to print Fibonacci series	3, 5

			using a for loop.	
Practical 32	C example to print "hello world" using a while loop and without using a semicolon.	1	Creating a C program using a while loop.	3, 5
Practical 33	C Program to find the sum of the first and last digit using a while loop.	1	Creating a C program to demonstrate while loop for finding the sum of the first and last digit.	3, 5
Practical 34	C program to reverse a number using a while loop.	1	Creating a program for reversing a number using a while loop.	3, 5
Practical 35	C Program to print the first 10 natural numbers using a while loop.	1	Creating a program to print the first 10 natural numbers using a while loop.	3, 5
Practical 36	C program to print all natural numbers in reverse from n to 1 using a while loop.	1	Creating a C program to print all natural numbers in reverse using a while loop.	3, 5
Practical 37	Write a c program to print Fibonacci series using while loop	1	Creating a program to display the Fibonacci series using a while loop.	3, 5
Practical 38	C example to print "hello world" using do while loop.	1	Creating a program to display the do while loop.	3, 5
Practical 39	C Program to print first n natural numbers using do while loop.	1	Creating a program to display the first n natural number using a do while loop.	3, 5
Practical 40	C program to print all the numbers from 20 to 1 in reverse order on the screen using do while loop.	1	Displaying the natural numbers in reverse using a do while loop.	3, 5
Practical 41	C program to print all the even numbers from 10 to 20 on the screen using do while loop	1	Displaying the even numbers from 10-20 using a do while loop.	3, 5
Practical 42	C Program to print multiplication table using do...while loop.	1	Displaying the multiplication table using a do while loop.	3, 5
Practical 43	C program to input a 4-digit number and find the sum of its digits using do while loop.	1	Displaying the sum of 4 digit numbers and finding its sum using a do while loop.	3, 5

TEXT BOOKS:

T1: E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
T2: Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, PrenticeHall of India.

REFERENCE BOOKS:

R1: Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the basic terminology used in computer programming to write, compile and debug programs in C programming language.	**1,2 & 8**
2	Examine the syntax and semantics and be fluent in the use of various Operators of C Programming.	**1,2 & 8**
3	Demonstrate the concept of Searching and Sorting in programming.	**1,2 &8**
4	Develop programs to describe the applications of derived data types such as arrays and strings etc.	**1,2 ,4, 5,6,7 & 8**
5	Illustrate the dynamics of memory by the use of pointers and Structures	**1,2 ,4**

SEMESTER – I									
Course Title	**MATHEMATICS – I**								
Course code	**23BCAO113R**	**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 Computer Application**								
Semester	**Fall/ I semester of the first year of the program**								
Course Objectives	1. To make understand to evaluate definite and improper integrals. Apart from these some special functions like Beta and Gamma function must be introduced. 2. To provide the application of differential and integral calculus. 3. To make understand the convergence and divergence of sequence and series.								
CO1	Illustrate the foundation concepts in Mathematics like Matrices, Set, relations and functions								
CO2	Outline Differential Integration and Differentiation and with this background.								
CO3	Learn about Multivariable Calculus for Limit, continuity and partial derivatives								
CO4	Decribe matrices like Inverse and rank of a matrix, rank-nullity theorem								
CO5	Apply the foundation concepts in programming and analytical subjects.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	***Calculus:*** Evaluates and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	**8**	Describe, illustrate, and explain Integrals and its applications	1,2
II	***Calculus:*** Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima..	**12**	Describe, illustrate, and explain various theorems of calculus	1,2
III	***Sequences and series:*** Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.	**8**	Describe, illustrate, and explain numbers series	1,2
IV	***Multivariable Calculus (Differentiation):*** Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.	**8**	Describe, illustrate, and explain multivariable calculus	1,2
V	***Matrices:*** Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.	**9**	Describe, illustrate, and explain types of matrices	1,2

TEXT BOOKS:

T1:G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
T2:Erwinkreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
T3:Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

REFERENCE BOOKS:

R1: N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

R2: B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Illustrate the foundation concepts in Mathematics like Matrices, Set, relations and functions	1 & 6
2	Outline Differential Integration and Differentiation and with this background.	1 & 6
3	Learn about Multivariable Calculus for Limit, continuity and partial derivatives	1 & 6
4	Describe matrices like Inverse and rank of a matrix, rank-nullity theorem	1 & 6
5	Apply the foundation concepts in programming and analytical subjects.	1 & 6

SEMESTER – I										
Course Title	**Fundamentals of Computer Applications**									
Course code	**23BCAO114R**	**Total credits: 4** **Total hours: 45T+15P**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			3	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ I semester of the first year of the program**								
Course Objectives	quire the basic knowledge of Computer Systems and their uses. ow about Application Software and Programming environments fy and protect from computer viruses and online threats.								
CO1	Explain the working of a computer and its various components.								
CO2	Discuss the use of Software and programming in a computer system.								
CO3	Outline the basic concepts of Computer Networks and Internet Protocols.								
CO4	Develop Proficiency in Identifying different types of computer viruses, worms, and malware to enhance threat awareness.								
CO5	Apply the role of various Software packages for Office Automation								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Basics of Computer** What is Computer and its History, Generation of Computers, Classification of Computers; Components of a Digital Computer: CPU, Memory, I/O devices; Storage Devices (RAMs, ROMs, Hard Disk etc.), Backup System and it is use.	**8**	Understand and explain the different types of computers, working of computer, and identify the various components.	1, 2
II	**Software and Languages** What is Computer Software and its need, Types of Computer Software's; Computer languages, Generation of Computer Languages, Classification of Computer Languages.	**8**	Understand the basics of software and programming concepts, identify different types of programming language.	1, 2
III	**Networks** LAN, MAN, WAN, Internet, Intranet, Browsers, Basic Internet Protocols (http, TELNET, FTP).	**8**	Understand the working of an Internet and Network. Identify and apply the different types of networks.	1, 2, 3
IV	**Computer Viruses and Security**. Type of Virus, Worms, Malware, Firewalls, Phishing, Anti-Virus.	**8**	Understand and identify different types of viruses and worms, firewall and phishing.	1, 2
V	**Software packages for Office Automation** (Any available standard Office Suite may be referred) Word Processing software, Spreadsheet software, Presentation software, Database software, Drawing and Graphics manipulation software.	**12**	Describe the different types of MS Office package. Apply and creating different files using MS Office Software.	3, 5
Practical Components				
Practical 1	Identify the components of a computer	1	Identifying and understanding the components of a computer.	2
Practical 2	Showing and explain the working process of the computer's components.	1	Remembering and understanding the working process of computer.	1,2
Practical 3	A computer is not powering on. List and demonstrate the steps you would take to	1	Applying the knowledge of computers to fix some	3

	diagnose and fix the issue.		issues related to computers.	
Practical 4	Access the BIOS/UEFI on a computer and describe how to change the boot order to prioritize booting from a USB drive.	1	Understanding and applying the knowledge on BIOS.	2,3
Practical 5	Demonstrate how to install an operating system (e.g., Windows, Linux) on a computer. Include partitioning the hard drive and configuring system settings.	1	Applying the knowledge of installation to install software's.	3
Practical 6	Connect and configure a printer or a scanner to a computer. Install the necessary drivers and software, and demonstrate printing or scanning a document.	1	Applying the knowledge to configure a printer.	3
Practical 7	Install a software application (e.g., a web browser or office suite) on a computer and configure its basic settings.	1	Applying the configuration knowledge for software installation.	1,3
Practical 8	Write a simple program in a language of your choice (e.g., C, C++) that takes user input and performs a basic calculation or task.	1	Applying and creating a first program in any language.	3,5
Practical 9	Demonstrate how to use version control software (e.g., Git) to clone a repository, make changes, commit those changes, and push them to a remote repository.	1	Understanding and applying the Git knowledge to clone repositories, etc.	2,3
Practical 10	Use an Integrated Development Environment (IDE) to write, debug, and run a simple program. Explain the benefits of using an IDE.	1	Using different IDEs for creating, solving and running simple programs.	3
Practical 11	Set up a small local area network (LAN) with at least two computers. Ensure that they can communicate with each other by sharing files.	1	Identifying and applying the knowledge on different types of networking.	2,3
Practical 12	Explain the difference between static and dynamic IP addressing. Configure a computer with a static IP address.	1	Explaining and differentiating between static and dynamic IP addressing.	2,4
Practical 13	Use the ping and traceroute (or tracert on Windows) commands to diagnose network connectivity issues between two devices on a network.	1	Using ping and traceroute knowledge to diagnose networks.	3
Practical 14	Install an antivirus program on a computer. Perform a full system scan and demonstrate how to handle detected threats.	1	Understanding and demonstrating how to handle threats.	2,3
Practical 15	Explain safe browsing practices to avoid malware. Show how to configure a web browser with extensions and settings to enhance security.	1	Understanding and explaining safe browser practices.	2,3
Practical 16	Demonstrate how to create strong passwords and manage them using a password manager. Explain the importance of using different passwords for different accounts	1	Explaining and creating strong passwords using different characters and different passwords for different accounts.	2,5
Practical 17	Configure a software firewall on a computer to block all incoming connections except for a specific application (e.g., a web server).	1	Configuring a software firewall to block any connections from malicious users.	3,5
Practical 18	Make a Resume. It must include the features mentioned below— · Tables · Alignment · Bullets	1	Applying and creating a resume with MS Word.	3,5

	· At least 3 Font Styles and 3 Font Sizes One picture			
Practical 19	Create time table in MS Word.	1	Applying and creating a time table in MS Word.	3,5
Practical 20	Create University ID card in MS Word.	1	Applying different styles to create a University ID card.	3,5
Practical 21	Use MS-Word to create Project Reports or Thesis.	1	Applying and creating reports in MS Word.	3,5
Practical 22	Make a presentation of 3 slides in MS PowerPoint. The first slide should have a title and subtitle, the second slide an image with a caption, and the third slide a bulleted list.	1	Applying and building presentation with MS PowerPoint	3,5
Practical 23	Create time table in MS Excel	1	Creating time table in MS Excel	5
Practical 24	Prepare a stationary order for the month of March in MS Excel.	1	Applying the knowledge of MS Excel to create stationary order details.	3,5
Practical 25	Prepare a student marks distribution table in MS Excel	1	Creating a marks records using MS Excel	5
Practical 26	VLOOKUP and INDEX function in MS Excel	1	Using formulas like VLOOKUP and INDEX in MS Excel.	3,5
Practical 27	Joining two strings in MS Excel	1	Using excel formulas to join two strings.	3,5
Practical 28	Conditional Formatting in MS Excel	1	Applying conditional formatting for different data cells.	3

TEXT BOOKS:

T1: Introduction of Computer Sc. ITL ESL, Pearson Education India.
T2: Computer Fundamentals. Rajaraman, V.

REFERENCE BOOKS:

R1: Computer Fundamentals: Concepts, Systems & Applications Priti Sinha, Pradeep K., Sinha, BPB Publications

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the working of a computer and its various components.	**3,8**
2	Discuss the use of Software and programming in a computer system.	**1,2,3,8**
3	Outline the basic concepts of Computer Networks and Internet Protocols.	**2,8**
4	Develop Proficiency in Identifying different types of computer viruses, worms, and malware to enhance threat awareness.	**2,3,8**
5	Apply the role of various Software packages for Office Automation	**2,3,8**

SEMESTER – I									
Course Title	**ELEMENTARY ENGLISH**								
Course code	**23UBPD112R**	**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	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 Arts in Psychology/Bachelor of Trauma, Emergency and Disaster Management/Bachelor of Science in Biotechnology/Bachelor of Science in Microbiology/Bachelor of Science in Food Nutrition and Dietetics/Bachelor of Computer Application/ Bachelor of Computer Application (P)/Bachelor of Science in Information Technology (P)/ Bachelor of Science in Information Technology/Bachelor of Computer Application on Cloud Technology and Information Security/Bachelor of Computer Application on Artificial Intelligence and Machine Learning/Bachelor of Computer Application on Artificial Intelligence and Machine Learning								
Semester	**Fall/I or Winter/II Semester of First Year of the Programme**								
Course Objectives	To recognize and identify parts of a sentence and their significance in a language. To enhance listening and speaking/skills for self-development. To give insight into English pronunciation and into central concepts in phonetics. 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, pick and form different kinds of sentences.								
CO4	Knowledge of communication will be enhanced through practical examples.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	**Unit 1- Basics of Grammar (Flipped classroom)** i. Parts of Speech ii. Articles iii. Auxiliary Verbs iv. Affirmative and Negative Sentences	**4**	Understanding, identifying and analyzing part of speech, articles, auxiliary verbs, affirmative and negative sentences.	1,2,4
II	**Grammar (Flipped classroom)** i. Determiners ii. Sentence Construction iii. Types of Sentences (Assertive, Imperative, etc.) iv. Degree of Comparison	**4**	Understand, identify and construct clear sentences, determiners and degree of comparison.	1,2,3
III	**Speaking Skills** **i**. Introduction and Greetings ii. Pronunciation, Intonation, Stress iii. Asking and offering information	**6**	Develop the ability to effectively introduce themselves, engage in self-discovery, grasp the basics of phonetics and pronunciation, deliver extempore speeches, and use video recording for self-reflection to enhance their speaking skills.	2,4
IV	**Communication Skills** i. Introduction to Communication ii. Process and Types of Communication,	**6**	Understand the fundamentals and importance of communication skills, identify the purpose and types of communication, differentiate between formal and	5

	iii. Formal and informal communication iv. Understanding Barriers to Communication		informal communication	
V	**Presentation Skills** i. Introduction ii. Essential characteristics of a good presentation iii. Use of Visual Aids in Presentation	**8**	Ability to present self-introduction and using visual aids in presentation.	2

TEXT BOOKS:

T1:Chaturvedi, P.D., ChaturvediMukesh, 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, 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 by Klett

OTHER LEARNING RESOURCES:

- https://youtu.be/bEB8- SWMYhIhttps://youtu.be/- zZau_dttRY

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	It enables learners to recognize the structure of a sentence and its variations as they learn to understand, speak and write.	**2 and 6**
2	Introduction to Phonetics and its importance will improve the learners' pronunciation	**6 and 8**
3	Students will be able to identify, pick and form different kinds of sentences.	**2 and 6**
4	Knowledge of communication will be enhanced through practical examples.	**2 and 6**

SEMESTER – I									
Course Title	**CO-CURRICULAR ACTIVITY**								
Course code	**23UBCC111**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Winter/ II semester of the second year of the program**								
Course Objectives	It is to develop the social and soft skills and to promote a holistic development of the learners								
CO1	Connect and adapt cultural diversity among communities.								
CO2	Enhance team for working toward a shared vision								
CO3	Demonstrate and apply interdisciplinary connections and Cultivate spirit of creative thought and curiosity to achieve goals								
CO4	Learn to effectively communicate, delegate responsibilities and motivate team members.								
CO5	Develop strong teamwork and collaboration skills by engaging in group activities.								
Course Contents	AdtU encourages activities that are aimed to develop the social and soft skills of students and promote a holistic development of the learners. Keeping in mind the 360 degree learning methodology, the students are engaged in different activities other than their regular classes. Experts are invited to conduct workshops that benefit the students. Technical quizzes are conducted to enhance the knowledge of the students. Technical seminars help them to develop their public speaking abilities.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Connect and adapt cultural diversity among communities.	4,5,6,7,8
2	Enhance team for working toward a shared vision	4,5,6,7,8
3	Demonstrate and apply interdisciplinary connections and Cultivate spirit of creative thought and curiosity to achieve goals	4,5,6,7,8
4	Learn to effectively communicate, delegate responsibilities and motivate team members.	5,6,7,8
5	Develop strong teamwork and collaboration skills by engaging in group activities.	5,6,7,8

SEMESTER – I									
Course Title	**Field Based Learning**								
Course code	**23BCAO115R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**0**	**0**	**8**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Winter / I semester of the first year of the program**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings.								
CO1	Apply theoretical concepts to real-world situations.								
CO2	Conduct field-based research and gather data effectively.								
CO3	Analyze and interpret field data to draw meaningful conclusions.								
CO4	Communicate findings clearly and effectively, both orally and in writing.								
CO5	Demonstrate professional behaviour and teamwork skills in field settings.								
Course Contents	The organization will provide the students two field visit for this program. The students will be taken to a specific site for learning purposes. The students will visit a relevant site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners regarding the subject or purpose of the visit. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial findings.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply theoretical concepts to real-world situations.	**2,4 and 8**
2	Conduct field-based research and gather data effectively.	**2,3 and 8**
3	Analyze and interpret field data to draw meaningful conclusions.	**2,3 and 7**
4	Communicate findings clearly and effectively, both orally and in writing.	**2,5 and 6**
5	Communicate findings clearly and effectively, both orally and in writing.	**5,6 and 7**

SEMESTER – I									
Course Title	**MOOCS I (INTRODUCTION TO GIT AND GITHUB)**								
Course code	**23MOSY113R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Fall/ I semester of the first year of the program**								
Course Objectives	1. To learn and apply basic Git commands (init, clone, add, commit, status, log) to manage local repositories and track changes. 2. To create and manage branches, perform merges, and resolve conflicts to maintain a smooth development workflow. 3. To create a GitHub account, set up remote repositories, and perform push and pull operations to synchronize local and remote repositories.								
CO1	Acquire a solid foundation in using Git for version control, including initializing repositories, committing changes, and managing version history								
CO2	Master advanced Git functionalities such as branching, merging, and resolving conflicts to manage and streamline development workflows.								
CO3	Develop the skills to effectively use GitHub for hosting remote repositories, collaborating on projects, and managing code reviews.								
CO4	Learn best practices for collaborating with others using Git and GitHub, including forking, pull requests, and managing repository settings.								
CO5	Create and maintain a professional portfolio on GitHub, showcasing projects and demonstrating the ability to use Git and GitHub effectively.								

Unit	**Contents**	**Contact Hrs.**	**Learning Outcome**	**BL**
I	**Introduction to Version Control:** In this module, introduction to the concept of version control, which will make managing and rolling back the code look super easy. Learn how to differentiate between files and the tools at your disposal to make this happen. Next, you'll be introduced to Git and how you can leverage that platform to improve your coding abilities. Once you've got a grasp on what Git is, you'll install it and start using it to create and clone code repositories. Last up, you'll deep dive into Git in order to get more familiar with the different tools and commands it has to offer.	**9**	Understanding and applying the knowledge of Git and GitHub and its version control.	1,3

II	**Using Git Locally:** In this module, you'll dive into advanced Git interactions by skipping the staging area for small code changes, and understand how Git uses the HEAD alias to represent checked-out snapshots. Next, you'll explore how to move and remove files before finally getting a study guide to help you in your Git explorations! The next step of your learning will include how to undo changes before committing and how to amend commits once they're submitted. Finally, you'll be able to identify errors in commits that were submitted a while back. In the final section of this module, you'll explore the concept of branching and merging. You'll learn what a branch is, how to create one, and how they work in harmony with you and your code. Once you're comfortable with branching, you'll dive into merging, how it works with branched data, and how to deal with merge conflicts.	**6**	Remembering, understanding, and applying git knowledge to use different functions.	1,2,3
III	**Working with Remotes:** In this module, you'll be introduced to GitHub and learn how it works with Git. You'll create new repositories and clone those repositories onto your computer. Next, we'll explain what a remote repository is, how we can work with them, and how we can host them. You'll get familiar with commands like modify, stage, and commit, which will be used for local changes, as well as the fetch command, which can pull any changes from remote repositories. We'll cover secure shell protocol and when to use API keys. Our final lesson will focus on learning about conflicts. This will allow you to explore the concepts of pull-merge-push workflows, pushing remote branches and rebasing your changes.	**5**	Understanding and applying the knowledge of git in GitHub and creating new repositories.	1,3,5

IV	**Collaboration:** In this module, you'll continue to explore the collaboration tools available in Git. You'll learn about the tools that are available to help improve the quality of your code and to better track your code. This includes an overview of pull requests and how the typical workflow of a pull request looks like on GitHub. Next, you'll dive into how you can squash changes in your code. We'll finish up by providing you with a study guide on fork and pull requests. Next up, we'll cover what code reviews are and what the code review workflow looks like. Then, you'll learn about how to use code reviews on GitHub. The final lesson of this module will focus on managing projects. We'll take a rundown of best practices on managing projects and how to manage collaboration within those projects. We'll explore different ways of tracking issues and finish up by discussing the concept of continuous integration with your projects.	**6**	Understanding, analyzing, and applying new tools available.	1,3,4

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Acquire a solid foundation in using Git for version control, including initializing repositories, committing changes, and managing version history	3 and 8
2	Master advanced Git functionalities such as branching, merging, and resolving conflicts to manage and streamline development workflows.	2 and 3
3	Develop the skills to effectively use GitHub for hosting remote repositories, collaborating on projects, and managing code reviews.	3 and 7
4	Learn best practices for collaborating with others using Git and GitHub, including forking, pull requests, and managing repository settings.	6 and 7
5	Create and maintain a professional portfolio on GitHub, showcasing projects and demonstrating the ability to use Git and GitHub effectively.	7 and 8

SEMESTER – II									
Course Title	**Data Structure using C**								
Course code	**23BCAO121R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+15P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	Fundamentals of programming logic	**Co-requisite**	C Programming						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ II semester of the first year of the program**								
Course Objectives	1. To impart the basic concepts of data structures and algorithms. 2. To understand basic concepts about stacks, queues, lists, trees and graphs. 3. To understand concepts about searching and sorting techniques								
CO1	Illustrate the Basic concepts of Data Structures.								
CO2	Apply Data Structure techniques on computing problem.								
CO3	Analyse and develop algorithms to solve real world problems.								
CO4	Implement and developed program for various concepts of data structures including array, stack, queue, graphs and trees.								
CO5	Demonstrate and analyze various sorting algorithms and hashing techniques.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction:** Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.	**8**	Analyze the algorithms to determine the time and computation complexity and justify the correctness	1,2,3
II	**Stacks and Queues**: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	**10**	Analyze the problem of stacks, queues and linked list to determine the time and computation complexity	2,3
III	**Linked Lists:** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.	**10**	Analyze the problem of stacks, queues and linked list to determine the time and computation complexity	3
IV	**Trees:** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis	**9**	Implement basic tree-based traversal and search algorithms, learn about applications using tree	1.3

V	**Sorting and Hashing:** Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. **Graph:** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	**8**	Summarize Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity. Graph search and traversal algorithms and determine the time and computation complexity	2,3
Practical Component				
Practical 1	Array implementation of stack using C program	2	Understand the basics of stack	2,3
Practical 2	Array implementation of queue using C program	2	Understand the basics of queue	2,3
Practical 3	Array implementation of list using C program	2	Understand the basics of array implementation	2
Practical 4	Linked list implementation of list using C program [singly linked list]	2	Understand the basics of linked list	2,3
Practical 5	Linked list implementation of stack using C program	2	Understand and implement stack using linked list	2,3
Practical 6	Linked list implementation of queue using C program	2	Understand and implement queue using linked list	2,3
Practical 7	Applications of list polynomialAddition and subtraction using C program	2	Understand and apply polynomial addition and subtraction	4
Practical 8	Infix to postfix using C program	2	Understand and convert infix to postfix using C program.	3
Practical 9	Expression evaluation using C program	2	Evaluate expression using C program.	3,4
Practical 10	Implementation of avl trees using C program	2	Understand AVL tree and implement using array.	3
Practical 11	Implementation of heap using priority Queues using C program	2	Develop heap using priority queue.	3,4
Practical 12	Representation of graph using C program	2	Understand graph and it representation.	3
Practical 13	Graph traversal-breadth first traversal using C program	2	Understand the concepts of traversal breadth first traversal.	3
Practical 14	Graph traversal-depth first Traversalusing C program	2	Understand and apply the concepts of traversal depth first traversal.	3
Practical 15	Linear search using C program	2	Understand and apply linear search	2,3,4
Practical 16	Binary search using C program	2	Understand and apply binary search	2,3,4
Practical 17	Insertion sort using C program	2	Implement and apply Insertion sort.	3,4
Practical 18	Bubble sort using C program	2	Implement and apply Bubble sort.	3,4
Practical 19	Quick sort using C program	2	Implement and apply Quick sort.	3,4
Practical 20	Merge sort using C program	2	Implement and apply Merge sort.	3,4

TEXT BOOKS:

T1: "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, SartajSahni, Computer Science Press.

REFERENCE BOOKS:

R1: Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company

R2: "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Illustrate the Basic concepts of Data Structures.	1,2,3
2	Apply Data Structure techniques on computing problem.	1,2,3
3	Analyse and develop algorithms to solve real world problems.	1,2,3
4	Implement and developed program for various concepts of data structures including array, stack, queue, graphs and trees.	1,2,3
5	Demonstrate and analyze various sorting algorithms and hashing techniques.	1,2,3,8

SEMESTER – II									
Course Title	**Computer Organization & Architecture**								
Course code	**23BCAO122R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+15P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ II semester of the first year of the program**								
Course Objectives	1. Discuss the organization and architecture of computer systems and electronic computers. 2. Analyze the basic components of computer systems besides the computer arithmetic. 3. Discuss input-output organization, memory organization and management, and pipelining.								
CO1	Outline the basics of instructions sets and their impact on processor design								
CO2	Examine the control unit design approaches, memory design technologies and I/O transfers.								
CO3	Explain the concepts of pipelining in Computer Architecture.								
CO4	Interpret and analyze Parallel Processing Principles and Applications.								
CO5	Demonstrate the concepts of Memory Organization Through Mapping Functions and Replacement Algorithms.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.	**9**	Infer the interaction of the components of a computer system with the instruction set architecture of a CPU and addressing modes	1,2,3
II	Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-andadd, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic. Introduction to x86 architecture.	**10**	Explain the various data representation techniques, perform computer arithmetic and discuss the various adders and multipliers. Examine the control unit design approaches, memory design technologies and I/O transfers. Demonstrate the concepts of pipelining, parallel processing and concurrent access to memory.	3,4

III	CPU control unit design: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU. Memory system design: semiconductor memory technologies, memory organization Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCII, USB	**10**	Explain the various data representation techniques, perform computer arithmetic and discuss the various adders and multipliers Demonstrate the concepts of pipelining, parallel processing and concurrent access to memory. Summarize the concepts of memory organization with mapping functions and replacement algorithms	3,4
IV	Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.	**8**	Summarize the concepts of memory organization with mapping functions and replacement algorithms.	4
V	Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.	**8**	Summarize the concepts of memory organization with mapping functions and replacement algorithms	1,2
Practical				
Practical 1	Study and verify the truth table of logic gates.	**2**	Understanding and identifying different logic gates.	1,2
Practical 2	Design and verify the circuit and operation of half adder and full adder.	**2**	Understanding, designing and analyzing the circuit and operation of half and full adder.	1,4,5
Practical 3	Design and verify the circuit and operation of half subtractor and full subtractor.	**2**	Understanding, designing and analyzing the circuit and operation of half and full subtractor.	1,4,5
Practical 4	Design and verify Ripple Carry Adders.	**2**	Understanding, designing and analyzing the circuit and operation of ripple carry adders.	1,4,5
Practical 5	Design and verify Carry Look ahead Adders.	**2**	Understanding, designing and analyzing the circuit and operation of carry look ahead adders.	1,4,5
Practical 6	Design and verify Registers and Counters.	**2**	Understanding, designing and analyzing the circuit and operation of registers and counters.	1,4,5
Practical 7	Design and verify Combinational Multipliers.	**2**	Understanding, designing and analyzing the circuit and operation of combinational multipliers.	1,4,5

Practical 8	Design of Memory.	**2**	Designing a memory and analyzing it.	4,5
Practical 9	Design of Associative Cache and Direct Mapped cache.	**2**	Designing a associative and direct cache and analyzing it.	4,5
Practical 10	CPU Design	**2**	Designing a CPU and analyzing it.	4,5
Practical 11	Implement Booth's Algorithm	**2**	Understanding and implementing booth's algorithm	1,3
Practical 12	Design and set up a 4:1 Multiplexer.	**2**	Designing and analyzing 4:1 multiplexer.	4,5
Practical 13	Design and verify a 4-bit combinational shifter.	**2**	Designing and analyzing 4-bit combinational shifter.	4,5
Practical 14	Design and verify a BCD adder and subtractor using IC.	**2**	Designing and analyzing BCD adder and subtractor using IC.	4,5
Practical 15	Design a 4-bit adder subtractor.	**2**	Designing and analyzing 4-bit adder subtractor.	4,5
Practical 16	Design and verify Logic Unit using IC.	**2**	Designing and analyzing Logic unit using IC.	4,5

TEXT BOOKS:

T1: "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.

REFERENCE BOOKS:

R1: "Computer Organization and Embedded Systems", 6th Edition by Carl Hamacher, McGraw Hill Higher Education.

R2: "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill.

R3: "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Outline the basics of instructions sets and their impact on processor design	3,5,6,8
2	Examine the control unit design approaches, memory design technologies and I/O transfers.	2,3,5,6,8
3	Explain the concepts of pipelining in Computer Architecture.	2,3,5,6,7,8
4	Interpret and analyze Parallel Processing Principles and Applications.	2,3,5,7,8
5	Demonstrate the concepts of Memory Organization Through Mapping Functions and Replacement Algorithms.	2,3,7,8

SEMESTER – II									
Course Title	**Introduction to Web Technology**								
Course code	**23BCAO123R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+15P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ II semester of the first year of the program**								
Course Objectives	1. To understand the Fundamental principle of Web design, hosting and maintenance. 2. To understand tools required for Web design. 3. To understand server and client.								
CO1	Illustrate elements and attributes of a web page.								
CO2	Build web pages using HTML and Cascading Style Sheets								
CO3	Develop XML documents and Schemas								
CO4	Design and implement static and dynamic website								
CO5	Analyse best technologies for solving web client/server problems								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Basics of Internet:** Client/Server Computing: What is C/S Computing, Middleware, Fat client VS Fat Servers, N-tiered Software Architecture. Web's Robot global access to information, HTML, HTTP, IP address, DNS & ports; Accessing a web server, publishing on web server, secure HTTP, Secure Socket layer, WWW Proxies, IIS, Case study of Apache web server.	**10**	Illustrate elements and attributes of a web page.	1,2,3
II	**Searching and web casting Technique:** Popular web servers, basic feature; bookmarks, cookies, progress indicators, customization of browsers, browsing tricks, next generation web browsing, search engines, architecture of search engines, search tools, web crawler, focused crawler, agent based crawler, case study of any Web Browser.	**12**	Build web pages using HTML and Cascading Style Sheets Develop XML documents and Schemas Design and implement static and dynamic website	3,4
III	**Web page design:** Designing web pages with HTML- use of tags, hyperlinks, URLs, tables, text formatting, graphics & multimedia, imagemap, frames and forms in web pages. Use of Cascading Style Sheet in web pages. Introduction to DHTML.	**8**	Build web pages using HTML and Cascading Style Sheets. Design and implement static and dynamic website. Analyse best technologies for solving web client/server problems	3,4
IV	**Creating interactive and dynamic web pages with JavaScript:** JavaScript overview; constants, variables, operators, expressions & statements; user-defined & built-in functions; client-side form validation; using properties and methods of built-in objects. **Extensible Markup Language (XML):** Introduction- using user-defined tags in web pages; displaying XML contents; XML DTDs; use of XSL.	**8**	Analyse best technologies for solving web client/server problems	4

V	**Web Server:** Web services and web server functionality; web server composition; registration; conceptual architecture of some typical web servers. Server-side scripting: overview of server-side scripts like CGI, ASP, and JSP.Server side scripting using PHP; Web database connectivity- introduction to ODBC; PHP with database connectivity. **Exposure to Advanced Web Technologies:** Distributed Object based models- DCOM, CORBA, EJB; Web services and Related Technologies- ISAPI, SOAP, UDDI, WSDL; Other Advanced Web Technologies- AJAX, ISAPI, .NET.	**7**	Analyse best technologies for solving web client/server problems	4
Practical Component				
Practical 1	Write a HTML program for the demonstration of Unordered Lists.	2	Learn to create Unordered Lists	2,3
Practical 2	Write a HTML program for the demonstration of ordered Lists	2	Learn to create Ordered Lists	2,3
Practical 3	Write a HTML program for the demonstration of Definition Lists	2	Learn to create Definition Lists	2
Practical 4	Write a HTML program for the demonstration of Nested Lists	2	Learn to create Nested Lists Lists	2,3
Practical 5	Write a HTML program for demonstrating Hyperlinks. Navigation from one page to another and Navigation within the page.	2	Understand hyper link and implement hyperlink navigation from one page to another and within the page	2,3
Practical 6	Write a HTML program for time-table using tables.	2	Understand and implement queue using linked list	2,3
Practical 7	Write a HTML program to develop a static Home Page using frames.	2	Understand and apply polynomial addition and subtraction	4
Practical 8	Write a HTML program to develop a static Registration Form	2	Understand and convert infix to postfix using C program.	3
Practical 9	Write a HTML program to develop a static Login Page.	2	Evaluate expression using C program.	3
Practical 10	Write a HTML program to develop a static Web Page for Catalog.	2	Understand AVL tree and implement using array.	3
Practical 11	Write a HTML program to develop a static Web Page for Shopping Cart.	2	Develop heap using priority queue.	3
Practical 12	Write HTML for demonstration of cascading Embedded stylesheets.	2	Understand graph and it representation.	3
Practical 13	Write HTML for demonstration of cascading External stylesheets	2	Understand the concepts of traversal breadth first traversal.	3
Practical 14	Write HTML for demonstration of cascading Inline styles.	2	Understand and apply the concepts of traversal depth first traversal.	3
Practical 15	Write a JavaScript program to validate USER LOGIN page.	2	Develop a user login page	3

Practical 16	Write a program for implementing XML document for CUSTOMER DETAILS.	2	Develop skills in creating well-formed XML documents.	3
Practical 17	Write an internal Document Type Definition to validate XML for CUSTOMER DETAILS	2	Learn how to create an internal DTD to define the structure and constraints of an XML document.	3
Practical 18	Write an external Document Type Definition to validate XML for CUSTOMER DETAILS	2	Develop skills in managing and maintaining DTD files for multiple XML documents.	3
Practical 19	Write a simple servlet that displays a message	2	Develop skills in handling HTTP requests and generating HTTP responses.	3
Practical 20	Write a servlet that reads parameters from employee login page	2	Understand how to read and process parameters from HTTP requests in a servlet.	3

TEXT BOOKS:

T1: C. Xavier, "Web Technology & Design", New Age Publication, 2003

T2: Austin and Pawlan, "Advanced Programming for JAVA2 Platform", Pearson, 2000

REFERENCE BOOKS:

R1: Oliver, Dick; SAMS Teach Yourself Html 4 in 24 Hours; Techmedia.

R2: Ashbacher, Charles; SAMS Teach Yourself XML in 24 Hours; Techmedia.

OTHER LEARNING RESOURCES:

- https://books.google.co.in/books/about/Data_Structures_and_Algorithms.html?id=1lCHYj5eV-EC&redir_esc=y
- https://techdevguide.withgoogle.com/paths/data-structures-and-algorithms/

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Illustrate elements and attributes of a web page.	1,2,3,4,8
2	Build web pages using HTML and Cascading Style Sheets	1,2,3,4,7,8
3	Develop XML documents and Schemas	1,2,3,4,7,8
4	Design and implement static and dynamic website	1,2,3,4,7,8
5	Analyse best technologies for solving web client/server problems	1,2,3,4,7,8

SEMESTER – II									
Course Title	**Field Based Learning**								
Course code	**23BCAO124R**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**0**	**0**	**8**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Fall/ II semester of the first year of the program**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings.								
CO1	Apply theoretical concepts to real-world situations.								
CO2	Conduct field-based research and gather data effectively.								
CO3	Analyze and interpret field data to draw meaningful conclusions.								
CO4	Communicate findings clearly and effectively, both orally and in writing.								
CO5	Demonstrate professional behaviour and teamwork skills in field settings.								
Course Contents	The organization will provide the students two field visit for this program. The students will be taken to a specific site for learning purposes. The students will visit a relevant site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners regarding the subject or purpose of the visit. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial findings.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply theoretical concepts to real-world situations.	2, 4, and 8
2	Conduct field-based research and gather data effectively.	2, 3, and 8
3	Analyze and interpret field data to draw meaningful conclusions.	2, 3, and 7
4	Communicate findings clearly and effectively, both orally and in writing.	2, 5, and 6
5	Demonstrate professional behaviour and teamwork skills in field settings.	5, 6, and 7

SEMESTER – II									
Course Title	**Environmental Science**								
Course code	**23UBES101R**	**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 Computer Application**								
Semester	**Fall/ II semester of the first year of the program**								
Course Objectives	1. To understand the fundamental concepts and principles of environmental science. 2. To analyse the impact of human activities on the environment. 3. To explore ecological processes and the importance of biodiversity.								
CO1	Demonstrate the multidisciplinary nature of environmental studies								
CO2	Learning about natural resource, its importance and environmental impacts of Human activities on natural resource								
CO3	Explain environment and ecosystem, concept of biodiversity.								
CO4	Aware students about problems of environmental pollution, its impact and control measures.								
CO5	Illustrate the human population and the environment								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Multidisciplinary nature of environmental studies:** Definition, scope and importance Need for public awareness.	**8**	Understand basic ecological concepts and environmental processes.	**1,2**
II	**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.	**10**	Identify and analyze the impact of human activities on the environment. Gain knowledge about environment and ecosystem. Understand the concept of biodiversity and respect them.	**2,3,4**
	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.			

III	**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)	**9**	Identify and analyze the impact of human activities on the environment. Gain knowledge about environment and ecosystem	**3,4**
IV	**Biodiversity and its conservation** Introduction – Definition: genetic, species and ecosystem diversity. Biogeographical 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-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.	**9**	Gain knowledge about environment and ecosystem. Understand the concept of biodiversity and respect them 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	**4,5**
V	**The Interconnection Between Environmental Pollution and Social Issues: Impacts and Solutions:** 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.	**9**	Gain knowledge about environment and ecosystem. Understand the concept of biodiversity and respect them 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	**4,5**

	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.			

TEXT BOOKS:

T1: Harucha E. B, Textbook of Environmental Studies, Orient Blackswan 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
R2: Stadards, Vol I and II, Enviro Media (R)
R3: Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)
R4: Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
R5: 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

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Demonstrate the multidisciplinary nature of environmental studies	4
2	Learning about natural resource, its importance and environmental impacts of Human activities on natural resource	3,4
3	Explain environment and ecosystem, concept of biodiversity.	3,4
4	Aware students about problems of environmental pollution, its impact and control measures.	4,5,6,7
5	Illustrate the human population and the environment	4,8

SEMESTER – II									
Course Title	**ADVANCE IMPLICIT ENGLISH**								
Course code	**23UBPD124R**	**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 Computer Application**								
Semester	**Fall/ II semester of the first year of the program**								
Course Objectives	1. To enable students to learn, understand and practice transformation of sentences, correct usage of all tenses and rectify common grammatical errors. 2. To help students to expand their Vocabulary strength along with learning new words and collocations. 3. To train and guide students to improve and their sharpen their listening skill and to become good listeners,								
CO1	Enable students to understand grammar to write effectively and speak flawlessly, knowing correct usage of tenses and rectifying grammatical errors.								
CO2	Students will acquire the technique of expanding vocabulary and creating new words and use them in different contexts. Encouraging and helping them to sharpen their listening skills and to become good listeners.								
CO3	Encouraging and helping them to sharpen their listening skills and to become good listeners. Students will be able to develop and showcase their effective reading skills while reading any texts.								
CO4	Helping students to acquire the skill of time managing and apply the same in their profession lives along with the skills and information required for creating an excellent LinkedIn Profile.								
CO5	To make them prepare for various public and private sector exams & placement drives. To enhance the analytical skill and problem-solving skill of the students								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	**Grammar (flipped classroom)** 1. Interchange of Interrogative and Assertive Sentences, Exclamatory and Assertive Sentences 2. Types of Tenses 3. Common Errors 4. Non Verbal reasoning 5. Counting figures 6. Water images and mirror image 7. Clock images 8. Worksheet1 and Worksheet 2	12	Enrich in vocabulary.	**1,2,3**
II	**Vocabulary Development** 1. One word substitution 2. Homonyms and Homophones 3. Words often confused 4. Idioms and phrases 5. V.Average and Age 6. Average of numbers objects things and quantities 7. Problem on age 8. Solving questions on age and average	12	Identify common errors in English speaking and writing	**3,4**
III	**Listening Skills** 1. What is listening? 2. Types of Listening 3. Understanding Listening Barriers 4. Missing number/Letter 5. Letter Series(advanced) 6. Number series(advanced)	12	Improve listening skills.	**3,4**

IV	**Reading Skills** 1. Techniques of Effective Reading 2. Gathering ideas and information from a text 3. The SQ3R Technique 4. Venn diagram **5.** Introduction to venn diagram	10	Learn effective reading techniques.	**4**
V	**Time-Management Skills** 1. Introduction to Time Management 2. Purpose and Importance of Time Management 3. Basic Tips to maintain time 4. Classification a. Classification of odd one out. Number, meaningful word b. Classification based on priority	14	Learn time management techniques.	**2,4**

TEXTBOOKS:

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: Zinsser, William.(2006)*On Writing Well: The Classic Guide to Writing Nonfiction* HarperPerennial

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

R4: Quantitative Aptitude and Logical Reasoning by R.S. Agarwal

R5: Quantitative Aptitude and Logical Reasoning by Arihant

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOME

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Enable students to understand grammar to write effectively and speak flawlessly, knowing correct usage of tenses and rectifying grammatical errors.	5,6,8
2	Students will acquire the technique of expanding vocabulary and creating new words and use them in different contexts. Encouraging and helping them to sharpen their listening skills and to become good listeners.	5,6,8
3	Encouraging and helping them to sharpen their listening skills and to become good listeners. Students will be able to develop and showcase their effective reading skills while reading any texts.	5,6,8
4	Helping students to acquire the skill of time managing and apply the same in their profession lives along with the skills and information required for creating an excellent LinkedIn Profile.	5,6,7,8
5	To make them prepare for various public and private sector exams & placement drives. To enhance the analytical skill and problem-solving skill of the students	5,7,8

SEMESTER – II									
Course Title	**MOOCS II (REACT BASICS)**								
Course code	**23MOSY121R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ II semester of the first year of the program**								
Course Objectives	1. To learn the basics of React, including components, JSX syntax, and the Virtual DOM. 2. To gain proficiency in using state and props to manage data and interactions within components. 3. To learn to handle user events and utilize lifecycle methods to build dynamic applications.								
CO1	Use reusable components to render views where data changes over time								
CO2	Create more scalable and maintainable websites and apps								
CO3	Use props to pass data between components								
CO4	Create dynamic and interactive web pages and apps								
CO5	Use forms to allow users to interact with the web page. Build an application in React								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	**React Components:** In this module you will explore the basic structure and use of the React.js library. You will learn how to produce single page web applications using React components and to use JSX to style them.	**11**	Understanding the basics of React.js library and creating web applications.	1,2,5
II	**Data and State:** In this module you will explore the concept and practical use of state and stage-management. You will also gain knowledge on how to handle events and the ability to dynamically change content on a web page.	**7**	Understanding the stage and stage-management, handling event on a web page.	1,2,3
III	**Navigation, Updating and Assets in React.js:** In this module you will explore the basics of single and multi-page navigation, as well as the conditional rendering or changing of content in response to user status or choice.	**7**	Applying the navigation function for multiple pages on a web and rendering.	3,5
IV	**Your first React app:**In this module, you will be assessed on the key skills covered in the Course.	**3**	Applying and creating a react application using react.js	3,5

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	Course Outcome (CO)	Mapped Program Outcome
1	Use reusable components to render views where data changes over time	2,3,4,5,6,7,8
2	Create more scalable and maintainable websites and apps	2,3,4,5,6,7,8
3	Use props to pass data between components	2,3,4,5,6,7,8
4	Create dynamic and interactive web pages and apps	2,3,4,5,6,7,8
5	Use forms to allow users to interact with the web page. Build an application in React	2,3,4,5,6,7,8

SEMESTER – II									
Course Title	**EXTRA-CURRICULAR ACTIVITIES**								
Course code	**23UBEC121**	**Total credits:1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Fall / II semester of the first year of the program**								
Course Objectives	1. To develop problem-solving abilities through coding challenges and hackathons. 2. To participate in app development contests and exhibitions. 3. To develop entrepreneurial skills and mindset.								
CO1	Importance of different activities under different clubs.								
CO2	Formulate regular activities like workshops, competitions as per their interest and hobbies.								
CO3	Adapt to represent ADTU in various inter university, state and national level competitions.								
CO4	Discuss with invited experts in their respective fields.								
CO5	Develop an appreciation for diverse forms of artistic expression.								
Course 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 workshops that benefit the members and students by giving them the platform to learn from experts.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Importance of different activities under different clubs.	2,3,4,5,6,7
2	Formulate regular activities like workshops, competitions as per their interest and hobbies.	2,3,4,5,6,7
3	Adapt to represent ADTU in various inter university, state and national level competitions.	2,3,4,5,6,7,8
4	Discuss with invited experts in their respective fields.	2,3,4,5,6,7,8
5	Develop an appreciation for diverse forms of artistic expression.	2,3,5,6,7

SEMESTER – II									
Course Title	**BRIDGE I (ALGORITHMS FOR PROBLEM SOLVING)**								
Course code	**23BCAO125R**	**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 Computer Application**								
Semester	**Fall/ II semester of the first year of the program**								
Course Objectives	1. To understand the basics of algorithm and computational knowledge. 2. To understand computational thinking. 3. To apply algorithmic problem-solving techniques to real world problems.								
CO1	To understand the computational thinking and its four pillars.								
CO2	To understand and apply algorithms for various problems.								
CO3	To understand and analyze the principle of divide and conquer.								
CO4	Understanding graph theory and representation.								
CO5	To use forms to allow users to interact with the web page. Build an application in React								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	Introduction to Computational Thinking: About computational thinking, four pillars of computational thinking.	**12**	Understanding and applying computational thinking for different real-world computer-based problems.	1,3
II	Introduction to algorithm: About algorithm, basic algorithm like search and sort, pseudocode	**10**	Understanding and applying different algorithm and analyzing the algorithm	1,3 ,4
III	Divide and Conquer: Principles of divide and conquer, Quick Sort, Merge Sort	**12**	Understanding, applying divide and conquer method, and analyzing quick sort and merge sort.	1,3 ,4
IV	Graph Algorithms: Basics of graph theory, Graph representation and traversal. Shortest path algorithm.	**12**	Understanding, applying graph structure, and analyzing shortest path algorithm.	1,3 ,4
V	Data Structures: Basic data structures, linked list, trees, minimum spanning trees	**12**	Understanding data structure, and analyzing minimum spanning trees.	1,4

Textbooks:

T1: "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.
T2: “Computational Thinking: A Beginner's Guide to Problem-Solving and Programming” by Karl Beecher.
T3: "C Programming Absolute Beginner's Guide" by Perry and Miller

References:

R1: "Code: The Hidden Language of Computer Hardware and Software" by Charles Petzold.
R2: "Algorithms to Live By: The Computer Science of Human Decisions" by Brian Christian and Tom Griffiths.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	To understand the computational thinking and its four pillars.	1,2,3,4,5,6,7,8
2	To understand and apply algorithms for various problems.	1,2,3,4,5,6,7,8
3	To understand and analyze the principle of divide and conquer.	1,2,3,4,5,6,7,8
4	Understanding graph theory and representation.	1,2,3,4,5,6,7,8
5	To use forms to allow users to interact with the web page. Build an application in React	1,2,3,4,5,6,7,8

SEMESTER – II									
Course Title	**BRIDGE II (FUNDAMENTALS OF STATISTICS)**								
Course code	**23BCAO126R**	**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 Computer Application**								
Semester	**Fall/ II semester of the first year of the program**								
Course Objectives	1. To introduced the foundations of probability and statistical methods. 2. To explain the concepts in random variables and several distributions in engineering applications. 3. To learn the concepts of correlation, regression and estimations and their properties and to explain the concept of testing of hypothesis.								
CO1	Understanding the fundamental concepts of probability and statistics.								
CO2	Understanding measures of central tendency and measures of dispersion.								
CO3	Describe important probability distributions like Binomial, Poisson Distributions andnormal distribution.								
CO4	Explain the concept sampling distributions and estimation.								
CO5	Analyze the concepts of hypothesis testing.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	Introduction to statistics, population vs sample, collection of data,primary and secondary data, types of variables: dependent, independent, categorical and continuous variables, data visualization,	**12**	Understanding and applying statistical knowledge.	1,3
II	Measures of Central Tendency (Mean, median, mode, Skewness and symmetry) Measures of Dispersion (Range, variance, standard deviation, Inter quartilerange)	**10**	Understanding and applying different ways of measuring the central tendency.	1,3
III	Introduction to Probability: Probability rules (addition, multiplication, complement) Probability Distributions: Discrete and continuous distributions, Binomial, Poisson, and normal distributions.	**12**	Understanding, applying probability and its method.	1,3
IV	Sampling and Sampling Distributions, Introduction to Randomsampling, Confidence Intervals: Basic idea of estimation, Constructing simple confidence intervals.	**12**	Understanding, applying sampling distribution, and analyzing confidence interval.	1,3,4
V	Hypothesis Testing: Introduction to Hypothesis Testing, Formulating hypotheses, Basic understanding of pvalues, Common Tests.	**12**	Understanding hypothesis testing, and analyzing different hypothesis testing method.	1,4

TEXTBOOKS:

T1: Richard A. Johnson, "Miller & Freund's probability and statistics for engineers", 9th Edition,Pearson,2017.
T2: S.C. Gupta and V.K. Kapoor, "Fundamentals of Mathematical Statistics", 11th Edition, SultanChand & Sons Educational Publications, 2012.

REFERENCEBOOKS:

R1: W. Feller, "An Introduction to Probability Theory and its Applications", 3rd Edition, Wiley,1968.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understanding the fundamental concepts of probability and statistics.	1,2,3,4,6,7,8
2	Understanding measures of central tendency and measures of dispersion.	1,2,3,4,6,7,8
3	Describe important probability distributions like Binomial, Poisson Distributions and normal distribution.	1,2,3,4,6,7,8
4	Explain the concept sampling distributions and estimation.	1,2,3,4,6,7,8
5	Analyze the concepts of hypothesis testing.	1,2,3,4,6,7,8

SEMESTER – III									
Course Title	**Database Management Systems**								
Course code	**23BCAO211R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+15P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Fall/ I semester of the second year of the program**								
Course Objectives	1. To master core database concepts and SQL for efficient database design and implementation. 2. To explore advanced database features including NoSQL, data warehousing, and security. 3. To apply theoretical knowledge to real-world database management challenges through hands-on projects.								
CO1	Gain an understanding of fundamental database concepts and architectures.								
CO2	Develop proficiency in SQL and relational database design.								
CO3	Master advanced SQL features and database optimization techniques.								
CO4	Learn to design and manage solutions for unstructured data with NoSQL.								
CO5	Apply database knowledge to a real-world data analytics project.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Database Systems:** Overview of Database Systems: Definition and importance of databases, Evolution of DBMS Types of Database Systems: Relational, NoSQL, NewSQL databases Data models: Entity-Relationship diagram, Relational model, Database schema vs. data Database System Architecture: Roles of database users and administrators, DBMS architecture and data independence	**8**	Understand the definition, importance, and evolution of database systems; differentiate between relational, NoSQL, and NewSQL databases; comprehend data models including Entity-Relationship diagrams and relational models; and explain the roles of database users and administrators, DBMS architecture, and data independence.	2,4,5
II	**Relational Database Management:** SQL and Data Manipulation: Basic to advanced SQL, including queries, updates, and management Database Design: Normalization (1NF to BCNF), Integrity constraints, Indexing, and access methods Transaction Management: ACID properties, concurrency control, deadlock prevention	**10**	Utilize SQL for data manipulation, design normalized databases with integrity constraints and indexing, and manage transactions ensuring ACID properties, concurrency control, and deadlock prevention.	3,4,5
III	**Advanced Database Features:** Advanced SQL and Stored Procedures: Incorporating triggers, views, and procedures Database Security: Implementing data security measures, encryption, authorization, and authentication Performance Tuning and Optimization: Techniques for query optimization and database tuning	**8**	Apply advanced SQL features, implement database security measures, and optimize database performance through various tuning techniques.	3,4,5
IV	**Unstructured Data Management:** Introduction to Unstructured Data: Understanding the significance and	**6**	Understand the significance and challenges of managing unstructured data, explore	2,3,4

	management challenges NoSQL Databases: Types and applications: Document stores, key-value stores, wide-column stores, graph databases Data Modelling for NoSQL: Approaches to schema design, integration in NoSQL environments		various types and applications of NoSQL databases, and learn approaches to schema design and integration in NoSQL environments.	
V	**NoSQL Databases and Project-Based Applications:** MongoDB: Specifics of working with MongoDB, data model, query language, and tools for data manipulation and administration Practical Use Cases of NoSQL Databases: real-world applications and case studies that effectively utilize NoSQL databases to handle scalability, performance, and flexibility Project Design and Implementation Project Presentation and Evaluation	**5**	Understanding of MongoDB and NoSQL databases, analyze real-world applications, design and implement database projects, and effectively present and evaluate their work.	1,2,4,5
Practical Component				
Practical 1	**Consider the bank database given, where the primary keys are underlined. Construct the following SQL queries for this relational database.** a. Find the ID of each customer of the bank who has an account but not a loan. b. Find the ID of each customer who lives on the same street and in the same city as customer '12345'. c. Find the name of each branch that has at least one customer who has an account in the bank and who lives in "Harrison".	**4**	Describe, illustrate, explain, apply and develop DBMS Programming using commands.	1,2,3,4
Practical 2	**Create the below tables with the given attributes and enter some records.** a. Write a query to find the total number of marks obtained by each student. b. Write a query that gives the total marks obtained by Mohan. c. Write a query that displays the maximum marks of every subject. d. Write the SQL query which displays the name of those students who's total of all subjects is greater than 205. e. Display name of the students whose subjects total is greater than 205 and roll number is between 1 to 2. Pre-Experiment Questions 1. What is the use of sub Queries? 2. Explain different types of Join. Post Experiment Questions 1. How to alter Primary Key? 2. How to update a table by enforcing constraint?	**4**	Design and Create Database Tables, Write SQL Queries for Data Retrieval, Utilize SQL Functions, Implement Conditional Query Logic, Filter Data Based on Multiple Conditions, Understand and utilize subqueries, Alter table structures, Update data with constraints	2,3
Practical 3	**Create the table as given below, fill in the**	**4**	Understand Database	2,3

	data. Question: Which normal form in the table? After creating the table, create a second table (s) to convert the same into 2NF!		Normalization, Design and Create Database Tables, Identify Normal Forms,4Transform Tables to Achieve Higher Normal Forms, Implement Referential Integrity, Enhance Data Integrity and Reduce Redundancy	
Practical 4	**Write the SQL queries using Group by and having clause using following table.** Create the above tables with the given attributes and enter some records. I. Write a query to find the total number of marks obtained by each student. II. Write a query that gives the total marks obtained by Mohan. III. Write a query that displays the maximum marks of every subject. IV. Write the SQL query which displays the name of those students who's total of all subjects is greater than 205. V. Display name of the students whose subjects total is greater than 205 and roll number is between 1 to 2.	**4**	Understanding Table Creation and Data Insertion, Querying and Summarizing Data, Using Aggregate Functions, Filtering Grouped Data	1,2,3
Practical 5	**Create a table, fill it with customer details and do the following queries:** a. Find the total revenue for each customer b. List customers who have made more than one order c. Find the date of the most recent order for each customer d. Calculate the average order amount for each customer e. Retrieve the orders placed in January 2023 f. Find the top 3 customers with the highest total revenue g. Calculate the total revenue for each month in 2023 h. List orders with a total amount greater than the average total amount for all orders i. Find customers who have made orders on consecutive days j. Calculate the total revenue for each customer, including orders made by customers who haven't placed any orders	**4**	Table Creation and Data Insertion, Summarizing customer revenue, Analyging ordering data, Filtering and Retrieving Specific Orders, Identifying High-Value Customers	3,4
Practical 6	(Exercise on retrieving records from the table) EMPLOYEES (Employee_Id, First_Name, Last_Name, Email, Phone_Number, Hire_Date, Job_Id, Salary, Commission_Pct, Manager_Id, Department_Id) (a) Find out the employee id, names, salaries	**4**	Data Insertion, Summarizing customer revenue, Analyging ordering data, Filtering and Retrieving Specific Orders, Identifying High-Value Customers	

	of all the employees (b) List out the employees who works under manager 100 (c) Find the names of the employees who have a salary greater than or equal to 4800 (d) List out the employees whose last name is 'AUSTIN' (e) Find the names of the employees who works in departments 60,70 and 80 (f) Display the unique Manager_Id			
Practical 7	(Exercise on updating records in table) Create Client_master table with the following fields (ClientNO, Name, Address, City, State, bal_due) (a) Insert five records (b) Find the names of clients whose bal_due>5000. (c) Change the bal_due of Client NO "C123" to Rs. 5100 (d) Change the name of Client_master to Client12. (e) Display the bal_due heading as "BALANCE"	4	Table Creation and Data Insertion, Summarizingcustomer revenue, Analyging ordering data, Filtering and Retrieving Specific Orders	3,4
Practical 8	Rollback and Commit commands Create Teacher table with the following fields(Name, DeptNo, Date of joining, DeptName, Location, Salary) (a) Insert five records (b) Give Increment of 25% salary for Mathematics Department . (c) Perform Rollback command (d) Give Increment of 15% salary for Commerce Department (e) Perform commit command	**4**	Data Insertion, Summarizing customer revenue, Analyging ordering data, Filtering and Retrieving Specific Orders, using roll back and commit command	2,3,4
Practical 9	(Exercise on order by and group by clauses) Create Sales table with the following fields(Sales No, Salesname, Branch, Salesamount, DOB) (a) Insert five records (b) Calculate total sales amount in each branch (c) Calculate average sales amount in each branch . (d) Display all the salesmen, DOB who are born in the month of December as day in character format i.e. 21-Dec-09 (e) Display the name and DOB of salesman in alphabetical order of the month.	**4**	Creation and Insertion of records, use of group by clouse	2,3,4
Practical 10	Create an Emp table with the following fields: (EmpNo, EmpName, Job,Basic, DA, HRA,PF, GrossPay, NetPay) (Calculate DA as 30% of Basic and HRA as 40% of Basic)	**4**	Database Design and Table Creation, Data Manipulation and Retrieval, **Querying Data with Conditions,** Aggregate Functions and Grouping, Updating Data,	2,3,4

	(a) Insert Five Records and calculate GrossPay and NetPay. (b) Display the employees whose Basic is lowest in each department . (c) If NetPay is less than <Rs. 10,000 add Rs. 1200 as special allowances . (d) Display the employees whose GrossPay lies between 10,000 & 20,000 (e) Display all the employees who earn maximum salary			
Practical 11	Create a table, fill it with customer details and do the following queries: a) Find the total revenue for each customer b) List customers who have made more than one order c) Find the date of the most recent order for each customer d) Calculate the average order amount for each customer e) Retrieve the orders placed in January 2023 f) Find the top 3 customers with the highest total revenue g) Calculate the total revenue for each month in 2023 h) List orders with a total amount greater than the average total amount for all orders i) Find customers who have made orders on consecutive days j) Calculate the total revenue for each customer, including orders made by customers who haven't placed any orders.	**4**	Table Creation and Data Insertion, summarizing customer revenue, Analyging ordering data, Filtering and Retrieving Specific Orders.	
Practical 12	Employee Database An Enterprise wishes to maintain a database to automate its operations. Enterprise is divided into certain departments and each department consists of employees. The following two tables describes the automation schemas Dept (deptno, dname, loc) Emp (empno, ename, job, mgr, hiredate, sal, comm, deptno) a) Update the employee salary by 15%, whose experience is greater than 10 years. b) Delete the employees, who completed 30 years of service. c) Display the manager who is having maximum number of employees working under him? d) Create a view, which contain employee names and their manager	**4**	Database Design and Table Creation, Data Manipulation and Retrieval, **Querying Data with Conditions,** Aggregate Functions and Grouping, Updating Data,	2,3,4,5
Practical 13	Using Employee Database perform the following queries a) Determine the names of employee, who	**4**	Table Creation and Data Insertion, Summarizing customer revenue, Analyging	2,3,4,5

	earn more than their managers. b) Determine the names of employees, who take highest salary in their departments. c) Determine the employees, who are located at the same place. d) Determine the employees, whose total salary is like the minimum Salary of any department. e) Determine the department which does not contain any employees.		ordering data, Filtering and Retrieving Specific Orders.	
Practical 14	11. Write the SQL queries using Group by and having clause using following table. Create the above tables with the given attributes and enter some records. a) Write a query to find the total number of marks obtained by each student. b) Write a query that gives the total marks obtained by Mohan. c) Write a query that displays the maximum marks of every subject. d) Write the SQL query which displays the name of those students who's total of all subjects is greater than 205. e) Display name of the students whose subjects total is greater than 205 and roll number is between 1 to 2.	**4**	Design and Create Database Tables, Write SQL Queries for Data Retrieval, Utilize SQL Functions, Implement group by clause Logic, Filter Data Based on Multiple Conditions, Understand and utilize subqueries, display data	2,3,4,5
Practical 15	Create the following tables : Book(accession-no, title, publisher, year, date-of-purchase, status) Member(member-id, name, number-of-books-issued, max-limit) Book-issue(accession-no, member-id, date-of-issue) (a) Create a form to accept the data from the user with appropriate validation checks. (b) Generate queries to do the following : (i) List all those books which are due from the students to be returned. A book is considered to be due if it has been issued 15 days back and yet not returned. (ii) List all those members who cannot be issued any more books.	**4**	Table Creation and Data Insertion, Summarizing customer revenue, Analyging ordering data, Filtering and Retrieving Specific Orders	2,3,4,5
Practical 16	You are given a dataset containing information about various books in JSON format. Each book has attributes such as title, author, published_year, genres, and ISBN. Write a Python script to: 1. Connect to a MongoDB database. 2. Insert the dataset into a collection called books. 3. Query the database to find all books published after the year 2000 and print their titles and authors.	**2**	Connect to a MongoDB database using Python, insert a JSON dataset into a MongoDB collection, and perform queries to retrieve specific data based on given criteria. This exercise enhances their understanding of database operations and data manipulation using MongoDB.	3,5

Practical 17	Using Redis as a key-value store, write a Python script to perform the following tasks: 1. Connect to a Redis server. 2. Store user session data with keys as session_id and values as JSON objects containing user_id, login_time, and status. 3. Retrieve and print the session data for a given session_id.	**2**	Connect to a Redis server using Python, store and manage user session data in a key-value format, and retrieve session data for a given session ID.	3,5
Practical 18	You are tasked with creating a data model in Cassandra to store user activity logs. Each log entry should contain user_id, activity_type, timestamp, and details. Write a Python script to: 1. Connect to a Cassandra cluster. 2. Create a keyspace called user_activity. 3. Create a table called activity_logs with appropriate columns and data types. 4. Insert sample data into the table. 5. Query the table to retrieve all activity logs for a specific user_id.	**2**	Connect to a Cassandra cluster using Python, create a keyspace and table to store user activity logs, insert sample data, and query the table to retrieve logs for a specific user ID.	3,5
Practical 19	You are tasked with managing a MongoDB database for an e-commerce application. The database contains a collection called products with documents that include fields such as product_id, name, category, price, and stock_quantity. Write a Python script to: 1. Connect to the MongoDB database. 2. Insert the following products into the products collection: {"product_id": 1, "name": "Laptop", "category": "Electronics", "price": 1200, "stock_quantity": 30} {"product_id": 2, "name": "Smartphone", "category": "Electronics", "price": 800, "stock_quantity": 50} {"product_id": 3, "name": "Office Chair", "category": "Furniture", "price": 150, "stock_quantity": 20} 3. Write a query to find all products in the "Electronics" category and print their names and prices.	**2**	Establish a connection to a MongoDB database, perform CRUD (Create, Read) operations, and construct queries to filter and retrieve specific data.	2,3,5
Practical 20	You are building a scalable blog platform using MongoDB to manage blog posts. Each blog post document contains post_id, title, author, content, tags, published_date, and views. Write a Python script to: • Connect to the MongoDB database. • Insert the following blog posts into the blog_posts collection: {"post_id": 101, "title": "Introduction to MongoDB", "author": "Alice", "content": "This is a blog post about MongoDB.", "tags": ["MongoDB", "Database"],	**2**	Handling large-scale data, performing CRUD operations, and writing complex queries to analyze and retrieve high-traffic data efficiently.	3,4,5

	"published_date": "2024-01-15", "views": 120} {"post_id": 102, "title": "Scaling Applications with NoSQL", "author": "Bob", "content": "This post discusses scaling applications using NoSQL databases.", "tags": ["NoSQL", "Scalability"], "published_date": "2024-02-10", "views": 200} • Write a query to find all blog posts with more than 150 views and print their titles and authors.			

Text Books:

T1: Database System Concepts, Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, 7th Edition, 2019

T2: SQL in a Nutshell, Kevin Kline, Brand Hunt, and Daniel Kline, 4th Edition, 2020

T3: NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pramod J. Sadalage and Martin Fowler, 1st Edition, 2012

T4: Designing Data-Intensive Applications, The Big Ideas Behind Reliable, Scalable, and Maintainable Systems, Martin Kleppmann, 1st Edition, 2017

Reference Books:

R1: Fundamentals of Database Systems, RamezElmasri&Shamkant B. Navathe, 8th Edition, 2020

R2: Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, 2002

R3: MongoDB: The Definitive Guide, Kyle Banker and Kristina Chodorow

OTHER LEARNING RESOURCES:

- **https://www.jbiet.edu.in/coursefiles/cse/HO/cse2/DBMSI-III.pdf**
- **https://cs.ulb.ac.be/public/_media/teaching/infoh303/dbmsnotes.pdf**
- **SQLZoo-** https://sqlzoo.net/
- DB-Engines- https://db-engines.com/
- MongoDB - https://www.mongodb.com/online

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Gain an understanding of fundamental database concepts and architectures.	1,2, 3, 4, 6,7, 8
2	Develop proficiency in SQL and relational database design.	1,2, 3, 6, 7, 8
3	Master advanced SQL features and database optimization techniques.	1,2, 3, 6, 7, 8
4	Learn to design and manage solutions for unstructured data with NoSQL.	1,2, 3, 6, 7, 8
5	Apply database knowledge to a real-world data analytics project.	1,2, 3, 4, 6,7, 8

SEMESTER – III									
Course Title	**Operating Systems**								
Course code	**23BCAO212R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+15P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Winter / I semester of the second year of the program**								
Course Objectives	1. To learn the mechanisms of OS to handle processes and threads and their communication and the mechanisms involved in memory management in contemporary OS. 2. To gain knowledge on Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols 3. To know the components and management aspects of concurrency management.								
CO1	Explain the basic concepts of Operating Systems and related concepts.								
CO2	Summarize the concepts of processes and threads, process scheduling including Throughput, Turnaround Time, Waiting Time, Response Time.								
CO3	Identify the concept for optimally allocating memory to processes by increasing memory utilization and improving the access time.								
CO4	Demonstrate and implement the concepts of deadlocks and related concepts								
CO5	Implement various techniques of memory and file management.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction:** Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.	**7**	Understand the Concept of Operating Systems, Trace the Generations of Operating Systems, Identify Types of Operating Systems, Comprehend OS Services, Utilize System Calls, Understand OS Structures, Conceptualize the Virtual Machine	
II	**Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. **Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, **Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling.	**8**	Understand the Definition of a Process, Comprehend Process Relationships, Identify Different States of a Process, Understand Process State Transitions, Explore the Process Control Block (PCB), Understand Context Switching, Define Threads, Identify Various States of Threads, Understand the Benefits of Threads, Conceptualize Multithreading, Understand the Foundation and Objectives of Process Scheduling, Identify Types of Schedulers, Understand Scheduling Criteria, Explore Scheduling Algorithms, Comprehend Multiprocessor Scheduling	
III	**Inter-process Communication:** Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution **Deadlocks:** Definition, Necessary and sufficient	**8**	Understand the Concept of Inter-Process Communication, Comprehend the Critical Section Problem, Identify Race Conditions, Understand Mutual	

	conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery		Exclusion, Explore Hardware Solutions for Mutual Exclusion, Understand the Definition of Deadlock, Identify Necessary and Sufficient Conditions for Deadlock, Understand Deadlock Prevention, Explore Deadlock Avoidance, Comprehend Deadlock Detection and Recovery	
IV	**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging. **Virtual Memory**: Basics of Virtual Memory – Hardware and control, l structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).	**8**	Understand the Basic Concept of Memory Management, Comprehend Logical and Physical Address Mapping, Explore Memory Allocation Techniques, Identify Internal and External Fragmentation, Understand Compaction, Explore Paging, Understand the Basics of Virtual Memory, Comprehend Hardware and Control Structures for Virtual Memory, Explore the Concept of Locality of Reference, Understand Page Faults, Comprehend the Working Set Model, Understand Dirty Pages and Dirty Bits, Explore Demand Paging, Understand Page Replacement Algorithms,	
V	**I/O Hardware:** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure.. **File Management**: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management. **Disk Management:** Disk structure, Disk scheduling, Disk reliability, Disk formatting, Boot-block, Bad blocks.		Understand the Different Types of I/O Devices, Comprehend Device Controllers, Understand Direct Memory Access (DMA), Comprehend the Goals of Interrupt Handlers, Understand Device Drivers, Explore Device-Independent I/O Software, Understand Secondary-Storage Structure, Understand the Concept of a File, Explore File Access Methods, Comprehend File Operations, Understand Directory Structure, Explore File System Structure, Understand File Allocation Methods, Comprehend Free-Space Management, Understand Disk Structure, Explore Disk Scheduling, Comprehend Disk Reliability, Understand Disk Formatting, Explore the Boot Block and Bad Blocks,	

Practical				
Practical 1	CPU scheduling algorithms first come first serve (FCFS).	2	Implement and understand the working of the First Come First Serve (FCFS) CPU scheduling algorithm.	2,3
Practical 2	CPU scheduling algorithms shortest job first (SJF).	2	Apply and analyze the Shortest Job First (SJF) CPU scheduling algorithm.	3,4
Practical 3	CPU scheduling algorithms round robin.	2	Implement and evaluate the performance of the Round Robin CPU scheduling algorithm.	3,6
Practical 4	CPU scheduling algorithms priority.	2	Design and simulate the Priority CPU scheduling algorithm.	4,5
Practical 5	Producer-consumer problem using semaphores.	2	Solve synchronization problems using semaphores in the Producer-Consumer scenario.	3
Practical 6	Dining-philosophers problem.	2	Implement the Dining Philosophers problem to understand deadlock and concurrency control.	3
Practical 7	Memory management techniques multi programming with fixed number of task (MFT).	2	Analyze and implement memory allocation using Multiprogramming with Fixed Number of Tasks (MFT).	3,4
Practical 8	Memory management techniques multi programming with variable number of task (MVT).	2	Implement memory management using Multiprogramming with Variable Number of Tasks (MVT).	3
Practical 9	Contiguous memory allocation worst fit.	2	Apply and evaluate the Worst Fit algorithm for contiguous memory allocation.	3,6
Practical 10	Contiguous memory first fit.	2	Implement and assess the First Fit algorithm for contiguous memory allocation.	3,6
Practical 11	Contiguous memory best fit.	2	Analyze and implement the Best Fit algorithm for contiguous memory allocation.	3,4
Practical 12	Page replacement algorithms in first in first out (FIFO).	2	Implement the FIFO page replacement algorithm and analyze its performance.	3
Practical 13	Page replacement algorithms least recently used (LRU).	2	Apply the LRU page replacement algorithm and evaluate its effectiveness.	3
Practical 14	Page replacement algorithms optimal.	2	Implement the Optimal page replacement algorithm and compare it with other algorithms.	3,6
Practical 15	File organization techniques single level directory.	2	Design and implement file organization using a Single Level Directory structure.	3,5
Practical 16	File organization techniques two level directory.	2	Understand and implement file organization using a Two Level	2,3

			Directory structure.	
Practical 17	File allocation sequentially, indexed, and linked.	2	Implement and compare different file allocation techniques: Sequential, Indexed, and Linked.	3,6
Practical 18	Dead lock avoidance and prevention.	2	Understand and implement techniques for deadlock avoidance and prevention.	2,3
Practical 19	Disk scheduling algorithms FCFS.	2	Implement and evaluate the First Come First Serve (FCFS) disk scheduling algorithm.	3,6
Practical 20	Disk scheduling algorithms SCAN.	2	Apply and analyze the SCAN disk scheduling algorithm.	3,4

TEXT BOOKS:

T1: Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.

T2: Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

REFERENCE BOOKS:

R1: Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing.

R2: Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley

R3: Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India

R4: Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

OTHER LEARNING RESOURCES:

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the basic concepts of Operating Systems and related concepts.	2, 3, 5,6,8
2	Summarize the concepts of processes and threads, process scheduling including Throughput, Turnaround Time, Waiting Time, Response Time.	1, 2, 3, 5, 6, 8
3	Identify the concept for optimally allocating memory to processes by increasing memory utilization and improving the access time.	2, 3, 5, 6, 8
4	Demonstrate and implement theconcepts of deadlocks and related concepts	1,2
5	Implement various techniques of memory and file management.	1,2

SEMESTER – III									
Course Title	**Object Oriented Programming Paradigm**								
Course code	**23BCAO213R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:45T+30P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Basic Programming**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Fall/ I semester of the second year of the program**								
Course Objectives	1. To enable students to understand the basic object-oriented programming concepts and apply them in problem solving. 2. To illustrate among students, the inheritance concepts for reusing the program. 3. To enable students to develop GUI-based applications using AWT, Swing, JavaFX and Event handling.								
CO1	Understand object-oriented programming concepts and implement in java.								
CO2	Demonstrate building blocks of OOPs language, inheritance, package and interfaces, and analyze real-world problems in terms of these.								
CO3	Apply the exception handling methods on programming.								
CO4	Develop interactive as well as GUI-based java applications in project-based learning.								
CO5	Outline the concept of package, interface, multithreading and File handling in java.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Java Overview:** Java Introduction, Platform Independence, JVM & JDK, Data types, Operators, If, else statement, Switch condition, while, do-while, for loop, break and continue statement. Array and String: Single Array & Multidimensional Array, Library Classes-String, String Buffer & Wrapper Class, Command line arguments and Various String Operations.	**12**	Understand and apply the fundamentals of Java, including control flow, data structures, and string operations, to write basic Java programs.	2,3
II	**Classes, Objects and Methods:** Class and Object, Object reference, Constructor: Constructor Overloading, Method: Method Overloading, Recursion, Passing and Returning object form Method, new operator, this and static keyword, finalize() method, Import statement, Static import, Access control, Nested class, Inner class, Anonymous inner class.	**8**	Develop object-oriented Java applications by creating and manipulating classes, objects, constructors, and methods, including the use of inner classes.	3,5
III	**Inheritance and Interfaces in Java:** Overview of Inheritance, inheritance in constructor, Inheriting Data members and Methods, Multilevel Inheritance – method overriding Handle multilevel constructors super keyword, Stop Inheritance, final keyword. Creation and Implementation of an interface, Interface reference, instance of operator, Interface inheritance, Dynamic method dispatch, Abstract class, Comparison between Abstract Class and interface, inside of System.out.println – statements.	**10**	Implement inheritance and interfaces in Java to design complex class hierarchies, promoting code reuse and flexibility in object-oriented applications.	3,5

IV	**Exception Handling in Java:** Exception and Error, Use of try, catch, throw, throws and finally, Built in Exception, Custom exception, Throwable Class. **JAVA File Handling:** Overview of Different Stream (Byte Stream, Character stream), Readers and Writers class, File Class, File Input Stream, File Output Stream, Input Stream Reader and Output Stream Writer class, File reader and writer class, File Writer, Buffered Reader class.	**7**	Create robust Java applications by implementing exception handling and efficient file I/O operations using Java's exception and file handling mechanisms.	3,5
V	**Applet, AWT, Swing and JavaFX:** Applet: Applet Fundamental, Applet Architecture, Applet Skeleton, Requesting Repainting , Event Handling: various event handling mechanisms, various classes related to event sources and event listeners, AWT: window fundamentals, creating frames, Adding removing various controls, Layout managers, Introduction To Swing and JavaFX.	**8**	Design and develop graphical user interfaces in Java using AWT, Swing, and JavaFX, incorporating event handling and layout management principles.	5
Practical Component				
Practical 1	Program to print all even numbers between 1 and 50 using for loop.	**2**	Demonstrate the understanding of for loops and conditional statements	2
Practical 2	2. Program to calculate and print factorial of a number 'n' using for loop	**2**	Apply the knowledge of for loops and mathematical concepts	3
Practical 3	3. Program to check two arrays are equal or not.	**2**	Analyze and compare two arrays to determine if they are equal by writing a program that iterates through the arrays and checks for element-wise equality	4
Practical 4	Program to add two matrices.	**2**	Apply the understanding of matrix operations	3
Practical 5	Program to display marks, percentage, grade based on attendance.	**2**	Explain how attendance data impacts marks, percentage, and grades	2
Practical 6	Program to check if a number is odd or even.	**2**	Determine and explain whether a number is odd or even by writing a program that uses conditional statements	2
Practical 7	Program to check if a number is prime or not.	**2**	Determine and explain whether a number is prime by writing a program that tests the number's divisibility by integers other than 1 and itself	2
Practical 8	Program to use switch case to print seasons.	**2**	Apply the knowledge of switch case statements by writing a program that prints the appropriate season based on a given input	3

Practical 9	Program to print Volume of box using Constructor overloading.	**2**	Analyze and differentiate between various constructor implementations by writing a program that uses constructor overloading	4
Practical 10	Program to show function overloading.	**2**	Apply the understanding of function overloading	3
Practical 11	Program to show return by object.	**2**	Apply object-oriented programming concepts by writing a program that returns an object from a function to demonstrate encapsulation and data handling	3
Practical 12	Program to show pass by value.	**2**	Understand and explain the concept of pass by value by writing a program that shows how passing arguments by value affects the function's behaviour	2
Practical 13	Program to show pass by reference.	**2**	Understand and explain the concept of pass by reference by writing a program that shows how passing arguments by reference affects the function's behavior	2
Practical 14	Program to find Factorial using recursive function.	**2**	Apply the understanding of recursion by writing a program that calculates the factorial of a number using a recursive function	3
Practical 15	Program to find Month- season using switch case.	**2**	Apply the knowledge of switch case statements by writing a program that determines and prints the season based on the input month	3
Practical 16	Program to print data of employee.	**2**	Demonstrate their understanding of data structures and object-oriented programming	2
Practical 17	Program to print student data.	**2**	Apply object-oriented programming principles	3
Practical 18	Write a Java program to create a new Box class in Java.	**2**	Synthesize the knowledge of object-oriented programming by designing and implementing a new class in Java	6

TEXT BOOKS:

T1: Herbert Schildt and Dale Skrien, “Java Fundamentals – A comprehensive Introduction”, McGraw Hill.
T2: Herbert Schildt, “Java the complete reference”, McGraw Hill, Osborne.
T3: T. Budd, “Understanding Object- Oriented Programming with Java”, Pearson Education.

REFERENCE BOOKS:

R1: P.J.Dietel and H.M.Dietel , “Java How to program”, Prentice Hall.
R2: P.Radha Krishna , “Object Oriented programming through Java”, CRC Press.

R3: S.Malhotra and S. Choudhary, “Programming in Java”, Oxford University Press.

OTHER LEARNING RESOURCES:

Web References:

1. http://java.sun.com
2. http://www.oracle.com/technetwork/java/index.html)
3. http://java.sun.com/javase
4. http://www.oracle.com/technetwork/java/javase/overview/index.html
5. http://download.oracle.com/javase/7/docs/api/index.html

E-Text Books:

1. http://docs.oracle.com/javase/tutorial/
2. iiti.ac.in/people/~tanimad/JavaTheCompleteReference.pdf
3. https://www.codejava.net/books/4-best-free-java-e-books-for-beginners

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the object-oriented programming concepts and implement in java.	1, 2, 5, 8
2	Demonstrate the building blocks of OOPs language, inheritance, package and interfaces, and analyse real-world problems in terms of these.	2, 3, 4, 5, 7, 8
3	Apply the exception handling methods on programming	7
4	Develop interactive as well as GUI-based java applications in project-based learning.	2, 3, 4, 5, 7, 8
5	Outline the concept of package, interface, multi-threading and File handling in java.	1, 2, 3

SEMESTER – III										
Course Title	**WEB AND MOBILE PROGRAMMING TECHNOLOGIES**									
Course code	**23BCAO214R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 45T+15P	**3**	**0**	**2**	**0**	**0**	**0**	**4**	
Pre-requisite	**Nil**	**Co-requisite**	**Nil**							
Programme	**Bachelor of Computer Applications**									
Semester	**Winter/ I semester of the second year of the program**									
Course Objectives	1. To create responsive web pages using HTML and CSS. 2. To understand and apply JavaScript in web development. 3. To equip with the knowledge of frontend development with React.									
CO1	Understand the concept of web development and building website with HTML, CSS.									
CO2	Understand JavaScript language and its role in website development, and implementing it.									
CO3	Equip the knowledge of frontend development with React.js.									
CO4	Understanding the concept of backend development and understanding PHP and its role in backend development.									
CO5	Understanding MySQL and mobile app development, implementing PHP with MySQL with different operations.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Overview of HTML, CSS:** Overview HTML, elements and attributes; CSS styling, selectors, box model; Responsive Design Principles.	**6**	Gain foundational knowledge of web and mobile development, build responsive websites using HTML, CSS	2,3,5
II	**Introduction to Java Script:** Basic syntax, data types, variables, operators, control flow, functions, array, object, DOM manipulation; ES6 features, DOM manipulation with JavaScript; Event handling, asynchronous JavaScript.	**10**	Understanding JavaScript, applying JavaScript knowledge to solve different problems.	2,3
III	**Introduction to Frontend Development:** Introduction to react, react components and JSX, state and lifecycle methods, handling events in React. React Hooks, React Router for single-page applications, State management with Context API, Integrating APIs with React.	**10**	Understand the concept of frontend development and JSX. Understanding React.js and applying its knowledge to create webapp with react.	2,3,5
IV	**Introduction to Backend Development:**Introduction to backend development;Introduction to PHP, syntax, data types, variables, operators, control flow, functions, array, object; Form handling and user input, database connectivity.	**10**	Understand the knowledge in server-side programming with PHP, enabling efficient data handling, user interaction, and database integration.	2,3,5
V	**Backend Development II and Mobile App:** MySQL, connecting PHP to MySQL database, CRUD operations; Mobile app development platforms (iOS, Android); Mobile UI/UX design principles; Mobile app architecture.	**12**	Develop robust full-stack web applications with PHP and MySQL, while also gaining insights into mobile app development principles and best practices.	3,5
Practical Component				
Practical 1	Create a basic HTML page with a title, heading, and paragraph. Explain the significance of each HTML tag used.	**2**	Demonstrate the ability to create a basic HTML document structure with a	5

			title, heading, and paragraph using appropriate HTML tags.	
Practical 2	Create a responsive web page using HTML5 and CSS3. Include a header, main content area, and footer. Design a web page layout using Flexbox. Create a navigation bar with horizontally aligned items that adjust on smaller screens. Implement media queries to adjust the layout for different screen sizes. Test it on different devices.	**2**	Develop and implement a responsive web page layout using HTML5, CSS3 (including Flexbox and media queries), to ensure optimal viewing experience across various screen sizes.	3,5
Practical 3	Create a product card layout using the CSS box model. Include an image, product name, description, and price.Make the product card layout responsive, ensuring it looks good on both desktop and mobile devices.	**2**	Understand and apply the CSS box model to design web page layouts. They will gain experience in creating responsive designs that adapt to different screen sizes, enhancing their web development skills.	2,3
Practical 4	Write a JavaScript function to calculate the factorial of a number entered by the user.	**2**	Demonstrate proficiency in basic JavaScript syntax and functions. They will be able to solve mathematical problems programmatically and improve their problem-solving skills.	3
Practical 5	Create a JavaScript program that takes user input for name and age, then outputs a message greeting the user and mentioning their age.	**2**	Handle user inputs and outputs using JavaScript, which is essential for creating interactive web applications. They will also improve their understanding of JavaScript data types and variables.	3
Practical 6	Write a JavaScript script to store a list of students and their scores in an array of objects. Calculate and display the average score.	**2**	Experience working with arrays and objects in JavaScript. They will learn how to organize data effectively and perform calculations based on that data, which is crucial for developing data-driven applications.	4
Practical 7	Create a to-do list application where users can add, remove, and mark tasks as completed. Use JavaScript to manipulate the DOM.	**2**	Enhance their skills in DOM manipulation using JavaScript. They will learn how to create dynamic, interactive web applications that respond to user actions in real time.	5
Practical 8	Implement a simple counter that increases or decreases a value when buttons are clicked.	**2**	Understand the basics of event handling in JavaScript. They will learn to create simple yet interactive features in web applications,	3

			which is foundational for more complex interactivity.	
Practical 9	Create a simple web app that fetches and displays a list of posts from a public API. Implement error handling for failed API requests.	**2**	Experience with asynchronous JavaScript and API integration. They will learn how to fetch data from external sources and handle potential errors, preparing them for real-world web development scenarios.	5
Practical 10	Build a simple React application that displays a list of products using components. Each product should have a name, image, and price.	**2**	Learn the basics of React, including the creation and use of components. They will develop an understanding of how to structure a React application and manage state, laying the foundation for building complex user interfaces.	5
Practical 11	Create a React component that fetches and displays current weather information based on user input for a city.	**2**	Apply their knowledge of React to build components that interact with APIs. They will gain experience in handling asynchronous operations within React components, which is essential for creating dynamic web applications.	5
Practical 12	Develop a React form component for user login with email and password. Implement form validation and submit handling.	**2**	Learn how to create and manage forms in React, including validating user input and handling form submissions. This is crucial for developing user authentication systems and other interactive features.	5
Practical 13	Convert a class-based component for a counter into a functional component using React Hooks.	**2**	Understand the difference between class-based and functional components in React. They will gain experience using React Hooks to manage state and lifecycle methods, which is vital for modern React development.	4
Practical 14	Set up a React application with multiple pages (e.g., Home, About, Contact) using React Router. Include navigation links.	**2**	Learn how to create single-page applications with multiple views using React Router. They will understand the basics of client-side routing and navigation in React applications.	5
Practical 15	Write a PHP script to calculate the sum, difference, product, and quotient of two numbers provided by the user via a form.	**2**	Demonstrate basic PHP programming skills, including handling user inputs and performing	3

			arithmetic operations. This exercise will help them understand the fundamentals of server-side scripting.	
Practical 16	Create a PHP script that stores a list of books with title, author, and price. Display the list as an HTML table.	**2**	Learn how to work with arrays and data storage in PHP. They will also gain experience in generating dynamic HTML content from server-side scripts, which is a core skill in web development.	5
Practical 17	Develop a PHP form that collects user feedback (name, email, message) and displays the submitted data on a new page.	**2**	Understand how to handle and process form data using PHP. They will learn the basics of form submission, data validation, and user interaction on the server side.	3
Practical 18	Create a PHP script that connects to a MySQL database and displays a list of users from a user's table.	**2**	Learn to implement full CRUD (Create, Read, Update, Delete) operations in a web application using PHP and MySQL. This is a fundamental skill for building and managing web-based databases.	3
Practical 19	Develop a PHP application that allows users to create, read, update, and delete records in a products table.	**2**	Learn to implement full CRUD (Create, Read, Update, Delete) operations in a web application using PHP and MySQL. This is a fundamental skill for building and managing web-based databases.	5
Practical 20	Create a PHP script for user registration and login, including password hashing and session management.	**2**	Understand the basics of user authentication and session management in PHP. They will learn how to securely handle user credentials and manage user sessions, which is crucial for developing secure web applications.	5

Textbooks:

T1. "Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics" by Jennifer Niederst Robbins.

T2. "Eloquent JavaScript: A Modern Introduction to Programming" by MarijnHaverbeke.

T3. "React Up & Running: Building Web Applications" by StoyanStefanov.

Reference:

R1. "Learning Node: Moving to the Server-Side" by Shelley Powers.

R2. "Express in Action: Writing, building, and testing Node.js applications" by Evan Hahn.

R3. "Beginning Flutter: A Hands-on Guide to App Development" by Marco L. Napoli.

R4. "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws" by DafyddStuttard and Marcus Pinto.

R5. "The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations" by Gene Kim, Jez Humble, Patrick Debois, and John Willis.

Other Materials:

- "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation" by Jez Humble and David Farley.
- FreeCodeCamp - Creating a RESTful API with Node.js
- https://www.reactnative.express/
- https://flutterbyexample.com/

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the concept of web development and building website with HTML, CSS.	2, 3, 5, 6, 7, and 8
2	Understand JavaScript language and its role in website development, and implementing it.	2, 3, 5, 6, 7, and 8
3	Equip the knowledge of frontend development with React.js.	2, 3, 5, 6, 7, and 8
4	Understanding the concept of backend development and understanding PHP and its role in backend development.	2, 3, 5, 6, 7, and 8
5	Understanding MySQL and mobile app development, implementing PHP with MySQL with different operations.	2, 3, 5, 6, 7, and 8

SEMESTER – III									
Course Title	**PE I: FUNDAMENTALS OF AI /ML**								
Course code	**23BCAO215R**	**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 Computer Application**								
Semester	**Winter/ I semester of the second year of the program**								
Course Objectives	1. Learn the basic principles of machine learning and how they can be applied to different scenarios. 2. Understand the differences between supervised and unsupervised learning algorithms. 3. Understand the fundamental concepts and terminology of Artificial Intelligence (AI)								
CO1	Explain machine learning concepts, applications, challenges, and basic data descriptions								
CO2	Apply and evaluate clustering techniques using various methods.								
CO3	Differentiate prediction and classification, apply algorithms, and evaluate performance.								
CO4	Implement and compare various search strategies and algorithms.								
CO5	Use logic and probabilistic models for knowledge representation and reasoning.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Machine Learning:** What is machine learning, applications of machine learning, issues and challenges faced in machine learning, types of data attributes – nominal, binary, ordinal, numeric, discrete and continuous, basic statistical descriptions of data – measures of central tendency and dispersion, major tasks in data pre-processing	**8**	Define machine learning, list its applications, identify common issues, distinguish between types of data attributes, describe basic statistical data measures, and outline key data pre-processing tasks.	1, 2, 4
II	**Unsupervised Learning - Data Clustering:** what is cluster analysis, need for cluster analysis, data matrix, dissimilarity matrix, proximity and dissimilarity measures for different data attribute types, partitioning based clustering methods, density-based clustering methods and hierarchical clustering methods, measuring cluster quality	**8**	Define cluster analysis, explain its necessity, describe data and dissimilarity matrices, discuss proximity and dissimilarity measures, compare partitioning, density-based, and hierarchical clustering methods, and evaluate cluster quality.	1, 2, 3, 4
III	**Supervised Learning – Prediction:** What is prediction, application areas of prediction, Simple linear regression, Multiple linear regression, Predictor Error measures **Classification**: What is classification, differences between classification and prediction, applications of classification, Some classification algorithms, Confusion matrix and metrics for evaluating classifier performance	**8**	Define prediction and classification, identify their applications, explain the differences between them, describe linear regression models and prediction error measures, list classification algorithms, and evaluate classifier performance using confusion matrices and metrics.	1, 2, 3, 4
IV	**Introduction to Search:** Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha – Beta pruning.	**8**	Understand various search strategies, including uninformed and informed methods, explore local search algorithms and adversarial search techniques, and apply alpha-beta pruning in game	2, 3, 4

			search scenarios.	
V	**Knowledge Representation & Reasoning:** Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.	**8**	Master propositional and first-order logic, implement inference mechanisms like forward and backward chaining and resolution, understand probabilistic reasoning including Hidden Markov Models and Bayesian Networks, and apply concepts of utility theory.	3, 4, 5

TEXT BOOKS:

T1: Jiawei Han and MichelineKamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, India

T2: Russell, S., &Norvig, P. Artificial intelligence: a modern approach. Third Edition. Pearson new international edition. 2014

REFERENCE BOOKS:

R1: Han, Manilla and Smyth, Principles of Data Mining, PHI, India

R2: Tan, Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education Inc.

R3: E. Rich and K. Knight, Artificial Intelligence, Tata McGrawHill.

R4: N. J. Nilsson, Principles of Artificial Intelligence, Narosa

R5: D. W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India.

OTHER LEARNING RESOURCES:

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain machine learning concepts, applications, challenges, and basic data descriptions	1, 2, 3
2	Apply and evaluate clustering techniques using various methods.	2, 3, 4
3	Differentiate prediction and classification, apply algorithms, and evaluate performance.	2, 3, 6
4	Implement and compare various search strategies and algorithms.	2, 3, 7
5	Use logic and probabilistic models for knowledge representation and reasoning.	3, 4, 5

SEMESTER – III									
Course Title	**PE I: BUSINESS INTELLIGENCE**								
Course code	**23BCAO216R**	**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 Computer Application**								
Semester	**Winter/ I semester of the third year of the program**								
Course Objectives	1. To learn how managers utilise business analytics to create, address, and assist management decision-making for company challenges. 2. To become accustomed to the procedures required to create, present, and analyse business data. 3. Get knowledge on how to use Excel and its add-ons to solve business challenges								
CO1	Understand the basic concepts of Business Analytics, including the roles of Business Intelligence and the value proposition of integrating business with technology to enhance decision-making.								
CO2	Demonstrate the ability to organize and source data, address data quality issues, and classify data effectively to prepare for advanced visualization techniques.								
CO3	Create and interpret a variety of data visualizations (such as bar charts, pie charts, scatter plots, heat maps) and utilize these visualizations in dashboards and storyboards to convey meaningful analytics insights.								
CO4	Apply predictive analytics techniques such as linear and multi-linear regression and time series forecasting, alongside utilizing prescriptive analytics methods								
CO5	Synthesize knowledge gained from industry experts on emerging trends in business analytics and intelligence through practical demonstrations.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Overview of Business Analytics**: Introduction to Analytics, The Challenge of Decision Making, What Is Business Intelligence, The Business Intelligence Value Proposition, The Combination of Business and Technology	**8**	Define and understand the fundamentals of business analytics, the decision-making challenges, the concept and value of business intelligence, and the synergistic relationship between business and technology.	1,2
II	**Introduction to Data Visualization:** Visualization/ Data Issues, Organization/sources of data, Importance of data quality, Dealing with missing or incomplete data, Data Classification.	**8**	Master the principles of data visualization, including data organization, the significance of data quality, strategies for handling missing data, and data classification techniques.	2, 3
III	**Descriptive Analytics**: Data Visualization and Analytics- Charts (Bars-Pie-Line-Scatter-Map-Bubble-Box & Whisker-Tree map - Heat map-Circle and Area) -Worksheet, Dashboard and Story Board creation	**8**	Create and interpret diverse charts and visualizations such as bar, pie, line, scatter, map, bubble, box & whisker, tree map, heat map, and area charts, and develop comprehensive worksheets, dashboards, and storyboards.	3, 6
IV	**Predictive Analytics**: Linear Regression, Multi-linear Regression and Time Series Forecasting. **Prescriptive Analytics**: Linear optimization, Integer optimization, Non-linear programming, Optimization of Network models and Monte Carlo Simulation	**8**	Apply linear and multi-linear regression models and time series forecasting for predictive analytics, and utilize optimization techniques	3, 4

V	**Applications:** Practical demonstration using R or Python or SPSS by industry experts on Emerging trends in business analytics and intelligence	**8**	Demonstrate proficiency in using software tools like R, Python, or SPSS to implement advanced analytics techniques	3, 5, 6

TEXT BOOKS:

T1: Sharda R, Delen D, Turban E, Aronson J, Liang T. P, (2014), Business Intelligence and Analytics: Systems for Decision Support, 10th edition, Pearson Education.

T2: Powell S. G, Barker K. R, (2014), Management Science: The Art of ModelingWith Spreadsheets, (W/Cd), 4th edition, John Wiley & Sons.

REFERENCE BOOKS:

R1: Linoff G. S, Berry M. J, (2011), Data mining techniques: for marketing, sales, and customer relationship management, 3rd edition, John Wiley & Sons.

R2. Frank B, Green B, Harris T, Van De Vanter K, (2010), Business Intelligence Strategy: A Practical Guide for Achieving BI Excellence, MC Press.

R3. Hair, J. F, Black W. C, Babin B. J, Anderson R. E, Tatham R. L, (2009), Multivariate data analysis, 7th edition, Pearson education.

OTHER LEARNING RESOURCES:

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basic concepts of Business Analytics, including the roles of Business Intelligence and the value proposition of integrating business with technology to enhance decision-making.	2, 3, 4
2	Demonstrate the ability to organize and source data, address data quality issues, and classify data effectively to prepare for advanced visualization techniques.	2, 3
3	Create and interpret a variety of data visualizations (such as bar charts, pie charts, scatter plots, heat maps) and utilize these visualizations in dashboards and storyboards to convey meaningful analytics insights.	2, 3, 6
4	Apply predictive analytics techniques such as linear and multi-linear regression and time series forecasting, alongside utilizing prescriptive analytics methods	2, 3, 7
5	Synthesize knowledge gained from industry experts on emerging trends in business analytics and intelligence through practical demonstrations.	2, 3, 7, 8

SEMESTER – III									
Course Title	**PE I: Exploratory Data Analysis**								
Course code	**23BCAO217R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Probability and Statistics**	**Co-requisite**	NIL						
Programme	**Bachelor of Computer Application (BCA)**								
Semester	**VI**								
Course Objectives	1.To gain insights and understanding from a dataset through visual and quantitative methods. 2.To identify patterns, relationships, and anomalies in the data, this can inform further analysis or decision-making. 3.To extract meaningful information from data and communicate it effectively to stakeholders.								
CO1	Demonstrate the importance of exploratory data analysis in data analysis and decision-making.								
CO2	Develop skills in data visualization using various tools and techniques.								
CO3	Learn how to effectively communicate insights and findings from data analysis.								
CO4	Apply EDA techniques to real-world data analysis problems.								
CO5	Enhance critical thinking skills to identify patterns, trends, and outliers in data.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Exploratory Data Analysis** EDA Introduction, what is EDA? EDA vs Classical & Bayesian, EDA vs Summary, EDA Goals, The Role of Graphics, An EDA/Graphics Example, General Problem Categories.	**6**	Explain EDA and understand and Apply EDA in different datasets with Examples.	**1, 2, 3**
II	**Underlying Assumptions** Importance, Techniques for Testing Assumptions, Interpretation of 4-Plot, Consequences.	**6**	Understand and Applying Different Testing Assumptions and Analysis with Graph.	**2, 3, 4**
III	**EDA Techniques** Introduction, Analysis Questions, Graphical Techniques: Alphabetical, Graphical Techniques: By Problem Category, Quantitative Techniques, Probability Distributions.	**8**	Understanding and Applying different datasets and analyses with Graph Quantitatively.	**2, 3, 4**
IV	**EDA Case Studies** Case Studies Introduction, Case Studies: Normal random numbers, Uniform random numbers, Random walk, Josephson Junction Cryo thermometry, Beam Deflections, .Filter Transmittance, Standard Resistor, Heat Flow Meter 1, Airplane Glass Failure Time, Ceramic Strength.	**10**	Understanding different case study and Applying with suitable example. Analyze with graphs	**2 , 3, 4**
V	**Data Visualization** Design principles for charts and graphs, ggplot2 and Tableau tools for creating data visualizations, The process creating visualizations and selecting the appropriate visual display, Designing effective digital presentations, Visualization as exploration, Visualizing categorical data, Visualizing time series data, Visualizing multiple variables,	**6**	Understanding the different charts, graphs and their interpretations. And Analyses with different datasets.	**2, 3, 4**

	Visualizing geospatial data, Dashboard design, Web- based visualizations, Interactive visualizations and motion.			
Practical	NIL			

Text Books:

1. Exploratory Data Analysis John Tukey Pearson;1st edition

Reference Books:

1. Engineering Statistics Handbook http://www.itl.nist.gov/div898/handbook/nist.gov

2. Hands-On Exploratory Data Analysis with Python: Perform EDA techniques to understand, summarize and investigate your data Paperback Suresh Kumar Mukhiya, Usman Ahmed Packet Publishing Limited

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate the importance of exploratory data analysis in data analysis and decision-making.	1, 2 and 3
2	Develop skills in data visualization using various tools and techniques.	1, 2, 3, 5 and 8
3	Learn how to effectively communicate insights and findings from data analysis.	1, 2, and 3
4	Apply EDA techniques to real-world data analysis problems.	1, 2, 3, 5 and 7
5	Enhance critical thinking skills to identify patterns, trends, and outliers in data.	1, 2, 3, 5, 7 and 8

SEMESTER – III									
Course Title	**PE I: Information Security and Cryptosystems**								
Course code	**23BCAO2112R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45 T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Winter/ I semester of the second year of the program**								
Course Objectives	1. To learn about security policies and their impacts. 2. To assess the framework, lifecycle and controls of security under a variety of scenarios. 3. To analyze the security risk calculations and mitigating them by using various policies.								
CO1	Understand the principles and policies of information security. Analyze and explore the information security controls								
CO2	Assess and evaluate the risk management practices of information security. Identify the disasters and recovering from them with appropriate decisions.								
CO3	Understand the fundamental of Cryptosystems requirements. Identify and apply the concept of Cryptographic algorithms.								
CO4	Analyze and explore the use of authentication and hashing. Gain a deep insight into attacks and emerging security algorithms.								
CO5	Explore and analyze of signature and key exchange algorithms.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Information security principles and framework:** Information Security- Need for Information Security, Assets and Types; CIA - Confidentiality, Integrity, and Availability; Threats -Phishing, DDS, etc; Risk and Impact - Policy & Procedures- Organizational Policy, Standards and Procedures - Information Security Governance - Information Assurance Programme Implementation - Security Incident Management - India Legal Framework: Security Standards and Procedures.	**10**	Understand and implement fundamental information security principles, policies, and governance frameworks to protect organizational assets against diverse threats.	
II	**Security life cycle and controls, Risk Management:** Information Security Life Cycle - Testing, Audit, Review and Controls - Systems Development and Support - General Controls - People Security - User Access Controls - Technical Security - Protection from Malicious Software - Physical Security - Different Uses of Controls; Risk Management Framework and Process - Managing Risk - Risk Treatment- Alternative Risk Management Methodologies.	**8**	Master the security life cycle and develop robust control measures, ensuring comprehensive protection across all layers of an organization's infrastructure.	
III	**Cryptography and Classical Cryptography:** Cryptosystems and basic cryptographic tools, Message integrity- Message authentication codes, Signature Schemes, Nonrepudiation, Certificates, Hash function; Cryptographic protocols, Security; Simple cryptosystems – Shift, Substitution, Affine, Vigenere, Hill, Permutation, and Stream Cipher;	**8**	Understand and implement basic cryptosystems, ensuring message integrity and secure communication using cryptographic tools and protocols.	
IV	**Cryptanalysis, Block Ciphers and Stream Ciphers:**Cryptanalysis – Affine, Substitution, Vigenere, Hill, and LFSR Stream Cipher. Shannon's Theory – Linear Cryptanalysis – Differential Cryptanalysis – Description and Analysis of DES – Description and Analysis of AES – Modes of	**9**	Analyze and apply cryptographic theories to evaluate and secure cryptographic systems, with a focus on block ciphers and stream	

	Operation.		ciphers.	
V	**Hash Function and message authentication, public key cryptography and Discrete Logarithms:** Diffie Hellman, RSA, Hash Functions and Data Integrity – Security of Hash Functions – MD5 – SHA512 – Nested MAC and HMAC – CBC MAC.RSA Cryptosystem – Shanks' Algorithm – Elliptic Curves Over the Reals – Elliptic Curves Modulo a Prime – Elliptic Curves Over Finite Fields – ElGamal Cryptosystems on Elliptic Curves - Elliptic Curve Diffie – Hellman.	**11**	Acquire proficiency in modern cryptographic techniques, including block and stream ciphers, hash functions, and public-key cryptography, to ensure secure communication and data integrity.	

TEXT BOOKS:

T1: Andy Taylor, David Alexander, Amanda Finch and David Sutton, "Information Security Principles",2020, Third Edition, BCS, United Kingdom.

T2: Michael E. Whitman and Herbert J. Mattord, "Management of Information Security", 2018, Sixth Edition, Cengage Learning, United States of America.

T3: Douglas R. Stinson, "Cryptography: Theory and Practice", 2018, 4th Edition, CRC Press, United states.

REFERENCE BOOKS:

R1: Calder, A., and Watkins, S. G., "Information security risk management for ISO27001/ISO27002", 2018, Third Edition, IT Governance Ltd, United States of America.

R2: Susanto, H., and Almunawar, M. N, "Information security management systems: A novel framework and software as a tool for compliance with information security standards", 2018, First Edition, Apple Academic Press, New York.

R3: Bruce Schneier, "Applied Cryptography: Protocols, Algorithms and Source code in C", 2017, 20th edition, John Wiley & Sons, New York

R4: Behrouz A Forouzan, DebdeepMukhopadhyay, "Cryptography and Network Security", 2011, Tata Mcgraw Hill education private limited, India.

R5: Phishing and Communication Channels - A Guide to Identifying and Mitigating Phishing Attacks, Gunikhan Sonowal

OTHER LEARNING RESOURCES:

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the principles and policies of information security. Analyze and explore the information security controls	1, 2, 3, 4, 5, 6, 7, and 8
2	Assess and evaluate the risk management practices of information security. Identify the disasters and recovering from them with appropriate decisions.	1, 2, 3, 4, 5, 6, 7, and 8
3	Understand the fundamental of Cryptosystems requirements. Identify and apply the concept of Cryptographic algorithms.	1, 2, 3, 4, 5, 6, 7, and 8
4	Analyze and explore the use of authentication and hashing. Gain a deep insight into attacks and emerging security algorithms.	1, 2, 3, 4, 5, 6, 7, and 8
5	Explore and analyze of signature and key exchange algorithms.	1, 2, 3, 4, 5, 6, 7, and 8

SEMESTER – III									
Course Title	**MOOCS III (Introduction to Hardware and Operating Systems)**								
Course code	**23MOSY212R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Winter / I semester of the second year of the program**								
Course Objectives	1. To gain foundational knowledge of computers, including their definition, four core functions, essential components, and benefits of using them. 2. To explore the distinction between computer hardware and peripherals. Learn about various types of hardware components and peripherals, including printers, scanners, input/output devices, external storage devices, and audio/video devices. 3. To explore how internal and external components of a computer connect and interact to receive input, process information, and deliver output								
CO1	Define computers, explain their core functionalities, and identify key components. Understand advantages of using computers and data representation concepts.								
CO2	Differentiate hardware and peripherals. Gain knowledge of various types and their roles in computer operations.								
CO3	Explain communication between internal components and peripherals using ports, interfaces, and connectors.								
CO4	Identify and explain the functions of key internal components like CPU, memory, storage, and motherboard.								
CO5	Manage basic workstation setup (focusing on Windows), organize files effectively, and learn troubleshooting methods.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Computing Fundamentals:** Welcome to your first module! After completing this module, you'll be able to define what a computer is. You'll learn about the four functions of computing, the parts of a computer associated with each of those functions, and the benefits of computing. Explore how to classify computing devices based on size and usage and describe the evolution of operating systems. Discover how computers communicate using notational (numeric) systems for processing and storing data, displaying onscreen text, hardware addresses, website colors, and web addresses. You'll gain the practical knowledge needed to evaluate computing performance and storage. You'll know the four ways to log into Microsoft Windows, be able to describe how to use the Start menu, Tiles, taskbar, and settings capabilities, and will be able to explain how to manage Windows on the desktop. You'll round out your week with a lab where you'll locate programs and navigate Windows to find important information about the computer and the Windows operating system	**3**	Gain a foundational understanding of computers and their role in the modern world.	2
II	**Computing Devices and Peripherals:**	**3**	Differentiate between	2,3

	Computer hardware is the set of physical parts that make up the interior of your computer. Peripherals are pieces of hardware that are added to the outside of a computer for it to work more efficiently. Both hardware and peripherals are used to take input, store data, display output, and execute commands. This week, you will learn about several types of hardware components and peripherals. You will learn about printers and scanners, input and output devices, external storage devices, and audio and video devices.		computer hardware and peripherals, and identify their various types and functionalities within a computer system.	
III	**Interfaces and Connectors:** A computer's multiple components, both internal and external, are constantly interacting with each other to receive input, perform requested computing functions, and provide output. As technology has evolved and connection methods have standardized, a vast array of external devices can now easily and successfully connect with computers and reliably perform their tasks. This week, you will learn how hardware and peripheral devices connect to form a functioning computer. You will learn about ports, interfaces, and connectors used by graphics, audio, networks, printers, and other peripheral devices. You will also learn about the types of installations these devices use to become operational.	**3**	Explain how internal components and external peripherals connect and communicate with each other to facilitate data flow within a computer system.	2,3
IV	**Internal Computer Components:** Computer hardware, the physical part of a computer, is infrequently changed, while software and data are modified frequently. When you think of the term computer hardware, you probably think of what's inside your personal computer at home or your computer at work. However, computer hardware does not specifically refer to personal computers. Instead, it is all types of computer systems. Computer hardware is located in embedded systems in automobiles, microwave ovens, CD players, DVD players, and many more devices. In this lesson, you'll learn about common internal components of home and business computer systems.	**3**	Identify and explain the functions of key internal computer components like the CPU, memory, storage devices, and motherboard.	2,3
V	**Windows Workstation Setup, Evaluation, and Troubleshooting:** Workstation setup, operating system configuration, and workstation	**5**	Gain the practical skills to perform basic workstation setup (focusing on Windows), manage file	3

	troubleshooting are all in a day's work for IT support. Whether the task is selecting a new computer for a colleague, reconfiguring an operating system for a coworker's accessibility needs, or troubleshooting a file or directory visibility issue, IT support personnel need procedures that help them complete these tasks quickly, confidently, and correctly. This week, you'll gain knowledge of workstation procurement and basic Windows operating system configuration and management. You'll discover techniques that help you optimize file and folder organization and perhaps even help users locate hidden files. Learn timesaving keyboard commands to capture screens using Windows 10 workstations, macOS workstations, and Chromebooks. You will complete your learning with an overview of business continuity principles used for fault tolerance and disaster recovery.		organization effectively, and apply basic troubleshooting methods to resolve common issues.	

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Define computers, explain their core functionalities, and identify key components. Understand advantages of using computers and data representation concepts.	1, 2, 3, and 8
2	Differentiate hardware and peripherals. Gain knowledge of various types and their roles in computer operations.	3 and 8
3	Explain communication between internal components and peripherals using ports, interfaces, and connectors.	2 and 3
4	Identify and explain the functions of key internal components like CPU, memory, storage, and motherboard.	3 and 8
5	Manage basic workstation setup (focusing on Windows), organize files effectively, and learn troubleshooting methods.	3 and 8

SEMESTER – III									
Course Title	**Field Base Learning**								
Course code	**23BCAO218R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**0**	**0**	**8**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Fall/ I semester of the first year of the program**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To develop problem-solving skills in practical settings.								
CO1	Apply theoretical concepts to real-world situations.								
CO2	Conduct field-based research and gather data effectively.								
CO3	Analyze and interpret field data to draw meaningful conclusions.								
CO4	Communicate findings clearly and effectively, both orally and in writing.								
CO5	Demonstrate professional behaviour and teamwork skills in field settings.								
Course Contents	The organization will provide the students two field visit for this program. The students will be taken to a specific site for learning purposes. The students will visit a relevant site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners regarding the subject or purpose of the visit. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial findings.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply theoretical concepts to real-world situations.	2, 4, and 8
2	Conduct field-based research and gather data effectively.	2, 3, and 8
3	Analyze and interpret field data to draw meaningful conclusions.	2, 3, and 7
4	Communicate findings clearly and effectively, both orally and in writing.	2, 5, and 6
5	Demonstrate professional behaviour and teamwork skills in field settings.	5, 6, and 7

SEMESTER – III									
Course Title	**BASIC LIFE SAVING SKILLS(BLSS)**								
Course code	**23UULS212R**	**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 Computer Applications**								
Semester	**Winter / I semester of the second year of the program**								
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	Understand the specific skills of Basic life-saving skill and knowledge that individuals should acquire and demonstrate after completing a BLS training course.								
CO2	Explain the soft skill attributes and abilities that enable students to interact effectively and harmoniously with others, both personally and professionally.								
CO3	Implement the knowledge and skills needed to effectively recognize, assess, and manage various types of traumatic injuries and emergencies.								
CO4	Understand the principles and purpose of the Triage system in healthcare settings.Describe thedifferent levels of triage and their significance in prioritizing patient care.								
CO5	Identify common medical conditions and injuries that require immediate attention and those that can be managed at a later stage.Recognize the importance of accurate and timely patient assessment during triage.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Basic Life Support (BLS)** Introduction of BLS Chain of survival ABCs Assessment CPR and Ventilation Technique AED Choking for adult and children	**5**	Basic Life Support (BLS) are the specific skills and knowledge that individuals should acquire and demonstrate after completing a BLS training course. These outcomes are essential for anyone who may encounter a medical emergency and need to provide immediate assistance before professional medical help arrives	1,2
II	**Soft skills** Introduction Communications Skills Situational Skills Team Work Other Soft Skills	**4**	Soft skills are a set of personal attributes and abilities that enable students to interact effectively and harmoniously with others, both personally and professionally. These skills are highly valued and can lead to better communication, collaboration, and overall success in various aspects of life	1,2
III	**Trauma emergencies** Introduction Priorities of Initial approach in pre-hospital care Scene safety Primary assessment Bleeding control Helmet removal Care of amputated body part Extrication of victims and safe transfer Cervical spine stabilization	**10**	Focus on the knowledge and skills needed to effectively recognize, assess, and manage various types of traumatic injuries and emergencies. Essential for healthcare professionals, first responders, and anyone involved in emergency care.	1,2,3

	Cervical collar application Splinting of broken Limbs			
IV	**Triage system** Introduction Flow chart approach of Triage Triage of Multiple Casualties in Pre-Hospital setting Triage of Single casualt	**5**	Understand the principles and purpose of the Triage system in healthcare settings. Describe the different levels of triage (e.g., immediate, delayed, minimal, expectant) and their significance in prioritizing patient care. Identify common medical conditions and injuries that require immediate attention and those that can be managed at a later stage. Recognize the importance of accurate and timely patient assessment during triage	1,2,3,4
V	**Medical emergencies:** Introduction Victim centred approach in medical emergency Management of :- a)seizures b)heart attack c)asthma diabetic emergencies emergency childbirth stroke recovery position	**6**	Identify common medical emergency conditions: Learners should be able to recognize and differentiate between common medical emergencies, including myocardial infarction (heart attack), stroke, diabetic emergencies, anaphylaxis, respiratory distress, seizures, and allergic reactions.	1,2,3,4

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the specific skills of Basic life-saving skill and knowledge that individuals should acquire and demonstrate after completing a BLS training course.	5,6
2	Explain the soft skill attributes and abilities that enable students to interact effectively and harmoniously with others, both personally and professionally.	5,6
3	Implement the knowledge and skills needed to effectively recognize, assess, and manage various types of traumatic injuries and emergencies.	5,6
4	Understand the principles and purpose of the Triage system in healthcare settings. Describe the different levels of triage and their significance in prioritizing patient care.	5,6
5	Identify common medical conditions and injuries that require immediate attention and those that can be managed at a later stage. Recognize the importance of accurate and timely patient assessment during triage.	5,6

SEMESTER – III									
Course Title	**ENGLISH LANGUAGE FOR EXCELLENCE (Communicative English & 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 Computer Applications**								
Semester	**Fall/ I semester of the second year of the program**								
Course Objectives	1. To enable students to learn, understand and practice different ways of presentation and use of correct grammar. 2. To augment the writing skills in different areas including CV and cover letter writing. 3. To boost productivity and performance at work, which assists in the achievement of professional goals.								
CO1	Develop better listening skills and enhance writing abilities.								
CO2	Identify both positive and negative nonverbal gestures and signs.								
CO3	Improve adept presentation skills by practicing delivery, refining communication techniques, and ensuring clarity of expression.								
CO4	Enhance writing abilities and develop the ability to recognize awkward expressions, correct grammatical errors, and enhance the overall coherence of your writing								
CO5	Plan efficiently for discussions in different platforms by enhancing their thought process and problem-solving skills.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Grammar :** I. Use of Prepositions II. Tag questions III. Simple, complex, compound sentences	**10**	Describe, illustrate, and explain Prepositions, types of sentences	1,2
II	**Grammar:** I. Active and Passive Voice II. Direct and Indirect Speech	**15**	Describe, illustrate, and explain Voice, Types of voice, Speech	1,2
III	**Writing Skills :** The Basics of Writing; avoid ambiguity and vagueness I. Paragraph Writing II. Letter Writing III. Resume, CV and Cover Letter	**15**	Describe, illustrate, and explain about Paragraph writing, letter writing, Creation of resume, cover letter.	1,2,3
IV	**Self- Management Skills** SWOT Analysis Self- Regulation Personal Hygiene	**10**	Describe, illustrate, and explain and apply Self management skills	1,2,3,4
V	**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. Body Language Do's and Don'ts, Doubt Clearing Session.	**10**	Describe, illustrate, and explain and apply Non verbal communication.	1,2,3,4

TEXT BOOKS:

1. What Employers Want : The Work skills Handbook- Karen Holmes, 2011
2. English Grammar in Use, Raymond Murphy 4th edition, CUP

REFERENCES:

1. Professional Communication, 2015, by Dr.PrachiDr. S. K. Singh

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Develop better listening skills and enhance writing abilities.	5,6,8
2	Identify both positive and negative nonverbal gestures and signs.	5,6,8
3	Improve adept presentation skills by practicing delivery, refining communication techniques, and ensuring clarity of expression.	3,5,6,7,8
4	Enhance writing abilities and develop the ability to recognize awkward expressions, correct grammatical errors, and enhance the overall coherence of your writing	5,6,8
5	Plan efficiently for discussions in different platforms by enhancing their thought process and problem-solving skills.	2,3,5,6,7,8

SEMESTER – III									
Course Title	**Personal Financial Planning**								
Course code	**23UUFL213R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 15P	**0**	**0**	**2**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Winter / I semester of the second year of the program**								
Course Objectives	1. To create awareness among students about the need for possessing financial literacy education. 2. To Identification of money as a working asset. 3. To impart the ability to make better financial decisions								
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	**Introduction:** i. Meaning, need and importance of Financial Literacy; ii. Different components of Financial Literacy; iii. Prerequisites of financial literacy; iv. Savings – Meaning and Difference between savings and investment; v. Types of Financial Institutions and the services provided - Banking and Non-Banking; vi. Different investment avenues.	**7**	Describe, illustrate, and explain concepts of money, Importance of Financial Literacy heir applications to financial planning.	1,2
II	**Financial Planning:** i. Meaning, need and importance for financial planning, ii. Economic needs, balancing between economic need and resources; iii. Three pillars of investments-risk, return, liquidity; iv. Budgeting and its importance in financial planning; v. Steps involved in Financial Planning Process; vi. Preparation of personal budgets, budget surplus and budget deficit, avenues for savings from surplus, sources for meeting deficit. vii. Informal Society funds and crowd funding	**6**	Describe, illustrate, and explain financial planning process, the life cycle of financial plans, and methods of goal achievement.	1,2
III	**Banks & Post Office - As financial service provider:** i. Meaning and evolution of money, ii. Banks – meaning, types & functions; types of accounts; Formalities to open various accounts.	**6**	Describe, illustrate, and explain Formulation of budget, record keeping system, and tax planning strategy based on current financial goals.	1,2,3

	iii. Different types of Post Office saving schemes: Recurring deposit, savings, term deposit; NSC; KisanVikasPatra; Monthly Income scheme (MIS) Account, iv. ublic Provident Funds (PPF), Senior citizen savings scheme (SCSS), SukanyaSamriddhi Accounts, v. Indian Postal Order; International Money transfer service; Forex Services; vi. Money remittance services; Jansuraksha Scheme.			
IV	**Insurance - As financial service provider:** i. Different types of Risks and their Management, Diversification of risk; ii. Meaning,need and importance of Insurance; Types of Insurance – Life Insurance, Health Insurance, General Insurance, Term Insurance, iii. Pension and retirement policies; iv. Post office life insurance schemes, Postal life insurance and rural postal life insurance.	**6**	Describe, illustrate, and explain and Creation of financial plan that covers Risk management, importance of Insurance.	1,2,3,4
V	**Transformations in Digital Money market:** i. Various functions & innovative services of Banks; Mobile Banking, NEFT, IMPS, RTGS, ii. Money transfer, Different types of cards- Debit & Credit, E-Banking,Unified payment interface(UPI), iii. Credit Scoring - CIBIL, Digital Banking, crypto currency and related transactions, **iv.** Fintech, Block chain; Understanding Digital Payments.		Explain the Digital money market , credit score, CIBIL score.	

Textbooks:

T1. Sinha Pradeep K. and Priti Sinha. Computer Fundamentals: Concepts Systems and 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 Jil Schlesinger.

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.	1,2,4,5,6,7,8
2	Design a diversified investment portfolio that addresses several different investment objectives.	2,3,4,5,6,7
3	Differentiate between open- and closed-end mutual funds, exchange-traded funds, and direct or indirect real estate investments.	4,5,6,8
4	Create a financial plan that covers your income needs in retirement and helps protect you and your estate.	1,2,3,4,5,6,7,8
5	Develop a cash management strategy and a plan to facilitate the home or automobile buying process.	1,2,3,5,6,7,8

SEMESTER – III									
Course Title	**Generic Elective I (Introduction to Digital Marketing)**								
Course code	**23BCAO001R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Winter/ I semester of the second year of the program**								
Course Objectives	1. To understand the transition from traditional to digital marketing strategies and its significance in modern business. 2. To learn about key digital marketing technologies and platforms, including search engines and social media. 3. To analyze the customer journey and how digital marketing influences purchase decisions.								
CO1	Explain the shift from traditional to digital marketing and its impact on business practices.								
CO2	Utilize key digital marketing platforms and technologies effectively in marketing campaigns.								
CO3	Analyze and map the customer journey to optimize marketing strategies and improve conversion rates.								
CO4	Create engaging digital content tailored to target audiences that enhances brand presence.								
CO5	Implement digital marketing strategies that help businesses stand out in competitive environments.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Search Engine Marketing - Can Customers Find You?** Welcome to Module 1. Search Engine Marketing, (SEM), allows businesses to be found online. With millions of businesses out there vying for the same eyeballs, SEM's two main elements, Search Engine Optimization (SEO) and Pay-per-click (PPC) strategies can lead to online marketing success through discovery.	**8**	Describe, illustrate, and Explain Search Engine, SEM, SEO	1,2
II	**Social Media - Two-Way Communication with Customers:** social-media facilitates the sharing of ideas, thoughts, and information through the building of networks. It is two-way communication between the brand and its audience. In this module, you will learn techniques to effectively communicate and engage with audiences through social media	**8**	Describe, illustrate, and explain Social-Media, Communication with customer.	1,2
III	**Reputation Management - You Are Who Your Customers Think You Are:** While marketing is essential for communication with audiences, "word of mouth" remains the most powerful voice. Online reviews are today's "digital word of mouth". It's easier than ever for customers to tell others about their best (and worst) experiences, which can make or break a business. In this module you will explore how to harness this tool.	**8**	Describe, illustrate, and explain map customer journey, optimize marketing strategy.	1,2,3
IV	**Content Marketing - Storytelling is the Key to Great Content:** The key to any effective marketing is to capture	**8**	Describe, illustrate, and explain Content Marketing, enhance brand presence.	1,2,3

	and keep the attention of an audience. Digital stories incorporate essential communication and marketing elements to create a compelling narrative. Stories about a brand can attract a target audience by differentiating it in the marketplace. Digital sharing is the key, and is the foundation to good storytelling and digital marketing.			

TEXT BOOKS:

1. "Digital Marketing: Strategy, Implementation and Practice" by Dave Chaffey and Fiona Ellis-Chadwick
2. "Marketing 4.0: Moving from Traditional to Digital" by Philip Kotler, HermawanKartajaya, and IwanSetiawan

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the shift from traditional to digital marketing and its impact on business practices.	2,3,4,5,6,7,8
2	Utilize key digital marketing platforms and technologies effectively in marketing campaigns.	2,3,4,5,6,7,8
3	Analyze and map the customer journey to optimize marketing strategies and improve conversion rates.	2,3,5,6,7
4	Create engaging digital content tailored to target audiences that enhances brand presence.	2,3,4,5,6,7,8
5	Implement digital marketing strategies that help businesses stand out in competitive environments.	2,3,4,5,6,7,8

SEMESTER – III									
Course Title	**CO-CURRICULAR ACTIVITY**								
Course code	**23UBCC211**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Fall/ I semester of the second year of the program**								
Course Objectives	1. To develop the social and soft skills 2. To promote a holistic development of the learners 3. To Provide opportunities to apply theoretical knowledge in real-world scenarios.								
CO1	Connect and adapt cultural diversity among communities.								
CO2	Developed team for working toward a shared vision								
CO3	Demonstrate and apply interdisciplinary connections and Cultivate spirit of creative thought and curiosity to achieve goals								
CO4	Build effective communicate, delegate responsibilities and motivate team members.								
CO5	Improve strong teamwork and collaboration skills by engaging in group activities.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	AdtU encourages activities that are aimed to develop the social and soft skills of students and promote a holistic development of the learners. Keeping in mind the 360-degree learning methodology, the students are engaged in different activities other than their regular classes. Experts are invited to conduct workshops that benefit the students. Technical quizzes are conducted to enhance the knowledge of the students. Technical seminars help them to develop their public speaking abilities.	**4**	Demonstrate improved proficiency in programming, software development, and the use of various technological tools and platforms. Apply theoretical knowledge to real-world problems through projects, internships, and industry collaborations.	1,2,3,4

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
CO1	Connect and adapt cultural diversity among communities.	4,5,6,7,8
CO2	Developed team for working toward a shared vision	4,5,6,7,8
CO3	Demonstrate and apply interdisciplinary connections and Cultivate spirit of creative thought andcuriosity to achieve goals	4,5,6,7,8
CO4	Build effective communicate, delegate responsibilities and motivate team members.	6,7,8
CO5	Improve strong teamwork and collaboration skills by engaging in group activities.	6,7,8

SEMESTER – III									
Course Title	**MINI PROJECT-I**								
Course code	**23BCAO219R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ I semester of the second year of the program**								
Course Objectives	1. To develop the knowledge, skills and attitudes of a professional Computer Application professional. 2. To become confident in designing Software solutions to complex software problems utilising a systems approach. 3. Develop a deep understanding of computer applications to enhance professional knowledge, skills, and attitudes necessary for the field.								
CO1	Demonstrate a sound technical knowledge of their selected project topic.								
CO2	Undertake problem identification, formulation and solution.								
CO3	Design Software solutions to complex problems utilising a systems approach.								
CO4	Communicate with the community at large in written an oral-forms.								
CO5	Demonstrate the knowledge, skills and attitudes of a Computer Application or IT professional.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: • theoretical studies • computer simulations • hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project; 4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field; 5. Prepare a formal report describing the work undertaken and results obtained so far; and Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.	**90**	Analyze current knowledge through a comprehensive literature review in a chosen technical field, apply advanced methods like theoretical studies, computer simulations, and hardware construction. Synthesize findings into progress reports and professional journals, evaluate and present these findings in seminars, and demonstrate practical outcomes through poster presentations and operational demonstrations.	3, 4, 5

OTHER LEARNING RESOURCES:

As given by Project supervisor.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Students will be able to demonstrate a sound technical knowledge of their selected project topic.	1, 2, 4
2	Students will be able to undertake problem identification, formulation, and solution.	1, 3
3	Students will be able to design Software solutions to complex problems utilising a systems approach.	2, 3, 5, 7
4	Students will be able to communicate with the community at large in written an oral forms.	2, 3, 5, 6, 7
5	Demonstrate the knowledge, skills and attitudes of a Computer Application or IT professional.	1, 2, 3, 7

SEMESTER – III									
Course Title	**Internet Concept and Web Design**								
Course code	**23BCAO2110R**	**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 Computer Applications**								
Semester	**Fall/ I semester of the 1st year of the program**								
Course Objectives	1. To provide the conceptual and technological developments in the field of Internet and web designing 2. Understand the historical context and development of the Internet. 3. Explain the key protocols and standards that underpin the Internet.								
CO1	Review the current topics in Web & Internet technologies.								
CO2	Describe the basic concepts for network implementation.								
CO3	Learn the basic working scheme of the Internet and World Wide Web.								
CO4	Understand fundamental tools and technologies for web design.								
CO5	Apply design best practices to create visually appealing and functional web pages.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Internet:** Growth of Internet, Owners of the Internet, Anatomy of Internet, ARPANET and Internet history of the World Wide Web, basic Internet Terminology, Net etiquette. Internet Applications – Commerce on the Internet, Governance on the Internet, Impact of Internet on Society – Crime on/through the Internet.	**8**	Explain the historical development and growth of the Internet, including key milestones and contributors. Analyze the evolution from ARPANET to the modern Internet infrastructure.	2,3
II	**TCP/IP – Internet Technology and Protocols:** Packet switching technology, Internet Protocols: TCP/IP, Router, Internet Addressing Scheme: Machine Addressing (IP address), E-mail Addresses, Resources Addresses	**8**	Explain the concept of packet switching and its role in efficient data transmission over networks.Describe the TCP/IP protocol suite, including its layers (TCP, IP, UDP, etc.) and their functions in network communication.	3
III	**Internet Connectivity:** Connectivity types: level one, level two and level three connectivity, Setting up a connection: hardware requirement, selection of a modem, software requirement, modem configuration, Internet accounts by ISP: Telephone line options, Protocol options, Service options, Telephone line options – Dialup connections through the telephone system, dedicated connections through the telephone system	**8**	Evaluate options provided by Internet Service Providers (ISPs) for setting up Internet accounts, including telephone line options, protocol options	3,4
IV	**Internet Network:** Network definition, Common terminologies: LAN, WAN, Node, Host, Workstation, bandwidth, Interoperability, Network administrator, network security,	**10**	Describe the roles and interactions of servers and clients in network environments, understanding their functions in data storage, processing, and	3,4

	Network Components: Severs, Clients, Communication Media, Types of network: Peer to Peer, Clients Server, Addressing in Internet: DNS, Domain Name and their organization, understanding the Internet Protocol Address.		access.Define an IP address and its significance in network communication.	
V	**Web Publishing and Browsing:** Overview, SGML, Web hosting, HTML. CGL, Documents Interchange Standards, Components of Web Publishing, Document management, Web Page Design Consideration and Principles, Search and Meta Search Engines, WWW, Browser, HTTP, Publishing Tools	**10**	Utilize HTML to structure and format web pages, incorporating elements such as text, images, hyperlinks, tables, and forms.	3,4,5

TEXT BOOKS:

1. Fundamentals of Internet and www, Greenlaw R and Hepp E, Tata Mc Graw Hill, 2007

REFERENCE BOOKS:

1. The Internet Book Pearson Education, 2009. D Comer, Pearson Education, 2019.
2. The Complete reference to Internet, M. L. Young, Tata McGraw Hill, 2007

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Review the current topics in Web & Internet technologies.	2, 3, 4, 6, 7, and 8
2	Describe the basic concepts for network implementation.	2, 3, 4, 5, 6, 7, and 8
3	Learn the basic working scheme of the Internet and World Wide Web.	2, 3, 4, 5, 6, 7, and 8
4	Understand fundamental tools and technologies for web design.	2, 3, 4, 6, 7, and 8
5	Apply design best practices to create visually appealing and functional web pages.	2, 3, 4, 5, 6, 7, and 8

SEMESTER – III									
Course Title	**COMPUTER APPLICATION TECHNIQUES**								
Course code	**23BCAO2111R**	**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 Computer Applications**								
Semester	**Winter/ I semester of the second year of the program**								
Course Objectives	1. To introduce advanced computer systems and application software, including the latest technologies such as cloud computing and IoT. 2. To equip students with programming skills using languages such as Python and introduce web development basics, including HTML, CSS, and JavaScript. 3. To provide an in-depth understanding of networking fundamentals, including network types, topologies, and protocols. 4. To introduce database management systems, SQL, and data modeling techniques and cover data privacy, protection laws, and encryption methods. 5. To create effective documents, spreadsheets, and presentations.								
CO1	Understand and explain the functions and applications of various computer systems and software, including emerging technologies such as cloud computing and IoT.								
CO2	Apply basic programming principles and software development methodologies to create and debug simple programs, particularly in Python and web development.								
CO3	Demonstrate knowledge of fundamental networking concepts, web technologies, and basic network security measures, and apply this knowledge to solve network-related problems.								
CO4	Design, manage, and query databases using SQL, and understand the principles of data privacy, protection, and cybersecurity to secure data effectively.								
CO5	Utilize advanced features of office productivity tools, such as word processors, spreadsheets, and presentation software, to enhance productivity and collaborate effectively in a professional setting.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Computer Applications and Techniques:** Introduction to Computer Applications, Operating Systems and Their Functions, Application Software, Emerging Technologies in Computer Applications – Cloud Computing Basics and IoT	**8**	Understanding and describe the functions and applications of various computer systems and software. Explain the basic functions of different operating systems, including file and process management. Identify and use various types of application software for different purposes.	2
II	**Software Development and Problem-Solving Techniques:** Introduction to Programming, Object-Oriented Programming Concepts, Software Development Methodologies, Web Development Basics.	**8**	Write basic programs using variables, data types, and control structures in Python. Implement object-oriented programming concepts such as classes and inheritance in Python and explain and apply Agile and Scrum methodologies in software development projects. Create simple web pages using HTML, CSS, and JavaScript	2,3,5
III	**Networking and Internet Application Techniques:** Fundamentals of Networking, Internet and Web Technologies, Network Security Basics, Introduction to Cloud Computing.	**8**	Describe different types of networks, their topologies, and protocols, explain how the internet works, including DNS and HTTP/HTTPS protocols, identify common network threats and basic security measures to protect against them and explain the basics of cloud computing, including different types of cloud services and their benefits.	2,4
IV	**Data Management and Security**	**8**	Describe different types of databases	2,3,5

	Techniques: Introduction to Databases, Structured Query Language (SQL), Data Privacy and Protection, Cybersecurity Principles.		and their management systems, write basic SQL commands to manage and query databases, explain data encryption methods and data privacy laws and evaluate common cyber threats and implement basic cybersecurity practices to protect data.	
V	**Office Automation and Productivity Techniques:** Document Management Techniques, Advanced Spreadsheet Techniques, Presentation and Communication Techniques, Project Management and Collaboration Tools.	**12**	Utilize advanced features of word processing tools to manage documents effectively, analyze data using advanced spreadsheet functions and create automated workflows with macros, design and deliver effective presentations using presentation software, and manage projects and collaborate effectively using digital tools such as project management software and collaborative platforms.	5,6

TEXT BOOKS:

T1: Introduction to Computer Science" by John S. Collins

T2: "Learning Python" by Mark Lutz

T3: "Computer Networking: A Top-Down Approach" by James F. Kurose and Keith W. Ross

REFERENCE BOOKS:

R1: "Database System Concepts" by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan

OTHER LEARNING RESOURCES:

Online resources and documentation for Python, HTML/CSS/JavaScript, and Microsoft Office Suite.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand and explain the functions and applications of various computer systems and software, including emerging technologies such as cloud computing and IoT.	1,2,3,4,5,6,7, and 8
2	Apply basic programming principles and software development methodologies to create and debug simple programs, particularly in Python and web development.	1,2,3,4,5,6,7, and 8
3	Demonstrate knowledge of fundamental networking concepts, web technologies, and basic network security measures, and apply this knowledge to solve network-related problems.	1,2,3,4,5,6,7, and 8
4	Design, manage, and query databases using SQL, and understand the principles of data privacy, protection, and cybersecurity to secure data effectively.	1,2,3,4,5,6,7, and 8
5	Utilize advanced features of office productivity tools, such as word processors, spreadsheets, and presentation software, to enhance productivity and collaborate effectively in a professional setting.	1,2,3,4,5,6,7, and 8

SEMESTER – IV									
Course Title	**Design and Analysis of Algorithms**								
Course code	**23BCAO221R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Data Structures**	**Co-requisite**	**C /C++ Programming**						
Programme	**Bachelor of Computer Applications**								
Semester	**Winter/ II semester of the second year of the program**								
Course Objectives	1. Analyze the asymptotic performance of algorithms. 2. Demonstrate a familiarity with major algorithms and data structures. 3. Apply important algorithmic design paradigms and methods of analysis.								
CO1	For a given algorithm, analyze worst-case running time based on asymptotic analysis and justify the correctness of algorithm.								
CO2	Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.								
CO3	Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.								
CO4	Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For given problems of dynamic-programming, develop the dynamic programming algorithms, and analyze it to determine its computational complexity.								
CO5	For a given model engineering problem, model it using graph and write the corresponding algorithm to solve the problems.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.	**8**	Define and Identify Characteristics of Algorithms, Understand and Perform Asymptotic Analysis, Evaluate Algorithm Performance, Solve Recurrence Relations, Use Master's Theorem,	**1,2,3**
II	Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics –characteristics and their application domains.	**12**	Understand Brute-Force Techniques, Apply Greedy Algorithms, Implement Dynamic Programming Solutions, Use Branch and Bound Techniques, Solve Problems Using Backtracking, Practical Application of Strategies,	**3,4**
III	Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth 6First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.	**8**	Solve Problems Using Backtracking, Understand and Implement DFS and BFS, Apply Shortest Path Algorithms, Calculate Transitive Closure, Find Minimum Spanning Trees, Perform Topological Sorting, Understand and Implement Network Flow Algorithms	**3,4**
IV	Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem,	**6**	Understand and Explain Cook's Theorem, Identify Standard NP-complete Problems, Solve and Analyze	**4**

	Standard NP-complete problems and Reduction techniques		NP-complete Problems, Apply Reduction Techniques,	
V	Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE	**5**	Understand Approximation Algorithms, Apply Approximation Algorithms, Understand Randomized Algorithms, Understand P SPACE	**4**

TEXT BOOKS:

T1: Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, 4TH Edition, MIT Press/McGraw-Hill.

T2: Fundamentals of Algorithms – E. Horowitz et al.

REFERENCE BOOKS:

R1: Jon Kleinberg and ÉvaTardos, Algorithm Design, 1ST Edition, , Pearson.

R2: Michael T Goodrich and Roberto Tamassia, Wiley Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition,.

R3: Udi Manber, Algorithms -- A Creative Approach, 3RD Edition, Addison-Wesley, Reading, MA.

OTHER LEARNING RESOURCES:

1. https://ocw.mit.edu/courses/6-006-introduction-to-algorithms-fall-2011/pages/lecture-notes/
2. https://www.vssut.ac.in/lecture_notes/lecture1428551222.pdf

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	For a given algorithm, analyze worst-case running time based on asymptotic analysis and justify the correctness of algorithm.	1,8
2	Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.	1,8
3	Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.	1, 2, 3, 8
4	Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For given problems of dynamic-programming, develop the dynamic programming algorithms, and analyze it to determine its computational complexity	1, 2, 3
5	For a given model engineering problem, model it using graph and write the corresponding algorithm to solve the problems.	1, 2, 3

SEMESTER – IV									
Course Title	**Basics of Python Programming**								
Course code	**23BCAO222R**	**Total credits: 5**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:30T+30P	**2**	**1**	**4**	**0**	**0**	**0**	**5**
Pre-requisite	**Data Structures**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Winter/ II semester of the second year of the program**								
Course Objectives	1. Understand the programming basics (operations, control structures, data types, etc.) 2. Understand and begin to implement compound data like python lists, tuples etc 3. Read/write to files and learn to use basic libraries in python for data analysis								
CO1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.								
CO2	Express proficiency in the handling of strings and functions.								
CO3	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets								
CO4	Identify the commonly used operations involving file systems and regular expressions.								
CO5	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	**Introduction to Python:** Unique features of Python, Python-2 and Python-3 differences, Install Python and Environment Setup, First Python Program, Python Identifiers, Keywords and Indentation, inserting comments in python, Command line arguments, Getting User Input, Data types, Operators, Precedence and associativity	**6**	Understand Python's Features, Compare Python Versions, Install Python, Manage Virtual Environments, Write a Basic Python Program, Understand Python Syntax, Use Comments Effectively, Use Command Line Arguments, Get User Input, Understand Python Data Types	**1,2,3**
II	**Conditional execution and Iteration:** Boolean expressions, logical operators, conditional and alternative execution, chained and nested conditionals, the while statement, infinite loops and *break*, finishing iterations with *continue*, *for* loops	**6**	Understand Boolean Expressions, Use Logical Operators, Implement Conditional Execution, Use Alternative Execution, Use Chained Conditionals, Implement Nested Conditionals, Understand and Use While Loops, Understand and Use For Loops	**3,4**
III	**Functions:** python built-in functions, defining and calling a function, parameters and arguments, fruitful functions and void functions, anonymous functions	**8**	Understand Built-in Functions, Define Functions, Use Parameters and Arguments, Use Parameters and Arguments, Understand Fruitful Functions	**3,4**
IV	**Data Structures and strings in Python:** Lists – traversing a list, list operations, list slices, list methods Dictionaries – dictionary as a set of counters, looping and dictionaries, Tuples – tuple assignment, dictionaries and tuples, using tuples as keys in dictionaries Strings – string slices, looping and	**12**	Understand and Traverse Lists, Perform List Operations, Utilize List Slices, Apply List Methods, Work with Dictionaries, Utilize Dictionaries as Counters, Understand Tuple Assignment, Work with Dictionaries and Tuples,	**4**

	counting, the *in* operator, string comparison, string methods ,		Utilize String Slices, Loop through Strings and Count, Use the in Operator, Compare Strings, Apply String Methods	
V	**Basic File and Exception Handling in python:** Reading and Writing to Files, Exception Handling **Introduction to basic libraries for data analysis:** Introduction to Matplotlib library, NumPy, Pandas	**8**	Understand the Importance of Exception Handling, Implement Basic Exception Handling, Understand Basic Concepts of Matplotlib, Understand the Role of Numpy in Data Analysis, Use Numpy for Data Manipulation, Understand the Importance of Pandas in Data Analysis	**4**
Practical				
Practical 1	Program to find area and circumference of a circle.	**1**	Creating a python program to find the area and circumference of a circle.	5
Practical 2	Program to convert temperature from degree centigrade to Fahrenheit	**1**	Creating a python program to convert degree to Fahrenheit.	5
Practical 3	Program to calculate Sum of 5 subject and find Percentage	**1**	Creating a python program to calculate the sum of 5 subjects and find the percentage.	5
Practical 4	Program to show swap of two numbers by using third variable	**1**	Creating a python program to swap two numbers using a third variable.	5
Practical 5	Program to show swap of two numbers by without using third variable	**1**	Creating a python program to swap two numbers without using the third variable.	5
Practical 6	Program to reverse a given number	**1**	Creating a python program to reverse a given number.	5
Practical 7	Program to find greatest among 3 Numbers	**1**	Creating a python program to find the greatest number from three inputs.	5
Practical 8	Program to find whether the given number is even or odd	**1**	Creating a python program to find the given number is odd or not.	5
Practical 9	Program to use switch statement	**1**	Creating a python program to make use of the switch case statement.	3, 5
Practical 10	Program to display first 10 natural number and their sum	**1**	Creating a python program for displaying the natural numbers and its sum.	5
Practical 11	Program to find Fibonacci series up to a range	**1**	Creating a python program to print the Fibonacci series.	5
Practical 12	Program to count Number of digits	**1**	Creating a python program to count the number of digits.	5
Practical 13	Program to find factorial of a number	**1**	Creating a python program to find the factorial of a given number.	5
Practical 14	Program to check whether the given number is palindrome or not	**1**	Creating a python program to check a palindrome number	5
Practical 15	Program to find whether the given number is prime or not	**1**	Creating a python program to check for a prime number	5
Practical 16	Program to show dynamic list	**1**	Creating a python program for	5

	implementation		dynamic lists.	
Practical 17	Program to find dynamic array implementation	**1**	Creating a python program for dynamic array	5
Practical 18	Program to display matrix	**1**	Creating a python program to display a matrix	5
Practical 19	Program to show the sum of 10 elements of array and show their average	**1**	Creating a python program to calculate the sum of 10 elements of an array and show their average.	5
Practical 20	Program to show the sum of 10 elements of list and show their average	**1**	Creating a python program to calculate the sum of 10 elements of a list and show their average.	5
Practical 21	Program to find the maximum and minimum number in an array	**1**	Creating a python program to find the maximum and minimum number in an array	5
Practical 22	Program to find the maximum and minimum number in a list	**2**	Creating a python program to find the maximum and minimum number in a list	5
Practical 23	Program to create a list and perform the following operation ● Insert a new value in 4th index ● Delete the value from the 2nd index ● Replace the existing value of 1st position ● Insert the value at the end of the list ● Sort the list in ascending order ● Print the reverse of the list	**2**	Creating a python program insert, delete, and replace the value in the list.	5
Practical 24	Program to implement queue using list	**2**	Creating a python program to implement a queue.	5
Practical 25	Program to implement stack using list	**2**	Creating a python program to implement a stack	5
Practical 26	Program to show the sum of two matrices	**2**	Creating a python program to display the addition of two matrices.	5
Practical 27	Program to calculate the square of the elements of a list by using list comprehension method and print the final list	**2**	Creating a python program to calculate the square of the element of a list.	5
Practical 28	Program to explain tuple conversion function	**2**	Creating a python program understand the tuple conversion function.	5
Practical 29	Program to perform the following operation ● Creation of a tuple ● Updation of a tuple ● Deletion of a tuple Slicing of a tuple	**2**	Creating a python program for a different operation on a tuple.	5

TEXT BOOKS:

T1: Allen B. Downy, O'reilly, Think Python

T2: Charles Severance, Python for Everybody: Exploring Data Using Python 3

REFERENCE BOOKS:

R1: Jakes Vander Plas O' Reilly, Python Data Science Handbook

R2: Eric Matthes, "Python Crash Course, A Hands – on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019

OTHER LEARNING RESOURCES:

1. https://www.w3schools.com/python/python_intro.asp
2. https://www.tutorialspoint.com/python/index.htm

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.	1, 2, 3, 8
2	Express proficiency in the handling of strings and functions.	1, 2, and 8
3	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets	1, 2, and 8
4	Identify the commonly used operations involving file systems and regular expressions.	1, 2, and 8
5	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python	1, 2, and 8

SEMESTER – IV									
Course Title	**Computer Networks**								
Course code	**23BCAO223R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	**Programming Skills**	**Co-requisite**	**LINUX**						
Programme	**Bachelor of Computer Applications**								
Semester	**Winter/ II semester of the second year of the program**								
Course Objectives	1. Understand the fundamentals of data communications principles of media access, switching, routing and flow control. 2. Understand the basics of network protocol design and analysis. 3. Be familiar with the TCP/IP protocol suite and with application layer protocols.								
CO1	Explain the basics of data communication, networking, internet, physical layer techniques and circuit switching.								
CO2	Explain the different data link layer techniques and protocols including flow and error control.								
CO3	Discuss network layer protocols along with routing issues.								
CO4	Summarize transport and application layer operations and protocols along with QoS services								
CO5	Analyse the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	Introduction to networks, internet, protocols and standards, the OSI model, layers in OSI model, TCP/IP suite, Addressing, Analog and digital signals. Physical Layer: digital transmission, multiplexing, transmission media, circuit switched networks, Datagram networks, virtual circuit networks, switch and Telephone network.	**8**	Understand the Concept of Computer Networks, Explain the Internet and its Components, Describe the OSI Model, Understand the TCP/IP Protocol Suite, Understand Signals in Networking, Define switching in networking	**1,2,3**
II	Data link layer: Introduction, Block coding, cyclic codes, checksum, framing, flow and error control, Noiseless channels, noisy channels, HDLC, point to point protocols	**8**	Introduction to Data Link Layer, describe block coding and its use in error detection and correction, describe block coding, Explain cyclic redundancy check (CRC), Define flow control and its importance	**3,4**
III	Network Layer: Logical addressing, internetworking, tunnelling, address mapping, ICMP, IGMP, forwarding, uni-cast routing protocols, multicast routing protocols.	**8**	Define logical addressing, Describe the concept of internetworking, define tunnelling, Explain address mapping techniques	**3,4**
IV	Transport Layer: Process to process delivery, UDP and TCP protocols, SCTP, data traffic, congestion, congestion control, QoS, integrated services, differentiated services, QoS in switched networks.	**9**	Explain address mapping techniques, Define ICMP and its role in reporting errors, Explain IGMP and its role, Define forwarding, Describe unicast routing protocols	**4**
V	Application Layer – Domain name space, DNS in internet, electronic mail, FTP, WWW, HTTP, SNMP, multi-media, network security	**6**	Define domain name space, Describe the role of DNS, Define electronic mail, Define FTP and its role in transferring files, Describe the World Wide Web, Define HTTP and its role	**4**

TEXT BOOKS:

T1: Behrouz A. Forouzan, Data Communications and Networking, Fourth Edition TMH,2006

T2: Andrew S Tanenbaum, Computer Networks, 4th Edition, Pearson Education.

REFERENCE BOOKS:

R1: S.Keshav, An Engineering Approach to Computer Networks, 2nd Edition, Pearson Education

R2: W.A.Shay, Understanding communications and Networks, Cengage Learning 3rd Edition

R3: Nader F. Mir, Computer and Communication Networks, Pearson Education

R4: James F.Kurose,K.W.Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Edition, Pearson Education

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the basics of data communication, networking, internet, physical layer techniques and circuit switching.	1, 2, 3, 8
2	Explain the different data link layer techniques and protocols including flow and error control.	1, 2, 3, 8
3	Discuss network layer protocols along with routing issues.	1, 2, 3, 8
4	Summarize transport and application layer operations and protocols along with QoS services.	1, 2, 3, 8
5	Analyse the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.	1, 2, 3, 8

SEMESTER – IV									
Course Title	**Introduction to Linux**								
Course code	**23BCAO224R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T+15P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Programming Skills**	**Co-requisite**	**LINUX**						
Programme	**Bachelor of Computer Applications**								
Semester	**Winter/ II semester of the second year of the program**								
Course Objectives	1. To teach principles of operating system including File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking Commands, Basic Linux commands, Scripts and filters. 2. To familiarize fundamentals of the Bourne again shell (bash), shell programming, pipes, input and output redirection Control structures, arithmetic in shell interrupt processing, functions, debugging shell scripts. 3. To impart fundamentals of file concepts kernel support for file, File structure related system calls (file API's). 4. To facilitate students in understanding Processes, Inter process communication, and Shared Memory.								
CO1	Demonstrate the basic knowledge of Linux commands in linux shell environment								
CO2	Apply Linux commands to write Shell Programming for operating the files and folders								
CO3	Analyze the procedure for creating parent, child, zombie, orphon process and relationship between them								
CO4	Create Network Programming to make efficient use of various resources available on different machines in a network.								
CO5	Design various client server application using TCP and UDP protocols								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	**Introduction To Linux And Linux Utilities:** A brief history of LINUX, architecture of LINUX, features of LINUX, introduction to vi editor. Linux commands- PATH, man, echo, printf, script, passwd, uname, who, date, stty, pwd, cd, mkdir, rmdir, ls, cp, mv, rm, cat, more, wc, lp, od, tar, gzip, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands, unlink, du, df, mount, umount, find, unmask, ulimit, ps, w, finger, arp, ftp, telnet, rlogin.Text Processing utilities and backup utilities , tail, head, sort, nl, uniq, grep, egrep, fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, cpio	**8**	Understand the history and evolution of the LINUX, Utilize basic and advanced vi editor commands, Understand and effectively use the PATH environment variable, Use utilities like wc, lp, od, tar, and gzip, Use disk utilities like du, df, mount, and umount Use command for text processing, Employ utilities for backup and archiving	**1,2,3**
II	**Introduction to Shells:** Linux Session, Standard Streams, Redirection, Pipes, Tee Command, Command Execution, Command-Line Editing, Quotes, Command Substitution, Job Control, Aliases, Variables, Predefined Variables, Options, Shell/Environment Customization. **Filters:** Filters and Pipes, Concatenating files, Display Beginning and End of files, Cut and Paste, Sorting, Translating	**8**	Understand the basics of a Linux session, Gain knowledge of standard input, Learn how to redirect input and output, Understand the usage of the tee command, Develop skills to execute commands, Learn techniques for editing commands, Understand the concept of filters, Learn how to concatenate files, Gain an in-	**3,4**

	Characters, Files with Duplicate Lines, Count Characters, Words or Lines, Comparing Files. **Grep:** Operation, grep Family, Searching for File Content. **Sed :** Scripts, Operation, Addresses, commands, Applications, grep and sed.		depth understanding of how the grep command works, Understand how to write and execute sed scripts.	
III	**Unix/Linux File Structure:** Introduction to UNIX file system, inode (Index Node), file descriptors, system calls and device drivers. **File Management:** File Structures, System Calls for File Management – create, open, close, read, write, lseek, link, symlink, unlink, stat, fstat, lstat, chmod, chown, Directory API – opendir, readdir, closedir, mkdir, rmdir, umask.	**8**	Gain an understanding of the UNIX file system, Gain insight into different file structures used in UNIX, Learn to use system calls, Develop skills to open, read from, and close directories programmatically	**3,4**
IV	**Process And Signals:** Process, process identifiers, process structure: process table, viewing processes, system processes, process scheduling, starting new processes: waiting for a process, zombie processes, orphan process, fork, vfork, exit, wait, waitpid, exec, signals functions, unreliable signals, interrupted system calls, kill, raise, alarm, pause, abort, system, sleep functions, signal sets. File locking: creating lock files, locking regions, use of read and write with locking, competing locks, other lock commands, deadlocks.	**8**	Understand the concept of processes, Learn about signals, Understand the concept and purpose of lock files	**4**
V	**Inter Process Communication:** Pipe, process pipes, the pipe call, parent and child processes, and named pipes: fifos, semaphores: semget, semop, semctl, message queues: msgget, msgsnd, msgrcv, msgctl, shared memory: shmget, shmat, shmdt, shmctl, ipc status commands. **Introduction To Sockets:** Socket, socket connections - socket attributes, socket addresses, socket, connect, bind, listen, accept, socket communications.	**7**	Understand the concept of pipes, Learn the use of semaphores in process synchronization, Understand the concept and purpose of message queues, Gain an understanding of shared memory and its benefits, Understand the concept of sockets, Learn about socket attributes	**4**
Practical				
Practical 1	Write a shell script that accept a file name starting and ending line numbers as arguments and display all the lines between given line no:	**2**	Describe, Shell Programming using Linux commands.	**2,3**
Practical 2	Write a shell script that delete all lines containing a specified word	**2**	Illustrate, explain, Shell Programming using Linux	**2,3**

			commands	
Practical 3	Write a shell script that displays a list of all the files in the current directory	**2**	Describe, illustrate, explain, apply and develop Shell Programming using Linux commands in current directory.	**2,3**
Practical 4	Write a shell script that receives any number of file names as arguments checks if every argument supplied is a file or a directory and reports accordingly, whenever the argument is a file or directory.	**2**	Compare and analyse different methods for checking file types in shell scripting.	**2,3**
Practical 5	Write a shell script that accept a list of file names as arguments count and report the occurrence of each word.	**2**	Evaluate the script's performance and reliability in different scenarios.	**2,3,4**
Practical 6	Write a awk script to find the number of characters, words and lines in a file? linked list respectively.	**2**	Evaluate the accuracy and efficiency of the AWK script in various scenarios.	**2,3,4**
Practical 7	Write a C Program that makes a copy of a file using standard I/O and system calls? using Cat command	**2**	Design a script that generates a detailed report of file and directory statuses, including permissions and sizes.	**2,3,4**
Practical 8	Implement in C the following Unix commands using system calls “mv”	**2**	Design a C program that mimics other Unix commands, such as cp or rm, using similar system calls and techniques.	**2,3,4**
Practical 9	Implement in C the following Unix commands using system calls “ls”	**2**	Explain the purpose and functionality of the ls command and its variations (ls -l).	**2,3,4**
Practical 10	Write a C program to emulate the Unix ls-l command?	**2**	Create more advanced programs that incorporate additional features of the ls command, such as sorting or filtering.	**2,3,4**
Practical 11	Write a C program to list for every file in a directory,itsinode number and filename.?	**2**	Demonstrate the ability to use system calls to read directory contents and retrieve file information.	**2,3,4**
Practical 12	Write a C program to create a child process and allow the parent to display “parent” and the child to display “child” on the screen	**2**	Assess the synchronization and communication between parent and child processes in a C program.	**2,3,4**
Practical 13	Write a C program to create a Zombie process.?	**2**	Create a more advanced script that includes additional functionalities such as recursive directory checks	**2,3,4**
Practical 14	Write a C program that illustrates how an orphan is created.	**2**	Evaluate the program's correctness in creating orphan processes and handling command execution with pipes.	**4,5**

Practical 15	Write a program that illustrates how to execute two commands concurrently with a command pipe.	**2**	esign a system that uses process control and pipes to perform more sophisticated tasks, such as a custom shell or command interpreter.	**4,5**

TEXT BOOKS:,

T1: W. Richard. Stevens, Advanced Programming in the UNIX Environment, Pearson Education, New Delhi, India.

T2: Behrouz A. Forouzan, Richard F. Gilberg.Thomson, UNIX and shell Programming

REFERENCE BOOKS:

R1: Robert Love, O'Reilly, Linux System Programming, SPD

R2: W.R.Stevens, Advanced Programming in the UNIX environment, Pearson Education.

R3: W.R. Stevens, UNIX Network Programming, PHI

R4: Graham Glass, King Ables, UNIX for Programmers and Users, Pearson Education

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate the basic knowledge of Linux commands in linux shell environment	1, 2, 3, 4, and 5
2	Apply Linux commands to write Shell Programming for operating the files and folders	1, 2, 3, 4, and 5
3	Analyze the procedure for creating parent, child, zombie, orphon process and relationship between them	1, 2, 3, 4, and 5
4	Create Network Programming to make efficient use of various resources available on different machines in a network.	1, 2, 3, 4, and 5
5	Design various client server application using TCP and UDP protocols	1, 2, 3

SEMESTER – IV									
Course Title	**PE II: DATA ANALYTICS USING PYTHON**								
Course code	**23BCAO225R**	**Total Credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total Hours: 30T+15P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ II semester of the second year of the program**								
Course Objectives	1. Equip students with essential skills in algebra and statistical analysis fundamental to data science. 2. Teach students to effectively manipulate data using Python libraries like NumPy and Pandas and create comprehensive visualizations. 3. Enable students to implement unsupervised learning methods and engage with the latest data science advancements through practical applications and case studies.								
CO1	Understand and apply concepts of functions, exponentials, logarithms, polynomials, alternate coordinate systems, and statistical distributions								
CO2	Demonstrate proficiency in using NumPy for various operations and broadcasting, and manipulate data frames in Pandas, including loading data in different formats								
CO3	Create and interpret various types of data visualizations such as histograms, box plots, bar plots, pie charts, and line charts								
CO4	Implement and evaluate unsupervised learning techniques in Python, including K-Means clustering, hierarchical clustering, and Principal Component Analysis (PCA)								
CO5	Analyze the latest improvements and applications in data science through case studies and exploratory data analysis (EDA) in interdisciplinary research areas.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction:** Intermediate Algebra& Linear Algebra: Functions, Exponentials and Logarithm's, Polynomial's, Alternate Coordinate systems, Binomial Distribution, Poisson distribution and Normal distribution its properties, Assumption of ANOVA, Measures of Central Tendency in Data.	**8**	Demonstrate understanding and application of intermediate algebra and linear algebra concepts	1,2
II	**Introduction about NumPy:** Different NumPy Operations, Broadcasting with NumPy, Introduction about Pandas, Reading or Loading data into Data frame, Pandas Data Frame Manipulations, Data Loading /Reading in different formats (CSV, Excel, Json, HTML)	**8**	Master the use of NumPy for performing array operations, broadcasting techniques, and Pandas for data manipulation, including reading, loading, and transforming data within data frames across various formats	2, 3
III	**Introduction to data Visualizations:** Principles Behind Data Visualizations, Histograms Visualize, Box plots-Visualize, the Distribution of Continuous Numerical Variables (Bar Plots Pie Chart Line Chart). Data Visualization using R-Line Plots and Regression.	**8**	Develop the ability to create and interpret various data visualizations, including histograms, box plots, bar plots, pie charts, line charts, and utilize R for generating line plots and conducting regression analysis to effectively communicate data insights.	3, 4
IV	**Unsupervised Learning in Python:**K-Means Theory/ Implementation, Quantifying K-Means Clustering Performance, Hierarchical Clustering Theory, Principal Component Analysis	**8**	Apply unsupervised learning techniques in Python, including K-Means clustering and hierarchical clustering, evaluate their performance,	3, 4

	(PCA) theory / Implementation. Selection criteria for number of clusters choosing.		implement Principal Component Analysis (PCA), and determine the appropriate number of clusters based on selection criteria.	
V	The improvements and most recent developments in the course's topics as well as their most recent applications in the field Data Science. Case Study and EDA in the interdisciplinary research areas of Data Science.	**8**	Analyze recent advancements and applications in data science, applying knowledge through case studies and exploratory data analysis (EDA) in various interdisciplinary research areas to understand current trends and innovations.	4, 5
Practical				
Practical 1	Write a Python Program to implement basic mathematical functions.	**2**	Visualize and Analyse polynomial behaviour.	**4**
Practical 2	Write a Python Program to Plot normal distribution using Matplotlib.	**2**	Implement Binomial Distribution.	**3**
Practical 3	Write a Python Program to calculate mean, median, and mode	**2**	Visualize Cartesian and polar coordinates conversion.	**4**
Practical 4	Write a Python Program to create and manipulate arrays using NumPy.	**2**	Calculate the dot product of two matrices using NumPy.	**3**
Practical 5	Write a program to add a 1D array to a 2D array using broadcasting.	**2**	Create a DataFrame from a dictionary.	**5**
Practical 6	Write a program to load a JSON file into a DataFrame.	**2**	Read data from an Excel file into a Pandas DataFrame	**3**
Practical 7	Write a Python Program to visualize data distribution with histograms.	**2**	Create a histogram for any dataset.	**5**
Practical 8	Write a Python Program to visualize data spread and outliers with box plots.	**2**	Analyze two datasets using box plots.	**4**
Practical 9	Write a Python Program to visualize proportions using pie charts.	**2**	Plot a line chart for stock prices over time.	**5**
Practical 10	Write a Python Program to implement K-Means.	**2**	Evaluate clustering performance using inertia and silhouette scores.	**6**
Practical 11	Write a Python Program to implement PCA (Principal Component Analysis).	**2**	Apply PCA to reduce data dimensions and visualize results.	**3, 4**
Practical 12	Write a Python Program to visualize the inertia for different numbers of clusters.	**2**	Use the elbow method and silhouette analysis to determine the optimal number of clusters	**3, 4**
Practical 13	Write a Python Program to visualize Data Distributions.	**2**	Use Python libraries like seaborn and matplotlib for visualizations.	**3**
Practical 14	Write a Python Program to implement Predictive Modelling.	**2**	**Dataset**: Sales data with features like product ID, sales amount, date, category, etc	**3**
Practical 15	Predicting Rainfall Dataset: Historical weather data. **EDA** (Exploratory Data Analysis) Goal: Identify correlations between humidity, temperature, and rainfall patterns.	**2**	Predicting Student Performance **Dataset**: Student grades, attendance, and engagement data. **EDA Goal**: Determine factors influencing academic success.	**3, 4**

TEXT BOOKS:

T1: Think Python, Allen B. Downy, O'reilly

T2: Python for Everybody: Exploring Data Using Python 3 Book by Charles Severance

REFERENCE BOOKS:

R1: Python Data Science Handbook, Jakes Vander Plas O' Reilly

R2: Eric Matthes, Python Crash Course, A Hands – on Project Based Introduction to Programming, 2nd Edition, No Starch Press, 2019

OTHER LEARNING RESOURCES:

https://www.w3schools.com/python/python_intro.asp

https://www.tutorialspoint.com/python/index.htm

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand and apply concepts of functions, exponentials, logarithms, polynomials, alternate coordinate systems, and statistical distributions	2, 3, 4, 5, and 8
2	Demonstrate proficiency in using NumPy for various operations and broadcasting, and manipulate data frames in Pandas, including loading data in different formats	1, 2, 3, and 5
3	Create and interpret various types of data visualizations such as histograms, box plots, bar plots, pie charts, and line charts	2, 3, 5, and 6
4	Implement and evaluate unsupervised learning techniques in Python, including K-Means clustering, hierarchical clustering, and Principal Component Analysis (PCA)	2, 3, 5, and 7
5	Analyze the latest improvements and applications in data science through case studies and exploratory data analysis (EDA) in interdisciplinary research areas.	2, 3, 5, 7, and 8

SEMESTER – IV									
Course Title	**PE II –Ethical Hacking Fundamentals**								
Course code	**23BCAO228R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T+15P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ II semester of the second year of the program**								
Course Objectives	1. Acquire knowledge and skills needed for performing the hacking process. 2. Understand the various hacking methodologies. 3. Analyze the hacking process on different platforms and the formal reporting writing process.								
CO1	Discuss the basics of ethical hacking.								
CO2	Elaborate on the hacking methodology.								
CO3	Demonstrate the hacking process on different platforms.								
CO4	Illustrate the various application of attacks on different wireless platforms.								
CO5	Create formal reports for the security attacks launched.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	**Introduction to Ethical Hacking** Ethical Hacking Concepts, Scope, Types, and Phases, Process of Malicious Hacking, Information Security Controls, Physical Security, Incident Management, Vulnerability Assessment, and Penetration Testing.	**5**	Understand the concepts, scope, and phases of ethical hacking, describe the processes of malicious hacking and information security controls, and apply knowledge of physical security, incident management, vulnerability assessment, and penetration testing.	1,3
II	**Pre Hacking Phases** Footprinting, Reconnaissance, Scanning, and Enumeration; Foot printing concepts, Footprinting methodology, Website Footprinting. Email Footprinting, Information Gathering, WHOIS Footprinting, DNS Footprinting, Footprinting through Social Engineering Footprinting tools. Footprinting Countermeasures. Overview of Scanning, Network, Scanning, methodology. Enumeration Concepts.	**6**	Analyze foot printing, reconnaissance, scanning, and enumeration concepts and methodologies, apply tools for various foot printing techniques such as website, email, and DNS, and develop countermeasures to mitigate risks in pre-hacking phases.	3,4, 5
III	**The system, Web, and Network Hacking** System Hacking, Trojans and Black Box Vs White Box Techniques. Denial of Service, Botnets, Sniffers, and Hacking Web Servers: Session Hijacking, Web Application Vulnerabilities, and Web-Based Password Cracking Techniques, SQL Injection, Viruses, Worms and Physical Security: Viruses and Worms, Physical Security. Linux Hacking: Linux Hacking. Evading IDS and Firewalls: Evading IDS and Firewalls.	**6**	Identify vulnerabilities in system hacking, Trojans, DoS attacks, and botnets, examine web application vulnerabilities and password cracking techniques, and apply methods for Linux hacking and evading IDS and firewalls.	1,3, 4

IV	**Hacking Wireless Networks, Mobile Platforms** Wireless threats: Access control Attacks, Integrity Attacks, Rouge Access Point attacks, Ad Hoc Connection attacks, Jamming Signal attacks. Wireless Hacking Methodology: Foot Printing wireless Network, Wi-Fi discovery tools. Mobile Platform Attack: Vulnerabilities in the Business environment, OWASP mobile top 10 risks, Security Issues – Mobile Apps, Hacking Android OS, Apple iOS, Windows Phone OS, Jailbreaking, Mobile Device Management (MDM), Bring Your Own Device (BOYD), BOYD Risks, Mobile Security guidelines.	**7**	Evaluate wireless threats and attack types, apply wireless hacking methodologies using Wi-Fi discovery tools, and assess mobile platform vulnerabilities while proposing security guidelines for mitigation.	3,5, 6
V	**Report Writing & Mitigation** Introduction to Report Writing & Mitigation, requirements for low-level reporting & high-level reporting of Penetration testing results, Demonstration of vulnerabilities, and Mitigation of issues identified including tracking.	**7**	Develop comprehensive penetration testing reports at different levels, demonstrate vulnerabilities with actionable mitigation strategies, and track the resolution of identified issues.	3,5
Practical				
Practical 1	Performing Active and Passive reconnaissance.	**2**	Demonstrate the ability to gather information about a target system through active and passive reconnaissance techniques, enhancing skills in intelligence gathering and risk identification.	3
Practical 2	Port Scanning information using Nmap.	**2**	Analyze network configurations and security posture by performing port scans with Nmap, identifying open ports, and evaluating potential vulnerabilities.	4
Practical 3	Vulnerability Scanning using Wireshark.	**2**	Perform vulnerability scanning using Wireshark, interpret captured packets, and identify potential network vulnerabilities.	3, 4
Practical 4	Exploiting NetBIOS Vulnerability.	**2**	Demonstrate exploitation of NetBIOS vulnerabilities to understand risks associated with network protocols, and propose mitigation strategies.	3, 5
Practical 5	Creating and analyzing virus.	**2**	Develop a simple virus for educational purposes, analyze its behaviour, and evaluate security measures to mitigate similar threats.	4,5, 6

Practical 6	Performing SQL injection attack.	**2**	Perform an SQL injection attack to understand web application vulnerabilities and evaluate techniques to secure databases from similar exploits.	3,6
Practical 7	Creating and analyzing spoofed emails.	**2**	Create and analyze spoofed emails to understand phishing attacks and recommend countermeasures to enhance email security.	4,5, 6
Practical 8	Wi-Fi password cracking.	**2**	Demonstrate Wi-Fi password cracking techniques to identify security gaps in wireless networks and propose measures to strengthen wireless security.	3,5
Practical 9	Performing MITM attack.	**2**	Conduct a Man-In-The-Middle (MITM) attack to understand the risks of data interception and develop mitigation strategies.	3,5
Practical 10	Launching DDoS attack.	**2**	Simulate a DDoS attack to analyze its impact on network performance and evaluate strategies to defend against such threats.	3,5

Textbooks:

1. CEH v9: Certified Ethical Hacker - Version 9 Study, Sean-Philip Oriyano (Author), Wiley Publications, 2016.

References:

1. *"The Basics of Hacking and Penetration Testing"* by Patrick Engebretson.
2. *"Ethical Hacking and Penetration Testing Guide"* by Rafay Baloch.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Discuss the basics of ethical hacking.	2,3,4,5,6, and 8
2	Elaborate on the hacking methodology.	2,3,5,6, and 8
3	Demonstrate the hacking process on different platforms.	2,3,5,6,7, and 8
4	Illustrate the various application of attacks on different wireless platforms.	2,3,4,5,6,7, and 8
5	Create formal reports for the security attacks launched.	2,3,5,6,7, and 8

SEMESTER – IV									
Course Title	**PE II – Cyber Forensics**								
Course code	**23BCAO2212R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T+15P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Fall/ II semester of the second year of the program**								
Course Objectives	1. Introduce students to the fundamental concepts and procedures in computer forensics and cybercrime investigations. 2. Provide an in-depth understanding of storage devices, data acquisition, and recovery techniques. 3. Familiarize students with forensic techniques for Windows, Linux, mobile devices, networks, and email tracking.								
CO1	Describe the principles of computer forensics and implement cybercrime investigation procedures.								
CO2	Analyze storage devices and apply techniques for data recovery and volatile data analysis.								
CO3	Utilize forensic tools and techniques for investigating various platforms, including networks, mobile devices, and email systems.								
CO4	Apply cyber law principles and evidence-handling procedures to ensure legal compliance during investigations.								
CO5	Conduct forensic analysis of web applications, including server logs and security breaches, to identify intruders and vulnerabilities.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Computer Forensics** Introduction to Computer Forensics, Forms of Cyber Crime, First Responder Procedure- Non-technical staff, Technical Staff, Forensics Expert and Computer Investigation procedure, Case Studies.	**8**		
II	**Storage Devices & Data Recover Methods** Storage Devices- Magnetic Medium, Non-magnetic medium and Optical Medium, Working of Storage devices-Platter, Head assembly, spindle motor, Data Acquisition, Data deletion and data recovery method and techniques, volatile data analysis, Case Studies.	**10**		
III	**Forensics Techniques** Windows forensic, Linux Forensics, Network forensics – sources of network-based evidence, other basic technical fundamentals, Mobile Forensics – data extraction & analysis, Steganography, Password cracking-Brute force, Cross-drive analysis, Live analysis, deleted files, stochastic forensics, Dictionary attack, Rainbow attack, Email Tacking – Header option of SMTP, POP3, IMAP, examining browsers, Case Studies.	**8**		
IV	**Cyber Law** Corporate espionage, digital evidences handling procedure, Chain of custody, Main features of Indian IT Act 2008 (Amendment), Case Studies, Incident specific procedures – virus and worm incidents, Hacker incidents, Social incidents,	**6**		

	physical incident, Guidelines for writing forensic report.			
V	**Forensic Analysis of Web Application** Forensic analysis of web server, network analysis of web server compromise, web server log analysis, web application forensic, forensic analysis of web application security, intruder profiling, forensic for code injection attack, Case Studies	**5**		
Practical Component – NIL				

Text Books:

T1. Computer Forensics: Computer Crime Scene Investigation by John Vacca, Laxmi Publications, 1st ed; 2015

T2. Digital Forensic: The Fascinating World of Digital Evidences by Nilakshi Jain, et.al, Wiley, 1st ed; 2016

T3. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics by John Sammons, Syngress, 2nd ed; 2014

T4. Cyber Forensics in India: A Legal Perspective by Nishesh Sharma, Universal Law Publishing - an imprint of LexisNexis; First 2017 edition

T5. NetworkForensics:Tracking Hackers Throu by Davidoff, Pearson India, 1st ed; 2013

Reference Books:

R1.Hacking Exposed Computer Forensics by Aaron Philipp, David Cowen, McGraw Hill, 2nd ed; 2009

R2.Mastering Mobile Forensics by SoufianeTahiri, Packt Publishing, 1st ed; 2016

R3.Computer Forensics: A Beginners Guide by David Cowen, McGraw Hill, 1st ed; 2013

R4.Practical Digital Forensics Kindle Edition by Richard Boddington, Packt Publishing, 1st ed; July 2016

R5.Learning Network Forensics by Samir Datt, Packt Publishing, 1st ed; 2016

OTHER LEARNING RESOURCES:

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Describe the principles of computer forensics and implement cybercrime investigation procedures.	2,3,5,6,7, and 8
2	Analyze storage devices and apply techniques for data recovery and volatile data analysis.	1,2,3,5,6,7, and 8
3	Utilize forensic tools and techniques for investigating various platforms, including networks, mobile devices, and email systems.	1,2,3,5,6,7, and 8
4	Apply cyber law principles and evidence-handling procedures to ensure legal compliance during investigations.	2,3,4,5,6,7, and 8
5	Conduct forensic analysis of web applications, including server logs and security breaches, to identify intruders and vulnerabilities.	1,2,3,5,6,7, and 8

SEMESTER – IV									
Course Title	**PE II: KNOWLEDGE ENGINEERING**								
Course code	**22BCAO2210R**	**Total Credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total Hours: 30T+15P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ V semester of the third year of the program**								
Course Objectives	1. Understand the basics of Knowledge Engineering. 2. Discuss the knowledge representation and reasoning methods. 3. Apply reasoning and uncertainty for intelligent systems								
CO1	Understand the basics of Knowledge Engineering								
CO2	Interpret the knowledge representation and reasoning methods.								
CO3	Apply reasoning and uncertainty for intelligent systems								
CO4	Design and develop ontologies								
CO5	Understand learning and rule learning								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Knowledge Engineering:** Introduction Data, Information and Knowledge Skills of Knowledge Engineer Knowledge based systems Types of Knowledge based systems Expert Systems Neural Networks Case Based Reasoning Genetic Algorithms Intelligent Systems Data Mining	**8**	Gain a foundational understanding of data, information, and knowledge distinctions; acquire skills essential for a knowledge engineer	1,2
II	**Knowledge Representation and Reasoning:** Knowledge Acquisition Knowledge Representation and Reasoning Using Knowledge Logic, Rules and Representation Developing Rule based Systems Semantic Networks Frames	**8**	Master the processes of knowledge acquisition and representation, develop skills in reasoning with knowledge using logic and rules, and effectively create rule-based systems, while understanding the applications of semantic networks and frames in artificial intelligence.	2, 3
III	**Reasoning under Uncertainty:** Introduction Abductive reasoning Probabilistic reasoning Enumerative Probabilities Subjective Bayesian view Belief Functions Baconian Probability Fuzzy Probability Uncertainty methods Evidence based reasoning Intelligent Agent Mixed Initiative Reasoning Knowledge Engineering.	**8**	Understand and apply various methods of reasoning under uncertainty; develop competence in integrating these approaches within intelligent agents and mixed-initiative reasoning environments for effective knowledge engineering.	3, 4
IV	**Ontologies Design and Development:** Concepts and Instances Generalization Hierarchies Object Features Defining Features Representation Transitivity Inheritance Concepts as Feature Values Ontology Matching Design and Development Methodologies Steps in Ontology Development	**8**	Acquire skills to design and develop ontologies, understanding the structural elements such as concepts, instances, generalization hierarchies, and object features, and apply methodologies for ontology matching and development	3, 4
V	**Learning and Rule Learning:** Machine Learning Concepts	**8**	Master the foundational concepts of machine learning,	3, 4, 5

	Generalization and Specialization Rules Types of Generalization and Specialization Formal definition of Generalization. Modelling, Learning and Problem Solving		focusing on generalization and specialization principles; understand formal definitions and different types of generalization, and apply these concepts in modelling, learning, and problem-solving contexts to develop effective rule-based learning systems	
Practical				
Practical 1	Implement a basic expert system in Python using a set of rules to classify diseases based on symptoms input by the user.	**2**	Apply rule-based reasoning to create an expert system and develop a knowledge-based system that classifies input data.	**3, 5**
Practical 2	Write a Python program that uses a neural network (e.g., Multi-Layer Perceptron) to predict stock market trends based on historical data.	**2**	Implement a neural network to make predictions and analyze historical data for trend prediction.	**3, 4**
Practical 3	Implement a case-based reasoning system in Python that recommends movies based on user preferences and ratings from a dataset.	**2**	Design and implement a case-based reasoning system and apply similarity measures to make recommendations.	**3, 5**
Practical 4	Implement a Python program that represents knowledge using semantic networks. Use this to represent relationships between various entities in a knowledge domain.	**2**	Create semantic network representations of knowledge and apply logical reasoning to entities and their relationships	**5**
Practical 5	Write a Python script that represents knowledge using frames. Develop a system to infer information based on predefined frame structures.	**2**	Implement frame-based knowledge representation and apply reasoning techniques to infer new knowledge.	**3, 4**
Practical 6	Implement a rule-based reasoning system in Python using logical rules to deduce new facts based on known information.	**2**	Apply rule-based reasoning to derive new conclusions from known facts and create systems that work based on logical rules.	**3**
Practical 7	Implement a Python script that demonstrates probabilistic reasoning by calculating the probability of an event given prior probabilities and conditional probabilities.	**2**	Apply probabilistic reasoning techniques and calculate probabilities based on known data and relationships.	**3**
Practical 8	Write a Python program to apply Bayesian reasoning for decision making in uncertain environments, such as predicting the weather based on past observations.	**2**	Apply Bayesian reasoning to solve real-world problems and implement decision-making models using probabilistic techniques.	**3, 5**
Practical 9	Implement a Python function that uses belief functions to model uncertain knowledge and make inferences.	**2**	Apply belief functions for reasoning under uncertainty and demonstrate uncertainty handling in a knowledge-based system.	**3**
Practical 10	Write a Python program to represent an ontology for a given domain (e.g., animals or vehicles) using classes and instances.	**2**	Design ontologies to represent knowledge in specific domains and create classes and instances to represent	**5**

			real-world concepts.	
Practical 11	Implement a Python function to demonstrate ontology matching, where two ontologies are compared to identify similar concepts.	**2**	Apply ontology matching techniques and compare ontologies to find similar or equivalent concepts.	**3, 6**
Practical 12	Write a Python program to define a hierarchy of concepts in an ontology and demonstrate inheritance using object-oriented principles.	**2**	Design ontological hierarchies and define relationships between concepts and apply inheritance principles in an ontology structure.	**1, 5**
Practical 13	Implement a rule learning algorithm in Python to extract rules from a dataset, such as classifying objects based on attributes (e.g., Iris dataset).	**2**	Implement rule learning algorithms to extract useful patterns and apply these rules to classify data effectively.	**3**
Practical 14	Write a Python program to demonstrate generalization and specialization by modifying rules to adapt to new data.	**2**	Apply generalization and specialization techniques to adapt rules to new situations and develop systems that can refine rules based on incoming data.	**3, 5**
Practical 15	Develop a Python script that uses machine learning techniques to generalize from a set of training data and apply it to make predictions on new data.	**2**	Apply machine learning techniques to model data and generalize from training data to make predictions on unseen data.	**3**

TEXT BOOKS:

T1: Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018

T2: Gheorghe Tecuci, DorinMarcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016

T3: Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.

T4: John F. Sowa: Knowledge Representation Logical, Philosophical, and Computational Foundations, Brooks Cole, Thomson Learning, 2000

REFERENCE BOOKS:

R1: King, Knowledge Management and Organizational Learning, Springer, 2009.

R2: Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition, 2001

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basics of Knowledge Engineering	1, 2, 3, 4, 5, and 8
2	Interpret the knowledge representation and reasoning methods.	2, 3, 5, 7
3	Apply reasoning and uncertainty for intelligent systems	2, 3, 5, 7
4	Design and develop ontologies	2, 3, 5, 7
5	Understand learning and rule learning	1,2,3,5,6,7,8

SEMESTER – IV									
Course Title	**PE - II Pattern Recognition**								
Course code	**23BCAO2211R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T+15P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	Fundamentals of probability, linear algebra and Digital Image Processing	**Co-requisite**	NIL						
Programme	**Bachelor of Computer Application (BCA)**								
Semester	**Fall / II semester of the Second Year**								
Course Objectives	1.Pattern recognition which has several important applications on classical computer engineering problems like word/sentence-based searches, etc. 2.The emphasis of the course is on algorithms for pattern recognition 3.The representation of patterns and classes and the proximity measures are an important aspect of pattern recognition								
CO1	Summarize the various techniques involved in pattern recognition.								
CO2	Categorize the various pattern recognition techniques into supervised and unsupervised								
CO3	Understand feature selection and extraction techniques.								
CO4	Illustrate the artificial neural network-based pattern recognition								
CO5	Discuss the applications of pattern recognition in various real-world applications								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction and Mathematical Preliminaries**: Pattern Recognition: Definition, Applications and Examples, Clustering Vs Classification, Supervised Vs Unsupervised, Basic of Linear Algebra, Vector Spaces, Basics of Probability, Basics of Estimation Theory, Decision Boundaries, Decision Regions, Metric Spaces	**9**	Explain Pattern Recognition, Understanding different Clustering Techniques and their theory. Applying in real world scenario.	**1, 2, 4**
II	**Classification:** Bayes Decision Rules, Error Probability, Examples, Normal Distribution, Linear Discriminant Function, Non-Linear Decision Boundaries, Mahalanobis Distance, K-NN Classifier, Single and Multi-Layer Perceptron, Training Set, Test Set, Standardization and Normatization	**9**	Explaining different Classification technique and understanding their interpretation by applying in different datasets.	**1, 2, 4**
III	**Clustering:** Basics, Similarity/Dissimilarity Measures, Clustering Criteria, Different distance functions and similarity measures, within cluster distance criterion, K-means algorithm, Single linkage and complete linkage algorithms, MST,K-medoids, DBSCAN, Data sets: Visualization, Unique Clustering	**9**	Explaining different Clustering technique and understanding their interpretation by applying in different datasets.	**1, 2, 4**
IV	**Feature Selection and Extraction**: Problem statement and Uses, Branch and Bound Algorithm, Sequential Forward / Backward Selection Algorithms, (l,r) algorithm, Probabilistic separability based	**8**	Explaining different Feature Selection and Extraction technique and understanding their role in enhancing models.	**1, 2, 3, 4**

	criterion functions, interclass distance based criterion functions, Feature Extraction, PCA + Kernel PCA			
V	**Recent Advances in Pattern Recognition**: Structural PR, SVMs, FCM, Soft-Computing and Neuro-Fuzzy Techniques, Real-Life Examples	**8**	Understanding Recent Advance Pattern Recognition Technique with Real life Examples	**1, 2, 3, 4**
Practical				
Practical 1	Implement a basic pattern recognition algorithm in Python to classify points in a 2D plane based on their distance from the origin. Use the concept of Euclidean distance.	**2**	Applying pattern recognition algorithms to classify data based on distance metrics and visualize the results using Python libraries	**3, 5**
Practical 2	Write a Python function to generate random data points and visualize them using Matplotlib. Label the points with distinct colors based on their class (e.g., red and blue) using a simple threshold.	**2**	Creating random datasets, apply color-coding techniques to label data points, and visualize the data effectively using Python tools	**3, 5**
Practical 3	Create a Python script that performs vector space transformations (e.g., translation, scaling, and rotation) on a set of 2D points. Visualize the points before and after the transformations using Matplotlib.	**2**	Demonstrate an understanding of vector space transformations and apply them to datasets, followed by visualizing the transformations	**3, 5**
Practical 4	Implement Bayes' Theorem in Python to classify data points based on the likelihood of their attributes. Use Gaussian Naive Bayes for the classification task and apply it to a simple dataset (e.g., two-dimensional points with Gaussian distribution).	**2**	Implement Bayes' Theorem and apply Gaussian Naive Bayes for classification tasks	**3, 4**
Practical 5	Write a Python function to calculate the error rate of a classification model. Apply it to a set of predicted and actual class labels.	**2**	Calculate the error rate of a classification model and analyze the model's performance using Python	**3, 4**
Practical 6	Implement a Linear Discriminant Analysis (LDA) classifier in Python. Test the classifier on a 2D dataset and visualize the decision boundary using Matplotlib.	**2**	Apply Linear Discriminant Analysis (LDA) for classification and visualize decision boundaries	**3, 5**
Practical 7	Write a Python script to perform K-means clustering on a 2D dataset. Plot the resulting clusters and the cluster centroids. Use scikit-learn'sKMeans implementation.	**2**	Apply the K-means clustering algorithm to a dataset and visualize clusters and centroids	**3, 5**
Practical 8	Implement a Python function to compute the Euclidean distance between two data points. Use this function to perform hierarchical clustering using agglomerative (single linkage) and divisive methods.	**2**	Implement distance calculations and apply them in hierarchical clustering using Python	**3, 4**
Practical 9	Implement the DBSCAN (Density-Based Spatial Clustering of Applications with Noise) algorithm in Python. Visualize the results of DBSCAN on a 2D dataset and	**2**	Implement the DBSCAN algorithm, compare it with K-means, and visualize the clustering results	**3, 4, 6**

	compare it with K-means clustering.			
Practical 10	Write a Python function to perform feature selection using the sequential forward selection algorithm. Apply it to the Iris dataset and print the selected features.	**2**	Implement feature selection algorithms and apply them to real datasets	**3, 4**
Practical 11	Implement PCA (Principal Component Analysis) in Python from scratch to reduce the dimensionality of a dataset. Visualize the data before and after dimensionality reduction.	**2**	Implement PCA from scratch and visualize the effects of dimensionality reduction	**3, 5**
Practical 12	Write a Python script that applies feature normalization (e.g., Min-Max scaling or Z-score normalization) to a dataset and visualize the effect of normalization on the data distribution.	**2**	Apply feature normalization techniques and visualize the effect on data distribution	**3, 5**
Practical 13	Implement a basic Support Vector Machine (SVM) classifier using the scikit-learn library in Python. Train it on a simple dataset, such as the Iris dataset, and visualize the decision boundaries.	**2**	Implement an SVM classifier and visualize decision boundaries for model evaluation	**3, 5**
Practical 14	Write a Python program to implement Fuzzy C-Means (FCM) clustering using skfuzzy. Apply it to a 2D dataset and visualize the resulting fuzzy clusters.	**2**	Implement the Fuzzy C-Means algorithm and visualize fuzzy clusters in a dataset	**3, 5**
Practical 15	Implement a neuro-fuzzy system in Python using the anfis library (Adaptive Neuro-Fuzzy Inference System). Use it for a regression task on a simple dataset and visualize the results.	**2**	Implement a neuro-fuzzy system for regression tasks and visualize the results using Python	**3, 5**

Text Books:

1. J.I. Tou& R.C. Gonzalez, Pattern Recognition Principles, Addition-Wesley.
2. MR. Schalkoff, Pattern Recognition - Statistical, Structural and Neural Approaches, John Wiley, 1992.

Reference Books:

1. P.A. Devijer& J. Kittler, Pattern Recognition - A Statistical Approach, Prentice-Hall.
2. Christopher. M. Bishop, 'Pattern recognition and machine learning, Springer, 2006.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Summarize the various techniques involved in pattern recognition.	1,2,3,7, and 8
2	Categorize the various pattern recognition techniques into supervised and unsupervised	1,2,3,7, and 8
3	Understand feature selection and extraction techniques.	1,2,3,7, and 8
4	Illustrate the artificial neural network based pattern recognition	1,2,3,7, and 8
5	Discuss the applications of pattern recognition in various real-world applications	1,2,3,5,7, and 8

SEMESTER – IV									
Course Title	**PE – III: Applied AI/ML**								
Course code	**23BCAO226R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T+15P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Basics of AI**	**Co-requisite**	NIL						
Programme	**Bachelor of Computer Application (BCA)**								
Semester	**Fall / II semester of the Second Year**								
Course Objectives	1.To introduce the applications of Artificial Intelligence (AI) in various domains. 2.To learn how to apply AI to solve practical problems. 3.To understand the real-world application								
CO1	Outline the basic concepts of machine learning and Artificial intelligence.								
CO2	Analyse various AI and ML techniques in expert systems and other machine learning models.								
CO3	Illustration and application of supervised learning in different domains.								
CO4	Application of un-supervised learning in expert systems.								
CO5	Implementation of advanced concepts of AI and ML in emerging filed like Medical and Agricultural sciences.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**AI in healthcare:** Role of AI in enhancing clinical decision-making process, classifying and segmenting 2D and 3D medical images to augment diagnosis, build predictive models using different Algorithms: Supervised and unsupervised, Naïve Bayes, Decision Tree, Logistic Regression, SVM, KNN etc. Medical data: imaging such as X-ray, CT, MRI, Mammography, Pathology. Build different AI models for different clinical scenarios that involve 2D/3D images.	**10**	Explain AI in healthcare. Understanding and Applying different ML in Healthcare datasets.	**1, 2, 3**
II	**AI in Agriculture:** Introduction of Smart farming, Definition of Smart and Precision farming, AI in Smart/Precision farming, Predictive Analytics in farming, Autonomous Farming using IoT and ML. Example: Yield Prediction, Disease Detection, Weed Detection, Crop Quality, Species Recognition, Animal Welfare, Livestock Production, Water Management, Soil Management	**10**	Describe AI is useful in Agriculture. Understand different Analysis in Agriculture and Applying in real world scenario	**1, 2, 3**
III	**AI for Language Processing** Introduction to NLP - Various stages of NLP –The Ambiguity of Language: Why NLP Is	**8**	Understanding NLP and Applying in day to day life. Analysis with different real world example.	**2, 3, 4**

	Difficult. Parts of Speech. Components of NLP: Natural Language Understanding (NLU), Natural Language Generation (NLG). Difficulties in NLU, NLP Terminology, Steps in NLP. Implementation Aspects of Syntactic Analysis: Context-Free Grammar, Top-Down Parser.			
IV	**AI for Image Processing** Digital Image Formation: point spread functions -sampling and quantization. Spatial Transforms: convolution concept - low and highpass filtering. Image corrections: Atmospheric Correction, Image enhancement and filtering, Image classification (Unsupervised, Supervised) and Accuracy assessment. Remote Sensing Concepts: spatial and radiometric characteristics – spectral and temporal characteristics. Data reception, Data processing & Data generation: Ground station, Data generation, Data processing & correction. Radiometric and Geometric corrections: Radiometric corrections Random noise correction, Atmospheric correction, Geometric errors and corrections.	**10**	Explain different images Processing techniques. Understanding with example and Applying with different images.	**1, 2, 3**
V	**AI for Remote Sensing** Spatial and radiometric characteristics – spectral and temporal characteristics. Data reception, Data processing & Data generation: Ground station, Data generation, Data processing & correction. Radiometric and Geometric corrections: Radiometric corrections Random noise correction, Atmospheric correction, Geometric errors and corrections. .	**8**	Understanding AI for Remote Sensing with example. Applying with different ML techniques.	**2, 3**
Practical				
Practical 1	Classify medical images (e.g., X-ray) as normal or abnormal using logistic regression.	**2**	Understand how to use Logistic Regression for binary classification problems in healthcare.	**2**

Practical 2	Segment medical images (e.g., CT scans) into regions based on pixel intensities.	**2**	Learn unsupervised learning techniques to analyze and process medical images.	**4**
Practical 3	Build a decision tree model to predict a disease based on patient data (features include symptoms and medical test results).	**2**	Develop predictive models for clinical decision-making and interpret the decision tree structure.	**3**
Practical 4	Predict the crop yield based on factors like rainfall, temperature, and soil quality.	**2**	Understand predictive analytics for estimating crop yield using linear regression.	**2**
Practical 5	Classify whether a crop leaf is healthy or diseased based on image features.	**2**	Learn basic image classification techniques for crop disease detection.	**2**
Practical 6	Predict crop quality based on soil nutrients and environmental factors.	**2**	Use decision trees to assess and improve crop quality.	**3**
Practical 7	Demonstrate tokenization and POS tagging using NLTK.	**2**	Introduces basic NLP stages such as tokenization and POS tagging, showing the difficulty in understanding language syntax.	**2**
Practical 8	Implement a top-down parser using a simple CFG.	**2**	Teaches syntactic analysis using CFG and demonstrates the implementation of a top-down parser.	**3, 4**
Practical 9	Use spaCy to perform NER and demonstrate how ambiguity in language can be identified.	**2**	Focuses on handling language ambiguity using NER, highlighting real-world NLP challenges.	**3**
Practical 10	Demonstrate the convolution operation for applying lowpass and highpass filters to an image.	**2**	Understand and implement convolution for image filtering, exploring lowpass and high-pass filters.	**2, 3**
Practical 11	Perform unsupervised classification of an image into clusters based on pixel intensities.	**2**	Perform unsupervised image classification using K-Means clustering, a critical concept in remote sensing.	**3**
Practical 12	Remove random noise from an image using a median filter.	**2**	Apply radiometric corrections by implementing a median filter to reduce random noise in an image.	**3**
Practical 13	Remove random noise from a remote sensing image using a median filter.	**2**	Apply radiometric corrections to remove random noise from remote sensing data.	**3**
Practical 14	Visualize spectral bands (e.g., Red, Green, Blue, and NIR) from a remote sensing image.	**2**	Analyze spectral characteristics by extracting and visualizing individual bands.	**4**
Practical 15	Correct geometric errors in a satellite image using affine transformation.	**2**	Perform geometric corrections using affine transformations to rectify spatial distortions.	**3**

Text Books:

1. Handbook of Artificial Intelligence in Healthcare Vol 2: Practicalities and Prospects CP Lim Vol 2, Springer
2. Artificial Intelligence in Agriculture Rajesh Singh, Anita Gehlot, Mahesh Kumar Prajapat, Bhupendra Singh 1st Edition
3. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition Daniel Jurafsky and James H.Marti Prentice Hall Series in Artificial Intelligence, 2020
4. Digital Image Processing R. C. Gonzalez and R. E. Woods Pearson, India, third edition, 2017.
5. Remote sensing and Image interpretation Lillesand and Keifer John Wiley and Sons, 2000

Reference Books:

1. Natural Language Processing: A Quick Introduction to NLP with Python and NLTK Samuel Burns 2019
2. Introductory digital image processing - A Remote Sensing perspective John R. Jenson Prentice Hall, 1986

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Outline the basic concepts of machine learning and Artificial intelligence.	1, 2, 3 and 8
2	Analyse various AI and ML techniques in expert systems and other machine learning models.	1, 2 and 3
3	Illustration and application of supervised learning in different domains.	1, 2, 3 and 8
4	Application of un-supervised learning in expert systems.	1, 2, 3 and 8
5	Implementation of advanced concepts of AI and ML in emerging filed like Medical and Agricultural sciences.	1, 2, 3 and 8

SEMESTER – IV									
Course Title	**Cyber Security Incident Response Management**								
Course code	**23BCAO229R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T+15P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	Information Security and Cryptosystems	**Co-requisite**	**Computer Networks**						
Program	**Bachelor of Computer Applications**								
Semester	**Winter/ II semester of the second year of the program**								
Course Objectives	1. To understand the principles and practices of managing cyber security incidents 2. To learn how to design, implement, and evaluate an effective Incident Response (IR) plan. 3. To develop skills for identifying, containing, eradicating, and recovering from cyber incidents.								
CO1	Demonstrate an understanding of fundamental concepts of cybersecurity, threat landscapes, and the importance of incident response management in safeguarding organizational assets.								
CO2	Apply techniques for identifying, detecting, and analyzing security incidents, including recognizing patterns of malicious activity and differentiating between false positives and genuine threats.								
CO3	Develop and evaluate incident response plans, policies, and procedures that align with organizational goals and regulatory compliance standards.								
CO4	Utilize appropriate tools and frameworks to investigate, mitigate, and remediate cybersecurity incidents effectively, ensuring minimal disruption to business operations.								
CO5	Analyze post-incident findings to generate reports, improve security policies, and implement measures to prevent future incidents, fostering a proactive cybersecurity posture.								
Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**						**BL**
I	Definition of Cyber Security Incidents, Importance of Incident Response Management, Incident Types and Categories, Incident Response Lifecycle (NIST Framework)	**6**	Understand cyber incidents, their importance, classification, and types; learn to apply the NIST Incident Response Lifecycle for effective preparation, detection, containment, recovery, and post-incident improvements.						**1,2**
II	Developing an Incident Response Plan (IRP), Roles and Responsibilities in IR Teams, Policies, Procedures, and Communication Strategies, Risk Management in Incident Response	**6**	Develop effective IR plans, define team roles, establish policies and communication strategies, and manage risks to ensure efficient incident response.						**2, 3**
III	Tools and Techniques for Incident Detection, Indicators of Compromise (IoCs), Log Analysis and Monitoring, Threat Intelligence and its Role in Detection	**6**	Master tools and techniques for detection, analyze logs and IoCs, and leverage threat intelligence to identify and address incidents effectively.						**3,4**
IV	Containment Strategies (Short-term and Long-term), Malware Analysis and Removal Techniques, Threat Actor Identification, Forensics and Evidence Collection	**6**	Apply containment strategies, conduct malware analysis, identify threat actors, and utilize forensics to collect evidence and mitigate cyber incidents effectively.						**4**
V	System and Data Restoration, Ensuring Security Post-Recovery, Post-Incident Analysis and Reporting, Lessons Learned and Process Improvement Automated and AI-Driven Incident Response, Cloud-Specific Incident Response Challenges, Incident Response in IoT and OT Environments, Threat	**3**	Restore systems and data securely, analyze incidents, generate reports, and apply lessons learned to enhance processes and future incident response. Implement automated, AI-driven responses, address cloud,						**4,5**

	Hunting and Proactive Defense		IoT, and OT challenges, and employ threat hunting and proactive defense strategies.	
Practical				
Practical 1	Introduction to Incident Response Lifecycle	**2**	Understand and apply the phases of the Incident Response Lifecycle.	**3**
Practical 2	Log Analysis and Preprocessing of Data	**2**	Analyze and preprocess logs to extract actionable insights for security.	**4**
Practical 3	Digital Forensics Techniques	**2**	Apply digital forensics techniques to investigate, analyze, and preserve evidence.	**3**
Practical 4	Network Traffic Analysis	**2**	Analyze network traffic to detect anomalies, threats, and ensure security.	**3**
Practical 5	Malware Analysis Basics	**2**	Identify, analyze, and mitigate malware threats using basic analysis techniques.	**4**
Practical 6	Automated Incident Response Tools	**2**	Use automated tools to streamline incident response and improve efficiency.	**3**
Practical 7	Building a Simple Intrusion Detection Model	**2**	Develop and deploy a basic intrusion detection model for security.	**4**
Practical 8	Real-Time Intrusion Detection	**2**	Implement real-time intrusion detection to identify and mitigate security threats.	**5**
Practical 9	Automating Intrusion Response	**2**	Automate intrusion response processes to quickly detect and mitigate threats.	**4, 5**
Practical 10	Incident Containment Strategies	**2**	Implement effective containment strategies to minimize damage and prevent escalation.	**4**
Practical 11	Developing and evaluating an IR Plan	**2**	Design, implement, and evaluate incident response plans for effective management.	**4**
Practical 12	Introduction to Cloud Incident Response Scenarios	**2**	Understand and respond to cloud-based incidents using appropriate response strategies.	**5**

TEXT BOOKS:

T1: "Incident Response & Computer Forensics" by Chris Prosise, Kevin Mandia, and Matt Pepe, Second Edition, McGraw-Hill

T2: "Computer Security Incident Handling Guide" by NIST (SP 800-61 Revision 2)

REFERENCE BOOKS:

R1: "The Art of Incident Response" by Melissa McCarthy

R2: Threat intelligence reports and current cybersecurity news articles.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate an understanding of fundamental concepts of cybersecurity, threat landscapes, and the importance of incident response management in safeguarding organizational assets.	2,3,4,5,6,7,8
2	Apply techniques for identifying, detecting, and analyzing security incidents, including recognizing patterns of malicious activity and differentiating between false positives and genuine threats.	1,2,3,4,5,6,7,8
3	Develop and evaluate incident response plans, policies, and procedures that align with organizational goals and regulatory compliance standards.	1,2,3,4,5,6,7,8
4	Utilize appropriate tools and frameworks to investigate, mitigate, and remediate cybersecurity incidents effectively, ensuring minimal disruption to business operations.	1,2,3,4,5,6,7,8
5	Analyze post-incident findings to generate reports, improve security policies, and implement measures to prevent future incidents, fostering a proactive cybersecurity posture.	2,3,4,5,6,7,8

SEMESTER – IV										
Course Title	**PE – III: Recommender System**									
Course code	**23BCAO2213R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:30T+15P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Fundamental of I/ML**	**Co-requisite**	NIL						
Programme	**Bachelor of Computer Application (BCA)**								
Semester	**Fall / II semester of Second Year**								
Course Objectives	1. To understand the foundations of the recommender system. 2. To learn about content-based and collaborative filtering 3. To learn the significance of machine learning and data mining algorithms for Recommender systems								
CO1	Understand the basic concepts of recommender systems								
CO2	Gain proficiency in Content-Based Recommendation Systems								
CO3	Learn about Collaborative Filtering Techniques								
CO4	Understand security concerns in recommender systems and gain the ability to design attack-resistant recommender systems								
CO5	Learn about evaluating paradigms of recommender systems								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction** Introduction and basic taxonomy of recommender systems , Traditional and non-personalized Recommender Systems, Overview of data mining methods for recommender systems, similarity measures, Dimensionality reduction Singular Value Decomposition (SVD)	**9**	Explain and understand the different data mining methods. Applying SVD in different datasets.	**1, 2, 3**
II	**Content-Based Recommendation Systems** High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.	**9**	Understanding different Content Based Architecture and Apply different retrieval and Classification algorithms.	**2, 3**
III	**Collaborative Filtering** A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighbourhood methods (rating normalization, similarity weight computation, and neighbourhood selection.	**9**	Understanding Collaborative Filtering and Applying in different ways.	**2, 3**
IV	**Attack-Resistant Recommender Systems** Types of Attacks, Detecting attacks on recommender systems Individual attack and Group Attack Strategies for robust recommender design, Robust	**9**	Understanding different attract Resistant system and applying different recommendation Algorithms.	**2, 3**

	recommendation algorithms.			
V	**Evaluating Recommender Systems** Evaluating Paradigms, Online and Offline Evaluation Goals of evaluation design, Design Issues, Accuracy metrics, Limitations of Evaluation measures	**9**	Understanding and Applying Evaluation Recommender Systems and Analyses it with different metrics.	**2, 3, 4**
Practical				
Practical 1	Write a Python Program to implement Item-Based Collaborative Filtering (Using Cosine Similarity)	**2**	Understand and Implement Recommender System Types: Non-personalized: Recommender systems based on item popularity or overall trends.	**2, 3**
Practical 2	Write a Python Program to demonstrate SVD- is used to reduce the dimensionality of the user-item interaction matrix.	**2**	Evaluation Metrics:Learn how to assess recommender systems' effectiveness using. RMSE or other performance metrics.	**2**
Practical 3	Write a Python Program to implement User-Based Collaborative Filtering (Using Cosine Similarity)	**2**	Applications: Practical applications in e-commerce, entertainment (e.g., movie/music recommendations), and content platforms (e.g., news or articles).	**3**
Practical 4	Write a Python Program to **create a Sample Dataset-** This program creates a sample dataset of items with their descriptions and genres.	**2**	Content-Based Recommendation Systems: Understand how content-based recommender systems work by leveraging item attributes such as descriptions.	**2**
Practical 5	Write a Python Program for **Item Profile Representation using TF-IDF-** This program converts item descriptions into numerical vectors using **TF-IDF** (Term Frequency-Inverse Document Frequency).	**2**	Feature Representation: Learn to represent items using TF-IDF and how this can be used to create item profiles.	**2**
Practical 6	**Learning User Profiles Based on Item Ratings-** This program demonstrates how to create a **user profile** by averaging the **TF-IDF vectors** of the items rated by the user.	**2**	Similarity Measures: Understand cosine similarity and how it helps in recommending items based on their similarity to others.	**2**
Practical 7	Write a Python Program to create a sample dataset with **user-item interactions** or ratings to build collaborative filtering models.	**2**	Learn to implement**user-based**and**item-based CF(Collaborative Filtering)** models in Python.	**2, 3**
Practical 8	Write a Python Program to implement user-based collaborative filtering recommends items by identifying similar users based on their rating patterns.	**2**	Apply **hybrid recommender systems**, which combine **content-based** and **collaborative filtering.**	**3**
Practical 9	Write a Python Program to implement Item-based collaborative filtering recommends items based on the similarity between items.	**2**	Apply**cosine similarity**to determine which users or items are most similar to others.	**3**

Practical 10	Create a dataset with user-item ratings, then simulate an attack by injecting fake ratings (shilling attack).	**2**	Understand how to use **clustering** to identify suspicious user groups that might indicate group attacks.	**2**
Practical 11	Apply Group Attack Detection Using User Clustering	**2**	Understand how **weighted averaging** and **robust regression** can make recommendation systems less sensitive to malicious ratings.	**2**
Practical 12	Building Robust Recommender Systems	**2**	Write Program applying techniques like **cosine similarity, K-means clustering**, and **SVD**	**5**
Practical 13	Develop a recommender system	**2**	Analyze the trade-offs involved in choosing between different evaluation methods.	**4**
Practical 14	Compute **RMSE, MAE, Precision, Recall**, and **F1-Score**	**2**	Understand the limitations of standard evaluation metrics and the need for context-based evaluations.	**3**
Practical 15	Implement **A/B testing** can be used in real-world applications to evaluate recommender systems on live users.	**2**	Understand the concept of **conversion rates** and how they can be used to evaluate the success of a recommendation algorithm.	**3**

Text Books:

1. Recommender Systems: The Textbook Charu C. Aggarwal Springer, 2016.
2. Recommender Systems: An Introduction DietmarJannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich Cambridge University Press (2011), 1st ed.

Reference Books:

1. Recommender Systems Handbook Francesco Ricci, Lior Roach, BrachaShapira 1st ed, Springer (2011)
2. Mining of massive datasets Jure Leskovec, AnandRajaraman, Jeffrey David Ullman Cambridge University Press, 2020

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basic concepts of recommender systems	1,2,3, and 8
2	Gain proficiency in Content-Based Recommendation Systems	1,2,3,7, and 8
3	Learn about Collaborative Filtering Techniques	1,2,3,7, and 8
4	Understand security concerns in recommender systems and gain the ability to design attack-resistant recommender systems	1,2,3,7, and 8
5	Learn about evaluating paradigms of recommender systems	1,2,3,7, and 8

SEMESTER – IV									
Course Title	**PE III – IT Governance, Risk & Information Security Management**								
Course code	**23BCAO2214R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T+15P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Fall/ II semester of the second year of the program**								
Course Objectives	1. To help students understand the need for governance in information security 2. To make it possible for students to learn how important concepts of IT governance is integrated with information security 3. To facilitate students to learn key frameworks used in information security and risk management and need for a metrics-based approach for effective information security								
CO1	Analyze and evaluate IT governance principles and their application in aligning IT strategies with business goals, as well as ensuring the security of information systems across an organization.								
CO2	Apply industry-standard frameworks like COBIT, Val-IT, and Risk-IT for developing and managing effective IT governance and risk management strategies that support information security and organizational objectives.								
CO3	Design and develop security strategies that integrate business objectives with IT and security initiatives, ensuring a robust security posture within the organization.								
CO4	Implement risk management programs using structured processes and frameworks to identify, assess, and mitigate risks, ensuring strategic decision-making for IT and information security management.								
CO5	Evaluate and improve information security management programs, leveraging continuous assessment and frameworks such as COBIT to optimize security performance and ensure compliance across organizational levels.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**IT Governance-Part 1** Introduction & Concepts, Origin of Governance, Corporate Governance, Best Practices for IT Governance, Role of Governance in Information Security, Six outcomes of effective Security Governance, benefits of good governance, Cultural aspects in governance.	**8**	Define IT governance concepts, evaluate corporate governance practices, analyze the role of governance in information security, and examine the cultural aspects and benefits of good governance in ensuring effective security outcomes.	1,3, 6
II	**IT Governance-Part 2** IT Governance-Roles and Responsibilities, Role of IT Strategy Committee and Security Steering Committee, Standard IT Balanced Scorecard. Val-IT framework of ISACA, Governance in multi-department and multi-country enterprises, Importance of Governance in establishing a sustainable Security Culture in the organization	**10**	Demonstrate roles and responsibilities in IT governance, apply governance frameworks like Val-IT and the IT Balanced Scorecard, and analyze the impact of governance in establishing a sustainable security culture across multi-departmental and multi-country enterprises.	3,4
III	**Information Systems Strategy** Role of Strategic Planning for IT, Strategic Direction and Alignment of Security Strategy with Business Objectives, Role of CISO, Security Metrics Program.	**8**	Design IT strategies aligned with business objectives, examine the role of CISO in strategic planning, and develop security metrics programs to measure the effectiveness of information security strategies.	3,4, 5
IV	**Risk Management Program** Develop a Risk Management Program. Risk Management Process, Roles and Responsibilities, Risk-IT Framework of ISACA, Strategic Security decisioning using Risk	**6**	Develop and implement a risk management program, apply the Risk-IT framework of ISACA, and make strategic security decisions based on comprehensive risk	3,5

	Management		analysis and management processes.	
V	**Information Security Management** Introduction, Performance Optimization, Management Information Security Forum, Segregation of Duties, Description of COBIT and other Frameworks, Security Program Effectiveness, Continuous Assessment and Improvement, In-sourcing versus Out-sourcing, Impact of ISM program across organization	**5**	Manage information security programs, evaluate the effectiveness of security measures, implement continuous improvement processes, and assess the impact of ISM programs across organizations.	3,5, 6
Practical Component – NIL				

Text Books:

T1. Information Security Governance by S.H. Solms, RossouwSolms, Springer; 1st Edition. 2nd Printing, 2008 edition (12 December 2008)

T2. IT Governance: How Top Performers Manage IT Decision Rights for Superior Results by Weill, Harvard Business Review Press; First edition (1 June 2004)

T3.ISACA publications

Reference Books:

R1. IT Governance: An International Guide to Data Security and ISO27001/ISO27002 by Alan Calder, Steve Watkins, Kogan Page; 6 edition (3 September 2015)

R2. ISACA publications on COBIT, RiskIT and ValIT

R3. Information Security Governance: Guidance for Information Security Managers by W. KragBrotby and IT Governance Institute, Isaca (2 June 2008)

R4. COBIT 5 Framework Perfect by Isaca, (10 April 2012)

R5. Cobit 5 Foundation-reference and Study Guide by Ana Cecilia Delgado, Create Space Independent Publishing Platform; Stg edition (20 June 2016)

R6. Governance of Enterprise IT Based on COBIT 5: A Management Guide by Geoff Harmer (Author), IT Governance Publishing, (6 February 2014)

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Analyze and evaluate IT governance principles and their application in aligning IT strategies with business goals, as well as ensuring the security of information systems across an organization.	1,2,3,4,5,6,7,8
2	Apply industry-standard frameworks like COBIT, Val-IT, and Risk-IT for developing and managing effective IT governance and risk management strategies that support information security and organizational objectives.	1,2,3,4,5,6,7,8
3	Design and develop security strategies that integrate business objectives with IT and security initiatives, ensuring a robust security posture within the organization.	1,2,3,4,5,6,7,8
4	Implement risk management programs using structured processes and frameworks to identify, assess, and mitigate risks, ensuring strategic decision-making for IT and information security management.	1,2,3,4,5,6,7,8
5	Evaluate and improve information security management programs, leveraging continuous assessment and frameworks such as COBIT to optimize security performance and ensure compliance across organizational levels.	1,2,3,4,5,6,7,8

SEMESTER – IV									
Course Title	**BASIC ACCLIMATIZING SKILLS (BAS)**								
Course code	**23UULS221R**	**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	**All the Under Graduate Programmes**								
Semester	**Fall/I or Winter/II Semester of Second Year of the Programme**								
Course Objectives	1. To impart knowledge of the fundamentals of Hospitality industry and its applications. 2. To familiarize with the cooking equipment& Utensils. 3. 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 households amenities for day- to-day use.								
CO5	Understand the importance of time management and organization in acclimatizing to new academic demands.								

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.	**7**	Describe, illustrate, and explain cell organization and functions, microscopy, and structural differences.	1,2
II	**Fundamentals of Cooking**: Definition of cookery –Aim & Objectives of cooking, Use of basic Cooking equipment, Personal Hygiene and Safety, Use of Fire & Fuels	**10**	Describe, illustrate, and explain membrane structure, function; cell organization, and the proteins involved in transportation.	1,2
III	**Methods of Cooking:** Different Cuts. Use of Herbs and Spices. Basic Food and Beverage Preparation. Regional food Habits	**10**	Describe, illustrate, and explain chromosomal structure and types.	1,2
IV	**Forms & Format's**: C –form Reservation form Registration form Passport Application form Legal Rent Agreement	**8**	Describe, illustrate, and explain the mechanism of cell-to-cell communication	1,2
Practical	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).	**30**	Describe, illustrate and explain and apply staining techniques and carry out microscopic examination.	1,2,3,4

TEXT BOOKS:

T1 Arora K (2011). Theory of cookery, Frank brothers & company (pub) pvtltd-New Delhi.

T2 Bruce H. Axler, Carol A. Litrides (2010) Food and Beverage Service Volume 1 ofWiley Professional Restauranteur, Guides.

T3 Mohammed Zulfikar (2010) - Introductions to Tourism and Hotel Industry Introduction to Tourism and Hotel Industry. Vikas Publishing.

T4 Sudhir Andrews (2013) Food and Beverage Service: A Training Manual, Tata McGraw Hill, 2013.

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%20Biolpgy

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Able to explain the fundamentals and advances of cytology including structure and functions of cell and cell organelles.	1,3 & 4
2	Able to explain the cell cycle and cell division.	1,2
3	Learn and develop skills for operating microscope, preparing slides by various staining techniques	7.9,10
4	Apply knowledge of cellular processes to explain how cells operate and interact within living organisms.	5,7
5	Demonstrate a comprehensive understanding of cell structure and function.	5,8

SEMESTER – IV									
Course Title	**Generic Elective II (Strategy of Content Marketing)**								
Course code	**23BCAO002R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**BCA**								
Semester	**Fall /II Semester of Second Year of the Programme**								
Course Objectives	1. To understand the fundamental strategies used in content marketing for acquiring and retaining customers. 2. To develop, organize, and implement effective content marketing strategies. 3. To analyze and measure the effectiveness of content marketing efforts. 4. To learn the principles of writing compelling and strategic copy.								
CO1	Explain core content marketing strategies and their role in customer acquisition and retention.								
CO2	Develop a comprehensive content marketing strategy tailored to specific business goals.								
CO3	Organize and implement content marketing plans effectively.								
CO4	Analyze content marketing performance using appropriate metrics and tools.								
CO5									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	The Content Marketing Ecosystem	**3**	Understanding Content Marketing Fundamentals, Components of the Content Marketing Ecosystem, Audience Research and Persona Development, Content Strategy Development, Content Creation and Storytelling, Content Curation, Content Distribution and Promotion, SEO and Content Optimization, Content Measurement and Analytics, Content Marketing Technology and Tools, Trends and Best Practices.	2
II	The Strategic Context (The 7A Framework)	**3**	Understanding the Content Marketing Ecosystem, 7A Framework, Integration of the 7A Framework.	1,3
III	Mapping the Journey: Crafting a Content Marketing Strategy	**6**	Understanding the Importance of a Content Marketing Strategy, Conducting Audience Research, Setting Clear Objectives and Goals, Content Audit and Gap Analysis, Developing a Content Plan, Creating Engaging and Valuable Content, Content Distribution and Promotion, Utilizing Content Management Tools and Platforms, Measuring and Analyzing Performance, Optimizing and Refining the Strategy, Developing a	3,4

			Content Calendar.	
IV	The Strategic Types of Content	**6**	Advanced Technical Proficiency, Professional Communication, Project Management, Problem-Solving and Critical Thinking, Team Collaboration, Industry Awareness, Ethical and Professional Responsibility, Career Preparation.	2,4

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain core content marketing strategies and their role in customer acquisition and retention.	1,2,3,5,6,7,8
2	Develop a comprehensive content marketing strategy tailored to specific business goals.	1,2,3,5,6,7,8
3	Organize and implement content marketing plans effectively.	1,2,3,5,6,7,8
4	Analyze content marketing performance using appropriate metrics and tools.	1,2,3,5,6,7,8

SEMESTER – IV									
Course Title	**MOOCS IV (RECOVERING THE HUMANKIND'S PAST AND SAVING THE UNIVERSAL HERITAGE)**								
Course code	**23MOSY221R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ IV semester of the third year of the program**								
Course Objectives	1. To provide students with an understanding of the historical development of archaeology and its contemporary significance, including major revolutions in the field such as New Archaeology and Processual Archaeology. 2. To equip students with knowledge of archaeological methods and tools for recovering material remains and constructing chronologies, and to understand the role of historical sources in shaping archaeological research. 3. To introduce students to the methodologies and techniques of 3D digital acquisition and reconstruction, enabling them to create digital models and virtual reconstructions of cultural heritage objects.								
CO1	Comprehend the historical development of archaeology, including the birth of New Archaeology and Processual Archaeology, and the integration of scientific methods into the field.								
CO2	Analyze various archaeological methods and tools used for recovering material remains, conducting surface surveys, and constructing chronologies.								
CO3	Apply 3D acquisition and reconstruction techniques to create digital models of cultural heritage objects and understand their role in preservation and communication.								
CO4	Evaluate techniques for managing and structuring digital data on cultural objects, utilizing frameworks like the European Data Model to organize and enrich information.								
CO5	Design and propose strategies for the protection and preservation of cultural heritage, considering principles of heritage equality and the role of international organizations in mitigating threats.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**The recovery of the human past and the protection of the universal heritage.The birth of archaeology and its role in the contemporary world:** The study of the past of the planet marked the first serious reflections on humankind's past, although archaeology was in fact considered the practice to collect objects. "New Archaeology" represents the first major revolution, promptly followed by the more structured and aggressive "Processual Archaeology". The opening towards different disciplines implied the "loss of innocence" for archaeology, bringing at the same time scientific methods into the reconstructions of the past.	**3**	Describe the development of archaeology from its origins to contemporary practices, and understand how the integration of scientific methods has revolutionized the field.	2
II	**The birth of archaeology and its role in the contemporary world:** Material remains of the past and their state of recovery vary according also to environments. Surface surveys lead to a more intense knowledge of territories, visualizing archaeologicallandscapes in a variety of ecological situations. The objectives of archaeological research have been moulded in the historical	**3**	Analyze the methods and tools used in archaeology to recover material remains and construct chronologies, and evaluate the influence of historical sources on archaeological research.	4

	development of the discipline. Historical sources have always been a sourceof inspiration for research, opening new problems. Chronology is a construct depending on dating tools, and scientific methods have been employed in determining an absolute chronology.			
III	**Digitalizing Cultural objects and 3D virtual reconstruction:** In this module, Emanuel Demetrescu will explain us the last methodologies and techniques in the field of 3D acquisition and reconstruction of cultural heriatage. These applications improve the knowledge and preservation and have a central role in the way we can communicate cultural heritage to the society. Making digital copies from real objects now has several very fun and precise technologies that are also available to everybody at very low cost budget. Demetrescu will show us how to use these tools to make our own models and share them with others. The virtual reconstruction of no-more-exstant objects (like a lost temple) will be the argument of the last part of the module: a state of the art of the methodologies will help us to understand how to approach such a process from a scientific point of view (archaeological method)	**3**	Apply 3D acquisition and reconstruction techniques to create digital models of cultural heritage objects and share these models for educational and preservation purposes.	3
IV	**Digitalizing Cultural objects and 3D virtual reconstruction:** In this module, Andrea Vitaletti will show us the basic techniques to effectively manage the unprecedented amount of digital contents on cultural objects nowadays offered by cultural heritage providers. Raw data, need to be organized in structured information in order to effectively support advanced functionalities, such as indexing and searching. We will present the basic techniques to structure the data in order to facilitate the access to digital contents and we will focus on the European Data Model, a framework for collecting, connecting and enriching data on cultural objects provided by a number of museum, archives, sites and libraries in Europe.	**3**	Evaluate the effectiveness of different techniques for managing and structuring digital data on cultural objects, and use the European Data Model to organize and enrich cultural heritage information.	6
V	**Digitalizing Cultural objects and 3D virtual reconstruction:** This module deals with some basic issues and principles. All heritages are “equal among them”. Heritages are a property of humankind and not of the single countries. Heritages need to be protected	**3**	Design and propose strategies for the protection and preservation of cultural heritage, considering international principles and the role of international organizations in mitigating	5

	and preserved in their context. But many threats are posed to heritages: illegal digging is a serious risk, as well as actions due to hatred for the "other" and his heritage. As a consequence of what stated above, damages to heritage are a crime against all humankind. International Organizations are engaged in protecting the heritage, the future of which represents a contribution to dialogue and peace.		threats.	

Other Learning Resources:

- Coursera

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Comprehend the historical development of archaeology, including the birth of New Archaeology and Processual Archaeology, and the integration of scientific methods into the field.	2,3,4,5,6,8
2	Analyze various archaeological methods and tools used for recovering material remains, conducting surface surveys, and constructing chronologies.	2,3,4,5,6,7,8
3	Apply 3D acquisition and reconstruction techniques to create digital models of cultural heritage objects and understand their role in preservation and communication.	2,3,4,5,6,7,8
4	Evaluate techniques for managing and structuring digital data on cultural objects, utilizing frameworks like the European Data Model to organize and enrich information.	2,3,4,5,6,7,8
5	Design and propose strategies for the protection and preservation of cultural heritage, considering principles of heritage equality and the role of international organizations in mitigating threats.	2,3,4,5,6,7,8

SEMESTER – IV									
Course Title	**ENGLISH FOR EMPLOYABILITY (Communicative English, Soft Skills & Logical Reasoning)**								
Course code	**23UBPD222R**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30P	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	English Language for Excellence	**Co-requisite**	**Nil**						
Programme	**All the UnderGraduate Programmes**								
Semester	**Fall /II Semester of Second Year of the Programme**								
Course Objectives	1. To familiarize students with Public Speaking and helping them overcome stage fear. 2. To enhance the writing skills in different areas including CV and cover letter writing. 3. To enable students, know about the email etiquettes and draft professional emails.								
CO1	Develop skills in script preparation and understand nonverbal communication pivotal to effective public speaking.								
CO2	Improve student's ability in drafting clear, concise, and effective emails.								
CO3	Master the creation, submission, and understanding of screening processes for resumes.								
CO4	Bulid conflict management skills within themselves.								
CO5	Plan efficiently for discussions in different platforms by enhancing their thought process and problem-solving skills								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Public Speaking:** 1.Preparation of Scripts and understanding Nonverbal cues of Public Speaking 2.Understanding and Overcoming Fear of Public Speaking 3.Practice strategies of Public Speaking Pipe and cistern i. Introduction of pipes and cistern ii. Solving different types of questions	**10**	Understand and overcome the fear of public speaking, and practice strategies to improve their delivery and confidence.	1,2
II	**Practical session on Resume and Cover letter:** i. Preparation, submission & screening of Resume. ii. Practical session on cover letter screening session Mixture allegation and Clock i.Introduction of basics ii. Solving questions on mixture	**10**	Students will master the creation, submission, and understanding of screening processes for resumes.	2,3
III	**Email Etiquettes** I. Different Parts of Email and Usage ii.Drafting emails effectively Statement and Course of action i. Revision of syllogism ii. Statement and conclusion Iii. Course of action based on statement	**15**	Identify, address, and resolve conflicts effectively, enhancing their ability to maintain positive and productive relationships in both personal and professional settings.	1,2,3
IV	**Interview Skills (Mock sessions)** I. Preparing Commonly asked Interview Questions ii.Mock Interview sessions Sitting	**15**	Familiarity with Common Interview Questions, Practice in Answering Interview Questions, Feedback and	2,3

	arrangement (puzzle) i. Linear arrangement puzzle ii. Circular arrangement puzzle iii. Matrix		Improvement, Building Confidence, Understanding Sitting Arrangement Puzzles, Enhancing Logical Reasoning Skills, Teamwork and Collaboration, Preparedness for Assessment Tests	
V	**Conflict Management** i. Definition ii. Type of Conflict Management iii. Effects of Conflict Management Profit loss and discount i. Introduction to basics ii. Introduction to discount iii. Probems related on the topic	**10**	Understand what conflict management entails, including the identification, resolution, and mitigation of conflicts in various contexts, concepts related to profit and loss, including revenue, costs, profit margin, concept of discounting, including types of discounts and their significance in pricing strategies.	1,2,3,4

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)

T3 Professionalism Skills for Workplace Success, Lydia E. Anderson, Sandra B. Bolt, Publisher: Pearson Education

T4 The Art of Public Speaking, Dale Carnegie, Publisher:Diamond Pocket Books Pvt Ltd

T5 English for Academic CVs, Resumes, and Online Profiles, Adrian Wallwork, Publisher:Springer International Publishing

T6 Employment & Volunteering: Job Interview Basics, Lisa Renaud, Publisher:Classroom Complete Press

REFERENCE BOOKS:

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

R4 Real-resumes for Teachers, Anne McKinney, Publisher:Prep Pub.

R5 Public Speaking for Success, Dale Carnegie, Publisher:Penguin Publishing Group

R6 Job Interview Skills , Paige Labert, Publisher:DiDioCalderoneGiuseppina

R7 Dressology: The Science of Power Dressing, Nandita Pandey, Publisher:Pan Macmillan

R8 The Anatomy of Peace: Resolving the Heart of Conflict (Paperback) by The Arbinger Institute

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	Develop skills in script preparation and understand nonverbal communication pivotal to effective public speaking.	1,3 & 4
2	Improve student's ability in drafting clear, concise, and effective emails.	1,2
3	Master the creation, submission, and understanding of screening processes for resumes.	7.9,10
4	Bulid conflict management skills within themselves.	5,7
5	Plan efficiently for discussions in different platforms by enhancing their thought process and problem-solving skills	5,8

SEMESTER – IV									
Course Title	**Computational Systems and Digital World**								
Course code	**23UCDL221R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 15P	**0**	**0**	**2**	**0**	**0**	**0**	**1**
Pre-requisite		**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Fall / II semester of the second year of the program**								
Course Objectives	1. To understand the fundamentals of computer systems and Internet search along with advanced features of Ms Office. 2. To learn data management, statistical analysis and visualization. 3. To use social media and e-commerce portals, Digital Payment systems, and other utility software.								
CO1	Basic understanding of computer systems and internet search.								
CO2	Solve data analysis, management and visualization issues using Ms Office products.								
CO3	Efficiently and ethically use social media and e-commerce sites.								
CO4	Introduction to various utility software used in research and information management.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Fundamentals of Computer Systems, Office Automation and Internet Search:** Components of a computer and their functions; Office automation using Ms Word, Ms Excel, and Ms PowerPoint; Data management, statistical data analysis and data visualization with Ms Excel; Use of functions, graphs, and charts in Ms Excel.	**4**	Understand the components of computers and its functions. Apply the knowledge of different Ms Office for different real-world problem.	**2,3**
II	**Internet and Cyber World:** Introduction to computer networks, internet and world wide web, websites and web portals; Creation and use of email accounts; Web browsing, web searching, different aspects of web searching – search keyword, conditions and combinations; Study different search engines like Google, Microsoft Bing, Yahoo, Yandex, DuckDuckGo, Ask.com, etc; Cyber Crimes, cyber laws and IT Act 2000, India.	**4**	Understanding the basics of Computer network, internet and WWW. Creating email accounts for different purpose. Understanding the search engine and study the different search engines.	**2, 3, 5**
III	**Introduction to Social-Media and E-Commerce:** Relevance of Social-Media in present scenario. Posting different types of contents in Social-Media; Creating accounts and using some popular social media portals and Apps like WhatsApp, Facebook, etc. Social Media etiquettes and crimes; Definition of e-commerce, e-commerce versus traditional commerce; Cast studies of popular e-commerce portals like Amazon; E-commerce etiquettes and crimes.	**4**	Understand what social-media is, and what is the impact of social media on different field. Creating social-media account of different platforms. Understanding e-commerce and case studying on popular e-commerce portals.	**2,3,5**
IV	**Digital payments and Digital Transactions:** Introduction to digital payment systems; Creating accounts and using Digital Payment Systems like Credit Cards, Debit Cards, Net banking, UPI; Digital payments etiquettes and crimes.	**4**	Understand the process if digital payment and transactions system. Creating an account for digital payment.	**2, 3, 5**

V	**Basic Accounting and Utility Software:** Introduction to Basic accounting concepts; Introduction to an Accounting Software like GnuCash or Tally; Introduction to Technical Document writing using LaTex; Introduction to Data Visualization software – Sigma, Google Charts, Tableau.	**4**	Equips you with basic accounting principles, accounting software usage, technical document writing with LaTex, and data visualization tools for practical application.	**2,3,5**
Practical				
Practical 1	Create a new document with Ms Word, save it with the name "*Student_Name*" in the Documents folder. Formatting text, paragraph alignment.	**1**	Create, save, and format documents in Ms Word, including text formatting and paragraph alignment.	**5**
Practical 2	Creating tables, inserting shapes and images. Creating profile with description and wrapping the images.	**1**	Create tables, insert and format images and shapes in Ms Word documents. Design a profile with a description and incorporate image wrapping for a visually appealing layout.	**5**
Practical 3	Using mail merge, creating documents with existing templates, enable track changes.	**1**	Utilize mail merge in Ms Word to create personalized documents from existing templates. Enable track changes functionality for collaborative document editing in Ms Word.	**5**
Practical 4	Create a simple document with title, author, and body text. Learn basic text formatting options like bold, italic, and underline.	**1**	Create a basic LaTex document with proper structure. Gain control over text appearance and presentation in your document.	**5**
Practical 5	Structure your document with sections and subsections. Learn how to write mathematical equations in LaTex.	**1**	Organize your document for better readability and navigation. Represent mathematical expressions clearly in your document.	**5**
Practical 6	Creating a presentation with Ms PowerPoint, adding and formatting text	**1**	Create presentations in Ms PowerPoint by adding and formatting text content.	**5**
Practical 7	Applying slide layouts, using transitions, inserting and formatting shapes.	**1**	Apply various slide layouts and transitions for visually engaging presentations in MS PowerPoint. Insert and format shapes effectively in MS Power Point presentations.	**5**
Practical 8	Creating and managing animations, using slide master, embedding and linking media.	**1**	Create and manage animations in Ms PowerPoint presentations to enhance visual impact. Utilize the slide master feature in Ms PowerPoint to maintain consistent formatting across slides.	**5**
Practical 9	Creating new excel file, entering data, formatting cells, using basic formulas.	**1**	Create and manage spreadsheets in Ms Excel by entering and formatting data. Utilize basic formulas in Ms Excel for calculations.	**3, 5**
Practical 10	Creating and formatting table, using functions like VLOOKUP, IF,	**1**	Create and format tables in Ms Excel for organized data	**5**

	CONCATENATE, etc.		presentation. Utilize advanced formulas like VLOOKUP, IF, and CONCATENATE in Ms Excel for complex calculations and data manipulation.	
Practical 11	Creating and inserting graphs using different kind of data.	**1**	Create and insert various charts and graphs to visually represent data in Ms Excel.	**5**
Practical 12	Use of advanced formulas, data validation, pivot tables, macros, and automation.	**1**	Utilize advanced formulas in Ms Excel, including data validation for error prevention. Create pivot tables in Ms Excel for data summarization and analysis. Gain an introduction to macros and automation for repetitive tasks in Ms Excel.	**5**
Practical 13	Exploration on search engines, how it works and so on.	**1**	Understand the basic principles of how search engines work and explore techniques for effective online searching.	**2**
Practical 14	Creating a social media account, e-commerce websites, etc. Upload images, videos, exploring the e-commerce websites and learning about etiquette and crimes.	**1**	Create social media accounts and navigate e-commerce websites. Understand online etiquette for responsible interactions on social media platforms. Be aware of potential crimes associated with social media and e-commerce platforms.	**5**
Practical 15	Creating an account in any platform for digital payments and learning about digital payment etiquettes and crimes.	**1**	Create accounts for digital payments. Understand safe practices for online transactions and be aware of potential digital payment crimes.	**5**
Practical 16	Learn how to create basic tables in LaTex.	**1**	Present tabular data in a well-organized manner.	**5**

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
- Latest updates available in WWW.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Basic understanding of computer systems and internet search.	2
2	Solve data analysis, management and visualization issues using Ms Office products.	2,3
3	Efficiently and ethically use social media and e-commerce sites.	2,3
4	Introduction to various utility software used in research and information management.	2

SEMESTER – IV									
Course Title	**Extra-Curricular Activity**								
Course code	**23UBEC221**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**4**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Applications**								
Semester	**Fall/ II semester of the second year of the program**								
Course Objectives	1. To develop problem-solving abilities through coding challenges and hackathons. 2. To participate in app development contests and exhibitions. 3. To develop entrepreneurial skills and mindset.								
CO1	Importance of different activities under different clubs.								
CO2	Formulate regular activities like workshops, competitions as per their interest and hobbies.								
CO3	Adapt to represent ADTU in various inter university, state and national level competitions.								
CO4	Discuss with invited experts in their respective fields.								
CO5	Develop an appreciation for diverse forms of artistic expression.								
Unit-No.	**Content**		**Contact Hour**	**Learning Outcome**					**KL**
I	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 the platform to learn from experts.		**2**	Demonstrate improved proficiency in programming, software development, and the use of various technological tools and platforms. Apply theoretical knowledge to real-world problems through projects, internships, and industry collaborations.					**1,2,3,4**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Students engagement in different activities under different clubs.	2,3,4,5,6,7
2	Role play in regular activities like workshops, competitions as per their interest and hobbies.	2,3,4,5,6,7
3	Adapt and trained to represent ADTU in various inter university, state and national level competitions.	2,3,4,5,6,7,8
4	The students will be given a platform to earn from invited experts in their respective fields.	2,3,4,5,6,7,8
5	Develop an appreciation for diverse forms of artistic expression.	2,3,5,6,7,8

<table>
<tr><th colspan="9">SEMESTER – IV</th></tr>
<tr><td>Course Title</td><td colspan="8">MINI PROJECT-II</td></tr>
<tr><td rowspan="2">Course code</td><td rowspan="2">23BCAO227R</td><td rowspan="2">Total credits: 1</td><td>L</td><td>T</td><td>P</td><td>S</td><td>R</td><td>O/F</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>4</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td>Nil</td><td>Co-requisite</td><td colspan="6">Nil</td></tr>
<tr><td>Programme</td><td colspan="8">Bachelor of Computer Application</td></tr>
<tr><td>Semester</td><td colspan="8">Fall/ II semester of the second year of the program</td></tr>
<tr><td>Course Objectives</td><td colspan="8">1. To develop the knowledge, skills and attitudes of a professional Computer Application professional.
2. To become confident in designing Software solutions to complex software problems utilising a systems approach.
3. Develop a deep understanding of computer applications to enhance professional knowledge, skills, and attitudes necessary for the field.</td></tr>
<tr><td>CO1</td><td colspan="8">Demonstrate a sound technical knowledge of their selected project topic.</td></tr>
<tr><td>CO2</td><td colspan="8">Undertake problem identification, formulation and solution.</td></tr>
<tr><td>CO3</td><td colspan="8">Design Software solutions to complex problems utilising a systems approach.</td></tr>
<tr><td>CO4</td><td colspan="8">Communicate with the community at large in written an oral-forms.</td></tr>
<tr><td>CO5</td><td colspan="8">Demonstrate the knowledge, skills and attitudes of a Computer Application or IT professional.</td></tr>
<tr><td>Unit-No.</td><td colspan="3">Content</td><td>Contact Hour</td><td colspan="3">Learning Outcome</td><td>KL</td></tr>
<tr><td>I</td><td colspan="3">This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor.
Students will be required to:
6. Perform a literature search to review current knowledge and developments in the chosen technical area;
7. Undertake detailed technical work in the chosen area using one or more of:
• theoretical studies
• computer simulations
• hardware construction;
8. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project;
9. Deliver a seminar on the general area of work being undertaken and specific contributions to that field;
10. Prepare a formal report describing the work undertaken and results obtained so far; and
Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.</td><td>90</td><td colspan="3">Analyze current knowledge through a comprehensive literature review in a chosen technical field, apply advanced methods like theoretical studies, computer simulations, and hardware construction. Synthesize findings into progress reports and professional journals, evaluate and present these findings in seminars, and demonstrate practical outcomes through poster presentations and operational demonstrations.</td><td>3, 4, 5</td></tr>
</table>

OTHER LEARNING RESOURCES:

As given by Project supervisor.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Students will be able to demonstrate a sound technical knowledge of their selected project topic.	1, 2, 4
2	Students will be able to undertake problem identification, formulation, and solution.	1, 3
3	Students will be able to design Software solutions to complex problems utilising a systems approach.	2, 3, 5, 7
4	Students will be able to communicate with the community at large in written an oral forms.	2, 3, 5, 6, 7
5	Demonstrate the knowledge, skills and attitudes of a Computer Application or IT professional.	1, 2, 3, 7

SEMESTER – V									
Course Title	**ADVANCE APPLICATION DEVELOPMENT**								
Course code	**23BCAO311R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T+15P	**2**	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Winter / V semester of the third year of the program**								
Course Objectives	1. To understand the MERN stack for application development. 2. To develop full-stack proficiency for front-end and back-end development. 3. To create RESTful APIs to handle requests and responses.								
CO1	Understanding the concept of MERN stack.								
CO2	Create RESTful APIs using Express.js.								
CO3	Implementing authorization and authentication using JWT.								
CO4	Creating UI and responsive design using React.js								
CO5	Implementing authorization and authentication in an application.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**Introduction to MERN Stack:** Introduction to Full-Stack Development - Overview of MERN Stack components (MongoDB, Express.js, React.js, Node.js) - Setting up development environment with Node.js and package managers (npm/yarn)	**8**	This unit lays the groundwork for the MERN stack by establishing a foundational understanding of full-stack development, exploring the core components (MongoDB, Express.js, React.js, Node.js), and setting up the development environment.	**1,2**
II	**Databases and MongoDB and JavaScript Deep Dive:** Introduction to database concepts (relational vs. NoSQL) - MongoDB fundamentals (data models, documents, collections) - Connecting to MongoDB from Node.js applications - Mongoose ODM (Object Data Modeling) for MongoDB; Advanced JavaScript concepts (ES6+, closures, modules), Asynchronous programming (promises, async/await), Introduction to DOM manipulation and event handling	**12**	This unit dives deeper into data management, exploring relational vs. NoSQL concepts, the fundamentals of MongoDB (data models, documents, collections), and connecting to it from Node.js applications using Mongoose ODM. Additionally, students will solidify their grasp of advanced JavaScript features (ES6+, closures, modules) and asynchronous programming (promises, async/await) while gaining an introduction to DOM manipulation.	**2,3**
III	**Building User Interfaces with React.js:** Introduction to React components (functional, class-based) - JSX syntax and component lifecycle - State management with React hooks (useState, useEffect); Introduction to routing and user authentication	**12**	This unit focuses on building interactive user interfaces with React.js. Students will learn to create reusable components (functional and class-based), work with JSX syntax and the component lifecycle, manage application state effectively using hooks (useState, useEffect), and gain a basic understanding of routing and user authentication in React applications.	**2,3**

V	**Backend Development with Node.js & Express.js:** Introduction to Node.js and server-side programming concepts - Building RESTful APIs with Express.js - Connecting to MongoDB databases using Mongoose ODM; Implementing user authentication and authorization.	**12**	This unit delves into server-side development using Node.js and Express.js. Students will learn to build RESTful APIs, connect Node.js applications to MongoDB databases with Mongoose ODM, and implement user authentication and authorization mechanisms to secure their backend applications.	**3,4**
V	**Deployment and Project Development:** Testing strategies for web applications (unit testing, integration testing); Deployment considerations and options (cloud platforms); Introduction to CI/CD pipelines.	**10**	Explore testing strategies (unit testing, integration testing), evaluate deployment considerations (cloud platforms), gain an introduction to CI/CD pipelines, and culminate the course by developing a full-stack web application using the MERN stack, demonstrating their ability to apply the learned concepts to real-world development.	**3,5**

Practical

Practical	Content	Contact Hour	Learning Outcome	KL
Practical 1	Install Node.js and npm/yarn on your machine. Create a simple "Hello World" application using Node.js. Initialize a new Node.js project using npminit or yarn init. Install a few packages (e.g., lodash) and demonstrate their usage in your project.	**2**	Learn to install Node.js and npm/yarn, and initialize a Node.js project.	**3**
Practical 2	Set up a basic folder structure for a MERN stack application. Create a server.js file to serve as the entry point for your Node.js server. Set up a simple Express server with a few routes (/, /about, /contact).	**2**	Understand the basic folder structure for a MERN stack application and set up an Express server.	**3**
Practical 3	Create a RESTful API using Express.js with endpoints for GET, POST, PUT, and DELETE operations. Use middleware to handle errors and log requests.	**2**	Develop a RESTful API with Express.js, handling various HTTP operations and middleware.	**5**
Practical 4	Install MongoDB and set up a local database. Create a collection and insert a few documents using the MongoDB shell.	**2**	Install and set up MongoDB, and perform basic operations using the MongoDB shell.	**3**
Practical 5	Write a few ES6+ features like arrow functions, template literals, and destructuring.	**2**	Apply modern JavaScript features such as arrow functions, template literals, and destructuring.	**3**
Practical 6	Create a Node.js application that connects to a MongoDB database.	**2**	Create a Node.js application that connects to MongoDB	**3**

	Perform basic CRUD operations using Mongoose ODM.		and performs CRUD operations using Mongoose.	
Practical 7	Write functions using promises and async/await for asynchronous operations. Manipulate the DOM using vanilla JavaScript to create a simple interactive page.	**2**	Write asynchronous functions with promises and async/await, and manipulate the DOM with JavaScript.	**3**
Practical 8	Define complex data models with relationships (e.g., user and posts). Implement advanced queries and data validation using Mongoose.	**2**	Define complex data models and implement advanced queries with Mongoose.	**5**
Practical 9	Create a small project demonstrating closures, modules, and event handling.	**2**	Demonstrate JavaScript concepts like closures and modules through a small project.	**5**
Practical 10	Set up a new React project using Create React App. Create functional and class-based components. Write components using JSX. Implement component lifecycle methods in class-based components.	**2**	Set up a React project, create components, and manage component lifecycle methods.	**3**
Practical 11	Use React hooks like useState and useEffect to manage state and side effects. Create a simple form with state management.	**2**	Manage state and side effects in React using hooks like useState and useEffect.	**3**
Practical 12	Implement routing in your React application using react-router-dom.	**2**	Implement routing in a React application using react-router-dom.	**3**
Practical 13	Manage complex state using context API or state management libraries like Redux. Implement user authentication and conditional rendering based on user state.	**2**	Manage complex state and implement user authentication in a React application.	**3**
Practical 14	Design and implement reusable components with proper props and state management.	**2**	Design and implement reusable components with proper props and state management.	**5**
Practical 15	Set up a basic Express server with routes for different HTTP methods. Create middleware for request logging.	**2**	Set up an Express server with various HTTP method routes and create middleware for logging.	**3**
Practical 16	Develop a RESTful API with endpoints for creating, reading, updating, and deleting resources. Connect the API to a MongoDB database using Mongoose. Implement user authentication using JWT (JSON Web Tokens).	**2**	Develop a RESTful API connected to MongoDB and implement user authentication using JWT.	**5**
Practical 17	Implement user authorization and role-based access control. Create and handle complex query parameters and request validation.	**2**	Implement user authorization and role-based access control in an API.	**5**
Practical 18	Write unit and integration tests for your API using testing libraries like Mocha or Jest.	**2**	Write unit and integration tests for APIs using testing libraries like Mocha or Jest.	**6**
Practical 19	Develop a full-fledged MERN stack application with user authentication, data validation, and complex state	**4**	Develop a comprehensive MERN stack application with advanced features like real-	**5**

	management. Implement advanced features like real-time updates using WebSockets or data visualization.		time updates and data visualization.	

TEXT BOOKS:

T1: "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node" by Vasan Subramanian

T2: "Learning React: A Hands-On Guide to Building Web Applications Using React and Redux" by KirupaChinnathambi

REFERENCE BOOKS:

R1: "Node.js Design Patterns" by Mario Casciaro

R2: "Express.js Guide: The Comprehensive BookonExpress.js" by AzatMardan

R3: "MongoDB: The Definitive Guide" by Shannon Bradshaw, Kristina Chodorow, and Michael Dirolf.

OTHER LEARNING RESOURCES:

- https://frontendmasters.com/
- https://www.codecademy.com/catalog
- https://v2.scrimba.com/
- https://learn.mongodb.com/
- https://expressjs.com/
- https://nodejs.org/en/download/package-manager
- https://www.freecodecamp.org/

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understanding the concept of MERN stack.	1,2,3,5,6,8
2	Create RESTful APIs using Express.js.	1,2,3,5,6,7,8
3	Implementing authorization and authentication using JWT.	1,2,3,5,6,7,8
4	Creating UI and responsive design using React.js	1,2,3,5,6,7,8
5	Implementing authorization and authentication in an application.	1,2,3,5,6,7,8

SEMESTER – V									
Course Title	**CLOUD COMPUTING AND VIRTUALIZATION**								
Course code	**23BCAO312R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+15P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ V semester of the third year of the program**								
Course Objectives	1. To elucidate both theoretical and practical aspects of cloud computing. 2. To equip students with the skills to design, implement, and manage cloud computing solutions effectively in both personal and professional settings. 3. To foster proficiency in evaluating cloud-based systems and optimizing them for enhanced performance and security.								
CO1	Understand cloud computing's fundamental concepts, including its history, architecture, and key advantages and disadvantages.								
CO2	Acquire knowledge of different cloud service and deployment models, assessing their impact on security and privacy.								
CO3	Comprehend virtualization techniques and their practical applications within cloud infrastructures.								
CO4	Explore the relationship between IoT and cloud computing, including emerging technologies like fog computing.								
CO5	Master the essentials of cloud security, focusing on risk management and protective measures for cloud-based systems.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Cloud Computing - An Introduction:** Introduction to Cloud Computing, History of Cloud Computing, Cloud Architecture, Cloud Storage, Why Cloud Computing Matters, Advantages of Cloud Computing, Disadvantages of Cloud Computing, Cloud Services.	**8**	Understand and describe the foundational aspects of cloud computing, including its history, architecture, storage solutions, and the overall significance, as well as the advantages and disadvantages of using cloud services.	**1,2**
II	**Cloud Deployment Models and Cloud Architecture:** Cloud reference model, Platform as service, Software as a service, Infrastructure as service, Cloud deployment models, public clouds, Private clouds, Community cloud, Hybrid clouds, security, trust and privacy	**8**	Understand and differentiate various cloud deployment models and architectures, including public, private, community, and hybrid clouds, along with cloud service models like Platform as a Service (PaaS), Software as a Service (SaaS), and Infrastructure as a Service (IaaS). Evaluate their implications for security, trust, and privacy.	**2, 4**
III	**Cloud Virtualization Technology:** Overview of Virtualization techniques, Types of Virtualizations, Implementation Levels of Virtualization Structures, Virtualization benefits, Server virtualization, Hypervisor management software, Virtual infrastructure requirements	**8**	Understand and explain various virtualization techniques and types, assess the benefits and levels of virtualization structures, and apply knowledge of server virtualization and hypervisor management to meet specific virtual infrastructure requirements.	**2, 3**
IV	**IoT and the Cloud Computing** Introduction to IoT, Difference between	**8**	Understand the fundamentals of IoT and its distinction from	**2, 3, 4**

	Cloud Computing and IoT, Fog Computing: The Next Evolution of Cloud Computing, Role of Cloud Computing in IoT, Living on the Edge, An Abstract Edge Architecture Model, Connecting devices at the edge and to the cloud		cloud computing, analyze the integration and role of cloud computing within IoT ecosystems, and apply concepts of fog computing and edge architectures to enhance connectivity and functionality between devices and the cloud.	
V	**Cloud security:** Introduction to Security, Cloud Security challenges and Risks, Software-as-a-Service Security, Security Monitoring, Security Architecture Design, Data Security, Application Security, Virtual Machine Security, Identity Management and Access Control	**8**	Understand cloud security fundamentals and challenges; design and apply security measures for data, applications, and identity management; and evaluate the efficacy of these security solutions in cloud environments.	**3, 4, 5**

TEXT BOOKS:

T1: Michael Miller, "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", Que Publishing, August 2008

REFERENCE BOOKS:

R1: K.ChandraSekaran, "Essentials of Cloud Computing", 1st Edition, 2015, CRC Press, Taylor & Francis Group.

R2: A.Srinivasan and J.Suresh, "Cloud Computing, A practical approach for learning and implementation", Pearson, 2014.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand cloud computing's fundamental concepts, including its history, architecture, and key advantages and disadvantages.	1,2,3,4,5,6,7,8
2	Acquire knowledge of different cloud service and deployment models, assessing their impact on security and privacy.	1,2,3,4,5,6,7,8
3	Comprehend virtualization techniques and their practical applications within cloud infrastructures.	1,2,3,4,5,6,7,8
4	Explore the relationship between IoT and cloud computing, including emerging technologies like fog computing.	1,2,3,4,5,6,7,8
5	Master the essentials of cloud security, focusing on risk management and protective measures for cloud-based systems.	1,2,3,4,5,6,7,8

SEMESTER – V									
Course Title	**PROJECT-I**								
Course code	**23BCAO313R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30 P	**0**	**0**	**4**	**0**	**6**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ V semester of the third year of the program**								
Course Objectives	1. To develop the knowledge, skills and attitudes of a professional Computer Application professional. 2. To become confident in designing Software solutions to complex software problems utilising a systems approach. 3. Develop a deep understanding of computer applications to enhance professional knowledge, skills, and attitudes necessary for the field.								
CO1	Demonstrate a sound technical knowledge of their selected project topic.								
CO2	Undertake problem identification, formulation and solution.								
CO3	Design Software solutions to complex problems utilising a systems approach.								
CO4	Communicate with the community at large in written an oral forms.								
CO5	Demonstrate the knowledge, skills and attitudes of a Computer Application or IT professional.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to: 1. Perform a literature search to review current knowledge and developments in the chosen technical area; 2. Undertake detailed technical work in the chosen area using one or more of: o theoretical studies o computer simulations o hardware construction; 3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project; 4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field; 5. Prepare a formal report describing the work undertaken and results obtained so far; and Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.	**90**	Analyze current knowledge through a comprehensive literature review in a chosen technical field, apply advanced methods like theoretical studies, computer simulations, and hardware construction. Synthesize findings into progress reports and professional journals, evaluate and present these findings in seminars, and demonstrate practical outcomes through poster presentations and operational demonstrations.	**3, 4, 5**

OTHER LEARNING RESOURCES:

As given by Project supervisor.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate a sound technical knowledge of their selected project topic.	1, 2, 4
2	Undertake problem identification, formulation and solution.	1, 3
3	Design Software solutions to complex problems utilising a systems approach.	2, 3, 5, 7
4	Communicate with the community at large in written an oral forms.	2, 3, 5, 6, 7
5	Demonstrate the knowledge, skills and attitudes of a Computer Application or IT professional.	1, 2, 3, 7

SEMESTER – V									
Course Title	**UI/UX DESIGN**								
Course code	**23BCA0314R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 15T+30P	**1**	**0**	**4**	**0**	**6**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Winter / I semester of third year**								
Course Objectives	1. To introduce students to industry-standard UI/UX design tools such as Figma and Visily, providing hands-on experience in creating wireframes, prototypes, and interactive designs. 2. To introduce the fundamental UI/UX design principles, including layout, color theory, typography, and responsive design, enabling them to create aesthetically pleasing and user-friendly interfaces. 3. To guide in creating and implementing design systems, ensuring consistency and reusability of UI components across various projects, and promoting efficient team collaboration.								
CO1	Demonstrate proficiency in using Figma and Visily for designing wireframes, prototypes, and interactive UI components, leveraging these tools to create user-centered designs.								
CO2	Understand and apply fundamental UI/UX design principles, including layout, color theory, typography, and responsive design, to create visually appealing and functional interfaces.								
CO3	Develop interactive prototypes and user flows, using advanced features of Figma and Visily to simulate real-world user interactions and test design hypotheses.								
CO4	Create and implement comprehensive design systems, ensuring consistency and reusability of UI components across multiple projects, and facilitating effective collaboration within design teams.								
CO5	Integrate UI/UX designs with development workflows, exporting assets and collaborating with developers to ensure seamless transition from design to implementation, and managing content within CMS or E-commerce platforms								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to UI/UX Design:** Definition of UI and UX, Importance of UI/UX Design, Key Differences between UI and UX; User Research Methods, Creating User Personas, User Journey Mapping; Introduction to Design Thinking, Phases of Design Thinking, Empathy in Design; Types of Prototypes, Tools for Prototyping, Low-fidelity vs. High-fidelity Prototypes.	**8**	Understanding the concept of UI/UX design, differentiate between UI and UX, understanding	**1, 4**
II	**UI Design Fundamentals:** Introduction to Figma, Sketch, Visily, and Adobe XD; Color Theory, Typography, Layout and Composition; Buttons, Icons, Forms, and Input Fields; Responsive Design, Mobile-First Design, Grid Systems.	**10**	Understand the theory of color, typography with different tools of designing. Apply buttons, icons, forms, and inputs. Creating responsive design.	**2, 3, 5**
III	**UX Design Fundamentals:** User Research Techniques - Surveys, Interviews, Focus Groups, Usability Testing; Information Architecture - Site Mapping, Card Sorting, Navigation Design; Interaction Design - Principles of Interaction Design, Designing User Flows, Micro-interactions; Wireframing and Mockups - Importance of Wireframing, Tools for Wireframing, Creating High-fidelity Mockups	**10**	Applying research techniques through surveys, interviews, focus groups. Designing navigation, sorting card.	**3, 4, 5**
IV	**Advance UI/UX Design Concepts:** Accessibility in design - Principles of Accessible Design, WCAG Guidelines, Tools for Checking Accessibility; Design	**12**	Understanding the accessibility design, using tools for checking the accessibility, creating a design system, and interactive	**2,3, 4,5**

	Systems - What is a Design System, Benefits of Design Systems, Creating a Design System; Advanced Prototyping Techniques - Interactive Prototypes, Animation and Transitions, Tools for Advanced Prototyping; Usability Testing and Evaluation - : Planning a Usability Test, Conducting Usability Tests, Analyzing Results.		prototypes, animations and transitions, analyzing the results.	
V	**UI/UX Designing and Portfolio Development:** Project Planning and Scope - Defining Project Goals, creating a Project Plan, Setting Milestones; Design Execution - Iterative Design Process, Collaboration and Feedback, Design Handoff; Building a Portfolio - Importance of a Portfolio, Elements of a Strong Portfolio, Showcasing Projects; Final Presentation.	**12**	Creating a project by applying all the techniques and tools.	**3, 5**
Practical				
Practical 1	Create a simple wireframe for a landing page using basic shapes and text in Figma. Explore Basic Tools and Interface Components in Figma	**2**	Gain familiarity with Figma's interface and basic tools. Understand how to use shapes and text to create a simple wireframe.	**1,5**
Practical 2	Design a Simple Wireframe for a Landing Page. Plan and sketch a wireframe layout for a landing page.	**2**	Practice planning and sketching wireframe layouts. Learn to structure content effectively for a landing page.	**5**
Practical 3	Create multiple layers by adding different shapes and text. Rename layers and organize them using frames and groups. Use the layers panel to reorder and hide/show layers.	**2**	Understand how to manage layers and organize them using frames and groups in Figma. Learn efficient workflow practices.	**2, 5**
Practical 4	Use Figma's layout grids and frames to structure the wireframe. Add placeholders for images, text blocks, and buttons.	**2**	Master the use of layout grids and frames to structure wireframes effectively. Practice adding placeholders for various content elements.	**3**
Practical 5	Define a color palette using Figma'scolor picker or hex codes. Apply colors to different elements (background, text, shapes) in your wireframe. Use the color styles panel to create reusable color swatches	**2**	Develop skills in defining and applying cohesive color palettes. Learn to use Figma'scolor styles for efficient design consistency.	**5**
Practical 6	Design a component (e.g., card, button) using Figma's vector tools. Convert the component into an Auto Layout frame. Resize the frame to see how elements adjust automatically.	**2**	Create and manipulate components using Figma's Auto Layout feature. Understand how to design responsive UI elements.	**3**
Practical 7	Create a new frame sized for a mobile screen (e.g., iPhone X). Design UI components using adaptive variants for different screen sizes. Preview the design in Figma's device preview mode.	**2**	Practice designing UI components for mobile screens. Learn to preview designs and adjust for different device sizes in Figma.	**3**
Practical 8	Design multiple screens for a simple app or website flow. Use Figma's prototyping	**2**	Gain proficiency in prototyping with Figma. Learn to link	**4**

	feature to link screens together. Define interactions (e.g., click, hover) to simulate user navigation		screens, define interactions, and simulate user navigation.	
Practical 9	Design custom icons or illustrations using Figma's vector tools. Experiment with stroke styles, fills, and path operations. Use these assets to enhance your wireframes or UI designs.	**2**	Develop skills in designing custom icons and illustrations using Figma's vector tools. Understand stroke styles and path operations.	**5**
Practical 10	Define a design system for consistent UI elements (buttons, forms, typography). Create component libraries and style guides using Figma's design tokens. Share the design system with your team for reuse across projects.	**2**	Learn to create and manage design systems in Figma. Practice using design tokens and component libraries for consistent UI elements.	**6**
Practical 11	Set up design handoff using Figma plugins or integrations (e.g., Zeplin, Avocode). Export CSS, XML, or JSON code snippets for developers.	**2**	Explore Figma plugins for design handoff. Learn to export CSS, XML, or JSON code snippets for developers.	**6**
Practical 12	Creating sitemaps and user flows.	**2**	Practice creating sitemaps and user flows. Understand how to visually represent website or app structures and user interactions.	**5**
Practical 13	Designing user flows, Interactive wireframes, User Flow Design in Figma	**2**	Develop skills in designing interactive wireframes and user flows using Figma's prototyping features.	**4**
Practical 14	Use Figma's prototyping and animation features to create and simulate micro-interactions within a mobile app interface.	**2**	Learn to create and simulate micro-interactions and animations within a mobile app interface using Figma's prototyping tools.	**5**
Practical 15	Create two variants of the same web page in Figma, focusing on different design elements (e.g., button placement, color schemes) for A/B testing.	**2**	Practice creating different variants of web pages for A/B testing. Understand the impact of design elements on user behavior.	**6**
Practical 16	Use Figma's vector tools to create and customize basic shapes (rectangles, circles, lines) and combine them to form UI elements.	**2**	Master Figma's vector tools to create and customize basic UI elements like rectangles, circles, and lines.	**5**
Practical 17	Set up a grid system in Figma and use guides to ensure consistent spacing and alignment across your design.	**2**	Develop skills in setting up grid systems and using guides for consistent spacing and alignment in Figma designs.	**3**
Practical 18	Use Figma's text tools to add, style, and organize text elements, and experiment with different fonts and typographic hierarchies.	**2**	Practice adding, styling, and organizing text elements. Experiment with fonts and typographic hierarchy in Figma.	**3**
Practical 19	Import and position images and video placeholders, and adjust their properties to create an engaging design.	**2**	Learn to import, position, and adjust properties of images and video placeholders in Figma designs.	**3**
Practical 20	Create a Visily Account and Start Your First Project, add basic shapes and text elements to the canvas.	**2**	Gain familiarity with Visily's interface and basic tools. Learn to add and customize UI elements using drag-and-drop.	**1,5**

Practical 21	Explore Basic Tools and Interface Components in Visily: Use Visily's drag-and-drop tools to add and customize UI elements. Arrange and group elements for organization.	**2**	Practice designing form layouts and implementing input validation rules using Visily's form elements.	**5**
Practical 22	Create Interactive Forms with Input Fields and Validation. Design a form layout using Visily's form elements (text inputs, checkboxes). Implement input validation rules (e.g., required fields, email format).	**2**	Learn to plan and structure wireframes using Visily's layout grids and containers. Incorporate placeholder content effectively.	**3**
Practical 23	Plan a wireframe layout for a website homepage (header, hero section, features). Use Visily's layout grids and containers to structure the wireframe. Add placeholder content such as images and text blocks.	**2**	Develop skills in defining color schemes and applying colors to various elements across pages using Visily.	**3**
Practical 24	Define a color scheme using Visily'scolor picker or palette options. Apply colors to different elements (background, text, buttons) across pages.	**2**	Practice creating navigation structures and interactive components like dropdown menus in Visily. Apply hover effects for interactive navigation.	**3**
Practical 25	Create a navigation bar or menu structure in Visily. Add dropdown menus using Visily's interactive components. Apply hover effects to menu items for interactive navigation.	**2**	Master Visily's grid and flexbox features to create responsive grid layouts for webpages or app screens.	**3**
Practical 26	Create a responsive grid layout in Visily for a webpage or app screen. Use Visily's grid and flexbox features to align elements across different screen sizes.	**2**	Develop proficiency in designing multiple pages and linking them together using interactive elements in Visily.	**4**
Practical 27	Design multiple pages for a website prototype in Visily. Link pages together using interactive elements (e.g., buttons, text links). Define transition effects and animations for a seamless user experience.	**2**	Learn to design and convert templates into reusable components in Visily for efficient project workflow.	**5**
Practical 28	Create a responsive grid layout in Visily for a webpage or app screen. Use Visily's grid and flexbox features to align elements across different screen sizes.	**2**	Practice integrating Visily with Content Management Systems (CMS) or E-commerce platforms for efficient content management.	**3**
Practical 29	Design reusable templates (e.g., headers, footers) in Visily. Convert templates into custom components for easy reuse across projects.	**2**	Design and develop reusable templates in Visily, converting them into custom components for consistent and efficient use across multiple projects.	**5**
Practical 30	Integrate Visily with CMS or E-commerce Platforms for Content Management	**2**	Integrate Visily designs with CMS or E-commerce platforms, enhancing their ability to manage and deploy content effectively in real-world applications.	**3**

TEXT BOOKS:

T1: "Don't Make Me Think, Revisited: A Common-Sense Approach to Web Usability" by Steve Krug."
T2: "The Design of Everyday Things" by Don Norman."
T3: "Interaction Design: Beyond Human-Computer Interaction" by Yvonne Rogers, Helen Sharp, and Jenny Preece"

REFERENCE BOOKS:
R1: "Sketching User Experiences: Getting the Design Right and the Right Design" by Bill Buxton"
R2: "Designing Interfaces: Patterns for Effective Interaction Design" by Jenifer Tidwell"

OTHER LEARNING RESOURCES:
https://www.interaction-design.org/courses/user-experience-the-beginner-s-guide
https://uxplanet.org/
https://material.io/design/Software/Hardware Tools to be used in
"Figma for UI Design" (Online Course Material)

MOOCS:
https://www.coursera.org/learn/ux-design-fundamentals
https://www.coursera.org/learn/introtoux-principles-and-processes?specialization=michiganux
https://www.coursera.org/learn/visual-elements-user-interface-design https://www.udemy.com/course/ui-ux-web-design-using-adobe-xd/

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate proficiency in using Figma and Visily for designing wireframes, prototypes, and interactive UI components, leveraging these tools to create user-centered designs.	2,3,6,7,8
2	Understand and apply fundamental UI/UX design principles, including layout, color theory, typography, and responsive design, to create visually appealing and functional interfaces.	2,3,6,8
3	Develop interactive prototypes and user flows, using advanced features of Figma and Visily to simulate real-world user interactions and test design hypotheses.	2,3,6,7,8
4	Create and implement comprehensive design systems, ensuring consistency and reusability of UI components across multiple projects, and facilitating effective collaboration within design teams.	2,3,6,7,8
5	Integrate UI/UX designs with development workflows, exporting assets and collaborating with developers to ensure seamless transition from design to implementation, and managing content within CMS or E-commerce platforms	2,3,6,7,8

SEMESTER – V									
Course Title	**SUMMER INTERNSHIP**								
Course code	**23BCAO317R**	**Total credits: 3**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**12**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ V semester of the third year of the program**								
Course Objectives	1. Apply academic knowledge and develop industry-specific skills in a professional setting. 2. Gain insight into career pathways and enhance problem-solving, communication, and teamwork skills. 3. Build a professional network and understand workplace dynamics.								
CO1	Demonstrate the application of theoretical knowledge in a practical environment.								
CO2	Identify and develop key professional skills relevant to the field of study.								
CO3	Reflect on personal and professional growth throughout the internship.								
CO4	Produce professional documents, such as a resume, cover letter, and portfolio.								
CO5	Present the internship experience and learning outcomes effectively.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**Orientation and Preparation:** Introduction to the internship, setting goals, understanding workplace expectations, and professional behaviour.	**8**	Demonstrate the application of theoretical knowledge in a practical environment.	**1, 2**
II	**Skills Development:** Developing industry-specific skills, working on assigned projects, and regular feedback sessions.	**8**	Identify and develop key professional skills relevant to the field of study.	**2, 3**
III	**Professional Growth:** Understanding workplace dynamics, building a professional network, and learning from mentors and colleagues.	**8**	Reflect on their personal and professional growth throughout the internship.	**2, 3**
IV	**Professional Documentation**: Creating and refining professional documents such as resumes, cover letters, and portfolios.	**8**	Produce professional documents, such as a resume, cover letter, and portfolio.	**3, 4**
V	**Presentation and Reflection:** Presenting the internship experience, discussing learning outcomes, and reflecting on personal growth and future career plans.	**8**	Present their internship experience and learning outcomes effectively.	**3, 4, 5**

TEXT BOOKS:
REFERENCE BOOKS:
OTHER LEARNING RESOURCES:

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate the application of theoretical knowledge in a practical environment.	1, 2
2	Identify and develop key professional skills relevant to their field of study.	2, 3, 7
3	Reflect on their personal and professional growth throughout the internship.	8
4	Produce professional documents, such as a resume, cover letter, and portfolio.	6
5	Present their internship experience and learning outcomes effectively.	6

SEMESTER – V									
Course Title	**RESEARCH/INDUSTRY INTERNSHIP**								
Course code	**23BCAO315R/ 23BCAO316R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**16**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ V semester of the third year of the program**								
Course Objectives	1. Apply academic knowledge and develop industry-specific skills in a professional setting. 2. Gain insight into career pathways and enhance problem-solving, communication, and teamwork skills. 3. Build a professional network and understand workplace dynamics.								
CO1	Demonstrate the application of theoretical knowledge in a practical environment.								
CO2	Identify and develop key professional skills relevant to the field of study.								
CO3	Reflect on personal and professional growth throughout the internship.								
CO4	Produce professional documents, such as a resume, cover letter, and portfolio.								
CO5	Present the internship experience and learning outcomes effectively.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**Orientation and Preparation:** Introduction to the internship, setting goals, understanding workplace expectations, and professional behaviour.	**8**	Demonstrate the application of theoretical knowledge in a practical environment.	**1, 2**
II	**Skills Development:** Developing industry-specific skills, working on assigned projects, and regular feedback sessions.	**8**	Identify and develop key professional skills relevant to the field of study.	**2, 3**
III	**Professional Growth:** Understanding workplace dynamics, building a professional network, and learning from mentors and colleagues.	**8**	Reflect on their personal and professional growth throughout the internship.	**2, 3**
IV	**Professional Documentation**: Creating and refining professional documents such as resumes, cover letters, and portfolios.	**8**	Produce professional documents, such as a resume, cover letter, and portfolio.	**3, 4**
V	**Presentation and Reflection:** Presenting the internship experience, discussing learning outcomes, and reflecting on personal growth and future career plans.	**8**	Present their internship experience and learning outcomes effectively.	**3, 4, 5**

TEXT BOOKS:

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate the application of theoretical knowledge in a practical environment.	1, 2
2	Identify and develop key professional skills relevant to their field of study.	2, 3, 7
3	Reflect on their personal and professional growth throughout the internship.	8
4	Produce professional documents, such as a resume, cover letter, and portfolio.	6
5	Present their internship experience and learning outcomes effectively.	6

SEMESTER – V									
Course Title	**MOOCS V (MEAN Stack Developer: Mongo DB, Express JS, Angular JS & Node JS)**								
Course code	**23MOSY311R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ V semester of the third year of the program**								
Course Objectives	1. To develop proficiency in MongoDB for efficient NoSQL data management. 2. To harness the power of ExpressJS to streamline server-side JavaScript development. 3. To master AngularJS for dynamic and responsive front-end application design.								
CO1	Understand the fundamentals of NoSQL databases.								
CO2	Gain in-depth knowledge of Express.js framework for building web applications.								
CO3	Build dynamic and interactive web applications using AngularJS.								
CO4	Grasp the concepts of event-driven programming and asynchronous I/O in Node.js.								
CO5	Learn to integrate MongoDB, Express.js, AngularJS, and Node.js components to build a complete MEAN stack application.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**MongoDB: The Complete Guide to NoSQL Database Development:** This comprehensive course ensures to develop a foundational understanding of MongoDB, covering its principles, architecture, and essential operations. Gain hands-on skills installing MongoDB, executing CRUD operations, and navigating its architecture. Progressing to advanced concepts, delve into schema design, indexing, and performance optimization, incorporating advanced querying techniques using Mongoose. The course further extends to integrating MongoDB with Mongoose, emphasizing document creation, RESTful API design, and validation practices. Finally, explore MongoDB's advanced functionalities, mastering data distribution, fault tolerance, and performance strategies. Will possess a robust skill set for proficient MongoDB development and management by the course's conclusion.	**9**	Understanding the basics of MEAN Stack. Applying the knowledge of MongoDB.	**1, 3**
II	**ExpressJS Essentials: Building Modern Web APIs:** This comprehensive module provides a deep dive into Express.js, a robust web application framework for Node.js. Participants will master fundamental concepts, architecture, and the step-by-step process of setting up Express.js projects. Explore HTTP methods, route definition, and parameter extraction, gaining practical skills in setting up requests with Thunder Client and Postman tools. Delve into middleware's pivotal role, crafting custom functions	**6**	Understanding the working of APIs and ExpressJS. Applying different APIs and integrating MongoDB with ExpressJS.	**1, 3, 5**

	and distinguishing built-in from custom middleware. Navigate error handling with proficiency in addressing synchronous errors and transmitting appropriate responses. The course extends to integrating MongoDB with Express.js, covering CRUD operations. Concluding with user authentication, participants acquire skills in generating and managing JWTs for secure authentication practices.			
III	**Angular Fundamentals: Building Responsive Web Apps with Ease:** This comprehensive module takes through AngularJS, delving into foundational principles, including architecture, data binding, and essential features. Deepen the understanding of AngularJS architecture, empowering to initiate critical application development. Exploring advanced concepts, interpret adept implementation of routing, navigation, and form controls, showcasing proficiency in data binding. The module guarantees a thorough comprehension of Angular services, user authentication, and the execution of role-based access control. Delving into advanced Angular concepts, construct modular components, implement effective state management, and ensure code reliability through testing and debugging practices. Additionally, the course emphasizes seamless Bootstrap integration into AngularJS and practical application in creating a MEAN stack project, showcasing expertise in web development and design.	**5**	Understanding the basics of responsive web apps with AngularJS. Creating responsive Web Apps with AngularJS.	**1, 3, 5**
IV	**NodeJS Unleashed: Mastering Backend Development:** Embark on a comprehensive Node.js development journey with this module. Starting with the fundamentals, it will establish a solid foundation by mastering Node.js installation and utilizing Visual Studio Code. Later, lets delve into advanced topics, such as asynchronous programming, error handling, CRUD operations, and OS module usage for system information retrieval. The module progresses to web development essentials, covering HTTP request handling, JSON manipulation, and Express.js configuration. Authentication, authorization, and email communication with Nodemailer are explored for secure	**6**	Understanding the backend development. Creating a backend with NodeJS.	**1, 3, 5**

	applications. The module culminates in advanced Node.js features, including WebSocket communication, real-time chat application construction using Socket.io, and scalability/performance optimization for responsive applications. It will emerge adept in foundational and advanced Node.js concepts.			

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the fundamentals of NoSQL databases.	1, 2, 3, 5, 6, and 8
2	Gain in-depth knowledge of Express.js framework for building web applications.	2, 3, 5, 6, 7, and 8
3	Build dynamic and interactive web applications using AngularJS.	2, 3, 5, 6, 7, and 8
4	Grasp the concepts of event-driven programming and asynchronous I/O in Node.js.	1, 2, 3, 5, 6, 7, and 8
5	Learn to integrate MongoDB, Express.js, AngularJS, and Node.js components to build a complete MEAN stack application.	2, 3, 5, 6, 7, and 8

SEMESTER – VI									
Course Title	**COMPUTER VISION**								
Course code	**23BCAO321R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T+15P	**2**	**1**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	Basic Programming Skills, Mathematics	**Co-requisite**	NIL						
Programme	**Bachelor of Computer Application**								
Semester	**VI**								
Course Objectives	1. Introduce the fundamentals of computer vision and its applications. 2. Equip students with the skills to acquire, pre-process, and analyse image and video data. 3. Explore various techniques for image feature extraction, segmentation, and object recognition.								
CO1	Explain the essential concepts of computer vision, including its applications, challenges, and limitations, drawing comparisons with human vision.								
CO2	Classify the different image feature extraction techniques (edge detection, corner/blob detection, texture analysis, shape descriptors) to extract relevant information from images.								
CO3	Develop various image segmentation algorithms (thresholding, region-based, edge-based, morphological) to partition images into meaningful regions for further analysis.								
CO4	Justify supervised and unsupervised learning methods (k-NN, SVM, neural networks, K-means, PCA) for object recognition and classification tasks in images.								
CO5	Examine the diverse applications of computer vision in various domains like image retrieval, medical imaging, robotics, and security systems, highlighting its potential impact.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Computer Vision:** Definition, history, and applications of computer vision, the human visual system vs. computer vision Images in the Spatial Domain: Pixels and Windows	**6**	Describe and explain Computer vision and Spatial Domain of Images	**1, 2**
II	Image Formation: 2D transformations, 3D transformations, 3D rotations, 3D to 2D projections, Photometric image formation, The digital camera, Sampling and aliasing, Compression.	**8**	Describe, Illustrate and Analyse the Image Formation and their different form	**1,2,4**
III	Image processing: Point operators, Linear filtering, Fourier transforms, Pyramids and wavelets, Parametric transformations, Mesh-based warping, Application: Feature-based morphing	**8**	Explain and Applying Image processing like Fourier transforms, Parametric transform etc	**2, 3**
IV	Feature detection and matching: Points and patches, Performance-driven animation, Edge detection, Edge linking, Vanishing points Image **Segmentation,Snakes** Image classification, Application: Visual similarity search	**8**	Describe and Applying Feature detection and matching in different images	**2, 3**
V	Applications of Computer Vision: Image and video retrieval: searching for specific images or videos in a database, Medical imaging: diagnosis and analysis of medical images, Surveillance and security: object tracking and anomaly detection	**6**	Describe and Applying Various Computer Vision techniques like Searching, Medical images diagnosis, etc	**2, 3**
Practical				
Practical 1	**Image Loading and Display:** Learn how to read and display images using OpenCV.	**2**	Describe, illustrate and explain and apply different imaging techniques and carry out	**1,2,3,4**

			practical in lab.	
Practical 2	Image Grayscale Conversion: Understand the process of converting color images to grayscale.	**2**	Understand the importance of grayscale conversion, implement color-to-grayscale transformation using OpenCV, and analyze its impact on image processing.	**3,4**
Practical 3	Image Thresholding: Explore thresholding techniques for image binarization.	**2**	Explore different thresholding techniques (binary, adaptive, Otsu's), apply thresholding for image segmentation, and analyze their effects on images.	**3,4**
Practical 4	Image Smoothing and Blurring: Implement various filters for smoothing and blurring images.	**2**	Implement Gaussian, median, and bilateral filters for noise reduction, and evaluate their effectiveness in image enhancement.	**3,5**
Practical 5	Edge Detection: Detect edges in images using Canny edge detection and other methods.	**2**	Detect edges using Canny, Sobel, and Laplacian operators, and analyze edge detection results for feature extraction.	**3,4**
Practical 6	Image Morphological Operations: Apply morphological operations like erosion and dilation for image processing.	**2**	Apply erosion, dilation, opening, and closing operations to enhance or remove image features, and understand their role in image pre-processing.	**3,4**
Practical 7	Image Geometric Transformations: Perform scaling, rotation, and other geometric transformations on images.	**2**	Perform image scaling, rotation, translation, and affine transformations, and analyze their use in computer vision applications.	**3,4**
Practical 8	Contour Detection and Object Recognition: Find contours in images and use them for object recognition.	**2**	Extract contours from images using OpenCV and apply them for object recognition and shape analysis.	**3,4**
Practical 9	Histogram Analysis and Equalization: Analyze image histograms and perform histogram equalization for image enhancement.	**2**	Understand image histograms, apply histogram equalization for contrast enhancement, and evaluate its impact on image clarity.	**4,5**
Practical 10	Template Matching: Find occurrences of a template image within a larger image.	**2**	Detect specific objects within images using template matching techniques, and compare different matching methods.	**4,5**
Practical 11	Feature Detection and Keypoints: Detect keypoints like corners and Harris corners in images.	**2**	Detect keypoints like Harris corners and Shi-Tomasi points, and analyze their importance in feature extraction.	**3,4**
Practical 12	Feature Matching and Homography: Match features between images and estimate homography for image registration.	**2**	Perform feature matching using SIFT, ORB, or SURF, and estimate homography for aligning images.	**3,5,6**
Practical 13	Image Pixel Manipulation and Display with OpenCV.	**2**	Learn how to access and modify pixel values in an image, and apply transformations based on pixel intensity.	**3,4**
Practical 14	Python program to draw various shapes.	**2**	Implement OpenCV functions to draw basic shapes like lines, rectangles, and circles for	**3,6**

			graphical applications.	
Practical 15	Python program to draw a simple bullseye with the cv2.circle function.	**2**	Use OpenCV to generate circular patterns, and explore its applications in visual representation.	**3,6**
Practical 16	Program to perform various transformation in an image.	**2**	Apply geometric transformations like perspective shift, shearing, and flipping, and analyze their effects.	**3,4**
Practical 17	Python program that finds and draws contours of objects in an image.	**2**	Detect, analyze, and highlight object boundaries using contour detection methods.	**3,4**
Practical 18	Detecting Blue Objects.	**2**	Use color thresholding techniques to detect objects of a specific color in an image.	**3,4**
Practical 19	Program for detecting face.	**2**	Implement face detection using Haar cascades or DNN models and analyze its accuracy.	**3,5**
Practical 20	Program for Face and Smile Detection.	**2**	Combine facial recognition with smile detection to develop real-time emotion tracking applications.	**3,5,6**
Practical 21	Image segmentation based on color	**2**	Implement color-based segmentation using K-means clustering, watershed algorithm, or thresholding.	**3,5**
Practical 22	Image Color Conversion: Convert the color space of the image (e.g., RGB to grayscale, HSV, LAB, etc.) and analyze the channels separately.	**2**	Convert images between different color spaces (RGB, HSV, LAB) and analyze how different color representations affect processing.	**3,4**

Text Books:

1. Szeliski, Richard. *Computer Vision: Algorithms and Applications*. Springer Nature, 2022.
2. Davies, E. Roy. *Computer and Machine Vision: Theory, Algorithms, Practicalities*. Academic Press, 2012.
3. Gonzalez, Rafael C. *Digital Image Processing*. Pearson Education India, 2009.

Reference Books:

1. Forsyth, David A., and Jean Ponce. *Computer Vision: A Modern Approach*. Prentice Hall Professional Technical Reference, 2002.
2. Brownlee, Jason. *Data Preparation for Machine Learning: Data Cleaning, Feature Selection, And Data Transforms In Python*. Machine Learning Mastery, 2020.

Additional Resources:

- OpenCV Tutorials and Documentation: https://opencv.org/
- Python libraries for computer vision: Scikit-image, TensorFlow, PyTorch
- https://nptel.ac.in/courses/117105079
- https://nptel.ac.in/courses/106105216/

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the essential concepts of computer vision, including its applications, challenges, and limitations, drawing comparisons with human vision.	1, 2, 7 and 8
2	Classify the different image feature extraction techniques (edge detection, corner/blob detection, texture analysis, shape descriptors) to extract relevant information from images.	1, 2, 7 and 8
3	Develop various image segmentation algorithms (thresholding, region-based, edge-based, morphological) to partition images into meaningful regions for further analysis.	1, 2, 7 and 8
4	Justify supervised and unsupervised learning methods (k-NN, SVM, neural networks, K-means, PCA) for object recognition and classification tasks in images.	1, 2, 7 and 8
5	Examine the diverse applications of computer vision in various domains like image retrieval, medical imaging, robotics, and security systems, highlighting its potential impact.	1, 2, 7 and 8

SEMESTER – VI									
Course Title	**Introduction to Cybersecurity**								
Course code	**23BCAO322R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T+15P	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite		**Co-requisite**	NIL						
Programme	**Bachelor of Computer Application (BCA)**								
Semester	**VI**								
Course Objectives	1. To understand the foundational concepts of cyberspace, including the architecture of the internet, web technologies, and the regulatory frameworks governing cyberspace.. 2. To identify and classify various types of cybercrimes, comprehend cybercriminals' methodologies, and analyze the legal aspects of cybercrimes under the IT Act 2000 and its amendments. 3. To explain the fundamentals of cryptography, distinguish between symmetric and asymmetric encryption algorithms, and demonstrate knowledge of Public Key Infrastructure (PKI) and digital certificates.								
CO1	Understand the foundational concepts of cyberspace, including the architecture of the internet, communication protocols, and governance structures.								
CO2	Identify and classify various types of cybercrimes, their modus operandi, and the legal frameworks governing cybercrimes in India.								
CO3	Explain the fundamentals of cryptography, distinguish between symmetric and asymmetric encryption, and understand the role of PKI and digital certificates.								
CO4	Analyze the security challenges and best practices in e-commerce, including threats, digital payment mechanisms, and regulatory guidelines.								
CO5	Implement cybersecurity risk management strategies, including risk assessment methodologies, incident response planning, and compliance with security policies and procedures.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Cybersecurity:**Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.	**9**	After completion of this module, students would be able to understand the concept of Cyber security and issues and challenges associated with it.	**1,2,3**
II	**Cybercrime and Cyber law:**Classification of cybercrimes, Common cybercrimes- cybercrime targeting computers and mobiles, cybercrime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of cybercrime, IT Act 2000 and its amendments, Cybercrime and offences, Organisations dealing with	**8**	Students, at the end of this module, should be able to understand the cybercrimes, their nature, legal remedies and as to how report the crimes through available platforms and procedures.	**2,3,4**

	Cybercrime and Cyber security in India, Case studies.			
III	**Cryptography and Encryption:** Fundamentals of cryptography and encryption algorithms Symmetric vs. asymmetric encryption Public key infrastructure (PKI) and digital certificates.	**10**	Explain network security principles, assess vulnerabilities, and implement measures to secure networks against external and internal threats.	**2,3,4**
IV	**E-Commerce and Digital Payments:** Definition of E-Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions. Relevant provisions of Payament Settlement Act,2007,	**9**	After the completion of this module, students would be able to understand the basic concepts related to E-Commerce and digital payments. They will become familiar with various digital payment modes and related cyber security aspects, RBI guidelines and preventive measures against digital payment frauds.	**2,3,4**
V	**Cybersecurity Risk Management, Digital Devices Security, Tools and Technologies for Cyber Security:** Risk assessment methodologies and frameworks Security policies, procedures, and compliance Incident response and disaster recovery planning; End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third-party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.	**9**	Discuss cybersecurity governance frameworks, analyze regulatory requirements, and develop policies to align with organizational goals and ensure compliance. Understand the basic security aspects related to Computer and Mobiles. They will be able to use basic tools and technologies to protect their devices.	**1,2,3**
Practical				
Practical 1	Implement Caesar cipher encryption in Python and decrypt a	**2**	Implementing Caesar cipher encryption in Python enables students to understand	**3,4**

	given text.		classical cryptographic techniques, apply encryption and decryption logic, and analyze the security limitations of substitution ciphers.	
Practical 2	Explain the differences between symmetric and asymmetric encryption with examples.	**2**	Explaining the differences between symmetric and asymmetric encryption helps students understand their fundamental principles, compare their use cases, and evaluate their advantages and disadvantages in real-world applications.	**2,5**
Practical 3	Write a Python program to encrypt and decrypt text using AES encryption.	**2**	Writing a Python program to encrypt and decrypt text using AES encryption allows students to apply advanced cryptographic algorithms, manage encryption keys securely, and analyze the importance of block ciphers in data protection.	**3,6**
Practical 4	Generate an RSA key pair using OpenSSL and encrypt/decrypt a sample message.	**2**	Generating an RSA key pair using OpenSSL and encrypting/decrypting a sample message enables students to understand public-key cryptography, apply RSA encryption for secure communication, and evaluate key management best practices.	**3,5**
Practical 5	Verify the SSL certificate of a website. Identify the Certificate Authority (CA) and encryption algorithm used.	**2**	Verifying the SSL certificate of a website helps students analyze HTTPS encryption, identify the Certificate Authority (CA), and evaluate the role of TLS security in web communication.	**4,5**
Practical 6	Use GPG (GNU Privacy Guard) to encrypt and sign an email message.	**2**	Using GPG (GNU Privacy Guard) to encrypt and sign an email message enables students to implement secure email communication, apply digital signatures, and evaluate the importance of end-to-end encryption.	**3,5**
Practical 7	Analyze the encryption methods used in messaging apps like WhatsApp.	**2**	Analyzing the encryption methods used in messaging apps like WhatsApp allows students to understand end-to-end encryption (E2EE), explore secure key exchange mechanisms, and evaluate the effectiveness of encrypted communication.	**4,5**
Practical 8	Analyze a real-world E-Commerce fraud case and suggest preventive measures.	**2**	Analyzing a real-world E-Commerce fraud case and suggesting preventive measures helps students understand financial cybercrime, assess fraud detection techniques, and propose security solutions for online transactions.	**4,5**
Practical 9	Conduct a mock UPI transaction and analyze the security features in Google Pay/PhonePe.	**2**	Conducting a mock UPI transaction and analyzing the security features in Google Pay/PhonePe allows students to explore digital payment security, identify authentication methods, and evaluate fraud prevention measures in financial transactions.	**3,5**
Practical 10	Analyze a phishing website pretending to be a bank portal using SSL Labs security scanner.	**2**	Analyzing a phishing website pretending to be a bank portal using SSL Labs security scanner enables students to detect fraudulent websites, evaluate SSL/TLS security configurations, and understand how cybercriminals exploit weaknesses in online banking.	**4,5**
Practical 11	Perform a risk assessment for an organization's IT infrastructure. What are the potential threats?	**2**	Performing a risk assessment for an organization's IT infrastructure helps students identify cybersecurity threats, evaluate risk mitigation strategies, and	**4,5**

			propose security controls for protecting sensitive information.	
Practical 12	Create a basic cybersecurity policy for an educational institution.	**2**	Creating a basic cybersecurity policy for an educational institution allows students to develop security guidelines, define access control measures, and ensure compliance with best practices in data protection.	**5,6**
Practical 13	Configure and analyze Windows Defender Firewall settings.	**2**	Configuring and analyzing Windows Defender Firewall settings enables students to manage host-based security, implement firewall rules, and evaluate the effectiveness of network protection measures.	**3,5**
Practical 14	Develop an incident response plan for a data breach scenario.	**2**	Developing an incident response plan for a data breach scenario helps students understand forensic investigation, define response strategies, and evaluate compliance requirements for cybersecurity incidents.	**5,6**
Practical 15	Write a Python script to automate data backups and store them securely.	**2**	Writing a Python script to automate data backups and store them securely allows students to implement secure backup solutions, explore encryption-based data protection, and evaluate best practices for disaster recovery.	**3,6**

Text Books:

T1: Introduction to Computer Security" by Michael T. Goodrich and Roberto Tamassia

T2: "Cybersecurity: A Practical Guide to the Law of Cyber Risk" by Andrew Serwin

T3: Network Security Essentials: Applications and Standards" by William Stallings

Reference Books:

R1: "Cryptography and Network Security: Principles and Practice" by William Stallings

R2:"Security Engineering: A Guide to Building Dependable Distributed Systems" by Ross Anderson

R3: "Principles of Computer Security: CompTIA Security+ and Beyond" by Wm. Arthur Conklin, Greg White, Chuck Cothren, Roger L. Davis, Dwayne Williams

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the foundational concepts of cyberspace, including the architecture of the internet, communication protocols, and governance structures.	1,2,3,4,5,6,7, and 8
2	Identify and classify various types of cybercrimes, their modus operandi, and the legal frameworks governing cybercrimes in India.	1,2,3,4,5,6,7, and 8
3	Explain the fundamentals of cryptography, distinguish between symmetric and asymmetric encryption, and understand the role of PKI and digital certificates.	1,2,3,4,5,6,7, and 8
4	Analyze the security challenges and best practices in e-commerce, including threats, digital payment mechanisms, and regulatory guidelines.	1,2,3,4,5,6,7, and 8
5	Implement cybersecurity risk management strategies, including risk assessment methodologies, incident response planning, and compliance with security policies and procedures.	1,2,3,4,5,6,7, and 8

SEMESTER – VI									
Course Title	**Project II**								
Course code	**23BCAO323R**	**Total credits: 6**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**8**	**0**	**12**	**0**	**6**
Pre-requisite		**Co-requisite**	NIL						
Programme	**Bachelor of Computer Application (BCA)**								
Semester	**VI**								
Course Objectives	1. To develop the practical skill 2. To enhance Critical Thinking and Problem-Solving Abilities 3. To Improve Communication and Collaboration Skills								
CO1	Demonstrate a sound technical knowledge of the selected project topic.								
CO2	Illustrate problem identification, formulation, and solution.								
CO3	Plan solutions to complex problems utilizing a systems approach.								
CO4	Design the prototype of the solution and analyze the prototype using testing methods.								
CO5	Improve ethical and professional sustainability while working in a team and communicate effectively for the benefit of the society.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Project Introduction and Planning** Overview of project goals and objectives. Importance of project planning and management. Project Proposal Development: Identifying a project topic or problem Conducting preliminary research Writing a project proposal Setting timelines and milestones Resource allocation (materials, tools, etc.) Risk assessment and management strategies		Describe, illustrate and explain problem	**2,3**
II	Literature Review and Research Methodology Identifying and reviewing relevant literature Summarizing and synthesizing existing research Highlighting gaps and formulating research questions Choosing appropriate research methods (qualitative, quantitative, or mixed methods) Designing research instruments (surveys, interviews, experiments, etc.) Ethical considerations in research		Describe, illustrate and Literature Review	**2,3,4**
III	Data Collection and Analysis Gathering primary data (surveys, experiments, interviews, observations) Ensuring data accuracy and reliability Storing and organizing data Using statistical tools and software for data analysis Interpreting data and drawing conclusions Visualizing data (charts, graphs, tables)		Describe, illustrate and explain data collection and analysis	**2,3,4**
IV	Project Implementation and Monitoring Project Execution: Implementing the project plan Monitoring progress and making adjustments as needed Documentation and Record Keeping: Keeping detailed records of project activities and outcomes Troubleshooting and problem-solving		Describe, illustrate and explain project implementation and execution	**6**

	during implementation Interim Reporting: Preparing and presenting progress reports Receiving and incorporating feedback			
V	Project Presentation and Evaluation Final Reporting: Writing the final project report (structure, content, formatting) Ensuring clarity, coherence, and completeness Project Presentation: Preparing visual aids (slides, posters, etc.) Practicing presentation skills (public speaking, answering questions) Evaluation and Reflection: Assessing project outcomes against objectives Reflecting on the project process and personal learning Identifying areas for future improvement and potential follow-up projects		Describe, illustrate and explain testing and documentation	**2,3,5**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate a sound technical knowledge of selected project topic.	1, 2 and 4
2	Illustrate problem identification, formulation and solution.	1, and 2
3	Plan solutions to complex problems utilizing a systems approach.	1, 2, 3, 5 and 7
4	Design the prototype of the solution and analyze the prototype using testing methods.	1, 2, 3, 5, 6, 7, and 8
5	Improve ethical and professional sustainability while working in a team and communicate effectively for the benefit of the society.	1, 2, 3, 6 and 8

SEMESTER – VI									
Course Title	**RESEARCH/INDUSTRY INTERNSHIP**								
Course code	**23BCAO324R/ 23BCAO325R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**2**	**4**	**12**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Computer Application**								
Semester	**Fall/ VI semester of the third year of the program**								
Course Objectives	1. Apply academic knowledge and develop industry-specific skills in a professional setting. 2. Gain insight into career pathways and enhance problem-solving, communication, and teamwork skills. 3. Build a professional network and understand workplace dynamics.								
CO1	Demonstrate the application of theoretical knowledge in a practical environment.								
CO2	Identify and develop key professional skills relevant to the field of study.								
CO3	Reflect on personal and professional growth throughout the internship.								
CO4	Produce professional documents, such as a resume, cover letter, and portfolio.								
CO5	Present the internship experience and learning outcomes effectively.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**Orientation and Preparation:** Introduction to the internship, setting goals, understanding workplace expectations, and professional behaviour.	**8**	Demonstrate the application of theoretical knowledge in a practical environment.	**1, 2**
II	**Skills Development:** Developing industry-specific skills, working on assigned projects, and regular feedback sessions.	**8**	Identify and develop key professional skills relevant to the field of study.	**2, 3**
III	**Professional Growth:** Understanding workplace dynamics, building a professional network, and learning from mentors and colleagues.	**8**	Reflect on their personal and professional growth throughout the internship.	**2, 3**
IV	**Professional Documentation**: Creating and refining professional documents such as resumes, cover letters, and portfolios.	**8**	Produce professional documents, such as a resume, cover letter, and portfolio.	**3, 4**
V	**Presentation and Reflection:** Presenting the internship experience, discussing learning outcomes, and reflecting on personal growth and future career plans.	**8**	Present their internship experience and learning outcomes effectively.	**3, 4, 5**

TEXT BOOKS:
REFERENCE BOOKS:
OTHER LEARNING RESOURCES:

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate the application of theoretical knowledge in a practical environment.	1, 2
2	Identify and develop key professional skills relevant to their field of study.	2, 3, 7
3	Reflect on their personal and professional growth throughout the internship.	8
4	Produce professional documents, such as a resume, cover letter, and portfolio.	6
5	Present their internship experience and learning outcomes effectively.	6

ASSAM DOWN TOWN UNIVERSITY

Curriculum and Syllabus

Master of
Computer Application

OUTCOME BASED EDUCATION FRAMEWORK

CHOICE BASED CREDIT SYSTEM

Version: 1.0

FACULTY OF COMPUTER TECHNOLGY

July, 2023

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 Board of Studies (BOS) meeting of the Faculty of Computer Technology held on dated 14/07/2023 and approved by the Emergent Academic Council (AC) meeting held on dated 28/07/2023.

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 multi disciplinary 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 conflict-free global society.

6. To be renowned for creating new knowledge through high quality inter disciplinary research for betterment of society.

7. Become a key hub for the growth and excellence of AdtU's stake holders 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 Computer Application (MCA) is a Post Graduate Degree awarded for the programme in Computer Technology. Being one of the top universities, we want to establish a unified educational environment that incorporates the newest technical advancements and meets market demands. To give students the greatest technical education possible, the FoCT has partnerships with leading academic and research institutions across the world and focuses on the emerging areas of computer technology such as Artificial Intelligence, Machine Learning, Deep Learning, Cyber Security, Data Science, Augmented Reality, Virtual Reality, etc. Deserving students can apply for scholarships.

I. Specific Features of the Curriculum

Master of Computer Application curriculum has been designed as per the latest requirements of Industry Employability.

II. Eligibility Criteria:

To pursue the MCA (Master of Computer Application) course, the candidates will have to fulfil the given below eligibility criteria:

- The candidate must have passed BCA/B.Sc. (Computer Science)/B.Tech (IT)/ B.E. (CSE)/B.Tech (CSE)/B.E. (IT)/ B.Tech. (IT) or equivalent Degree;

or

- Passed any graduation degree B.Sc/B.Com. / B.A./ B.Voc preferably with Mathematics at 10+2 level or at Graduation level.

Note: Candidate having graduation without mathematics must undertake and clear additional bridge courses.

III. Program Educational Objectives(PEO):

PEO-1: To produce post graduates with a two-year professional education in Computer Applications with technical, professional, and communications skills.

PEO-2: To encourage effective software development and heighten technological awareness among the students, so that they become the future specialists in the industry.

PEO-3: To encourage students to learn, engage and update themselves to carryout independent or collaborative research so that they can address technological challenges in their corresponding field of expertise.

IV. Program Specific Outcomes(PSO):

PSO1: Ability to demonstrate a degree of mastery in computer applications.

PSO2: Ability to independently carry out research/investigation and developmental work to solve practical problems.

PSO3: Develop sound knowledge and skill sets in fields related to human-computer interaction and management of industrial processes for the design and implementation of intelligent systems.

V. Program Outcomes(PO):

PO1: Computational knowledge: Apply the knowledge of computing fundamentals, computing specialisation, and mathematics to solve real world problems.

PO2: **Problem analysis:** Identify, formulate, review literature, and analyse to solve complex problems using knowledge of mathematics and computer science.

PO3: Design/development of solutions: Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet with the needs of appropriate public health and safety, cultural, societal, and environmental scenarios.

PO4: **Conduct investigations of complex computing problems**: Use research-based knowledge and methods to design experiments, analyse and interpret data and perform information synthesis so as to provide valid conclusions.

PO5: Modern tool usage: Create, select, adapt, and apply appropriate techniques, resources, and modern tools for solving complex computing problems, along with an understanding of their limitations.

PO6: Individual and team work: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PO7: Professional ethics: Commit to professional ethics, responsibilities, and norms of computing practices.

PO8: Environment and sustainability: Understand and demonstrate the impact of the professional solutions in societal and environmental contexts and need for sustainable development.

PO9: Communication efficacy: Communicate effectively on complex technical activities with the computing community, and with society at large.

PO10. Innovation and entrepreneurship: Using innovation to identify opportunity and to create value and wealth for the betterment of the individual and society as a whole.

PO11. Project management and finance: Demonstrate knowledge and understanding of software engineering and project management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning for continual development as a computing professional.

VI. Total Credits to be Earned: 95

VII. Career Prospects:

The career prospects for MCA graduates are generally good, as there is a high demand for IT professionals in India and around the world. The MCA degree provides you with a strong foundation in computer science and software development, which can open doors to a variety of career opportunities.

The following are the career prospects of the MCA courses:

Software Developer: This is one of the most common career paths for MCA graduates. Software developers design, develop, and test software applications. They may work for a variety of companies, including software development firms, IT consulting firms, and large corporations.

Data Scientist: Data scientists are responsible for collecting, analysing, and interpreting data to solve business problems. They are in high demand across a variety of industries, including finance, healthcare, and retail.

Cloud Architect: Cloud architects design and build cloud-based solutions for businesses. They need to have a strong understanding of cloud computing technologies and how to use them to meet the needs of their clients.

Web Developer: Web developers design and develop websites and web applications. They may work for a variety of companies, including web development firms, marketing agencies, and e-commerce businesses.

IT Project Manager: IT project managers are responsible for planning, executing, and monitoring IT projects. They need to have strong technical skills as well as strong project management skills.

Cybersecurity Specialist: Cybersecurity specialists are responsible for protecting computer systems and networks from cyberattacks. They need to have a strong understanding of cybersecurity threats and how to prevent them.

The salary for MCA graduates can vary depending on their experience, skills, and location. However, MCA graduates typically earn more than graduates with other degrees.In addition to the career options listed above, MCA graduates can also work as system analysts, database administrators, network engineers, and quality assurance testers.

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-Voice etc.:

i) Practical examination shall be conducted in the presence of one external expert and one or more internal examiners.

ii) Viva-Voice, 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 x 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.

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

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, Gi is the Grade Point secured in the i^{th} registered Course and Ci 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, Gi is the Grade Point secured in the ith completed Course and Ci is the Credit (weight)of that Course.

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

(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 class room teaching through series of lectures delivering concepts using ITC facilities, white or black board. Notes may also be circulated to the students however; the students are to be involved in preparation of the notes. The teacher will be responsible in 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 student 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 visit to the laboratory for experiments or field and survey. 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 a project-Based learning at least 4 months duration. This approach will help the student to think critically, evaluate, analyse, 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 with problems. During the library hours the student along with the teacher visits library search probable solution for the assigned problem. The same has to be done in group 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, Student present and deliver lectures in presence of teacher and supervised by teacher	60%
Student visit fields or perform experiments or teacher perform demonstration	05%
Flipped Classroom approach	10%
Cooperative learning approach	05%

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

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

Breakdown of Credits

Sl. No	Category		Total number of Credits
1	University Core(UC)	Skill Enhancement Course (SEC)	0
		Ability Enhancement Course(AEC)	6
		Field Training	0
		Discipline Specific Elective (DSE)	0
		Value Added Course (VAC)	1
2	University Elective (UE)	Multidisciplinary Course (MDC)	3
		Value Added Course (VAC)	1
3	Program Core(PC)	Discipline Specific Core(DSC)	42
		Field Training	1
		Research /Industry Internship	14
		Summer Internship	0
4	Program Elective (PE)	Discipline Specific Elective (DSE)	6
		Value Added Course (VAC)	0
5	Faculty Core(FC)	Skill Enhancement Course (SEC)	7
		Ability Enhancement Course(AEC)	0
6		Bridge Course	14
Total			**95**

Breakdown by categories of courses

Sl no	Category	Credits	%
1	Science	3	3.16%
2	Engineering	91	95.79%
3	Commerce and Management	1	1.05%
Total		**95**	**100%**

SEMESTER WISE COURSE DISTRIBUTION

	S. N.	Course Code	Course Title	Course Category	Engagement							Maximum Marks for			
					L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
Semester I	1.	23MCAO111R	Programming Language I – Python	DSC (Major)	3	0	4	0	0	0	5	40	60	100	200
	2	23MCAO112R	Advanced Web Applications Development	DSC (Major)	3	0	2	0	0	0	4	40	60	100	200
	3	23MCAO113R	Mathematics	DSC (Minor)	2	0	0	0	0	0	2	40	60	0	100
	4	23MCAO114R	Fundamentals of Statistics	DSC (Minor)	2	0	0	0	0	0	2	40	60	0	100
	5	23MCAO115R	Programming and Data Structures	DSC (Major)	2	0	2	0	0	0	3	40	60	100	200
	6	23MCAO116R	Mini Research (Review of Literature – R1)	Research	0	0	0	4	8	0	2	0	0	100	100
	7	23UMPD111R	PDP I – Effective English	AEC	0	0	4	0	0	0	2	0	0	100	100
	8	23MOSY114R/ 23MOSY115R/ 23MOSY116R	MOOCS I – Foundations of User Experience (UX) Design/ Learn to Program: The Fundamentals/ Foundations: Data, Data, Everywhere	SEC	1	0	0	0	0	0	1	0	0	100	100
	Total Without Bridge Course				**13**	**0**	**12**	**4**	**8**	**0**	**21**	**200**	**300**	**600**	**1100**
	9	23MCAO117R	Internet Concept and Web Design	Bridge Course	3	0	4	0	0	0	5	40	60	100	200
	10	23MCAO118R	Algorithms for Problem Solving	Bridge Course	3	0	0	0	0	0	3	40	60	100	200
	Total				19	0	16	4	8	0	29	280	420	800	1500

	S. N.	Course Code	Course Title	Course Category	Engagement							Maximum Marks for			
					L	T	P	S	R	O	C	IA*	SEE*	PE*	Total
Semester II	1.	23MCAO121R	Advanced Data Structures	DSC (Major)	2	0	4	0	0	0	4	40	60	100	200
	2	23MCAO122R	Advanced Database Management Systems	DSC (Major)	2	0	4	0	0	0	4	40	60	100	200
	3	23MCAO123R	Advanced Operating Systems	DSC (Major)	4	0	0	0	0	0	4	40	60	0	100
	4	23MCAO124R	Techno Professional Skills I – R Programming	SEC	0	0	4	0	0	0	2	0	0	100	100
	5	23MCAO125R	Mini Research (Research Gap Analysis-R2)	Research	1	0	0	4	0	0	2	0	0	100	100
	6	23MOSY121R/ 23MOSY122R/ 23MOSY123R	MOOCS II – Developing Android Apps with App Inventor/ Django WebFramework/ Software Development Lifecycle Specialization	SEC	1	0	0	0	0	0	1	0	0	100	100
	7	23MCAO128R/ 23MCAO129R/ 23MCAO1210R	Generic Elective I (Coursera)- Data Science Fundamentals with Python and SQL Specialization/ Business Strategy/ Positive Psychiatry and Mental Health	SEC	2	0	0	0	0	0	2	0	0	100	100
	8	23UMRM121R	Research Methodology and Statistical Analysis	MDC	1	0	0	4	0	0	2	40	60	0	100
	9	23UUHV106R	Universal Human Values and Professional Ethics	VAC	1	0	0	0	0	0	1	40	60	0	100
	10	23UMPD122R	PDP II – Communication Mastery	AEC	0	0	4	0	0	0	2	0	0	100	100
	Total Without Bridge Course				14	0	16	8	0	0	24	200	300	700	1200
	11	23MCAO126R	Computer Application Techniques	Bridge Course	3	0	0	0	0	0	3	40	60	0	100
	12	23MCAO127R	Fundamentals of Digital Design	Bridge Course	3	0	0	0	0	0	3	40	60	0	100
	Total				**20**	**0**	**16**	**8**	**0**	**0**	**30**	**280**	**420**	**700**	**1400**

	S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			
					L	T	P	S	R	O		IA*	SEE*	PE*	Total
Semester III	1.	23MCAO211R	Computer Network and Information Security	DSC (Major)	2	0	4	0	0	0	4	40	60	100	200
	2	23MCAO212R	Usability Design of Software Application	DSC (Major)	3	0	0	0	0	0	3	40	60	0	100
	3	23MCAO213R	Object Oriented Programming Paradigm	DSC (Major)	2	0	2	0	0	0	3	40	60	100	200
	4	23MCAO214R	Techno Professional Skills II - EDA	SEC	0	0	2	0	0	0	1	0	0	100	100
	5	23MCAO215R/ 23MCAO219R	PE I - Fundamentals of AI /ML/ Business Intelligence	DSC (Major)	2	0	2	0	0	0	3	40	60	100	200
	6	23MCAO216R	Mini Research R3 (Survey/Experiments)	Research	2	0	0	8	12	0	6	0	0	100	100
	7	23MCAO217R	Field Training	Field Training	0	0	0	0	0	8	1	0	0	100	100
	8	23UMPD211R	PDP III - Corporate Proficiency	AEC	0	0	4	0	0	0	2	0	0	100	100
	9	23MCAO001R/ 23MCAO002R/ 23MCAO003R	Generic Elective II (Coursera) - Google - Foundations of Digital Marketing and E-commerce/ Imperial College London - Creative Thinking: Techniques and Tools for Success/ Marketing digital para E-commerce	MDC	1	0	0	0	0	0	1	0	0	100	100
	Total				**12**	**0**	**14**	**8**	**12**	**8**	**24**	**160**	**240**	**800**	**1300**

	S. N.	Course Code	Course Title	Course Category	Engagement						C	Maximum Marks for			
					L	T	P	S	R	O		IA*	SEE*	PE*	Total
Semester IV	1.	23MCAO221R	Design and Analysis of Algorithms	DSC (Major)	2	0	4	0	0	0	4	40	60	100	200
	2	23MCAO222R/ 23MCAO224R	Programme Elective II -Data Engineering/ Pattern Recognition	DSC (Major)	2	0	2	0	0	0	3	40	60	100	200
	3	23MCAO223R	Mini Research – R4 (Experimentation/Data Analysis and Thesis Preparation)	Research	0	0	0	8	12	0	4	0	0	100	100
	4	23MCAO004R/ 23MCAO005R/ 23MCAO006R	Generic Elective III (Coursera) – Leading Diverse Teams & Organizations/ Generative AI with Large Language Models/ Google - Digital Transformation Using AI/ML with Google Cloud Specialization	VAC	1	0	0	0	0	0	1	0	0	100	100
	Total				**5**	**0**	**6**	**8**	**12**	**0**	**12**	**80**	**120**	**400**	**600**

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

SEMESTER – I										
Course Title	**Programming Language I – Python**									
Course code	**23MCAO111R**	**Total credits: 5** **Total hours: 45T+60P**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			3	**0**	**4**	**0**	**0**	**0**	**5**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Fall/ I semester of the 1st year of the programme**								
Course Objectives	1. To provide the basic knowledge of Python programming. 2. To enhance the problem-solving capability using programming. 3. To explore and apply Python in practical applications								
CO1	Understand fundamental Python concepts, such as version distinctions, environment setup, and basic programming skills								
CO2	Apply conditional execution and iteration in Python, demonstrating a grasp of fundamental control flow concepts								
CO3	Understand and apply various types of Python functions								
CO4	Apply Python's data structures, showcasing practical application skills and achieving proficiency in manipulating diverse data formats								
CO5	Comprehend and apply object-oriented programming principles in Python, demonstrating the ability to design and implement modular and scalable software solutions.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Python:** Unique features of Python, Python-2 and Python-3 differences, Install Python and Environment Setup, First Python Program, Python Identifiers, Keywords and Indentation, inserting comments in python, Command line arguments, Getting User Input, Data types, Operators, Precedence and as sociativity.	**8**	Describe the unique features of Python, identify and use Python identifiers, keywords, and indentation rules, utilize command-line arguments to pass inputs to Python programs.	1, 2
II	**Conditional execution and Iteration:** Boolean expressions, logical operators, conditional and alternative execution, chained and nested conditionals, the while statement, infinite loops and *break*, finishing iterations with *continue*, *for* loops	**8**	Implement conditional execution using if-else statements, including alternative and nested conditionals.	3
III	**Functions:** Python built-in functions, defining and calling a function, parameters and arguments, fruitful functions and void functions, anonymous functions	**8**	Utilize Python's built-in functions effectively to perform common tasks. Define user-defined functions with parameters and arguments, demonstrating an understanding of function	2,3,4

			signatures and argument passing.	
IV	**Data Structures in Python:** Lists – traversing a list, list operations, list slices, list methods; Dictionaries – dictionary as a set of counters, looping and dictionaries; Tuples – tuple assignment, dictionaries, and tuples, using tuples as keys in dictionaries; Strings – string slices, looping and counting, the *in* operator, string comparison, string methods	**10**	Perform list operations such as appending, extending, inserting, and deleting elements. Use dictionaries to implement counters and mappings in Python. Assign values to tuples and understand the immutability of tuple elements. Manipulate strings using string slices for substring extraction and modification.	2, 3, 4
V	**Object Oriented Programming OOP in Python:** Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, Error and Exceptions: Difference between an error and Exception	**10**	Define and implement classes in Python, encapsulating data and behaviour. Understand the self variable and its role in instance methods within class definitions.	2, 3, 4
Practical				
Practical 1	Write a program to perform different calculation operations.	**4**	Understand and apply basic Python syntax, including variables, data types, operators, and expressions.	2, 3
Practical 2	Write a program to perform calculations from user input.	**4**	Demonstrate proficiency in Python syntax, data types, variables, and basic operations.	3
Practical 3	Write a python program to find the sum of *n* natural numbers with given range.	**4**	Define and interpret the problem of calculating the sum of natural numbers within a specified range.	2, 3
Practical 4	Write a python program to print multiplication table of a given number.	**4**	Define and interpret the problem of generating a multiplication table for a specified number. Decompose the problem into sequential steps for implementation in Python.	2, 3
Practical 5	Write a python program with function to find out whether a given number is prime or not.	**4**	Understanding and implementing prime number identification through efficient algorithmic and computational thinking.	2, 3, 4
Practical 6	Write a python program to check	**4**	Understand and apply	2, 3

	whether a number is palindrome or not.		basic Python syntax, including variables, data types, operators, and expressions.	
Practical 7	Write a python program to find largest number among three numbers.	**4**	Understand and apply basic Python syntax, including variables, data types, operators, and expressions.	2, 3
Practical 8	Write a python program to read a number and display corresponding day using if_elif_else.	**4**	Implement control structures such as if-else statements and loops (for and while) to control program flow based on conditions.	3,4
Practical 9	Write a python program to create a menu with the following options: a. To perform addition b. To perform subtraction c. To perform multiplication d. Accepts user input and perform the operation accordingly.	**4**	Accept user input to select an operation from the menu and input operands for the selected operation.	3
Practical 10	Write a python program for matrix operation between two matrices: add, multiply and subtract.	**4**	Develop basic algorithms and problem-solving skills using Python programming constructs.	4
Practical 11	Write a python program for constructor and destructor.	**4**	Define and understand constructor and destructor within a Python class to initialize object attributes during object creation.	2, 3
Practical 12	Write a python program to demonstrate the single and hybrid inheritance.	**4**	Utilize Python syntax and class definitions to implement single and hybrid inheritance within a program. Demonstrate the reuse of code and functionality through inheritance, avoiding redundancy and promoting modular design.	3, 4
Practical 13	Write a program to check if a year is leap or not.	**4**	Develop an algorithm to implement the leap year check using conditional statements and basic arithmetic operations.	3, 4, 5
Practical 14	Write a python program with a function to add and subtract two numbers.	**4**	Understand and apply the concept of function values to output the computed cube.	2, 3
Practical	Write a program with a function to	**4**	Implement the cube	3, 4, 5

15	calculate the cube of a number.		calculation function using Python syntax and basic operators. Understand and apply the concept of function return values to output the computed cube.	

TEXT BOOKS:

T1: Guttag J. Introduction to Computation and Programming Using Python. 2nd edition. Cambridge: MIT Press; 2016.
T2: Rao R. Nageswara. Core Python Programming. 2nd edition. New Delhi: Dreamtech Press; 2018.

REFERENCE BOOKS:

R1:Sedgewick R, Wayne K, Dondero R. Introduction to Programming in Python. 1st edition. Boston: Pearson; 2016.
R2: Chen DY. Pandas for Everyone: Python Data Analysis. 1st edition. Boston: Pearson Education; 2018

OTHER LEARNING RESOURCES:

https://onlinecourses.swayam2.ac.in/aic20_sp33/preview
https://www.codecademy.com/catalog/language/python

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand fundamental Python concepts, such as version distinctions, environment setup, and basic programming skills	**1, 5**
2	Apply conditional execution and iteration in Python, demonstrating a grasp of fundamental control flow concepts	**2, 3**
3	Understand and apply various types of Python functions	**1, 3**
4	Apply Python's data structures, showcasing practical application skills and achieving proficiency in manipulating diverse data formats	**1, 4**
5	Comprehend and apply object-oriented programming principles in Python, demonstrating the ability to design and implement modular and scalable software solutions.	**3, 5**

SEMESTER – I										
Course Title	**Advanced Web Applications Development**									
Course code	**23MCAO112R**	**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 Computer Application**									
Semester	**Fall/ I semester of the 1st year of the programme**									
Course Objectives	1. To understand the Fundamental principle of Web design, hosting and maintenance. 2. To understand tools required for Web design 3. To develop robust server-side applications using Node.js, other back-end frameworks.									
CO1	Understand the fundamentals of web application development, including client-side and server-side technologies.									
CO2	Create web pages using HTML, Cascading Style Sheets, JavaScript and XML									
CO3	Develop dynamic web applications using server-side programming languages and frameworks such as PHP, Python									
CO4	Implement data storage and retrieval in web applications using databases like MySQL									
CO5	Understand basic of Internet									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Basics of Internet:** Client/Server Computing: What is C/S Computing, Middleware, Fat client VS Fat Servers, N-tiered Software Architecture; WWW, Browser, Server, Webpage, Web development, HTML, HTTP, IP address, DNS & ports; secure HTTP, Secure Socket layer, WWW Proxies	**8**	Describe, illustrate, and explain Internet, Internet history and browsers, Servers.	1, 2
II	**Searching and Web Casting Technique:** Popular web servers, basic feature; bookmarks, cookies, progress indicators, customization of browsers, browsing tricks, search engines, architecture of search engines, search tools, web crawlerSed:Scripts, Operation, Addresses, commands, Applications, grep and sed.	**8**	Demonstrate the use of bookmarks, cookies, and progress indicators in web browsers. Integrate web technologies and search techniques into real-world applications.	1, 2
III	**Web page design:** Designing web pages with HTML- use of tags, hyperlinks, URLs, tables, text formatting, graphics & multimedia, imagemap, frames and forms in web pages. Use of Cascading Style Sheet in web pages. Introduction to DHTML.	**10**	Design and develop interactive, well-structured, and visually appealing web pages using HTML, CSS, and DHTML.	2, 3
IV	**Creating interactive and dynamic web pages with JavaScript:** JavaScript overview; constants,	**10**	Describe key concepts of JavaScript, including constants, variables,	2, 3, 4

	variables, operators, expressions & statements; user-defined & built-in functions; client-side form validation; using properties and methods of built-in objects. **Extensible Markup Language (XML):** Introduction- using user-defined tags in web pages; displaying XML contents; XML DTDs; use of XSL		operators, expressions, statements, and XML basics such as user-defined tags, XML DTDs, and XSL Implement JavaScript Design and develop dynamic and interactive web pages that leverage JavaScript for interactivity and XML for structured data	
V	**Web Server:** Web services and web server functionality; web server composition; registration; conceptual architecture of some typical web servers. Server-side scripting: overview of server-side scripts like CGI, ASP, and JSP. Server-side scripting using PHP; Web database connectivity- introduction to ODBC; PHP with database connectivity.	**8**	Explain the concepts and purposes of server-side scripting languages, develop and deploy web applications that incorporate server-side scripting, demonstrating a comprehensive understanding of web server functionality and web services..	3, 4, 5
Practical				
Practical 1	Write a HTML program for the demonstration of Unordered Lists.	**2**	Learn to create Unordered Lists	2, 3
Practical 2	Write a HTML program for the demonstration of ordered Lists	**2**	Learn to create Ordered Lists	2, 3
Practical 3	Write a HTML program for the demonstration of Definition Lists	**2**	Learn to create Definition Lists	2
Practical 4	Write a HTML program for the demonstration of Nested Lists	**2**	Learn to create Nested Lists	2, 3
Practical 5	Write a HTML program for demonstrating Hyperlinks. Navigation from one page to another and Navigation within the page.	**2**	Understand hyperlink and implement hyperlink navigation from one page to another and within the page	2, 3
Practical 6	Write a HTML program for time-table using tables.	**2**	Understand and implement queue using linked list	2, 3
Practical 7	Write a HTML program to develop a static Home Page using frames.	**2**	Understand and apply polynomial addition and subtraction	4
Practical 8	Write a HTML program to develop a static Registration Form	**2**	Understand and convert infix to postfix using C program.	3
Practical 9	Write a HTML program to develop a static Login Page.	**2**	Evaluate expression using C program.	3
Practical 10	Write a HTML program to develop a static Web Page for Catalog.	**2**	Understand AVL tree and implement using array.	3
Practical 11	Write a HTML program to develop a	**2**	Develop heap using	3

	static Web Page for Shopping Cart.		priority queue.	
Practical 12	Write HTML for demonstration of cascading Embedded stylesheets.	**2**	Understand graph and its representation.	3
Practical 13	Write HTML for demonstration of cascading External stylesheets	**2**	Understand the concepts of traversal breadth first traversal.	3
Practical 14	Write HTML for demonstration of cascading Inline styles.	**2**	Understand and apply the concepts of traversal depth first traversal.	3
Practical 15	Write a JavaScript program to validate USER LOGIN page.	**2**	Develop a user login page	3
Practical 16	Write a program for implementing XML documents for CUSTOMER DETAILS.	**2**	Develop skills in creating well-formed XML documents.	3
Practical 17	Write an internal Document Type Definition to validate XML for CUSTOMER DETAILS	**2**	Learn how to create an internal DTD to define the structure and constraints of an XML document.	3
Practical 18	Write an external Document Type Definition to validate XML for CUSTOMER DETAILS	**2**	Develop skills in managing and maintaining DTD files for multiple XML documents.	3
Practical 19	Write a simple servlet that displays a message	**2**	Develop skills in handling HTTP requests and generating HTTP responses.	3
Practical 20	Write a servlet that reads parameters from employee login page	**2**	Understand how to read and process parameters from HTTP requests in a servlet.	3

TEXT BOOKS:

T1: Xavier C. Web Technology & Design. 1st edition. New Delhi: New Age Publication; 2003.
T2: Austin K, Pawlan M. Advanced Programming for JAVA2 Platform. 1st edition. Boston: Pearson; 2000.

REFERENCE BOOKS:

R1: Oliver D. SAMS Teach Yourself HTML 4 in 24 Hours. 1st edition. New Delhi: Techmedia; 1999.
R2: Ashbacher C. SAMS Teach Yourself XML in 24 Hours. 1st edition. New Delhi: Techmedia; 2000.

OTHER LEARNING RESOURCES:

https://onlinecourses.swayam2.ac.in/nou24_cs09/preview

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the fundamentals of web application development, including client-side and server-side technologies.	**1, 5**
2	Create web pages using HTML, Cascading Style Sheets, JavaScript and XML	**3, 5**
3	Develop dynamic web applications using server-side programming languages and frameworks such as PHP, Python	**1, 3**
4	Implement data storage and retrieval in web applications using databases like MySQL	**1, 4**
5	Understanding the basics of the Internet.	**1, 8**

SEMESTER – I										
Course Title	**Mathematics**									
Course code	**23MCAO113R**	**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 Computer Application**									
Semester	**Fall/ I semester of the 1st year of the programme**									
Course Objectives	1. Use discrete mathematics to model and solve problems in computer science 2. Understand and apply basic algebraic concepts and techniques 3. Use mathematical knowledge to enhance their understanding of other computer science topics.									
CO1	Understand and use the principles of mathematical reasoning to solve real-world problems.									
CO2	Interpret the results of mathematical computations and make contributions to their field.									
CO3	Use appropriate mathematics skills and techniques in the analysis of data									
CO4	Demonstrate proficiency in using matrix techniques to develop solutions									
CO5	Apply mathematical machines to solve practical problems in areas such as automata theory, formal languages, and computational complexity.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Set Relations and Functions:** Definition of sets and subsets, Intersection, Union and complements, DeMorgan's law, Cardinality Relations, Equivalence Relations etc, Mappings One-one, Onto etc, Counting principles, pigeon hole principle, Lattice, Boolean Algebra, Grammar and Language	**6**	Explain the properties of relations, examine and distinguish between different types of relations, mappings, and algebraic structures	1, 2
II	**Algebraic Structures:** Group, Semigroup, Monoid, Ring, Field, Vector Space	**6**	Explain the axioms and properties, use the principles and operations of groups, semigroups, monoids, rings, fields, and vector spaces to solve relevant mathematical problems.	2, 3
III	**Logic**: Logic operators like AND OR etc, Truth Tabkes, Theory of inference and deduction, Mathematical Induction, Predicate Calculus	**6**	Explain the construction and interpretation of truth tables, Examine logical statements and arguments, identifying valid and invalid inferences, and analyzing the structure of logical proofs.	2, 3
IV	**Linear Equation and Matrices**: Row / column operations, Gaussian Eliminations, Decomposition, Inverse System of linear equations, Linear dependence, Eigen values,	**6**	Explain the principles and procedures, analyze the structure and properties of matrices, interpret the significance of eigenvalues	2, 3, 4

	Eigen vectors		and eigenvectors in practical applications.	
V	**Mathematical Machines**: Finite state machine, Push down automata and Turing machine (Introduction and preliminary concepts only)	**6**	Explain the operational principles and theoretical foundations of finite state machines, evaluate the efficiency and effectiveness of using different types of mathematical machines for specific computational problems	3, 4, 5

TEXT BOOKS:

T1: Liu CL. Elements of Discrete Mathematics – A Computer Oriented Approach. 4th edition.

REFERENCE BOOKS:

R1: Tremblay JP, Manohar R. Discrete Mathematical Structures with Applications to Computer Science. 1st edition.

OTHER LEARNING RESOURCES:

https://onlinecourses.nptel.ac.in/noc24_ma68/preview

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand and use the principles of mathematical reasoning to solve real-world problems.	**1, 2**
2	Interpret the results of mathematical computations and make contributions to their field.	**2, 4**
3	Use appropriate mathematics skills and techniques in the analysis of data	**1, 4**
4	Demonstrate proficiency in using matrix techniques to develop solutions	**1, 3**
5	Apply mathematical machines to solve practical problems in areas such as automata theory, formal languages, and computational complexity.	**1, 3**

SEMESTER – I										
Course Title	**Fundamentals of Statistics**									
Course code	**23MCAO114R**	**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 Computer Application**								
Semester	**Fall/ I semester of the 1st year of the programme**								
Course Objectives	1. To introduce the foundations of probability and statistical methods. 2. To explain the concepts in random variables and several distributions in engineering applications. 3. To learn the concepts of correlation, regression and estimations and their properties and to explain the concept of testing of hypotheses.								
CO1	Understanding the fundamental concepts of probability and statistics.								
CO2	Describe important probability distributions like Binomial, Poisson Distributions and Normal Distributions.								
CO3	Explain the concept of testing hypotheses.								
CO4	Analyse the concepts of correlation, regression and estimations and their properties.								
CO5	Apply appropriate statistical tests using the t-distribution, F-test, and chi-squared (χ^2) test to analyze data and draw valid conclusions.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to statistics:** population vs sample, collection of data, primary and secondary data, types of variables: dependent, independent, categorical and continuous variables, data visualization, measures of central tendency, measures of dispersion	**6**	Understand the fundamentals of statistics, including the distinction between population and sample, and the importance of representative data sampling.	2
II	**Random variables:** discrete and continuous, probability mass and density functions, probability distribution Binomial, Poisson, normal distribution- and their properties(Mathematical expectation and variance).	**6**	Differentiate between discrete and continuous random variables, andtheir fundamental properties and characteristics.	2, 3
III	**Correlation:** correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight line, parabola and exponential curves). Estimation: Parameter, statistic, sampling distribution, point estimation, properties of estimators, interval estimation.	**6**	Define and interpret correlation and correlation coefficient concepts to measure the strength and direction of linear relationships between variables. Apply regression analysis techniques to model and analyze relationships between variables, including simple linear regression and multiple regression models.	2, 3
IV	**Formulation of null**	**6**	Formulate null hypotheses	4

	hypothesis:Alternative hypothesis, critical region, two types of errors, level of significance and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means confidence interval for parameters in one sample and two sample problems.		(H0) and alternative hypotheses (H1) to make assertions about population parameters based on sample data.	
V	**Student t-distribution**: test for single mean, two means and paired t-test, testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.	**6**	Understand the properties and application of the student t-distribution in hypothesis testing, develop critical thinking skills to evaluate the appropriateness of chosen hypotheses, understand the assumptions underlying each test	4, 5

TEXT BOOKS:

T1: Johnson RA. Miller & Freund's Probability and Statistics for Engineers. 9th edition. Boston: Pearson; 2017.

T2: Gupta SC, Kapoor VK. Fundamentals of Mathematical Statistics. 11th edition. New Delhi: Sultan Chand & Sons Educational Publications; 2012.

REFERENCE BOOKS:

R1: Feller W. An Introduction to Probability Theory and Its Applications. 3rd edition. New York: Wiley; 1968.

OTHER ONLINE RESOURCES:

https://onlinestatbook.com/2/index.html

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understanding the fundamental concepts of probability and statistics.	**1, 12**
2	Describe important probability distributions like Binomial, Poisson Distributions and Normal Distributions.	**1, 4**
3	Explain the concept of testing hypotheses.	**2, 4**
4	Analyse the concepts of correlation, regression and estimations and their properties.	**1, 3**
5	Apply appropriate statistical tests using the t-distribution, F-test, and chi-squared (χ^2) test to analyze data and draw valid conclusions.	**1, 4**

SEMESTER – I										
Course Title	**Programming and Data Structures**									
Course code	**23MCAO115R**	**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 Computer Application**								
Semester	**Fall/ I semester of the 1st year of the programme**								
Course Objectives	1. To understand the basic programming in C 2. To acquire the basic concepts of Data Structures and their applications 3. To acquire knowledge on Searching and Sorting and their applications								
CO1	Understand the fundamental concepts and principles of data structures								
CO2	Use and implement appropriate data structure for the required problems using a programming language such as C								
CO3	Implement various data structures *viz*. Stacks, Queues, Linked Lists, Trees and Graphs								
CO4	Understand various searching & sorting techniques								
CO5	Apply algorithms for various sorting techniques and compare their performance in terms of Space and Time complexity								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Data Structures:** Algorithms and Flowcharts, Basics Analysis on Algorithm, Complexity of Algorithm, Introduction and Definition of Data Structure, Classification of Data, Arrays, Various types of Data Structure, Static and Dynamic Memory Allocation, Function, Recursion.	**4**	Interpret and create flowcharts to represent algorithms systematically, understand the concepts of algorithmic complexity and its significance in evaluating the efficiency of algorithms.	2, 3
II	**Arrays, Pointers and Strings:** Introduction to Arrays, Definition, One Dimensional Array and Multidimensional Arrays, Pointer, Pointer to Structure, various Programs for Array and Pointer. Strings. Introduction to Strings, Definition, Library Functions of Strings.	**4**	Understand the concept of arrays as a sequential collection of elements of the same data type. Understand pointers as variables that store memory addresses. Define strings as arrays of characters	2
III	**Stacks and Queue:** Introduction to Stack, Definition, Stack Implementation, Operations of Stack, Applications of Stack and Multiple Stacks. Implementation of Multiple Stack Queues, Introduction to Queue, Definition, Queue Implementation, Operations of Queue, Circular Queue, De-queue and Priority Queue.	**6**	Understand the concept of a stack as a Last In, First Out (LIFO) data structure.Identify scenarios where stacks are applicable, Understand the concept of a queue as a First In, First Out (FIFO) data structure.	2
IV	**Linked Lists and Trees:**	**8**	Understand the concept	2, 3

	Introduction, Representation and Operations of Linked Lists, Singly Linked List, Doubly Linked List, Circular Linked List, And Circular Doubly Linked List **Trees:** Introduction to Tree, Tree Terminology Binary Tree, Binary Search Tree, Strictly Binary Tree, Complete Binary Tree, Tree Traversal, Threaded Binary Tree, AVL Tree B Tree, B+ Tree.		of a linked list as a linear data structure, understand tree terminologies such as parent, child, sibling, leaf, and height.	
V	**Graphs, Searching, Sorting and Hashing Graphs:** Introduction, Representation to Graphs, Graph Traversals Shortest Path Algorithms. **Searching and Sorting:** Searching, Types of Searching, Sorting, Types of sorting like quick sort, bubble sort, merge sort, selection sort **Hashing:** Hash Function, Types of Hash Functions, Collision, Collision Resolution Technique (CRT), Perfect Hashing	**8**	Understand the concept of a graph as a collection of vertices (nodes) and edges connecting pairs of vertices. Define and implement searching and sorting algorithms. Define a hash function and its role in converting keys into array indices.	2,3, 4, 5
Practical				
Practical 1	Write a C program to calculate the sum of first n natural numbers using for loop.	**2**	Understand the basic syntax, data types, variables, operators, and control structures in C.	2, 3
Practical 2	Write a C program to find the factorial of a number.	**2**	Analyse and Develop skills in designing and writing structured and modular programs using procedural programming concepts.	3, 4
Practical 3	Write a C program to print Fibonacci series using for loop.	**2**	Develop skills in designing and writing structured and modular programs using procedural programming concepts.	4
Practical 4	Write a C Program to check whether a number is a prime number or not.	**2**	Develop the ability to implement an algorithm to determine whether a number is prime using efficient techniques like trial division.	4
Practical 5	Write a C program to print Prime Numbers From 1 to N.	**2**	Gain a clear understanding of prime numbers and their characteristics	2
Practical 6	Write a C program to insert elements	**2**	Understand the basics of	2, 3

	in an array and display the same.		arrays in C programming, including declaration and initialization.	
Practical 7	Write a C program to search an element in array using C (linear search)	**2**	Understand and implement the linear search algorithm for finding an element in an array.	2, 4
Practical 8	Write a C program to implement stack operations (Push, Pop and Display).	**2**	Understand the stack data structure and its operations (Push, Pop).	2
Practical 9	Write a C Program to Implement a Queue using an Array(insert, delete and display).	**2**	Understand the queue data structure and its operations (Insert, Delete). Implement a queue using an array and manage elements using queue operations.	2, 3
Practical 10	Write a C program to sort N numbers in ascending order using Bubble sort and print both the given and the sorted array	**2**	Understand the bubble sort algorithm and its basic principles. Learn to manipulate arrays for sorting purposes.	2, 3
Practical 11	Write a C Program to sort an array using Insertion Sort.	**2**	Understand the insertion sort algorithm and its key features. Implement insertion sort to rearrange elements in an array.	2, 3, 4
Practical 12	Write a C Program to sort an array using Selection Sort.	**2**	Understand the selection sort algorithm and its characteristics. Apply selection sort to sort arrays of varying sizes efficiently.	2, 3, 4
Practical 13	Write a C program to perform Link List operations (Insert in the beginning, last, specified position, Delete from Beginning, last, specified location, Show)	**2**	Implement linked list operations (Insert at beginning, end, specified position; Delete from beginning, end, specified position).	4
Practical 14	Write a C program to convert Infix to post-fix	**2**	Understand the process of converting infix expressions to postfix (Reverse Polish Notation),	2, 3
Practical 15	Write a C program to convert Post-fix to infix	**2**	Implement a stack to assist in the conversion	3,4,5

			of postfix expressions to infix	

TEXT BOOKS:

T1: Horowitz E, Sahni S, Anderson-Freed S. Fundamentals of Data Structures in C. 2nd edition. Hyderabad: University Press; 2008.

REFERENCE BOOKS:

R1: Kushwaha DS, Misra AK. Data Structures: A Programming Approach with C. 1st edition. New Delhi: PHI Learning; 2008.

R2: Kruse R, Tondo CL, Leung B. Data Structures and Program Design in C. 2nd edition. Boston: Pearson; 1997.

ONLINE LEARNING RESOURCES:

https://www.programiz.com/dsa

https://onlinecourses.swayam2.ac.in/cec24_cs17/preview

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the fundamental concepts and principles of data structures	**1, 5**
2	Use and implement appropriate data structure for the required problems using a programming language such as C.	**1, 3**
3	Implement various data structures viz. Stacks, Queues, Linked Lists, Trees and Graphs.	**1, 3**
4	Understand various searching & sorting techniques.	**2, 5**
5	Apply algorithms for various sorting techniques and compare their performance in terms of Space and Time complexity.	**1, 4**

SEMESTER – I										
Course Title	**Mini Research (Review of Literature- R1)**									
Course code	**23MCAO116R**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**4**	**8**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Fall/ I semester of the 1st year of the programme**								
Course Objectives	1. To develop a comprehensive understanding of the research process and its significance in academic and professional settings. 2. To familiarize students with the concept of a literature review and its role in establishing the theoretical framework and identifying research gaps. 3. To enable students to critically analyze existing literature related to a specific research topic or area of interest.									
CO1	Understand the review process and assess the scientific literature critically.									
CO2	Compare and contrast the empirical findings from a variety of studies.									
CO3	Assess the rational, empirical, and methodological strengths and weakness of different studies.									
CO4	Derive a novel, meaningful, informed, and testable research hypothesis from a literature review.									
CO5	Understanding on how to critically read and assess research papers and reviews.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Research Process**: Overview of the research process, role and significance of literature review **Formulating Research Questions and Objectives**: Defining research questions and objectives, developing a research framework	**6**	Define what research is and understand the purpose and importance of conducting research in various fields. Learn about different research methodologies, understand the strengths and limitations of each methodology.	1, 2
II	**Searching for Scholarly Sources:** Effective search strategies and techniques, Utilizing databases and search engines **Evaluating Source Credibility**: Criteria for assessing source credibility, Identifying reliable and reputable sources	**6**	Understand how to formulate search queries using keywords, develop the ability to recognize bias, identify conflicts of interest, and verify the accuracy of the information presented in scholarly sources.	1, 2, 4
III	**Critical Analysis and Synthesis**: Analysing and interpreting research findings Synthesizing information from multiple sources **Identifying Research Gaps**: Identifying gaps in existing literature, formulating research hypotheses or objectives	**6**	Learn to evaluate the strengths and weaknesses of research studies, develop skills to recognize areas where additional research is needed to address unanswered questions or emerging issues.	2, 3, 4
IV	**Writing Literature Review**: **Structure and Organization**:	**6**	Learn the purpose of each section in the context of	2, 3, 4

	Introduction, body, and conclusion of a literature review Structuring the literature review effectively **Writing Literature Review**: **Language and Style:** Academic writing conventions Developing clarity and coherence in writing		synthesizing existing research and setting the stage for new contributions. Develop the ability to write a comprehensive literature review that synthesizes existing research, identifies gaps, and justifies the relevance of the study.	
V	**Revising and Finalizing the Literature Review**: Reviewing and revising the literature review, Polishing the final version	**6**	Develop skills to critically review and revise the literature review to enhance clarity, coherence, and logical flow. Develop skills to polish and finalize the literature review, ensuring it meets academic standards and is ready for submission or publication.	3, 4

TEXT BOOKS:

T1: Hart C. Doing a Literature Review. 2nd edition. London: Sage Publications; 2018.

REFERENCE BOOKS:

R1: Booth A, Papaioannou D, Sutton A. Systematic Approaches to a Successful Literature Review. 2nd edition. London: Sage Publications; 2016.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the review process and assess the scientific literature critically.	**4, 12**
2	Compare and contrast the empirical findings from a variety of studies.	**2, 4**
3	Assess the rational, empirical, and methodological strengths and weakness of different studies.	**2, 4**
4	Derive a novel, meaningful, informed, and testable research hypothesis from a literature review.	**2, 10**
5	Understanding on how to critically read and assess research papers and reviews.	**4, 12**

SEMESTER – I										
Course Title	**PDP I - EFFECTIVE ENGLISH**									
Course code	**23UMPD111R**	**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	**Master of Computer Application**								
Semester	**Fall/ I semester of the 1st 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 introduce the 3 P's (Planning, prioritizing & performing) of Time Management.								
CO1	Enable students to analyze and identify the different types of sentences.								
CO2	Integrate the skills of reading and speaking in professional communication.								
CO3	Learn Dress code Etiquettes that will boost their confidence and morals.								
CO4	Learn about the effective and efficient utilization of time.								
CO5	Develop learners' pronunciation with the knowledge of Phonetics.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Grammar:** Interchange of Interrogative and Assertive Sentences, Exclamatory and Assertive Sentences Types of Tenses, Common Errors, Synonyms, Antonyms, Homonyms	**12**	Understand the rules for converting interrogative sentences into assertive sentences and vice versa. Develop the ability to express the same idea in different sentence forms, enhancing language flexibility and communication skills.	2, 3, 4
II	**Reading Skills:** Techniques of Effective Reading, Gathering ideas and information from a text The SQ3R Technique Interpret the text	**12**	Develop and apply various reading strategies such as skimming, scanning, and in-depth reading for different purposes.	3
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,	**12**	Learn the stages of the listening process: receiving, understanding, evaluating, remembering, and responding. Develop awareness of each stage to improve overall listening effectiveness. Acquire and practice techniques to improve the listening process, such as maintaining eye contact, providing feedback, and avoiding interruptions.	2, 3, 4
IV	**Conflict Management:** Definition, Type of Conflict Management, Effects of Conflict Management, Methods to deal	**12**	Define conflict management and understand its significance in personal, professional, and social contexts.	3, 4

	with Conflicts (Negative)		Develop techniques to address and manage negative conflicts effectively, such as active listening, empathy, and open communication.	
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.	**12**	Recognize the role of effective time management in achieving goals and maintaining work-life balance. Understand the purpose of time management, including improving efficiency, productivity, and reducing stress. Develop skills to track and analyze how time is spent on various activities.	3, 4, 5

TEXT BOOKS:

T1: Wren PC, Martin H. High School English Grammar and Composition. Revised edition. New Delhi: S Chand Publishing; 1995.

T2: Barrett G. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking. 1st edition. Berkeley: Zephyros Press; 2016.

REFERENCE BOOKS:

R1: McCarthy M, O'Dell F. English Vocabulary in Use (Advanced). 1st edition. Cambridge: Cambridge University Press; 2002.

R2: Bhatnagar N. Effective Communication and Soft Skills. 1st edition. New Delhi: Pearson; 2011.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Enable students to analyze and identify the different types of sentences.	**2, 9**
2	Integrate the skills of reading and speaking in professional communication.	**6, 9**
3	Learn Dress code Etiquettes that will boost their confidence and morals.	**7, 8**
4	Learn about the effective and efficient utilization of time.	**11, 12**
5	Develop learners' pronunciation with the knowledge of Phonetics.	**6, 9**

SEMESTER – I									
Course Title	**MOOCS I - Foundations of User Experience (UX) Design**								
Course code	**23MOSY114R**	**Total credits: 1** **Total hours: 15T**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			1	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Fall/I semester of the 1st year of the programme**								
Course Objectives	1. To define User Experience (UX) design and list its core principles. 2. To explain the user-centered design (UCD) framework and its stages. Students will be able to identify design best practices, including inclusive design and accessibility considerations, and apply them to a design scenario. 3. To define design sprints and identify the different stages involved. Students will be able to explain how to plan and participate effectively in a design sprint.								
CO1	Explain the importance of UX design in user-centered product creation and describe the responsibilities of a UX designer within a design team.								
CO2	Analyze how design decisions impact user experience across different platforms.								
CO3	Evaluate the value of design sprint retrospectives in iterative design processes.								
CO4	Analyze the appropriateness of different research methods for specific design scenarios.								
CO5	Create and test prototypes and wireframes, incorporating user feedback to improve usability and functionality.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introducing user experience design:** World of UX and the factors that contribute to great user experience design. job of a UX designer and teams that UX designers often work with, expectations of the Google UX Design Certificate.	**3**	Identify the key elements that contribute to great user experience design. Apply basic UX principles to suggest improvements to these interactions.	2, 3
II	**Thinking like a UX designer:** User-centered design and one of the design frameworks that UX designers use on the job, design best practices, including the importance of inclusive design and accessibility when designing, how to think across platforms to design seamless user experiences.	**3**	Understand the principles of user-centered design. Implement inclusive design principles to create products that are usable by a diverse range of people. Develop the ability to critically evaluate design solutions.	2, 3, 4
III	**Joining design sprints:** The world of design sprints, including the phases of a design sprint, retrospectives, which is a way to constructively reflect on a design sprint and identify areas of improvement to implement next time.	**3**	Describe the phases of a design sprint, including Understand, Define, Sketch, Decide, Prototype, and Test. Develop a plan to address identified issues and incorporate best practices into subsequent sprints.	2, 3, 4
IV	**Integrating research into the**	**3**	Explain the importance of	3, 4,

	design process: The role of research in the design process to help better understand and empathize with users, the benefits and drawbacks of common UX research methods, biases that can arise when conducting research.		research in the UX design process. Develop a research plan that includes objectives, methodologies, and timelines. Create user journey maps to visualize users' experiences and identify pain points and opportunities for improvement.	5
V	**Prototyping and Wire framing:** Practical aspects of bringing UX designs to life, visualization and testing of ideas before full-scale development, types of prototypes, ranging from low-fidelity sketches to high-fidelity interactive models.	**3**	Create low-fidelity and high-fidelity prototypes using industry-standard tools, conduct usability testing on their prototypes, analyze user feedback, and iterate on their designs to improve usability and functionality, ensuring a user-centered approach throughout the design process.	4, 5

ONLINE LEARNING RESOURCES:

https://www.coursera.org/learn/foundations-user-experience-design?msockid=1954f0e1fa896a282311e344fb616b5c

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the importance of UX design in user-centered product creation and describe the responsibilities of a UX designer within a design team.	**3, 6**
2	Analyze how design decisions impact user experience across different platforms.	**3, 5**
3	Evaluate the value of design sprint retrospectives in iterative design processes.	**11, 12**
4	Analyze the appropriateness of different research methods for specific design scenarios.	**2, 4**
5	Create and test prototypes and wireframes, incorporating user feedback to improve usability and functionality.	**3, 4**

SEMESTER – I										
Course Title	**Bridge Course I - Internet Concept and Web Design**									
Course code	**23MCAO117R**	**Total credits: 5** **Total hours: 45T+60P**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
			3	**0**	**4**	**0**	**0**	**0**	**5**	
Pre-requisite	**Nil**	**Co-requisite**	**Nil**							
Programme	**Master of Computer Application**									
Semester	**Fall/I semester of the 1st year of the programme**									
Course Objectives	1. To provide the conceptual and technological developments in the field of Internet and web designing 2. Understand the historical context and development of the Internet. 3. Explain the key protocols and standards that underpin the Internet.									
CO1	Review the current topics in Web & Internet technologies.									
CO2	Describe the basic concepts for network implementation.									
CO3	Learn the basic working scheme of the Internet and World Wide Web.									
CO4	Understand fundamental tools and technologies for web design.									
CO5	Apply design best practices to create visually appealing and functional web pages.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Internet:** Growth of Internet, Owners of the Internet, Anatomy of Internet, ARPANET and Internet history of the World Wide Web, basic Internet Terminology, Net etiquette. Internet Applications – Commerce on the Internet, Governance on the Internet, Impact of Internet on Society – Crime on/through the Internet.	**8**	Explain the historical development and growth of the Internet, including key milestones and contributors. Analyze the evolution from ARPANET to the modern Internet infrastructure.	2, 3
II	**TCP/IP – Internet Technology and Protocols:** Packet switching technology, Internet Protocols: TCP/IP, Router, Internet Addressing Scheme: Machine Addressing (IP address), E-mail Addresses, Resources Addresses	**8**	Explain the concept of packet switching and its role in efficient data transmission over networks. Describe the TCP/IP protocol suite, including its layers (TCP, IP, UDP, etc.) and their functions in network communication.	3
III	**Internet Connectivity:** Connectivity types: level one, level two and level three connectivity, Setting up a connection: hardware requirement, selection of a modem, software requirement, modem configuration, Internet accounts by ISP: Telephone line options, Protocol options, Service options, Telephone line options – Dialup connections through the telephone system, dedicated connections through the telephone system	**8**	Evaluate options provided by Internet Service Providers (ISPs) for setting up Internet accounts, including telephone line options, protocol options	3, 4

IV	**Internet Network:** Network definition, Common terminologies: LAN, WAN, Node, Host, Workstation, bandwidth, Interoperability, Network administrator, network security, Network Components: Severs, Clients, Communication Media, Types of network: Peer to Peer, Clients Server, Addressing in Internet: DNS, Domain Name and their organization, understanding the Internet Protocol Address.	**8**	Describe the roles and interactions of servers and clients in network environments, understanding their functions in data storage, processing, and access. Define an IP address and its significance in network communication.	3, 4
V	**Web Publishing and Browsing:** Overview, SGML, Web hosting, HTML. CGL, Documents Interchange Standards, Components of Web Publishing, Document management, Web Page Design Consideration and Principles, Search and Meta Search Engines, WWW, Browser, HTTP, Publishing Tools	**8**	Utilize HTML to structure and format web pages, incorporating elements such as text, images, hyperlinks, tables, and forms.	3, 4, 5
Practical				
Practical 1	Write HTML code to develop a Web page having the background in red and title "My First Page" in any other colour.	**2**	Understand the basic structure of an HTML document, Implement basic design principles	2
Practical 2	Create an HTML document giving details of your name, age, telephone number, address, TLC code & enrolment number aligned in proper order.	**2**	Apply knowledge of HTML and CSS to create structured documents with well-organized content and proper alignment.	2, 3
Practical 3	Write an HTML code to design a page containing text, in the form of paragraphs giving suitable heading style.	**2**	Use semantic HTML tags to structure content logically and provide meaningful labels	3, 4
Practical 4	Create a page to show different attributes of the Font tag.	**2**	Explore various attributes such as color, face, size, and style within the <font> tag to control the appearance of text.	2, 3
Practical 5	Create a page to show different attributes: italics, bold, underline.	**2**	Explore various attributes such as color, face, size, and style within the <font> tag to control the appearance of text.	2, 3
Practical 6	Design a page having background colour yellow, giving text colour red and using all the attributes of font tab.	**2**	Use the color attribute to set text color to red, demonstrating the use of hexadecimal color codes	3, 4
Practical 7	Write an HTML code to create a Web page of blue color and display links in red colour.	**2**	Evaluate the visual impact of color choices on text readability and aesthetic appeal in web pages.	3, 4
Practical 8	Write an HTML code to create a Web	**2**	Utilize the <img> tag to insert	3,

	page that contains an image at its center.		an image into a web page, specifying attributes such as src (source) and alt (alternative text) for accessibility.	4, 5
Practical 9	Create a Web page with appropriate content and insert an image towards the left- hand side of the page. When user clicks on the image, it should open another Web page.	**2**	Apply learned concepts to create interactive web pages that integrate images with hyperlinks to enhance user engagement and site navigation.	3, 4, 5
Practical 10	Create a Web page, wherein when the user clicks on the link it should go to the bottom of the page.	**2**	Apply CSS or JavaScript techniques to achieve smooth scrolling effects when navigating to the linked section at the bottom of the page.	4, 5
Practical 11	Write HTML code to create a Web page of pink colour and display a moving message in red colour.	**2**	Apply knowledge of color codes to customize text colors effectively in various HTML elements.	4, 5
Practical 12	Build an HTML page that serves as a personal biography. The page should include a header with your name, a photograph, and at least three paragraphs describing your background, interests, and professional aspirations. Also, include a list of hobbies.	**2**	Understand and apply various HTML elements like headers, paragraphs, and lists to construct a structured personal biography webpage.	5, 6
Practical 13	Develop an HTML page that displays a list of at least five products for an e-commerce store. Each product should have a name, description, price, and an image.	**2**	Learn to use HTML tables or div elements effectively to display product information in a clean and organized manner on an e-commerce page.	5, 6
Practical 14	Create an HTML form for event registration that collects the participant's name, email, date of birth, and a dropdown to select a T-shirt size (S, M, L, XL). Include a 'Submit' button.	**2**	Gain proficiency in creating interactive forms using HTML, incorporating elements for user input, and implementing basic form validations.	5, 6
Practical 15	Build an HTML page that details a recipe. The page should include the recipe name, ingredients, and step-by-step cooking instructions.	**2**	Master the use of semantic HTML5 to structure content-rich webpages, including articles and sections, enhancing content accessibility and SEO.	5, 6

TEXT BOOKS:

T1: Greenlaw R, Hepp E. Fundamentals of Internet and WWW. 1st edition. New Delhi: Tata McGraw-Hill; 2007.

REFERENCE BOOKS:

R1: Comer D. The Internet Book. 5th edition. Boston: Pearson Education; 2019.

R2: Young ML. The Complete Reference to Internet. 1st edition. New Delhi: Tata McGraw-Hill; 2007.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Review the current topics in Web & Internet technologies.	**1, 12**
2	Describe the basic concepts for network implementation.	**1, 5**
3	Learn the basic working scheme of the Internet and World Wide Web.	**1, 4**
4	Understand fundamental tools and technologies for web design.	**3, 5**
5	Implement principles of UX design to create intuitive and user-friendly web interfaces.	**3, 9**

SEMESTER – I										
Course Title	**Bridge Course II - Algorithm for Problem Solving**									
Course code	**23MCAO118R**	**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	**Master of Computer Application**									
Semester	**Fall/I semester of the 1st year of the programme**									
Course Objectives	1. To understand the basics of algorithm and computational knowledge. 2. To understand computational thinking. 3. To apply algorithmic problem-solving techniques to real world problems.									
CO1	Understanding of algorithms and their significance in problem-solving across various domains									
CO2	Understanding of computational thinking and programming									
CO3	Implement and analyze computational thinking for different computational problems.									
CO4	Apply various algorithmic solutions to real world problems									
CO5	Implementing problem decomposition and representation.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Computational Thinking:** About computational thinking, four pillars of computational thinking.	**8**	Gain a foundational understanding of computational thinking and its importance in problem-solving across various disciplines.	1, 2
II	**Problem Decomposition and Representation:** Breaking down problems, introduction to trees, graphs, flowchart.	**8**	Learn techniques for breaking down complex problems into smaller, more manageable parts. Understand the fundamentals of tree graph data structures.	2, 3
III	**Introductions to Computers and Programming:** Hardware and software, introduction to programming, learning to program, variables, data types, user I/O, operators, loops, conditional statements	**8**	Identify and understand the major hardware components of a computer (CPU, memory, storage, I/O devices).	3
IV	**Functions and advanced data types:** Introduction to function, define and call functions, arrays.	**10**	Understand the concept of functions and their role in modular programming. Learn how to define functions with appropriate parameters and return types.	2, 3
V	**Introduction to algorithms:** About algorithms, basic algorithms like search and sort, pseudocode.	**10**	Gain a clear understanding of what an algorithm is and why algorithms are fundamental in computer science and problem-solving.	2, 3, 4

TEXT BOOKS:

T1: Cormen TH, Leiserson CE, Rivest RL, Stein C. Introduction to Algorithms. 4th edition. Cambridge: MIT Press; 2022.

T2: Beecher K. Computational Thinking: A Beginner's Guide to Problem-Solving and Programming. 1st edition. Swindon: British Computer Society; 2017.

REFERENCE BOOKS:

R1: Petzold C. Code: The Hidden Language of Computer Hardware and Software. 1st edition. Redmond: Microsoft Press; 2000.

R2: Christian B, Griffiths T. Algorithms to Live By: The Computer Science of Human Decisions. 1st edition. New York: Henry Holt and Company; 2016.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understanding of algorithms and their significance in problem-solving across various domains	**1, 2**
2	Understanding of computational thinking and programming	**1, 12**
3	Implement and analyze computational thinking for different computational problems.	**2, 3**
4	Apply various algorithmic solutions to real world problems	**1, 3**
5	Implementing problem decomposition and representation.	**2, 3**

SEMESTER – II									
Course Title	**Advanced Data Structures**								
Course code	**23MCAO121R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T+60P	**2**	**0**	**4**	**0**	**0**	**0**	**4**
Pre-requisite	**Basics of data structures**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Winter/ II semester of the first year of the programme**								
Course Objectives	1. To acquire the advanced concepts of Data Structures and their applications. 2. To acquire knowledge on Searching and Sorting and their applications. 3. To gain the ability to apply and implement algorithm design techniques.								
CO1	Understand the fundamental concepts and principles of data structures								
CO2	Understanding of advanced data structures such as balanced search trees (AVL, Red-Black trees), heaps, graphs, and hash tables.								
CO3	Develop problem-solving skills by applying advanced data structures to solve complex programming problems efficiently								
CO4	Understand how to analyze the efficiency and performance of algorithms that utilize advanced data structures								
CO5	Ability to apply and implement learned algorithm design techniques and data structures to solve problems								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**BL**
I	**Introduction: Basic Terminologies:** Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.	**6**	Understand and apply basic data structures and algorithms, including insertion, deletion, and traversal operations, and will be able to analyse the efficiency of algorithms using asymptotic notations and understand the complexity of linear and binary search techniques.	1, 2, 3
II	**Stacks and Queues:** ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue, Operations on each types of Queues: Algorithms and their analysis.	**6**	Understand and implement Abstract Data Type (ADT) Stacks and Queues, perform standard operations, and analyse their complexities.	2, 3
III	**Linked Lists:** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue,	**8**	Understand and implement various types of linked lists, including singly linked lists, doubly linked lists, and circular linked lists.	2, 3

	Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.			
IV	: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree, Red-Black trees; Tree operations **Trees**on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.	**5**	Understand and implement various types of trees, including binary trees, threaded binary trees, binary search trees, AVL trees, red-black trees, B-trees, and B+ trees.	2, 3
V	**Sorting and Hashing**: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	**5**	Understand the objectives and properties of various sorting algorithms, including selection sort, bubble sort, insertion sort, quick sort, merge sort, and heap sort. Analyze and compare the performance of these algorithms.	2, 3, 4
Practical				
Practical 1	Write a C program to implement stack operations (Push, Pop and Display) using an array.	**2**	Understand and apply different stack operations	2, 3
Practical 2	Write a C Program to implement Queue operations (insert, delete and display) using an array.	**2**	Understand and apply different stack operations	2, 3
Practical 3	Program to Tree traversal in C	**2**	Understand Tree data structure.	2
Practical 4	C program to Insert a node in a Binary tree.	**2**	Understand and apply Binary tree	3
Practical 5	C program to delete a node in Binary Search Tree.	**2**	Understand and apply bottom-up parsing techniques, specifically SLR parsing.	3
Practical 6	C program to Delete a Tree.	**2**	Apply recursive techniques to traverse and delete all nodes in a binary tree, effectively freeing allocated memory and ensuring efficient memory management in tree data structures.	3
Practical 7	C program to implement Binary tree (inorder, preorder, and postorder	**2**	Understanding of tree traversal techniques and	2,3

	traversal).		their applications in data structure manipulation.	
Practical 8	C Program for Searching in Binary Tree	**2**	Apply search operations in a binary tree using both recursive and iterative approaches,	3
Practical 9	C program to find the shortest path for a given graph	**2**	Gain understanding and practical experience in graph traversal techniques for pathfinding applications.	2, 3
Practical 10	C Program on Dijkstra Algorithm for finding the Minimum Distance of Vertices	**2**	Understanding of graph traversal techniques and priority queue management, enabling them to solve shortest path problems efficiently.	2,3
Practical 11	C program of Adjacency Matrix Representation of Graph	**2**	Understanding of graph representation, matrix operations, and memory management, preparing them to effectively work with graph algorithms and data structures.	2, 3
Practical 12	Write a C program to perform Link List operations (Insert in the beginning, last, specified position, Delete from Beginning, last, specified location, Show)	**2**	Implement and manipulate linked lists in C	3
Practical 13	Write a C program to implement the linked list and check if the letters are alternate or not.	**2**	Enhance the understanding of linked list operations and logical conditions in programming, preparing them to handle complex data structures and algorithms effectively..	3
Practical 14	Write a C program sort and reversed a linked list	**2**	Enhance the understanding of linked list manipulation techniques	3
Practical 15	Write a C program to convert Infix to post-fix	**2**	Understand and apply optimization techniques at the code generation level.	3
Practical 16	Write a C program to convert Post-fix to infix	**2**	Gain practical experience in stack operations, operator precedence handling, and expression parsing, essential for developing interpreters and compilers where expression evaluation is fundamental.	3
Practical	Write a C program to implement the	**2**	Enhances the understanding	2, 3

17	tower of Hanoi.		of recursive problem solving techniques	
Practical 18	Write a C Program to sort an array using Insertion Sort.	**2**	Understanding of sorting techniques and analysing it.	2, 3
Practical 19	Write a C Program to sort an array using Selection Sort.	**4**	Understanding of sorting techniques and analysing it.	2, 3
Practical 20	Program to sort an array using Bubble Sort.	**4**	Understanding of sorting techniques and analysing it.	2, 3
Practical 21	Program to sort an array using Merge Sort.	**4**	Understanding of sorting techniques and analysing it.	2, 3
Practical 22	C Program to Implement Bellman Ford Algorithm	**4**	Understanding of algorithmic techniques for pathfinding in graphs and prepares them for implementing and analysing more complex graph algorithms in programming.	2, 3, 4
Practical 23	C Program to implement Floyd's Algorithm	**4**	Understanding of algorithmic techniques for pathfinding in graphs and prepares them for implementing and analysing more complex graph algorithms in programming.	2, 3
Practical 24	C Program to find a minimum spanning tree using Prim's algorithm	**4**	Understanding of dynamic programming techniques applied to graph algorithms, preparing them for more advanced studies and applications in graph theory and algorithm design.	2, 3

TEXT BOOKS:

T1: Horowitz E, Sahni S, Anderson-Freed S. Fundamentals of Data Structures in C. 2nd edition. Hyderabad: Universities Press; 2008.
T2: Kushwaha DS, Misra AK. Data Structures: A Programming Approach with C. 1st edition. New Delhi: PHI Learning; 2008.

REFERENCE BOOKS:

R1: Gilberg RF, Forouzan BA. Data Structures: A Pseudocode Approach with C. 2nd edition. Boston: Cengage Learning; 2004.
R2: Weiss MA. Data Structures and Algorithm Analysis in C. 2nd edition. Boston: Pearson; 1997.
R3: Tanenbaum AM, Langsam Y, Augenstein MJ. Data Structures Using C. 1st edition. Boston: Pearson; 1990.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the fundamental concepts and principles of data structures	**1, 2, 3, 12**
2	Understanding of advanced data structures such as balanced search trees (AVL, Red-Black trees), heaps, graphs, and hash tables.	**1, 2, 3, 12**
3	Develop problem-solving skills by applying advanced data structures to solve complex programming problems efficiently	**1, 2, 3, 12**
4	Understand how to analyse the efficiency and performance of algorithms that utilize advanced data structures	**1, 2, 3, 4, 12**
5	Ability to apply and implement learned algorithm design techniques and data structures to solve problems	**1, 2, 3, 12**

SEMESTER – II									
Course Title	**Advanced Database Management System**								
Course code	**23MCAO122R**	**Total credits: 4** **Total hours:30T + 60P**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			2	**0**	**4**	**0**	**0**	**0**	**4**
Pre-requisite	**Database Management System**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Winter/ II semester of the first year of the programme**								
Course Objectives	1. To learn the fundamentals of data models and to represent a database system using ER diagrams. 2. To understand the internal storage structures using different file and index techniques which will help in physical database design. 3. To understand the concepts of database administration, Homogeneous and Heterogeneous Systems and knowledge based and database systems.								
CO1	Understand core database concepts, including data, information, metadata, and components of a Database Management System								
CO2	Understand and apply various data modelling concepts								
CO3	Understand and apply relational database concepts, relational algebra and SQL								
CO4	Implement various normalization techniques ensuring efficient data organization								
CO5	Understand the concepts of deadlocks, database security and distributed database systems								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Database concept: Data, information metadata, Terminology of File, Association Between Fields, Entities and their attributes, Relationship Record and Files, Components of Database Management System, Mapping Between View, Data Independence.	**6**	Understanding of key database concepts including data modelling, entity-relationship modelling, and schema design.	1, 2, 3
II	Data Models: Entities, Attributes and Associations, Relationship Among Entities, Data Model Classification- Relational Model, Hierarchical Model & Network Model, Entity–Relationship Model, Concept of File Organization – Sequential Files, Index-Sequential Files, Direct Files, Secondary Key Retrieval.	**6**	Develop a foundational understanding of data modelling concepts, including entities, attributes, relationships, and the classification of data models such as relational, hierarchical, and network models.	3, 4
III	Relational Database: Attributes and Domains, Tuples, Relation and their Schemas, Relational Algebra: Basic Operations, Relational Algebra queries, Relational Calculus: Tuple Calculus, Domain Calculus, SQL, Data Manipulations in SQL, Data Manipulations in QBE	**6**	Design, query, and manipulate data within relational database systems using both SQL and QBE approaches.	3, 4
IV	Functional Dependency and	**6**	Understand and apply	2,

	Normalization: First, Second, Third Normal Forms, Good and Bad Decomposition, Multivalued Dependency, Fourth Normal Form, Fifth Normal Form, Network Data Model		database design principles, normalization techniques, and an understanding of alternative data models like the network data model.	3, 4
V	Database operations and maintenance: Database Administrator (DBA, Database Security, Integrity and Control, Distributed Database: Data Distribution, Deadlock in Distributed Systems, Security and Protection, Homogeneous and Heterogeneous Systems, Knowledge Base and Database Systems, Expert Database Systems, Object Database System.	**6**	Understanding of essential database management principles and practices, including the role of Database Administrators (DBAs), database security measures, integrity constraints, and control mechanisms.	2, 3, 4
Practical				
Practical 1	You are given the following table structure for a database that stores information about students in a university. Write an SQL statements to create this table. Table: Students • StudentID (Primary Key): Integer, Auto Increment • FirstName: Varchar(50), Cannot be NULL • LastName: Varchar(50), Cannot be NULL • DateOfBirth: Date • Email: Varchar(100), Unique, Cannot be NULL • EnrollmentDate: Date, cannot be NULL	**2**	Create a database table with specified constraints and properties using SQL.	1, 5
Practical 2	Write the SQL statement to create the Books table with the given structure. Table: Books • BookID (Primary Key): Integer, Auto Increment • Title: Varchar(100), Cannot be NULL • Author: Varchar(100), Cannot be NULL • PublishedYear: Year • Genre: Varchar(50) • ISBN: Varchar(13), Unique, Cannot be NULL Write SQL queries to: 1. Insert a new book into the Books table.	**2**	Create a database table and perform basic SQL operations such as inserting data, retrieving data, and updating records.	1, 5

	2. Retrieve all books written by a specific author. 3. Update the genre of a book based on its BookID.			
Practical 3	On the Books table, write SQL queries to: 1. Delete a book from the table by BookID 2. Retrieve all books published after the year 2000 3. Retrieve the count of books by each author	**2**	Create a database table and perform basic SQL operations	2
Practical 4	Create the following tables with the fields given below: EMPLOYEE (E_ID, Name, Age, Address, Salary, Dep_ID) DEPARTMENT (Dep_ID, Name, City) Select appropriate primary keys. Input at least 5 meaningful records in the tables. Select appropriate data types for all the fields.	**2**	Demonstrate the ability to create database tables with appropriate fields and primary keys.	3
Practical 5	Create the following tables with the fields given below : STUDENT (Student ID, Name, Programme, Teacher ID) TEACHER (Teacher ID, Department, Name, City, Specialization) Select appropriate primary keys. Input at least 5 meaningful records in the tables. Select appropriate data types for all the fields.	**2**	Create tables with specified fields and primary keys.	3
Practical 6	EMPLOYEES (Employee_Id, First_Name, Last_Name, Email, Phone_Number, Hire_Date, Job_Id, Salary, Commission_Pct, Manager_Id, Department_Id) (a) Find out the employee id, names, salaries of all the employees (b) List out the employees who works under manager 100 (c) Find the names of the employees who have a salary greater than or equal to 4800 (d) List out the employees whose last name is 'AUSTIN' (e) Find the names of the employees who works in departments 60, 70 and 80 (f) Display the unique Manager_Id	**2**	Execute and analyse SQL queries for specific data retrieval	3
Practical 7	Create Client_master table with the	**2**	Perform SQL operations to	2, 3

	following fields(ClientNO, Name, Address, City, State, bal_due) (a) Insert five records (b) Find the names of clients whose bal_due>5000 . (c) Change the bal_due of ClientNO" C123" to Rs. 5100 (d) Change the name of Client_master to Client12. (e) Display the bal_due heading as "BALANCE"		update records in table including inserting new records, updating balances, and modifying table properties	
Practical 8	Create Teacher table with the following fields (Name, DeptNo, Date of joining, DeptName, Location, Salary) (a) Insert five records (b) Give Increment of 25% salary for Mathematics Department. (c) Perform Rollback command (d) Give Increment of 15% salary for Commerce Department (e) Perform commit command	**2**	Apply SQL transactions using rollback and commit commands	3
Practical 9	Create Sales table with the following fields (Sales No, Salesname, Branch, Salesamount, DOB) (a) Insert five records (b) Calculate total sales amount in each branch (c) Calculate average sales amount in each branch. (d) Display all the salesmen, DOB who are born in the month of December as day in character format i.e. 21-Dec-09 (e) Display the name and DOB of salesman in alphabetical order of the month.	**2**	Apply SQL clauses such as ORDER BY and GROUP BY to perform aggregate calculations	2, 3
Practical 10	Create an Emp table with the following fields: (EmpNo, EmpName, Job, Basic, DA, HRA, PF, GrossPay, NetPay) (Calculate DA as 30% of Basic and HRA as 40% of Basic) (a) Insert Five Records and calculate GrossPay and NetPay. (b) Display the employees whose Basic is lowest in each department. (c) If NetPay is less than <Rs. 10,000 add Rs. 1200 as special allowances . (d) Display the employees whose GrossPay lies between 10,000 & 20,000 (e) Display all the employees who earn	**2**	Execute calculations and SQL queries for payroll management	2, 3

	maximum salary			
Practical 11	Create a table, fill it with customer details and do the following queries: a) Find the total revenue for each customer b) List customers who have made more than one order c) Find the date of the most recent order for each customer d) Calculate the average order amount for each customer e) Retrieve the orders placed in January 2023 f) Find the top 3 customers with the highest total revenue g) Calculate the total revenue for each month in 2023 h) List orders with a total amount greater than the average total amount for all orders i) Find customers who have made orders on consecutive days j) Calculate the total revenue for each customer, including orders made by customers who haven't placed any orders.	**4**	Analyse and interpret SQL query results.	2, 3
Practical 12	An Enterprise wishes to maintain a database to automate its operations. Enterprise is divided into certain departments and each department consists of employees. The following two tables describes the automation schemas Dept (deptno, dname, loc) Emp (empno, ename, job, mgr, hiredate, sal, comm, deptno) a) Update the employee salary by 15%, whose experience is greater than 10 years. b) Delete the employees, who completed 30 years of service. c) Display the manager who is having maximum number of employees working under him? d) Create a view, which contain employee names and their manager	**4**	Implement SQL operations and create database views	3
Practical 13	Using Employee Database perform the following queries a) Determine the names of employee, who earn more than their managers. b) Determine the names of employees,	**4**	Formulating and evaluating complex SQL queries	3

	who take highest salary in their departments. c) Determine the employees, who are located at the same place. d) Determine the employees, whose total salary is like the minimum Salary of any department. e) Determine the department which does not contain any employees.			
Practical 14	Create the following tables: Student (roll-no, name, date-of-birth, course-id) Course (Course-id, name, fee, duration) a) Create a form to accept the data from the user with appropriate validation checks. b) Generate queries to do the following: List all those students who are between 18-19 years of age and have opted for MCA course. List all those courses in which number of students are less than 10.	**4**	Designing and analysing SQL queries for complex conditions	3
Practical 15	Create the following tables: Branch (branch-id, branch-name, branch-city) Customer (customer- id, customer-name, customer-city, branch-id) a) Create a form to accept the data from the user with appropriate validation checks. (b) Generate queries to do the following: c) List all those customers who live in the same city as the branch in which they have account. d) List all those customers who have an account in more than one branch.	**4**	Analysing and interpreting SQL results based on specified conditions	3
Practical 16	Create the following tables: Book (accession-no, title, publisher, year, date-of-purchase, status) Member (member-id, name, number-of-books-issued, max-limit) Book-issue (accession-no, member-id, date-of-issue) (a) Create a form to accept the data from the user with appropriate validation checks. (b) Generate queries to do the following: (c) List all those books which are due from the students to be returned. A book is due if it has been issued 15	**4**	Implementing SQL queries for library management	3

	days back and yet not returned. (d) List all those members who cannot be issued any more books			
Practical 17	Create a Database of Library Management System	**4**	Designing and implementing database schema for Library domain	2, 3
Practical 18	Create a Database of Hospital Management System.	**4**	Designing and implementing database schema for healthcare domain	2, 3
Practical 19	Create a Database of Railway Reservation System.	**4**	Designing and implementing database schema for transportation domain	2, 3
Practical 20	Create a Database of Time Table Management System.	**4**	Designing and implementing database schema for educational scheduling	2, 3

TEXT BOOKS:

T1: Silberschatz A, Korth HF, Sudarshan S. Database System Concepts. 6th edition. New York: McGraw-Hill; 2017.
T2: Elmasri R, Navathe SB. Fundamentals of Database Systems. 6th edition. Boston: Pearson Education; 2014.

REFERENCE BOOKS:

R1: Ramakrishnan R. Database Management System. 3rd edition. New Delhi: Tata McGraw-Hill Publishing Company; 2007.
R2: Rob P, Coronel C. Database Systems: Design, Implementation, and Management. 5th edition. Boston: Thomson Learning Course Technology; 2003.
R3: Garcia-Molina H, Ullman JD, Widom J. Database System Implementation. 1st edition. United States: Pearson Education; 2000.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand core database concepts, including data, information, metadata, and components of a Database Management System	**1, 2, 5, 12**
2	Understand and apply various data modelling concepts	**1, 2, 3, 5, 12**
3	Understand and apply relational database concepts, relational algebra and SQL	**1, 2, 3, 5, 12**
4	Implement various normalization techniques ensuring efficient data organization	**1, 2, 3, 5, 12**
5	Understand the concepts of deadlocks, database security and distributed database systems	**1, 2, 5, 12**

SEMESTER – II										
Course Title	**Advanced Operating System**									
Course code	**23MCAO123R**	**Total credits: 4** **Total hours:60T**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			4	**0**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Winter/II semester of the first year of the program**								
Course Objectives	1. To learn the mechanisms of OS to handle processes and threads and their communication and the mechanisms involved in memory management in contemporary OS. 2. To gain knowledge on Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols 3. To know the components and management aspects of concurrency management.									
CO1	Understand the concepts of OS, the basic principles used in the design of modern operating system and process.									
CO2	Understanding the concepts of processes, process scheduling including Throughput, Turnaround Time, Waiting Time, Response Time.									
CO3	Understand the concepts of threads and mechanisms for synchronization.									
CO4	Understand the concepts related to deadlock and memory management.									
CO5	Understand the concepts of virtual memory management, file system.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction**: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.	**12**	Understand the concept of operating systems, distinguish between different generations and types of operating systems, explain the services provided by an operating system, and compare the structures of layered, monolithic, and microkernel operating systems.	2
II	**Processes**: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. **Thread**: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling.	**12**	Understand the definition of processes and threads, describe the different states and transitions of processes, explain the benefits and types of threads, discuss the objectives and criteria of process scheduling, and analyse various scheduling algorithms including FCFS, SJF, and RR.	2, 3
III	**Inter-process Communication**:	**12**	Identify critical sections and	5

	Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution **Deadlocks**: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.		race conditions, explain mutual exclusion and its hardware solutions, define deadlocks and its necessary conditions, discuss deadlock prevention techniques like Banker's algorithm, and describe deadlock detection and recovery methods.	
IV	**Memory Management**: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition –Internal and External fragmentation and Compaction; Paging. **Virtual Memory**: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).	**12**	Understand the basic concepts of memory management, differentiate between logical and physical address mapping, analyse memory allocation techniques including contiguous allocation and paging, explain virtual memory concepts such as demand paging and page replacement algorithms (e.g., LRU, FIFO), and discuss the advantages of virtual memory.	4
V	**File Management**: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management. Disk Management: Disk structure, Disk scheduling, Disk reliability, Disk formatting, Boot-block, Bad blocks.	**12**	Understand the concept of files, various file types and access methods, file operations and directory structures, analyse file system structures and allocation methods (contiguous, linked, indexed), and evaluate disk management aspects including disk structure, scheduling algorithms, reliability, and formatting.	5

TEXT BOOKS:

T1: Silberschatz A, Galvin P, Gagne G. Operating System Concepts Essentials. 9th edition. Singapore: Wiley Asia Student Edition; 2018.

REFERENCE BOOKS:

R1: Crowley C. Operating System: A Design-Oriented Approach. 1st edition. Boston: Irwin Publishing; 1996.

R2: Nutt GJ. Operating Systems: A Modern Perspective. 2nd edition. Boston: Addison-Wesley; 2000.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the concepts of OS, the basic principles used in the design of modern operating system and process.	**1, 2, 3, 5, 12**
2	Understanding the concepts of processes, process scheduling including - Throughput, Turnaround Time, Waiting Time, Response Time.	**1, 2, 4,**
3	Understand the concepts of threads and mechanisms for synchronization.	**3, 5, 12**
4	Understand the concepts related to deadlock and memory management.	**1, 2, 12**
5	Understand the concepts of virtual memory management, file system.	**2, 3, 5, 12**

SEMESTER – II										
Course Title	**Techno Professional Skills I - R Programming**									
Course code	**23MCAO124R**	**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	**Master of Computer Application**								
Semester	**Winter/ II semester of the first year of the program**								
Course Objectives	1. Understand and navigate the R language and RStudio environment. 2. Analyse data using basic functions and packages in R. 3. Create reports and implement statistical modelling and EDA using R Markdown.								
CO1	Understand R language and R studio								
CO2	Analyse the use of basic functions of R Package								
CO3	Create reports using R markdown								
CO4	Implement statistical modelling using R								
CO5	Demonstrate exploratory data analysis (EDA) for a given data set								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to R Programming:** Understanding the R language and its key features, getting familiar with the R Studio environment, Exploring R data types, variables, vectors, and basic syntax	**12**	Understand the key features of the R language, navigate and utilize the R Studio environment proficiently, differentiate R data types and variables, and apply basic syntax to perform simple operations.	2
II	**Basic Functions and R Packages**: Utilizing and manipulating data using basic functions in R, exploring popular R packages for data analysis and visualization, Performing data cleaning, transformation, and summarization using R functions	**12**	Understand how to use basic functions in R for data manipulation, explore and utilize popular R packages for data analysis and visualization, apply functions for data cleaning, transformation, and summarization tasks effectively.	2, 3
III	**Creating Reports with R Markdown**: Introduction to R Markdown and its advantages for reproducible research, creating dynamic reports by integrating R code, visualizations, and text, Customizing and formatting reports to effectively communicate data insights	**12**	Learn the advantages of R Markdown for reproducible research, create dynamic reports by integrating R code, visualizations, and text, and customize reports to effectively communicate data insights through formatting and styling.	6
IV	**Statistical Modelling with R**: Understanding the principles of statistical modelling using R Exploring commonly used statistical techniques, such as regression analysis and hypothesis testing Implementing statistical models using R	**2**	Grasp the principles of statistical modelling using R, apply commonly used techniques like regression analysis and hypothesis testing, implement statistical models using R packages, and interpret the results derived from these	4

	packages and interpreting the results		models.	
V	**Data Visualization with ggplot2**: Introduction to data visualization principles; Creating basic plots (scatter plots, bar charts, histograms) Customizing plots with color, labels, and themes; Creating advanced plots (faceting, layered plots, interactive plots)	**2**	Understand data visualization principles, create basic plots such as scatter plots, bar charts, and histograms using ggplot2, customize plots with colors, labels, and themes, and create advanced plots including faceted and layered plots.	5
Practical				
Practical 1	Calculate basic statistics (mean, median, standard deviation) for different variables in a dataset.	**2**	Ability to calculate and interpret basic statistical measures (mean, median, standard deviation) for various variables in a dataset.	2
Practical 2	Filter a dataset based on specific criteria (e.g., age > 25, income > $50,000).	**2**	Learn to filter and subset data frames in R based on specific conditions	3
Practical 3	Sort a data frame by a specific column (e.g., ascending order of prices).	**2**	Understand how to sort data frames by a particular column in ascending or descending order using R.	3
Practical 4	Join two data frames together based on a common identifier.	**2**	Ability to merge or join two data frames in R based on a common variable	3
Practical 5	Create a new variable based on a mathematical formula applied to existing data.	**2**	Learn to create new variables in R by applying mathematical formulas to existing variables in a data frame.	3
Practical 6	Calculate and visualize the correlation between two variables in a dataset.	**2**	Understand how to compute correlation coefficients between pairs of variables and visualize them using scatter plots or correlation matrices.	3, 4
Practical 7	Create a basic histogram to visualize the distribution of a numeric variable.	**2**	Ability to generate histograms in R to visualize the distribution and frequency of numeric data.	3
Practical 8	Plot a scatter plot to show the relationship between two variables.	**2**	Learn to create scatter plots in R to visually analyse the relationship between two continuous variables.	3
Practical 9	Create a bar chart to compare different categories in a dataset.	**2**	Understand how to use bar charts in R to compare categorical data across different groups or variables.	3
Practical 10	Customize a plot with labels, colors, legends, and titles.	**2**	Ability to customize various aspects of plots in R, including	6

			labels, colors, legends, and titles, to enhance visualization clarity.	
Practical 11	Create a boxplot to compare the distribution of data across different groups.	**2**	Learn to create boxplots in R to compare the distribution of numerical data across multiple categories or groups.	3
Practical 12	Build a time series plot to visualize trends over time.	**2**	Understand how to create time series plots in R to visualize and analyse trends and patterns in data over chronological time.	3
Practical 13	Write a simple function to clean text data and remove punctuation.	**2**	Understand how to create time series plots in R to visualize and analyse trends and patterns in data over chronological time.	3
Practical 14	Use a loop to iterate through a list of values and perform calculations.	**2**	Apply loops in R to iterate through lists or vectors of values and perform calculations or operations on each element.	3
Practical 15	Write an if-else statement to make decisions based on conditions.	**2**	Learn to use conditional statements (if-else) in R to make decisions based on logical conditions or comparisons.	3
Practical 16	Create a recursive function that calls itself repeatedly.	**2**	Understand recursion in programming by implementing recursive functions in R that call themselves repeatedly to solve problems.	4
Practical 17	Use nested loops to perform complex calculations on multi-dimensional data.	**2**	Learn to apply nested loops in R to perform complex calculations or operations on multi-dimensional arrays or data structures.	4
Practical 18	Install and load a new package from the CRAN repository.	**2**	Understand how to install and load R packages from the Comprehensive R Archive Network (CRAN) and use them for extended functionalities.	3
Practical 19	Use basic functions from the tidy verse package for data manipulation and visualization.	**2**	Learn to utilize core functions from the tidy verse package in R for efficient data manipulation, transformation, and visualization tasks.	3
Practical 20	Explore the functionalities of a specific package and apply them to your	**2**	Explore and apply specialized functionalities of a specific R package to manipulate, analyze, or visualize their dataset effectively	3
Practical 21	Combine R code with Markdown to create a report with formatted text and plots.	**4**	Understand how to integrate R code, data visualizations, and formatted text using R	6

			Markdown to create reproducible reports or documents.	
Practical 22	Simulate a random sample from a population and analyse its properties.	**4**	Learn to simulate random samples in R from a population dataset and analyse statistical properties such as mean, variance, and distribution.	4
Practical 23	Perform basic statistical tests to compare groups within a dataset.	**4**	Ability to perform basic statistical tests (e.g., t-tests, ANOVA) in R to compare groups or variables within a dataset and interpret the results.	3
Practical 24	Scrape data from a website and clean it for analysis.	**4**	Learn to scrape data from web sources using R, preprocess and clean the scraped data for further analysis or visualization.	3
Practical 25	Develop a simple function to perform a specific data analysis task.	**4**	Develop custom functions in R to perform specific data analysis tasks or calculations tailored to their dataset and research questions.	3

TEXT BOOKS:

T1: Davies TM. The Book of R. 1st edition. Shelter Island: No Starch Press; 2016.
T2: Venables WN, Smith DM, R Core Team. An Introduction to R: Manual for R. Version 4.3.0; 2023.

REFERENCE BOOKS:

R1: Wickham H, Grolemund G. R for Data Science. 1st edition. Sebastopol: O'Reilly Media; 2016.
R2: Grolemund G. Hands-On Programming with R. 1st edition. Sebastopol: O'Reilly Media; 2014.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand R language and R studio	**1, 5, 12**
2	Analyse the use of basic functions of R Package	**1, 2, 5, 12**
3	Create reports using R markdown	**1, 9, 12**
4	Implement statistical modelling using R	**1, 2, 4, 5, 12**
5	Demonstrate exploratory data analysis (EDA) for a given data set	**1, 2, 4, 5, 12**

SEMESTER – II									
Course Title	**Mini Research (Research Gap Analysis-R2)**								
Course code	**23MCAO125R**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 15T	**1**	**0**	**0**	**4**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Winter/II semester of the first year of the programme**								
Course Objectives	1. Create and implement a plan to bridge the research gap. 2. Analyse the current state of research to formulate objectives and strategies. 3. Communicate the significance and potential impact of addressing the research gap.								
CO1	Create and implement a plan to bridge the gap								
CO2	Understand the research gap to formulate the research objective								
CO3	Analyse the current state/work of research								
CO4	Implement the strategies to meet the research gap under supervision								
CO5	Communicate the significance of the research gap and the potential impact of the proposed research.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Understanding Literature Review	**3**	Understand the fundamental concepts and importance of a literature review in academic research, including its purpose and how it contributes to the research process.	1, 2
II	Initiating the Literature Review	**3**	Develop the skills to initiate a literature review by identifying relevant sources, effectively searching databases, and selecting appropriate literature for their research topic.	3
III	Crafting the Main Body of the Literature Review	**3**	Ability to synthesize and organize the selected literature into a coherent and structured main body, presenting the findings and discussions logically.	3, 4
IV	Formulating the Conclusion of the Literature Review	**3**	Learn to formulate a comprehensive and well-structured conclusion for their literature review, summarizing key findings and highlighting their relevance to the research questions or objectives.	4, 5
V	Analysing Gaps in the Literature Review	**3**	Identify unanswered questions, inconsistencies, or areas where existing research is lacking.	4, 5

TEXT BOOK:

T1: Swanson SM. Multiple Stressors: Literature Review and Gap Analysis. 12th edition. Alexandria, Virginia; London, England: Water Environment Research Foundation; IWA Publishing; 2004.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Create and implement a plan to bridge the gap	**2, 3, 11, 12**
2	Understand the research gap to formulate the research objective	**2, 4, 12**
3	Analyse the current state/work of research	**2, 4, 12**
4	Implement the strategies to meet the research gap under supervision	**2, 3, 11, 12**
5	Communicate the significance of the research gap and the potential impact of the proposed research.	**2, 4, 9, 12**

SEMESTER – II									
Course Title	**MOOCS II - Developing Android App with App Inventor**								
Course code	**23MOSY121R**	**Total credits: 1** **Total hours: 15T**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			1	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Winter/ II semester of the first year of the programme**								
Course Objectives	1. Understand the fundamentals of MIT App Inventor and basic application coding. 2. Develop simple applications using basic programming concepts and constructs. 3. Create applications incorporating advanced features like audio, video, location services, and web browsing.								
CO1	Identify the components and features of the MIT App Inventor interface. Explain basic programming concepts such as variables, loops, and conditionals.								
CO2	Use MIT App Inventor to create simple dialog boxes and implement basic programming constructs.								
CO3	Develop an alarm clock application that utilizes audio and video functionalities.								
CO4	Construct a drawing application, handling files and incorporating game mechanics.								
CO5	Combine device location services and web browsing features in a single application.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Introduction of MIT App Inventor, Application Coding	**3**	Explain the purpose of MIT App Inventor and describe the basic steps involved in creating a simple app.	2
II	Programming Basics & Dialog, More Programming Basics	**3**	Utilize basic programming blocks within the MIT App Inventor interface to create simple interactions within an app (e.g., displaying text, responding to button clicks).	3
III	Alarm Clock Application, Audio & Video	**3**	Design and develop a functional alarm clock application using relevant MIT App Inventor components (timers, notifications).	3, 6
IV	Drawing Application, File, Game	**3**	Build a drawing application that allows users to create and potentially save their drawings.	3, 6
V	Device Location, Web Browsing	**3**	Implement functionalities within an app that utilize device features like location services or web browsing capabilities.	3, 4

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Identify the components and features of the MIT App Inventor interface. Explain basic programming concepts such as variables, loops, and conditionals.	**1, 5, 12**
2	Use MIT App Inventor to create simple dialog boxes and implement basic programming constructs.	**1, 2, 12**
3	Develop an alarm clock application that utilizes audio and video functionalities.	**1, 3, 5, 12**
4	Construct a drawing application, handling files and incorporating game mechanics.	**1, 3, 5, 12**
5	Combine device location services and web browsing features in a single application.	**1, 3, 5, 12**

SEMESTER – II									
Course Title	**Research Methodology and Statistical Analysis**								
Course code	**23UMRM121R**	**Total credits: 2** **Total hours: 15T**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			1	**0**	**0**	**4**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Winter/ II semester of the first year of the programme**								
Course Objectives	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. 2. The course seeks to enhance the students' skills for developing critical thinking through research literature review in different domain. 3. To develop Students competency in planning, conducting, evaluating and presenting a research project.								
CO1	Understand the basic knowledge of Research methods								
CO2	Understand the knowledge of Research Methodology.								
CO3	Understand the Skill of questionnaire development								
CO4	Implement the acquired the knowledge to prepare the basic Report/dissertation.								
CO5	Apply different statistical methods for finding the ideation of the problem								

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	**3**	Understand the meaning and objectives of research, motivation behind conducting research, types of research, and the significance of good research practices.	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	**5**	Comprehend the meaning and need for research design, recognize features of a good research design, differentiate between various research designs including sampling design and experimental design, and understand principles such as One-way ANOVA, Two-way ANOVA, CRD, RBD, and LSD in experimental design.	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	**3**	Ability to identify types of data (nominal, ordinal, interval, ratio), understand sources and tools of data collection, and comprehend the construction and measurement of attitude scales	2

	scale in statistical analysis, Schedules for interviews preparation and standardization, development of survey instruments and item analysis for the questionnaire		including rating scales and semantic differentials.	
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**	Learn how to plan and organize a research report, including the format, structure, and steps involved in writing a research report or thesis/dissertation.	3
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	**2**	Understand the concept and need for intellectual property rights (IPR), including its relevance in India and globally.	2

TEXT BOOKS:

T1: Boyle JS. Styles of Ethnography. In: Morse JM, editor. Critical Issues in Qualitative Research Methods. Thousand Oaks, CA: Sage Publications; 1994. p. 159–185.
T2: Coughlan M, Cronin P, Ryan F. Step-by-Step Guide to Critiquing Research. Part 1: Quantitative Research. British Journal of Nursing. 2007;16(11):658–663.

REFERENCE BOOKS:

R1: Creswell JW. Qualitative Inquiry and Research Design: Choosing Among Five Traditions. Thousand Oaks, CA: Sage Publications; 1998.
R2: Denzin NK. Sociological Methods. New York: McGraw-Hill; 1978.
R3: Hanson WE, Creswell JW, Plano Clark VL, Petska KS, Creswell JD. Mixed Methods Research Designs in Counseling Psychology. Journal of Counseling Psychology. 2005;52(2):224–235.
R4: Johnson B, Christensen L. Educational Research: Quantitative, Qualitative, and Mixed Approaches. 2nd edition. Boston: Allyn & Bacon; 2004.

R5: Kothari CR. Research Methodology: Methods and Techniques. 2nd edition. New Delhi: New Age International (P) Limited, Publishers; 2004.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basic knowledge of Research methods	**1, 2, 4, 12**
2	Understand the knowledge of Research Methodology.	**1, 2, 4, 12**
3	Understand the Skill of questionnaire development	**2, 3, 9, 12**
4	Implement the acquired the knowledge to prepare the basic Report/dissertation.	**2, 3, 9, 12**
5	Apply different statistical methods for finding the ideation of the problem	**1, 2, 4, 12**

SEMESTER – II									
Course Title	**Universal Human Values and Professional Ethics**								
Course code	**23UUHV106R**	**Total credits: 1** **Total hours: 15T**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			1	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Winter/ II semester of the first year of the program**								
Course Objectives	1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity. 2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity. 3. 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.								
CO1	Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content, and process of value education								
CO2	Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body								
CO3	Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society								
CO4	Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.								
CO5	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Need for Value Education Guidelines and content for Value Education, Basic Requirements for Fulfilment of Human Aspirations, Right Understanding, Relationship and Physical Facility, Role of Education, Self Exploration	**3**	Understand the need for value education and the guidelines and content necessary for fulfilling human aspirations through right understanding, relationships, and physical facilities, exploring the role of education and self-exploration in achieving these goals.	2
II	Human being as co- existence of self and body, Harmony in self and also self with body	**3**	Comprehend the concept of human beings as a co-existence of self and body and recognize the importance of harmony within oneself and between the self and the body.	2
III	Harmony in the family, Trust as the foundation of relationships, Respect as the right evaluation, justice in relationship	**3**	Understand the human goals, the significance of right understanding and right feeling, and the concept of harmony from the family order to the world family order, culminating in a universal human order.	2

IV	Harmony in Society-understanding human goals, Right understanding and right feeling, Harmony from Family Order to World Family Order – Universal Human Order	**3**	Comprehend the organization and management of run-time storage, including activation records and parameter passing techniques, and learn the principles of intermediate code generation.	2
V	Understanding harmony in nature, Realising existence as co-existence in all levels Holistic Perception of Harmony	**3**	Understand the concept of harmony in nature by realizing existence as co-existence at all levels and developing a holistic perception of harmony.	2

TEXT BOOKS:

T1: Gaur RR, Sangal R, Bagaria GP. Human Values and Professional Ethics. 1st edition. New Delhi: Excel Books; 2010.
T2: Tripathi AN. Human Values. 1st edition. New Delhi: New Age International Publishers; 2004.

REFERENCE BOOKS:

R1: Schumacher EF. Small is Beautiful: A Study of Economics as if People Mattered. London: Blond & Briggs; 1973.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content, and process of value education	**7, 8, 9, 12**
2	Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body	**7, 8, 12**
3	Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society	**7, 8, 9, 12**
4	Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.	**8, 12**
5	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	**7, 8, 9, 12**

SEMESTER – II										
Course Title	**PDP II - COMMUNICATION MASTERY**									
Course code	**23UMPD122R**	**Total credits: 2** **Total hours: 60P**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
			0	**0**	**4**	**0**	**0**	**0**	**2**	
Pre-requisite	**Introductory English**	**Co-requisite**	**Nil**							
Programme	**Master of Computer Application**									
Semester	**Winter/ II semester of the first year of the programme**									
Course Objectives	1. Foster effective communication and interpersonal skills for professional and personal success. 2. Equip individuals with the skills to create compelling job application documents and excel in job interviews. 3. Empower individuals to communicate confidently and effectively in public and professional settings.									
CO1	Enable the students to take initiative, guide the discussion, and influence others positively.									
CO2	Improve student's ability in framing different sentences while speaking and writing.									
CO3	Develop writing skills in different areas including paragraph and email.									
CO4	Plan efficiently for discussions in different platforms by enhancing their thought process and problem-solving skills									
CO5	Encompass personal growth, career advancement, enhanced communication, and the ability to navigate a variety of professional situations successfully.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Techniques of Effective Reading, Different types of reading. Process of Listening, Types of Listening Understanding Listening Barriers Importance of Effective listening	**12**	Equipped with a diverse set of reading skills that can be applied across various contexts and types of texts, promoting both efficiency and comprehension.	1, 2, 3
II	Understanding difference between Resume, CV and Cover Letter. Creating Resume & CV using different online platforms	**12**	Leverage various online platforms effectively to create professional and visually appealing resumes and CVs,	2, 3
III	Introduction to public speaking Preparation for Public speaking (scripts, non- verbal cues) 1. Understanding and overcoming Fear of Public Speaking 2. Tips Public Speaking 3. Public speaking practical	**12**	Enhance their public speaking abilities, becoming more confident, engaging, and effective communicators.	2, 3, 4
IV	1. Types of interviews- telephonic, virtual & face to face, online interview, personal interview, Panel interview, Group interview. 2. Common interview questions and answering strategies	**12**	Understand consistent use of effective answering strategies help candidates create a positive impression, align their qualifications with the job requirements, and increase their chances of success in the	2, 3, 4

			interview process.	
V	1. Introduction to Dress Code Ethics 2. Purpose and Importance 3. How to Make FIRST Impression 4. What to Wear During Interviews or Any Other Formal Meetings – Male & Female	**9**	Enhanced self-awareness, adaptability, confidence, effective communication, knowledge and skills necessary to present themselves professionally.	1, 5, 6

TEXT BOOKS:

T1: Malarcher C. Developing Listening Skills 1. Seoul: Compass Publishing;
T2: Anderson LE, Bolt SB. Professionalism Skills for Workplace Success. Boston: Pearson Education;
T3: Carnegie D. The Art of Public Speaking. New Delhi: Diamond Pocket Books Pvt Ltd;
T4: Wallwork A. English for Academic CVs, Resumes, and Online Profiles. Cham: Springer International Publishing;

REFERENCE BOOKS:

R1: McKinney A. Real-Resumes for Teachers. Raleigh: Prep Pub;
R2: Williams JW. Listening Skills Training: How to Truly Listen, Understand, and Validate for Better and Deeper Connections. Seattle: Amazon Digital Services LLC - KDP Print US;

OTHER LEARNING RESOURCES:

https://www.coursera.org/specializations/english-interview-resume
https://www.coursera.org/learn/public-speaking
https://www.coursera.org/learn/enpublicspeaking

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Enable the students to take initiative, guide the discussion, and influence others positively.	**6, 9, 10**
2	Improve student's ability in framing different sentences while speaking and writing.	**9, 12**
3	Develop writing skills in different areas including paragraph and email.	**9, 12**
4	Plan efficiently for discussions in different platforms by enhancing their thought process and problem-solving skills	**2, 3, 6, 9, 12**
5	Encompass personal growth, career advancement, enhanced communication, and the ability to navigate a variety of professional situations successfully.	**6, 9, 11, 12**

SEMESTER – II									
Course Title	**Bridge Course III – Computer Applications Techniques**								
Course code	**23MCAO126R**	**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	**Master of Computer Application**								
Semester	**Winter/ II semester of the first year of the programme**								
Course Objectives	1. To acquire the basic knowledge of Computer Systems and their uses. 2. To know about Application Software and Programming environments. 3. To apply and implement computer techniques and software.								
CO1	Understand the working of a computer and its various components.								
CO2	Understand and analyse the use of Software and programming in a computer system.								
CO3	Understand basic concepts of Computer Networks and System Security issues and the role of various Software packages for Office Automation.								
CO4	Apply the knowledge of computer technique for computational problems.								
CO5	Implement the use of different software for different problems in the computer field.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Basics of Computer**: What is Computer and its History, Generation of Computers, Classification of Computers; Components of a Digital Computer: CPU, Memory, I/O devices; Storage Devices (RAMs, ROMs, Hard Disk etc.), Backup System and it is use.	**8**	Define a computer, explain its core components (CPU, Memory, Storage), and differentiate between RAM and ROM.	2
II	**Software and Languages**: What is Computer Software and its need, Types of Computer Software's; Computer languages, Generation of Computer Languages, Classification of Computer Languages.	**10**	Distinguish between computer software and hardware, and categorize different types of software (e.g., system software, application software).	3
III	**Networks**: LAN, MAN, WAN, Internet, Intranet, Browsers, Basic Internet Protocols (http, TELNET, FTP).	**8**	Describe the differences between LAN, MAN, WAN, Internet, and Intranet, and explain the function of a web browser.	1, 2
IV	**Computer Viruses and Security**: Type of Virus, Worms, Malware, Firewalls, Phishing, Anti-Virus.	**8**	Identify common types of threats like viruses, worms, and malware, and explain the role of an antivirus program.	2
V	**Software packages for Office Automation**: Word Processing software, Spreadsheet software, Presentation software, Database software, Drawing and Graphics manipulation software.	**10**	List and briefly describe the functionalities of common office suite applications (e.g., Word Processing, Spreadsheet, Presentation).	2,3

TEXT BOOKS:

T1: Rajaraman V. Computer Fundamentals. 5th edition. New Delhi: PHI Learning; 2009.

REFERENCE BOOKS:

R1: Sinha P, Sinha PK. Computer Fundamentals: Concepts, Systems and Applications. 4th edition. New Delhi: BPB Publications; 2007.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the working of a computer and its various components.	**1, 5, 12**
2	Understand and analyse the use of Software and programming in a computer system.	**1, 2, 3, 12**
3	Understand basic concepts of Computer Networks and System Security issues and the role of various Software packages for Office Automation.	**1, 2, 5, 12**
4	Apply the knowledge of computer technique for computational problems.	**1, 2, 3, 5, 12**
5	Implement the use of different softwares for different problems in the computer field.	**1, 2, 3, 5, 12**

SEMESTER – II									
Course Title	**Bridge Course IV - Fundamentals of Digital Design**								
Course code	**23MCAO127R**	**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	**Master of Computer Application**								
Semester	**Winter/ II semester of the first year of the programme**								
Course Objectives	1. Understand and apply different number systems, binary codes, Boolean algebra, and logic families in digital design. 2. Analyse the design and working principles of various memory types and register organization in digital systems. 3. Design and implement pipeline and parallel processing concepts using logic gates and digital circuits.								
CO1	Understand different number systems, binary codes, and Boolean algebra								
CO2	Understand the design and working principle of different memories.								
CO3	Understand Register Organization of digital design.								
CO4	Design and implement pipeline and parallel processing concepts.								
CO5	Understand and implement logic families and logic gates.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Integer Representation; Addition and Subtraction (Addition and Subtraction with Signed Magnitude Data, Addition and Subtraction with Signed-2's Complement Data); Booth's Multiplication Algorithm; Division Algorithm; Floating-Point Arithmetic Operations.	**8**	Understand the analysis-synthesis model of compilation and the role of lexical analysis in converting source code into tokens using tools like LEX.	1, 2, 3
II	Major Components of a CPU; General Register Organization; Stack Organization (Register Stack, Memory Stack, Reverse Polish Notation); Interrupts; Characteristics of Complex Instruction Set Computer (CISC) and Reduced Instruction Set Computer (RISC) Micro programmed Control and Hardwired Control; Control Memory, Control Word, Microinstruction, Microprogram, Mapping of Instructions; Instruction Formats (viz., Three Address Instructions, Two-Address Instructions and Zero-Address Instructions); Addressing modes.	**10**	Grasp the concepts of context-free grammars (CFGs) and develop skills in various parsing techniques including top-down and bottom-up parsing methods, utilizing tools like YACC.	3, 4
III	Parallel Processing; Flynn's Classification of computers; Pipelining, Data Dependency, Handling of Branch Instructions,	**8**	Learn to design and implement syntax-directed translation schemes, focusing on attribute	3, 4

	Delayed Load, Delayed Branch; Vector Processing, Array Processors.		grammars and type checking mechanisms, and understand the differences between structural and name equivalence of types.	
IV	Hardware Organization for Associative Memory; Different Mapping methods for Cache Memory, Different Writing Policies, Cache Coherence; Input Output Interface, I/O Bus, Memory Bus, Isolated I/O, Memory-Mapped I/O; Modes of Transfer (viz., Direct Memory Access(DMA), Programmed I/O, and Interrupt- Initiated I/O); Input-Output Processor.	**8**	Comprehend the organization and management of run-time storage, including activation records and parameter passing techniques, and learn the principles of intermediate code generation.	4
V	Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic	**8**	Acquire knowledge on the design and implementation of a code generator, emphasizing optimization techniques, basic blocks, flow graphs, and register allocation strategies.	4

TEXT BOOKS:

T1: Jain RP. Modern Digital Electronics. 4th edition. New Delhi: McGraw Hill Education; 2009.
T2: Mano MM. Computer System Architecture. 3rd edition. Boston: Pearson Education; 2007.

REFERENCE BOOKS:

R1: Mano MM. Digital Logic and Computer Design. 1st edition. New Delhi: Pearson Education India; 2016.
R2: Stallings W. Computer Organization and Architecture. 10th edition. Boston: Pearson Education; 2013.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand different number systems, binary codes and Boolean algebra	**1, 2, 3, 12**
2	Understand the design and working principle of different memories.	**1, 2, 3, 5, 12**
3	Understand Register Organization of digital design.	**1, 2, 3, 5, 12**
4	Design and implement pipeline and parallel processing concepts.	**1, 2, 3, 5, 12**
5	Understand and implement logic families and logic gates.	**1, 2, 3, 5, 12**

SEMESTER – II									
Course Title	**GENERIC ELECTIVE I - Data Science Fundamentals with Python and SQL Specialization**								
Course code	**23MCAO128R**	**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 Computer Application**								
Semester	**Winter/ II semester of the first year of the programme**								
Course Objectives	1. To introduce the essential tools used in data science workflows and their functionalities. 2. To equip students with the fundamental skills of Python programming for data science applications. 3. To provide students with an opportunity to apply their Python skills to a real-world data science project.								
CO1	Identify common data science tools and practice using them in cloud-based labs.								
CO2	Gain foundational Python programming skills to manipulate data and automate tasks using libraries like Pandas and NumPy.								
CO3	Apply Python skills to a real-world data science project, including data extraction, visualization, and dashboard creation.								
CO4	Analyse data using statistical methods and interpret results using Python in Jupyter Notebooks.								
CO5	Write SQL queries to access and manipulate data in relational databases for data science tasks.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Tools for Data Science: In order to be successful in Data Science, you need to be skilled with using tools that Data Science professionals employ as part of their jobs. This course teaches you about the popular tools in Data Science and how to use them. You will become familiar with the Data Scientist's tool kit which includes: Libraries & Packages, Data Sets, Machine Learning Models, Kernels, as well as the various Open source, commercial, Big Data and Cloud-based tools. Work with Jupyter Notebooks, JupyterLab, RStudio IDE, Git, GitHub, and Watson Studio. You will understand what each tool is used for, what programming languages they can execute, their features and limitations. This course gives plenty of hands-on experience in order to develop skills for working with these Data Science Tools. With the tools hosted in the cloud on Skills Network	**6**	Identify and use essential data science tools like libraries, datasets, and cloud environments (Jupyter Notebooks) to understand their functionalities	2, 3

	Labs, you will be able to test each tool and follow instructions to run simple code in Python, R, or Scala. Towards the end the course, you will create a final project with a Jupyter Notebook. You will demonstrate your proficiency preparing a notebook, writing Markdown, and sharing your work with your peers			
II	Python for Data Science, AI and Development: Kickstart your learning of Python with this beginner-friendly self-paced course taught by an expert. Python is one of the most popular languages in the programming and data science world and demand for individuals who have the ability to apply Python has never been higher. This introduction to Python course will take you from zero to programming in Python in a matter of hours—no prior programming experience necessary! You will learn about Python basics and the different data types. You will familiarize yourself with Python Data structures like List and Tuples, as well as logic concepts like conditions and branching. You will use Python libraries such as Pandas, Numpy& Beautiful Soup. You'll also use Python to perform tasks such as data collection and web scraping with APIs. You will practice and apply what you learn through hands-on labs using Jupyter Notebooks. By the end of this course, you'll feel comfortable creating basic programs, working with data, and automating real-world tasks using Python. This course is suitable for anyone who wants to learn Data Science, Data Analytics, Software Development, Data Engineering, AI, and DevOps as well as a number of other job roles.	**6**	Gain foundational Python programming skills to manipulate data (using libraries like Pandas, NumPy) and automate tasks for data science applications.	3, 4
III	Python project for Data Science: This mini-course is intended to for you to demonstrate foundational Python skills for working with data. This course primarily involves completing a project in which you will assume the	**6**	Apply Python skills to a real-world data science project, involving data acquisition (potentially including web scraping), exploration, visualization	3,5

	role of a Data Scientist or a Data Analyst and be provided with a real-world data set and a real-world inspired scenario to identify patterns and trends. You will perform specific data science and data analytics tasks such as extracting data, web scraping, visualizing data and creating a dashboard. This project will showcase your proficiency with Python and using libraries such as Pandas and Beautiful Soup within a Jupyter Notebook. Upon completion you will have an impressive project to add to your job portfolio. PRE-REQUISITE: **Python for Data Science, AI and Development** course from IBM is a pre-requisite for this project course. Please ensure that before taking this course you have either completed the Python for Data Science, AI and Development course from IBM or have equivalent proficiency in working with Python and data. NOTE: This course is not intended to teach you Python and does not have too much instructional content. It is intended for you to apply prior Python knowledge.		(dashboard creation), and demonstrating proficiency in working with relevant libraries.	
IV	Statistics for Data Science with Python: This Statistics for Data Science course is designed to introduce you to the basic principles of statistical methods and procedures used for data analysis. After completing this course you will have practical knowledge of crucial topics in statistics including - data gathering, summarizing data using descriptive statistics, displaying and visualizing data, examining relationships between variables, probability distributions, expected values, hypothesis testing, introduction to ANOVA (analysis of variance), regression and correlation analysis. You will take a hands-on approach to statistical analysis using Python and Jupyter Notebooks – the tools of choice for Data Scientists and Data Analysts. At the end of the course, you will complete a project to	**6**	Utilize statistical methods (descriptive statistics, hypothesis testing, regression analysis) with Python in Jupyter Notebooks to analyse data and interpret results for data science problem-solving	3, 6

	apply various concepts in the course to a Data Science problem involving a real-life inspired scenario and demonstrate an understanding of the foundational statistical thinking and reasoning. The focus is on developing a clear understanding of the different approaches for different data types, developing an intuitive understanding, making appropriate assessments of the proposed methods, using Python to analyze our data, and interpreting the output accurately. This course is suitable for a variety of professionals and students intending to start their journey in data and statistics-driven roles such as Data Scientists, Data Analysts, Business Analysts, Statisticians, and Researchers. It does not require any computer science or statistics background. We strongly recommend taking the Python for Data Science course before starting this course to get familiar with the Python programming language, Jupyter notebooks, and libraries. An optional refresher on Python is also provided.			
V	Databases and SQL for Data Science with Python: Working knowledge of SQL (or Structured Query Language) is a must for data professionals like Data Scientists, Data Analysts and Data Engineers. Much of the world's data resides in databases. SQL is a powerful language used for communicating with and extracting data from databases. In this course you will learn SQL inside out- from the very basics of Select statements to advanced concepts like JOINs. You will: -write foundational SQL statements like: SELECT, INSERT, UPDATE, and DELETE -filter result sets, use WHERE, COUNT, DISTINCT, and LIMIT clauses -differentiate between DML & DDL - CREATE, ALTER, DROP and load tables -use string patterns and ranges; ORDER and GROUP result sets, and built-in database functions -build sub-	**6**	Write and integrate SQL queries with Python code within Jupyter Notebooks to access, manipulate, and analyze data stored in relational databases for data science tasks	3, 4

	queries and query data from multiple tables -access databases as a data scientist using Jupyter notebooks with SQL and Python -work with advanced concepts like Stored Procedures, Views, ACID Transactions, Inner & Outer JOINs through hands-on labs and projects You will practice building SQL queries, work with real databases on the Cloud, and use real data science tools. In the final project you'llanalyze multiple real-world datasets to demonstrate your skills.			

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Identify common data science tools and practice using them in cloud-based labs.	**1, 5, 12**
2	Gain foundational Python programming skills to manipulate data and automate tasks using libraries like Pandas and NumPy.	**1, 2, 5, 12**
3	Apply Python skills to a real-world data science project, including data extraction, visualization, and dashboard creation.	**1, 2, 3, 5, 12**
4	Analyze data using statistical methods and interpret results using Python in Jupyter Notebooks.	**1, 2, 4, 5, 12**
5	Write SQL queries to access and manipulate data in relational databases for data science tasks.	**1, 2, 3, 5, 12**

SEMESTER – III										
Course Title	**Computer Network and Information Security**									
Course code	**23MCAO211R**	**Total credits: 4** **Total hours: 30T+60P**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			2	**0**	**4**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Fall/ III semester of the second year of the programme**								
Course Objectives	1. To gain a basic understanding of computer networking concepts and familiarise students with the fundamental taxonomy and terminology of computer networking. 2. To introduce students to advanced networking concepts in order to prepare them for entry-level Advanced courses in computer networking. 3. To enable the student to gain expertise in specific areas of networking, such as network design and maintenance.									
CO1	Explain basic concepts, OSI reference model, services and role of each layer of OSI model and TCP/IP. Apply channel allocation, framing, error and flow control techniques.									
CO2	Describe the functions of Network Layer. Explain the different Transport Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism.									
CO3	Explain the functions offered by session and presentation layer and their Implementation.									
CO4	Explain the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.									
CO5	Understand design issues in Network Security and to understand security threats, security services and mechanisms to counter.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introductory Concepts**: Goals and applications of networks, Categories of networks, Organization of the Internet, ISP, Network structure and architecture (layering principles, services, protocols and standards), The OSI reference model, TCP/IP protocol suite, Network devices and components. Physical Layer: Network topology design, Types of connections, Transmission media, Signal transmission and encoding, Network performance and transmission impairments, Switching techniques and multiplexing.	**6**	Understand the fundamentals of computer networks, including network types, Internet structure, ISP roles, and principles of network layering such as the OSI and TCP/IP models.	1, 2
II	**Link layer**: Framing, Error Detection and Correction, Flow control (Elementary Data Link Protocols, Sliding Window protocols). Medium Access Control and Local Area Networks: Channel allocation, Multiple access	**6**	Understand the concept of framing in data communication, error detection methods, flow control mechanisms, communication channels in a network, multiple access	1, 2

	protocols, LAN standards, Link layer switches & bridges (learning bridge and spanning tree algorithms).		protocols such as ALOHA, CSMA/CD, and CSMA/CA, LAN standards, ink layer switches and bridges in a network.	
III	Network Layer: Point-to-point networks, Logical addressing, Basic internetworking (IP, CIDR, ARP, RARP, DHCP, ICMP), Routing, forwarding and delivery, Static and dynamic routing, Routing algorithms and protocols, Congestion control algorithms, IPv6.	**6**	Understand the architecture and functioning of point-to-point networks, which involve direct connections between two devices.	1,2
IV	Transport Layer: Process-to-process delivery, Transport layer protocols (UDP and TCP), Multiplexing, Connection management, Flow control and retransmission, Window management, TCP Congestion control, Quality of service	**6**	Gain a solid foundation in transport layer concepts, enabling them to effectively design, implement, and manage transport protocols and network performance.	1, 2, 3
V	Application Layer: Domain Name System, World Wide Web and Hyper Text Transfer Protocol, Electronic mail, File Transfer Protocol, Remote login, Network management, Data compression, Cryptography – basic concepts.	**6**	Gain a comprehensive understanding of essential networking and data management concepts, equipping them with the knowledge to effectively work with various Internet protocols and technologies, ensuring secure and efficient communication.	1, 2, 3
Practical				
Practical 1	Familiarization with networking components and devices LAN adapter, Hub, Switches, Routers etc.	**2**	Become familiar with key networking components and devices such as LAN adapters, hubs, switches, and routers, understanding their functions and roles within a network.	1
Practical 2	Familiarization with Transmission media and tools: Co-axial cable, UTP cable, Crimping tool, Connectors etc.	**2**	Gain practical knowledge of transmission media and tools by identifying and understanding the uses of Co-axial cable, UTP cable, Crimping tool, and Connectors.	1, 2
Practical 3	Preparing the UTP cable for cross and direct connection using crimping tool.	**2**	Gain practical knowledge of transmission media and tools by identifying and understanding the uses of Co-	2, 3

			axial cable, UTP cable, Crimping tool, and Connectors.	
Practical 4	Introduction to various interior and exterior routing protocols.	**2**	Understand and describe the fundamental concepts and operational distinctions between various interior and exterior routing protocols such as OSPF, BGP, and EIGRP.	2
Practical 5	Installation and introduction of simulation tools packet tracer/GNS3.	**2**	Successfully install and navigate simulation tools such as Packet Tracer and GNS3, gaining proficiency in configuring virtual network environments.	3
Practical 6	Study of various LAN topologies and their creation using network devices, cables, and Computer.	**2**	Identify and construct various LAN topologies using network devices, cables, and computers to understand their structural differences and practical applications.	3
Practical 7	Configuration of TCP/IP protocols in Window/LINUX.	**2**	Configure TCP/IP settings on Windows and Linux systems to ensure proper network communication.	3
Practical 8	Configuration of TELNET protocols on router for remote access.	**2**	Configure TELNET on routers to enable remote network management and access.	3
Practical 9	Working with Sniffers for monitoring network communication using a) Ethereal b) Wire shark c) Snort d) tcp dump.	**2**	Utilize network sniffers like Ethereal, Wireshark, Snort, and tcpdump to monitor and analyze network traffic.	3, 4
Practical 10	Implementation and Performance evaluation of various cryptographic algorithms in C/C++ a) DES b) RSA	**2**	Implement and evaluate the performance of cryptographic algorithms such as DES and RSA using C/C++ to understand their efficiency and security implications.	4
Practical 11	Using IP TABLES on Linux and setting the filtering rules.	**2**	Implement and manage IP Tables on Linux systems to control network traffic through effective filtering rules.	3
Practical 12	Using open SSL for web server - browser communication.	**2**	Configure and utilize OpenSSL to secure web server-browser communications through SSL/TLS protocols.	3

Practical 13	Configuring S/MIME for e-mail communication.	**2**	Configure S/MIME to secure email communications by ensuring confidentiality and integrity of messages.	3
Practical 14	Understanding the buffer overflow and format string attacks.	**2**	Understand and identify vulnerabilities such as buffer overflows and format string attacks in software applications.	2, 4
Practical 15	Using NMAP for ports monitoring and Secure Socket programming	**2**	Use NMAP for monitoring network ports and implement secure socket programming to enhance network security.	3, 4

TEXT BOOKS:

TI: Forouzan B. Data Communication and Networking. 5th edition. New York: McGraw Hill; 2012.
T2: Tanenbaum A. Computer Networks. 5th edition. Upper Saddle River, NJ: Prentice Hall; 2010.

REFERENCE BOOKS:

R1: Stallings W. Data and Computer Communication. 10th edition. Boston: Pearson; 2013.
R2: Kurose J, Ross K. Computer Networking: A Top-Down Approach. 7th edition. Boston: Pearson; 2017.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain basic concepts, OSI reference model, services and role of each layer of OSI model and TCP/IP. Apply channel allocation, framing, error and flow control techniques.	**1, 2, 3, 4, 5, 12**
2	Describe the functions of Network Layer. Explain the different Transport Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism.	**1, 2, 3, 4, 5**
3	Explain the functions offered by session and presentation layer and their Implementation.	**1, 2, 3, 5**
4	Explain the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.	**1, 2, 3, 5**
5	Understand design issues in Network Security and to understand security threats, security services and mechanisms to counter.	**1, 2, 5, 7, 8**

SEMESTER – III										
Course Title	**Usability Design of Software Applications**									
Course code	**23MCAO212R**	**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	**Master of Computer Application**								
Semester	**Fall/ III semester of the second year of the programme**								
Course Objectives	1. The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects. 2. Topics include process models, software requirements, software design, software testing, Risk Management, Quality assurance etc. 3. Knowledge to acquaint themselves with the special challenges of starting new ventures.									
CO1	Understand various software characteristics and analyse software Development Models.									
CO2	Understanding project planning, and Risk Management.									
CO3	To sensitize the students to the fundamentals of User Centred Design and User Experience their relevance and contribution to businesses									
CO4	Analysis of different software testing strategies.									
CO5	Apply estimation techniques, schedule project activities, Quality Assurance and compute pricing.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	The Product and The Process; Evolving Role of Software, Software Characteristics; The Process; Software Engineering: A Layered Technology, The Software Process, Software Process Models	**9**	Gain a solid foundation in understanding the nature of software and the processes involved in its development. This knowledge will enable them to effectively participate in and manage software development projects, ensuring the delivery of high-quality software products.	1, 2
II	Software Project Planning; Project Planning Objectives, Software Scope, Project Estimation Technique; Empirical estimation techniques, Heuristic estimation techniques. Risk Management; Reactive Vs. Proactive Risk Strategies, Software Risk, Risk Identification, Risk Projection,	**9**	Gain a comprehensive understanding of software project planning and risk management	1, 2
III	Project Scheduling and Tracking; Basic Concepts, defining a Task set for the Software Project, Selecting Software Engineering Tasks, Defining a Task Network, Scheduling, The Project Plan;	**9**	Gain essential skills in project scheduling, tracking, and quality assurance in software engineering	1, 2, 3

	Software Quality Assurance; Quality Concepts, Software Reviews, Software Reliability, The ISO 9000 Quality Standards;			
IV	Analysis and Design; Basic Concepts and Principles: Analysis Modelling, The Data Dictionary; Software Reuse, Economics of Software Reuse; Reengineering: Software Reengineering, Reverse Engineering, Forward Engineering, The Economics of Reengineering	**9**	Gain a comprehensive understanding of analysis and design principles in software engineering, as well as the strategic aspects of software reuse and reengineering	1, 2
V	Introduction and Aspects of User Centred Design, Basics of User Centered Design, Product Appreciation Assignment – Evaluating the product from user centered design aspects such as Functionality, ease of use, ergonomics, and aesthetics. Software Testing; Different Software Testing Methods: Software Testing Fundamentals, White Box Testing, Black Box Testing.	**9**	Gain essential skills in user-centered design principles and software testing methodologies	1, 2, 3

TEXT BOOKS:

T1: Fundamentals of Software Engineering, Rajiv Mall, Prentice-Hall India, Fourth Edition, 2016

T2: Interaction Design: Beyond Human-Computer Interaction, Jennifer Preece, Helen Sharp, Yvonne Rogers, Wiley publications, 4th Edition, 2015

REFERENCE BOOKS:

R1: Software Engineering A Practitioner's Approach, R. S.Pressman, Tata McGraw-Hill, Seventh Edition, 2014

R2: About Face The Essentials of Interaction Design, Alan Cooper and Robert Riemann, Wiley Publications, 4th Edition, 2014.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand various software characteristics and analyse software Development Models.	**1, 2, 5, 12**
2	Understanding project planning, and Risk Management.	**2, 3, 7, 11**
3	To sensitize the students to the fundamentals of User Centred Design and User Experience their relevance and contribution to businesses	**1, 3, 9, 12**
4	Analysis of different software testing strategies.	**1, 3, 5, 12**
5	Apply estimation techniques, schedule project activities, Quality Assurance and compute pricing.	**2, 3, 4, 11, 12**

SEMESTER – III									
Course Title	**Object Oriented Paradigm**								
Course code	**23MCAO213R**	**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**	**Basic Programming**						
Programme	**Master of Computer Application**								
Semester	**Fall/ III semester of the second year of the programme**								
Course Objectives	1. To teach how to decompose the problem into a set of objects. 2. To teach how Objects interact with each other to solve the problem. 3. To teach how to create new type of objects to model elements from the problem space.								
CO1	Understanding fundamental principles of OO programming, OO analysis, design, and development.								
CO2	Apply inheritance and polymorphism concepts of OOPs on computing problem.								
CO3	Design applications for a range of problems using file and exception handling.								
CO4	Implementation of object-oriented based projects.								
CO5	Demonstrate the use of various OOPs concepts with the help of programs.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Principles of Objective Oriented Programming**: Object Oriented Programming Paradigm, Basic Concepts of Object-Oriented Programming, Benefits of Object-Oriented Programming, Object Oriented Languages, Applications of Object-Oriented Programming. Token Expressions & Control Structures: Tokens, Keywords, Identifiers and Constants, Data Types, Type Compatibility, Variables, Operators, Implicit Conversions, Operator Precedence, Control Structures.	**6**	Gain a solid foundation in object-oriented programming principles and fundamental concepts of token expressions and control structures	1, 2
II	**Array and String**: Single Array & Multidimensional Array, Library Classes-String, String Buffer & Wrapper Class, Command line arguments and Various String Operations. **Functions**: Function prototyping, function components, passing parameters, call by reference, return by reference, inline functions, default arguments, overloaded function. Pointers: Array of objects, pointers to objects, this pointer, dynamic allocation operators, dynamic objects.	**6**	Gain a comprehensive understanding of essential programming concepts related to arrays, strings, functions, and pointers	1, 2
III	**Object and Classes**: Making sense of core object concepts (Encapsulation,	**6**	Gain a solid foundation in object-oriented	1, 2

	Abstraction, Polymorphism, Classes, Messages Association, Interfaces), Implementation of class and Objects. Structures and classes. Classes objects and memory static class data. **Constructors & Destructors**: Constructors, Parameterized Constructors, Copy Constructors, Dynamic Constructors, Destructors.		programming principles, including encapsulation, abstraction, polymorphism, classes, constructors, and destructors	
IV	**Inheritance**: Concept of inheritance. Derived class and based class. Derived class constructors, member function, inheritance in the English distance class, class hierarchies, inheritance and graphics shapes, public and private inheritance, aggregation: Classes within classes, inheritance and program development. **Polymorphism**: Definition of Polymorphism, Compile Time Polymorphism, Runtime Polymorphism, Defining Operator Overloading, Overloading Operators, Rules for Overloading Operators, Type Conversions, Virtual Function	**6**	Gain a comprehensive understanding of inheritance and polymorphism in object-oriented programming	1, 2
V	**Exception handling**: Try, throw, and catch, exceptions and derived classes, function exception declaration, unexpected exceptions, exception when handling exceptions, resource capture and release. **Streams and Files**: Streams classes, Stream Errors, Disk File I/O with streams, file pointers, error handling in file I/O with member function, overloading the extraction and insertion operators, memory as a stream object, command line arguments, and printer output.	**6**	Gain proficiency in exception handling techniques to manage errors and exceptional conditions effectively in software development	1, 2, 3

Practical

Practical	Content	Contact Hour	Learning Outcome	KL
Practical 1	Program to show swap of two numbers by using third variable, and without using a third variable	**2**	Perform basic variable manipulation programmatically, handle user inputs and outputs, and write well-structured and documented code.	5, 6
Practical 2	Program to show leap year or not.	**2**	Gain proficiency in using conditional statements to solve problems, handling	5, 6

			user inputs and outputs, and writing well-structured and documented code	
Practical 3	Program to use switch statement.	**2**	Gain proficiency in using switch statements to implement decision-making logic	5, 6
Practical 4	Program to display first 10 natural number and their sum.	**2**	Gain proficiency in using loops, arithmetic operations, and output handling in programming	5, 6
Practical 5	Program to print star pattern of the following: * * * * * * * * * * * * * * *	**2**	Gain proficiency in using nested loops, controlling pattern formation	5, 6
Practical 6	Program to find Fibonacci series up to a range.	**2**	Gain proficiency in using loops, handling numerical sequences, managing user inputs and outputs	5, 6
Practical 7	Program to check a given number is Armstrong or not.	**2**	Gain proficiency in using loops for iterative operations, handling mathematical computations	5, 6
Practical 8	Program to find whether the given number is prime or not.	**2**	Gain proficiency in using loops for iterative operations, handling numerical operations	5,6
Practical 9	Program to display 1+3+5+. . .+n.	**2**	Gain proficiency in using loops for iterative operations, handling numerical operations involving odd numbers	5, 6
Practical 10	Program to show sum of 10 elements of array and show the average. find the maximum and minimum number in an array.	**2**	Gain proficiency in working with arrays, using loops for iterative operations, performing basic mathematical computations	5, 6
Practical 11	Program to demonstrate the use of constructors.	**2**	Gain proficiency in understanding the role and usage of constructors in object-oriented programming	5, 6
Practical 12	Program to demonstrate inheritance.	**2**	Develop proficiency in using destructors for resource management and understanding inheritance concepts	5, 6
Practical	Program to demonstrate function	**2**	Develop proficiency in	5, 6

13	overloading.		using function overloading effectively in programming, understanding its benefits in code organization and polymorphism	
Practical 14	Program to demonstrate operator overloading.	**2**	Develop proficiency in using operator overloading effectively in programming, understanding its benefits in code customization and usability	5, 6
Practical 15	Program to demonstrate virtual functions.	**2**	Develop proficiency in using virtual functions effectively in programming	5, 6

Text Book:

T1: Silberschatz A, Galvin P, Gagne G. Operating System Concepts Essentials. 9th edition. Singapore: Wiley Asia Student Edition; 2018.
T2: Stallings W. Operating Systems: Internals and Design Principles. 5th edition. New Delhi: Prentice Hall of India; 2004.

Reference Book:

R1: Crowley C. Operating System: A Design-Oriented Approach. 1st edition. Boston: Irwin Publishing; 1996.
R2: Nutt GJ. Operating Systems: A Modern Perspective. 2nd edition. Boston: Addison-Wesley; 2000.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understanding fundamental principles of OO programming, OO analysis, design and development.	**1, 2, 3, 12**
2	Apply inheritance and polymorphism concepts of OOPs on computing problem.	**1, 3, 4, 12**
3	Design applications for a range of problems using file and exception handling.	**1, 3, 4, 12**
4	Implementation of object-oriented based projects.	**3, 4, 5, 11, 12**
5	Demonstrate the use of various OOPs concepts with the help of programs.	**1, 3, 4, 5, 12**

SEMESTER – III									
Course Title	**Techno Professional Skills II - Exploratory Data Analysis**								
Course code	**23MCAO214R**	**Total credits: 1** **Total hours: 30P**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**2**	**0**	**0**	**0**	**1**
Pre-requisite	**Database management**	**Co-requisite**	**NIL**						
Programme	**Master of Computer Application**								
Semester	**Fall/ III semester of the second year of the programme**								
Course Objectives	1. To gain insights and understanding from a dataset through visual and quantitative methods. 2. To identify patterns, relationships, and anomalies in the data, this can inform further analysis or decision-making. 3. To extract meaningful information from data and communicate it effectively to stakeholders.								
CO1	Demonstrate the importance of exploratory data analysis in data analysis and decision-making.								
CO2	Develop skills in data visualization using various tools and techniques.								
CO3	Learn how to effectively communicate insights and findings from data analysis.								
CO4	Apply EDA techniques to real-world data analysis problems.								
CO5	Enhance critical thinking skills to identify patterns, trends, and outliers in data.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Exploratory Data Analysis**: EDA Introduction, What is EDA? EDA vs Classical & Bayesian, EDA vs Summary, EDA Goals, The Role of Graphics, An EDA/Graphics Example, General Problem Categories.	**6**	Gain a comprehensive understanding of Exploratory Data Analysis (EDA) principles, techniques, and applications	1, 2
II	**Underlying Assumptions**: Importance, Techniques for Testing Assumptions, Interpretation of 4-Plot, Consequences.	**6**	Develop proficiency in understanding, testing, and interpreting underlying assumptions in statistical analysis and data interpretation	1, 2
III	**EDA Techniques**: Introduction, Analysis Questions, Graphical Techniques: Alphabetical, Graphical Techniques: By Problem Category, Quantitative Techniques, Probability Distributions.	**6**	Gain proficiency in applying a variety of EDA techniques to explore, visualize, and analyze datasets effectively	1, 2, 3
IV	**EDA Case Studies**: Case Studies Introduction, Case Studies : Normal random numbers, Uniform random numbers, Random walk, Josephson Junction Cry thermometry, Beam Deflections, .Filter Transmittance, Standard Resistor, Heat Flow Meter 1, Airplane Glass Failure Time, Ceramic Strength.	**6**	Gain practical experience in applying EDA techniques to various real-world datasets	1, 2

V	**Data Visualization**: Design principles for charts and graphs, ggplot2 and Tableau tools for creating data visualizations, The process creating visualizations and selecting the appropriate visual display, Designing effective digital presentations, Visualization as exploration, Visualizing categorical data, Visualizing time series data, Visualizing multiple variables, Visualizing geospatial data, Dashboard design, Web-based visualizations, Interactive visualizations and motion.	**6**	Develop comprehensive skills in data visualization, enabling them to create impactful and insightful visual representations of data across various domains and applications.	1, 2, 3

Practical

Practical	Content	Contact Hour	Learning Outcome	KL
Practical 1	Calculate basic statistics (mean, median, standard deviation) for different variables in a dataset.	**1**	Develop essential skills in statistical analysis, gaining proficiency in calculating and interpreting mean, median, and standard deviation for different variables in datasets.	5, 6
Practical 2	Filter a dataset based on specific criteria (e.g., age > 25, income > $50,000).	**1**	Develop proficiency in filtering datasets based on specific criteria, gaining essential skills for data manipulation, analysis, and reporting in various domains such as business analytics, research, and data science.	5, 6
Practical 3	Sort a data frame by a specific column (e.g., ascending order of prices).	**1**	Develop proficiency in sorting data frames by specific columns, gaining essential skills for data manipulation, analysis, and presentation in various domains such as data science, business analytics, and research.	5, 6
Practical 4	Join two data frames together based on a common identifier.	**1**	Develop proficiency in joining data frames based on common identifiers, gaining essential skills for data manipulation, integration, and analysis in various domains such as data science, business analytics, and research.	5, 6

Practical 5	Create a new variable based on a mathematical formula applied to existing data.	**1**	Develop essential skills in data manipulation, transformation, and analysis, enabling them to create new variables based on mathematical formulas for various applications in data-driven decision-making, research, and problem-solving.	5, 6
Practical 6	Calculate and visualize the correlation between two variables in a dataset.	**1**	Develop essential skills in data analysis and visualization, enabling them to calculate and interpret correlations between variables effectively for decision-making, research, and further exploration in various domains.	5, 6
Practical 7	Create a basic histogram to visualize the distribution of a numeric variable.	**1**	Develop proficiency in creating and interpreting histograms to visualize the distribution of numeric variables, gaining essential skills for exploratory data analysis and visualization in data science, research, and business analytics.	5, 6
Practical 8	Plot a scatter plot to show the relationship between two variables.	**1**	Develop proficiency in creating and interpreting scatter plots to visualize relationships between variables, gaining essential skills for exploratory data analysis, visualization, and data-driven decision-making in various domains.	5, 6
Practical 9	Create a bar chart to compare different categories in a dataset.	**1**	Develop proficiency in creating and interpreting bar charts to compare different categories in datasets, gaining essential skills for data visualization, analysis, and communication in various domains.	5, 6
Practical 10	Customize a plot with labels, colors, legends, and titles.	**1**	Develop proficiency in customizing plots with labels, colors, legends, and titles, gaining essential	5, 6

			skills for effective data visualization, analysis, and communication in various domains.	
Practical 11	Create a boxplot to compare the distribution of data across different groups.	**1**	Develop proficiency in creating and interpreting boxplots to compare the distribution of data across different groups, gaining essential skills for exploratory data analysis, visualization, and data-driven decision-making in various domains.	5, 6
Practical 12	Build a time series plot to visualize trends over time.	**1**	Develop proficiency in building and interpreting time series plots to visualize trends over time, gaining essential skills for time-series analysis, forecasting, and data-driven decision-making in various domains.	5, 6
Practical 13	Write a simple function to clean text data and remove punctuation.	**1**	Develop proficiency in writing and applying text cleaning functions to remove punctuation and prepare text data for further analysis, gaining essential skills for data preprocessing and text mining in various domains.	5, 6
Practical 14	Use a loop to iterate through a list of values and perform calculations.	**1**	Develop proficiency in using loops to iterate through lists and perform calculations, gaining essential skills for data processing, automation, and analysis in various programming contexts.	5, 6
Practical 15	Write an if-else statement to make decisions based on conditions.	**1**	Develop proficiency in writing if-else statements to make decisions based on conditions, gaining essential skills for programming, automation, and data processing in various domains.	5, 6
Practical 16	Create a recursive function that calls itself repeatedly.	**1**	Develop proficiency in creating and applying recursive functions to solve	5, 6

			complex problems, gaining essential skills for programming, problem-solving, and algorithm design in various domains.	
Practical 17	Use nested loops to perform complex calculations on multi-dimensional data.	**1**	Develop proficiency in using nested loops to perform complex calculations on multi-dimensional data, gaining essential skills for data processing, analysis, and algorithm design in various programming contexts.	5, 6
Practical 18:	Install and load a new package from the CRAN repository.	**1**	Develop proficiency in installing and loading new packages from the CRAN repository, gaining essential skills for enhancing their R programming capabilities and performing advanced data analysis tasks.	5, 6
Practical 19:	Use basic functions from the tidyverse package for data manipulation and visualization.	**1**	Develop proficiency in using basic functions from the Tidyverse package for data manipulation and visualization, enhancing their data analysis capabilities in R.	5, 6
Practical 20:	Explore the functionalities of a specific package and apply them to your analysis.	**1**	Develop proficiency in exploring and applying the functionalities of a specific package to their analysis, enhancing their ability to leverage specialized tools for effective data analysis and problem-solving.	5, 6
Practical 21:	Combine R code with Markdown to create a report with formatted text and plots.	**2**	Develop proficiency in combining R code with Markdown to create professional, formatted reports that effectively communicate data analysis results, supporting decision-making and knowledge sharing.	5, 6
Practical 22:	Simulate a random sample from a population and analyze its properties.	**2**	Develop proficiency in simulating random samples from a population and analyzing their properties, enhancing their statistical	5, 6

			analysis skills and understanding of sampling theory.	
Practical 23	Perform basic statistical tests to compare groups within a dataset.	**2**	Develop proficiency in performing basic statistical tests to compare groups within a dataset, enhancing their ability to conduct rigorous data analysis and make informed decisions based on statistical evidence.	5, 6
Practical 24	Scrape data from a website and clean it for analysis.	**2**	Develop proficiency in scraping data from websites and cleaning it for analysis, enhancing their ability to gather and prepare diverse datasets for data-driven insights and decision-making.	5, 6
Practical 25:	Develop a simple function to perform a specific data analysis task.	**2**	Develop the skills and confidence to develop simple functions that automate specific data analysis tasks, facilitating efficient and reproducible data-driven insights in various domains and applications.	5, 6

TEXT BOOKS:

T1: Tukey JW. Exploratory Data Analysis. 1st edition. Boston: Pearson; 1977.

REFERENCE BOOKS:

R1: Engineering Statistics Handbook, http://www.itl.nist.gov/div898/handbook/, nist.gov

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate the importance of exploratory data analysis in data analysis and decision-making.	**1, 2, 12**
2	Develop skills in data visualization using various tools and techniques.	**1, 5, 12**
3	Learn how to effectively communicate insights and findings from data analysis.	**9, 12**
4	Apply EDA techniques to real-world data analysis problems.	**3, 4, 12**
5	Enhance critical thinking skills to identify patterns, trends, and outliers in data.	**2, 3, 12**

SEMESTER – III										
Course Title	**Programme Elective -I – Artificial Intelligence and Machine Learning**									
Course code	**23MCAO215R**	**Total credits: 3** **Total hours: 30T+30P**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
			2	**0**	**2**	**0**	**0**	**0**	**3**	
Pre-requisite	**Basic Programming Skills and Mathematics**	**Co-requisite**	**NIL**							
Programme	**Master of Computer Application**									
Semester	**Fall/ III semester of the second year of the programme**									
Course Objectives	1. To acquire a comprehensive understanding of AI and machine learning concepts, methodologies, and practical implementation skills using industry-relevant tools. 2. To master data pre processing, analysis, feature engineering, and apply principles of model evaluation and optimization for enhanced performance. 3. To develop an understanding of the ethical dimensions of AI, focusing on bias, fairness, and transparency, and learn strategies for responsible societal impact.									
CO1	Gain a comprehensive grasp of foundational AI and machine learning concepts, encompassing algorithms and methodologies									
CO2	Develop proficient hands-on skills in implementing AI and machine learning models, utilizing industry-relevant programming languages and frameworks									
CO3	Acquire expertise in pre processing and analyzing data, mastering techniques for feature selection and engineering to enhance model performance									
CO4	Demonstrate a sound understanding of model evaluation principles and optimization techniques, ensuring the ability to enhance model efficiency and effectiveness									
CO5	Explore the ethical dimensions of AI, examining issues related to bias, fairness, and transparency, and develop strategies for addressing societal implications responsibly.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to AI and Machine Learning**: Define AI, Machine Learning, and Deep Learning, Types of Machine Learning: Supervised, Unsupervised, Reinforcement Learning, History and applications of AI	**6**	Gain a foundational understanding of AI and Machine Learning concepts, types, historical development, and practical applications. They will be equipped to comprehend the fundamental principles and significance of AI in modern technology and society, preparing them for further studies or careers in AI and related fields.	1, 2
II	**Supervised Learning Fundamentals**: Concepts of linear models, cost functions, gradient descent, Implementation for prediction tasks (housing prices, etc.), Logistic Regression: Classification concepts, sigmoid function, decision boundaries, Implementation for binary classification problems (email spam, medical diagnosis) Decision	**6**	Develop a solid understanding of supervised learning fundamentals, including linear models, logistic regression, decision trees, random forests, and their practical applications in prediction and classification tasks	1, 2

	Trees & Random Forests: Building and interpreting decision trees, handling over fitting, Ensemble methods and the power of random forests			
III	**Deep Learning**: Neural Networks Neurons, activation functions, back propagation, Building simple neural networks (Multilayer Perceptron), Convolutional Neural Networks (CNNs): Image processing, kernels, pooling layers, CNN architectures for image classification tasks (MNIST, CIFAR-10)	**6**	Develop a comprehensive understanding of deep learning concepts, neural network architectures, and practical skills in building and training models for image processing and classification tasks using Convolutional Neural Networks (CNNs)	1, 2
IV	**Unsupervised Learning and Advanced Topics**: Clustering - K-Means, hierarchical clustering, applications **Dimensionality Reduction**: Principal Component Analysis (PCA), feature visualization **Natural Language Processing** (NLP): Text pre processing, word embeddings Introduction to Recurrent Neural Networks (RNNs)	**6**	Gain a comprehensive understanding of advanced topics in unsupervised learning, dimensionality reduction, natural language processing, and recurrent neural networks	1, 2, 3
V	**Applying AI**: Best Practices & Ethics: Bias & Fairness in AI, Transparency & Explainability, Fairness and Bias: **Types of bias in AI Transparency and Explainability**: The need for explainable AI (XAI), Methods for understanding model decisions, Balancing transparency with trade secrets and intellectual property **Privacy and Data Security**: Data protection principles in AI contexts, Strategies for secure data collection, storage, and use	**6**	Develop a comprehensive understanding of best practices and ethical considerations when applying AI	1, 2
Practical				
Practical 1	Write a Python script to demonstrate basic data types and their operations to refresh Python programming skills.	**2**	Understand and demonstrate the use of Python's basic data types and operations.	2
Practical 2	Implement a simple linear regression model from scratch using Python to predict housing prices based on dataset features.	**2**	Develop a simple linear regression model from scratch to predict housing prices and understand the underlying mathematics.	3

Practical 3	Develop a logistic regression model to classify emails as spam or not spam.	**2**	Develop and evaluate a logistic regression model to classify emails as spam or not spam, demonstrating understanding of classification thresholds and decision boundaries.	3
Practical 4	Build and visualize a decision tree using the scikit-learn library to classify patients based on medical diagnosis data.	**2**	Construct and visualize a decision tree to accurately classify medical diagnosis data, demonstrating understanding of tree-based learning algorithms.	3
Practical 5	Implement a Random Forest model to predict credit risk from financial datasets.	**2**	Develop a Random Forest model to predict credit risk from financial datasets and understand the concept of ensemble learning.	3
Practical 6	Create a Python program to simulate the gradient descent algorithm showing how it optimizes the cost function.	**2**	Create and demonstrate a Python simulation of the gradient descent algorithm to optimize a cost function, illustrating the process of parameter optimization.	3
Practical 7	Write a Python program to build a basic neural network using numpy to understand forward and backward propagation.	**2**	Develop a basic neural network using numpy to understand the principles of forward and backward propagation in neural computation.	5
Practical 8	Use TensorFlow and Keras to build a convolutional neural network to classify images from the CIFAR-10 dataset.	**2**	Build and train a convolutional neural network using TensorFlow and Keras for image classification, demonstrating the application of CNNs in deep learning.	5
Practical 9	Implement K-means clustering to segment customers based on shopping data.	**2**	Implement and evaluate the effectiveness of K-means clustering for customer segmentation, demonstrating understanding of clustering techniques in unsupervised learning.	5
Practical 10	Apply Principal Component Analysis using scikit-learn to reduce the dimensions of a dataset while preserving as much variance as possible.	**2**	Apply Principal Component Analysis to effectively reduce the dimensions of a dataset while preserving maximum variance, demonstrating the concept of feature reduction.	5
Practical 11	Write a script to preprocess text data, including tokenization, removing stopwords, and generating word embeddings.	**2**	Demonstrate proficiency in preprocessing text data by performing tokenization, removing stopwords, and generating word embeddings,	5

			understanding their impact on natural language processing tasks.	
Practical 12	Develop a Recurrent Neural Network to predict the next word in a sentence using TensorFlow.	**2**	Develop a Recurrent Neural Network using TensorFlow to predict the next word in a sentence, demonstrating understanding of sequential data and RNN architecture.	5
Practical 13	Create a program to analyze and report potential biases in a dataset used for training an AI model.	**2**	Critically analyze and identify potential biases in AI training datasets, demonstrating understanding of the implications of biased data on AI fairness and performance.	5
Practical 14	Implement a method to interpret the decisions made by a machine learning model, such as using SHAP or LIME.	**2**	Implement and use methods like SHAP or LIME to interpret and explain the decisions made by machine learning models, demonstrating the ability to apply techniques for model transparency.	4, 5
Practical 15	Write a Python script that demonstrates encryption and decryption methods to protect data used in AI applications.	**2**	Understand and demonstrate the application of encryption and decryption techniques to protect data integrity and privacy in AI applications.	4, 5

TEXT BOOKS:

T1: Russell S, Norvig P. Artificial Intelligence: A Modern Approach. 4th edition. Upper Saddle River, NJ: Pearson; 2020.
T2: Goodfellow I, Bengio Y, Courville A. Deep Learning. 1st edition. Cambridge: MIT Press; 2016.
T3: Barocas S, Hardt M, Narayanan A. Fairness and Machine Learning. 1st edition; 2023.

REFERENCE BOOKS:

R1: Géron A. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems. 2nd edition. Sebastopol: O'Reilly Media; 2019.
R2: Müller AC, Guido S. Introduction to Machine Learning with Python: A Guide for Data Scientists. 2nd edition. Sebastopol: O'Reilly Media; 2023.
R3: Bishop CM. Pattern Recognition and Machine Learning. 1st edition. New York: Springer; 2006.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Gain a comprehensive grasp of foundational AI and machine learning concepts, encompassing algorithms and methodologies	**1, 2, 12**
2	Develop proficient hands-on skills in implementing AI and machine learning models, utilizing industry-relevant programming languages and frameworks	**1, 3, 5, 12**
3	Acquire expertise in preprocessing and analyzing data, mastering techniques for feature selection and engineering to enhance model performance	**1, 3, 4, 12**
4	Demonstrate a sound understanding of model evaluation principles and optimization techniques, ensuring the ability to enhance model efficiency and effectiveness	**1, 3, 4, 12**
5	Explore the ethical dimensions of AI, examining issues related to bias, fairness, and transparency, and develop strategies for addressing societal implications responsibly.	**7, 8, 9, 12**

SEMESTER – III										
Course Title	**Programme Elective -I - Business Intelligence**									
Course code	**23MCAO219R**	**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	**Master of Computer Application**									
Semester	**Fall/ III semester of the second year of the programme**									
Course Objectives	1. To learn how managers utilise business analytics to create, address, and assist management decision-making for company challenges. 2. To become accustomed to the procedures required to create, present, and analyse business data. 3. Get knowledge on how to use Excel and its add-ons to solve business challenges									
CO1	Understand the basic concepts of Business Analytics, including the roles of Business Intelligence and the value proposition of integrating business with technology to enhance decision-making.									
CO2	Demonstrate the ability to organize and source data, address data quality issues, and classify data effectively to prepare for advanced visualization techniques.									
CO3	Create and interpret a variety of data visualizations (such as bar charts, pie charts, scatter plots, heat maps) and utilize these visualizations in dashboards and storyboards to convey meaningful analytics insights.									
CO4	Apply predictive analytics techniques such as linear and multi-linear regression and time series forecasting, alongside utilizing prescriptive analytics methods									
CO5	Synthesize knowledge gained from industry experts on emerging trends in business analytics and intelligence through practical demonstrations.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Overview of Business Analytics**: Introduction to Analytics, The Challenge of Decision Making, What Is Business Intelligence, The Business Intelligence Value Proposition, The Combination of Business and Technology	**9**	Define and understand the fundamentals of business analytics, the decision-making challenges, the concept and value of business intelligence, and the synergistic relationship between business and technology.	1, 2
II	**Introduction to Data Visualization**: Visualization/ Data Issues, Organization/sources of data, Importance of data quality, Dealing with missing or incomplete data, Data Classification.	**9**	Master the principles of data visualization, including data organization, the significance of data quality, strategies for handling missing data, and data classification techniques.	2, 3
III	**Descriptive Analytics**: Data Visualization and Analytics- Charts (Bars-Pie-Line-Scatter-Map-Bubble-Box & Whisker-Tree map - Heat map-Circle and Area) -Worksheet, Dashboard and Story Board creation	**9**	Create and interpret diverse charts and visualizations such as bar, pie, line, scatter, map, bubble, box & whisker, tree map, heat map, and area charts, and develop comprehensive worksheets, dashboards, and storyboards.	3, 6
IV	**Predictive Analytics**: Linear	**9**	Apply linear and multi-linear	3, 4

	Regression, Multi-linear Regression and Time Series Forecasting. Prescriptive Analytics: Linear optimization, Integer optimization, Non-linear programming, Optimization of Network models and Monte Carlo Simulation		regression models and time series forecasting for predictive analytics, and utilize optimization techniques	
V	**Applications**: Practical demonstration using R or Python or SPSS by industry experts on Emerging trends in business analytics and intelligence	**9**	Demonstrate proficiency in using software tools like R, Python, or SPSS to implement advanced analytics techniques	3, 5, 6

TEXT BOOKS:

T1: Sharda R, Delen D, Turban E, Aronson J, Liang TP. Business Intelligence and Analytics: Systems for Decision Support. 10th edition. Boston: Pearson Education; 2014.
T2: Powell SG, Barker KR. Management Science: The Art of Modeling with Spreadsheets (W/CD). 4th edition. Hoboken, NJ: John Wiley & Sons; 2014.

REFERENCE BOOKS:

R1: Linoff GS, Berry MJ. Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management. 3rd edition. Hoboken, NJ: John Wiley & Sons; 2011.
R2: Frank B, Green B, Harris T, Van De Vanter K. Business Intelligence Strategy: A Practical Guide for Achieving BI Excellence. New York: MC Press; 2010.
R3: Hair JF, Black WC, Babin BJ, Anderson RE, Tatham RL. Multivariate Data Analysis. 7th edition. Boston: Pearson Education; 2009.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basic concepts of Business Analytics, including the roles of Business Intelligence and the value proposition of integrating business with technology to enhance decision-making.	**1, 2, 12**
2	Demonstrate the ability to organize and source data, address data quality issues, and classify data effectively to prepare for advanced visualization techniques.	**1, 3, 5, 12**
3	Create and interpret a variety of data visualizations (such as bar charts, pie charts, scatter plots, heat maps) and utilize these visualizations in dashboards and storyboards to convey meaningful analytics insights.	**1, 3, 5, 12**
4	Apply predictive analytics techniques such as linear and multi-linear regression and time series forecasting, alongside utilizing prescriptive analytics methods	**1, 3, 4, 12**
5	Synthesize knowledge gained from industry experts on emerging trends in business analytics and intelligence through practical demonstrations.	**1, 6, 12**

SEMESTER – III									
Course Title	**Mini Research R3 (Survey/Experiments)**								
Course code	**23MCAO216R**	**Total credits: 6** **Total hours: 30T**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			2	**0**	**0**	**8**	**12**	**0**	**6**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Fall/ III semester of the second year of the programme**								
Course Objectives	1. To have a basic knowledge and understanding of surveys and experiments and its clinical implications in clinical practice. 2. Investigate a particular subject or phenomenon in detail to gain a deeper understanding of it. 3. Summarize and synthesize existing research related to the topic to identify gaps, trends, and key findings. 4. Formulate and test a specific hypothesis or set of hypotheses related to the research question.								
CO1	Enable Students a thorough understanding of how survey /experiments can provide useful causal inferences.								
CO2	Knowledge of how to design and analyze simple and complex experiments/ surveys								
CO3	Ability to evaluate experimental research / surveys and apply these methods in their own research.								
CO4	Enable students the basic knowledge and understanding in undertaking surveys and experiments into their clinical practice								
CO5	Enables the students to develop new skills and strategies in designing their survey/Experiments which can be implemented in patient care.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Surveys as Research Methodology**:What is survey research Survey strengths Survey weakness	**6**	Gain a foundational understanding of survey research methodology, its applications, strengths, and weaknesses. They will be equipped to design effective surveys, analyze survey data, and critically evaluate the reliability and validity of survey findings in research contexts.	1, 2
II	**Survey Process**: Survey design, sample selection, sample size, degree of precision, statistical power, effect size as a determinant of power, survey instrument development, Types of Survey	**6**	Develop a comprehensive understanding of the survey process, from design and sampling to instrument development and types of surveys	1, 2
III	**Qualitative Methods**: Unstructured & Semi-structured Interviewing Coding Responses to Open-Ended Questions	**6**	Develop essential skills in qualitative research methods, particularly in conducting unstructured and semi-structured interviews and coding responses from open-ended questions	1, 2, 3
IV	Survey Data Processing and	**6**	By effectively processing and	1, 2,

	Basic Data Analysis		analyzing survey data, researchers can uncover insights, trends, and correlations that inform decision-making, policy formulation, or further research directions.	3
V	**Advanced Survey Techniques and Applications** Survey Scaling Methods, Survey Data Collection Modes, Ethical Considerations in Survey Research, Applications of Survey Research,Future Trends in Survey Research	**6**	Gain a comprehensive understanding of survey research methods, including their design, strengths, weaknesses, and applications in various fields.	4, 5, 6

TEXT BOOKS:

T1: McGuire, W. G. (1997). Creative hypothesis generating in psychology: Some useful heuristics. Annual Review of Psychology, 48, 1-30.
T2: Beatty, P., & Hermann, D. (2002). To answer or not to answer: Decision processes related to survey item nonresponse. In D. A. Dillman, J. L. Eltinge, R. M. Groves, & R. J. A. Little (Eds.). (2002). Survey nonresponse (pp. 71-86). New York: Wiley3.
T3: Fink, A. (2019). Conducting research literature reviews: From the internet to paper. Sage publications.
T4: Cooper, H. (1998). Cooper, Harris, Synthesizing Research: A Guide for Literature Reviews, Thousand Oaks, CA: Sage, 1998.
T5: Hart, C. (2018). Doing a literature review: Releasing the research imagination.

OTHER LEARNING RESOURCES:

R1: Frey, J. H., & Oishi, S. M. (1995). How to conduct interviews by telephone and in person. Thousand Oaks, CA: Sage
R2: Fowler, F. J. (1995). Improving survey questions: Design and evaluation. Thousand Oaks, CA: Sage.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Enable Students a thorough understanding of how survey /experiments can provide useful causal inferences.	**1, 2, 12**
2	Knowledge of how to design and analyse simple and complex experiments/ surveys	**1, 3, 4, 12**
3	Ability to evaluate experimental research / surveys and apply these methods in their own research	**3, 4, 12**
4	Enable students the basic knowledge and understanding in undertaking surveys and experiments into their clinical practice	**1, 3, 12**
5	Enables the students to develop new skills and strategies in designing their survey/Experiments which can be implemented in patient care.	**3, 4, 12**

SEMESTER – III										
Course Title	**PDP III - Corporate Proficiency**									
Course code	**23UMPD211R**	**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	**Master of Computer Application**								
Semester	**Fall/ III semester of the second year of the programme**								
Course Objectives	1. Develop Proficiency in Writing 2. Cultivate Leadership and Communication Skills 3. Master Interview and Conflict Management Techniques								
CO1	Proficiency in writing concise and structured paragraphs.								
CO2	Understanding of different leadership styles and the distinction between managers and leaders.								
CO3	Mastery of email etiquette and effective communication strategies.								
CO4	Preparation and execution of successful job interviews, including non-verbal cues and appropriate attire.								
CO5	Competence in identifying and implementing conflict management strategies in professional settings.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Writing Skills** i. Writing short paragraphs (topic sentence, supporting sentences and concluding sentence on a given topic) ii. Writing business/professional letters/ Letters of application for employment iii. Technical writing (Report Writing, Proposal drafting)	**12**	Develop proficiency in crafting structured paragraphs, formal business letters, and technical documents such as reports and proposals.	3
II	**Self-Management and Leadership Skills**: i. Concepts of Leadership Styles ii. Manager VS Leader iii. How to be an Effective Leader	**12**	Understand diverse leadership styles, differentiate between managers and leaders, and develop effective leadership strategies.	2, 3
III	**Email Etiquette**: i. Different parts of emails and usage i. Magic Words & Wonder Phrases, iii. Effective Email Communication, iv. Responding effectively to a client's expectations	**12**	Master the components of effective email communication, including structure, persuasive language, and responsiveness to client expectations.	2, 3
IV	**Interview Skills**: i. Preparation before the interview ii. Non-verbal cues for	**12**	Prepare for interviews by mastering content, non-verbal cues, dress code, and understanding key interview	2, 3

	interview skills iii. Dress code for interview iv. Interview dos and don'ts		conduct.	
V	**Conflict Management**: i. Introduction to Conflict Management ii. Conflict Management Strategies	**12**	Gain insights into conflict management principles and strategies to handle workplace conflicts effectively.	3

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Proficiency in writing concise and structured paragraphs.	**1, 5., 9, 12**
2	Understanding of different leadership styles and the distinction between managers and leaders.	**2, 6, 9**
3	Mastery of email etiquette and effective communication strategies.	**5, 9**
4	Preparation and execution of successful job interviews, including non-verbal cues and appropriate attire.	**5, 6, 9, 11**
5	Competence in identifying and implementing conflict management strategies in professional settings.	**2, 3, 7, 9, 12**

SEMESTER – III									
Course Title	**Field Training**								
Course code	**23MCAO217R**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			0	**0**	**0**	**0**	**0**	**8**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Fall/ III semester of the second year of the programme**								
Course Objectives	1. To expose students to real-world applications of theoretical knowledge. 2. To enhance observational, analytical, and research skills through fieldwork. 3. To cultivate an appreciation for the complexities and challenges of professional practice in the field.								
CO1	Apply theoretical concepts to real-world situations.								
CO2	Conduct field-based research and gather data effectively.								
CO3	Analyze and interpret field data to draw meaningful conclusions.								
CO4	Communicate findings clearly and effectively, both orally and in writing.								
CO5	Demonstrate professional behaviour and teamwork skills in field settings.								
Course Contents	The organization will provide the students two field visit for this program. The students will be taken to a specific site for learning purposes. The students will visit a relevant site and then they will be guided and give a tour of the sites for observations. Followed by an interaction with professionals and practitioners regarding the subject or purpose of the visit. The students will have to maintain a journal to document the observations and reflections, and discussion on experiences and initial findings.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply theoretical concepts to real-world situations.	**1, 3, 10**
2	Conduct field-based research and gather data effectively.	**4, 5**
3	Analyze and interpret field data to draw meaningful conclusions.	**2, 4, 10**
4	Communicate findings clearly and effectively, both orally and in writing.	**8, 6**
5	Demonstrate professional behaviour and teamwork skills in field settings.	**6, 7**

SEMESTER – III										
Course Title	**Generic Elective II - Google Foundations of Digital Marketing And E-Commerce**									
Course code	**23MCAO001R**	**Total credits: 1** **Total hours: 15T**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
			1	**0**	**0**	**0**	**0**	**0**	**1**	
Pre-requisite	**NIL**	**Co-requisite**	**NIL**							
Programme	**Master of Computer Application**									
Semester	**Fall/ III semester of the second year of the programme**									
Course Objectives	1. Introduce fundamental concepts of digital marketing and e-commerce and their organizational roles. 2. Provide practical, hands-on training in digital marketing and e-commerce through expert-led examples. 3. Prepare students for entry-level jobs in digital marketing and e-commerce, emphasizing job roles and industry requirements.									
CO1	Define and differentiate digital marketing and e-commerce within business contexts.									
CO2	Describe responsibilities and roles of entry-level digital marketing and e-commerce positions.									
CO3	Summarize the course's contribution to career readiness in digital marketing and e-commerce.									
CO4	Identify the functions of digital marketing and e-commerce roles in organizational settings.									
CO5	Understand the marketing funnel, customer journey maps, and their relevance in strategic planning.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to Digital Marketing and E-commerce**: Understanding Digital Marketing and its Importance. Key Components of E-commerce. Evolution of Digital Marketing and E-commerce. Digital Marketing Landscape. Different Channels of Digital Marketing. The Role of Technology in Digital Marketing. Current Trends and Future of Digital Marketing.	**3**	Understand the fundamentals of digital marketing and e-commerce, and their evolution over time.	2
II	**Digital Marketing Strategies and Planning**: Developing a Digital Marketing Strategy. Setting Objectives and KPIs. Understanding Target Audience and Market Segmentation. Campaign Planning and Execution. Budgeting and Resource Allocation. Case Studies of Successful Digital Marketing Campaigns.	**3**	Develop and implement effective digital marketing strategies tailored to target audiences.	3
III	**Search Engine Optimization (SEO) and Search Engine Marketing (SEM)**: Fundamentals of SEO. On-page and Off-page SEO Techniques. Tools for SEO Analysis and Optimization. Basics of SEM. Creating Effective Ad Campaigns. Measuring and Analyzing Campaign Performance.	**3**	Apply SEO and SEM techniques to enhance online visibility and performance of digital marketing campaigns.	3
IV	**Social Media and Content Marketing**: Role of Social Media in Marketing. Building a Social Media Strategy. Tools for Social Media Management. Importance of Content in Digital Marketing. Creating Engaging Content. Content Distribution	**3**	Create and manage social media strategies and content marketing plans to engage audiences.	3

	and Promotion.			
V	**E-commerce and Digital Analytics**: E-commerce Business Models. Setting up an E-commerce Store. Payment Gateways and Security. Introduction to Digital Analytics. Key Metrics and Tools. Analyzing and Interpreting Data for Decision Making.	**3**	Set up and manage e-commerce platforms, and utilize digital analytics for data-driven decision-making.	3

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Define and differentiate digital marketing and e-commerce within business contexts.	**1, 2**
2	Describe responsibilities and roles of entry-level digital marketing and e-commerce positions.	**2**
3	Summarize the course's contribution to career readiness in digital marketing and e-commerce.	**3, 4**
4	Identify the functions of digital marketing and e-commerce roles in organizational settings.	**5, 8**
5	Understand the marketing funnel, customer journey maps, and their relevance in strategic planning.	**10, 11, 12**

SEMESTER – IV									
Course Title	**Design and Analysis of Algorithms**								
Course code	**23MCAO221R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 30T+30P	**2**	**0**	**4**	**0**	**0**	**0**	**4**
Pre-requisite	**Data Structures**	**Co-requisite**	**C/C++ Programming**						
Programme	**Master of Computer Application**								
Semester	**Winter/ IV semester of the second year of the programme**								
Course Objectives	1. Analyse the asymptotic performance of algorithms. 2. Demonstrate a familiarity with major algorithms and data structures. 3. Apply important algorithmic design paradigms and methods of analysis.								
CO1	Describe the Brute-Force paradigm, greedy paradigm, dynamic-programming paradigm, divide-and-conquer paradigm of algorithm design.								
CO2	Identify the most suitable algorithm design technique for a given problem.								
CO3	Analyse the time and space complexity of algorithms using asymptotic notation.								
CO4	Appreciate the limitations of algorithms and the concept of NP-hard problems.								
CO5	Design a given model engineering problem using graph and write the corresponding algorithm to solve the problems								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction**: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average, and worst-case behaviour; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.	**10**	Understand characteristics of Algorithms, Evaluate Time and Space Trade-offs, Analyse Recursive Algorithms, Apply Analysis Techniques to Real-world Problems	1, 2, 3
II	**Fundamental Algorithmic Strategies**: Brute-Force, Divide and Conquer (Merge sort, Quick sort), Greedy (Knapsack problem, Job sequencing), Dynamic Programming (Matrix chain multiplication, Shortest paths), Branch and Bound and Backtracking (N-Queens problem, Hamiltonian cycle) methodologies for the design of algorithm; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack, TSP.	**8**	Understand and Implement Brute-Force Algorithms, Apply Divide and Conquer Techniques, Utilize Greedy Algorithms, Implement Dynamic Programming, Explore Branch and Bound and Backtracking Techniques, Illustrate Techniques through Problem-Solving, Critical Thinking and Problem-Solving	3, 4
III	**Graph and Tree Algorithms**: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms (Dijkstra's algorithm, Floyd-Warshall algorithm), Transitive closure, Minimum Spanning Tree (Prim's algorithm, Kruskal's algorithm), Topological sorting,	**8**	Understand Graph and Tree Structures, Implement Traversal Algorithms, Apply Shortest Path Algorithms, Construct Minimum Spanning	3, 4

	Network Flow Algorithm.		Trees, Perform Topological Sorting, Solve Network Flow Problems, Enhance Problem-Solving Skills	
IV	**Tractable and Intractable Problems**: Computability of Algorithms, Computability classes – P, NP, NP complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques	**6**	Understand Computability of Algorithms, Classify Problems Based on Complexity, Comprehend the Concept of Tractability, Explore NP-Completeness, Recognize NP-Hard Problem, Apply Reduction Techniques,	4
V	**Advanced Topics**: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE	**6**	Understand the Concept of Approximation Algorithms, Analyse Performance of Approximation Algorithms, Apply Approximation Algorithms to Problems, Explore Trade-offs in Approximation Algorithms, Understand the Concept of Randomized Algorithms	4
Practical				
Practical 1	Create a binary search tree in C. Implement functions to insert a node, search for a node, and perform in-order traversal.	**2**	Develop skills to create a binary search tree in C, including implementing functions for node insertion, node search, and in-order traversal.	3, 4
Practical 2	Write a C program to represent a graph using an adjacency list. Implement a function to add an edge and display the graph.	**2**	Understand how to represent a graph using an adjacency list in C, and implement functions to add an edge and display the graph.	2, 3
Practical 3	Write a program to implement a priority queue using a binary heap. Include functions to insert an 2element, delete the maximum element, and display the heap.	**2**	Learn to implement a priority queue using a binary heap in C, including functions to insert elements, delete the maximum element, and display the heap.	3, 4

Practical 4	Implement a doubly linked list in C. Provide functions for insertion, deletion, and traversal in both forward and backward directions.	**2**	Develop skills to implement a doubly linked list in C, including functions for insertion, deletion, and traversal in both forward and backward directions.	3, 4
Practical 5	Create a circular linked list in C. Implement functions for insertion, deletion, and traversal.	**2**	Understand how to create a circular linked list in C and implement functions for insertion, deletion, and traversal.	2, 3
Practical 6	Implement the DFS algorithm for a graph represented using an adjacency matrix.	**2**	Understand and implement the DFS algorithm for a graph represented using an adjacency matrix in C	2, 3
Practical 7	Implement the brute-force string matching algorithm in C. Analyse its time complexity.	**2**	Develop skills to implement the brute-force string matching algorithm in C and analyse its time complexity.	3, 4
Practical 8	Write a C program to solve the fractional knapsack problem using the greedy algorithm.	**2**	Learn to implement the fractional knapsack problem using the greedy algorithm in C and analyse its efficiency.	3, 4
Practical 9	Write a C program to implement merge sort using the divide-and-conquer paradigm. Analyse its time complexity.	**2**	Develop skills to implement merge sort using the divide-and-conquer paradigm in C and analyse its time complexity.	3, 4
Practical 10	Write a C program to implement quick sort using the divide-and-conquer paradigm. Analyse its time complexity.	**2**	Learn to implement quick sort using the divide-and-conquer paradigm in C and analyse its time complexity.	3, 4
Practical 11	Implement binary search using the divide-and-conquer approach in C. Ensure that the program handles both iterative and recursive implementations. Analyse the time complexity.	**2**	Understand and implement binary search using the divide-and-conquer approach in C, handling both iterative and recursive implementations, and analyse its time complexity.	2, 3, 4

Practical 12	Write a C program to implement Strassen's algorithm for matrix multiplication. Compare its efficiency with the standard matrix multiplication algorithm.	**2**	Develop skills to implement Strassen's algorithm for matrix multiplication in C and compare its efficiency with the standard matrix multiplication algorithm.	3, 5
Practical 13	Write a C program to find the median of two sorted arrays using the divide-and-conquer approach. Analyse its time complexity.	**2**	Learn to implement an algorithm to find the median of two sorted arrays using the divide-and-conquer approach in C and analyse its time complexity.	3, 4
Practical 14	Implement an algorithm in C to count the number of inversions in an array using the divide-and-conquer approach. Analyse its time complexity.	**2**	Understand and implement an algorithm in C to count the number of inversions in an array using the divide-and-conquer approach and analyse its time complexity.	2, 3, 4
Practical 15	Implement the matrix chain multiplication problem using the divide-and-conquer approach in C. Analyse its time complexity.	**2**	Develop skills to implement the matrix chain multiplication problem using the divide-and-conquer approach in C and analyse its time complexity.	3, 4

TEXT BOOKS:

T1: Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, MIT Press/McGraw-Hill, 4th Edition
T2: E. Horowitz et al, Fundamentals of Algorithms, Computer Science Press, 12th Edition

REFERENCE BOOKS:

R1: Jon Kleinberg and Eva Tardos, Algorithm Design, 1st Edition, Pearson
R2: Michael T Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, 2nd Edition, Wiley
R3: Udi Manber, Addison-Wesley, Algorithms -A Creative Approach, 3rd Edition, Reading, MA.

OTHER LEARNING RESOURCES:

https://ocw.mit.edu/courses/6-006-introduction-to-algorithms-fall-2011/pages/lecture-notes/
https://www.vssut.ac.in/lecture_notes/lecture1428551222.pdf

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Describe the Brute-Force paradigm, greedy paradigm, dynamic-programming paradigm, divide-and-conquer paradigm of algorithm design.	**1, 2, 3**
2	Identify the most suitable algorithm design technique for a given problem.	**1, 2, 4**
3	Analyse the time and space complexity of algorithms using asymptotic notation.	**1, 2, 4**
4	Appreciate the limitations of algorithms and the concept of NP hard problems.	**1, 7, 12**
5	Design a given model engineering problem using graph and write the corresponding algorithm to solve the problems	**1, 2, 3, 5**

SEMESTER – IV									
Course Title	**Programme Elective II - Data Engineering**								
Course code	**23MCAO222R**	**Total credits: 3** **Total hours: 30T+30P**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			2	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Basic Programming and Database management skills**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Applications**								
Semester	**Winter/ IV semester of the second year of the programme**								
Course Objectives	1. To acquire mastery of data mining fundamentals and techniques 2. To gain skills to design and implement mathematical models for effective decision making in business environments 3. To develop an understanding of natural language processing (NLP) techniques, focusing on text pre processing, sentiment analysis, and topic modelling								
CO1	Develop an understanding of the data mining process and issues								
CO2	Understand various techniques for data mining								
CO3	Apply the techniques in solving data mining problems using data mining tools and systems								
CO4	Design mathematical model for decision making using business intelligence								
CO5	Analyse and apply Natural Language Processing								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Introduction to Data Mining: Overview of Data Mining: Understanding its importance and applications. Data Mining Process: Steps from data collection to knowledge discovery. Types of Data: Structured, unstructured, and semi-structured data.	**6**	Understand the Concept and Importance of Data Mining, Identify Applications of Data Mining, Understand the Steps of the Data Mining Process, Recognize the Challenges in Data Mining	1, 2, 3
II	Data Pre processing and Transformation: Data Cleaning: Techniques to handle missing values, outliers, and noise Data Transformation: Normalization, scaling, and discretization, Feature selection and dimensionality reduction Data Integration and Warehousing: Data warehouse concepts (OLTP vs. OLAP), ETL (Extract, Transform, Load) processes	**6**	Understand Data Cleaning Techniques, Handle Outliers and Noise, Apply Data Normalization and Scaling, Implement Discretization, Conduct Feature Selection and Dimensionality Reduction, Understand Data Warehouse Concepts	3, 4
III	Data Mining Techniques: Classification: Decision trees (e.g., C4.5, ID3), k-Nearest	**6**	Understand Decision Trees, Apply k-Nearest Neighbors (k-NN), Utilize Support Vector Machines	3, 4

	Neighbors (k-NN), Support Vector Machines (SVMs), Clustering: k-Means clustering, Hierarchical clustering Association Rule Mining: Apriori algorithm, Measures of interestingness (support, confidence), Market Basket Analysis		(SVMs), Apply k-Means Clustering, Understand Hierarchical Clustering, Apply the Apriori Algorithm, Measure Interestingness, Conduct Market Basket Analysis	
IV	Model Evaluation and Business Applications: Performance Metrics: Confusion matrix, accuracy, precision, recall, F1-score, ROC curves and AUC Model Selection and Optimization: Cross-validation, hyperparameter tuning Business Applications: Case studies in customer segmentation, churn prediction, fraud detection, recommender systems	**6**	Understand and Use the Confusion Matrix, Evaluate Models with Accuracy, Precision, Recall and F1-Score, Analyze Models Using ROC Curves and AUC, Apply Cross-Validation Techniques, Perform Hyperparameter Tuning, Understand and Apply Customer Segmentation	4
V	Natural Language Processing (NLP): NLP Fundamentals: Text preprocessing (tokenization, stemming, lemmatization), Bag-of-words, TF-IDF Sentiment Analysis: Lexicon-based and machine learning approaches Topic Modelling: LDA (Latent Dirichlet Allocation) Applications: Text classification, chatbots, information extraction	**6**	Understand and Implement Text Preprocessing Techniques, Apply Bag-of-Words Model, Implement Lexicon-Based Approaches, Apply Machine Learning Approaches, Understand and Implement Latent Dirichlet Allocation (LDA), Perform Text Classification, Develop and Implement Chatbots	4
Practical				
Practical 1	Implement a program to demonstrate the steps of the data mining process using a simple dataset, from data collection to knowledge discovery. Provide insights into the importance and applications of data mining.	**2**	Understand the steps of the data mining process and recognize its importance and applications.	2, 3
Practical 2	Write a program to perform data cleaning on a dataset. Include techniques to handle missing values, outliers, and noise.	**2**	Understand and apply data cleaning techniques.	3, 4
Practical 3	Implement a program to demonstrate data normalization, scaling, and discretization.	**2**	Apply data transformation techniques and conduct feature selection and dimensionality	3, 4

	Include feature selection and dimensionality reduction techniques.		reduction.	
Practical 4	Use a data mining tool (e.g., Weka, Orange) to implement decision tree classification on a given dataset. Analyse the results.	**2**	Apply decision tree classification using a data mining tool.	3, 4
Practical 5	Use a data mining tool to perform k-means clustering on a dataset. Visualize and interpret the results.	**2**	Apply k-means clustering using a data mining tool.	3, 4
Practical 6	Write a program to implement the Apriori algorithm for market basket analysis. Measure the interestingness of the rules using support and confidence.	**2**	Apply the Apriori algorithm for market basket analysis and measure interestingness.	3, 4
Practical 7	Implement a program to evaluate a classification model using performance metrics such as confusion matrix, accuracy, precision, recall, F1-score, ROC curves, and AUC.	**2**	Evaluate models using various performance metrics.	3, 4
Practical 8	Write a program to perform text preprocessing, including tokenization, stemming, and lemmatization on a given text dataset.	**2**	Understand and implement text preprocessing techniques.	3, 4
Practical 9	Implement a program to perform sentiment analysis using both lexicon-based and machine learning approaches. Compare their performance.	**2**	Apply sentiment analysis using different approaches and analyse their performance.	4, 5
Practical 10	Use a data mining tool or library (e.g., Gensim in Python) to implement Latent Dirichlet Allocation (LDA) for topic modeling on a text dataset. Analyse the results.	**2**	Understand and apply Latent Dirichlet Allocation (LDA) for topic modeling.	3, 4

TEXT BOOKS:

T1: Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, 3rd Edition
T2: Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, 2nd Edition

REFERENCE BOOKS:

R1: Christopher M. Bishop, Pattern Recognition and Machine Learning, 1st Edition
R2: Jure Leskovec, Anand Rajaraman and Jeff Ullman, Mining of Massive Datasets, 3rd Edition
R3: Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, 1st Edition

OTHER LEARNING RESOURCES:

https://onlinecourses.nptel.ac.in/noc21_cs69/preview

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Develop an understanding of the data mining process and issues	**1, 2, 4**
2	Understand various techniques for data mining	**1, 2, 5**
3	Apply the techniques in solving data mining problems using data mining tools and systems	**3, 5, 11**
4	Design mathematical model for decision making using business intelligence	**1, 3, 5**
5	Analyse and apply Natural Language Processing	**1, 2, 4, 5**

SEMESTER – IV										
Course Title	**Mini Research (Experimentation/Data analysis and Thesis Preparation - R4)**									
Course code	**23MCAO223R**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
			0	**0**	**0**	**8**	**12**	**0**	**4**	
Pre-requisite	**Nil**	**Co-requisite**	**Nil**							
Programme	**Master of Computer Application**									
Semester	**Winter/ IV semester of the second year of the programme**									
Course Objectives	1. Develop foundational research skills, mastering data collection and analysis techniques for accurate interpretation. 2. Cultivate effective documentation practices, emphasizing clarity, transparency, and ethical considerations. 3. Acquire proficiency in utilizing research tools, fostering continuous learning, and building a comprehensive research portfolio.									
CO1	Demonstrate proficiency in applying statistical analysis techniques to interpret data accurately and effectively in various contexts.									
CO2	Develop the capability to effectively interpret and draw meaningful conclusions from data sets, enhancing their decision-making skills.									
CO3	Engage in in-depth discussions and critically evaluate theories, methodologies, and research findings to enhance understanding and foster intellectual growth.									
CO4	Articulate the scope and limitations of features within projects, ensuring a thorough understanding of project boundaries and deliverables.									
CO5	Master the skills necessary to deliver professional and coherent final presentations									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Statistical Analysis**: Introduction to Statistical concepts	**4**	Understand Fundamental Statistical Concepts, Apply Descriptive Statistical Techniques, Conduct Basic Statistical Tests	1, 2, 3
II	**Data interpretation**: Parametric and Non-parametric Tests: t-tests, ANOVA, Chi-square tests Interpretation of Results: Drawing meaningful conclusions	**8**	Understand the Difference Between Parametric and Non-Parametric Tests, Conduct and Interpret t-tests, Perform and Analyse ANOVA (Analysis of Variance), Execute and Interpret Chi-Square Tests and draw interpretations	3, 4
III	**Discussions**: Implications of findings Addressing limitations	**8**	Analyse the Broader Impact of Research Findings, Draw Practical and Theoretical Conclusions, Communicate Findings Effectively, Identify and Acknowledge Research Limitations, Propose Solutions and Future Research Directions	3, 4
IV	**Future scope of the study**: Research Design and Methodology, Emerging Trends in Research Collaboration and Interdisciplinary Research	**8**	Identify Potential Areas for Future Research, Design Follow-Up Studies, Predict the Impact of Future Research, Construct Robust Research Designs, Implement Advanced Methodologies, Ensure	4

			Rigorous Data Collection and Analysis	
V	**Final presentation of the thesis:** Scientific Writing, Effective Oral Presentation, Ethical Considerations, Research Communication	**4**	Demonstrate Proficiency in Scientific Writing, Effectively Communicate Research Findings, Adhere to Academic Standards and Guidelines, Deliver Clear and Engaging Oral Presentations, Communicate Research Findings Effectively	4

TEXT BOOKS:

T1: John W. Creswell and J. Creswell, Research Design: Qualitative, Quantitative and Mixed Methods
T2: Alan Agresti and Barbara Finlay, Statistical Methods for the Social Sciences, 3rd Edition

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate proficiency in applying statistical analysis techniques to interpret data accurately and effectively in various contexts.	**1, 2, 4**
2	Develop the capability to effectively interpret and draw meaningful conclusions from data sets, enhancing their decision-making skills.	**2, 4, 9**
3	Engage in in-depth discussions and critically evaluate theories, methodologies, and research findings to enhance understanding and foster intellectual growth.	**2, 6, 12**
4	Articulate the scope and limitations of features within projects, ensuring a thorough understanding of project boundaries and deliverables.	**3, 6, 11**
5	Master the skills necessary to deliver professional and coherent final presentations	**6, 9, 12**

SEMESTER – IV									
Course Title	**Programme Elective II - Pattern Recognition**								
Course code	**23MCAO224R**	**Total credits: 3** **Total hours: 30T+30P**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			2	**0**	**2**	**0**	**0**	**0**	**3**
Pre-requisite	**Fundamentals of probability, linear algebra, and Digital Image Processing**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Winter/IV semester of the second year of the programme**								
Course Objectives	1. Pattern recognition which has several important applications on classical computer engineering problems like word/sentence-based searches, etc. 2. The emphasis of the course is on algorithms for pattern recognition 3. The representation of patterns and classes and the proximity measures are an important aspect of pattern recognition								
CO1	Summarize the various techniques involved in pattern recognition.								
CO2	Categorize the various pattern recognition techniques into supervised and unsupervised								
CO3	Understand feature selection and extraction techniques.								
CO4	Illustrate the artificial neural network-based pattern recognition								
CO5	Discuss the applications of pattern recognition in various real-world applications								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Introduction and Mathematical Preliminaries: Pattern Recognition: Definition, Applications and Examples, Clustering Vs Classification, Supervised Vs Unsupervised, Basic of Linear Algebra, Vector Spaces, Basics of Probability, Basics of Estimation Theory, Decision Boundaries, Decision Regions, Metric Spaces	**6**	Explain Pattern Recognition, Understanding different Clustering Techniques and their theory. Applying in real world scenario.	1, 2, 4
II	Classification: Bayes Decision Rules, Error Probability, Examples, Normal Distribution, Linear Discriminant Function, Non-Linear Decision Boundaries, Mahalanobis Distance, K-NN Classifier, Single and Multi-Layer Perceptron, Training Set, Test Set, Standardization and Normalization	**6**	Explaining different Classification technique and understanding their interpretation by applying in different datasets.	1, 2, 4
III	Clustering: Basics, Similarity/Dissimilarity Measures, Clustering Criteria, Different distance functions and similarity measures, within cluster distance criterion, K-means algorithm, Single linkage and complete linkage algorithms, MST, K-medoids, DBSCAN, Data sets: Visualization, Unique Clustering	**6**	Explaining different Clustering technique and understanding their interpretation by applying in different datasets.	1, 2, 4
IV	Feature Selection and Extraction:	**6**	Explaining different	1, 2,

	Problem statement and Uses, Branch and Bound Algorithm, Sequential Forward / Backward Selection Algorithms, (l, r) algorithm, Probabilistic separability based criterion functions, interclass distance based criterion functions, Feature Extraction, PCA + Kernel PCA		Feature Selection and Extraction technique and understanding their role in enhancing models.	3, 4
V	Recent Advances in Pattern Recognition: Structural PR, SVMs, FCM, Soft-Computing and Neuro-Fuzzy Techniques, Real-Life Examples	**6**	Understanding Recent Advance Pattern Recognition Technique with Real life Examples	1,2,3, 4
Practical				
Practical 1	Implement a program to demonstrate the difference between clustering and classification using simple datasets. Explain the key differences and provide real-world scenarios where each technique is applicable.	**3**	Explain Pattern Recognition, understanding different clustering techniques and their theory. Applying in real-world scenarios.	2, 3, 4
Practical 2	Write a program to classify a dataset using both a supervised learning algorithm (e.g., K-NN) and an unsupervised learning algorithm (e.g., K-means). Compare their results and discuss the differences.	**3**	Understanding the differences between supervised and unsupervised learning techniques and their applications.	2, 3, 4
Practical 3	Implement the Bayes decision rule for classification and test it on a sample dataset. Calculate the error probability and discuss the results.	**3**	Explain different classification techniques and understand their interpretation by applying them to different datasets.	2, 3, 4
Practical 4	Write a program to implement the sequential forward selection algorithm for feature selection. Apply it to a dataset and analyse the selected features' impact on model performance.	**3**	Explain different feature selection techniques and understand their role in enhancing models.	2, 3, 4
Practical 5	PCA for feature extraction and apply it to a high-dimensional dataset. Visualize the reduced features and discuss their significance.	**3**	Explain feature extraction techniques and understand their role in enhancing models.	3, 4
Practical 6	Write a program to implement a single-layer and multi-layer perceptron neural network for pattern recognition. Train the network on a dataset and evaluate its performance.	**3**	Illustrate neural network-based pattern recognition.	2, 3, 4
Practical 7	Implement an SVM classifier and apply it to a real-world dataset (e.g., handwritten digit recognition). Discuss the results and the classifier's effectiveness.	**3**	Understanding recent advances in pattern recognition techniques with real-life examples.	2, 3, 4
Practical 8	Develop a pattern recognition system for	**3**	Discuss the applications	3, 4

	a real-life application (e.g., spam email detection). Use appropriate feature selection, extraction, and classification techniques. Discuss the system's effectiveness and potential improvements.		of pattern recognition in various real-world scenarios.	
Practical 9	Implement the DBSCAN clustering algorithm and apply it to a dataset with noise. Visualize the clusters and discuss the results.	**3**	Explain different clustering techniques and understand their interpretation by applying them to different datasets.	2, 3, 4
Practical 10	Implement a simple neuro-fuzzy system for pattern recognition. Apply it to a dataset and analyse the results. Discuss how neuro-fuzzy techniques combine neural networks and fuzzy logic for pattern recognition.	**3**	Understanding recent advances in pattern recognition techniques with real-life examples.	2, 3, 4

TEXT BOOKS:

T1: J.I. Tou & R.C. Gonzalez, Pattern Recognition Principles, Addition-Wesley.
T2: MR. Schalkoff, Pattern Recognition - Statistical, Structural and Neural Approaches, John Wiley, 1992.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Summarize the various techniques involved in pattern recognition.	**1, 2, 4**
2	Categorize the various pattern recognition techniques into supervised and unsupervised	**1, 2, 6**
3	Understand feature selection and extraction techniques.	**1, 4, 5**
4	Illustrate the artificial neural network-based pattern recognition	**3, 5, 6**
5	Discuss the applications of pattern recognition in various real-world applications	**7, 8, 9**

SEMESTER – IV										
Course Title	**Generic Elective III - Leading Diverse Teams & Organizations**									
Course code	**23MCAO004R**	**Total credits: 1** **Total hours: 15T**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
			1	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Master of Computer Application**								
Semester	**Fall/ IV semester of the second year of the programme**								
Course Objectives	1. Explain the organizational benefits of diversity, equity, and inclusion. 2. Examine how demographic differences, implicit bias, and structural inequalities affect workplace dynamics. 3. Develop and apply best practices and tools for equitable and inclusive organizational processes.									
CO1	Describe the benefits of diversity, equity, and inclusion in the workplace.									
CO2	Identify conditions where diversity benefits teams and organizations.									
CO3	Understand the effects of demographic differences, implicit bias, and inequalities on workplace dynamics.									
CO4	Apply best practices for creating equitable organizational processes and norms.									
CO5	Lead inclusive teams using conflict management, group decision-making, and emotion regulation skills. Implement DEI strategies using data and forming DEI groups.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Understanding the Benefits of Diversity, Equity, and Inclusion (DEI): Introduction to Diversity, Equity, and Inclusion (DEI) Organizational benefits of DEI: Innovation, productivity, and employee satisfaction Case studies of successful DEI implementation	**3**	Define the core concepts of Diversity, Equity, and Inclusion (DEI). Explain the importance of a growth mindset for self-reflection on DEI topics.	2
II	Conditions for Optimal DEI Impact: Factors that enhance the benefits of diversity in teams and organizations, the role of inclusive culture and leadership in maximizing DEI benefits, challenges, and barriers to effective DEI implementation	**3**	Understand the key factors that enhance diversity benefits, the role of inclusive culture and leadership, and identify challenges and barriers to effective DEI implementation in teams and organizations.	3, 4
III	Understanding Bias and Inequality: Exploring demographic differences in the workplace, Implicit bias: Definition, examples, and impact, structural inequalities and their effects on team dynamics	**3**	Analyse demographic differences in the workplace, understand implicit bias and its impact, and explore structural inequalities and their effects on team dynamics.	6
IV	Best Practices for Equity in Organizational Processes: Defining and identifying equitable	**3**	Identify and define equitable organizational processes, implement best	4, 5

	organizational processes and norms, best practices for fostering equity in hiring, promotions, and daily operations, tools and frameworks for assessing and improving equity in organizations		practices for fostering equity in hiring, promotions, and daily operations, and utilize tools and frameworks to assess and improve equity in organizations.	
V	Leading Inclusive Teams and Implementing DEI Strategies: Essential skills for leading diverse and inclusive teams, conflict management and group decision-making best practices Emotion regulation in diverse teams, tools for DEI strategy implementation: Data, metrics, and DEI groups Capstone project: Designing a comprehensive DEI strategy for an organization	**3**	Develop essential skills for leading diverse and inclusive teams, manage conflicts and group decision-making effectively.	4, 5

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Describe the benefits of diversity, equity, and inclusion in the workplace.	**6, 7, 8, 9**
2	Identify conditions where diversity benefits teams and organizations.	**6, 7, 8, 9**
3	Understand the effects of demographic differences, implicit bias, and inequalities on workplace dynamics.	**2, 6, 7, 8, 9**
4	Apply best practices for creating equitable organizational processes and norms.	**3, 5, 7, 11**
5	Lead inclusive teams using conflict management, group decision-making, and emotion regulation skills. Implement DEI strategies using data and forming DEI groups.	**6, 7, 9, 10, 11**