ASSAM DOWN TOWN UNIVERSITY

Curriculum and Syllabus

Bachelor of Pharmacy

OUTCOME BASED EDUCATION FRAMEWORK

CHOICE BASED CREDIT SYSTEM

Version: 1.01

FACULTY OF PHARMACEUTICAL SCIENCE

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. All the programs offered by the Faculty of Pharmaceutical Science of Assam down town University strictly follow the curriculum approved by the Pharmacy Council of India (PCI), the statutory body responsible for regulating the profession of pharmacy in India. 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 program 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 Pharmaceutical Science held on dated 08/07/2023 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 Overview

B. Pharm programme designed to enrich students' basic and advanced knowledge in the Pharmaceutical Science domain, the programme follows the courses mandated by Pharmacy Council of India (PCI) education regulations. The semester-wise course sequence and the entire B. Pharm curricula have been arranged to provide hands-on training and real-world exposure to traditional and modern practices, making graduates industry-ready. As pharmacists are true drug experts, B. Pharm students are exposed to allied science courses and core pharmaceutical courses, fostering their aptitude for research and advancements in new drug development technologies.
Rules & Syllabus for the Bachelor of Pharmacy (B. Pharm) Course framed under Regulation 6, 7 & 8 of the Bachelor of Pharmacy (B. Pharm) course regulations 2014 as per by Pharmacy Council of India (PCI).

Duration of the course-

The course of study for B. Pharm shall extend over a period of eight semesters (four academic years) and six semesters (three academic ears) for lateral entry students.

I. Specific Features of the Curriculum

The BPharm curriculum is designed to align with the evolving needs of the pharmacy field and society at large. It offers a comprehensive blend of theoretical knowledge and practical applications essential for a profound understanding of pharmaceuticals, fostering the development of a wide array of skills. Encompassing vital subjects such as Pharmaceutical Chemistry, Pharmacology, Pharmaceutics, Pharmaceutical Analysis, Human Anatomy, Clinical Pharmacy, Pharmacognosy, and Pharmaceutical Microbiology, the B. Pharm program ensures a robust coverage of core topics pivotal to pharmacy education. This curriculum is thoughtfully designed to equip students with both theoretical acumen and hands-on proficiency, catering precisely to the requirements of the dynamic industry and the broader societal demands.

II. ELIGIBILITY Criteria:

First year B.Pharm: 10+2

Candidate shall have passed 10+2 examination conducted by the respective state/central government authorities recognized as equivalent to examination by the Association of Indian Universities (AIU) with English as one of the subjects and Physics, Chemistry, Mathematics (P.C.M) and or Biology (P.C.B /P.C.M.B.) as optional subjects individually. Any other qualification approved by the Pharmacy Council of India as equivalent to any of the above examinations.

B.Pharm lateral entry (to third semester):

A pass in D. Pharm. course from an institution approved by the Pharmacy Council of India under section 12 of the Pharmacy Act.

III. Program Educational Objectives (PEOs):

PEO-1: AdtU Pharmacy graduates will be well prepared for successful careers as Pharmaceutical Professionals across diverse sectors including the pharmaceutical industry, healthcare, corporate institutions and government organizations.

PEO-2: Pharmacy graduates will be academically prepared to become Registered

Pharmacists, poised to make significant contributions to the advancement of the healthcare sector.

PEO-3: The graduates will engage in professional practices to elevate their stature with a sense of responsibility and be successful in higher education, if pursued.

IV. Programme Specific Outcomes (PSOs):

PSO-1: Research Competency Apply pharmaceutical knowledge in research, and collaborative projects thereby contributing to the continuous advancement of pharmaceutical science.

PSO-2: Entrepreneurial Proficiency Exhibit entrepreneurial competency in capitalizing business opportunity.

PSO-3: Global Competency Excel in the profession with global competency that attained through global certifications from international learning platforms.

V. Program Outcome (PO):

PO.1: Pharmacy Knowledge: Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioral, social, and administrative pharmacy sciences; and manufacturing practices.

PO.2: Planning abilities: Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines.

PO.3: Problem analysis: Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.

PO.4: Modern tool usage: Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.

PO.5: Leadership skills: Understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfillment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizens or leadership roles when appropriate to facilitate improvement in health and well- being.

PO.6: Professional identity: Understand, analyze and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).

PO.7: Pharmaceutical ethics: Honour personal values and apply ethical principles in professional and social contexts. Demonstrate behavior that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.

PO.8: Communication: Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions.

PO.9: The Pharmacist and society: Apply reasoning informed by the contextual knowledge

to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.

PO.10: Environment and sustainability: Understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO.11: 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. Self- access and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.

VI. Career Prospects:

B. Pharm graduates are equipped to assume diverse roles, such as Industrial Pharmacist (in the field of Production and Manufacturing, Formulation Development, Quality Assurance, Quality Control, Packaging, R & D etc.), Hospital and Community Pharmacist, Medical Representative, Sales Executive, Bulk Medicine Distributor, Lecturer (for D.Pharm Students), Entrepreneurship, Drug Inspector, Drug Analyst etc. After completion of B.Pharmacy the students may go for higher studies in different M. Pharmacy specializations or in other fields

CHAPTER-I: REGULATIONS

1. Short Title and Commencement

These regulations shall be called as "The Revised Regulations for the B. Pharm. Degree Program (CBCS) of the Pharmacy Council of India, New Delhi". They shall come into effect from the Academic Year 2016-17. The regulations framed are Subject to modifications from time to time by Pharmacy Council of India.

1. Minimum qualification for admission.

1.1. First year B. Pharm:

Candidate shall have passed 10+2 examination conducted by the respective state/central government authorities recognized as equivalent to 10+2 examination by the Association of Indian Universities (AIU) with English as one of the subjects and Physics, Chemistry, Mathematics (P.C.M) and or Biology (P.C.B /P.C.M.B.) as optional subjects individually. Any other qualification approved by the Pharmacy Council of India as equivalent to any of the above examinations.

1.2. B. Pharm lateral entry (to third semester):

A pass in D. Pharm. course from an institution approved by the Pharmacy Council of India under section 12 of the Pharmacy Act.

2. Duration of the program

The course of study for B. Pharm shall extend over a period of eight semesters (four academic years) and six semesters (three academic years) for lateral entry students. The curricula and syllabi for the program shall be prescribed from time to time by Pharmacy Council of India, New Delhi.

3. Medium of instruction and examinations

Medium of instruction and examination shall be in English.

4. Working days in each semester

Each semester shall consist of not less than 100 working days. The odd semesters shall be conducted from the month of June/July to November/December and the even semesters shall be conducted from December/January to May/June in every calendar year.

5. Attendance and progress

A candidate is required to putting at least 80% attendance in individual course considering theory and practical separately. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

6. Program/Course credit structure

As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, tutorial hours, practical classes, etc. are measured in terms of credits. On satisfactory completion of the courses, a candidate earns credits. The amount of credit associated with a course is dependent upon the number of hours of instruction per week in that course. Similarly, the credit associated with any of the other academic, co/extra-curricular activities is dependent upon the quantum of work expected to be putting for each of these activities per week.

Credit assignment

Theory and Laboratory courses

Courses are broadly classified as Theory and Practical. Theory courses consist of lecture (L) and /or tutorial (T) hours, and Practical (P) courses consist of hours spent in the laboratory. Credits (C) for a course is dependent on the number of hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture and tutorial hours, and a

multiplier of half (1/2) for practical (laboratory) hours. Thus, for example, a theory course having three lectures and one tutorial per week throughout the semester carries a credit of 4. Similarly, a practical having four laboratory hours per week throughout semester carries a credit of 2.

Minimum credit requirements

The minimum credit points required for award of a B. Pharm. degree is 208. These credits are divided into Theory courses, Tutorials, Practical, Practice School and Project over the duration of Eight semesters. The credits are distributed semester-wise as shown in Table IX. Courses generally progress in sequences, building competencies and their positioning indicates certain academic maturity on the part of the learners. Learners are expected to follow the semester-wise schedule of courses given in the syllabus. The lateral entry students shall get 52 credit points transferred from their D. Pharm program. Such students shall take up additional remedial courses of 'Communication Skills' (Theory and Practical) and 'Computer Applications in Pharmacy' (Theory and Practical) equivalent to 3 and 4 credit points respectively, a total of 7 credit points to attain 59 credit points, the maximum of I and II semesters.

7. Academic work

A regular record of attendance both in Theory and Practical shall be maintained by the teaching staff of respective courses

8. Course of study

The course of study for B. Pharm shall include Semester Wise Theory & Practical as given in Table – I to VIII. The number of hours to be devoted to each theory, tutorial and practical course in any semester shall not be less than that shown in Table – I to VIII.

Table-I: Course of study for semester I

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP101T	Human Anatomy and Physiology I – Theory	3	1	4
BP102T	Pharmaceutical Analysis I–Theory	3	1	4
BP103T	Pharmaceutics I– Theory	3	1	4
BP104T	Pharmaceutical Inorganic Chemistry–Theory	3	1	4
BP105T	Communication skills–Theory*	2	-	2
BP106RBT BP106RMT	Remedial Biology/ Remedial Mathematics–Theory*	2	-	2
BP107P	Human Anatomy and Physiology–Practical	4	-	2
BP108P	Pharmaceutical Analysis I–Practical	4	-	2
BP109P	Pharmaceutics I–Practical	4	-	2
BP110P	Pharmaceutical Inorganic Chemistry – Practical	4	-	2
BP111P	Communication skills–Practical*	2	-	1
BP112RBP	Remedial Biology–Practical*	2	-	1
Total		**32/34$/6#**	**4**	**27/29$/30#**

#Applicable ONLY for the students who have studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB) course.

$Applicable ONLY for the students who have studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics (RM) course.

* Non University Examination (NUE)

Table-II: Course of study for semester II

Course Code	Name of the course	No. of hours	Tutorial	Credit points
BP201T	Human Anatomy and Physiology II–Theory	3	1	4
BP202T	Pharmaceutical Organic Chemistry I–Theory	3	1	4
BP203T	Biochemistry–Theory	3	1	4
BP204T	Pathophysiology–Theory	3	1	4
BP205T	Computer Applications in Pharmacy–Theory*	3	-	3
BP206T	Environmental sciences–Theory*	3	-	3
BP207P	Human Anatomy and Physiology II–Practical	4	-	2
BP208P	Pharmaceutical Organic Chemistry I–Practical	4	-	2
BP209P	Biochemistry–Practical	4	-	2
BP210P	Computer Applications in Pharmacy–Practical*	2	-	1
Total		**32**	**4**	**29**

*Non University Examination (NUE)

Table-III: Course of study for semester III

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP301T	Pharmaceutical Organic Chemistry II– Theory	3	1	4
BP302T	Physical Pharmaceutics I–Theory	3	1	4
BP303T	Pharmaceutical Microbiology–Theory	3	1	4
BP304T	Pharmaceutical Engineering–Theory	3	1	4
BP305P	Pharmaceutical Organic Chemistry II–Practical	4	-	2
BP306P	Physical Pharmaceutics I–Practical	4	-	2
BP307P	Pharmaceutical Microbiology–Practical	4	-	2
BP308P	Pharmaceutical Engineering–Practical	4	-	2
Total		**28**	**4**	**24**

Table-IV: Course of study for semester IV

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP401T	Pharmaceutical Organic Chemistry III–Theory	3	1	4
BP402T	Medicinal Chemistry I–Theory	3	1	4
BP403T	Physical Pharmaceutics II–Theory	3	1	4
BP404T	Pharmacology I–Theory	3	1	4
BP405T	Pharmacognosy and Phytochemistry I–Theory	3	1	4
BP406P	Medicinal Chemistry I–Practical	4	-	2
BP407P	Physical Pharmaceutics II–Practical	4		2
BP408P	Pharmacology I–Practical	4	-	2
BP409P	Pharmacognosy and Phytochemistry I–Practical	4	-	2
Total		**31**	**5**	**28**

Table-V: Course of study for semester V

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP501T	Medicinal Chemistry II–Theory	3	1	4
BP502T	Industrial Pharmacy I–Theory	3	1	4
BP503T	Pharmacology II–Theory	3	1	4
BP504T	Pharmacognosy and Phytochemistry II–Theory	3	1	4
BP505T	Pharmaceutical Jurisprudence– Theory	3	1	4
BP506P	Industrial Pharmacy I–Practical	4	-	2
BP507P	Pharmacology II–Practical	4	-	2
BP508P	Pharmacognosy and Phytochemistry II– Practical	4	-	2
Total		**27**	**5**	**26**

Table-VI: Course of study for semester VI

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP601T	Medicinal Chemistry III–Theory	3	1	4
BP602T	Pharmacology III –Theory	3	1	4
BP603T	Herbal Drug Technology–Theory	3	1	4
BP604T	Biopharmaceutics and Pharmacokinetics–Theory	3	1	4
BP605T	Pharmaceutical Biotechnology–Theory	3	1	4
BP606T	Quality Assurance–Theory	3	1	4
BP607P	Medicinal chemistry III–Practical	4	-	2
BP608P	Pharmacology III– Practical	4	-	2
BP609P	Herbal Drug Technology– Practical	4	-	2
Total		**30**	**6**	**30**

Table-VII: Course of study for semester VII

Course code	Name of the course	No.of hours	Tutorial	Credit points
BP701T	Instrumental Methods of Analysis –Theory	3	1	4
BP702T	Industrial Pharmacy II–Theory	3	1	4
BP703T	Pharmacy Practice–Theory	3	1	4
BP704T	Novel Drug Delivery System–Theory	3	1	4
BP705P	Instrumental Methods of Analysis–Practical	4	-	2
BP706PS	Practice School*	12	-	6
Total		**28**	**5**	**24**

*Non University Examination (NUE)

Table-VIII: Course of study for semester VIII

Sl No	Course Code	Name of the course	No. of hours	Tutorial	Credit points
1	BP801T	Biostatistics and Research Methodology	3	1	4
2	BP802T	Social and Preventive Pharmacy	3	1	4
3 4	BP803ET	Pharma Marketing Management	3+3=6	1+1=2	4+4=8
	BP804ET	Pharmaceutical Regulatory Science			
	BP805ET	Pharma covigilance			
	BP806ET	Quality Control and Standardization of Herbals			
	BP807ET	Computer Aided Drug Design			
	BP808ET	Cell and Molecular Biology			
	BP809ET	Cosmetic Science			
	BP810ET	Experimental Pharmacology			
	BP811ET	Advanced Instrumentation Techniques			
	BP812ET	Dietary Supplements and Nutraceuticals			
5	BP813PW	Project Work	12	-	6
6	BP814EA	Extracurricular/ Co-curricular activities**			1
	Total		**24**	**4**	**23**

Table-IX: Semester wise credits distribution

Semester	Credit Points
I	**27/29$/30#**
II	29
III	24
IV	28
V	26
VI	30
VII	24
VIII	23
Total credit points for the program	**211/213$/214#**

The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University. The criteria to acquire this credit point shall be defined by the colleges from time to time.

$Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics course.

#Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for remedial biology course.

9. Program Academic Committee Program Committee

1. The B. Pharm program shall have a Program Committee constituted by the Head of the institution in consultation with all the Heads of the departments.
2. The composition of the Program Committee shall be as follows:
   A senior teacher shall be the Chairperson; One Teacher from each department handling B.Pharm courses; and four student representatives of the program (one from each

academic year), nominated by the Head of the institution.

3. Duties of the Program Committee:
   i. Periodically reviewing the progress of the classes.
   ii. Discussing the problems concerning curriculum, syllabus and the conduct of classes.
   iii. Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.
   iv. Communicating its recommendation to the Head of the institution on academic matters.
   v. The Program Committee shall meet at least thrice in a semester preferably at the end of each Sessional exam (Internal Assessment) and before the end semester exam.

10. Examinations/Assessments

The scheme for internal assessment and end semester examinations is given in Table–X.

End semester examinations

The End Semester Examinations for each theory and practical course through semesters I to VIII shall be conducted by the university except for the subjects with asterix symbol (*) in table I and II for which examinations shall be conducted by the subject experts at college level and the marks/grades shall be submitted to the university.

Tables-X: Scheme for internal assessments and end semester examinations semester wise

Semester I

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP101T	Human Anatomy and Physiology I– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP102T	Pharmaceutical Analysis I– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP103T	Pharmaceutics I–Theory	10	15	1 Hr	25	75	3 Hrs	100
BP104T	Pharmaceutical Inorganic Chemistry– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP105T	Communication skills– Theory*	5	10	1 Hr	15	35	1.5Hrs	50
BP106RBT BP106RMT	Remedial Biology/ Mathematics– Theory*	5	10	1 Hr	15	35	1.5Hrs	50
BP107P	Human Anatomy and Physiology–Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP108P	Pharmaceutical Analysis I– Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP109P	Pharmaceutics I– Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP110P	Pharmaceutical Inorganic Chemistry– Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP111P	Communication skills– Practical*	5	5	2 Hrs	10	15	2 Hrs	25
BP112R BP	Remedial Biology– Practical*	5	5	2 Hrs	10	15	2Hrs	25
Total		**70/75$/80#**	**115/125$/130#**	**23/24$/26# Hrs**	**185/200$/210#**	**490/525$/540#**	**31.5/33 $/35#Hrs**	**675/725$/750#**

#Applicable ONLY for the students studied Mathematics/Physics/Chemistry at HSC and appearing for Remedial Biology (RB) course.

[$]Applicable ONLY for the Students studied Physics/Chemistry/Botany/Zoology at HSC and appearing for Remedial Mathematics (RM)course.

* Non University Examination (NUE)

Semester II

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP201T	Human Anatomy and Physiology II–Theory	10	15	1Hr	25	75	3Hrs	100
BP202T	Pharmaceutical Organic Chemistry I–Theory	10	15	1Hr	25	75	3Hrs	100
BP203T	Biochemistry–Theory	10	15	1Hr	25	75	3Hrs	100
BP204T	Pathophysiology–Theory	10	15	1Hr	25	75	3Hrs	100
BP205T	Computer Applications in Pharmacy–Theory*	10	15	1Hr	25	50	2Hrs	75
BP206T	Environmental sciences–Theory*	10	15	1Hr	25	50	2Hrs	75
BP207P	Human Anatomy and Physiology II–Practical	5	10	4Hrs	15	35	4Hrs	50
BP208P	Pharmaceutical Organic Chemistry I–Practical	5	10	4Hrs	15	35	4Hrs	50
BP209P	Biochemistry– Practical	5	10	4Hrs	15	35	4Hrs	50
BP210P	Computer Applications in Pharmacy–Practical*	5	5	2Hrs	10	15	2Hrs	25
Total		**80**	**125**	**20 Hrs**	**205**	**520**	**30 Hrs**	**725**

* The subject experts at college level shall conduct examinations

Semester III

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP301T	Pharmaceutical Organic Chemistry II–Theory	10	15	1Hr	25	75	3Hrs	100
BP302T	Physical Pharmaceutics I–Theory	10	15	1Hr	25	75	3Hrs	100
BP303T	Pharmaceutical Microbiology –Theory	10	15	1Hr	25	75	3Hrs	100
BP304T	Pharmaceutical Engineering– Theory	10	15	1Hr	25	75	3Hrs	100
BP305P	Pharmaceutical Organic Chemistry II–Practical	5	10	4Hr	15	35	4Hrs	50
BP306P	Physical Pharmaceutics I–Practical	5	10	4Hr	15	35	4Hrs	50
BP307P	Pharmaceutical Microbiology –Practical	5	10	4Hr	15	35	4Hrs	50
BP308P	Pharmaceutical Engineering– Practical	5	10	4Hr	15	35	4Hrs	50
Total		**60**	**100**	**20**	**160**	**440**	**28Hrs**	**600**

Semester IV

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP401T	Pharmaceutical Organic Chemistry III–Theory	10	15	1Hr	25	75	3Hrs	100
BP402T	Medicinal Chemistry I–Theory	10	15	1Hr	25	75	3Hrs	100
BP403T	Physical Pharmaceutics II– Theory	10	15	1Hr	25	75	3Hrs	100
BP404T	Pharmacology I–Theory	10	15	1Hr	25	75	3Hrs	100
BP405T	Pharmacognosy I–Theory	10	15	1Hr	25	75	3Hrs	100
BP406P	Medicinal Chemistry I–Practical	5	10	4Hr	15	35	4Hrs	50
BP407P	Physical Pharmaceutics II– Practical	5	10	4Hrs	15	35	4Hrs	50
BP408P	Pharmacology I–Practical	5	10	4Hrs	15	35	4Hrs	50
BP409P	Pharmacognosy I–Practical	5	10	4Hrs	15	35	4Hrs	50
Total		**70**	**115**	**21 Hrs**	**185**	**515**	**31 Hrs**	**700**

Semester V

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP501T	Medicinal Chemistry II–Theory	10	15	1Hr	25	75	3Hrs	100
BP502T	Industrial Pharmacy I–Theory	10	15	1Hr	25	75	3Hrs	100
BP503T	Pharmacology II–Theory	10	15	1Hr	25	75	3Hrs	100
BP504T	Pharmacognosy II–Theory	10	15	1Hr	25	75	3Hrs	100
BP505T	Pharmaceutical Jurisprudence –Theory	10	15	1Hr	25	75	3Hrs	100
BP506P	Industrial Pharmacy I–Practical	5	10	4Hr	15	35	4Hrs	50
BP507P	Pharmacology II–Practical	5	10	4Hr	15	35	4Hrs	50
BP508P	Pharmacognosy II–Practical	5	10	4Hr	15	35	4Hrs	50
Total		**65**	**105**	**17 Hr**	**170**	**480**	**27 Hrs**	**650**

Semester VI

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP601T	Medicinal Chemistry III–Theory	10	15	1Hr	25	75	3Hrs	100
BP602T	Pharmacology III–Theory	10	15	1Hr	25	75	3Hrs	100
BP603T	Herbal Drug Technology–Theory	10	15	1Hr	25	75	3Hrs	100
BP604T	Biopharmaceutics and Pharmacokinetics–Theory	10	15	1Hr	25	75	3Hrs	100
BP605T	Pharmaceutical Biotechnology– Theory	10	15	1Hr	25	75	3Hrs	100
BP606T	Quality Assurance–Theory	10	15	1Hr	25	75	3Hrs	100
BP607P	Medicinal chemistry III–Practical	5	10	4Hrs	15	35	4Hrs	50
BP608P	Pharmacology III–Practical	5	10	4Hrs	15	35	4Hrs	50
BP609P	Herbal Drug Technology–Practical	5	10	4Hrs	15	35	4Hrs	50
Total		**75**	**120**	**18 Hrs**	**195**	**555**	**30 Hrs**	**750**

Semester VII

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP701T	Instrumental Methods of Analysis – Theory	10	15	1Hr	25	75	3Hrs	100
BP702T	Industrial Pharmacy–Theory	10	15	1Hr	25	75	3Hrs	100
BP703T	Pharmacy Practice–Theory	10	15	1Hr	25	75	3Hrs	100
BP704T	Novel Drug Delivery System– Theory	10	15	1Hr	25	75	3Hrs	100
BP705P	Instrumental Methods of Analysis –Practical	5	10	4Hrs	15	35	4Hrs	50
BP706PS	Practice School*	25	-	-	25	125	5Hrs	150
Total		**70**	**70**	**8Hrs**	**140**	**460**	**21 Hrs**	**600**

***** The subject experts at college level shall conduct examinations

Semester VIII

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP801T	Biostatistics and Research Methodology –Theory	10	15	1Hr	25	75	3Hrs	100
BP802T	Social and Preventive Pharmacy – Theory	10	15	1Hr	25	75	3Hrs	100
BP803ET	Pharmaceutical Marketing– Theory	10+10 = 20	15 +15 = 30	1 +1 = 2Hrs	25 +25 = 50	75 +75 = 150	3 +3 = 6 Hrs	100 + 100 = 200
BP804ET	Pharmaceutical Regulatory Science – Theory							
BP805ET	Pharma co vigilance–Theory							
BP806ET	Quality Control and Standardization of Herbals– Theory							
BP807ET	Computer Aided Drug Design– Theory							
BP808ET	Cell and Molecular Biology– Theory							
BP809ET	Cosmetic Science– Theory							
BP810ET	Experimental Pharmacology– Theory							
BP811ET	Advanced Instrumentation Techniques–Theory							
BP812PW	Project Work	-	-	-	-	150	4Hrs	150
	Total	**40**	**60**	**4Hrs**	**100**	**450**	**16 Hrs**	**550**

Internal assessment: Continuous mode

The marks allocated for Continuous mode of Internal Assessment shall be awarded as per the scheme given below.

Table-XI: Scheme for awarding internal assessment: Continuous mode

Theory		
Criteria	**Maximum Marks**	
Attendance (Refer Table–XII)	4	2
Academic activities (Average of any 3 Activities eg. quiz, assignment, open book test, fieldwork, group discussion and seminar)	3	1.5
Student–Teacher interaction	3	1.5
Total	**10**	**5**
Practical		
Attendance(Refer Table–XII)	2	
Based on Practical Records, Regular viva voce, etc.	3	
Total	**5**	

Table-XII: Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95– 100	4	2
90– 94	3	1.5
85– 89	2	1
80– 84	1	0.5
Less than 80	0	0

11.2.1. Sessional Exams

Two Sessional exams shall be conducted for each theory / practical course as per the schedule fixed by the college(s).The scheme of question paper for theory and practical Sessional examinations is given below. The average marks of two Sessional exams shall be computed for internal assessment as per the requirements given in tables–X.

Sessional exam shall be conducted for 30 marks for theory and shall be computed for 15 marks. Similarly Sessional exam for practical shall be conducted for 40marks and shall be computed for 10 marks.

Question paper pattern for theory Sessional examinations for subjects having University examination

I. Multiple Choice Questions (MCQs) = 10x1 = 10

OR

II. Objective Type Questions (5x2) = 05x2 = 10

(Answer all the questions)

I. Long Answers (Answer 1out of 2) = 1x10 = 10

II. Short Answers (Answer 2 out of 3) = 2x5 = 10

Total = 30 marks

For subject shaving Non University Examination

I. Long Answers (Answer 1 out of 2) = 1x10 = 10

II. Short Answers (Answer 4 out of 6) = 4x5 = 20

Total = 30 marks

Question paper pattern for practical sessional examinations

I. Synopsis = 10

II Experiment = 25

III Viva Voice = 05

Total = 40 Marks

11. Promotion and award of grades

A student shall be declared PASS and eligible for getting grade in a course of B.Pharm. program if he/she secures at least 50% marks in that particular course including internal assessment. For example, to be declared as PASS and to get grade, the student has to secure a minimum of 50 marks for the total of 100 including continuous mode of assessment and end semester theory examination and has to secure a minimum of 25marks for the total 50 including internal assessment and end semester practical examination.

12. Carry forward of marks

In case a student fails to secure the minimum 50% in any Theory or Practical course as

specified in 12, then he/she shall reappear for the end semester examination of that course. However his/her marks of the Internal Assessment shall be carried over and he/she shall been titled for grade obtained by him/her on passing.

13. Improvement of internal assessment

A student shall have the opportunity to improve his/her performance only once in the Sessional exam component of the internal assessment. The re-conduct of the Sessional exam shall be completed before the commencement of next end semester theory examinations.

14. Re-examination of end semester examinations

Re-examination of end semester examination shall be conducted as per the schedule given in table XIII. The exact dates of examinations shall be notified from time to time.

Table-XIII: Tentative schedule of end semester examinations

Semester	For Regular Candidates	For Failed Candidates
I, III, V and VII	November/December	May/June
II, IV,VI and VIII	May/June	November/December

Question paper pattern for end semester theory examinations for 75 marks paper

I.	Multiple Choice Question (MCQs)	=	20x1	=	20
	OR				
	Objective Type Question (10x2)	=	10x2	=	20
	(Answer all the Question (10x2)				
II.	Long Answer (Answer 2 out of 3)	=	2x10	=	20
III.	Short Answer (Answer 7 of 9)	=	7x5	=	35
	Total	=	75 Mark		

For 50 marks paper

I. Long Answers(Answer 2 out of 3)	=	2x10	=	20
II. Short Answers(Answer 6 out of 8)	=	6x5	=	30
Total	=	50 marks		

For 35 marks paper

I. Long Answers (Answer 1out of 2)	=	1x10	=	10
II. Short Answers (Answer 5 out of 7)	=	5x5	=	25
Total	=	35 marks		

Question paper pattern for end semester practical examinations

I. Synopsis	=	5
II. Experiments	=	25
III. Viva voce	=	5
Total	=	35 marks

15. Academic Progression:

No student shall be admitted to any examination unless he/she fulfils the norms given in 6 Academic progression rules are applicable as follows:

A student shall be eligible to carry forward all the courses of I, II and III semesters till the IV semester examinations. However, he/she shall not be eligible to attend the courses of V semester until all the courses of I and II semesters are successfully completed.

A student shall be eligible to carry forward all the courses of III, IV and V semesters till the VI semester examinations. However, he/she shall not be eligible to attend the courses of VII semester until all the courses of I, II, III and IV semesters are successfully completed.

A student shall be eligible to carry forward all the courses of V, VI and VII semesters till the VIII semester examinations. However, he/she shall not be eligible to get the course completion certificate until all the courses of I,II,III,IV,V and VI semesters are successfully completed.

A student shall be eligible to get his/her CGPA upon successful completion of the courses of I to VIII semesters within the stipulated time period as per the norms specified in 26.

A lateral entry student shall be eligible to carry forward all the courses of III, IV and V semesters till the VI semester examinations. However, he/she shall not be eligible to attend the courses of VII semester until all the courses of III and IV semesters are successfully completed.

A lateral entry student shall be eligible to carry forward all the courses of V, VI and VII semesters till the VIII semester examinations. However, he/she shall not be eligible to get the course completion certificate until all the courses of III, IV, V and VI semesters are successfully completed.

A lateral entry student shall be eligible to get his/her CGPA upon successful completion of the courses of III to VIII semesters within the stipulated time period as per the norms specified in 26.

Any student who has given more than 4 chances for successful completion of I /III semester courses and more than 3 chances for successful completion of II / IV semester courses shall be permitted to attend V/VII semester classes ONLY during the subsequent academic year as the case may be. In simpler terms there shall NOT be any ODDBATCH for any semester.
Note: Grade AB should be considered as failed and treated as one head for deciding academic progression. Such rules are also applicable for those students who fail to register for examination (s) of any course in any semester.

16. Grading of performances

Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the end of the semester for each course. The letter grades and their corresponding grade points are given in Table– XII.

Table – XII: Letter grades and grade points equivalent to Percentage of marks and performances

Percentage of Marks Obtained	Letter Grade	Grade Point	Performance
90.00–100	O	10	Outstanding
80.00–89.99	A	9	Excellent
70.00 –79.99	B	8	Good
60.00 –69.99	C	7	Fair
50.00 –59.99	D	6	Average
Less than 50	F	0	Fail
Absent	AB	0	Fail

A learner who remains absent for any end semester examination shall be assigned a letter grade of AB and a corresponding grade point of zero. He/she should reappear for the said evaluation/examination in due course.

17. The Semester grade point average (SGPA)

The performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). The SGPA is the weighted average of the grade points obtained in all the courses by the student during the semester. For example, if a student takes five courses (Theory/Practical) in a semester with credits C1,C2, C3,C4and C5and the student's grade points in these courses are G1, G2, G3, G4 and G5, respectively, and then students' SGPA is equal to:

$$\text{SGPA} = \frac{C_1G_1+C_2G_2+C_3G_3+C_4G_4+C_5G_5}{C_1+C_2+C_3+C_4+C_5}$$

The SGPA is calculated to two decimal points. It should be noted that, the SGPA for any semester shall take into consideration the F and ABS grade awarded in that semester. For example if a learner has a F or ABS grade in course 4, the SGPA shall then be computed as:

$$\text{SGPA} = \frac{C_1G_1+C_2G_2+C_3G_3+C_4*\text{ZERO}+C_5G_5}{C_1+C_2+C_3+C_4+C_5}$$

18. Cumulative Grade Point Average (CGPA)

The CGPA is calculated with the SGPA of all the VIII semesters to two decimal points and is indicated in final grade report card/final transcript showing the grades of all VIIIsemestersandtheircourses.TheCGPAshallreflectthefailedstatusincaseofFgrade(s),till the course(s) is/are passed. When the course(s)is/are passed by obtaining a pass grade on subsequent examination(s) the CGPA shall only reflect the new grade and not the fail grades earned earlier. The CGPA is calculated as:

$$\text{CGPA} = \frac{C_1S_1+C_2S_2+C_3S_3+C_4S_4+C_5S_5+C_6S_6+C_7S_7+C_8S_8}{C_1+C_2+C_3+C_4+C_5+C_6+C_7+C_8}$$

where C_1, C_2, C_3,.... is the total number of credits for semester I,II,III,…. and S_1,S_2, S_3,....is the SGPA of semester I,II,III,…..

19. Declaration of class

The class shall be awarded on the basis of CGPA as follows: First Class with Distinction = CGPA of. 7.50 and above First Class =CGPA of 6.00 to7.49 Second Class =CGPA of 5.00 to5.99

20. Project work

All the students shall undertake a project under the supervision of a teacher and submit are port. The area of the project shall directly relate any one of the elective subject opted by the student in semester VIII. The project shall be carried out in group not exceeding 5 in number. The project report shall be submitted in triplicate (typed & bound copy not less than 25

pages).

The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). Students shall be evaluated in groups for four hours (i.e., about half an hour for a group of five students).The projects shall be evaluated as per the criteria given below.

Evaluation of Dissertation Book: Objective(s) of the work done 15 Marks Methodology adopted 20Marks Results and Discussions 20 Marks Conclusions and Outcomes 20Marks **Total 75 Marks**

Evaluation of Presentation: Presentation of work 25Marks Communication skills 20Marks Question and answer skills 30Marks **Total 75 Marks**

Explanation: The 75 marks assigned to the dissertation book shall be same for all the students in a group. However, the 75 marks assigned for presentation shall be awarded based on the performance of individual students in the given criteria.

21. Industrial training (Desirable)

Every candidate shall be required to work for at least 150 hours spread over four weeks in a Pharmaceutical Industry/Hospital. It includes Production unit, Quality Control department, Quality Assurance department, Analytical laboratory, Chemical manufacturing unit, Pharmaceutical R&D, Hospital (Clinical Pharmacy),Clinical Research Organization, Community Pharmacy, etc. After the Semester – VI and before the commencement of Semester – VII, and shall submit satisfactory report of such work and certificate duly signed by the authority of training organization to the head of the institute.

22. Practice School

In the VII semester, every candidate shall undergo practice school for a period of 150hours evenly distributed throughout the semester. The student shall opt any one of the domains for practice school declared by the program committee from time to time.

At the end of the practice school, every student shall submit a printed report (in triplicate)on the practice school he/she attended (not more than 25 pages). Along with the exams of semester VII, the report submitted by the student, knowledge and skills acquired by the student through practice school shall be evaluated by the subject experts at college level and grade point shall be awarded

23. Award of Ranks

Ranks and Medals shall be awarded on the basis of final CGPA. However, candidates who fail in one or more courses during the B.Pharm program shall not be eligible for award of ranks. Moreover, the candidates should have completed the B.Pharm program in minimum prescribed number of years,(four years)for the award of Ranks.

24. Award of degree

Candidates who fulfill the requirements mentioned above shall be eligible for award of degree during the ensuing convocation.

25. Duration for completion of the program of study

The duration for the completion of the program shall be fixed as double the actual duration of the program and the students have to pass within the said period, otherwise they have to get fresh Registration.

26. Re-admission after break of study

Candidate who seeks re-admission to the program after break of study has to get the approval from the university by paying a condo nation fee.

No condonation is allowed for the candidate who has more than 2 years of breakup period and he/she has to rejoin the program by paying the required fees.

SEMESTER – I									
Course Title	**HUMAN ANATOMY AND PHYSIOLOGY- I**								
Course code	**BP101T**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45	**3**	**1**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	1. Explain the gross morphology, structure and functions of various organs of the human body. 2. Describe the various homeostatic mechanisms and their imbalances. 3. Identify the various tissues and organs of different systems of human body. 4. Perform the various experiments related to special senses and nervous system. 5. Appreciate coordinated working pattern of different organs of each system								
CO1	Understand and apply the basic terminology and fundamental knowledge of the structure and functions of various cells and tissues of the human body.								
CO2	Describe the morphology and physiology of skeletal system along with the mechanism of muscle contraction in co-ordination with the joints and skin along with their significance.								
CO3	Understand the composition, function of various body fluids like blood and lymph, and describe significance and analyze their relation to disorders.								
CO4	Classify the peripheral nervous system, nerves and explain the morphology and working principles of special senses.								
CO5	Understand the anatomy, physiology of the heart and analyze the parameters to understand and explain their relation to CVS and related disorders.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction to human body** Definition and scope of anatomy And physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.**Cellular level of organization** Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrinec) Synaptic d) Endocrine **Tissue level of organization** Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.	**10**	Students will be able to learn gross morphology, structure and functions of various organs of the human body.	1,2, 3,4
II	**Integumentary system** Structure and functions of skin **Skeletal system** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system.		Students will be able to learn ab bones the joint of human body	

	Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction **Joints** Structural and functional classification, types of joints movements and its articulation	**10**		1,2, 3,4
III	**Body fluids and blood** Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rah factors, ransfusion, its significance and disorders of blood, Reticuloendothelial system. **Lymphatic system** Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions Of lymphatic system	**10**	Students will be able to learn various homeostatic mechanisms and their imbalances.	1,2, 3,4
IV	**Peripheral nervous system:** Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves. **Special senses:** Structure and functions of eye, ear, nose and tongue and their disorders.	**8**	Students will be able to learn about nervous system of human body	1,2, 3,4
V	**Cardiovascular system** Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and eartbeat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.	**7**	Students will be able to learn about cardiovascular system.	1,2, 3,4

TEXT BOOKS:

T1: Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers' medical publishers, New Delhi.

T2: Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York

REFERENCE BOOKS:

R1: Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.

R2: Text book of Medical Physiology- Arthur C, Guyton and John.E. Hall. Miamisburg, OH, U.S.A..

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand and apply the basic terminology and fundamental knowledge of the structure and functions of various cells and tissues of the human body.	**PO1,PO5,PO6,PO8,PO11**
2	Describe the morphology and physiology of skeletal system along with the mechanism of muscle contraction in co-ordination with the joints and skin along with their significance.	**PO1,PO5,PO6,PO8,PO11**
3	Understand the composition, function of various body fluids like blood and lymph, and describe significance and analyze their relation to disorders.	**PO1,PO5,PO6,PO8,PO11**
4	Classify the peripheral nervous system, nerves and explain the morphology and working principles of special senses.	**PO1,PO5,PO6,PO8,PO11**
5	Understand the anatomy, physiology of the heart and analyze the parameters to understand and explain their relation to CVS and related disorders.	**PO1,PO2,PO5,PO6,PO8,PO11**

SEMESTER – I									
Course Title	**PHARMACEUTICAL ANALYSIS-I**								
Course code	**BP102T**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45	**3**	**1**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	Upon completion of the course student shall be able to 1. understand the principles of volumetric and electro chemical analysis 2. carryout various volumetric and electrochemical titrations 3. develop analytical skills								
CO1	Understand the fundamentals of Pharmaceutical Analysis and predict the sources of errors and impurities								
CO2	Explain theories, classifications, and reactions of acid-base and non-aqueous titration involvement.								
CO3	Describe the basic principle, method, and application involved in various methods of precipitation, complexometric gravimetric, and diazotization titrations.								
CO4	Demonstrate adequate knowledge of basic principles and techniques of redox titrations and their application in pharmaceutical analysis.								
CO5	Illustrate the principle, electrodes used, and pharmaceutical application of electrochemical analysis methods.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	a) **pharmaceutical analysis**- Definition and scope i) Different techniques of analysis ii) Methods of expressing concentration iii) Primary and secondary standards. iv) Preparation and standardization of various molar and normal solutions-Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and cericammonium sulphate (b)**Errors**: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures (c)**Pharmacopoeia**, Sources of impurities in medicinal agents, limit tests.	**10**	Students will be able to learn Different techniques of pharmaceutical analysis, errors and pharmacopoeia	1,2, 3
II	**Acid base titration**: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves **Non aqueous titration**: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl	**10**	Students will be able to learn the acid base titration and non aqueous titration.	1,2, 3
III	**Precipitation titrations**: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride. **Complexometrictitration:** Classification, metal ion indicators, masking and demasking reagents,		Students will be able to learn precipitation titrations, complexometric titration, gravimetric analysis	

	estimation of Magnesium sulphate, and calcium gluconate. **Gravimetry**: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate. Basic Principles, methods and application of diazotisation titration.	**10**		1,2, 3
IV	**Redox titrations** (a) Concepts of oxidation and reduction (b) Types of redox titrations (Principles and applications) Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate	**8**	Students will be able to learn Concepts of oxidation and reduction and Types of redox titrations .	1,2, 3
V	Electrochemical methods of analysis **Conductometry**- Introduction, Conductivity cell, Conducto metric titrations, applications. **Potentiometry**-Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications. **Polarography**- Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications	**7**	Students will be able to learn Electrochemical methods of analysis	1,2, 3

TEXT BOOKS:

T1: A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone, Press of University of London

T2: A.I. Vogel, Text Book of Quantitative Inorganic analysis

REFERENCE BOOKS:

R1: P. Gundu Rao, Inorganic Pharmaceutical Chemistry**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the fundamentals of Pharmaceutical Analysis and predict the sources of errors and impurities.	**PO1,PO2,PO3,PO4,PO7,PO9 ,PO11**
2	Explain theories, classifications, and reactions of acid-base and non-aqueous titration involvement.	**PO1,PO2,PO3,PO4 ,PO11**
3	Describe the basic principle, method, and application involved in various methods of precipitation, complexometric gravimetric, and diazotization titrations.	**PO1,PO2,PO3,PO4 ,PO11**
4	Demonstrate adequate knowledge of basic principles and techniques of redox titrations and their application in pharmaceutical analysis.	**PO1,PO2,PO3,PO4 ,PO11**
5	Illustrate the principle, electrodes used, and pharmaceutical application of electrochemical analysis methods.	**PO1,PO2,PO3,PO4 ,PO8, PO11**

SEMESTER – I									
Course Title	**Pharmaceutics I**								
Course code	**BP103T**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45	**3**	**1**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	Upon completion of this course the student should be able to: 1. Know the history of profession of pharmacy 2. Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations 3. Understand the professional way of handling the prescription 4. Preparation of various conventional dosage forms								
CO1	Retrieve the historical background and development of the Pharmacy profession.								
CO2	Elaborate the knowledge of the pharmaceutical calculations for dosage forms, applying mathematical concepts in formulation and administration.								
CO3	Illustrate the knowledge of monophasic and biphasic liquid dosage forms								
CO4	Explain and demonstrate the concept of suppositories and pharmaceutical incompatibilities.								
CO5	Apply the knowledge to formulate and evaluate semi-solid pharmaceutical products proficiently.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Historical background and development of profession of pharmacy**: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia. **Dosage forms:** Introduction to dosage forms, classification and definitions **Prescription:** Definition, Parts of rescription, handling of Prescription and Errors in prescription. **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.	**10**	Students will be able to learn Historical background and development of profession of pharmacy	1,2, 3
II	**Pharmaceutical calculations:** **Weights And measures** – Imperial & Metric system, Calculations involvin percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight. **Powders:** Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent a	**10**	Students will be able to learn Pharmaceutical calculations, solid and liquid dosage form	1,2, 3

	Liquid dosage forms: Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques			
III	**Monophasic liquids**: Definitions and preparations of Gargles, Mouth washes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions. **Biphasic liquids:** **Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension &stability problems and methods to overcome. **Emulsions:** Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.	**10**	Students will be able to learn Monophasic and biphasic liquid dose	1,2, 3
V	**Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms	**7**	Students will be able to learn Semi solid dosage form	1,2, 3

TEXT BOOKS:

T1**:** H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi.

T2: Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.

REFERENCE BOOKS:

R1: Lachmann. Theory and Practice of Industrial Pharmacy, Lea& Fibiger Publisher, The University of Michigan.

R2: Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Retrieve the historical background and development of the Pharmacy profession.	**PO1,PO2,PO3,PO6,PO7,PO8 ,PO9,PO11**
2	Elaborate the knowledge of the pharmaceutical calculations for dosage forms, applying mathematical concepts in formulation and administration.	**PO1,PO2,PO3,PO6, PO8,PO9,PO11**
3	Illustrate the knowledge of monophasic and biphasic liquid dosage forms	**PO1,PO2,PO3PO4, PO6,PO8,PO9,PO11**
4	Explain and demonstrate the concept of suppositories and pharmaceutical incompatibilities.	**PO1,PO2,PO3PO4, PO6,PO8,PO9,PO11**
5	Apply the knowledge to formulate and evaluate semi-solid pharmaceutical products proficiently.	**PO1,PO2,PO3PO4, PO6,PO8,PO9,PO11**

SEMESTER – I									
Course Title	**Pharmaceutical Inorganic Chemistry**								
Course code	**BP104T**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45	**3**	**1**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	Upon completion of course student shall be able to 1. know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals 2. understand the medicinal and pharmaceutical importance of inorganic compounds								
CO1	Recall the history of the Pharmacopoeia, the impurity sources, and various limit tests for identifying pharmaceutical impurities.								
CO2	Examine the role of acids, bases, buffers, and electrolytes and summarize the need for dental products.								
CO3	Illustrate how compounds like acidifiers, antacids, cathartics, and antimicrobials play in medicine and pharmaceuticals.								
CO4	Define the relevance and applications of additional miscellaneous substances such as astringents, expectorants, emetics, haematinics, poisons, and antidotes.								
CO5	Describe the importance of radiopharmaceuticals and explain how radioactivity is measured.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Impurities in pharmaceutical substances:** History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate **General methods of preparation,** assay for the compounds super scripted with asterisk (*), properties and medicinal uses of inorganic compounds belonging to the following classes	**10**	Students will be able to learn the sources of impurities and quality control tests to determine the impurities in drugs and pharmaceuticals	1,2, 3
	Acids, Bases and Buffers: Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity. **Major extra and intracellular electrolytes:** Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.	**10**	Students will be able to learn the medicinal and pharmaceutical importance of inorganic compounds. Acquire knowledge on different types of diagnostic agents, dialysis fluids and dental products To understand about Major Extra &Intra Cellular electrolytes	1,2, 3

	Dental products: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.			
III	**Gastrointestinal agents** **Acidifiers:** Ammonium chloride* and Dil. HCl **Antacid:** Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminium hydroxide gel, Magnesium hydroxide mixture **Cathartics:** Magnesium sulphate, Sodium or thophosphate, Kaolin and Bentonite **Antimicrobials:** Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations	**10**	Students will be able to learn preparations and assay procedures of gastrointestinal agents, expectorants To understand about mechanism & Classification of Antimicrobials	1,2, 3
IV	**Miscellaneous compounds** **Expectorants:** Potassium iodide, Ammonium chloride*. **Emetics:** Copper sulphate*, Sodium potassium tartrate **Haematinics:** Ferrous sulphate*, Ferrous gluconate **Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite **Astringents:** Zinc Sulphate, Potash Alum	**8**	Students will be able to gain knowledge about Emetics, understand about Haematinic, Astringents Poison& Antidote	1,2, 3
V	**Radiopharmaceuticals:** Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half-life, radio isotopes and study of radioisotopes - Sodium iodide I^{131}, Storage conditions, precautions &pharmaceutical application of radioactive substances.	**7**	Students will be able to learn the measurement, storage and pharmaceutical applications of radiopharmaceuticals	1,2, 3

TEXT BOOKS:

T1: A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.

T2: A.I. Vogel, Text Book of Quantitative Inorganic analysis.

REFERENCE BOOKS:

R1: M.L Schroff, Inorganic Pharmaceutical Chemistry**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recall the history of the Pharmacopoeia, the impurity sources, and various limit tests for identifying pharmaceutical impurities.	**PO1,PO3,PO7,PO9,PO11**
2	Examine the role of acids, bases, buffers, and electrolytes and summarize the need for dental products.	**PO1,PO3,PO7,PO9,PO11**
3	Illustrate how compounds like acidifiers, antacids, cathartics, and antimicrobials play in medicine and pharmaceuticals.	**PO1,PO3,PO7,PO9,PO11**
4	Define the relevance and applications of additional miscellaneous substances such as astringents, expectorants, emetics, haematinics, poisons, and antidotes.	**PO1,PO3,PO7,PO9,PO11**
5	Describe the importance of radiopharmaceuticals and explain how radioactivity is measured.	**PO1,PO3,PO4, PO7,PO9,PO11**

SEMESTER – I									
Course Title	**Communication skills**								
Course code	**BP105T**	**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 Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	Upon completion of the course the student shall be able to Understand the behavioral needs for a pharmacist to function effectively in the areas of pharmaceutical operation Communicate effectively (Verbal and Non-Verbal) Effectively manage the team as a team player Develop interview skills Develop Leadership qualities and essentials								
CO1	Recognize the communication concept, its barriers, and the effects of diverse communication perspectives.								
CO2	Understand and become familiar with nonverbal cues and various styles of communication.								
CO3	Develop self-awareness, listening abilities, and writing abilities								
CO4	Understand the interview process, practice, and develop interview skills and presentation techniques.								
CO5	Gain knowledge of the group discussion process and practice interpersonal, cooperative, and time management skills.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context **Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychologica Barriers, Emotional barriers **Perspectives in Communication**: Introduction, Visual Perception, Language, Other factors affecting our perspective. Past Experiences, Prejudices, Feelings, Environment	**7**	Students will be able to gain comprehensive understanding of communication's significance, process effective communication and understand, identify and overcome diverse barriers that hinder communication and identify the Perspectives in Communication during the process of communication	1,2
II	**Elements of Communication:** Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication),	**7**	Students will be able to learn comprehensive understanding of Non-verbal communication and the uses. Togather the knowledge	1,2

	Verbal Communication, Physical Communication , **Communication Styles:** Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style		of the different Communication styles and apply them during communication.	
III	**Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Active Listener, Listening in Difficult Situations **Effective Written Communication:** Introduction, When and When Not to Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message	**7**	Students will be able to learn the ways of listening and develop listening skills. To gather the knowledge on writing skills and apply when required.	1,2
IV	**Interview Skills:** Purpose of an interview, Do's and Don'ts of an Interview **Giving Presentations:** Dealing with Fears, planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery	**5**	Students will be able to learn the process of interview and learn to face interview To understand the process presentation skills by overcoming fears, Effectively planning and structuring presentations, learn to deliver with confidence	1,2
V	**Group Discussion:** Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion	**4**	Students will be able to learn the skills to engage effectively in group discussions Through understanding their purpose.	1,2

TEXT BOOKS:

T1: Basic communication skills for Technology, Andréa. J. Ruther Ford, 2nd Edition, Pearson Education, 2011.

T2: Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011.

REFERENCE BOOKS:

R1: Organizational Behaviour, Stephen.P. Robbins, 1st Edition, Pearson, 2013.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recognize the communication concept, its barriers, and the effects of diverse communication perspectives.	**PO1,PO2,PO3,PO4,PO5,PO6 ,PO8,PO11**
2	Understand and become familiar with nonverbal cues and various styles of communication.	**PO1,PO2,PO3,PO4,PO5,PO6 ,PO8,PO11**
3	Develop self-awareness, listening abilities, and writing abilities	**PO1,PO2,PO3,PO4,PO5,PO6 ,PO8,PO11**
4	Understand the interview process, practice, and develop interview skills and presentation techniques.	**PO1,PO2,PO3,PO4,PO5,PO6 ,PO8,PO11**
5	Gain knowledge of the group discussion process and practice interpersonal, cooperative, and time management skills.	**PO1,PO2,PO3,PO4,PO5,PO6 ,PO8,PO11**

SEMESTER – I									
Course Title	**Remedial Biology**								
Course code	**BP106RBT**	**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 Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	Upon completion of the course, the student shall be able to 1. know the classification and salient features of five kingdoms of life 2. understand the basic components of anatomy & physiology of plant 3. know understand the basic components of anatomy & physiology animal with special reference to human								
CO1	Explain the living world and the morphology of flowering plants.								
CO2	Explain the body fluid, circulation, digestion, absorption, breathing, and respiration.								
CO3	Describe the concepts of the excretory system, nervous system, endocrine system, and Human Reproduction.								
CO4	Explain the plants and mineral nutrition and photosynthesis.								
CO5	Describe the plant respiration, growth and development, cell, and tissue.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Living world:** Definition and characters of living organisms Diversity in the living world Binomial nomenclature Five kingdoms of life and basis of classification. Salient features of Monera, Protista, Fungi, Animalia and Plantae, Virus, **Morphology of Flowering plants** Morphology of different parts of flowering plants –Root, stem, inflorescence, flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons &Dicotyledons.	**7**	**Students will be able to learn** Memorize about theLiving world Memorize about the five kingdoms Memorize about the Morphology of Flowering plants parts	1,2, 3
II	**Body fluids and circulation** Composition of blood, blood groups, coagulation of blood Composition and functions of lymph Human circulatory system Structure of human heart and blood vessels Cardiac cycle, cardiac output and ECG	**7**	**Students will be able to learn** Recall and better understand about the circulatory system and cardiovascular system Recall and better understand about the Digestive system Recall and better understand about The respiratory system	1,2, 3
	Digestion and Absorption Human alimentary canal and digestive glands Role of digestive enzymes Digestion, absorption and assimilation of digested food **Breathing and respiration** Human respiratory system Mechanism of breathing and its regulation Exchange of gases, transport of gases and regulation of respiration Respiratory			

	volumes			
III	**Excretory products and their elimination** Modes of excretion Human excretory system- structure and function Urine formation Rennin angiotens in system **Neural control and coordination** Definition and classification of nervous system Structure of a neuron Generation and conduction of nerve impulse Structure of brain and spinal cord Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata **Chemical coordination and regulation** Endocrine glands and their secretions Functions of hormones secreted by endocrine glands **Human reproduction** Parts of female reproductive system Parts of male reproductive system Spermatogenesis and Oogenesis Menstrual cycle	**7**	**Students will be able to** Recall and better understand about the Excretory system Recall and better understand about the Nervous system Recall and better understand about The Endocrine system and reproductive system	1,2, 3
	Plants and mineral nutrition: Essential mineral, macro and micronutrients Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation **Photosynthesis** Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors Affecting photosynthesis.	**5**	**Students will be able to learn** Recall and better understand about the Plants and mineral nutrition. Recall and better understand about the Photosynthsis	1,2, 3
V	**Plant respiration**: Respiration, glycolysis, fermentation (anaerobic). **Plant growth and development** Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators **Cell - The unit of life** Structure and functions of cell and cell organelles. Cell division **Tissues** Definition, types of tissues, location and functions.	**4**	**Students will be able to learn** Recall and better understand about the Plant respiration and Plant growth and Development Recall and better understand about the cell and tissue	1,2, 3

TEXT BOOKS:

T1: Text book of Biology by S. B. Gokhale

T2: A Text book of Biology by Dr.Thulajappa and Dr. Seetaram.

REFERENCE BOOKS:

R1: A Text book of Biology by B.V. Sreenivasa Naidu R2: A Text book of Biology by Naidu and Murthy**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the living world and the morphology of Flowering plants.	**PO1,PO3,PO4,PO5,PO7,PO8 ,PO9**
2	Explain the body fluid, circulation, digestion, absorption, breathing, and respiration.	**PO1,PO3,PO4,PO5,PO7,PO8 ,PO9**
3	Describe the concepts of the excretory system, nervous system, endocrine system, and Human Reproduction.	**PO1,PO3,PO4,PO5,PO7,PO8 ,PO9**
4	Explain the plants and mineral nutrition and photosynthesis.	**PO1,PO3,PO4,PO5,PO7,PO8 ,PO9**
5	Describe the plant respiration, growth and development, cell, and tissue.	**PO1,PO3,PO4,PO5,PO7,PO8 ,PO9**

SEMESTER – I									
Course Title	**Remedial Mathematics**								
Course code	**BP106RMT**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**2**	**0**	**0**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	Upon completion of the course the student shall be able to: - 1. Know the theory and their application in Pharmacy 2. Solve the different types of problems by applying theory 3. Appreciate the important application of mathematics in Pharmacy								
CO1	Know the theory and its application in Pharmacy.								
CO2	Solve the different types of problems by applying theory.								
CO3	Appreciate the important application of mathematics in Pharmacy.								
CO4	Solve different kinds of Analytical Geometrical problems.								
CO5	Apply mathematical concepts and principles to perform computations for Pharmaceutical Sciences and understanding to help in Clinical Pharmacy.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Partial fraction** Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics **Logarithms** Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems. **Function:** Real Valued function, Classification of real valued functions, **Limits and continuity:** Introduction, Limit of a function, Definition of limit of a function	**6**	**Students will be able to learn** Partial fraction, Logarithms, Limits and continuity	1,2
II	**Matrices and Determinant:** Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Product of determinants, Minors and co- Factors, Adjoint or adjugated of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix,	**6**	**Students will be able to learn** Matrices and Determinant	1,2

	Cayley– Hamilton theorem, application of Matrices in solving Pharmacokinetic equations			
III	**Calculus** Differentiation: Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function, Derivative Of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – Without Proof, Derivative of xn w.r.t x, where n is any rational number, Derivative of ex, Derivative of loge x, Derivative of ax, Derivative of trigonometric functions from first principles (without Proof), Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application	**6**	**Students will be able to learn** Calculus	1,2
IV	**Analytical Geometry** **Introduction:** Signs of the Coordinates, Distance formula, **Straight Line:** Slope or gradient of a straight line, Conditions for parallelism and perpendicular of two lines, Slope of a line joining two points, Slope Method of substitution, Method of Partial fractions, Integration by parts, definite integral, application	**6**	**Students will be able to learn** Analytical Geometry, Integration	1,2
V	**Differential Equations:** Some basic definitions, Order and degree, quations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations **Laplace Transform:** Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, Application in solving Chemical kinetics and Pharmacokinetics equations	**06**	**Students will be able to learn** Differential Equations, Laplace Transform	1,2

TEXT BOOKS:

T1: Differential Calculus by Shanthinarayan

T2: Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H.

REFERENCE BOOKS:

R1: Higher Engineering Mathematics by Dr.B.S.Grewal**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Know the theory and its application in Pharmacy.	**PO1,PO2, PO3,PO4,PO8,PO11**
2	Solve the different types of problems by applying theory.	**PO1,PO2, PO3,PO4,PO8,PO11**
3	Appreciate the important application of mathematics in Pharmacy.	**PO1,PO2, PO3,PO4,PO8,PO11**
4	Solve different kinds of Analytical Geometrical problems.	**PO1,PO2, PO3,PO4,PO8,PO11**
5	Apply mathematical concepts and principles to perform Computations for Pharmaceutical Sciences and understanding to help in Clinical Pharmacy.	**PO1,PO2,PO3,PO4,PO8,PO11**

SEMESTER – I									
Course Title	**Human Anatomy and Physiology**								
Course code	**BP107P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	1. Handle compound microscope. 2. Study the human organ system. 3. Determine hematological parameters.								
CO1	Perform the microscopical evaluation of various tissues to understand the components of the cellular system and their mechanisms.								
CO2	Identify and understand the axial and appendicular bones and their location, arrangements, and functions of various bones.								
CO3	Analyze various hematological and cardiovascular parameters, such as blood pressure, heart rate, and pulse rate, and differentiate healthy from diseased individuals.								
CO4	Identify and understand the various arrangements and organization of different tissues and organs using models and charts of the human body.								
CO5	Estimate the hematological parameters by comparing with healthy individuals to understand the physiology of blood in healthy and diseased individuals.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. Study of compound microscope. 2. Microscopic study of epithelial and connective tissue 3. Microscopic study of muscular and nervous tissue 4. Identification of axial bones 5. Identification of appendicular bones 6. Introduction to hemocytometry. 7. Enumeration of white blood cell (WBC) count 8. Enumeration of total red blood corpuscles (RBC) count 9. Determination of bleeding time 10. Determination of clotting time 11. Estimation of hemoglobin content 12. Determination of blood group. 13. Determination of erythrocyte sedimentation rate (ESR). 14. Determination of heart rate and pulse rate. 15. Recording of blood pressure.	**4**	**Students will be able to learn** The different parts and working mechanism of Compound microscope.	1,2
			Students will be able to learn perform hematological experiments and correlate haematological parameters with clinical conditions inrelevance to the healthcare	1,2
			Students will be able to learn Measure cardiovascular parameters	1,2
			Students will be able to learn about the microscopic study of epithelial, connective, muscular and nervous Tissue	1,2
			Students will be able to learn About axial and appendicular bones.	1,2

TEXT BOOKS:

T1: Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

REFERENCE BOOKS:

R1: Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje, Academic Publishers Kolkata**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Perform the microscopical evaluation of various tissues to understand the components of the cellular system and their mechanisms.	**PO1,PO2, PO3,PO4,PO5, PO6,PO8,PO9,PO11**
2	Identify and understand the axial and appendicular bones and recognize their location, arrangements, and functions of various bones.	**PO1,PO2, PO3,PO4,PO5, PO6,PO8,PO9,PO11**
3	Analyze various haematological and cardiovascular parameters, such as blood pressure, heart rate, and pulse rate, and differentiate healthy from diseased individuals.	**PO1,PO2, PO3,PO4,PO5, PO6,PO8,PO9,PO11**
4	Identify and understand the various arrangements and organization of different tissues and organs using models and charts of the human body.	**PO1,PO2, PO3,PO4,PO5, PO6,PO8,PO9,PO11**
5	Estimate the haematological parameters by comparing with healthy individuals to understand the physiology of blood in healthy and diseased individuals.	**PO1,PO2, PO3,PO4,PO5, PO6,PO8,PO9,PO11**

SEMESTER – I									
Course Title	**Pharmaceutical Analysis I**								
Course code	**BP108P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	. Gain hands-on experience with standard analytical reagents, laboratory instruments, and glassware. . Prepare various standard solutions using volumetric methods. . Perform drug assays through volumetric analysis. . Utilize electrochemical methods in analysis. . Develop skills in handling and preparing pharmaceutical analytical samples and substances.								
CO1	Applying principles to assess organic molecules using titration methods.								
CO2	Determine chloride, sulfate, Iron, and arsenic content in pharmaceutical substances.								
CO3	Prepare and standardize Sodium hydroxide, Sulphuric acid, Sodium thiosulfate, Potassium permanganate, and ceric ammonium sulfate.								
CO4	Analyze the purity of Ammonium chloride, ferrous sulfate, Copper sulfate, Calcium gluconate, Hydrogen peroxide, Sodium benzoate, and Sodium Chloride.								
CO5	Determine the normality of acids and bases by conductometry and potentiometry.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	I Limit Test of the following (1) Chloride (2) Sulphate (3) Iron (4) Arsenic II Preparation and standardization of (1) Sodium hydroxide (2) Sulphuric acid (3) Sodium thiosulfate (4) Potassium permanganate (5) Ceric ammonium sulphate III Assay of the following compounds along with Standardization of Titrant Ammonium chloride by acid base titration Ferrous sulphate by Cerimetry Copper sulphate by Iodometry Calcium gluconate by Complexometry Hydrogen peroxide by Permanganometry Sodium benzoate by non- aqueous titration Sodium Chloride by precipitation titration IV Determination of Normality by electro-analytical methods Conductometric titration of strong acid against strong base	**45**	**Students will be able to learn** the limit of chloride, limit of iron, limit of sulphate, limit of arsenic, preparation and standardization of Sodium hydroxide, the preparation and standardization of Sodium thiosulfate, preparation and standardization of ammonium sulphate Students will able to understand the preparation and standardization of Ferrous sulphate Students will able to understand the preparation and standardization of Sodium hydroxide Students will able to understand the preparation and standardization of Hydrogen peroxide Students will able to understand the preparation and standardization of Sodium benzoate Students will able to understand the preparation and standardization of Sodium hydroxide Students will able to understand about the etermination of Normality by electro- analytical methods Students will able to	4,5, 6

	Conductometric titration of strong acid and weak acid against strong base Potentiometric titration of strong acid against strong base		understand about the determination of Normality by electro-analytical methods Students will able to understand about the determination of Normality by electro-analytical Methods	

TEXT BOOKS:

T1:Bentley and Driver's Textbook of Pharmaceutical Chemistry. T2:John H. Kennedy, Analytical chemistry principles.

REFERENCE BOOKS:

R1: P. Gundu Rao, Inorganic Pharmaceutical Chemistry.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Applying principles to assess organic molecules using titration methods.	**PO1,PO2,PO3,PO4,PO5,PO 6,PO7,PO8,PO11**
2	Determine chloride, sulfate, Iron, and arsenic content in pharmaceutical substances.	**PO1,PO2,PO3,PO4,PO5,PO 6,PO7,PO8,PO11**
3	Prepare and standardize Sodium hydroxide, Sulphuric acid, Sodium thiosulfate, Potassium permanganate, and ceric ammonium sulfate.	**PO1,PO2,PO3,PO4,PO5,PO 6,PO7,PO10,PO11**
4	Analyze the purity of Ammonium chloride, ferrous sulfate, Copper sulfate, Calcium gluconate, Hydrogen peroxide, Sodium benzoate, and Sodium Chloride.	**PO1,PO2,PO3,PO4,PO5,PO 6,PO7,PO8,PO11**
5	Determine the normality of acids and bases by conductometry and potentiometry.	**PO1,PO2,PO3,PO4,PO5,PO 6,PO7,PO8,PO10, PO11**

SEMESTER – I									
Course Title	**Pharmaceutics I – Practical**								
Course code	**BP109P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	1. Demonstrate proficiency in weighing and measuring techniques essential for prescription dispensing. 2.Prepare solid powder dosage forms. 3.Estimate drug quantities needed for solutions of specific strengths. 4.Prepare, pack, and label various semisolid dosage forms. 5.Design suitable liquid dosage forms for given drugs								
CO1	Analyze the fundamental calculation for calculating the dosage by the requirements.								
CO2	Evaluate monophasic liquid dose formulations for both internal and external administration.								
CO3	Apply the formulating skills of making powder dosage forms as per requirements								
CO4	Explain the knowledge of formulating suppositories								
CO5	Prepare semisolid dosage forms, including cosmetics, as per requirements								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. Syrups a) Syrup IP'66 b) Compound syrup of Ferrous Phosphate BPC'68 2. Elixirs a) Piperazine citrate elixir b) Paracetamol pediatric elixir 3. Linctus a) Terpin Hydrate Linctus IP'66 Solutions b) Iodine Throat Paint (Mandles Paint) a) Strong solution of ammonium acetate b) Cresol with soap solution c) Lugol's solution 5. Suspensions a) Calamine lotion b) Magnesium Hydroxide mixture c) Aluminimum Hydroxide gel 6. Emulsions a) Turpentine Liniment b) Liquid paraffin emulsion 7. Powders and Granules a) ORS powder (WHO) b) Effervescent granules c) Dusting powder	**45**	**Students will be able to learn** to prepare and dispense Simple syrup I.P., to prepare and dispense Piperazine citrate elixir, to prepare and dispense Paracetamol paediatric syrup, to prepare and dispense Iodine Throat Paint , to prepare and dispense Cresol with soap solution, to prepare and dispense Calamine lotion ,to prepare and dispense Liquid paraffin emulsion, to prepare and dispense ORS powder (WHO), to prepare and dispense Effervescent granule, to prepare and dispense Dusting powder, to prepare and dispense Sulphur ointment, to prepare and dispense Iodine gargle	3,4
	d) Divded powders 8. Suppositories a) Glycero gelatin suppository b) Coca butter suppository c) Zinc Oxide suppository 8. Semisolids a) Sulphur ointment			

	b) Non-staining-iodine ointment with methyl salicylate c) Carbopal gel 9. Gargles and Mouthwashes a) Iodine gargle b) Chlorhexidine mouthwash			

TEXT BOOKS:

T1: Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.

REFERENCE BOOKS:

R1: Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, INC, New York..

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Analyze the fundamental calculation for calculating the dosage by the requirements.	**PO1,PO2,PO3,PO4,PO6,PO8 ,PO9,PO11**
2	Evaluate monophasic liquid dose formulations for both internal and external administration.	**PO1,PO2,PO3,PO4,PO6,PO8 ,PO9,PO11**
3	Apply the formulating skills of making powder dosage forms as per requirements	**PO1,PO2,PO3,PO4,PO6,PO8 ,PO9,PO11**
4	Explain the knowledge of formulating suppositories	**PO1,PO2,PO3,PO4,PO6,PO8 ,PO9,PO11**
5	Prepare semisolid dosage forms, including cosmetics, as per requirements	**PO1,PO2,PO3,PO4,PO6,PO8 ,PO9,PO11**

SEMESTER – I									
Course Title	**Pharmaceutical Inorganic Chemistry**								
Course code	**BP110P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	1. Conduct purity tests to assess Bentonite purity. 2. Evaluate the neutralizing capacity of Aluminum hydroxide Gel. 3. Prepare various inorganic compounds with pharmaceutical significance. 4. Detect chloride, sulfate, iron, and arsenic impurities in samples.								
CO1	Apply the theoretically learned limit test principles to the numerous ions and metals in the various compounds used to make pharmaceuticals.								
CO2	Identify several inorganic substances using various chemicals and evaluate the cations and anions.								
CO3	Experiment on the swelling capacity of Bentonite and interpret the result.								
CO4	Outline the importance of the neutralizing capacity of Aluminum hydroxide gel and Identify potassium iodate and iodine in potassium iodide								
CO5	Formulate various inorganic pharmaceuticals like Boric acid, Potash Alum, and Ferrous Sulfate.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	I Limit tests for following ions Limit test for Chlorides and Sulphates Modified limit test for Chlorides and Sulphates Limit test for Iron Limit test for Heavy metals Limit test for Lead Limit test for Arsenic II Identification test Magnesium hydroxide Ferrous sulphate Sodium bicarbonate Calcium gluconate Copper sulphate III Test for purity Swelling power of Bentonite Neutralizing capacity of aluminum hydroxide gel Determination of potassium iodate and iodine in potassium Iodide IV Preparation of inorganic pharmaceuticals Boric acid Potash alum Ferrous sulphate	**45**	Students will be able to learn Match test samples with standards whether they pass or fail is reported. Students will be able to learn Identify each of the Inorganic substance by chemical tests and report them Students will be able to learn Organize for purity, capacity and determination of the substance Students will be able to learn Plan preparation of Inorganic Pharmaceutical compound.	3,4

TEXT BOOKS:

T1: A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.

REFERENCE BOOKS:

R1: Anand & Chatwal, Inorganic Pharmaceutical Chemistry**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES4

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply the theoretically learned limit test principles to the numerous ions and metals in the various compounds used to make pharmaceuticals.	**PO1,PO2,PO3,PO5,PO7,PO8 ,PO11**
2	Identify several inorganic substances using various chemicals and evaluate the cations and anions.	**PO1,PO2,PO3,PO5,PO7,PO8 ,PO11**
3	Experiment on the swelling capacity of Bentonite and interpret the result.	**PO1,PO2,PO3,PO5,PO7,PO8 ,PO11**
4	Outline the importance of the neutralizing capacity of Aluminium hydroxide gel and Identify potassium iodate and iodine in potassium iodide	**PO1,PO2,PO3,PO5,PO7,PO8 ,PO11**
5	Formulate various inorganic pharmaceuticals like Boric acid, Potash Alum, and Ferrous Sulfate.	**PO1,PO2,PO3,PO5,PO7,PO8 ,PO11**

SEMESTER – I									
Course Title	**Communication skills**								
Course code	**BP111P**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 2	**0**	**0**	**2**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	1. Apply learned skills to craft compelling business written communication. 2. Compose formal emails and exhibit good interview etiquette. 3. Communicate effectively in business and healthcare scenarios. 4. Analyze language nuances, pronunciation, and communication requirements. 5. Prepare effective written materials.								
CO1	Enhance communication abilities and become more adept at meeting and greeting others.								
CO2	Learn and use appropriate sentence construction, pronunciation, and vocabulary.								
CO3	Develop listening skills and understanding skills by exposing various speeches								
CO4	Enhance presentation skills and become more adept in written communication. Learn to write an effective email.								
CO5	Develop interview-handling skills, such as communication skills (Verbal and nonverbal), self- presentation, negotiation skills, and active listening.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Basic communication covering the following topics Meeting People Asking Questions Making Friends What did you do? Dos and Don'ts Pronunciations covering the following topics Pronunciation (Consonant Sounds) Pronunciation and Nouns Pronunciation (Vowel Sounds) Advanced Learning Listening Comprehension / Direct and Indirect Speech Figures of Speech Effective Communication Writing Skills Effective Writing Interview Handling Skills E-Mail etiquette Presentation Skills	**2**	**Students will be able to learn** comprehensive understanding of communication's significance, process effective communication, comprehensive understanding of Pronunciations significance, process effective Pronunciation To gain comprehensive understanding of Effective Communication Writing Skills Effective Writing Interview Handling Skills E-Mail etiquette Presentation Skills	1,2

TEXT BOOKS:

T1: Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011.

REFERENCE BOOKS:

R1: The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, Pearson, 2013.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Enhance communication abilities and become more adept at meeting and greeting others.	**PO1,PO2,PO3,PO4,PO5,PO6 ,PO8,PO11**
2	Learn and use appropriate sentence construction, pronunciation, and vocabulary.	**PO1,PO2,PO3,PO4,PO5,PO6 ,PO8,PO11**
3	Develop listening skills and understanding skills by exposing various speeches	**PO1,PO2,PO3,PO4,PO5,PO6 ,PO8,PO11**
4	Enhance presentation skills and become more adept in written communication. Learn to write an effective email.	**PO1,PO2,PO3,PO4,PO5,PO6 ,PO8,PO11**
5	Develop interview-handling skills, such as communication skills (Verbal and nonverbal), self-presentation, negotiation skills, and active listening.	**PO1,PO2,PO3,PO4,PO5,PO6 ,PO8,PO11**

SEMESTER – I									
Course Title	**Remedial Biology**								
Course code	**BP112RBP**	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 2	0	0	**2**	0	0	0	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ I semester of first year of the Programme**								
Course Objectives	1. Study of cell and its inclusions 2. Perform microscopic study of tissues. 3. Study of blood parameters.								
CO1	Understand the handling of microscope and permanent slide preparation techniques.								
CO2	Recall the structure of a cell and its inclusions identify various plant parts and organize their modifications.								
CO3	Categorize the physiology of frogs by using computer models.								
CO4	Assess the microscopical study and identification of tissues pertinent to the stem, root, leaf, seed, fruit, and flower.								
CO5	Identify the bones and determine blood group, blood pressure and tidal volume.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. Introduction to experiments in biology a) Study of Microscope b) Section cutting techniques c) Mounting and staining d) Permanent slide preparation 2. Study of cell and its inclusions 3. Study of Stem, Root, Leaf, seed, fruit, flower and their modifications 4. Detailed study of frog by using computer models 5. Microscopic study and identification of tissues pertinent to Stem, Root Leaf, seed, fruit and flower 6. Identification of bones 7. Determination of blood group 8. Determination of blood pressure 9. Determination of tidal volume	**30**	**Students will be able to learn** microscopic study of tissues, measuring blood related parameters.	1,2

TEXT BOOKS:

T1: Practical human anatomy and physiology. by S.R.Kale and R.R.Kale.

T2: A Manual of pharmaceutical biology practical by S.B.Gokhale, C.K.Kokate and S.P.Shriwastava.

REFERENCE BOOKS:

R1: Biology practical manual according to National core curriculum. Biology forum of Karnataka. Prof .M.J.H.Shafi**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the handling of microscope and permanent slide preparation techniques.	**PO1,PO2,PO5,PO7,PO8,PO9**
2	Recall the structure of a cell and its inclusions identify various plant parts and organize their modifications.	**PO1,PO2,PO5,PO7,PO8,PO9**
3	Categorize the physiology of frogs by using computer models.	**PO1,PO2,PO5,PO7,PO8,PO9**
4	Assess the microscopical study and identification of tissues pertinent to the stem, root, leaf, seed, fruit, and flower.	**PO1,PO2,PO5,PO7,PO8,PO9**
5	Identify the bones and determine blood group, blood pressure and tidal volume.	**PO1,PO2,PO5,PO7,PO8,PO9**

SEMESTER – II									
Course Title	**HUMAN ANATOMY AND PHYSIOLOGY-II**								
Course code	**BP 201T**	**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 Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Explain various human body organs' gross morphology, structure, and functions. 2. Describe the various homeostatic mechanisms and their imbalances. 3. Identify the various tissues and organs of different human body systems. 4. Perform the hematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time, and record blood pressure, heart rate, pulse, and respiratory volume. 5. Appreciate coordinated working pattern of different organs of each system 6. Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.								
CO1	Explain the anatomy and physiology of the central nervous system, nerve tracts, and reflex actions								
CO2	Understand the functions, secretion, digestion, and absorption of nutrients in the gastrointestinal tract, its disorders, and the roles of ATP, creatinine, and BMR.								
CO3	Elaborate the anatomy and physiology of the respiratory and urinary systems and their disorders.								
CO4	Describe the various endocrine glands and interpret the different hormones, their functions, and their pathological conditions.								
CO5	Explain the anatomy and physiology of the male and female reproductive systems and the various life processes related to the reproductive system.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Nervous system** Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, Nerve impulse, receptors, synapse, neurotransmitters. Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid.structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts,reflex activity)	**10**	**Students will be able to learn** the anatomical structures, functions, and physiological mechanisms associated with urinary and respiratory system, including detailed knowledge of the urinary tract, kidney anatomy, nephron function, urine formation, micturition reflex, acid-base balance, and disorders of the kidney, as well as a thorough grasp of respiratory system anatomy, lung function, respiratory regulation, lung volumes and capacities, gas transport, and proficiency in artificial respiration and resuscitation methods.	1,2, 3
II	**Digestive system** Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the	**6**	**Students will be able to learn** Hormone classification, mechanisms of hormone	1,2, 3

	stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine 54 and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT. **Energetics** Formation and role of ATP, Creatinine Phosphate and BMR.		action, and the structure and functions of key endocrine glands such as the pituitary, thyroid, parathyroid, adrenal, pancreas, pineal, and thymus; further, they should be proficient in recognizing and explaining disorders associated with these glands.	
III	**Respiratory system** Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods. **Urinary system** Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.	**10**	**Students will be able to learn** the intricate anatomy and functions of the gastrointestinal tract, including the stomach, small and large intestine, salivary glands, pancreas, and liver; furthermore, they should grasp the movements of the GI tract, processes of digestion and nutrient absorption, and be able to identify and describe disorders associated with the gastrointestinal system. Additionally, students should have a comprehensive knowledge of energetics, encompassing the formation and roles of ATP, creatinine phosphate, and basal metabolic rate (BMR).	1,2, 3
IV	**Endocrine system** Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders	**10**	**Students will be able to learn** the anatomy and functions of the Male and female reproductive systems, including the roles of sex hormones and the physiological processes of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy, and parturition. Additionally, students should possess a foundational knowledge of genetics, encompassing chromosomes, genes, DNA, protein synthesis, and the principles of genetic inheritance patterns	1,2, 3
V	**Reproductive system** Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones,	**9**	**Students will be able to learn** neural organization, ncompassing the structure and function of neurons, neuroglia, and nerve	1,2, 3

	physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition **Introduction to genetics** Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance		fibers, while also grasping key concepts such as electrophysiology, action potential, nerve impulse, receptors, synapses, and neurotransmitters; additionally, they should exhibit knowledge of the central nervous system, including the meninges, ventricles, cerebrospinal fluid, and the structural and functional aspects of the brain and spinal cord.	

TEXT BOOKS:

T1: Textbook of Practical Physiology by C.L. Ghai, Jaypeebrothers medical publishers, New Delhi. T2: Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

REFERENCE BOOKS:

R1: Text book of Medical Physiology- Arthur C,Guyton and John.E. Hall. Miamisburg, OH, U.S.A.
R2: Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
R3: Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York.
R4: Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypeebrothers medical publishers, New Delhi.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the anatomy and physiology of the central nervous system, nerve tracts, and reflex actions the anatomy and physiology of various organs of the human body using models, charts, etc.	**PO1,PO5,PO6,PO8,PO11**
2	Understand the functions, secretion, digestion, and absorption of nutrients in the gastrointestinal tract, as well as its disorders, along with the roles of ATP, creatinine, and BMR.	**PO1,PO3,PO5,PO6,PO8,PO11**
3	Understand the anatomy and physiology of the respiratory and urinary systems, along with their disorders.	**PO1,PO3,PO5,PO6,PO8,PO11**
4	Describe the various endocrine glands and interpreting the different hormones and their functions, along with the pathological conditions.	**PO1,PO3,PO5,PO6,PO8,PO11**
5	Explain the anatomy and physiology of the male and female reproductive systems, along with the various life processes related to the reproductive system.	**PO1,PO3,PO5,PO6,PO8,PO11**

SEMESTER – II									
Course Title	**PHARMACEUTICAL ORGANIC CHEMISTRY-I**								
Course code	**BP 202T**	**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 Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Upon completion of the course, the student shall be able to 2. Write the structure, name, and the type of isomerism of the organic compound 3. Write the reaction, name the reaction and the orientation of the reactions 4. Account for the reactivity/stability of compounds 5. Identify/confirm the identification of organic compound								
CO1	Classify Organic compounds based on IUPAC nomenclature and make use of structural isomerism in Organic compounds								
CO2	Relate Alkanes, Alkenes, and Conjugated dienes and Utilize E1 and E2 reactions with mechanism, importance of Addition reactions with mechanism along with Diel's Alder reaction								
CO3	Categorize and Justify SN1 and SN2 reactions, with mechanism and stereochemistry, Outline the structures and uses of some compounds, and Analyze alcohols based on Qualitative tests								
CO4	Discuss some named reactions that involve Aldehydes and Ketones with Qualitative Analysis and distinguish some aldehydes with structures and uses								
CO5	Describe the Importance of the Acidity of Carboxylic acids and the Basicity of Amines, Analyze them by Qualitative Analysis with structures and uses of some compounds								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**Classification, nomenclature and isomerism** Classification of Organic Compounds Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds) Structural isomerisms in organic compounds	**7**	**Students will be able to learn** the classification of Organic Compounds, Common and IUPAC systems of nomenclature of organic compounds (Up to 10 Carbons open chain and carbocyclic compounds) To understand structural isomerism in organic compounds	1,2
II	**Alkanes*, Alkenes* and Conjugated dienes*** SP3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP2 hybridization in alkenes E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E1 verses E2 reactions, Factors affecting E1 and E2 reactions. Ozonolysis, electrophilic addition reactions of alkenes,	**10**	**Students will be able to learn** SP3 hybridization in alkanes, Halogenation of alkanes, and uses of paraffin. To understand the Stabilities of alkenes, SP2 hybridization in alkenes To understand E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations,	1

	Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation. Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement		Saytzeffs orientation, and evidence. E1 verses E2 reactions, Factors affecting E1 and E2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation. To understand the Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement	
III	**Alkyl halides*** SN1 and SN2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN1 versus SN2 reactions, Factors affecting SN1 and SN2 reactions Structure and usesof ethyl chloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform. **Alcohols*-** Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene	**10**	**Students will be able to learn** SN1 and SN2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry, and rearrangement of carbocations. To understand SN1 versus SN2 reactions, Factors affecting SN1 and SN2 reactions Structure and uses of ethyl chloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform. To understand Qualitative tests, Structure, and uses of Ethyl alcohol, Methyl alcohol, chloro-butanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol	2,3, 4
IV	**Carbonyl compounds*** (Aldehydes and ketones) Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde.	**10**	**Students will be able to learn** Nucleophilic addition, Electromeric effect, To understand aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation. To understand qualitative tests, Structure, and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, examine, Benzaldehyde, Vanilin, Cinnamaldehyde	1,3, 4
V	**Carboxylic acids*** Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for		**Students will be able to learn** the acidity of carboxylic acids, the effect of substituents on	

	carboxylic acids ,amide and ester Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid **Aliphatic amines*** Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine	**8**	acidity, inductive effect, and qualitative tests for carboxylic acids, amide, and ester. To understand the structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, and Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid To understand the Basicity, the effect of substituent on Basicity of amines. To understand Qualitative tests, Structure, and uses of Ethanolamine, Ethylenediamine, Amphetamine	2,3, 4

TEXT BOOKS:

T1: Organic Chemistry by Morrison and Boyd.

T2: Textbook of Organic Chemistry by B.S. Bahl & ArunBahl.

REFERENCE BOOKS:

R1: Organic Chemistry by I.L. Finar, Volume-I. R2: Organic Chemistry by P.L. Soni.

R3: Reaction and reaction mechanism by Chatwal. R4: Organic Chemistry by Clayden.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Classify Organic compounds based on IUPAC nomenclature and make use of structural isomerism in Organic compounds	**PO1,PO3,PO8,PO11**
2	Relate Alkanes, Alkenes, and Conjugated dienes and Utilize E1 and E2 reactions with mechanism, importance of Addition reactions with mechanism along with Diel's Alder reaction	**PO1,PO3,PO11**
3	Categorize and Justify SN1 and SN2 reactions, with mechanism and stereochemistry, Outline the structures and uses of some compounds, and Analyze alcohols based on Qualitative tests	**PO1,PO3,PO11**
4	Discuss some named reactions that involve Aldehydes and Ketones with Qualitative Analysis and distinguish some aldehydes with structures and uses	**PO1,PO3,PO8,PO11**
5	Describe the Importance of the Acidity of Carboxylic acids and the Basicity of Amines, Analyze them by Qualitative Analysis with structures and uses of some compounds	**PO1,PO3,PO8,PO11**

SEMESTER – II									
Course Title	**BIOCHEMISTRY**								
Course code	**BP 203T**	**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 Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Upon completion of course student shell able to 2. Understand the catalytic role of enzymes, the importance of enzyme inhibitors in designing new drugs, and the therapeutic and diagnostic applications of enzymes. 3. Understand the metabolism of nutrient molecules in physiological and pathological conditions. 4. Understand the genetic organization of the mammalian genome and the functions of DNA in synthesizing RNAs and proteins.								
CO1	Understand the basics of chemistry, function, classification, biological importance, qualitative Tests and applications of various biomolecules.								
CO2	Clarify the fundamentals of metabolism, process, and steps involved in the metabolism of biomolecules.								
CO3	Describe the metabolism of nutrient molecules in physiological and pathological conditions.								
CO4	Analyze the mammalian genome's genetic organization and the DNA's functions in synthesizing RNAs and proteins.								
CO5	Elaborate on the catalytic role of enzymes, the importance of enzyme inhibitors in the design of new drugs, and the therapeutic and diagnostic applications of enzymes.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Biomolecules** Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins. **Bioenergetics** Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential. Energy rich compounds; classification; biological significances of ATP and cyclic	**8**	**Students will be able to learn** the principles of chemistry in biology	2,3
II	**Carbohydrate metabolism** Glycolysis Pathway, energetics and significance Citric acid cycle- Pathway, energetics and significance HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency Glycogen metabolism Pathways and glycogen storage diseases (GSD) Gluconeogenesis - Pathway and its significance Hormonal regulation of blood glucose level and Diabetes mellitus	**10**	**Students will be able to learn** the metabolism of nutrient molecules in physiological and pathological conditions	2,3
	Biological oxidation Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation & its			

	mechanism and substrate phosphorylation Inhibitors ETC and oxidative phosphorylation / Uncouples			
III	**Lipid metabolism** β-Oxidation of saturated fatty acid (Palmitic acid) Formation and utilization of ketone bodies; ketoacidosis De novo synthesis of fatty acids (Palmitic acid) Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity. **Amino acid metabolism** General reactions of amino acid metabolism: Transamination, domination & decarboxylation, urea cycle and its disorders Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia) Synthesis and significance of biological substances; 5- HT, melatonin, dopamine, noradrenaline, adrenaline Catabolism of heme; hyperbilirubinemia and jaundice	**10**	**Students will be able to learn** the metabolism of nutrient molecules in physiological and pathological conditions	2,3
IV	**Nucleic acid metabolism and genetic information transfer** Biosynthesis of purine and pyrimidine nucleotides Catabolism of purine nucleotides and Hyperuricemia and Gout disease Organization of mammalian genome Structure of DNA and RNA and their functions DNA replication (semi conservative model) Transcription or RNA synthesis Genetic code, Translation or Protein synthesis and inhibitors	**10**	**Students will be able to learn** the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.	2,3
V	**Enzymes** Introduction, properties, nomenclature and IUB classification of enzymes Enzyme kinetics (Michaelis plot, Line Weaver Burke plot) Enzyme inhibitors with examples Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation Therapeutic and diagnostic applications of enzymes and isoenzymes Coenzymes– Structure and biochemical functions	**7**	**Students will be able to learn** the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.	2,3

TEXT BOOKS:

T1: Principles of Biochemistry by Lehninger.

T2: Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell. T3: Biochemistry by D. Satyanarayan and U.Chakrapani.

T4: Textbook of Biochemistry by Rama Rao. T5: Textbook of Biochemistry by Deb.

REFERENCE BOOKS:

R1: Biochemistry, C.B.Powar & G.R.Chatwal, Himalaya publishing house.
R2: L. Stryer, Text Book of Bio Chemistry. W.H. Freemann & Co. Ltd. 6th Edition. R3: West, Edward, Text Book of Biochemistry; Freeman and company, Sanfransisco.
R4: E.E.Conn and PK Stumpf, Outlines of Biochemistry; John Wiley and sons, New York

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basics of chemistry, function, classification, biological importance, qualitative tests, and applications of various biomolecules.	**PO1,PO2,PO3,PO4,PO6,PO7, PO8,PO9,PO11**
2	Clarify the fundamentals of metabolism, process, and steps involved in the metabolism of biomolecules.	**PO1,PO2,PO3,PO4,PO6,PO7, PO8,PO9,PO11**
3	Describe the metabolism of nutrient molecules in physiological and pathological conditions.	**PO1,PO2,PO3,PO4,PO6,PO7, PO8,PO9,PO11**
4	Analyze the mammalian genome's genetic organization and the DNA's functions in synthesizing RNAs and proteins.	**PO1,PO2,PO3,PO4,PO6,PO7, PO8,PO9,PO11**
5	Elaborate on the catalytic role of enzymes, the importance of enzyme inhibitors in the design of new drugs, and the therapeutic and diagnostic applications of enzymes.	**PO1,PO2,PO3,PO4,PO6,PO7, PO8,PO9,PO11**

SEMESTER – II									
Course Title	**PATHOPHYSIOLOGY**								
Course code	**BP 204T**	**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 Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Upon completion of the subject student shall be able to – 2. Describe the etiology and pathogenesis of the selected disease states. 3. Name the signs and symptoms of the diseases; and 4. Mention the complications of the diseases.								
CO1	Discuss the basic principles of cell injury, adaptation and mechanism involved in the process of inflammation and repair								
CO2	Describe the etiology, pathogenesis, and management of the selected diseases of the cardiovascular, respiratory, and renal system								
CO3	Understand the path physiological aspects of haematological diseases, selected diseases of the endocrine, nervous, and gastrointestinal system								
CO4	Clarify the etiology, pathogenesis and management of hepatitis, cancer, bones, and joint Disorders								
CO5	Explain the complications and path physiological conditions of selected infectious and sexually transmitted diseases								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Basic principles of Cell injury and Adaptation:** Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury, Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage),Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaphase, Dysplasia),Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis &Alkalosis, Electrolyte imbalance **Basic mechanism involved in the process of inflammation and repair:** Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, Mediators of inflammation, Basic principles of wound healing in the skin, Pathophysiology of Atherosclerosis	**10**	**Students will be able to learn** principles of Cell injury To gain knowledge on cellular adaptation To understand the basic mechanism involved in the process of inflammation and repair	2,3
II	**Cardiovascular System:** Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis) **Respiratory system:** Asthma, Chronic	**10**	**Students will be able to learn** gross path physiology of cardiovascular diseases To gain knowledge on the gross path physiology of renal diseases. To	2,3

	obstructive airways diseases. **Renal system:** Acute and chronic renal failure		understand the gross path physiology of respiratory diseases	
III	**Haematological Diseases**: Iron deficiency, megaloblasticanemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia **Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones **Nervous system:** Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease. **Gastrointestinal system:** Peptic Ulcer	**10**	**Students will be able to learn** disease condition and clinical aspects of blood disorders To gain knowledge on pathology of endocrine disease To understand the path physiology of psychiatric disorders To gain knowledge on pathological aspects of Gastrointestinal system	2,3
IV	Inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease. **Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout **Principles of cancer:** classification, etiology and pathogenesis of cancer **Diseases of bones and joints:** Rheumatoid Arthritis, Osteoporosis, Gout **Principles of Cancer:** Classification, etiology and pathogenesis of	**8**	**Students will be able to learn** path physiology of Inflammatory bowel diseases To gain knowledge on jaundice, hepatitis, To understand the path physiology of joint disorders and cancer	2,3
V	**Infectious diseases:** Meningitis, Typhoid, Leprosy, Tuberculosis Urinary tract infections **Sexually transmitted diseases:** AIDS, Syphilis, Gonorrhea	**7**	**Students will be able to learn** path physiology of infectious disease and sexually transmitted diseases	2,3

TEXT BOOKS:

T1: Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins & Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.

T2: Harsh Mohan; Text book of Pathology; 6th edition; India; Jaypee Publications; 2010.

REFERENCE BOOKS:

R1: Laurence B, Bruce C, Bjorn K.; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th edition; New York; McGraw-Hill; 2011.

R2: Best, Charles Herbert 1899-1978; Taylor, Norman Burke 1885-1972; West, John B (John Burnard); Best and Taylor's Physiological basis of medical practice; 12th ed; united states;

R3: William and Wilkins, Baltimore;1991 [1990 printing].

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Discuss the basic principles of cell injury, adaptation and mechanism involved in the process of inflammation and Repair	**PO1,PO3,PO4,PO6,PO8,PO9, PO11**
2	Describe the aetiology, pathogenesis, and management of the selected diseases of the cardiovascular, respiratory, and renal system	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,PO9,PO11**
3	Understand the path physiological aspects of haematological diseases, selected diseases of the endocrine, nervous, and gastrointestinal system	**PO1,PO3,PO4,PO6,PO8,PO9, PO11**
4	Clarify the aetiology, pathogenesis and management of hepatitis, cancer, bones, and joint disorders	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,PO9,PO11**
5	Explain the complications and path physiological conditions of selected infectious and sexually transmitted Diseases	**PO1,PO3,PO4,PO5,PO6,PO7, PO8,PO9,PO11**

SEMESTER – II									
Course Title	**COMPUTER APPLICATIONS IN PHARMACY**								
Course code	**BP 205T**	**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 Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Upon completion of the course the student shall be able to 2. Know the various types of application of computers in pharmacy 3. Know the various types of databases 4. Know the various applications of databases in pharmacy								
CO1	Remember and comprehend the various number systems used in computer applications.								
CO2	Understand and apply the concepts of information systems and software technologies implemented in health care system								
CO3	Apply the basics of HTML, XML, CSS, and programming languages and an introduction to web servers and server products.								
CO4	Describe of computers in pharmacy include drug data storage, pharmacokinetics, hospital, and clinical pharmacy, e-prescribing, and barcode medicine detection								
CO5	Evaluation of data by applying computers in experimental development								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**Number system:** Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement ,Two's complement method, binary multiplication, binary division **Concept of Information Systems and Software** Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the Project	**6**	**Students will be able to learn** the various number systems To understand number base conversions To understand binary arithmetic of addition and subtraction To understand the concepts of an information system	1,2
II	**Web technologies:** Introduction to HTML, XML,CSS and Programming languages, introduction to web servers and Server Products Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database	**6**	**Students will be able to learn** web technologies To understand the concept of programming languages To understand the concept of web servers To understand the concept of database management systems	1
III	**Application of computers in Pharmacy** – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence	**6**	**Students will be able to learn** Computers in pharmacy store are utilized for the data of medication information, records and documents, sedate administration. To appraise the applications of computers in pharmacy such as drug	1

	monitoring Diagnostic System, Lab-		information services,	
	diagnostic System, Patient Monitoring System, Pharma Information System		pharmacokinetics, mathematical model in drug design, hospital and clinical pharmacy etc.,	
IV	**Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery		**Students will be able to learn** the applications of computers in pharmacy such as drug information services, pharmacokinetics, mathematical model in drug design, hospital and clinical pharmacy etc.,	1
V	**Computers as data analysis in Preclinical development:** Chromatographic dada analysis(CDS), Laboratory Information management System (LIMS) and Text Information Management System(TIMS)		**Students will be able to learn** the application of computers clinical data analysis To understand the concept of Laboratory Information Management System To understand the concept of Text Information Management System	1

TEXT BOOKS:

T1: Understand data analysis to analyze pharmaceutical product development using computers.

REFERENCE BOOKS:

R1: Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Wi

R2: Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi - CBS Publishers and Distributors, 4596/1- A, 11 Darya

R3: Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and InfoPath – Cary N.Prague Delhi - 110002

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Remember and comprehend the various number systems used in computer applications.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9,PO11**
2	Understand and apply the concepts of information systems and software technologies implemented in health care system	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9,PO11**
3	Apply the basics of HTML, XML, CSS, and programming languages and an introduction to web servers and server products.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9,PO11**
4	Describe of computers in pharmacy include drug data storage, pharmacokinetics, hospital, and clinical pharmacy, e-prescribing, and barcode medicine detection	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9,PO11**
5	Evaluation of data by applying computers in experimental Development	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9,PO11**

SEMESTER – II									
Course Title	**ENVIRONMENTAL SCIENCES**								
Course code	**BP 206T**	**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 Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	**1.** Upon completion of the course, the student shall be able to**:** **2.** Create awareness about environmental problems among learners. **3.** Impart basic knowledge about the environment and its allied problems. **4.** Develop an attitude of concern for the environment. **5.** Motivate learners to participate in environmental protection and environmental improvement. **6.** Acquire skills to help the concerned individuals identify and solve environmental problems. **7.** Strive to attain harmony with Nature								
CO1	Understand environmental problems among learners.								
CO2	Outline basic knowledge about the environment and its allied problems.								
CO3	Develop an attitude of concern for the environment.								
CO4	Outline proactive engagement in environmental protection, fostering sustainable action.								
CO5	Acquire skills to help the concerned individuals in identifying and solving environmental problems.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	The Multidisciplinary nature of environmental studies Natural Resources Renewable and non- renewable resources: Natural resources and associated problems a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources	**10**	**Students will be able to learn** Create awareness about environmental problems among learners. Create awareness about environmental problems among learners. Develop an attitude of concern for the environment.	1,2
II	Ecosystems Concept of an ecosystem. Structure and function of an ecosystem. Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	**10**	**Students will be able to learn** Ecosystem and their functions and values Effectively apply basic principles of the natural and social sciences to current issues of natural resources and the environment. To gain knowledge about Understand and appropriately use the vocabularies of the natural and social sciences relevant to issues of natural resources and the environment. Identify significant ethical issues in natural resources and the environment and be able to address these issues in an	1,2, 3

			informed and thoughtful manner	
III	Environmental Pollution: Air pollution; Water pollution; Soil pollution	**10**	**Students will be able to learn** environmental pollutants Know about the different types of host of the pollutions Effect of pollution in environment as well as human healthTo know about the precautionary measures of environmental pollutions	1,2, 3

TEXT BOOKS:

T1: Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore T2: De A.K., Environmental Chemistry, Wiley Eastern Ltd.

REFERENCE BOOKS:

R1: Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.

R2: BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India,

R3: Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p R4: Clark R.S., Marine Pollution, Clanderson Press Oxford

R5: Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand environmental problems among learners.	**PO1,PO4,PO7,PO10,PO11**
2	Outline basic knowledge about the environment and its allied problems.	**PO1,PO4,PO7,PO10,PO11**
3	Develop an attitude of concern for the environment.	**PO1,PO4,PO7,PO10,PO11**
4	Outline proactive engagement in environmental protection, fostering sustainable action.	**PO1,PO3,PO4,PO7,PO10,PO11**
5	Acquire skills to help the concerned individuals in identifying and solving environmental problems.	**PO1,PO3,PO4,PO7,PO10,PO11**

SEMESTER – II									
Course Title	**Human Anatomy And Physiology**								
Course code	**BP 207P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Identify human body tissues and organs. 2. Conduct various blood estimations. 3. Measure human heart rate, blood pressure, body temperature, BMI, and blood oxygen levels using diverse methods. 4. Test human lung capacities using a spirometer.								
CO1	Understand the anatomy and physiology of various human body organs using models, charts, etc.								
CO2	Analyze the permanent slides of vital organs and gonads								
CO3	Discuss the different types of lung capacity tests and their estimation.								
CO4	Perform neurological reflex testing, body temperature measurement, BMR recording, etc.								
CO5	Describe and explain family planning devices and pregnancy diagnosis tests.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. To study the integumentary and special senses using specimen, models, etc 2. To study the nervous system using specimen, models, etc., 3. To demonstrate the general neurological examination 4. To demonstrate the function of olfactory nerve 5. To examine the different types of taste. 6. To demonstrate the visual acuity 7. To demonstrate the reflex activity 8. Determination of tidal volume and vital capacity. 9. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens. 10. Recording of basal massindex . 11. Study of family planning devices and pregnancy diagnosis test 12. Demonstration of total blood count by cell analyser 13. Permanent slides of vital organs and gonads. 14. To study the endocrine system using specimen, models, etc 15. Recording of body temperature To demonstrate positive and negative feedback mechanism.	**4**	**Students will be able to learn** the various experiments related to special senses and nervous system, various homeostatic mechanisms and their imbalances, gross morphology, structure and functions of various organs of the human body	3,4,5

TEXT BOOKS:

T1: Textbook of Practical Physiology by C.L. Ghai, Jaypeebrothers medical publishers, New Delhi. T2: Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

REFERENCE BOOKS:

R1: Text book of Medical Physiology- Arthur C,Guyton and John.E. Hall. Miamisburg, OH, U.S.A.
R2: Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
R3: Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York.
R4: Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypeebrothers medical publishers, New Delhi.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the anatomy and physiology of various human body organs using models, charts, etc.	**PO1,PO2,PO3,PO4,PO6,,PO8 .0O9,PO11**
2	Analyze the permanent slides of vital organs and gonads	**PO1,PO2,PO3,PO4,PO6,PO1 0,PO8.0O9,PO11**
3	Discuss the different types of lung capacity tests and their estimation.	**PO1,PO2,PO3,PO4,PO5, PO6,PO10,PO8.0O9,PO11**
4	Perform neurological reflex testing, body temperature measurement, BMR recording, etc.	**PO1,PO2,PO3,PO4,PO5,PO6, PO10,PO8.0O9,PO11**
5	Describe and explain family planning devices and pregnancy diagnosis tests.	**PO1,PO2,PO3,PO4,PO6,PO1 0,PO8.0O9,PO11**

SEMESTER – II									
Course Title	**PHARMACEUTICAL ORGANIC CHEMISTRY-I**								
Course code	**BP 208P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Prepare organic compounds. 2. Determine the melting and boiling points of organic compounds. 3. Construct molecular models of various organic compounds. 4. Identify preliminary tests and elements detection.								
CO1	Identify standard laboratory equipment and its functions, describe safety protocols for chemical handling, and demonstrate knowledge of the preliminary tests used in qualitative organic analysis.								
CO2	Explain the principles behind the detection of extra elements through Lassaigne's test and describe the significance of these tests in organic compound identification.								
CO3	Apply solubility tests to determine the solubility characteristics of organic compounds in different solvents and interpret the results to make informed decisions in the identification Process								
CO4	Analyze and differentiate organic compounds based on their functional groups, through systemic qualitative analysis.								
CO5	Synthesize suitable solid derivatives, confirm the identity of the unknown compound through melting point/boiling point determination, and construct various molecular models.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Systematic qualitative analysis of unknown organic compounds like Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test Solubility test Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides. Melting point/Boiling point of organic compounds Identification of the unknown compound from the literature using melting point/ boiling point. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point.	**4**	**Students will be able to learn** Laboratory Glassware usage and Safety Measurements with precautions in the ,laboratory. Preliminary test like Color, odor, aliphatic/aromatic compounds, saturation and unsaturation, To Detect the extra elements like Nitrogen, Sulphur, and Halogen by Lassaigne's test. To understand the Solubility of various organic compounds. To understand the functional group tests like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds, and Anilides	3,4
	8. Minimum 5 unknown organic compounds to be analysed systematically		To understand the Melting point/Boiling point of organic	

	Preparation of suitable solid derivatives from organic compounds Construction of molecular models		compounds. To identify the unknown compounds from the literature using MP/BP. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point. Preparation of suitable solid derivatives from organic compounds	

TEXT BOOKS:

T1: Practical Organic Chemistry by Mann and Saunders T2: Vogel's textbook Practical Organic Chemistry.

REFERENCE BOOKS:

R1: Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz. R2: Advanced Practical organic chemistry by N.K.Vishnoi.

R3: Reaction and reaction mechanism by Ahluwaliah/Chatwal.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Identify standard laboratory equipment and its functions, describe safety protocols for chemical handling, and demonstrate knowledge of the preliminary tests used in qualitative organic analysis.	**PO1,PO2,PO3,PO5,PO8,PO1 0 ,PO11**
2	Explain the principles behind the detection of extra elements through Lassaigne's test and describe the significance of these tests in organic compound identification.	**PO1,PO2,PO3,PO5,PO8,PO1 0 ,PO11**
3	Apply solubility tests to determine the solubility characteristics of organic compounds in different solvents and interpret the results to make informed decisions in the identification process	**PO1,PO2,PO3,PO5,PO8,PO1 0 ,PO11**
4	Analyze and differentiate organic compounds based on their functional groups, through systemic qualitative analysis.	**PO1,PO2,PO3,PO5,PO7,PO8, PO10 ,PO11**
5	Synthesize suitable solid derivatives, confirm the identity of the unknown compound through melting point/boiling point determination, and construct various molecular models.	**PO1,PO2,PO3,PO5,PO7, PO8,PO10 ,PO11**

SEMESTER – II									
Course Title	**BIOCHEMISTRY**								
Course code	**BP 209P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objective	1. Identify various amino acids and proteins in samples. 2. Qualitatively analyze carbohydrate samples. 3. Detect abnormal constituents in urine samples.								
CO1	Relate different reagents, and qualitative tests to be used.								
CO2	Choose what tests are applicable for different biological samples.								
CO3	Categorize different constituents present in biological samples.								
CO4	Estimate the constituents quantitatively in biological samples like blood, and urine.								
CO5	Create experiments on biological samples including Enzymes biological samples.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch) Identification tests for Proteins (albumin and Casein) Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method) Qualitative analysis of urine for abnormal constituents Determination of blood creatinine Determination of blood sugar Determination of serum total cholesterol Preparation of buffer solution and measurement of pH Study of enzymatic hydrolysis of starch Determination of Salivary amylase activity Study the effect of Temperature on Salivary amylase activity. Study the effect of substrate concentration on salivary amylase activity.	**4**	**Students will be able to learn** qualitative analysis of carbohydrates, Proteins, reducing sugars (DNSA quantitative analysis of blood creatinine, blood sugar and serum total cholesterol Preparation of buffer solution and measurement of pH catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.	3,4

TEXT BOOKS:

T1: Practical Biochemistry by R.C. Gupta and S. Bhargavan.

T2: Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.

REFERENCE BOOKS:

R1: Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition). R2: Practical Biochemistry by Harold Varley.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Relate different reagents, and qualitative tests to be used.	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,PO9,PO10 ,PO11**
2	Choose what tests are applicable for different biological samples.	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,PO9,PO10 ,PO11**
3	Categorize different constituents present in biological samples.	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,PO9,PO10 ,PO11**
4	Estimate the constituents quantitatively in biological samples like blood, and urine.	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,PO9,PO10 ,PO11**
5	Create experiments on biological samples including Enzymes biological samples.	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,PO9,PO10 ,PO11**

SEMESTER – II									
Course Title	**COMPUTER APPLICATIONS IN PHARMACY**								
Course code	**BP 210P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 2	**0**	**0**	**2**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Analyze data using Excel. 2. Create data tables using SQL. 3. Explore computer applications in pharmacy education. 4. Build and modify databases in MS Access.								
CO1	Apply MS Access to store and retrieve drug information								
CO2	Understand and apply knowledge of the Internet, graphic design, and multimedia.								
CO3	Create reports and print from the patient database								
CO4	Design and development of an HTML-based personal information web page								
CO5	Understand the conversion of tables of information, inquiries, forms, and reports to XML Webpages								

Unit- No.	Content	Contact Hour	Learning Outcome	KL
I	Design a questionnaire using a word processing package to gather information about a particular disease. Create a HTML web page to show personal information. Retrieve the information of a drug and its adverse effects using online tools Creating mailing labels Using Label Wizard , generating label in MS WORD Create a database in MS Access to store the patient information with the required fields Using access . Design a form in MS Access to view, add, delete and modify the patient record in the database . Generating report and printing the report from patient database . Creating invoice table using – MS Access . Drug information storage and retrieval using MS Access 0. Creating and working with queries in MS Access 1. Exporting Tables, Queries, Forms and Reports to web pages 12. Exporting Tables, Queries, Forms and Reports to XML pages	**4**	**Students will be able to learn** abilities in ethical considerations, data analysis, and effective communication of findings. To grasp web technologies, programming language concepts, web server functionalities, and database management system principles To learn ,create mailing labels in MS Word using the Label Wizard and generate patient information from a database designed in MS Access with a user-friendly form for viewing, adding, deleting, and modifying records Generate and print reports seamlessly from a patient database, create an invoice table in MS Access, and efficiently store and retrieve drug information using MS Access.. Efficiently create and manage queries in MS Access while exporting tables, queries, forms, and reports to both web and XML pages for versatile data utilization	3,4

TEXT BOOKS:

T1: Computer Application in Pharmacy – William E.Fassett –Lea and Febiger, 600South Washington Square USA, (215) 922-1330.

T2: Computer Application in Pharmaceutical Research and Development –Sean Ekins John Willey and Sons, INC., Publication.

T3: Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi - CBS Publishers and Distributors, 4596/1 110 002(INDIA).

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Apply MS Access to store and retrieve drug information	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9 ,PO11**
2	Understand and apply knowledge of the Internet, graphic design, and multimedia.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9 ,PO11**
3	Create reports and print from the patient database	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9 ,PO11**
4	Design and development of an HTML-based personal information web page	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9 ,PO11**
5	Understand the conversion of tables of information, inquiries, forms, and reports to XML webpages	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9 ,PO11**

SEMESTER – III									
Course Title	**Pharmaceutical Organic Chemistry-II**								
Course code	**BP301T**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45	**3**	**1**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ III semester of first year of the programme**								
Course Objectives	1. Write the structure, name, and the type of isomerism of the organic compound. 2. Write the reaction, name the reaction and orientation of reactions. 3. Account for reactivity/stability of compounds. 4. Prepare organic compounds.								
CO1	Understand and analyze the structural derivation, demonstrate a comprehensive understanding of the reactions of benzene, Identify and describe the different substituents and their effects on benzene, and explain the structure and applications of chemicals in various industrial and practical contexts.								
CO2	Explore the versatile reactivity of phenols, aromatic amines, and aromatic acids in diverse organic reactions, highlighting their crucial role in organic synthesis and analyze the influence of substituents on their reactivity and perform qualitative tests to differentiate them from other Compounds								
CO3	Demonstrate an understanding of the chemistry of fats and oils, evaluating their chemical mechanisms, and recognizing the importance of analytical constants in assessing fat and oil quality, purity, and composition, while understanding the principles behind their determination								
CO4	Analyze and demonstrate their knowledge through the synthesis and reactions of polynuclear hydrocarbons. Evaluate the structure and medicinal uses of listed polynuclear hydrocarbons and their derivatives, assess their potential applications in the field of medicine								
CO5	Assess cycloalkanes' synthesis techniques and reactivity, examine ring stability based on established theories, and justify the reactivity of cyclopropane and cyclobutene molecules.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Benzene and its derivatives** . Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule . Reactions of benzene - nitration, sulphonation, halogenation- reactivity, Friedel crafts alkylation- reactivity, limitations, Friedel crafts acylation. . Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction . Structure and uses of DDT, Saccharin, BHC and Chloramine	**10**	**Students will be able to learn** Analytical, synthetic, and other evidence to figure out the structure of benzene. Orbital picture, resonance in benzene, aromatic characters and Huckel's rule. different chemical reactions of benzene like nitration, sulphonation, halogenations reactivity, Friedel crafts alkylation- reactivity, limitations, Friedel crafts acylation. impact of substituents on reactivity and orientation of monosubstituted benzene compounds towards electrophilic substitution reaction. Structure and uses of DDT, Saccharin, BHC and Chloramine	3,4

II	**Phenols -** Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols **Aromatic Amines -** Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts **Aromatic Acids –**Acidity, effect of substituents on acidity and important reactions of benzoic acid.	**10**	**Students will be able to learn** acidity of phenols, consider how substituents affect acidity, aromatic acids, assess how substituents affectacidity, and list some of benzoic acid's key reactions.	4
III	**Fats and Oils** a. Fatty acids – reactions. b. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils. c. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.	**10**	**Students will be able to learn** how fatty acids react. Analyze the stability of fats and oils using the processes of hydrolysis, hydrogenation, saponification, rancidity, and drying. relevance of the underlying concept behind the following analytical constants for fats and oils: Acid value, Saponification value, Ester value, Iodine value, Acetyl value, and Reichert Meissl (RM) value	3
IV	**Polynuclear hydrocarbons:** a. Synthesis, reactions b. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives	**8**	**Students will be able to learn** Polynuclear Hydrocarbons' Synthesis and Reactions. structure and therapeutic applications of phenanthrene, anthracene, diphenylmethane, triphenylmethane, and its derivatives.	4,
V	**Cyclo alkanes** Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only	**7**	**Students will be able to learn** general preparation and reaction processes for cycloalkanes. Explain how Baeyer's strain theory explains the stability of cyclo alkanes and discuss its limits, as well as those of Coulson and Moffitt's modification, Sachse Mohr's theory (theory of strainless rings), and reactions involvingsolely cyclopropane and cyclobutane.	5

TEXT BOOKS:

T1: Organic Chemistry by Morrison and Boyd.

T2: Textbook of Organic Chemistry by B.S. Bahl & ArunBahl.

REFERENCE BOOKS:

R1: Organic Chemistry by I.L. Finar, Volume-I. R2: Organic Chemistry by P.L. Soni.

R3: Reaction and reaction mechanism by Chatwal. R4: Organic Chemistry by Clayden.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand and analyze the structural derivation, demonstrate a comprehensive understanding of the reactions of benzene, Identify and describe the different substituents and their effects on benzene, and explain the structure and applications of chemicals in various industrial and practical contexts.	**PO1,PO3,PO4,PO11**
2	Explore the versatile reactivity of phenols, aromatic amines, and aromatic acids in diverse organic reactions, highlighting their crucial role in organic synthesis and analyze the influence of substituents on their reactivity and perform qualitative tests to differentiate them from other Compounds	**PO1,PO3,PO4,PO11**
3	Demonstrate an understanding of the chemistry of fats and oils, evaluating their chemical mechanisms, and recognizing the importance of analytical constants in assessing fat and oil quality, purity, and composition, while understanding the principles behind their determination	**PO1,PO2,,PO3,PO4,PO10,PO11**
4	Analyze and demonstrate their knowledge through the synthesis and reactions of polynuclear hydrocarbons. Evaluate the structure and medicinal uses of listed polynuclear hydrocarbons and their derivatives, assess their potential applications in the field of medicine	**PO1,PO2, PO3,PO4,PO11**
5	Assess cycloalkanes' synthesis techniques and reactivity, examine ring stability based on established theories, and justify the reactivity of cyclopropane and cyclobutene molecules.	**PO1,PO3,PO4,PO11**

SEMESTER – III									
Course Title	**Physical Pharmaceutics I**								
Course code	**BP302T**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45	**3**	**1**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ III semester of third year of the programme**								
Course Objectives	. Understand various physicochemical properties of drug molecules in designing the dosage forms . Know the principles of chemical kinetics & use them for stability testing &determination of the expiry date of formulations . Demonstrate the use of physicochemical properties in developing and evaluating dosage forms.								
CO1	Understand the mechanisms of solute-solvent interactions and solubility of different drug Molecules								
CO2	Understand applications of different physicochemical properties of drug molecules as well as states of matter								
CO3	Gain expertise and practical understanding of the fundamentals and theories related to surface tension and its measurement techniques.								
CO4	Comprehend the diverse intermolecular forces contributing to complex formation and their practical applications								
CO5	Acquire knowledge of the procedures for preparing pharmaceutical buffers, pH, and their Significance								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Solubility of drugs:** Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications	**10**	**Students will be able to learn** drug solubility, its significance in pharmaceutical science, and the practical implications in drug formulation and development.	4
II	**States of Matter and properties of matter:** State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols – inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid- crystalline, amorphous & polymorphism. **Physicochemical properties of drug molecules:** Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications	**10**	**Students will be able to learn** the states of matter, classification, their properties, and the underlying principles governing physicochemical behavior of drug molecules.	3

III	**Surface and interfacial phenomenon:** Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface.	**8**	**Students will be able to learn** the stability and performance of pharmaceutical products and develop innovative solutions in the field of pharmaceutical science	4
IV	**Complexation and protein binding:** Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.	**8**	**Students will be able to learn** drug protein interactions, predict potential drug interactions, and consider the implications of protein binding on drug pharmacokinetics and pharmacodynamics.	3
V	**pH, buffers and Isotonic solutions:** Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.	**7**	**Students will be able to learn** pH, buffers, and isotonic solutions to real-world scenarios, such as medical treatments, pharmaceutical industry, research, laboratory procedures etc.	1

TEXT BOOKS:

T1: Text book of Physical Pharmaceutics by C.V.S. Subramanyam, VallabhPrakashan.

T2: Physical Pharmacy by S.P Agarwal and Rajesh Khana, CBS Publishers and distributors PVT Ltd; 2nd Edition.

REFERENCE BOOKS:

R1: Physical Pharmacy by Alfred Martin.

R2: Tutorial Pharmacy by Cooper and Gunn, CBS Publishers and distributors PVT Ltd.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the mechanisms of solute-solvent interactions and solubility of different drug molecules	**PO1,PO2,PO3,PO4,PO6,PO8PO11**
2	Understand applications of different physicochemical properties of drug molecules as well as states of matter	**PO1,PO2,PO3,PO4,PO6,PO8PO11**
3	Gain expertise and practical understanding of the fundamentals and theories related to surface tension and its measurement techniques.	**PO1,PO2,PO3,PO4,PO6,PO8PO11**
4	Comprehend the diverse intermolecular forces contributing to complex formation and their practical applications	**PO1,PO2,PO3,PO4,PO6,PO8PO11**
5	Acquire knowledge of the procedures for preparing pharmaceutical buffers, pH, and their significance	**PO1,PO2,PO3,PO4,PO6,PO8PO11**

SEMESTER – III									
Course Title	**Pharmaceutical Microbiology**								
Course code	**BP303T**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45	**3**	**1**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ III semester of Third year of the programme**								
Course Objectives	1. Understand methods of identification, cultivation and preservation of various microorganisms 2. To understand the importance and implementation of sterilization in pharmaceutical processing and industry 3. Learn sterility testing of pharmaceutical products. 4. Carried out microbiological standardization of Pharmaceuticals. 5. Understand the cell culture technology and its applications in pharmaceutical industries.								
CO1	Understand methods of identification, cultivation, and preservation of various microorganisms								
CO2	To understand the importance and implementation of sterilization in pharmaceutical processing and industry								
CO3	Learn sterility testing of pharmaceutical products.								
CO4	Carried out microbiological standardization of Pharmaceuticals.								
CO5	Understand the cell culture technology and its applications in pharmaceutical industries.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Introduction, history of microbiology, its branches, scope and its importance. Introduction to Prokaryotes and Eukaryotes Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of different types of phaseconstrast microscopy, dark field microscopy and electron microscopy.	**10**	**Students will be able to learn** history, branches and scope of microbiology To understand the structure and classification of bacteria To understand different requirement for culture media and cultivation of anaerobic bacteria To understand the instrumentation, use and application of different microscopes	2,3
II	Identification of bacteria using staining techniques (simple, Gram's &Acid fast staining) and biochemical tests (IMViC). Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipment's employed in large scale sterilization. Sterility indicators.	**10**	**Students will be able to learn** staining techniques for identification of bacteria To understand the sterilization and its different methods and instruments utilized	3,4
III	Study of morphology, classification, reproduction/replication andcultivation		**Students will be able to learn** Structure and classification	

	Fungi and Viruses. Classification and mode of action of disinfectants Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, Ophthalmic and othersterile according to IP, BP and USP.	**10**	of fungi and viruses To understand different disinfectant and their significance and application To understand the sterility testing methods for Quality Control of Pharmaceuticals	2,3
IV	Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification. Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic.	**8**	**Students will be able to learn** aseptic area for microbiological studies and different equipment used in aseptic area To understand methods and application of microbiological assays for quality control and assurance of pharmaceutical products like antibiotics.	1
V	Types of spoilage, factorsaffecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations. Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures. Application of cell cultures in pharmaceutical industry and research.	**7**	**Students will be able to learn** Microbiological contaminations and ways to prevent them. To understand the microbiological stability testing for pharmaceuticals. To understand concept of cell culture and its application in pharmaceutical industry and drug development Research	2,3

TEXT BOOKS:

T1: Pharmaceutical Microbiology – AshutoshKar, New Age International (P) Ltd., Publishers, New Delhi, India

T2: A textbook of Pharmaceutical Microbiology – Dr.Kuntal Das, NiraliPrakashan, Pune – 411005.

REFERENCE BOOKS:

R1: W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.

R2: Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.

R3: Review of Microbiology & Immunology - Apurba Sankar Sastry, Jaypee Brothers Medical Publishers (P) Limited, New Delhi – 110002.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand methods of identification, cultivation, and preservation of various microorganisms	**PO1,PO2,PO3,PO4,PO6,PO7, PO9,PO10, PO11**
2	To understand the importance and implementation of sterilization in pharmaceutical processing and industry	**PO1,PO2,PO3,PO4,PO6,PO7, PO9,PO10, PO11**
3	Learn sterility testing of pharmaceutical products.	**PO1,PO2,PO3,PO4,PO6,PO7, PO9,PO10, PO11**
4	Carried out microbiological standardization of Pharmaceuticals.	**PO1,PO2,PO3,PO4,PO6,PO7, PO9,PO10, PO11**
5	Understand the cell culture technology and its applications in pharmaceutical industries.	**PO1,PO2,PO3,PO4,PO6,PO7, PO9,PO10, PO11**

SEMESTER – III									
Course Title	**Pharmaceutical Engineering**								
Course code	**BP304T**	**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 Pharmacy**								
Semester	**Fall/ III semester of Third year of the programme**								
Course Objectives	1. To know various unit operations used in Pharmaceutical industries. 2. To understand the material handling techniques. 3. To perform various processes involved in pharmaceutical manufacturing process. 4. To carry out various tests to prevent environmental pollution. 5. To appreciate and comprehend significance of plant lay out design for optimumuse of resources.								
CO1	Understand the fundamental concepts of size reduction and separation and their pharmacological applications.								
CO2	Describe the fundamental concepts, methods, and applications of heat transfer, evaporation, and distillation in pharmaceutical preparations.								
CO3	Demonstrate the basic concepts and pharmaceutical applications of drying and mixing.								
CO4	Explain the theories, principles, and factors that impact filtering and centrifugation.								
CO5	Assess the construction of the facility, corrosion issues, and methods for preventing corrosion.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Flow of fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer. Size Reduction: Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill. Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.	**10**	**Students will be able to learn** significance of the flow of fluids, size reduction and size separation	1,2
II	• Heat Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits	**10**	**Students will be able to learn** concept of heat transfer, mechanism of evaporation and distillation technique	2,3

	and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator. Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation			
III	• Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer. • Mixing: Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier	**10**	**Students will be able to learn** principle involves in drying and mixing.	3
IV	• Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter. • Centrifugation: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non- perforated basket centrifuge, semi continuous centrifuge & super centrifuge.	**8**	**Students will be able to learn** principles and uses of filtration and centrifugation.	2,3
V	Materials of pharmaceutical plant construction, Corrosion and its prevention: Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.	**7**	**Students will be able to learn** Materials of pharmaceutical plant construction, Corrosion and its prevention	3

TEXT BOKS:

T1: Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition. T2: Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.
T3: Unit operation of chemical engineering – Mcabe Smith, Latest edition.

REFERENCE BOOKS:

R1:Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition.
R2:Remington practice of pharmacy- Martin, Latest edition.
R3T:heory and practice of industrial pharmacy by Lachmann, Latest edition. R4: Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
R5: Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the fundamental concepts of size reduction and separation and their pharmacological applications.	**PO1,PO3,PO4,PO6,PO8,,PO 10, PO11**
2	Describe the fundamental concepts, methods, and applications of heat transfer, evaporation, and distillation in pharmaceutical preparations.	**PO1,PO3,PO4,PO6,PO8,,PO 10, PO11**
3	Demonstrate the basic concepts and pharmaceutical applications of drying and mixing.	**PO1,PO3,PO4,PO6,PO8,,PO 10, PO11**
4	Explain the theories, principles, and factors that impact filtering and centrifugation.	**PO1,PO3,PO4,PO6,PO8,,PO 10, PO11**
5	Assess the construction of the facility, corrosion issues, and methods for preventing corrosion.	**PO1,PO3,PO4,PO6,PO8,,PO 10, PO11**

SEMESTER – III									
Course Title	**Pharmaceutical Organic Chemistry -II (Practical)**								
Course code	**BP305P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ III semester of third year of the programme**								
Course Objectives	1. Measure the yield and purity of synthesized organic compounds. 2. Design various classes of mono-substituted benzenes from diazonium salts.								
CO1	Identify standard laboratory equipment and their functions, and describe safety protocols for chemical handling								
CO2	Demonstrate the underlying principles of steam distillation and recrystallization techniques in the purification process.								
CO3	Evaluate the significance of these constants in assessing the quality, purity, and composition of fats and oils, and employ appropriate laboratory methods for their determination, emphasizing the relationship between the principles and practical applications								
CO4	Explain the fundamental principles and perform pharmaceutical synthesis experiments according to established procedures, including calculating reactant quantities and reaction conditions								
CO5	Assess the quality and purity of synthesized pharmaceutical compounds based on analytical data and characterization techniques.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
1	Experiments Involving Laboratory Techniques: 1. Recrystallization 2. Steam distillation Determination of Following Oil Values (Including Standardization of Reagents): 1. Acid value 2. Saponification value 3. Iodine value III. Preparation of Compounds: 1. Benzanilide / Phenyl benzoate/Acetanilide from Aniline/Phenol/Aniline by acylation reaction. 2. 2,4,6-Tribromoaniline/ Parabromoacetanilide from Aniline/Acetanilide by halogenation (Bromination) reaction. 3. 5-Nitrosalicylic acid/ Metadinitrobenzene from Salicylic acid/Nitro benzene by nitration reaction. 4. Benzoic acid from Benzyl chloride by oxidation reaction. 5. Benzoic acid/Salicylic acid from alkylbenzoate/ alkylsalicylate by	**4**	**Students will be able to learn** Experiments Involving Laboratory Techniques Standardization of Reagents Preparation of Compounds	3,4

	hydrolysis reaction.			
	6. 1-Phenylazo-2-naphthol from Aniline by diazotization and coupling reactions. 7. Benzil from Benzoin by oxidation reaction. 8. Dibenzalacetone from Benzaldehyde by Claisen-Schmidt reaction. 9. Cinnamic acid from Benzaldehyde by Perkin reaction. 10. P-- Iodobenzoic acid from P – aminobenzoic acid.			

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Identify standard laboratory equipment and their functions, and describe safety protocols for chemical handling	**PO1,PO2,PO3,PO4,PO6,PO9,,PO10, PO11**
2	Demonstrate the underlying principles of steam distillation and recrystallization techniques in the purification process.	**PO1,PO2,PO3,PO4,PO6,PO9,,PO10, PO11**
3	Evaluate the significance of these constants in assessing the quality, purity, and composition of fats and oils, and employ Appropriate laboratory methods for their determination, emphasizing the relationship between the principles and practicalApplications	**PO1,PO2,PO3,PO4,PO6,PO9,,PO10, PO11**
4	Explain the fundamental principles and perform pharmaceutical synthesis experiments according to established procedures, including calculating reactant quantities and reaction conditions	**PO1,PO2,PO3,PO4,PO6,PO9,PO10, PO11**
5	Assess the quality and purity of synthesized pharmaceutical compounds based on analytical data and characterization techniques.	**PO1,PO2,PO3,PO4,PO6,PO9,,PO10, PO11**

SEMESTER III									
Course Title	**Physical Pharmaceutics – I (Practical)**								
Course code	**BP306P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ III semester of third year of the programme**								
Course Objectives	1. Measure the HLB value of surfactants. 2. Estimate adsorption capacity of adsorbents. 3. Assess drug solubility in different solvents.								
CO1	Understand the concept of solubility of drug molecules								
CO2	Describe the effect of pKa and pH value in formulation, development of dosage form								
CO3	Understand the knowledge of hydrophobicity and membrane permeability of drug molecules by determining partition coefficient								
CO4	Understand the concept of CMC and demonstrate the various determining methods of Surface Tension								
CO5	Learn about the saponification method by evaluating the HLB value								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. Determination of the solubility of a drug at room temperature. 2. Determination of pKa value by half neutralization/Henderson-Hasselbalch equation. 3. Determination of partition coefficient of benzoic acid in benzene and water. 4. Determination of partition coefficient of iodine in CCl4 and water. 5. Determination of % composition of NaCl in a solution using phenol-water system by CST method. 6. Determination of surface tension of given liquids by drop count and drop weight method. 7. Determination of HLB (Hydrophilic-Lipophilic Balance) number of a surfactant by saponification method. 8. Determination of Freundlich and Langmuir constants using activated charcoal. 9. Determination of critical micellar concentration of surfactants. 10. Determination of stability constant anddonor-acceptor ratio of PABA-Caffeine complex by solubility method. 11. Determination of stability constant and donor-acceptor ratio of Cupric- Glycine complex by pH titration method.	**4**	**Students will be able to learn** the physicochemical features of colloidal and dispersed systems in raw materials are so important in the pharmaceutical sciences	3,4

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the concept of solubility of drug molecules	**PO1,PO2,PO3,PO4,PO7,PO9,PO10, PO11**
2	Describe the effect of pKa and pH value in formulation, development of dosage form	**PO1,PO2,PO3,PO4,PO7,PO9,PO10, PO11**
3	Understand the knowledge of hydrophobicity and membrane permeability of drug molecules by determining partition coefficient	**PO1,PO2,PO3,PO4,PO7,PO9,PO10, PO11**
4	Understand the concept of CMC and demonstrate the various determining methods of Surface tension	**PO1,PO2,PO3,PO4,PO7,PO9,PO10, PO11**
5	Learn about the saponification method by evaluating the HLB Value	**PO1,PO2,PO3,PO4,PO7,PO9,PO10, PO11**

SEMESTER III									
Course Title	**Pharmaceutical Microbiology (Practical)**								
Course code	**BP307P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ III semester of third year of the programme**								
Course Objectives	1. Identify microorganisms relevant to pharmaceutical microbiology. 2. Apply aseptic techniques in handling microorganisms. 3. Perform microbial isolation, identification, and characterization techniques.								
CO1	Recall different techniques of sterilization								
CO2	Demonstrate various staining methods – simple, gram staining and acid-fast staining.								
CO3	Understand the working, construction and application of different instruments used in Microbiology								
CO4	Understand the methods of isolation of pure culture of bacteria.								
CO5	Perform the microbial assay of antibiotics.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
	1. Introduction and study of different equipment and processing in experimental microbiology, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology. 2. Sterilization of glassware, preparation, and sterilization of media. 3. Subculturing of bacteria and fungus. Nutrient stabs and slants preparations. 4. Staining methods - Simple, Gram staining, and acid-fast staining (demonstration with practical). 5. Isolation of pure culture of microorganisms by multiple streak plate technique and other techniques. 6. Microbiological assay of antibiotics by cup plate method and other methods. 7. Motility determination by Hanging drop method. 8. Sterility testing of pharmaceuticals. 9. Bacteriological analysis of water. 10. Biochemical tests.	**4**	**Students will be able to learn** principle and, applications Perform different type of staining.	3,4

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recall different techniques of sterilization	**PO1,PO2,PO3,PO4,PO6,PO7, PO9,PO10, PO11**
2	Demonstrate various staining methods – simple, gram staining and acid-fast staining.	**PO1,PO2,PO3,PO4,PO6,PO7, PO9,PO10, PO11**
3	Understand the working, construction and application of different instruments used in microbiology	**PO1,PO2,PO3,PO4,PO6,PO7, PO9,PO10, PO11**
4	Understand the methods of isolation of pure culture of bacteria.	**PO1,PO2,PO3,PO4,PO6,PO7, PO9,PO10, PO11**
5	Perform the microbial assay of antibiotics.	**PO1,PO2,PO3,PO4,PO6,PO7, PO9,PO10, PO11**

SEMESTER III									
Course Title	**Pharmaceutical Engineering (Practical)**								
Course code	**BP308P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**		**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ III semester of third year of the programme**								
Course Objectives	1. Determine physical properties of pharmaceutical formulations. 2. Analysis of powder characteristics 3. Study the effects of distinct factors on pharmaceutical product development.								
CO1	Recall fundamental principles of pharmaceutical manufacturing processes.								
CO2	Explain the principles underlying pharmaceutical unit operations.								
CO3	Demonstrate the operation of pharmaceutical manufacturing equipment.								
CO4	Analyze the impact of process variables on drug product quality.								
CO5	Design experiments to investigate and improve pharmaceutical product quality.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. Determination of radiation constant of brass, iron, unpainted and painted glass. 2. Steam distillation – To calculate the efficiency of steam distillation. 3. To determine the overall heat transfer coefficient by heat exchanger. 4. Construction of drying curves (for calcium carbonate and starch). 5. Determination of moisture content and loss on drying. 6. Determination of humidity of air: 7. From wet and dry bulb temperatures 8. Use of Dewpoint method. 9. Description of Construction, working, and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, dehumidifier. 10. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots. 11. Size reduction: 12. To verify the laws of size reduction using ball mill. 13. Determining Kicks, Rittinger's, Bond's coefficients, power requirement, and critical speed of		**Students will be able to learn** Determination of radiation constant of brass, iron, unpainted and painted glass. Steam distillation. To determine the overall heat transfer coefficient by heat exchanger. Construction of drying curves Determination of moisture content and loss on drying. Determination of humidity of air: From wet anddry bulb temperatures Use of Dewpoint method. Description of Construction, working, and application Size analysis by sieving Size reduction To calculate the uniformity Index for given sample by using Double Cone Blender.	3,4

	Ball Mill.			
	14. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment. 15. Factors affecting rate of filtration and evaporation (surface area, concentration, thickness /viscosity). 16. To study the effect of time on the Rate of Crystallization. 17. To calculate the uniformity Index for given sample by using Double Cone Blender.			

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recall fundamental principles of pharmaceutical manufacturing processes.	**PO1,PO2,PO3,PO4,PO6,PO9, PO10, PO11**
2	Explain the principles underlying pharmaceutical unit operations.	**PO1,PO2,PO3,PO4,PO6,PO9, PO10, PO11**
3	Demonstrate the operation of pharmaceutical manufacturing equipment.	**PO1,PO2,PO3,PO4,PO6,PO9, PO10, PO11**
4	Analyze the impact of process variables on drug product quality.	**PO1,PO2,PO3,PO4,PO6,PO9, PO10, PO11**
5	Design experiments to investigate and improve pharmaceutical product quality.	**PO1,PO2,PO3,PO4,PO6,PO9, PO10, PO11**

SEMESTER – IV									
Course Title	**Pharmaceutical Organic Chemistry –III**								
Course code	**BP401T**	**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 Pharmacy**								
Semester	**Fall/ IV semester of 2nd year of the programme**								
Course Objectives	1. Understand the methods of preparation and properties of organic compounds 2. Explain the stereo chemical aspects of organic compounds and stereo chemical reactions 3. Know the medicinal uses and other applications of organic compounds								
CO1	Illustrate Stereo-chemical features including conformation and stereo-electronic effects of organic molecules.								
CO2	Comprehend the basic experimental principles of geometrical isomerism and atrop isomerism								
CO3	Outline the structures and synthesis of simple five-member heterocyclic organic compounds.								
CO4	Describe the structures and synthesis of essential six - membered organic heterocyclic Compounds								
CO5	Describe detailed mechanisms for common naming reactions								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Stereoisomerism Optical isomerism– Optical activity, enantiomerism, diastereoisomer ism, mesocompounds Elements of symmetry, chiral and achiral molecules DL system of nomenclature of optical isomers, sequencerules, RS system of nomenclature of optical isomers Reactions of chiral molecules Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute	**10**	**Students will be able to learn** Stereo-chemical features including conformation and stereoelectronic effects of organic molecules.	1,2
II	Geometrical isomerism Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems) Methods of determination of configuration of geometrical isomers. Conformational isomerism in Ethane, n-Butane and Cyclohexane. Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity. Stereospecific and stereoselective reactions	**10**	**Students will be able to learn** Geometrical Isomerism. Nomenclature of Geometrical Isomerism. configuration and methods of determination of configuration of geometrical isomerism. about Conformational Isomerism in alkanes. Stereoisomerism in Biphenyl Compounds and Stereospecific and Stereoselective Reactions	1,2
III	Heterocyclic compounds: Nomenclature and classification Synthesis, reactions and Medicinal uses of following compounds/derivatives Pyrrole, Furan, and Thiophene Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene	**10**	**Students will be able to learn** Heterocyclic Compounds. Nomenclature & apply this to Naming of Heterocyclic Compounds. Classification of Heterocyclic Compounds. Synthesize reactions associated	1,2

			with heterocycles. Medicinal	
			Compounds of these heterocycles. Relative Aromaticity and Reactivity of these heterocycles	
IV	Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrazole, Imidazole, Oxazole and Thiazole. Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives	**8**	**Students will be able to learn** Heterocyclic Compounds. synthesize the reactions associated with Heterocyclic compounds . structures and synthesis of basic six- membered organic heterocyclic compounds	1,2
V	Reactions of synthetic importance Metal Hydride reduction (NaBH4 and LiAlH4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation	**7**	**Students will be able to learn** Some Important Organic reactions. Reactions of Synthetic Importance. the applications of some Organic Compounds.	1,2

TEXT BOOKS:

T1:A text book of organic chemistry – Arun Bahl, B.S. Bahl. T2: Heterocyclic Chemistry by Raj K. Bansal.

REFERENCE BOOKS:

R1 Organic Chemistry by Morrison and Boyd 5. R2 Organic chemistry by I.L. Finar, Volume-I & II**.**

https://www.carewellpharma.in/bpharmacy/notes/4th-sem/pharmaceutical-organic-chemistry-3

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Illustrate Stereo-chemical features including conformation and stereo-electronic effects of organic molecules.	**PO1,PO2,PO3,PO7, PO8, PO11**
2	Comprehend the basic experimental principles of geometrical isomerism and atropisomerism	**PO1,PO2,PO3,PO7, PO8, PO11**
3	Outline the structures and synthesis of simple five-member heterocyclic organic compounds.	**PO1,PO2,PO3,PO7, PO8, PO11**
4	Describe the structures and synthesis of essential six- membered organic heterocyclic compounds	**PO1,PO2,PO3,PO7, PO8, PO11**
5	Describe detailed mechanisms for common naming reactions	**PO1,PO2,PO3,PO7, PO8, PO11**

SEMESTER – IV									
Course Title	**MEDICINALCHEMISTRY–I**								
Course code	**BP402T**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**3**	**0**	**2**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ IV semester of 2nd year of the programme**								
Course Objectives	1. Understand the chemistry of drugs concerning their pharmacological activity 2. Understand the drug metabolic pathways, adverse effect, and therapeutic value of drugs 3. Know the Structural Activity Relationship (SAR) of different class of drugs 4. Write the chemical synthesis of some drugs								
CO1	Understand the basic principles of medicinal chemistry								
CO2	Identify the cause of disease or disorder and the mechanism of action for drugs acting on ANS								
CO3	Illustrate how the chemistry of pharmaceuticals relates to their pharmacological and pharmacokinetic profiles.								
CO4	Recall the structural activity relationship (SAR) between various medication classes and the biological activity of drugs acting on CNS								
CO5	Understand the synthesis of various drug products with classification based on chemical structure.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Introduction to Medicinal Chemistry History and development of medicinal chemistry Physicochemical properties in relation to biological action Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bio isosterism, Optical and Geometrical isomerism. Drug metabolism Drug metabolism principles- Phase-I and Phase-II. Factors affecting drug metabolism including stereo-chemical aspects.	**10**	**Students will be able to learn** physicochemical properties in relation to biological action and the concepts of Drug metabolism in Medicinal chemistry	1,2
II	Drugs acting on Autonomic Nervous System Adrenergic Neurotransmitters: Biosynthesis and catabolism of catecholamine. Adrenergic receptors (Alpha & Beta) and the distribution. Sympathomimetic agents: SAR of Sympathomimetic agents Direct acting- Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline. Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine. Agents with mixed mechanism: Ephedrine, Metaraminol. Adrenergic Antagonists: Alpha adrenergic	**10**	**Students will be able to learn** the drugs acting on ANS i.e., Sympathomimetic agents	1,2

	blockers: Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide. Beta adrenergic blockers: SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol			
III	**Cholinergic neurotransmitters:** Biosynthesis and catabolism of acetylcholine. Cholinergic receptors (Muscarinic & Nicotinic) and their distribution. **Para-sympathomimetic agents:** SAR of Para- sympathomimetic agents Direct acting agents: Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine. Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible): Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorphate, Echothiophate iodide, Parathione, Malathion. **Cholinesterase reactivator:** Pralidoxime chloride. Cholinergic Blocking agents: SAR of cholinolytic agents Solanaceous alkaloids and analogues: Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*. **Synthetic cholinergic blocking agents:** Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.	**10**	**Students will be able to learn** the drugs acting on ANS i.e., Parasympathomimetic agents	1,2
IV	Drugs acting on Central Nervous System: **A. Sedatives and Hypnotics:** Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem Barbiturtes: SAR of barbiturates, Barbital*, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital Miscelleneous: Amides & imides: Glutethmide. Alcohol & their carbamate derivatives: Meprobomate, Ethchlorvynol. Aldehyde & their derivatives:	**8**	**Students will be able to learn** the drugs acting on CNS	1,2

	Triclofos sodium, Paraldehyde. **B. Antipsychotics** Phenothiazeines: SAR of Phenothiazeines – Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride. Ring Analogues of henothiazeines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine. Fluro buterophenones: Haloperidol, Droperidol, Risperidone. Beta amino ketones: Molindone hydrochloride. Benzamides: Sulpieride. **C. Anticonvulsants:** SAR of Anticonvulsants, mechanism of anticonvulsant action Barbiturates: Phenobarbitone, Methabarbital. Hydantoins: Phenytoin*, Mephenytoin, Ethotoin Oxazolidine diones: Trimethadione, Paramethadione Succinimides: Phensuximide, Methsuximide, Ethosuximide* Urea and monoacylureas: Phenacemide, Carbamazepine* Benzodiazepines: Clonazepam Miscellaneous: Primidone, Valproic acid , Gabapentin, Felbamate			
V	Drugs acting on Central Nervous System: General anesthetics: Inhalation anesthetics: Halothane*, Methoxy flurane, Enflurane, Sevoflurane, Isoflurane, Desflurane. Ultra short acting barbitutrates: Methohexital sodium*, Thiamylal sodium, Thiopental sodium. Dissociative anesthetics: Ketamine hydrochloride.* Narcotic and non-narcotic analgesics Morphine and related drugs: SAR of Morphineanalogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate. Narcotic antagonists: Nalorphine hydrochloride, Levallorphantartarate, Naloxone hydrochloride. Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.	**7**	**Students will be able to learn** the SAR of the drugs acting on ANS and CNS	1,2

TEXT BOOKS:

T1: Medicinal Chemistry – I by Dr. Sanjay G. Walode – Nirali Prakash Publication T2: Medicinal Chemistry – I by K.G. Bothara - Nirali Prakash Publication

T3: Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry. T4: Foye's Principles of Medicinal Chemistry.

T5: Burger's Medicinal Chemistry, Vol I to IV. T6: Martindale's extra pharmacopoeia.

T7: The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.

REFERENCE BOOKS:

R1: Remington's Pharmaceutical Sciences.

R2: Introduction to principles of drug design- Smith and Williams. R3: Organic Chemistry by I.L. Finar, Vol. II.

R4: Indian Pharmacopoeia.

R5: Text book of practical organic chemistry- A.I.Vogel.

https://www.carewellpharma.in/bpharmacy/notes/4th-sem/medicinal-chemistry-1

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basic principles of medicinal chemistry	**PO1,PO3,PO8, PO11**
2	Identify the cause of disease or disorder and the mechanism of action for drugs acting on ANS	**PO1,PO2,PO3,PO6, PO8, PO11**
3	Illustrate how the chemistry of pharmaceuticals relates to their pharmacological and pharmacokinetic profiles.	**PO1,PO2,PO3,PO6, PO8, PO11**
4	Recall the structural activity relationship (SAR) between various medication classes and the biological activity of drugs acting on CNS	**PO1,PO2,PO3,PO6, PO8, PO11**
5	Understand the synthesis of various drug products with classification based on chemical structure.	**PO1,PO2,PO3,PO6, PO8, PO11**

SEMESTER – IV									
Course Title	**Physical Pharmaceutics-II**								
Course code	**BP403T**	**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 Pharmacy**								
Semester	**Fall/ IV semester of 2nd year of the programme**								
Course Objectives	1. Understand various physicochemical properties of drug molecules in designing the dosage forms 2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations 3. Demonstrate use of physicochemical properties in developing and evaluating dosage forms.								
CO1	Understand the physicochemical properties of colloidal systems, dispersed system, and their kinetic and electrical properties in pharmaceutical sciences.								
CO2	Develop a basic understanding of the rheology and flow properties of solids and fluids and their application in pharmaceutical sciences.								
CO3	Develop a basic knowledge of pharmaceutical suspensions, emulsions and HLB systems and the role of surfactants and interfacial phenomena in pharmaceutical sciences.								
CO4	Understand the micromeritics and size distributions of various pharmaceutical dosage forms and their applications								
CO5	Understand the chemical kinetics, pharmaceutical applications of various physical and chemical behaviors of dosage forms and their accelerated stability testing procedure, photolytic degradation, prevention, etc.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Colloidal dispersions:** Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general roperties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization & protective action.	**5**	**Students will be able to learn** classification and significance, properties of colloidal dispersion in pharmaceutical science, and the practical implications in drug formulation and development	1,2
II	Rheology: Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers Deformation of solids: Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus	**10**	**Students will be able to learn** Newtonian and non-newtonian flow, viscosity and the underlying principles governing deformation of solids	1,2
III	Coarse dispersion: Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.	**10**	**Students will be able to learn** Optimize the stability and performance of Coarse dispersion and develop innovative suspension, emulsion in the field of pharmaceutical science.	1,2
IV	Micromeretics: Particle size and distribution, mean		**Students will be able to learn**	

	particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.	**10**	assess Micromeritics, determination methods of particle size, and properties of powders and its pharmaceutical application.	1,2
V	Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the Chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration Dating of pharmaceutical dosage forms. Photolytic degradation and its prevention	**10**	**Students will be able to learn** Kinetics of dosage forms, accelerated stability study and in Expiration dating of pharmaceutical dosage forms as well as the photolytic degradation and its prevention.	1,2

TEXT BOOKS:

T1: Text book of Physical Pharmaceutics by C.V.S. Subramanyam, Vallabh Prakashan.

T2: Physical Pharmacy by S.P Agarwal and Rajesh Khana, CBS Publishers and distributors PVT Ltd; 2nd Edition.

REFERENCE BOOKS:

R1: Physical Pharmacy by Alfred Martin

R2: Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2,3. Marcel Dekkar Inc**.**

https://www.carewellpharma.in/bpharmacy/notes/4th-sem/physical-pharmaceutics-2#google_vignette

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the physicochemical properties of colloidal systems, dispersed system, and their kinetic and electrical properties in pharmaceutical sciences.	**PO1 ,PO2,PO3, PO4, PO11**
2	Develop a basic understanding of the rheology and flow properties of solids and fluids and their application in pharmaceutical sciences.	**PO1 ,PO2,PO3, PO4, PO11**
3	Develop a basic knowledge of pharmaceutical suspensions, emulsions and HLB systems and the role of surfactants and interfacial phenomena in pharmaceutical sciences.	**PO1 ,PO2,PO3, PO4, PO11**
4	Understand the micromeritics and size distributions of various pharmaceutical dosage forms and their applications	**PO1 ,PO2,PO3, PO4, PO11**
5	Understand the chemical kinetics, pharmaceutical applications of various physical and chemical behaviors of dosage forms and their accelerated stability testing procedure, photolytic degradation, prevention, etc.	**PO1 ,PO2,PO3, PO4, PO11**

SEMESTER – IV									
Course Title	**Pharmacology-I**								
Course code	**BP404T**	**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 Pharmacy**								
Semester	**Fall/ IV semester of 2nd year of the programme**								
Course Objectives	1. Understand the pharmacological actions of different categories of drugs 2. Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels. 3. Apply basic pharmacological knowledge to prevent and treat various diseases. 4. Observe the effect of drugs on animals by simulated experiments 5. Appreciate correlation of pharmacology with other bio medical sciences								
CO1	Understand and demonstrate the Pharmacology, nature, and source of drugs, the essential drug concept, routes of drug administration, and the Pharmacokinetics of drugs.								
CO2	Analyze and Apply the Principles and mechanisms of drug action and Receptor theories and learn about adverse drug reaction management.								
CO3	Understand about drug action on the autonomous nervous system and its mechanism.								
CO4	Explain the drug's action on the central nervous system and its mechanism.								
CO5	Apply the drug therapy to different disease conditions and understand drug addiction, drug abuse, tolerance, and dependence.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**General Pharmacology** **a. Introduction to Pharmacology-** Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists(competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy,allergy.b. **Pharmacokinetics-** Membrane transport, absorption, distribution, metabolism and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination	**8**	**Students will be able to** learn various drug sources and comprehend the essential drugs concept. Recognize and explain addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, and drug allergies. Understand the processes involved in drug absorption, distribution, metabolism, and excretion	1,2
II	General Pharmacology **a. Pharmacodynamics-** Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.	**12**	**Students will be able to learn** the principles and mechanisms of drug action. Comprehend receptor theories and the classification of receptors. Explore drug-receptor interactions and signal transduction mechanisms. Understand drug interactions at the pharmacokinetic level. .	1,2

	b. Adverse drug reactions. **c. Drug interactions** (pharmacokinetic and pharmacodynamic) **d. Drug discovery and clinical evaluation of new drugs** -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.			
III	2. Pharmacology of drugs acting on peripheral nervous system a. Organization and function of ANS. b. Neurohumoral transmission, co-transmission and classification of neurotransmitters. c. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics. d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). e. Local anesthetic agents. f. Drugs used in myasthenia gravis and glaucoma	**10**	**Students will be able to learn** the organization and fundamental functions of the autonomic nervous system. Comprehend the mechanisms of neurohumoral transmission and co- ransmission. Understand the pharmacology of parasympathomimetics and their effects. Understand the pharmacology of sympatholytics and their clinical applications	1,2
IV	Pharmacology of drugs acting on central nervous system Neurohumoral transmission in the C.N.S. special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. General anesthetics and pre-anesthetics. Sedatives, hypnotics and centrally acting muscle relaxants. Anti-epileptics Alcohols and disulfiram	**8**	**Students will be able to learn** the significance of various neurotransmitters in the CNS, including GABA, glutamate, glycine, serotonin, and dopamine. Comprehend the mechanisms of neurohumoral transmission in the CNS. Learn about the pharmacology, mechanisms of action, and clinical uses of general anesthetics and pre-anesthetics.	1,2
V	Pharmacology of drugs acting on central nervous system a. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens. b. Drugs used in Parkinsons disease and Alzheimer's disease. c. CNS stimulants and nootropics. d. Opioid analgesics and antagonists e. Drug addiction, drug abuse, tolerance and dependence.	**7**	**Students will be able to learn** the pharmacology, mechanisms, and therapeutic uses of CNS stimulants. Comprehend the pharmacological actions and potential cognitive benefits of nootropic agents. Learn about the pharmacology, mechanisms of action, and clinical applications of opioid analgesics.	1,2

TEXT BOOKS:

T1: Goodman and Gilman's, The Pharmacological Basis of Therapeutics, 13th Edition (2017).

REFERENCE BOOKS:

R1: Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology Churchil

Livingstone Elsevier, 9th Edition (2019).
R2: Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw Hill, 12th Edition (2012).
R3: Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins, 9th Edition (2008).
R4: Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology, 8th Edition (2022).
R5: K. D. Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi, 8th Edition (2019).
R6: Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher, 2nd Edition (2012).
R7: Modern Pharmacology with clinical Applications, by Charles R. Craig & Robert, 6th Edition (2003).
R8: Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata, 7th Edition (2019).
R9: Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan (2014). .
https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/health_science_students/Pharmacology.pdf

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand and demonstrate the Pharmacology, nature, and source of drugs, the essential drug concept, routes of drug administration, and the Pharmacokinetics of drugs.	**PO1,PO3,PO6,PO9,PO11**
2	Analyze and Apply the Principles and mechanisms of drug action and Receptor theories and learn about adverse drug reaction management.	**PO1,PO3,PO6,PO9,PO11**
3	Understand about drug action on the autonomous nervous system and its mechanism.	**PO1,PO3,PO6,PO9,PO11**
4	Explain the drug's action on the central nervous system and its mechanism.	**PO1,PO3,PO6,PO9,PO11**
5	Apply the drug therapy to different disease conditions and understand drug addiction, drug abuse, tolerance, and dependence.	**PO1,PO3,PO6,PO9,PO11**

SEMESTER – IV									
Course Title	**PHARMACOGNOSY AND PHYTOCHEMISTRY I**								
Course code	**BP405T**	**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 Pharmacy**								
Semester	**Fall/ IV semester of 2nd year of the programme**								
Course Objectives	1. To know the techniques in the cultivation and production of crude drugs 2. To know the crude drugs, their uses and chemical nature 3. Know the evaluation techniques for the herbal drugs 4. To carry out the microscopic and morphological evaluation of crude drugs								
CO1	Understand the arrangement of crude drugs from natural sources and their standardization techniques.								
CO2	Illustrate the factors for cultivating healthy medicinal plants and explain their collection and commercial conservation.								
CO3	Understand the importance of plant tissue culture and its significance in pharmacognosy.								
CO4	Describe to illustrate the various types of secondary metabolites and their utilization in traditional and modern systems of medicine.								
CO5	Explain different plant fibers, sources of primary metabolites from nature, and therapeutic agents from marine sources.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**Introduction to Pharmacognosy:** (a) Definition, history, scope and development of Pharmacognosy Sources of Drugs – Plants, Animals, Marine & Tissue culture (b) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo-gum -resins). **Classification of drugs:** Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical **Quality control of Drugs of Natural Origin**: Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties Quantitative microscopy of crude drugs including lycopodium spore method, leafconstants, camera lucida and diagrams of microscopic objects to scale with camera lucida.	**10**	**Students will be able to learn** about sources of natural drugs. To understand evaluation techniques for natural drugs	1,2
II	**Cultivation, Collection, Processing and storage of drugs of natural origin:** Cultivation and Collection of drugs of natural origin Factors influencing cultivation of medicinal plants. Plant	**10**	**Students will be able to learn** the factors affecting medicinal plant cultivation, collection, and commercial conservation.	1,2

	hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants			
III	**Plant tissue culture:** Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines	**7**	**Students will be able to learn** Of advance techniques for cultivation.	1,2
IV	**Pharmacognosy in various systems of medicine:** Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine. Introduction to **secondary metabolites:** Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins	**10**	**Students will be able to learn** the utilization of natural drugs in different system of medicine. To know the chemical nature of the natural drugs.	1,2
V	following drugs Plant Products: Fibers - Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens Primary metabolites: General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites: Carbohydrates: Acacia, Agar, Tragacanth, Honey Proteins and Enzymes : Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin). Lipids(Waxes, fats, fixed oils) : Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax Marine Drugs: Novel medicinal agents from marine sources	**8**	**Students will be able to learn** about additive products of natural sources.	1,2

TEXT BOOKS:

T1: Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.

T2: Text Book of Pharmacognosy by T.E. Wallis.

REFERENCE BOOKS:

R1: W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.

R2: Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.

R3: Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.

R4: Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007

R5: Anatomy of Crude Drugs by M.A. Iyengar

R6: Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae

R7: Pharmacognosy for diploma in pharmacy: Mohidul Islam, Dr. Faruk Alam.
https://www.carewellpharma.in/bpharmacy/notes/4th-sem/pharmacognosy-1

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the arrangement of crude drugs from natural sources and their standardization techniques.	**PO1,PO3,PO10,PO11**
2	Illustrate the factors for cultivating healthy medicinal plants and explain their collection and commercial conservation.	**PO1,PO3,PO8,PO7, PO10,PO11**
3	Understand the importance of plant tissue culture and its significance in pharmacognosy.	**PO1,PO4,PO7,PO10,PO11**
4	Describe to illustrate the various types of secondary metabolites and their utilization in traditional and modern systems of medicine.	**PO1**
5	Explain different plant fibers, sources of primary metabolites from nature, and therapeutic agents from marine sources.	**PO1**

SEMESTER IV									
Course Title	**Medicinal Chemistry – I (Practical)**								
Course code	**BP406P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ IV semester of third year of the programme**								
Course Objectives	4. Analyze crude drugs using microscopic and chemical methods. 5. Determine crude drug purity using quantitative microscopic methods.								
CO1	Synthesize the selected drugs or drugs intermediate as per the synthetic scheme.								
CO2	Prepare standard solutions as per the volumetric monograph.								
CO3	Carry out the assay procedure to check the purity of the selected drugs.								
CO4	Determine the partition coefficient of any selected drugs.								
CO5	Determine the physicochemical properties of drugs and draw their importance.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Preparation of drugs/ intermediates** 1,3-pyrazole 1,3-oxazole Benzimidazole Benztriazole 2,3-diphenyl quinoxaline Benzocaine Phenytoin Phenothiazine Barbiturate **Assay of drugs** Chlorpromazine Phenobarbitone Atropine Ibuprofen Aspirin Furosemide **Determination of Partition coefficient for any two drugs**	**4**	**Students will be able to learn** Stereo-chemical features including conformation and stereoelectronic effects of organic molecules. The students should be able TO gain knowledge about Geometrical Isomerism.	1,2

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Synthesize the selected drugs or drugs intermediate as per the synthetic scheme.	**PO1,PO2,PO3,PO5,PO7,PO8, PO11**
2	Prepare standard solutions as per the volumetric monograph.	**PO1,PO2,PO3,PO5,PO7,PO8, PO11**
3	Carry out the assay procedure to check the purity of the selected drugs.	**PO1,PO2,PO3,PO5,PO7,PO8, PO11**
4	Determine the partition coefficient of any selected drugs.	**PO1,PO2,PO3,PO5,PO7,PO8, PO11**
5	Determine the physicochemical properties of drugs and draw their importance.	**PO1,PO2,PO3,PO5,PO7,PO8, PO11**

SEMESTER IV									
Course Title	**Physical Pharmaceutics- II (Practical)**								
Course code	**BP407P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ III semester of third year of the programme**								
Course Objectives	1. Measure reaction rate constants and half-lives of various order reactions. 2. Demonstrate powder/granules flow properties. 3. Assess fluid viscosity								
CO1	Understand various particle size analysis methods for formulation, development of a pharmaceutical dosage form								
CO2	Understand different physicochemical characteristics of drugs and excipients for designing pharmaceutical dosage form								
CO3	Elaborate on the mechanism and application of various types of viscometers.								
CO4	Describe the physical stability, settling tendencies, and efficacy of various suspension agents								
CO5	Illustrate the fundamentals of chemical kinetics and apply them to determine the expiration date of a formulation								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. Determination of particle size, particle size distribution using sieving method 2. Determination of particle size, particle size distribution using Microscopic method 3. Determination of bulk density, true density, and porosity 4. Determine the angle of repose and influence of lubricant on angle of repose 5. Determination of viscosity of liquid using Ostwald's viscometer 6. Determination of sedimentation volume with effect of different suspending agents 7. Determination of sedimentation volume with effect of different concentrations of a single suspending agent 8. Determination of viscosity of semisolid by using Brookfield viscometer 9. Determination of reaction rate constant for first order 10. Determination of reaction rate constant for second order 11. Accelerated stability studies	**4**	**Students will be able to learn** Determination of particle size, particle size distribution using sieving method Determination of particle size, particle size distribution using Microscopic method Determination of bulk density, true density, and porosity Determine the angle of repose and influence of lubricant on angle of repose Determination of viscosity of liquid using Ostwald's viscometer Determination of sedimentation volume with effect of different suspending agents Determination of sedimentation volume with effect of different concentrations of a single suspending agent Determination of viscosity of semisolid by using Brookfield viscometer Determination of reaction rate constant for first order Determination of reaction rate constant for second order Accelerated stability studies	1,2

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand various particle size analysis methods for formulation, development of a pharmaceutical dosage form	**PO1,PO2,PO3,PO4,PO,PO11**
2	Understand different physicochemical characteristics of drugs and excipients for designing pharmaceutical dosage form	**PO1,PO2,PO3,PO4,PO,PO11**
3	Elaborate on the mechanism and application of various types of viscometers.	**PO1,PO2,PO3,PO4,PO,PO11**
4	Describe the physical stability, settling tendencies, and efficacy of various suspension agents	**PO1,PO2,PO3,PO4,PO,PO11**
5	Illustrate the fundamentals of chemical kinetics and apply them to determine the expiration date of a formulation	**PO1,PO2,PO3,PO4,PO,PO11**

SEMESTER IV									
Course Title	**PHARMACOLOGY-I (Practical)**								
Course code	**BP408P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ III semester of third year of the programme**								
Course Objectives	1. Maintenance of laboratory animals as per CPCSEA guidelines 2. Study the effects of drugs using software.								
CO1	Summarize the Pre-clinical Pharmacology and routes of drug administration and collection of body fluids in experimental animals.								
CO2	Summarize the CPCSEA guidelines and study of commonly used instruments in experimental pharmacology.								
CO3	Identify the effect of drugs on animals by simulated experiments								
CO4	Illustrate the mechanisms of drug action and its biological effects.								
CO5	Develop the process of new drug discovery and development of a drug.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. Introduction to experimental pharmacology 2. Commonly used instruments in experimental pharmacology 3. Study of common laboratory animals 4. Maintenance of laboratory animals as per CPCSEA guidelines 5. Common laboratory techniques: blood withdrawal, serum and plasma separation, anesthetics, and euthanasia used for animal studies 6. Study of different routes of drug administration in mice/rats 7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice 8. Effect of drugs on ciliary motility of frog esophagus 9. Effect of drugs on rabbit eye 10. Effects of skeletal muscle relaxants using rota-rod apparatus 11. Effect of drugs on locomotor activity using actophotometer 12. Anticonvulsant effect of drugs by MES and PTZ method 13. Study of stereotype and anti-catatonic activity of drugs on rats/mice 14. Study of anxiolytic activity of drugs using rats/mice 15. Study of local anesthetics by different methods Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by software and videos.	**4**	**Students will be able to learn** Introduction to experimental Pharmacology Commonly used instruments in experimental pharmacology Study of common laboratory animals Maintenance of laboratory animals as per CPCSEA guidelines Common laboratory techniques: blood withdrawal, serum and plasma separation, anesthetics, and euthanasia used for animal studies Study of different routes of drug administration in mice/rats Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice	3,4, 5,6

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Summarize the Pre-clinical Pharmacology and routes of drug administration and collection of body fluids in experimental animals.	**PO1, PO2, PO6, PO7, PO8, PO11**
2	Summarize the CPCSEA guidelines and study of commonly used instruments in experimental pharmacology.	**PO1, PO2, PO6, PO7, PO8, PO10, PO11**
3	Identify the effect of drugs on animals by simulated experiments	**PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO11**
4	Illustrate the mechanisms of drug action and its biological effects.	**PO1,PO2, PO6, PO7, PO8, PO11**
5	Develop the process of new drug discovery and development of a drug.	**PO1, PO2, PO6, PO7, PO8, PO11**

SEMESTER IV									
Course Title	**PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)**								
Course code	**BP409P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ III semester of third year of the programme**								
Course Objectives	1. Evaluate crude drugs using microscopic and morphological methods. 2. Choose extraction techniques for isolating phytoconstituents. 3. Identify unorganized drugs through qualitative chemical tests.								
CO1	Understand the identification of crude drugs utilizing chemical evaluation methods.								
CO2	Utilize physical evaluation methods to assess the quality and purity of crude drugs.								
CO3	Describe to explicate linear measurements for crude drug identification.								
CO4	Understand the illustration of quality control methods for the standardization of herbal drugs.								
CO5	Define to exhibit the significance of the physiochemical evaluation of crude drugs.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. Analysis of crude drugs by chemical tests: Tragacanth, Acacia, Agar, Gelatin, Starch, Honey, Castor oil 2. Determination of stomatal number and index 3. Determination of vein-islet number, vein-islet termination, and palisade ratio 4. Determination of size of starch grains, calcium oxalate crystals by eyepiece micrometer 5. Determination of fiber length and width 6. Determination of number of starch grains by Lycopodium spore method 7. Determination of ash value 8. Determination of extractive values of crude drugs 9. Determination of moisture content of crude drugs 10. Determination of swelling index and foaming	**4**	**Students will be able to learn** Analysis of crude drugs by chemical tests: Tragacanth, Acacia, Agar, Gelatin, Starch, Honey, Castor oil Determination of stomatal number and index Determination of vein-isle number, vein-islet termination, and palisade ratio Determination of size of starch grains, calcium oxalate crystals by eyepiece micrometer Determination of fiber length and width Determination of number of starch grains by Lycopodium spore method Determination of ash value Determination of extractive values of crude drugs Determination of moisture content of crude drugs Determination of swelling index and foaming	3,4, 5

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the identification of crude drugs utilizing chemical evaluation methods.	**PO1,PO2,PO3,PO5,PO8,PO11**
2	Utilize physical evaluation methods to assess the quality and purity of crude drugs.	**PO1,PO2,PO3,PO5,PO8,PO11**
3	Describe to explicate linear measurements for crude drug identification.	**PO1,PO2,PO3,PO5,PO8,PO11**
4	Understand the illustration of quality control methods for the standardization of herbal drugs.	**PO1,PO2,PO3,PO5,PO8,PO11**
5	Define to exhibit the significance of the physiochemical evaluation of crude drugs.	**PO1,PO2,PO3,PO4, PO5,PO8,PO11**

SEMESTER – V									
Course Title	**Medicinal Chemistry – II (Theory)**								
Course code	**BP501T**	**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 Pharmacy**								
Semester	**Fall/ V semester of third year of the programme**								
Course Objectives	Upon completion of the course the student shall be able to 1. Understand the chemistry of drugs concerning their pharmacological activity 2. Understand the drug metabolic pathways, adverse effects, and therapeutic value of drugs 3. Know the Structural Activity Relationship of different classes of drugs 4. Study the chemical synthesis of selected drugs								
CO1	Understand the classification, nomenclature, and structure-activity relationship concerning their mechanism of action of various antihistamines, proton pump inhibitors, and anti- neoplastic agents.								
CO2	Recall the chemical aspects, synthesis, mode of action, and medicinal benefits of cardiovascular agents, including diuretics, anti-aging, calcium channel blockers, and other anti-hypertensives.								
CO3	Explain the synthetic methods, primary structural requirements, pharmacophoric features, and structural activity relationships for various classes of medicinal agents used as anti- arrhythmics, anti-hyperlipidemics, coagulants, and drugs used in congestive heart failure.								
CO4	Describe hormones' role, structure, and biological and therapeutic significance.								
CO5	Utilize the structural aspects and synthesis of agents for treating diabetes and local anesthesia drugs.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Antihistaminic agents:** Histamine, receptors and their distribution in the Human body **H_1–antagonists:** Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylaminescuccinate, Clemastinefumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidaminetartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium **H_2-antagonists:** Cimetidine*, Famotidine, Ranitidin. **Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole	**10**	Student will be able to learn classification, uses & mechanism of action of antihistaminic agents To understand the chemical synthesis of selected drug and understand the Structural Activity Relationship of different class of drugs.	2,3

	Anti-neoplastic agents: **Alkylating agents:** Meclorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa **Antimetabolites:** Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine **Antibiotics:** Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin **Plant products:** Etoposide, Vinblastinsulphate, Vincristinsulphat **Miscellaneous:** Cisplatin, Mitotane.			
II	**Anti-anginal**: **Vasodilators:** Amyl nitrite, Nitroglycerin*, Pentaerythritoltetranitrate, Isosorbidedinitrite*, Dipyridamole. **Calcium channel blockers:** Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine. **Diuretics:** Carbonic anhydrase inhibitors: Acetazolamide, Methazolamide, Dichlorphenamide. Thiazides: Chlorthiazide, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide, Loop diuretics: Furosemide, Bumetanide, Ethacrynic acid.Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride. Osmotic Diuretics: Mannitol **Anti-hypertensive Agents**: Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride, Clonidine hydrochloride, Guanethidinemonosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride	**10**	Student will be able to learn the classification, uses & mechanism of action of antianginal agents. To understand the chemical synthesis of selected drugs and understand The Structural Activity Relationship of different class of drugs	2,3
III	**Anti-arrhythmic Drugs**: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol. **Anti-hyperlipidemicagents**: Clofibrate, Lovastatin, Cholesteramine and Cholestipol **Coagulant & Anticoagulants** Menadione, Acetomenadione, Warfarin, Anisindione,	**10**	Student will be able to learn the classification, uses & mechanism of action of Anti-Arrhythmic Drugs, Anti-Hyperlipidemic Agents, Coagulant and Anticoagulants & Drugs used in Congestive Heart Failure agents To understand the chemical synthesis of selected drugs. and to understand the Structural Activity Relationship of different class of	2,3, 4

	clopidogrel **Drugs used in Congestive Heart Failure:** Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.		drugs.	
IV	**Drugs acting on Endocrine system** Nomenclature, Stereochemistry and metabolism of steroids **Sex hormones**: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol. **Drugs for erectile dysfunction:** Sildenafil, Tadalafil. **Oral contraceptives:** Mifepristone, Norgestril, Levonorgestrol **Corticosteroids:** Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone **Thyroid and antithyroid drugs**: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.	**8**	Student will be able to learn the classification, uses & mechanism of action of Drugs acting on Endocrine System, Drugs for Erectile Dysfunction, Oral Contraceptives, Corticosteroids & Thyroid and Anti Thyroid Drugs To understand the chemical synthesis of selected drugs and understand the Structural Activity Relationship of different class of drugs.	2,3, 4
V	**Antidiabetic agents:** Insulin and its preparations Sulfonylureas: Tolbutamide Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide. Glucosidase inhibitors: Acrabose, Voglibose. **Local Anesthetics:** SAR of Local anesthetics **Benzoic Acid derivatives**; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine. **Amino Benzoic acid derivatives**: Benzocaine, Butamben, Procaine, Butacaine, Propoxycaine, Tetracaine, Benoxinate. **Lidocaine/Anilide derivatives**: Lignocaine, Mepivacaine, Prilocaine, Etidocaine. **Miscellaneous**: Phenacaine, Diperodon, Dibucaine.	**7**	Student will be able to learn the classification, uses & mechanism of action of Antidiabetic Agents & Local Anaesthetics To understand the chemical synthesis of selected drugs and understand the Structural Activity Relationship of different class of drugs.	2,3, 4

TEXT BOOKS:

T1: Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry. T2: Foye's Principles of Medicinal Chemistry.

REFERENCE BOOKS:

R1: Burger's Medicinal Chemistry, Vol I to IV.

R2: Introduction to principles of drug design- Smith and Williams.

R3: The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1to 5**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the classification, nomenclature, and structure-activity relationship concerning their mechanism of action of various antihistamines, proton pump inhibitors, and anti-neoplastic agents.	**PO1,PO2,PO3,PO6,PO8,PO11**
2	Recall the chemical aspects, synthesis, mode of action, and medicinal benefits of cardiovascular agents, including diuretics, anti-aging,calcium channel blockers, and other anti-hypertensives.	**PO1,PO2,PO3,PO6,PO8,PO11**
3	Explain the synthetic methods, primary structural requirements, pharmacophoric features, and structural activity relationships for various classes of medicinal agents used as anti- arrhythmics, anti-hyperlipidemics, coagulants, and drugs used in congestive heart failure.	**PO1,PO2,PO3,PO6,PO8,PO11**
4	Describe hormones' role, structure, and biological and therapeutic significance.	**PO1,PO2,PO3,PO6,PO8,PO11**
5	Utilize the structural aspects and synthesis of agents for treating diabetes and local anesthesia drugs.	**PO1,PO2,PO3,PO6,PO8,PO11**

SEMESTER – V									
Course Title	**Industrial Pharmacy I (Theory)**								
Course code	**BP502T**	**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 Pharmacy**								
Semester	**Fall/ V semester of third year of the programme**								
Course Objectives	Upon completion of the course the student shall be able to 1. Know the various pharmaceutical dosage forms and their manufacturing techniques. 2. Know various considerations in the development of pharmaceutical dosage forms 3. Formulate solid, liquid, and semisolid dosage forms and evaluate them for their quality								
CO1	Understand the various pharmaceutical dosage forms and their manufacturing techniques.								
CO2	Describe various considerations in the development of pharmaceutical dosage forms.								
CO3	Evaluate the quality of pharmaceutical dosage form								
CO4	Apply the basics of formulations of Cosmetics and Pharmaceutical Aerosols.								
CO5	Categorize legal and official requirements for Packaging Materials Science and quality control tests.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Preformulation Studies:** Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances. ***a. Physical properties:*** Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism ***b. Chemical Properties:*** Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs & its significant Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.	**7**	Students will be able to learn the need of preformulation study.	1,2
II	**Tablets:** a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling. b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and	**10**	Students will be able to learn formulation and characterization of tablets and oral liquids.	1,2

	defects in coating. c. Quality control tests: In process and finished product tests **Liquid orals:** Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia			
III	**Capsules:** ***a.*** **Hard gelatin capsules:** Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules. ***b.*** **Soft gelatin capsules:** Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications. **Pellets:** Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets	**8**	Students will be able to learn formulation and characterization of capsules and pellets.	1,2
IV	**Parenteral Products:** a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity b. Production procedure, production facilities and controls, aseptic processing c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products. d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products. **Ophthalmic Preparations:** Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations	**10**	Students will be able to learn formulation and characterization of parenteral and ophthalmic preparations.	1,2

V	**Cosmetics:** Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens. **Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies. **Packaging Materials Science:** Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.	**10**	Students will be able to learn formulation and characterization of cosmetic preparation and aerosols.s	1,2, 3,4

TEXT BOOKS:

T1: Theory and Practice of Industrial Pharmacy by Liberman & Lachman.

REFERENCE BOOKS:

R1: Pharmaceutical dosage forms-Tablets, volume1-3byH.A. Liberman, Leon Lachman & J.B.Schwartz.
R2: Pharmaceutical dosage form-Parenteral medication vol-1 & 2 by Liberman & Lachman. R3**:**
Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman.
R4**:** Modern Pharmaceutics by Gilbert S.Banker& C.T.Rhodes,3rd Edition.
R5**:** Remington: The Science and Practice of Pharmacy,20th edition Pharmaceutical Science (RPS)**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the various pharmaceutical dosage forms and their manufacturing techniques.	**PO1,PO2,PO6,PO10,PO11**
2	Describe various considerations in the development of pharmaceutical dosage forms.	**PO1,PO2,PO3,PO6,PO10,PO 11**
3	Evaluate the quality of pharmaceutical dosage form	**PO1,PO2,PO3,PO6,PO11**
4	Apply the basics of formulations of Cosmetics and Pharmaceutical Aerosols.	**PO1,PO2,PO6,PO10,PO11**
5	Categorize legal and official requirements for Packaging Materials Science and quality control tests.	**PO1,PO2,PO3,PO6,PO10,PO 11**

SEMESTER – V									
Course Title	**Pharmacology-II (Theory)**								
Course code	**BP503T**	**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 Pharmacy**								
Semester	**Fall/ V semester of third year of the programme**								
Course Objectives	Upon completion of this course the student should be able to 1. Understand the mechanism of drug action and its relevance in the treatment of different diseases 2. Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments 3. Demonstrate the various receptor actions using isolated tissue preparation 4. Appreciate the correlation of pharmacology with related medical sciences								
CO1	Understand the hemodynamic and electrophysiology of the heart and analyze and estimate the mechanism of action of drugs that affect cardiovascular systems.								
CO2	Explain the mechanism of action of different drugs acting on blood and blood-forming organs and the urinary system.								
CO3	Analyze and evaluate the mechanism of action of different autocoids and related drugs.								
CO4	Discuss the basic concepts in endocrine pharmacology and analyze and evaluate the mechanism of action of different drugs acting on the endocrine system.								
CO5	Utilize the principles and applications of bio assay, compare different types of bioassays, and illustrate the mechanism of action of various drugs acting on the female reproductive system.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Pharmacology of drugs acting on cardio vascular system** Introduction to hemodynamic and lectrophysiology of heart. Drugs used in congestive heart failure Anti-hypertensive drugs. Anti-anginal drugs. Anti-arrhythmic drugs. Anti-hyperlipidemic drugs	**10**	Students will be able to learn about drugs used in congestive heart failure, Anti-hypertensive drugs, Anti-anginal drugs, Anti-arrhythmic drugs, Antihyperlipidemic drugs.	1,2
II	**Pharmacology of Drugs Acting on Cardiovascular System:** a. Drugs used in the therapy of shock. b. Hematinics, coagulants, and anticoagulants. c. Fibrinolytics and anti-platelet drugs. d. Plasma volume expanders. **Pharmacology of Drugs Acting on Urinary System: a.** Diuretics. b. Anti-diuretics.	**10**	Students will be able to learn about drug used in the therapy of shock, hematinics, coagulants and anticoagulants, fibrinolytics and antiplatelet drugs, Plasma volume expanders, Diuretics and Anti-diuretics.	1,2
III	**Autocoids and related drugs** a. Introduction to autacoids and classification b. Histamine, 5-HT and their antagonists. c. Prostaglandins, Thromboxanes and Leukotrienes. d. Angiotensin, Bradykinin and Substance P. e. Non-steroidal anti-inflammatory agents f. Anti-gout drugs Antirheumatic drugs	**10**	Students will be able to learn about autacoids and classification, Histamine, 5-HT and their antagonists, Prostaglandins, Thromboxanes and Leukotrienes, Angiotensin, Bradykinin and Substance P, Non-steroidal anti-inflammatory agents, Anti-gout	1,2

			drugs, Antirheumatic drugs	
IV	**Pharmacology of drugs acting on endocrine system** a. Basic concepts in endocrine pharmacology. b. Anterior Pituitary hormones- analogues and their inhibitors. c. Thyroid hormones- analogues and their inhibitors. d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D. e. Insulin, Oral Hypoglycemic agents and glucagon. f. ACTH and corticosteroids.	**8**	Students will be able to learn about basic concepts in endocrine pharmacology, Anterior Pituitary hormones- analogues and their inhibitors, Thyroid hormones- analogues and their inhibitors, Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D, Insulin, Oral Hypoglycemic agents and glucagon, ACTH and corticosteroids.	1,2
V	**Pharmacology of drugs acting on endocrine system** a. Androgens and Anabolic steroids. b. Estrogens, progesterone and oral contraceptives. c. Drugs acting on the uterus. **Bioassay** a. Principles and applications of bioassay. b. Types of bioassay c. Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT	**7**	Students will be able to learn about androgens and Anabolic steroids, Estrogens, progesterone and oral contraceptives, Drugs acting on the uterus	1,2

TEXT BOOKS:

T1: Goodman and Gilman's, The Pharmacological Basis of Therapeutics, 13th Edition (2017).

REFERENCE BOOKS:

R1: Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology Churchil Livingstone Elsevier, 9th Edition (2019).

R2: Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata McGrawHill, 12th Edition (2012).

R3: Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins, 9th Edition (2008).

R4: Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology, 8th Edition (2022).

R5: K. D. Tripathi.Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi, 8th Edition (2019).

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the hemodynamic and electrophysiology of the heart and analyze and estimate the mechanism of action of drugs that affect cardiovascular systems.	**PO6,PO8,PO9,PO11**
2	Explain the mechanism of action of different drugs acting on blood and blood-forming organs and the urinary system.	**PO6,PO8,PO9,PO11**
3	Analyze and evaluate the mechanism of action of different autocoids and related drugs.	**PO6,PO8,PO9,PO11**
4	Discuss the basic concepts in endocrine pharmacology and analyze and evaluate the mechanism of action of different drugs acting on the endocrine system.	**PO6,PO8,PO9,PO11**
5	Utilize the principles and applications of bioassay, compare different types of bioassays, and illustrate the mechanism of action of various drugs acting on the female reproductive system.	**PO1,PO3,PO6,PO8,PO9,PO1 1**

SEMESTER – V									
Course Title	**Pharmacognosy And Phytochemistry II (Theory)**								
Course code	**BP504T**	**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 Pharmacy**								
Semester	**Fall/ V semester of third year of the programme**								
Course Objectives	Upon completion of the course, the student shall be able 1. To know the modern extraction techniques, characterization, and identification of the herbal drugs and phytoconstituents 2. To understand the preparation and development of herbal formulation. 3. To understand the herbal drug interactions 4. To carryout isolation and identification of phytoconstituents								
CO1	Understand the formation of secondary metabolites by several metabolic pathways in plants.								
CO2	Describe the composition, chemistry, chemical classes, bio sources, therapeutic uses, and commercial applications of medicinal plant secondary metabolites.								
CO3	Explain the method of isolation, identification, and analysis of various chemical constituents from plant sources.								
CO4	Describe the industrial production, estimation, and utilization of essential chemical constituents from the plant.								
CO5	Understand the various extraction techniques and the role of spectroscopy and Chromatographic techniques in the isolation, purification, and identification								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Metabolic pathways in higher plants and their determination** Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway. Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.	**7**	Students will be able to learn about the synthetic pathways	2,3
II	General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites: **Alkaloids:** Vinca, Rauwolfia, Belladonna, Opium, **Phenylpropanoids and Flavonoids:** Lignans, Tea, Ruta **Steroids, Cardiac Glycosides & Triterpenoids**: Liquorice, Dioscorea, Digitalis **Volatile oils**: Mentha, Clove, Cinnamon, Fennel, Coriander, **Tannins:** Catechu, Pterocarpus **Resins:** Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony **Glycosides:** Senna, Aloes, Bitter Almond **Iridoids, Other Terpenoids & Naphthaquinones:**Gentian, Artemisia, taxus,	**14**	Students will be able to learn about the utilization of natural products in treating several diseases. and separation of responsible components from raw material.	2,3

	carotenoids			
III	Isolation, Identification and Analysis of Phytoconstituents a. Terpenoids: Menthol, Citral, Artemisin b. Glycosides: Glycyrhetinic acid &Rutin c. Alkaloids: Atropine, Quinine, Reserpine, Caffeine d. Resins: Podophyllotoxin, Curcumin	**6**	Students will be able to learn about the synthetic processes for production of phytoconstituents.	2,3 ,4, 5
IV	Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine	**10**	Students will be able to learn about modern techniques of isolation of phytoconstituents.	2,3
V	**Basics of Phytochemistry** Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.	**8**	Students will be able to learn about various and extraction isolation technique.	2,3

TEXT BOOKS:

T1: Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, NiraliPrakashan, New Delhi.

T2: Text Book of Pharmacognosy by T.E. Wallis.

REFERENCE BOOKS:

R1: W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.

R2: Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.

R3: Mohammad Ali.Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi. R4: Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007 R5: Anatomy of Crude Drugs by M.A.Iyengar

R6: Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the formation of secondary metabolites by several metabolic pathways in plants.	**PO1,PO4,PO11**
2	Describe the composition, chemistry, chemical classes, bio sources, therapeutic uses, and commercial applications of medicinal plant secondary metabolites.	**PO1,PO4,PO7,PO11**
3	Explain the method of isolation, identification, and analysis of various chemical constituents from plant sources.	**PO1,PO2,PO4, PO7,PO11**
4	Describe the industrial production, estimation, and utilization of essential chemical constituents from the plant.	**PO1,PO4,PO7, PO11**
5	Understand the various extraction techniques and the role of spectroscopy and chromatographic techniques in the isolation, purification, and identification of phytoconstituents.	**PO1,PO4,PO11**

SEMESTER – V									
Course Title	**Pharmaceutical Jurisprudence (Theory)**								
Course code	**BP505T**	**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 Pharmacy**								
Semester	**Fall/ V semester of third year of the programme**								

Course Objectives	Upon completion of the course, the student shall be able to understand: 1. Pharmaceutical legislation and their implications in developing and marketing pharmaceuticals. 2. Various Indian pharmaceutical Acts and Laws 3. The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals 4. The code of ethics during the pharmaceutical practice
CO1	Explain the schedules and functioning of various committees in the Drug and Cosmetic Act, rules, and Indian pharmaceutical Acts.
CO2	Illustrate the regulatory authorities and agencies governing the manufacture and sale of labelling requirements and packaging guidelines for drugs and cosmetics
CO3	Understand about the production, processing, and control of narcotic and psychotropic drugs.
CO4	Describe the salient Features of the Drugs and Magic Remedies Act and its Rules, the Prevention of Cruelty to Animals Act1960 and the National Pharmaceutical Pricing Authority
CO5	Describe the code of ethics for pharmaceutical practice and explain other laws, including international laws, as prescribed by the Pharmacy Council of India from time to time.

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Objectives, Definitions, Legal definitions of schedules to the Act and Rules** Import of drugs – Classes of drugs and cosmetics prohibited from import, Import Under license or permit. Offences and penalties. Manufacture of drugs – Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions Of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.	**10**	Students will be able to learn about legal process involved in Import and manufacturing of drugs.	2,3, 4
II	**Drugs and Cosmetics Act, 1940 and its rules 1945.** Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA) Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties Labeling &Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties. Administration of the Act and Rules – Drugs	**10**	Students will be able to learn about provisions of drugs and cosmetics act.	2,3, 4

	Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors			
III	**Pharmacy Act –1948**: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and Penalties **Medicinal and Toilet Preparation Act – 1955**: Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. Offences and Penalties. **Narcotic Drugs and Psychotropic substances Act-1985 and Rules**: Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties	**10**	Students will be able to learn about provisions of Pharmacy act.	2,3, 4,5
IV	**Study of Salient Features of Drugs and Magic Remedies Act and its rules:** Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties **Prevention of Cruelty to animals Act-1960:** Objectives, Definitions, Institutional Animal Ethics Committee, CPCSEA guidelines for Breeding and Stocking of Animals, Performance of Experiments, Transfer and acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties **National Pharmaceutical Pricing Authority:** Drugs Price Control Order (DPCO)- 2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM)	**8**	Students will be able to learn About provisions of magic remedies act, prevention of animal cruelty act and DPCO 2013.	2,3
V	**Pharmaceutical Legislations –** A brief		Students will be able to learn	

	review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee **Code of Pharmaceutical ethics** Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath **Medical Termination of Pregnancy Act** **Right to Information Act Introduction to Intellectual Property Rights (IPR)**	**7**	about the pharmaceutical ethics.	2,3

TEXT BOOKS:

T1: Forensic Pharmacy by B. Suresh.
T2: Text book of Forensic Pharmacy by B.M. Mithal. T3: Hand book of drug law-by M.L. Mehra.
T4: A text book of Forensic Pharmacy by N.K. Jain.
T5: Drugs and Cosmetics Act/Rules by Govt. of India publications.

REFERENCE BOOKS:

R1: Medicinal and Toilet preparations act 1955 by Govt. of India publications.
R2: Narcotic drugs and psychotropic substances act by Govt. of India publications. R3: Drugs and Magic Remedies act by Govt. of India publication.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the schedules and functioning of various committees in the Drug and Cosmetic Act, rules, and Indian pharmaceutical Acts.	**PO1,PO3,PO4,PO5,PO11**
2	Illustrate the regulatory authorities and agencies governing the manufacture and sale of labelling requirements and packaging guidelines for drugs and cosmetics	**PO1,PO3,PO4,PO7,PO10,PO 11**
3	Understand about the production, processing, and control of narcotic and psychotropic drugs.	**PO1,PO2,PO4,PO5,PO7,PO1 1**
4	Describe the salient Features of the Drugs and Magic Remedies Act and its Rules, the Prevention of Cruelty to Animals Act1960 and the National Pharmaceutical Pricing Authority	**PO1,PO3,PO4,PO5,PO10,PO 11**
5	Describe the code of ethics for pharmaceutical practice and explain other laws, including international laws, as prescribed by the Pharmacy Council of India from time to time.	**PO1,PO3,PO4,PO5,PO11**

SEMESTER – V									
Course Title	**Industrial Pharmacy I (Practical)**								
Course code	**BP506P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ V semester of third year of the programme**								
Course Objectives	1. Demonstrate proficiency in pre-formulation studies. 2. Apply SOPs and GLP while performing experiments and handling equipment. 3. Develop skills in formulating and compounding various dosage forms.								
CO1	Understand the drugs' numerous physicochemical parameters to be discussed before pre-formulation.								
CO2	Demonstrate the manufacturing and evaluation of multiple solid dosage forms such as tablets, capsules, pills, and powder								
CO3	Comprehend and execute the principles related to producing and assessing parenteral pharmaceutical formulations, including injectable and ophthalmic solutions.								
CO4	Gain proficiency in applying knowledge to produce semisolid pharmaceutical formulations like creams and gels.								
CO5	Assemble the numerous techniques and analyze pharmaceutical packaging materials.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
1	1. Preformulation studies on Paracetamol, Aspirin, or any other drug 2. Preparation and evaluation of Paracetamol tablets 3. Preparation and evaluation of Aspirin tablets 4. Coating of tablets - film coating of tablets/granules 5. Preparation and evaluation of Tetracycline capsules 6. Preparation of Calcium Gluconate injection 7. Preparation of Ascorbic Acid injection 8. Quality control test of (as per IP) marketed tablets and capsules 9. Preparation of eye drops and eye ointments 10. Preparation of creams (cold/vanishing cream) 11. Evaluation of glass containers (as per IP)	4	Students will be able to learn about about preformulation study and prepare and evaluate pharmaceutical formulation.	3,4

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the drugs' numerous physicochemical parameters to be discussed before pre-formulation.	**PO1,PO2,PO3,PO4,PO9,PO11**
2	Demonstrate the manufacturing and evaluation of multiple solid dosage forms such as tablets, capsules, pills, and powder	**PO1,PO2,PO3,PO4,PO9,PO11**
3	Comprehend and execute the principles related to producing and assessing parenteral pharmaceutical formulations, including injectable and ophthalmic solutions.	**PO1,PO2,PO3,PO4,PO7,PO9,PO11**
4	Gain proficiency in applying knowledge to produce semisolid pharmaceutical formulations like creams and gels.	**PO1,PO2,PO3,PO4,PO7,PO9,PO11**
5	Assemble the numerous techniques and analyze pharmaceutical packaging materials.	**PO1,PO2,PO3,PO4,PO7,PO8,PO9,PO11**

SEMESTER – V									
Course Title	**Pharmacology-II (Practical)**								
Course code	**BP507P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ V semester of third year of the programme**								
Course Objectives	1. Operate lab equipment according to SOPs for preclinical experimentation. 2. Conduct bioassay experiments in different tissues								
CO1	Explain in-vitro pharmacology, bioassay, and the physiological salt solution used for performing bioassay.								
CO2	Demonstrate bioassay of insulin, oxytocin, vasopressin, ACTH, d- tubocurarine, digitalis, histamine, and 5-HT software-based simulated experiments.								
CO3	Prepare Dose-Response Curves using suitable isolated tissue preparations and observe the effect of agonist and antagonist software-based simulated experiments.								
CO4	Evaluate the efficacy of analgesic and anti-inflammatory drugs in in-vivo animal models using software-based simulated experiments.								
CO5	Correlate pharmacology with related medical sciences and appreciate the newer targets of several disease conditions for treatment.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. Introduction to in-vitro pharmacology and physiological salt solutions. 2. Effect of drugs on isolated frog heart. 3. Effect of drugs on blood pressure and heart rate of dog. 4. Study of diuretic activity of drugs using rats/mice. 5. DRC of acetylcholine using frog rectus abdominis muscle. 6. Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively. 7. Bioassay of histamine using guinea pig ileum by matching method. 8. Bioassay of oxytocin using rat uterine horn by interpolation method. 9. Bioassay of serotonin using rat fundus strip by three-point bioassay. 10. Bioassay of acetylcholine using rat ileum/colon by four-point bioassay. 11. Determination of PA2 value of prazosin using rat anococcygeus muscle (by Schild's plot method). 12. Determination of PD2 value using guinea pig ileum. 13. Effect of spasmogens and spasmolytics using rabbit jejunum. 14. Anti-inflammatory activity of drugs using carrageenan-induced paw-edema model. Analgesic activity of drugs using central and peripheral methods.	4	Students will be able to learn about various procedure to evaluate the pharmacological effect of drugs on laboratory animal in software.	3,4, 5,6

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain in-vitro pharmacology, bioassay, and the physiological salt solution used for performing bioassay.	**PO1,PO2,PO3,PO4,PO5,PO6, PO8,PO9,PO11**
2	Demonstrate bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine, and 5-HT software-based simulated experiments.	**PO1,PO2,PO3,PO4,PO5,PO6, PO8,PO9,PO11**
3	Prepare Dose-Response Curves using suitable isolated tissue preparations and observe the effect of agonist and antagonist software-based simulated experiments.	**PO1,PO2,PO3,PO4,PO5,PO6, PO8,PO9,PO11**
4	Evaluate the efficacy of analgesic and anti-inflammatory drugs in in-vivo animal models using software-based simulated experiments.	**PO1,PO2,PO3,PO4,PO5,PO6, PO8,PO9,PO11**
5	Correlate pharmacology with related medical sciences and appreciate the newer targets of several disease conditions for treatment.	**PO1,PO2,PO3,PO4,PO5,PO6, PO8,PO9,PO11**

SEMESTER – V									
Course Title	**Pharmacognosy And Phytochemistry II (Practical)**								
Course code	**BP508P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ V semester of third year of the programme**								
Course Objectives	1. Identify phytoconstituents in crude drugs. 2. Prepare herbal formulations. 3. Analyze sample purity compared to standard values.								
CO1	Perform the morphological and microscopical evaluation techniques in the identification of crude drugs.								
CO2	Perform the extraction of phytoconstituents from crude drugs.								
CO3	Accomplish the isolation of phytoconstituents from crude drugs.								
CO4	Apply various chromatographic methods to evaluate herbal extracts and phytoconstituents.								
CO5	Demonstrate the extraction of volatile oils and chemical tests for crude drugs								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	1. Morphology, histology, and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel, and Coriander 2. Exercise involving isolation & detection of active principles: a. Caffeine from tea dust b. Diosgenin from Dioscorea c. Atropine from Belladonna d. Sennosides from Senna 3. Separation of sugars by paper chromatography 4. TLC of herbal extract 5. Distillation of volatile oils and detection of phytoconstituents by TLC 6. Analysis of crude drugs by chemical tests: i.Asafoetida ii.Benzoin iii. Colophony iv.Aloes v.Myrrh	4 hours per practical	Students will be able to learn about separation of phytoconstituents and their identification by icroscopic method, isolation methods of phytoconstituents, use of chromatographic techniques.	3,4,5,6

TEXT BOOKS:

T1: Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Perform the morphological and microscopical evaluation techniques in the identification of crude drugs.	**PO1,PO7,PO8,PO11**
2	Perform the extraction of phytoconstituents from crude drugs.	**PO1,PO2,PO3,PO4,PO7,PO8, PO10,PO11**
3	Accomplish the isolation of phytoconstituents from crude drugs.	**PO1,PO2,PO3,PO4,PO7,PO8, PO11**
4	Apply various chromatographic methods to evaluate herbal extracts and phytoconstituents.	**PO1,PO2,PO3,PO4,PO7,PO8, PO11**
5	Demonstrate the extraction of volatile oils and chemical tests for crude drugs	**PO1,PO2,PO3,PO4,PO7,PO8, PO10,PO11**

SEMESTER – VI									
Course Title	**MEDICINAL CHEMISTRY-III**								
Course code	**BP 601T**	**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 Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Understand the importance of drug design and different drug design techniques. 2. Understand the chemistry of drugs concerning their biological activity. 3. Know the metabolism, adverse effects, and therapeutic value of drugs. 4. Know the importance of SAR of drugs.								
CO1	Relate and Illustrate the history and development of Antibiotics with structures, degradation, and classification								
CO2	Summarize and Organize the classification, synthesis, and SAR of Antibiotics, antimalarials, Quinolines and Miscellaneous								
CO3	Organize and Categorize Antitubercular agents, Quinolones, Antiviral agents with synthesis, Mechanism of action and SAR.								
CO4	Distinguish and Prioritize Antifungal, Antiprotozoal, Anthelmintics and Sulfonamides structures including Mechanism of action and SAR								
CO5	Decide and Compile various drug design, physicochemical properties, Docking techniques and Combinatorial synthesis with Applications								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Antibiotics Historical background, Nomenclature, Stereochemistry, Structure Activity relationship, Chemical degradation classification and important products of the following classes. β-Lactam antibiotics: Penicillin, Cepholosporins, β-Lactamase inhibitors, Monobactams Aminoglycosides: Streptomycin, Neomycin, Kanamycin Tetracyclines: Tetracycline,Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline	**10**	To understand about History of Development of Antibiotics. To Understand and Remember the Degradation products with structures. To Remember the classification and understand Mechanism of action. To Classify and synthesize various classes of Antibiotics. To Apply SAR for nucleus of Penicillins, Cephalosporins.	4,5
II	Antibiotics Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. Macrolide: Erythromycin Clarithromycin, Azithromycin. Miscellaneous: Chloramphenicol*, Clindamycin. Prodrugs: Basic concepts and application of prodrugs design. Antimalarials: Etiology of malaria. Quinolines: SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine. Biguanides and dihydro triazines: Cycloguanilpamoate, Proguanil. Miscellaneous: Pyrimethamine,	**10**	To understand about Macrolides, Prodrugs concept. To Understand and Remember the degradation Products of Macrolides with structures. To Remember the classification and understand Mechanism of action. To Classify and synthesize various classes of Chloramphenicol, Chloroquine and Pamaquine, Prodrugs. To Apply SAR for nucleus of Macrolides, Quinolines.	4,5

	Artesunete, Artemether, Atovoquone.			
III	Anti-tubercular Agents Synthetic anti tubercular agents: Isoniozid, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid. Anti tubercular antibiotics: Rifampicin, Rifabutin, Cycloserine, Streptomycine, Capreomycin sulphate. Urinary tract anti-infective agents Quinolones: SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin Miscellaneous: Furazolidine, Nitrofurantoin, Methanamine. Antiviral agents: Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridinetrifluoride, Acyclovir, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.	**10**	To gain knowledge about Anti-tubercular agents. To understand mechanism of action with synthesis and classification of Antitubercular agents. To Understand and Remember, about classification, synthesis mechanism of Quinolones. To Remember the synthesis of Nitrofurantoin. To analyze the classification with structures and synthesis of Antiviral agents.	4,5
IV	Antifungal agents: Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin. Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconozole, Miconazole, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate. Anti-protozoal Agents: Metronidazole, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, PentamidineIsethionate, Atovaquone, Eflornithine. Anthelmintics: Diethylcarbamazine citrate, Thiabendazole, Mebendazole, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin. Sulphonamides and Sulfones Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide, Sulphapyridine, Sulfamethoxaole, Sulphadiazine, Mefenide acetate, Sulfasalazine. Folatereductase inhibitors: Trimethoprim, Cotrimoxazole. Sulfones: Dapsone.	**8**	To gain knowledge about Antifungal agents. To understand Mechanism of action with synthesis and classification. To Understand and Remember, about classification, synthesis mechanism of Anthelmintics. To analyze SAR of Suphonamides with synthesis and structures and classification. To Remember the synthesis of Trimethoprim and Dapsone	4,5
V	Introduction to Drug Design Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition co efficient, ammet's		To Understand and Remember, About Various approaches for drug design. To analyze and evaluate the physicochemical parameters like Hansch analysis	

	electronic parameter, Tafts steric Parameter and Hansch analysis. Pharmacophore modeling and docking techniques. Combinatorial Chemistry: Concept and applications chemistry: solid phase and solution phase synthesis. of Combinatorial	**7**	and concepts of combinatorial chemistry. To develop and create different agents by combinatorial chemistry and Docking of drugs on to various proteins..	4,5

TEXT BOOKS:

T1: A text book of Medicinal chemistry – Vol 1and Vol 2 Surendra Nath Pandey Latest Edition. T2: A text book of Medicinal Chemistry – Vol 1 and Vol 2 Kadam Mahadik Latest Edition.

REFERENCE BOOKS:

R1: Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry. R2: Foye's Principles of Medicinal Chemistry.

R3: Introduction to principles of drug design- Smith and Williams. R4: Organic Chemistry by I.L. Finar, Vol. II.

R5: The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Relate and Illustrate the history and development of Antibiotics with structures, degradation, and classification	**PO1,PO4,PO8,PO9,PO10,PO11**
2	Summarize and Organize the classification, synthesis, and SAR of Antibiotics, antimalarials, Quinolines and Miscellaneous	**PO1,PO2,PO3,PO4,PO8,PO9,PO10 ,PO11**
3	Organize and Categorize Antitubercular agents, Quinolones, Antiviral agents with synthesis, Mechanism of action and SAR.	**PO1,PO2,PO3,PO4,PO8,PO9,PO10 ,PO11**
4	Distinguish andPrioritize Antifungal, Antiprotozoal, Anthelmintics and Sulfonamides structures including Mechanism of action and SAR	**PO1,PO2,PO3,PO4,PO8,PO9,PO10 ,PO11**
5	Decide and Compile various drug design, physicochemical properties, Docking techniques and Combinatorial synthesis with Applications	**PO1,PO2,PO3,PO4,PO8,PO9,PO10 ,PO11**

SEMESTER – VI									
Course Title	**PHARMACOLOGY-III**								
Course code	**BP 602T**	**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 Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases 2. Comprehend the principles of toxicology and treatment of various poisonings 3. Appreciate the correlation of pharmacology with related medical sciences.								
CO1	Compare and contrast the specific pharmacology of the major classes of drugs, essential distinctions among members of each class, the risks, and benefits, etc.								
CO2	Elaborate the pharmacological and toxicological effects of drugs for infectious and non-infectious diseases.								
CO3	Evaluate the principles and several types of Toxicity.								
CO4	Correlate of pharmacology with other biomedical sciences.								
CO5	Describe the path physiology, symptoms, and treatment options of various disease conditions.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Pharmacology of drugs acting on Respiratory system a. Anti -asthmatic drugs b. Drugs used in the management of COPD c. Expectorants and antitussives d. Nasal decongestants e. Respiratory stimulants . Pharmacology of drugs acting on the Gastrointestinal Tract a. Antiulcer agents. b. Drugs for constipation and diarrhoea. c. Appetite stimulants and suppressants. d. Digestants and carminatives. e. Emetics and anti-emetics.	**10**	To understand the drug mechanism of respiratory system and gastrointestinal tract	4,5
II	3. Chemotherapy a. General principles of chemotherapy. b. Sulfonamides and cotrimoxazole. c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and Aminoglycosides	**10**	To gain knowledge about the pharmacology of Chemotherapy	4,5
III	Chemotherapy a. Antitubercular agents b. Antileprotic agents c. Antifungal agents d. Antiviral drugs e.Anthelmintics f. Antimalarial drugs g. Antiamoebic agents	**10**	To get the knowledge about Chemotherapeutic agent	4,5
IV	Chemotherapy		To know about the chemotherapy	

	Urinary tract infections and sexually transmitted diseases. Chemotherapy of malignancy. 4. Immunopharmacology a. Immunostimulants b. Immunosuppressant Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars	**8**	for UTI, sexually transmitted diseases, malignancy and also know about the Immunopharmacology	4,5
V	Principles of toxicology a. Definition and basic knowledge of acute, subacute and chronic toxicity. b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity c. General principles of treatment of poisoning d. Clinical symptoms and management of barbiturates, morphine, and organophosphorus compound and lead, mercury and arsenic poisoning. e. Chronopharmacology f. Definition of rhythm and cycles. g. Biological clock and their significance leading to chronotherapy.	**7**	To gather the knowledge about The toxicology and Chronopharmacology	4,5

TEXT BOOKS:

T1: K. D. Tripathi.Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.

T2: Rang & Dale's Pharmacology, Elsevier.

T3: Lippincott Illustrated Reviews: Pharmacology.

T4: Goodman and Gilman's, The Pharmacological Basis of Therapeutics.

REFERENCE BOOKS:

R1: PHARMACOLOGY – III, by Dr. SACHIN V. TEMBHURNE.

R2: Pharmacology-III, by Dr.Shaik Harun Rasheed, SIA Publishers & Distributors Pvt Ltd.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Compare and contrast the specific pharmacology of the major classes of drugs, essential distinctions among members of each class, the risks, and benefits, etc.	**PO1,PO3,PO6,PO7,PO8,PO9, PO11**
2	Elaborate the pharmacological and toxicological effects of drugs for infectious and non-infectious diseases.	**PO1,PO3,PO6,PO7,PO8,PO9, PO11**
3	Evaluate the principles and several types of Toxicity.	**PO1,PO6,PO7,PO8,PO9,PO1 1**
4	Correlate of pharmacology with other biomedical sciences.	**PO1,PO3,PO6,PO7,PO8,PO9, PO11**
5	Describe the path physiology, symptoms, and treatment options of various disease conditions.	**PO1,PO3,PO6,PO7,PO8,PO9, PO11**

SEMESTER – VI									
Course Title	**HERBAL DRUG TECHNOLOGY**								
Course code	**BP 603T**	**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 Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Understand raw material as a source of herbal drugs from cultivation to herbal drug product. 2. Know the WHO and ICH guidelines for the evaluation of herbal drugs. 3. Know the herbal cosmetics, natural sweeteners, nutraceuticals. 4. Appreciate patenting of herbal drugs, GMP.								
CO1	Describe the definition of herbs, herbal medicine, herbal medicinal products, and herbal drug preparation.								
CO2	Apply their knowledge of nutraceuticals to identify and analyze the health benefits and potential applications of specific herbs in managing ailments like diabetes, ardiovascular diseases, and gastrointestinal disorders.								
CO3	Analyze the raw materials of herbal origin used in herbal cosmetics, including their properties, functions, and applications in skincare, hair care, and oral hygiene products.								
CO4	Integrate their understanding of WHO and ICH guidelines to develop and implement stability testing protocols for herbal drugs.								
CO5	Illustrate the significance of Good Manufacturing Practices (GMP) in producing herbal drugs.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Herbs as raw materials Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs Selection, identification and authentication of herbal materials Processing of herbal raw material Biodynamic Agriculture Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides. Indian Systems of Medicine a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika, Churna, Lehya and Bhasma	**11**	Herb, Herbal Formulation, Modern cultivation, Holistic drugs	4,5
II	Nutraceuticals General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng,	**7**	Various nutraceuticals and Herb-Drug interactions	4,5

	Ashwagandha, Spirulina Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.			
III	Herbal Cosmetics Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products. Herbal excipients: Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors& perfumes. Herbal formulations : Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes	**10**	Materials and methods involved in manufacturing of Herbal cosmetics, Herbal excipients-importance and use, Preparations of Herbal formulations	4,5
IV	Evaluation of Drugs WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs. Patenting and Regulatory requirements of natural products: a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem. Regulatory Issues - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.	**10**	Who and ICH guidelines, IPR in herbal drug, Regulations in manufacturing herbal drug.	4,5
V	General Introduction to Herbal Industry Herbal drugs industry: Present scope and future prospects. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India. Schedule T – Good Manufacturing Practice of Indian systems of medicine Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and	**7**	Overview of Herbal Industry, introduction of objectives and components of Schedule T.	4,5

TEXT BOOKS:

T1: Textbook of Pharmacognosy by Trease& Evans.

T2: Textbook of Pharmacognosy by Tyler, Brady & Robber. T3: Pharmacognosy by Kokate, Purohit and

Gokhale.
T4: Essential of Pharmacognosy by Dr. S .H.Ansari.

REFERENCE BOOKS:

R1: Pharmacognosy & Phytochemistry by V.D.Rangari.
R2: Pharmacopoeial standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy).
R3:Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Describe the definition of herbs, herbal medicine, herbal medicinal products, and herbal drug preparation.	**PO1,PO11**
2	Apply their knowledge of nutraceuticals to identify and analyze the health benefits and potential applications of specific herbs in managing ailments like diabetes, cardiovascular diseases, and gastrointestinal disorders.	**PO1,PO10,PO11**
3	Analyze the raw materials of herbal origin used in herbal cosmetics, including their properties, functions, and applications in skincare, hair care, and oral hygiene products.	**PO1,PO3,PO7,PO9,PO10,PO 11**
4	Integrate their understanding of WHO and ICH guidelines to develop and implement stability testing protocols for herbal drugs.	**PO1,PO7,PO8,PO9,PO11**
5	Illustrate the significance of Good Manufacturing Practices (GMP) in producing herbal drugs.	**PO1,PO7,PO8,PO9,PO10,PO 11**

SEMESTER – VI									
Course Title	**BIOPHARMACEUTICS AND PHARMACOKINETICS**								
Course code	**BP 604T**	**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 Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance. 2. Use plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, and elimination. 3. To understand the concepts of bioavailability and bioequivalence of drug products and their significance. 4. Understand various pharmacokinetic parameters, their significance &applications								
CO1	Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.								
CO2	Use plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, and elimination.								
CO3	Apply the concepts of bioavailability and bioequivalence of drug products and their significance.								
CO4	Analyze various pharmacokinetic parameters, their significance & applications								
CO5	Illustrate the concepts of Non-linearity.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Absorption; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes, Distribution Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding	**10**	Students will be able to learn about absorption of drugs in human body	4,5
II	Elimination: Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs Bioavailability and Bioequivalence: Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, in-vitro drug dissolution models, in-vitro-in-vivo correlations, bioequivalence studies, methods to enhance the dissolution rates and	**10**	Students will be able to learn about elimination of drugs in human body	4,5

	bioavailability of poorly soluble drugs.			
III	Pharmacokinetics: Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - KE ,t1/2,Vd,AUC,Ka, Clt and CLR-definitions methods of eliminations, understanding of their significance and application	**10**	Students will be able to learn about pharmacokinetics parameters	4,5
IV	Multicompartment models: Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and mainetnance doses and their significance in clinical settings.	**8**	Students will be able to learn about compartment model	4,5
V	Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs	**7**	Students will be able to learn about nonlinear pharmacokinetics	4,5

TEXT BOOKS:

T1: Bio pharmaceutics and Pharmacokinetics-A Treatise, By M. Brahmankar and Sunil B.Jaiswal,Vallabh Prakashan Pitampura, Delhi

T2: Text Book of Biopharmaceutics and Pharmacokinetics; By Robert F Notari

REFERENCE BOOKS:

R1: Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition, Prentice-Hall International USA

R2: Text book of Biopharmaceutics and Clinical Pharmacokinetics by, Milo R3: Pharmacokinetics: By Milo Glbaldi Donald, R. Mercel Dekker

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.	**PO1,PO2,PO4,PO6,PO9,PO10,PO11**
2	Use plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, and elimination.	**PO1,PO2,PO9,PO10,PO11**
3	Apply the concepts of bioavailability and bioequivalence of drug products and their significance.	**PO1,PO2,PO9,PO10,PO11**
4	Analyze various pharmacokinetic parameters, their significance & applications	**PO1,PO2,PO4,PO6,PO9,PO10,PO11**
5	Illustrate the concepts of Non-linearity.	**PO1,PO2,PO4,PO6,PO9,PO10,PO11**

SEMESTER – VI									
Course Title	**PHARMACEUTICAL BIOTECHNOLOGY**								
Course code	**BP 605T**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**3**	**1**					**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Understanding the importance of Immobilized enzymes in Pharmaceutical Industries 2. Genetic engineering applications about production of pharmaceuticals 3. Importance of Monoclonal antibodies in Industries 4. Appreciate the use of microorganisms in fermentation technology								
CO1	Understand the importance of Immobilized enzymes in Pharmaceutical Industries.								
CO2	Apply genetic engineering principles to the production of pharmaceuticals.								
CO3	Explain the significance of Monoclonal antibodies in Industries								
CO4	Describe microorganisms in fermentation technology and large-scale production fermenter design and its various controls.								
CO5	Illustrate the blood products and their Collection, Processing and Storage.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Brief introduction to Biotechnology with reference to Pharmaceutical Sciences. Enzyme Biotechnology- Methods of enzyme immobilization and applications. Biosensors- Working and applications of biosensors in Pharmaceutical Industries. Brief introduction to Protein Engineering. Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase. Basic principles of genetic engineering	**10**	Understanding the basic concepts of biotechnology. Understanding of importance of Immobilized enzymes in Pharmaceutical Industries	4,5
II	Study of cloning vectors, restriction ndonucleases and DNA ligase. Recombinant DNA technology. Application of genetic engineering in medicine. Application of r DNA technology and genetic engineering in the production of: i) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin. d) Brief introduction to PC	**10**	Understand the concept of vectors and r DNA technology. Apply the concept of genetics in production of pharmaceuticals	4,5
III	Types of immunity- humoral immunity, cellular immunity a) Structure of Immunoglobulins b) Structure and Function of MHC c) Hypersensitivity reactions, Immune stimulation and Immune suppressions. d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood	**10**	Understand about the human immune system. Students will learn about the production of vaccines and blood products	4,5

	derivatives and other products relative to immunity. e) Storage conditions and stability of official vaccines f) Hybridoma technology- Production, Purification and Applications g) Blood products and Plasma Substituties.			
IV	Immuno blotting techniques- ELISA, Western blotting, Southern blotting. Genetic organization of Eukaryotes and Prokaryotes Microbial genetics including transformation, transduction, conjugation, plasmids and transposons. Introduction to Microbial biotransformation and applications. Mutation: Types of mutation/mutants	**8**	Learn about microbial genetics	4,5
V	Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring. Large scale production fermenter design and its various controls. Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin, Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substituties.	**7**	Understanding of fermentation technique	4,5

TEXT BOOKS:

T1: Pharmaceutical Biotechnology by Prof. Chandrakant Kokare T2: Pharmaceutical Biotechnology by Ravi Kumar Madelia

REFERENCE BOOKS:

R1: B.R.Glick and , J.J.Pasternak: Molecular Biotechnology: Principles and Applications Of Recombinant DNA: ASM Press Washington D.C.

R2: RA Goldshyet.al.,: Kuby Immunology. R3: J.W.Goding: Monoclonal Antibodies.

R4: J.M.Walker and, E.B.Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry.

R5: Zaborsky: Immobilized Enzymes, CRCPress, Degraland, Ohio.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.	**PO1,PO2,PO3,PO4.PO5,PO6,PO8, PO9,PO10,PO11**
2	Use plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, and elimination.	**PO1,PO2,PO3,PO4.PO5,PO6,PO8, PO9,PO10,PO11**
3	Apply the concepts of bioavailability and bioequivalence of drug products and their significance.	**PO1,PO2,PO3,PO4.PO5,PO6,PO8, PO9,PO10,PO11**
4	Analyze various pharmacokinetic parameters, their significance & applications	**PO1,PO2,PO3,PO4.PO5,PO6,PO8, PO8,PO9,PO10,PO11**
5	Illustrate the concepts of Non-linearity.	**PO1,PO2,PO3,PO4.PO5,PO6,PO8, PO9,PO10,PO11**

SEMESTER – VI									
Course Title	**PHARMACEUTICAL QUALITY ASSURANCE**								
Course code	**BP 606T**	**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 Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Understanding the importance of Immobilized enzymes in Pharmaceutical Industries 2. Genetic engineering applications about production of pharmaceuticals 3. Importance of Monoclonal antibodies in Industries 4. Appreciate the use of microorganisms in fermentation technology								
CO1	Understand the importance of Immobilized enzymes in Pharmaceutical Industries.								
CO2	Apply genetic engineering principles to the production of pharmaceuticals.								
CO3	Explain the significance of Monoclonal antibodies in Industries								
CO4	Describe microorganisms in fermentation technology and large-scale production fermenter design and its various controls.								
CO5	Illustrate the blood products and their Collection, Processing and Storage.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP Total Quality Management (TQM): Definition, elements, philosophies ICH Guidelines: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines Quality by design (QbD): Definition, overview, elements of QbD program, tools ISO 9000 & ISO14000: Overview, Benefits, Elements, steps for registration NABL accreditation : Principles and procedures	**10**	Understand the cGMP aspects in a pharmaceutical industry	3,4,5
II	Organization and personnel: Personnel responsibilities, training, hygiene and personal records. Premises: Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination. Equipments and raw materials: Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw m	**10**	Utilize the knowledge for maintenance and its importance of documentation	3,4,5
III	Quality Control: Quality control test for containers, rubber closures and secondary Packing materials. Good Laboratory Practices: General Provisions, Organization and Personnel, Facilities,	**10**	Understand the responsibilities of QA & QC departments.	3,4,5

	Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities			
IV	Complaints: Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal. Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.	**8**	Understand the scope of quality certifications applicable to pharmaceutical industries ractices.	4,5
V	Calibration and Validation: Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation. Warehousing: Good warehousing practice, materials management	**7**	Understand and summarize the general Principles of validation concepts.	3,4

TEXT BOOKS:

T1: Quality Assurance Guide by organization of Pharmaceutical Products of India. T2: Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.

REFERENCE BOOKS:

R1: The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms

R2: Good laboratory Practices – Marcel Deckker Series R3: ICH guidelines, ISO 9000 and 14000 guidelines

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the importance of Immobilized enzymes in Pharmaceutical Industries.	**PO1,PO3,PO5,PO6,PO9,PO10,PO11**
2	Apply genetic engineering principles to the production of pharmaceuticals.	**PO1,PO2,PO6,PO9,PO10,PO11**
3	Explain the significance of Monoclonal antibodies in Industries	**PO1,PO5,PO6,PO7,PO9,PO10,PO11**
4	Describe microorganisms in fermentation technology and large-scale production fermenter design and its various controls.	**PO1,PO2,PO3.PO5,PO6,PO8,PO9, PO10,PO11**
5	Illustrate the blood products and their Collection, Processing and Storage.	**PO1.PO5,PO6PO7,,PO8,PO9,PO10 ,PO11**

SEMESTER – VI									
Course Title	**MEDICINAL CHEMISTRY- III**								
Course code	**BP 607P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Prepare medicinally important compounds and intermediates. 2. Characterize prepared compounds using physicochemical methods. 3. Illustrate structures and reactions using chem draw/chem sketch								
CO1	Identify and relate the glassware and equipment synthesizing various drugs and intermediates.								
CO2	Demonstrate and Develop the method for Assay of drugs								
CO3	Build and analyze the results obtained by synthesizing drugs using the microwave method.								
CO4	Categorize and justify the structures and reactions drawn using Chem Draw.								
CO5	Develop physicochemical properties, Drug likeness and Lipinski RO5 in Drug design.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	To study the integumentary and special senses I Preparation of drugs and intermediates 1 Sulphanilamide 2 7-Hydroxy, 4-methyl coumarin 3 Chlorobutanol 4 Triphenyl imidazole 5 Tolbutamide 6 Hexamine Assay of drugs 1 Isonicotinic acid hydrazide 2 Chloroquine 3 Metronidazole 4 Dapsone 5 Chlorpheniramine maleate 6 Benzyl penicillin I Preparation of medicinally important compounds or intermediates by Microwave irradiation technique Drawing structures and reactions using chem draw® Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinskies RO5)	**4**	To understand about Synthesis of Intermediates. To Remember the reactions carried out To Apply, Analyze and Evaluate the Results obtained. To understand about Assay of drugs. To Remember Titrations to be carried out To Apply the principle, Analyze and Evaluate the Results obtained. To understand about Synthesis of Intermediates using Microwave. To Remember the reactions carried out To Apply, Analyze and Evaluate the Results obtained. To Understand, Remember what software is used to draw structures. To Apply and Analyze the structures drawn. To Evaluate the structures drawn and naming them. To Understand, Remember what softwares are used to find physicochemical properties. To Apply and Analyze the structures for drug likeness using Lipinski RO5 To Evaluate the structures by Lipinski RO5 whether they pass or not and Create new structures and applying the RO5.	4,5

TEXT BOOKS:

T1: Text book of practical organic chemistry- A.I.Vogel.

T2: The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.

REFERENCE BOOKS:

R1: Organic Chemistry by I.L. Finar, Vol. II.

R2: Introduction to principles of drug design- Smith and Williams. R3: Martindale's extra pharmacopoeia.

R4: Indian Pharmacopoeia Latest edition R5: Remington's Pharmaceutical Sciences.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Identify and relate the glassware and equipment synthesizing various drugs and intermediates.	**PO1,PO2,PO3.PO4,PO5,PO6,PO7, PO8,PO9,PO10,PO11**
2	Demonstrate and Develop the method for Assay of drugs	**PO1,PO2,PO3.PO4,PO5,PO6,PO7, PO8,PO9,PO10,PO11**
3	Build and analyze the results obtained by synthesizing drugs using the microwave method.	**PO1,PO2,PO3.PO4,PO5,PO6,PO7, PO8,PO9,PO10,PO11**
4	Categorize and justify the structures and reactions drawn using Chem Draw.	**PO1,PO2,PO3.PO4,PO5,PO6,PO7, PO8,PO9,PO10,PO11**
5	Develop physicochemical properties, Drug likeness and Lipinski RO5 in Drug design.	**PO1,PO2,PO3.PO4,PO5,PO6,PO7, PO8,PO9,PO10,PO11**

SEMESTER – VI									
Course Title	**PHARMACOLOGY-III**								
Course code	**BP 608P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Conduct skillful tissue analysis. 2. Operate lab equipment according to SOPs for preclinical experimentation								
CO1	Understand the principles of bioassay and its types including advantages and disadvantages.								
CO2	Describe unknown concentrations of various drugs using suitable isolated tissue preparations using different bioassays.								
CO3	Understand the effect of drugs on laboratory animals and toxicity studies.								
CO4	Evaluate the various pharmacological effects (analgesic, locomotion, muscle relaxant, etc.) in animals using the software.								
CO5	Understand the importance, methods, and application of biostatistics in pharmacology.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. Dose calculation in pharmacological experiments 2. Antiallergic activity by mast cell stabilization assay 3. Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model. 4. Study of effect of drugs on gastrointestinal motility 5. Effect of agonist and antagonists on guinea pig ileum 6. Estimation of serum biochemical parameters by using semi- autoanalyser 7. Effect of saline purgative on frog intestine 8. Insulin hypoglycemic effect in rabbit 9. Test for pyrogens (rabbit method) 10. Determination of acute oral toxicity (LD50) of a drug from a given data 11. Determination of acute skin irritation / corrosion of a test substance 12. Determination of acute eye irritation / corrosion of a test substance 13. Calculation of pharmacokinetic parameters from a given data 14. Biostatistics methods in experimental pharmacology(student's t test, ANOVA) Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)	**4**	To understand about importance of Drug Dose calculation and evaluate the effect of mast cell stabilizer using Ex-Pharm software To evaluate the antiulcer and gastrointestinal motility using Ex Pharm software To evaluate the different agonist and antagonists effect using Ex-Pharm software and estimate serum biochemical parameters To check purgative and Insulin hypoglycemic effect using Ex-Pharm software To test pyrogens and determine the oral LD50 value To determine the acute skin irritation and acute eye irritation To calculate pharmacokinetic parameters and understand different biostatistics methods	3,4, 5,6

TEXT BOOKS:

T1: K. D. Tripathi.Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.

T2: Rang & Dale's Pharmacology, Elsevier.

T3: Lippincott Illustrated Reviews: Pharmacology.

T4: Goodman and Gilman's, The Pharmacological Basis of Therapeutics.

REFERENCE BOOKS:

R1: PHARMACOLOGY – III, by Dr. SACHIN V. TEMBHURNE.

R2: Pharmacology-III, by Dr.Shaik Harun Rasheed, SIA Publishers & Distributors Pvt Ltd.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the principles of bioassay and its types including advantages and disadvantages.	**PO1,PO2,PO5,PO6,PO7,PO8,PO9, PO10,PO11**
2	Describe unknown concentrations of various drugs using Suitable isolated tissue preparations using different bioassays.	**PO1,PO2,PO3.PO4,PO5,PO6,PO7, PO8,PO9,PO11**
3	Understand the effect of drugs on laboratory animals and toxicity studies.	**PO1,PO2,,PO5,PO6,PO7,PO8,PO9, PO11**
4	Evaluate the various pharmacological effects (analgesic, locomotion, muscle relaxant, etc.) in animals using the software.	**PO1,PO2,PO3.PO4,PO5,PO6,PO7, PO8,PO9,PO11**
5	Understand the importance, methods, and application of biostatistics in pharmacology.	**PO1,PO2,PO3.PO4,PO5,PO6,PO7, PO8,PO9,PO11**

SEMESTER – VI									
Course Title	**HERBAL DRUG TECHNOLOGY**								
Course code	**BP 609P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ II semester of first year of the programme**								
Course Objectives	1. Perform phytochemical screening of crude drug. 2. Determine phytochemical content in crude drug								
CO1	Understand the principles and techniques involved in preliminary phytochemical screening of crude drugs.								
CO2	Explain the methodology and principles for determining the alcohol content of Asava and Arista.								
CO3	Analyze and evaluate the use of excipients of natural origin in pharmaceutical formulations.								
CO4	Demonstrate the ability to incorporate prepared and standardized herbal extracts into cosmetic formulations like creams, lotions, and shampoos, and evaluate their effectiveness.								
CO5	Apply knowledge of Pharmacopoeial requirements to incorporate prepared and standardized herbal extracts into formulations like syrups, mixtures, and tablets and evaluate their compliance with the standards.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. To perform preliminary phytochemical screening of crude drugs. 2. Determination of the alcohol content of Asava and Arista 3. Evaluation of excipients of natural origin 4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation. 5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements. 6. Monograph analysis of herbal drugs from recent Pharmacopoeias 7. Determination of Aldehyde content 8. Determination of Phenol content 9. Determination of total alkaloids	**4**	Methods of Chemical Evaluation Excipient Evaluations Manufacturing of Herbal Cosmetics	3,4

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the principles and techniques involved in preliminary phytochemical screening of crude drugs.	**PO1 ,PO8, PO11**
2	Explain the methodology and principles for determining the alcohol content of Asava and Arista.	**PO1,PO2,PO3.PO4,PO6,PO7,PO8, PO11**
3	Analyze and evaluate the use of excipients of natural origin in pharmaceutical formulations.	**PO1,PO2,PO3.PO4,PO6,PO7,PO8, PO11**
4	Demonstrate the ability to incorporate prepared and standardized herbal extracts into cosmetic formulations like creams, lotions, and shampoos, and evaluate their effectiveness.	**PO1,PO2,PO3.PO4,PO5,PO6,PO7, PO8,PO9,PO11**
5	Apply knowledge of Pharmacopoeial requirements to incorporate prepared and standardized herbal extracts into formulations like syrups, mixtures, and tablets and evaluate their compliance with the standards.	**PO1,PO2,PO3.PO4,PO5,PO6,PO7, PO8,PO9,PO11**

SEMESTER – VII									
Course Title	**Instrumental Methods Of Analysis (Theory)**								
Course code	**BP701T**	**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 Pharmacy**								
Semester	**VII semester of Fourth year of the programme**								
Course Objectives	Upon completion of the course the student shall be able to 1. Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis 2. Understand the chromatographic separation and analysis of drugs. 3. Perform quantitative & qualitative analysis of drugs using various analytical instruments.								
CO1	Understand the basic theoretical principles, instrumentation and applications of UV Visible spectrophotometer and fluorimeter								
CO2	Remember the principles, instrumentation and applications of IR spectroscopy, flame photometry, AAS and AES, Nephelometry and Turbidimetry.								
CO3	Apply and analyze the principles and Instrumentation of column chromatography, paper chromatography, TLC, and electrophoresis								
CO4	Evaluate the principles, theory, and instrumentation of HPLC and gas chromatography								
CO5	Apply the theory and principle involved in gel, ion exchange, and affinity chromatography.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**UV Visible Spectroscopy** Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, derivation and deviations. Instrumentation: Sources of radiation, wavelength selectors, sample cells, detectors - Phototube, Photomultiplier tube, Photovoltaic cell, Silicon Photodiode. Applications: Spectrophotometric titrations, single component and multicomponent analysis. **Fluorimetry** Theory: Concepts of singlet, doublet, and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching. Instrumentation and applications.	**10**	Understand the principles and Instrumentation of UV-Visible spectroscopy and Fluorimetry	3,4, 5
II	**IR Spectroscopy** Introduction, fundamental modes of vibrations in polyatomic molecules, sample handling, factors affecting vibrations. Instrumentation: Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermistor, Pyroelectric detector, and applications. **Flame Photometry** Principle, interferences, instrumentation, and applications. **Atomic Absorption Spectroscopy** Principle,	**10**	Understand the principles and instrumentation of IR spectroscopy, Flame Photometry, Atomic absorption spectroscopy and Nepheloturbidometry	3,4, 5

	interferences, instrumentation, and applications. **Nepheloturbidometry** Principle, Instrumentation, and applications.			
III	**Introduction to Chromatography** Adsorption and partition column chromatography: Methodology, advantages, disadvantages, and applications. **Thin layer chromatography**: Introduction, principle, methodology, Rf values, advantages, disadvantages, and applications. **Paper chromatography:** Introduction, methodology, development techniques, advantages, disadvantages, and applications. **Electrophoresis**: Introduction, factors affecting electrophoretic mobility, techniques of paper, gel, capillary electrophoresis, applications.	**10**	Understand the principles and instrumentations of various chromatographic studies	3,4, 5
IV	**Gas Chromatography**: Introduction, Theory, instrumentation, and applications.	**8**	Understand the principles and Instrumentations of GC and HPLC chromatographic studies	3,4, 5
V	**Ion Exchange Chromatography**: Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology, and applications. **Gel Chromatography**: Introduction, theory, instrumentation, and applications. **Affinity Chromatography**: Introduction, theory, instrumentation, and applications.	**7**	Understand the principles and instrumentations of Ion exchange chromatography, Gel chromatography and Affinity chromatography	3,4, 5

TEXT BOOKS:

T1: Instrumental Methods of Chemical Analysis by B.K Sharma. T2: Organic spectroscopy by Y.R Sharma.

T3: Text book of Pharmaceutical Analysis by Kenneth A. Connors.

T4: Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel. T5: Organic Chemistry by I. L. Finar.

REFERENCE BOOKS:

R1: Organic spectroscopy by William Kemp.

R2: Quantitative Analysis of Drugs by D. C. Garrett.

R3: Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi. R4: Spectrophotometric identification of Organic Compounds by Silverstein**.**

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basic theoretical principles, instrumentation and applications of UV Visible spectrophotometer and fluorimeter	**PO1,PO2,PO3,PO4,O6,PO8,PO9, PO11**
2	Remember the principles, instrumentation and applications of IR spectroscopy, flame photometry, AAS and AES, Nephelometry and Turbidimetry.	**PO1,PO2,PO3,PO4,O6,PO8,PO9, PO11**
3	Apply and analyze the principles and Instrumentation of column chromatography, paper chromatography, TLC, and electrophoresis	**PO1,PO2,PO3,PO4,O6,PO7,PO8, PO9,PO11**
4	Evaluate the principles, theory, and instrumentation of HPLC and gas chromatography	**PO1,PO2,PO3,PO4,O6,PO7,PO8, PO9,PO11**
5	Apply the theory and principle involved in gel, ion exchange, and affinity chromatography.	**PO1,PO2,PO3,PO4,O6,PO7,PO8, PO9,PO11**

SEMESTER – VII									
Course Title	**Industrial Pharmacy II (Theory)**								
Course code	**BP702T**	**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 Pharmacy**								
Semester	**VII semester of Fourth year of the programme**								
Course Objectives	Upon completion of the course, the student shall be able to: 1. Know the process of pilot plant and scale up of pharmaceutical dosage forms 2. Understand the process of technology transfer from lab scale to commercial batch 3. Know different Laws and Acts that regulate the pharmaceutical industry 4. Understand the approval process and regulatory requirements for drug products								
CO1	Recognize the relevance of manpower and space needs in pilot plant scale-up. Explain the necessity of choosing adequate raw materials for scale-up.								
CO2	Description of WHO-recommended nomenclature and technology transfer procedure, as well as quality risk management during R&D-to-production technology transfer.								
CO3	Apply regulatory knowledge for drug approval and IND application and assess clinical study management and FDA data submissions.								
CO4	Set the QbD and Six Sigma to pharmaceutical processes. Assess out-of-specifications (OOS) and change control implementation.								
CO5	Investigate fresh drug approval procedures and Certificate of Pharmaceutical Product relevance and utilize Indian regulatory standards to guarantee pharmaceutical compliance.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Pilot Plant Scale-Up Techniques**: General considerations - including significance of personnel requirements, space requirements, raw materials. Pilot plant scale-up considerations for solids, liquid orals, semi-solids, and relevant documentation. SUPAC guidelines, introduction to platform technology.	**10**	Understand the significance of personnel and space requirements in pilot plant scale-up. - Explain the importance of selecting appropriate raw materials for pilot plant scale up. -Apply pilot plant scale-up techniques for solids, liquid orals, and semi-solids.	3,4, 5
II	**Technology Development and Transfer:** WHO Guidelines for Technology Transfer (TT) Terminology, Technology Transfer Protocol, Quality Risk Management, Transfer from R&D to Production (Process, Packaging, and Cleaning), Granularity of TT Process (API, Excipients, Finished Products, Packaging Materials), Documentation, Premises and Equipment Qualification and Validation, Quality Control, Analytical Method Transfer, Approved Regulatory Bodies and Agencies, Commercialization - Practical Aspects and Problems (Case Studies), TT Agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE/SIDBI, TT Related	**10**	Explain the terminology and technology transfer protocols according to WHO guidelines. - Implement quality risk management during technology transfer. - Apply technology transfer concepts to process, packaging, and cleaning aspects.	3,4, 5

	Documentation - Confidentiality Agreement, Licensing, MoUs, Legal Issues			
III	**Regulatory Affairs:** Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory Affairs department, Responsibility of Regulatory Affairs Professionals **Regulatory Requirements for Drug Approval:** Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies	**10**	Understand the roles of approved regulatory bodies and agencies for technology transfer. - Analyze practical aspects and case studies related to technology commercialization. - Identify technology transfer agencies in India and their functions.	3,4, 5
IV	**Quality Management Systems: Quality Management & Certifications** Quality management concepts: Concept of Quality, Total Quality Management (TQM), Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL (National Accreditation Board for Testing and Calibration Laboratories), GLP (Good Laboratory Practice)	**8**	Understand the concepts of Quality and Total Quality Management (TQM). - Apply Quality by Design (QbD) and Six Sigma concepts to improve pharmaceutical - Apply concepts of OOS and Change Control in maintaining product quality. - Understand ISO 9000 series of quality systems standards and ISO 14000. - Recall the concept of NABL and GLP in pharmaceutical manufacturing	3,4, 5
V	**Indian Regulatory Requirements: Central Drug Standard Control Organization (CDSCO) and State Licensing Authority** **Organization and Responsibilities:** Central Drug Standard Control Organization (CDSCO) and State Licensing Authority roles and responsibilities. **Certificate of Pharmaceutical Product (COPP):** Overview and significance of the Certificate of Pharmaceutical Product (COPP) in regulatory processes. **Regulatory Requirements and Approval Procedures for New Drugs:** Detailed procedures and requirements for	**7**	Recall the organization and responsibilities of CDSCO and State Licensing Authority. - Understand the importance of Certificate of Pharmaceutical Product (COPP). - Comprehend the regulatory requirements and approval procedures for new drugs in India.	3,4, 5

	obtaining regulatory approval for new drugs in India.			

TEXT BOOKS:

T1: Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition.

REFERENCE BOOKS:

R1: Regulatory Affairs brought by learning plus, inc. available at http.//www.cgmp.com/ra.htm. 2. R2: Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April available at http,//en.wikipedia.org/wiki/Regulatory_ Affairs.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recognize the relevance of manpower and space needs in pilot plant scale-up. Explain the necessity of choosing adequate raw materials for scale-up.	**PO1,PO2,PO3,PO4,PO6,PO10,PO11**
2	Description of WHO-recommended nomenclature and technology transfer procedure, as well as quality risk management during R&D-to-production technology transfer.	**PO1,PO2,PO5,PO11**
3	Apply regulatory knowledge for drug approval and IND application and assess clinical study management and FDA data submissions.	**PO1,PO2,PO3,POPO11**
4	Set the QbD and Six Sigma to pharmaceutical processes. Assess out-of-specifications (OOS) and change control implementation.	**PO1,PO2,PO5,PO10,PO11**
5	Investigate fresh drug approval procedures and Certificate of Pharmaceutical Product relevance and utilize Indian regulatory standards to guarantee pharmaceutical compliance.	**PO1,PO2,PO11**

SEMESTER – VII									
Course Title	**Pharmacy Practice (Theory)**								
Course code	**BP703T**	**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 Pharmacy**								
Semester	**VII semester of Fourth year of the programme**								
Course Objectives	Upon completion of the course, the student shall be able to 1. Know various drug distribution methods in a hospital 2. Appreciate the pharmacy store management and inventory control 3. Monitor the drug therapy of the patient through medication chart review and clinical review. 4. Obtain medication history interview and counsel the patients 5. Identify drug-related problems 6. Detect and assess adverse drug reactions 7. Interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states. 8. Know pharmaceutical care services 9. Do patient counseling in a community pharmacy. 10. Appreciate the concept of rational drug therapy.								
CO1	Understand the hospital's organization, the hospital pharmacy, and any adverse drug reactions, and apply this knowledge to the community pharmacy.								
CO2	Learn about the patient medication history interview, apply in the community pharmacy management, and understand the hospital formulary, therapeutic drug monitoring, medication adherence, and the hospital drug distribution system.								
CO3	Apply the drug distribution system in a hospital, hospital formulary, therapeutic drug monitoring, Medication adherence, patient medication history interview, and community pharmacy management.								
CO4	Learn and apply the budget preparation and implementation of clinical Pharmacy, and OTC drugs.								
CO5	Understand drug store management and analysis, inventory control, investigational drug use, and the ability to interpret clinical laboratory tests.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**a) Hospital and Its Organization Definition andClassification of Hospital:** Primary, Secondary, and Tertiary hospitals; Classification based on clinical and non-clinical basis. **Organization Structure of a Hospital:** Overview of the organizational structure and medical staff involved, their roles, and functions. **b) Hospital Pharmacy and Its Organization Definition and Functions of Hospital Pharmacy:** Functions of hospital pharmacy, including dispensing, compounding, and patient care.	**7**	Know various drug distribution Methods in a hospital. Know pharmacy stores management and inventory control. Identify drug related problems and detect and assess adverse drug reactions. Know about Community Pharmacy.	3,4, 5

	Organization Structure, Location, Layout, and Staff Requirements: Layout and organizational requirements of hospital pharmacies, roles of pharmacists and support staff. **Responsibilities and Functions of Hospital Pharmacists:** Role and responsibilities of hospital pharmacists in patient care, medication management, and ensuring drug safety. **c) Adverse Drug Reactions Classifications of Adverse Drug Reactions:** Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs. **Drug Interactions:** Beneficial interactions, adverse interactions, pharmacokinetic drug interactions. Methods for detecting drug interactions, including spontaneous case reports and record linkage studies. **Adverse Drug Reaction Reporting and Management:** Procedures for reporting and managing adverse drug reactions in healthcare settings. **d) Community Pharmacy Organization and Structure of Retail and Wholesale Drug Stores:** Types and designs of retail and wholesale drug stores, including legal requirements for establishment and maintenance. **Dispensing of Proprietary Products:** Processes and regulations for dispensing proprietary products in community pharmacies. **Maintenance of Records of Retail and Wholesale Drug Stores:** Requirements and practices for maintaining records in retail and wholesale drug stores.			
II	**a) Drug Distribution System in a Hospital Dispensing of Drugs to Inpatients:** Methods and procedures for dispensing drugs to hospitalized patients.	**10**	Drug distribution system in a hospital. Monitor drug therapy of patient through medication chart review and clinical review. Monitor drug therapy of patient	3,4,5

	Types of Drug Distribution Systems: Overview of different systems used for distributing drugs within hospitals. **Charging Policy and Labeling:** Policies and practices related to drug charges and labeling in hospital settings. **Dispensing of Drugs to Ambulatory Patients:** Processes involved in dispensing medications to patients who are not hospitalized. **Dispensing of Controlled Drugs:** Guidelines and procedures for dispensing controlled substances in hospitals. **b) Hospital Formulary Definition:** Explanation of what constitutes a hospital formulary and its purpose. **Contents of Hospital Formulary:** Types of medications included, guidelines for inclusion, and categories of drugs. **Differentiation of Hospital Formulary and Drug List:** Comparison between a hospital formulary and a general drug list. **Preparation and Revision:** Steps involved in preparing and updating the hospital formulary. **Addition and Deletion of Drugs from Hospital Formulary:** Procedures for adding new drugs and removing existing ones from the formulary. **c) Therapeutic Drug Monitoring Need for Therapeutic Drug Monitoring:** Reasons why monitoring drug levels in patients is essential. **Factors to Consider during Therapeutic Drug Monitoring:** Key considerations and parameters monitored during the process. **Indian Scenario for Therapeutic Drug Monitoring:** Specific considerations and practices related to therapeutic drug monitoring in India. **d) Medication Adherence Causes of Medication Non- Adherence:** Factors contributing to patients not following prescribed medication		through medication chart review and clinical review	

	regimens. **Pharmacist Role in Medication Adherence:** Ways pharmacists can assist patients in adhering to their medication schedules. **Monitoring of Patient Medication Adherence:** Methods and strategies used to monitor and improve patient adherence to medications. **e) Patient Medication History Interview Need for the Patient Medication History Interview:** Importance of gathering comprehensive medication history from patients. **Medication Interview Forms:** Tools and forms used to conduct medication history interviews effectively. **f) Community Pharmacy Management Financial, Materials, Staff, and Infrastructure Requirements:** Key requirements and considerations for managing a community pharmacy effectively.			
III	**a) Pharmacy and Therapeutic Committee Organization and Functions:** Structure and roles of the Pharmacy and Therapeutic Committee in hospital settings. **Policies of the Pharmacy and Therapeutic Committee:** Guidelines for including drugs into the formulary, managing inpatient and outpatient prescriptions, automatic stop orders, and preparing emergency drug lists. **Drug Information Services Drug and Poison Information Centre:** Role and functions of the Drug and Poison Information Centre in providing information and guidance. **Sources of Drug Information:** Various sources used for obtaining drug-related information. **Computerized Services and Storage Retrieval of Information:** Use of computerized systems for managing and retrieving drug information. **b) Patient Counseling Definition of**	**10**	Know about pharmacy and therapeutic committee, Know about Role of pharmacist in the education and training program.	3,4, 5

	Patient Counseling: Explanation of what constitutes patient counseling and its importance. **Steps Involved in Patient Counseling:** Process and procedures followed during patient counseling sessions. **Special Cases that Require the Pharmacist:** Instances where pharmacists play a crucial role in specialized patient counseling. **c) Education and Training Program in the Hospital Role of Pharmacist in the Education and Training Program:** Responsibilities of pharmacists in conducting educational and training programs. **Internal and External Training Programs:** Overview of training programs conducted within the hospital and external educational initiatives. **Services to Nursing Homes/Clinics:** Support and services provided by pharmacists to nursing homes and clinics. **Code of Ethics for Community Pharmacy:** Ethical guidelines and standards applicable to community pharmacy practice. **Role of Pharmacist in Interdepartmental Communication and Community Health Education:** Importance of pharmacist involvement in internal communication and community health education initiatives. **d) Prescribed Medication Order and Communication Skills Prescribed Medication Order:** Interpretation of medication orders and legal requirements for handling prescriptions. **Communication Skills:** Effective communication practices when interacting with prescribers and patients.			
IV	**a) Budget Preparation and Implementation Budget Preparation and Implementation:**	**8**	Know about Budget preparation and implementation in pharmacy	3,4, 5

	Process and steps involved in preparing and implementing budgets. **b) Clinical Pharmacy Introduction to Clinical Pharmacy:** Overview and introduction to the field of clinical pharmacy. **Concept of Clinical Pharmacy:** Definition and principles underlying clinical pharmacy practice. **Functions and Responsibilities of Clinical Pharmacist:** Roles and duties of clinical pharmacists in healthcare settings. **Drug Therapy Monitoring:** Methods and procedures for monitoring drug therapy effectiveness: • Medication chart review • Clinical review • Pharmacist intervention • Ward round participation • Medication history and pharmaceutical care. **Dosing Pattern and Drug Therapy based on Pharmacokinetic & Disease Pattern:** Considerations and methodologies for determining dosing patterns based on pharmacokinetic principles and disease characteristics. **c) Over-the-Counter (OTC) Sales Introduction and Sale of Over-the- Counter (OTC) Medications:** Overview of OTC medications and their sale practices. **Rational Use of Common Over-the- Counter Medications:** Guidelines and principles for the appropriate and rational use of common OTC medications.			
V	**Drugstore Management and Inventory Control Organization of Drug Store:** Structure and management practices within a drug store setting. **Types of Materials Stocked and Storage Conditions:** Various categories of materials stocked in drug stores and appropriate storage conditions. **Purchase and Inventory Control:** Principles of inventory management,	**7**	Perform Drug store management and inventory control in hospitals. Interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states	3,4, 5

	including purchase procedures, purchase orders, procurement, and stocking practices. **Economic Order Quantity (EOQ) and Reorder Quantity Level:** Concepts and calculations related to EOQ and reorder quantity levels in inventory management. **Methods Used for the Analysis of Drug Expenditure:** Approaches and techniques for analyzing and managing drug expenditure. **Investigational Use of Drugs Description and Principles Involved:** Overview of investigational drug use and underlying principles. **Classification, Control, and Identification:** Methods and regulatory aspects related to classifying, controlling, and identifying investigational drugs. **Role of Hospital Pharmacist and Advisory Committee:** Involvement of hospital pharmacists and advisory committees in managing investigational drug use. **c) Interpretation of Clinical Laboratory Tests Blood Chemistry, Hematology, and Urinalysis:** Understanding and interpretation of clinical laboratory tests related to blood chemistry, hematology, and urinalysis.			

TEXT BOOKS:

T1: Merchant S.H. and Dr. J.S.Quadry. A textbook of hospital pharmacy, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001. 2

T2: Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. A textbook of Clinical Pharmacy Practiceessential concepts and skills, 1 st ed. Chennai: Orient Longman Private Limited; 2004.

REFERENCE BOOKS:

R1: William E. Hassan. Hospital pharmacy, 5th ed. Philadelphia: Lea &Febiger; 1986. R2: Tipnis Bajaj. Hospital Pharmacy, 1st ed. Maharashtra: Career Publications; 2008.

R3: Scott LT. Basic skills in interpreting laboratory data, 4thed. American Society of Health System Pharmacists Inc; 2009.

R4: Parmar N.S. Health Education and Community Pharmacy, 18th ed. India: CBS Publishers & Distributers; 2008.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the hospital's organization, the hospital pharmacy, and any adverse drug reactions, and apply this knowledge to the community pharmacy.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO19,PO11**
2	Learn about the patient medication history interview, apply in the community pharmacy management, and understand the hospital formulary, therapeutic drug monitoring, medication adherence, and the hospital drug distribution system.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO19,PO11**
3	Apply the drug distribution system in a hospital, hospital formulary, therapeutic drug monitoring, Medication adherence, patient medication history interview, and community pharmacy management.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO19,PO11**
4	Learn and apply the budget preparation and implementation of clinical Pharmacy, and OTC drugs.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO19,PO11**
5	Understand drug store management and analysis, inventory control, investigational drug use, and the ability to interpret clinical laboratory tests.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO19,PO11**

SEMESTER – VII									
Course Title	**Novel Drug Delivery Systems (Theory)**								
Course code	**BP704T**	**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 Pharmacy**								
Semester	**VII semester of Fourth year of the programme**								
Course Objectives	Upon completion of the course student shall be able. 1. To understand various approaches for the development of novel drug delivery systems. 2. To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation, and evaluation								
CO1	Understand the basics of controlled drug delivery systems and apply the knowledge in formulation development.								
CO2	Understand the formulation and drug release mechanism of microencapsulation, mucosal drug delivery, and implants.								
CO3	Understand the concept of drug delivery systems through the transdermal and Nano pulmonary routes, their application, advantages, and disadvantages.								
CO4	Understand the concept of targeted drug delivery.								
CO5	Develop a drug delivery system for the eyes and uterus.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Controlled Drug Delivery Systems:** Introduction, terminology/definitions, and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution, and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations. **Polymers:** Introduction, classification, properties, advantages, and application of polymers in the formulation of controlled release drug delivery systems.	**10**	Students will be able to understand the concept of novel drug delivery systems, its classification and applications. They will also learn the utilization of polymers in pharmaceutical formulation development.	3,4
II	**Microencapsulation** Microencapsulation: Definition, advantages, disadvantages, microspheres/microcapsules, microparticles. Methods of icroencapsulation and applications. **Mucosal Drug Delivery System** Introduction to mucosal drug delivery systems. Principles of bioadhesion /mucoadhesion, concepts, advantages, disadvantages. Transmucosal permeability and formulation considerations of buccal delivery systems. **Implantable Drug Delivery Systems** Introduction to implantable drug delivery systems, advantages, disadvantages. Concept	**10**	Understand the concept of microencapsulation, mucosal drug delivery and implantable drug delivery.	3,4

	of implants and osmotic pump technology.			
III	**Transdermal Drug Delivery Systems** Introduction to transdermal drug delivery systems. Permeation through the skin, factors affecting permeation, permeation enhancers. Basic components of TDDS and formulation approaches. **Gastroretentive Drug Delivery Systems** Introduction to gastroretentive drug delivery systems. Advantages and disadvantages. Approaches for GRDDS including floating systems, high-density systems, inflatable systems, gastroadhesive systems, and their applications. **Nasopulmonary Drug Delivery System** Introduction to nasopulmonary drug delivery systems. Overview of nasal and pulmonary routes of drug delivery. Formulation of inhalers (dry powder and metered dose), nasal sprays, nebulizers.	**10**	Learn about the techniques involved in improving the delivery of drugs through the skin. Students will understand the concept of localized drug delivery to the GIT and lungs.	3,4
IV	**Targeted Drug Delivery** Concepts and approaches to targeted drug delivery. Advantages and disadvantages of targeted drug delivery systems. Introduction to: Liposomes, Niosomes, Nanoparticles, Monoclonal antibodies Overview of their applications in drug delivery.	**8**	Students will be able to learn the techniques involved in targeted drug delivery.	3,4
V	**Ocular Drug Delivery Systems** Introduction to oculardrug delivery systems. Overview of intraocular barriers and methods to overcome them. Preliminary study of ocular formulations and ocuserts. **Intrauterine Drug Delivery Systems** Introduction to intrauterine drug delivery systems. Advantages and disadvantages of using intrauterine devices (IUDs). Development of IUDs and their applications.	**7**	Know about delivery of drugs to eyes and uterine cavity	3,4

TEXT BOOKS:

T1: N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).

T2:. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

REFERENCE BOOKS:

R1: Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.

R2: Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basics of controlled drug delivery systems and apply the knowledge in formulation development.	**PO1,PO2,PO3,PO6,PO11**
2	Understand the formulation and drug release mechanism of microencapsulation, mucosal drug delivery, and implants.	**PO1,PO2,PO3,PO6,PO11**
3	Understand the concept of drug delivery systems through the transdermal and Nano pulmonary routes, their application, advantages, and disadvantages.	**PO1,PO2,PO3,PO6,PO11**
4	Understand the concept of targeted drug delivery.	**PO1,PO2,PO3,PO6,PO11**
5	Develop a drug delivery system for the eyes and uterus.	**PO1,PO2,PO3,PO6,PO11**

SEMESTER – VII									
Course Title	**INSTRUMENTAL METHODS OF ANALYSIS (Practical)**								
Course code	**BP705P**	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 4	**0**	**0**	**4**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**VII semester of Fourth year of the programme**								
Course Objectives	1. Compare operational techniques of UV, HPLC fluorimeter, flame photometer, etc. 2. Develop basic practical skills using instrumental techniques. 3. Correlate quantitative and qualitative drug analysis using various analytical instruments.								
CO1	Understand the fundamental and theoretical concepts of instrumentation techniques								
CO2	Apply practical knowledge of various instrumentation techniques for drug and excipient analysis.								
CO3	Evaluate the absorption maxima, effect of absorption, and unknown concentration of the drug sample by using UV-visible spectroscopy.								
CO4	Analyze and estimate the Sodium and potassium ions by using Flame photometry.								
CO5	Evaluate the organic compounds/amino acids/plant pigments by using various chromatographic and spectroscopical techniques.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds. 2. Estimation of dextrose by colorimetry. 3. Estimation of sulfanilamide by colorimetry. 4. Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy. 5. Assay of paracetamol by UV-Spectrophotometry. 6. Estimation of quinine sulfate by fluorimetry. 7. Study of quenching of fluorescence. 8. Determination of sodium by flame photometry. 9. Determination of potassium by flame photometry. 10. Determination of chlorides and sulphates by nepheloturbidometry. 11. Separation of amino acids by paper chromatography.		Understand the qualitative and quantitative analysis of drugs by various spectroscopic technique, fluorimetry methods, flame photometry and nephelo turbidometry methods.	3,4, 5,6
	12. Separation of sugars by thin layer chromatography.			

	13. Separation of plant pigments by column chromatography. 14. Demonstration experiment on HPLC. Demonstration experiment on Gas Chromatography.			

TEXT BOOKS:

T1: Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake T2: Quantitative Analysis of Drugs byD. C. Garrett

REFERENCE BOOKS:

R1: Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi R2: Spectrophotometric identification of Organic Compounds by Silverstein

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the fundamental and theoretical concepts of instrumentation techniques	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO19,PO11**
2	Apply practical knowledge of various instrumentation techniques for drug and excipient analysis.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO19,PO11**
3	Evaluate the absorption maxima, effect of absorption, and unknown concentration of the drug sample by using UV-visible spectroscopy.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO19,PO11**
4	Analyze and estimate the Sodium and potassium ions by using Flame photometry.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO19,PO11**
5	Evaluate the organic compounds/amino acids/plant pigments by using various chromatographic and spectroscopical techniques.	**PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO19,PO11**

SEMESTER – VIII									
Course Title	**BIOSTATISITCS AND RESEARCH METHODOLOGY**								
Course code	**BP801T**	**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 Pharmacy**								
Semester	**Fall/ VIII semester of first year of the programme**								
Course Objectives	Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment) Know the various statistical techniques to solve statistical problems Appreciate statistical techniques in solving the problems								
CO1	Understand the basic concepts of statistics, mean, median, mode and coefficients used.								
CO2	Categorize the distributions, sample population errors and parametric tests.								
CO3	Evaluate the data obtained by using different non parametric tests and phases of clinical Trials								
CO4	Apply the knowledge of different softwares such as Excel, SPSS, MINITAB for the data acquired.								
CO5	Explain the statistical design for the experiments and analysis.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Introduction:** Statistics, Biostatistics, Frequency distribution **Measures of central tendency:** Mean, Median, Mode- Pharmaceutical examples Measures of dispersion: Dispersion, Range, standard deviation, Pharmaceutical problems **Correlation:** Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples	**10**	Introduction of Biostatics, central tendency and Correlation	1,2, 3,4, 5
II	**Regression:** Curve fitting by the method of least squares, fitting the lines y= a + bx and x = a + by, Multiple regression, standard error of regression– Pharmaceutical Examples. **Probability:** Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties – problems Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples. **Parametric test:** t-test(Sample, Pooled or Unpaired and Paired) , ANOVA, (One way and Two way), Least Significance difference	**10**	Categorize the distributions, sample population errors and parametric tests.	1,2, 3,4, 5
III	**Non Parametric tests:** Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test. **Introduction to Research:** Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism. **Graphs:** Histogram, Pie Chart, Cubic Graph,		Evaluate the data obtained by using different non parametric tests and phases of clinical trials.	1,2, 3,4, 5

	response surface plot, Counter Plot graph **Designing the methodology:** Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases.	**10**		
IV	Blocking and confounding system for Two-level factorials. **Regression modeling:** Hypothesis testing in Simple and Multiple regression models. **Introduction to Practical components of Industrial and Clinical Trials Problems:** Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R – Online Statistical Software's to Industrial and Clinical trial approach.	**8**	Solve using different software (Excel, SPSS, MINITAB) for the data acquired.	1,2, 3,4, 5
V	**Design and Analysis of experiments**: **Factorial Design:** Definition, 2^2, 2^3design. Advantage of factorial design. **Response Surface methodology:** Central composite design, Historical design, Optimization Techniques	**7**	Develop a statistical design for the experiments and analysis	1,2, 3,4, 5

TEXT BOOKS:

T1: Biostatistics and Research Methodology, Dr.Vinod Kumar Bais, PEE VEE.

REFERENCE BOOKS:

R1: Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. New York.

R2: Design and Analysis of Experiments –PHI, Learning Private Limited, R. Pannerselvam. R3: Sharp, Lester W. Fundamentals of Cytology. 1st edition. McGraw Hill Company; 1943.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the basic concepts of statistics, mean, median, mode, and coefficients used.	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,,PO11**
2	Categorize the distributions, sample population errors, and parametric tests.	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,,PO11**
3	Evaluate the data obtained using different non-parametric tests and phases of clinical trials.	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,,PO11**
4	Apply the knowledge of software such as Excel, SPSS, and MINITAB for the data acquired.	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,,PO11**
5	Explain the statistical design for the experiments and analysis.	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,,PO11**

SEMESTER – VIII									
Course Title	**SOCIAL AND PREVENTIVE PHARMACY**								
Course code	**BP 802T**	**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 Pharmacy**								
Semester	**Fall/ VIII semester of first year of the programme**								
Course Objectives	1. Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide 2. Have a critical way of thinking based on current healthcare development. 3. Evaluate alternative ways of solving problems related to health and pharmaceutical issues.								
CO1	Identifying the fundamental concept, health concept, disease, education, hygiene practice.								
CO2	Categorize some diseases' symptoms and preventive medications.								
CO3	Determine the objectives, functioning, and consequences of national health programmes.								
CO4	Evaluating some of India's national health programmes in relation to WHO's role								
CO5	The significance of health education in schools and community service in rural and urban areas.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Concept of health and disease:** Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick. **Social and health education:** Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention. **Sociology and health:** Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health **Hygiene and health:** Personal hygiene and health care; avoidable habits	**10**	Recognize theconcepts and evaluation of public health. Understand the concept of prevention and control of disease. Illustrate sociocultural factors and its relation with health. Identify avoidable habits for personal hygiene and health. Understand malnutrition and its prevention. Recognize the community services in rural, urban and school health. Identify avoidable habits for personal hygiene and health	1,2, 3,4
II	**Preventive medicine:** General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse.	**10**	Identify and understand the general measures and strategies to be followed in social and preventive pharmacy	1,2, 3,4
III	**National health programs, its objectives, functioning and outcome of the following:** HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, National programme for prevention and control of deafness, Universal	**10**	Illustrate sociocultural factors and its relation with health. Identify and understand the general measures and strategies to be followed in social and preventive pharmacy.	1,2, 3,4

	immunization programme, National programme for control of blindness, Pulse polio programme.			
IV	National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program.	**8**	Identify and understand the general measures and strategies to be followed in social and preventive pharmacy	1,2, 3,4
V	Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.	**7**	Understand and expressed the principles on the prevention and control of communicable and non-communicable diseases	1,2, 3,4

TEXT BOOKS:

T1: Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, ISBN:9789380704104, JAYPEE Publications.

T2: Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, SahaIndranil, 4thEdition, 2013, ISBN: 9789350901878, JAYPEE Publications.

T3: Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS

REFERENCE BOOKS:

R1: Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications.

R2: Research in Social and Administrative Pharmacy, Elsevier, Ireland.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Define the fundamental health concepts, including disease, education, and hygiene practice.	**PO1,PO2,PO3,PO4,PO5,PO6, PO8PO9,PO10, PO11**
2	Categorize disease symptoms and preventive measures	**PO1,PO2,PO3,PO4,PO5,PO6, PO8PO9,PO10, PO11**
3	Define objectives, functions, and outcomes of national health programs	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,PO9,PO10, PO11**
4	Describe India's national health programmes concerning WHO's role	**PO1,PO2,PO3,PO4,PO5,PO6, PO7,PO8,PO9,PO10, PO11**
5	Emphasize the importance of health education in schools and community service in rural and urban areas.	**PO1,PO2,PO3,PO4,PO5,PO6, PO8PO9,PO10, PO11**

SEMESTER – VIII									
Course Title	**PHARMA MARKETING MANAGEMENT**								
Course code	**BP 803ET**	**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 Pharmacy**								
Semester	**Fall/ VIII semester of first year of the programme**								
Course Objectives	1. Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide 2. Have a critical way of thinking based on current healthcare development. 3. Evaluate alternative ways of solving problems related to health and pharmaceutical issues.								
CO1	Understand and enumerate the concept of pharmaceutical marketing and product management in pharmaceutical industry								
CO2	Remember the various components of promotion of pharmaceutical products								
CO3	Understand the different pharmaceutical marketing channels								
CO4	Remember the role and responsibility of professional sales representative and pricing authorities in India								
CO5	Apply the emerging concepts of marketing and the role market research								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**Marketing:** Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior. **Pharmaceutical market:** Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation & targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. Analyzing the Market; Role of market research.	**10**	Able to articulate the definition, general concepts, and the broad scope of marketing. This outcome focuses on achieving a solid understanding of foundational marketing principles.	1,2
II	**Product decision:** Classification, product line and product mix decisions, product life cycle,p roduct portfolio analysis; product positioning; New product decisions; Product branding, packaging and labelling decisions, Product management in pharmaceutical industry.	**10**	Able to formulate effective product management strategies, including decisions related to product classification, product lines, and product mix. Understand the product life cycle, engage in product portfolio analysis, and implement successful product positioning strategies	1,2
III	**Promotion:**		Able to design and implement	

	Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.	**10**	integrated promotion strategies by understanding the determinants of the promotional mix. This outcome emphasizes the ability to create cohesive and effective promotional campaigns that utilize multiple channels for maximum impact.	4,5
IV	**Pharmaceutical marketing channels:** Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management. **Professional sales representative (PSR):** Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.	**10**	Able to design, analyze, and optimize pharmaceutical marketing channels. This outcome emphasizes the ability to strategically navigate the complexities of pharmaceutical distribution to ensure efficient and effective product reach.	4,5
V	**Pricing:** Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority).	**10**	Able to learn to navigate and comply with regulatory frameworks while making pricing decisions. Apply advanced marketing concepts, including vertical and horizontal marketing, rural marketing, consumerism, industrial marketing, and global marketing.	4,5

TEXT BOOKS:

T1: Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi T2: Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill
T3: Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India T4: Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition)
T5: Ramaswamy, U.S & Nanakamari, S: Marketing Managemnt: Global Perspective, Indian Context, Macmilan India, New Delhi.
T6: Shanker, Ravi: Service Marketing, Excell Books, New Delhi

REFERENCE BOOKS:

R1: Subba Rao Changanti, Pharmaceutical Marketing in India (GIFT – Excel series) Excel Publications
R2: Walker, Boyd and Larreche: Marketing Strategy- Planning and Implementation, Tata MC GrawHill, New Delhi.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand and enumerate the concept of pharmaceutical marketing and product management in the pharmaceutical industry	**PO1,PO2,PO3,PO4,PO5,PO6, ,PO8,PO9,PO11**
2	Use various components of promotion of pharmaceutical products.	**PO1,PO2,PO3,PO4,PO5,PO6, ,PO8,PO9,PO11**
3	Understand the different pharmaceutical marketing channels	**PO1,PO2,PO3,PO4,PO5,PO6, ,PO8,PO9,PO11**
4	Describe the role and responsibility of professional sales representatives and pricing authorities in India.	**PO1,PO2,PO3,PO4,PO5,PO6, ,PO8,PO9,PO11**
5	Apply the emerging concepts of marketing and the role of market research.	**PO1,PO2,PO3,PO4,PO5,PO6, ,PO8,PO9,PO11**

SEMESTER – VIII									
Course Title	**COSMETIC SCIENCE**								
Course code	**BP 809ET**	**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 Pharmacy**								
Semester	**Fall/ VIII semester of first year of the programme**								
Course Objectives	1. Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide 2. Have a critical way of thinking based on current healthcare development. 3. Evaluate alternative ways of solving problems related to health and pharmaceutical issues.								
CO1	Understand how Indian and EU legislation classifies cosmetics and cosmeceuticals. Learn the anatomy of the skin, hair, and oral cavities and aesthetic therapy excipients								
CO2	List skin and hair care product components and processes. Explain developing cream, shampoo, toothpaste, and color formulation skills.								
CO3	Create many sun protection cosmetics formulas using your new skills. Visit BIS for toothpaste, skin cream, and shampoo details.								
CO4	Design a method for researching and rating hair and skin care products. The theory behind instruments like sebumeters and corneometers.								
CO5	Cosmetics R&D efforts focused on developing novel approaches to greasy hair, dry skin, and dandruff.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Classification of cosmetic and cosmeceutical products Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs **Cosmetic excipients:** Surfactants, rheology modifiers, humectants, emollients, preservatives. Classification and application **Skin:** Basic structure and function of skin. **Hair:** Basic structure of hair. Hair growth cycle. **Oral Cavity:** Common problem associated with teeth and gums.	**10**	Understand the cosmetic products as per Indian & EU regulation. Understand the key ingredients suitable in the formulation of various cosmetics products. Understand the elements of biology that relate to the structure function and disorders of the skin, hair and oral cavity & discuss the various problems related to the skin and hair. Study the structure and function of skin	4,5
II	**Principles of formulation and building blocks of skin care products:** Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmecuticals. **Antiperspants& deodorants**- Actives & mechanism of action. **Principles of formulation and building blocks of Hair care products:** Conditioning	**10**	Discuss different shampoos and the concept of hair dye.. Understand the mechanism of action of antiperspants & deodorants	4,5

	shampoo, Hair conditioner, anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phylenediamine based hair dye. **Principles of formulation and building blocks of oral care products:** Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash			
III	Sun protection, Classification of Sunscreens and SPF. **Role of herbs in cosmetics:** **Skin Care:** Aloe and turmeric. **Hair care:** Henna and amla. **Oral care:** Neem and clove **Analytical cosmetics:** BIS specification and analytical methods for shampoo, skin- cream and toothpaste.	**10**	Describe the evaluation of hair and skin preparations	4,5
IV	**Principles of Cosmetic Evaluation:** Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties **Soaps, and syndet bars**. Evaluation and skin benefits.	**8**	Explain sebumeter, and corneometer.	4,5
V	Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis. **Cosmetic problems associated with Hair and scalp:** Dandruff, Hair fall causes Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor. **Antiperspirants and Deodorants-** Actives and mechanism of action	**7**	Explain the terms blemishes, wrinkles, acne etc.	4,5

TEXT BOOKS:

T1: Cosmetics - Formulation, Manufacture and quality control, PP.Sharma, 4th edition
T2: Handbook of cosmetic science and Technology A.O.Barel, M.Paye and H.I. Maibach. 3rd edition.
T3: Text book of cosmeticology by Sanju Nanda &Roop K. Khar, Tata Publishers.

REFERENCE BOOKS:

R1: Harry's Cosmeticology, Wilkinson, Moore, Seventh Edition, George Godwin. R2: Poucher's perfume cosmetics and Soaps, 10th edition.
R3: Cosmetic and Toiletries recent suppliers' catalogue.
R4: CTFA (The Cosmetic, Toiletry & Fragrance Association) directory.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand how Indian and EU legislation classifies cosmetics and cosmeceuticals. Learn the anatomy of the skin, hair, and oral cavities and the excipients used in aesthetic therapy.	**PO1,PO3,PO4,PO6,PO7,PO8, PO9,PO10,PO11**
2	Explain skin and hair care product components and processes and develop skills in cream, shampoo, toothpaste, and color formulation.	**PO1,PO3,PO4,PO6,PO7,PO8, PO9,PO10,PO11**
3	Create many sun protection cosmetics formulas using your new skills.	**PO1,PO3,PO4,PO6,PO7,PO8, PO9,PO10,PO11**
4	Design a method for researching and rating hair and skin care products.	**PO1,PO3,PO4,PO6,PO7,PO8, PO9,PO10,PO11**
5	Apply cosmetics R&D efforts focused on developing novel approaches to greasy hair, dry skin, and dandruff.	**PO1,PO3,PO4,PO6,PO7,PO8, PO9,PO10,PO11**

SEMESTER – VIII									
Course Title	**Project Work**								
Course code	**BP813PW**	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 45T	**3**	**1**	**2**	**0**	**0**	**0**	**6**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Programme	**Bachelor of Pharmacy**								
Semester	**Fall/ VIII semester of first year of the programme**								
Course Objectives	1. Acquire research skills. 2. Develop scientific writing skills. 3. Foster critical thinking ability. 4. Apply application-oriented learning. 5. Improve time management and organizational skills. 6. Enhance communication skills.								
CO1	Perform an Interdisciplinary work.								
CO2	Apply theoretical knowledge from the literature review. Start Experiment.								
CO3	Utilize the Literature Review and Design Objectives and Plan of work.								
CO4	Analyze the Results obtained and Evaluate them using Statistical methods with a Conclusion.								
CO5	Build Design and Compose a Manuscript for Publication.								

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Perform an Interdisciplinary work.	**PO1,PO2,PO3,PO4,PO6,PO7,PO8 ,PO9,PO10,PO11**
2	Apply theoretical knowledge from the literature review. Start Experiment.	**PO1,PO2,PO3,PO4,PO6,PO7,PO8 ,PO9,PO10,PO11**
3	Utilize the Literature Review and Design Objectives and Plan of work.	**PO1,PO2,PO3,PO4,PO6,PO7,PO8 ,PO9,PO10,PO11**
4	Analyze the Results obtained and Evaluate them using Statistical methods with a Conclusion.	**PO1,PO2,PO3,PO4,PO6,PO7,PO8 ,PO9,PO10,PO11**
5	Build Design and Compose a Manuscript for Publication.	**PO1,PO2,PO3,PO4,PO6,PO7,PO8 ,PO9,PO10,PO11**

ASSAM DOWN TOWN UNIVERSITY

Curriculum and Syllabus

Master of Pharmacy

(Pharmaceutics)

OUTCOME BASED EDUCATION FRAMEWORK

CHOICE BASED CREDIT SYSTEM

Version: 1.01

FACULTY OF

PHARMACEUTICAL SCIENCE

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 program, collectively embodies the vision and mission of the university. All the programs offered by the Faculty of Pharmaceutical Science of Assam down town University strictly follow the curriculum approved by the Pharmacy Council of India (PCI), the statutory body responsible for regulating the profession of pharmacy in India. 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 program 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 Pharmaceutical Science held on dated 08/07/2023 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 Overview

M.Pharm programme designed to enrich students' basic and advanced knowledge in the Pharmaceutical Science domain, the programme follows the courses mandated by Pharmacy Council of India (PCI) education regulations. The semester-wise course sequence and the entire M. Pharm curricula have been arranged to provide hands-on training and real-world exposure to traditional and modern practices, making graduates industry-ready. As pharmacists are true drug experts, M. Pharm students are exposed to allied science courses and core pharmaceutical courses, fostering their aptitude for research and advancements in new drug development technologies.

Rules & Syllabus for the Master of Pharmacy (M. Pharm) Course framed under Regulation of the 2014 as per by Pharmacy Council of India (PCI).

Duration of the course

The course of study for M.Pharm shall extend over a period of four semesters (two academic years).

Specific Features of the Curriculum

The M Pharm curriculum is designed to align with the evolving needs of the pharmacy field and society at large. It offers a comprehensive blend of theoretical knowledge and practical applications essential for a profound understanding of pharmaceuticals, fostering the development of a wide array of skills. This curriculum is thoughtfully designed to equip students with both theoretical acumen and hands-on proficiency, catering precisely to the requirements of the dynamic industry and the broader societal demands.

ELIGIBILITY Criteria:

A Pass in the following examinations:

B. Pharm Degree examination of an Indian university established by law in India from an institution approved by Pharmacy Council of India and has scored not less than 55% of the maximum marks (aggregate of 4 years of B.Pharm.)

Every student, selected for admission to post graduate pharmacy program in any PCI approved institution should have obtained registration with the State Pharmacy Council or should obtain the same within one month from the date of his/her admission, failing which the admission of the candidate shall be cancelled.

Note: It is mandatory to submit a migration certificate obtained from the respective university where the candidate had passed his/her qualifying degree (B.Pharm.)

Program Educational Objectives (PEOs):

PEO-1: AdtU Pharmacy graduates will be well prepared for successful careers as Pharmaceutical Professionals across diverse sectors including the pharmaceutical industry, healthcare, corporate institutions and government organizations.

PEO-2: Pharmacy graduates will be academically prepared to become Registered Pharmacists, poised to make significant contributions to the advancement of the healthcare sector.

PEO-3: The graduates will engage in professional practices to elevate their stature with a sense of responsibility and be successful in higher education, if pursued.

Programme Specific Outcomes (PSOs):

PSO-1: Professional Excellence: Translate the high-level of understanding of drug action into key stages in preclinical, clinical research studies and interpret data of pharmaceutical experiments in drug discovery and modifications as per the needs of pharmaceutical industries.

PSO-2: Practice in Research: Apply pharmacy knowledge and competency in research, and collaborative projects thereby contributing to the continuous advancement of pharmaceutical science.

PSO-3: International Competency: Demonstrate global professional competencies by attaining interdisciplinary knowledge through specialized certifications offered on international learning platforms.

Program Outcome (POs):

PO.1: Pharmacy Knowledge: Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioural, social, and administrative pharmacy sciences; and manufacturing practices.

PO.2: Planning abilities: Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines.

PO.3: Problem analysis: Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyse, evaluate and apply information systematically and shall make defensible decisions.

PO.4: Modern tool usage: Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.

PO.5: Leadership skills: Understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfilment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizens or leadership roles when appropriate to facilitate improvement in health and well- being.

PO.6: Professional identity: Understand, analyse and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).

PO.7: Pharmaceutical ethics: Honour personal values and apply ethical principles in professional and social contexts. Demonstrate behaviour that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.

PO.8: Communication: Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions.

Career Prospects:

M. Pharm graduates are equipped to assume diverse roles, such as Industrial Pharmacist (in the field of Production and Manufacturing, Formulation Development, Quality Assurance, Quality Control, Packaging, R&D etc.), Hospital and Community Pharmacist, Medical Representative, Sales Executive, Bulk Medicine Distributor, Lecturer, Entrepreneurship, Drug Inspector, Drug Analyst etc. After completion of M. Pharmacy, the students may go for higher studies in PhD programs.

CHAPTER –I: REGULATIONS

1. Short Title and Commencement

These regulations shall be called as "The Revised Regulations for the Master of Pharmacy (M.Pharm) Degree Program - Credit Based Semester System (CBSS) of the Pharmacy Council of India, New Delhi". They shall come into effect from the Academic Year 2016-17. The regulations framed are subject to modifications from time to time by the authorities of the university.

2. Minimum qualification for admission

A Pass in the following examinations:

B.Pharm Degree examination of an Indian university established by law in India from an institution approved by Pharmacy Council of India and has scored not less than 55% of the maximum marks (aggregate of 4 years of B.Pharm.)

Every student, selected for admission to post graduate pharmacy program in any PCI approved institution should have obtained registration with the State Pharmacy Council or should obtain the same within one month from the date of his/her admission, failing which the admission of the candidate shall be cancelled.

Note: It is mandatory to submit a migration certificate obtained from the respective university where the candidate had passed his/her qualifying degree (B.Pharm.)

3. Duration of the program

The program of study for M.Pharm. Shall extend over a period of four semesters (two academic years). The curricula and syllabi for the program shall be prescribed from time to time by Pharmacy Council of India, New Delhi.

4. Medium of instruction and examinations

Medium of instruction and examination shall be in English.

5. Working days in each semester

Each semester shall consist of not less than 100 working days. The odd semesters shall be conducted from the month of June/July to November/December and the even semesters shall be conducted from the month of December/January to May/June in every calendar year.

6. Attendance and progress

A candidate is required to put in at least 80% attendance in individual courses considering theory and practical separately. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

7. Program/Course credit structure

As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, practical classes, seminars, assignments, etc. are measured in terms of credits. On satisfactory completion of the courses, a candidate earns credits. The amount of credit associated with a course is dependent upon the number of hours of instruction per week in that course. Similarly, the credit associated with any of the other academic, co/extra- curricular activities is dependent upon the quantum of work expected to be put in for each of these activities per week/per activity.

8. Credit assignment

8.1 Theory and Laboratory courses

Courses are broadly classified as Theory and Practical. Theory courses consist of lecture (L) and Practical (P) courses consist of hours spent in the laboratory. Credits (C) for a course is dependent on the number of hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture and a multiplier of half (1/2) for practical (laboratory) hours. Thus, for example, a theory course having four lectures per week throughout the semester carries a credit of 4. Similarly, a practical having four laboratory hours per week throughout semester carries a credit of 2.

The contact hours of seminars, assignments and research work shall be treated as that of practical courses for the purpose of calculating credits. i.e., the contact hours shall be multiplied by 1/2. Similarly, the contact hours of journal club, research work presentations and discussions with the supervisor shall be considered as theory course and multiplied by 1.

8.2 Minimum credit requirements

The minimum credit points required for the award of M. Pharm degree is 95. However based on the credit points earned by the students under the head of co-curricular activities, a student shall earn a maximum of 100 credit points. These credits are divided into Theory courses, Practical, Seminars, Assignments, Research work, Discussions with the supervisor, Journal club and Co-Curricular activities over the duration of four semesters. The credits are distributed semester-wise as shown in Table 12. Courses generally progress in sequence, building competencies and their positioning indicates certain academic maturity on the part of the learners. Learners are expected to follow the semester-wise schedule of courses given in the syllabus.

9. Academic work

A regular record of attendance both in Theory, Practical, Seminar, Assignment, and Journal club, Discussion with the supervisor, Research work presentation and Dissertation shall be maintained by the department / teaching staff of respective courses.

10. Course of study

The specializations in M.Pharm program is given in Table 1.

Table – 1: List of M.Pharm. Specializations and their Code

S. No.	Specialization	Code
1.	Pharmaceutics	MPH
2.	Industrial Pharmacy	MIP
3.	Pharmaceutical Chemistry	MPC
4.	Pharmaceutical Analysis	MPA
5.	Pharmaceutical Quality Assurance	MQA
6.	Pharmaceutical Regulatory Affairs	MRA
7.	Pharmaceutical Biotechnology	MPB
8.	Pharmacy Practice	MPP
9.	Pharmacology	MPL
10.	Pharmacognosy	MPG

The course of study for M.Pharm specializations shall include Semester wise Theory & Practical as given in Table – 2 to 11. The number of hours to be devoted to each theory and practical course in any semester shall not be less than that shown in Table – 2 and 3.

Table – 2: Course of study for M. Pharm (Pharmaceutics)

Course Code	Course	Credit Hours	Credit Points	Hrs./wk.	Marks
Semester I					
MPH101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPH102T	Drug Delivery System	4	4	4	100
MPH103T	Modern Pharmaceutics	4	4	4	100
MPH104T	Regulatory Affair	4	4	4	100
MPH105P	Pharmaceutics Practical I	12	6	12	150
MPH106NA	Seminar/Assignment	7	4	7	100
Total		35	26	35	650

Semester II					
MPH201T	Molecular Pharmaceutics (Nano Tech and Targeted DDS)	4	4	4	100
MPH202T	Advanced Biopharmaceutics & Pharmacokinetics	4	4	4	100
MPH203T	Computer Aided Drug Delivery System	4	4	4	100
MPH204T	Cosmetic and Cosmeceuticals	4	4	4	100
MPH205P	Pharmaceutics Practical II	12	6	12	150
MPH206NA	Seminar/Assignment	7	4	7	100
Total		35	26	35	650

Table – 3: Course of study for M. Pharm. III Semester

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
MRM302NA	Journal club	1	1
MRM303NA	Discussion / Presentation (Proposal Presentation)	2	2
MRM304NA	Research Work	28	14
Total		35	21

* Non University Exam

Table – 4: Course of study for M. Pharm. IV Semester

Course Code	Course	Credit Hours	Credit Points
MRM401NA	Journal Club	1	1
MRM402NA	Discussion/Final Presentation	3	3
MRM403NA	Research Work and Colloquium	31	16
MRM404NA	Scholarly Activity		3
Total		35	23

Table – 5: Semester wise credits distribution

Semester	Credit Points
I	26
II	26
III	23
IV	23
Co-curricular Activities/Scholarly Activities (Attending Conference, Scientific Presentations and Scholarly Activities) Credit Points will be included in IV semester and 4 credit point will be allocated for other certificate courses	Minimum=04
Total Credit Points	100

Table – 6: Guidelines for Awarding Credit Points for Co-curricular Activities

Name of the Activity	Maximum Credit Points Eligible / Activity
Participation in National Level Seminar/ Conference/ Workshop/ Symposium/ Training Programs (related to the specialization of the student)	01
Participation in international Level Seminar/ Conference/ Workshop/ Symposium/ Training Programs (related to the specialization of the student)	02
Academic Award/Research Award from State Level/National Agencies	01
Academic Award/Research Award from International Agencies	02
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)	01
Research / Review Publication in International Journals (Indexed in Scopus / Web of Science)	02

Note: International Conference: Held outside India International Journal: The Editorial Board outside India

*The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University. The criteria to acquire this credit point shall be defined by the colleges from time to time.

11. Program Committee

The M. Pharm. programme shall have a Programme Committee constituted by the Head of the institution in consultation with all the Heads of the departments.

The composition of the Programme Committee shall be as follows:

A teacher at the cadre of Professor shall be the Chairperson; One Teacher from each M.Pharm specialization and four student representatives (two from each academic year), nominated by the Head of the institution.

Duties of the Programme Committee:

- Periodically reviewing the progress of the classes.
- Discussing the problems concerning curriculum, syllabus and the conduct of classes.
- Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.
- Communicating its recommendation to the Head of the institution on academic matters.
- The Programme Committee shall meet at least twice in a semester preferably at the end of each sessional exam and before the end semester exam.
- Examinations/Assessments
- The schemes for internal assessment and end semester examinations are given in Table – 8.

12. End semester examinations

12.1. The End Semester Examinations for each theory and practical course through semesters I to IV shall be conducted by the respective university except for the subject with asterix symbol (*) in table I and II for which examinations shall be conducted by the subject experts at college level and the marks/grades shall be submitted to the university

Table – 7: Schemes for internal assessments and end semester

(Pharmaceutics- MPH)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
SEMESTER I								
MPH 101T	Modern Pharmaceutical Analytical Techniques	10	15	1 Hr	25	75	3 Hrs	100
MPH 102T	Drug Delivery System	10	15	1 Hr	25	75	3 Hrs	100
MPH 103T	Modern Pharmaceutics	10	15	1 Hr	25	75	3 Hrs	100
MPH104T	Regulatory Affair	10	15	1 Hr	25	75	3 Hrs	100
MPH105P	Pharmaceutics Practical I	20	30	6 Hrs	50	100	6 Hrs	150
MPH106NA	Seminar/Assignment	-	-	-	-	-	-	100
Total								650
SEMESTER II								
MPH 201T	Molecular Pharmaceutics (Nano Tech and Targeted DDS)	10	15	1 Hr	25	75	3 Hrs	100
MPH 202T	Advanced Biopharmaceutics & Pharmacokinetics	10	15	1 Hr	25	75	3 Hrs	100
MPH 203T	Computer Aided Drug Delivery System	10	15	1 Hr	25	75	3 Hrs	100
MPH204T	Cosmetic and Cosmeceuticals	10	15	1 Hr	25	75	3 Hrs	100
MPH 205P	Pharmaceutics Practical II	20	30	6 Hrs	50	100	6 Hrs	150
MPH206NA	Seminar/Assignment	-	-	-	-	-	-	100
Total								650

Table – 8: Schemes for internal assessments and end semester examinations (Semester III& IV)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
SEMESTER III								
MRM30 1T	Research Methodology and Biostatistics*	10	15	1 Hr	25	75	3 Hrs	100
MRM302NA	Journal club	-	-	-	25	-	-	25
MRM303NA	Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
MRM304NA	Research work*	-	-	-	-	350	1 Hr	350
Total								525
SEMESTER IV								
MRM401NA	Journal club	-	-	-	25	-	-	25
MRM402NA	Discussion / Final Presentation	-	-	-	-	75		75
MRM403NA	Research work and Colloquium	-	-	-	-	400	-	400
MRM404NA	Scholarly Activity	-	-	-	-	175	-	175
Total								675

*Non University Examination

12.2. Internal assessment: Continuous mode

The marks allocated for Continuous mode of Internal Assessment shall be awarded as per the scheme given below.

Sessional Exams

Two sessional exams shall be conducted for each theory / practical course as per the schedule fixed by the college(s). The scheme of question paper for theory and practical sessional examinations is given in the table. The average marks of two sectional exams shall be computed for internal assessment as per the requirements given in tables.

Table – 9: Scheme for awarding internal assessment: Continuous mode

Theory	
Criteria	Maximum Marks
Attendance (Refer Table – 28)	8
Student – Teacher interaction	2
Total	10
Practical	
Criteria	Maximum Marks
Attendance (Refer Table – 28	10
Based on Practical Records, Regular viva voce, etc.	10
Total	20

Table – 10: Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

13. Promotion and award of grades

A student shall be declared PASS and eligible for getting grade in a course of M.Pharm. Programme if he/she secures at least 50% marks in that particular course including internal assessment.

13. Carry forward of marks

In case a student fails to secure the minimum 50% in any Theory or Practical course as specified in 12, then he/she shall reappear for the end semester examination of that course. However, his/her marks of the Internal Assessment shall be carried over and he/she shall be entitled for grade obtained by him/her on passing.

14. Improvement of internal assessment

A student shall have the opportunity to improve his/her performance only once in the sectional exam component of the internal assessment. The re-conduct of the sectional exam shall be completed before the commencement of next end semester theory examinations.

15. Re-examination of end semester examinations

Re-examination of end semester examination shall be conducted as per the schedule given in table 29. The exact dates of examinations shall be notified from time to time.

Table – 11: Tentative schedule of end semester examinations

Semester	For Regular Candidates	For Failed Candidates
I and III	November / December	May / June
II and IV	May / June	November / December

16. Allowed to keep terms (ATKT):

No student shall be admitted to any examination unless he/she fulfils the norms given in 6. ATKT rules are applicable as follows:

A student shall be eligible to carry forward all the courses of I and II semesters till the III semester examinations. However, he/she shall not be eligible to attend the courses of IV semester until all the courses of I, II and III semesters are successfully completed.

A student shall be eligible to get his/her CGPA upon successful completion of the courses of I to IV semesters within the stipulated time period as per the norms.

Note: Grade AB should be considered as failed and treated as one head for deciding ATKT. Such rules are also applicable for those students who fail to register for examination(s) of any course in any semester.

17. Grading of performances

Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the end of the semester for each course. The letter grades and their corresponding grade points are given in Table – 12.

Table – 12: Letter grades and grade points equivalent to Percentage of marks and performances

Percentage of Marks Obtained	Letter Grade	Grade Point	Performance
90.00 – 100	O	10	Outstanding
80.00 – 89.99	A	9	Excellent
70.00 – 79.99	B	8	Good
60.00 – 69.99	C	7	Fair
50.00 – 59.99	D	6	Average
Less than 50	F	0	Fail
Absent	AB	0	Fail

A learner who remains absent for any end semester examination shall be assigned a letter grade of AB and a corresponding grade point of zero. He/she should reappear for the said evaluation/examination in due course.

The Semester grade point average (SGPA)

The performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). The SGPA is the weighted average of the grade points obtained in all the courses by the student during the semester. For example, if a student takes five courses (Theory/Practical) in a semester with credits C1, C2, C3 and C4 and the student's grade points in these courses are G1, G2, G3 and G4, respectively, and then students' SGPA is equal to:

$$SGPA = \frac{C1G1 + C2G2 + C3G3 + C4G4}{C1 + C2 + C3 + C4}$$

The SGPA is calculated to two decimal points. It should be noted that, the SGPA for any semester shall take into consideration the F and ABS grade awarded in that semester. For example if a learner has a F or ABS grade in course 4, the SGPA shall then be computed as:

$$SGPA = \frac{C1G1 + C2G2 + C3G3 + C4* ZERO}{C1 + C2 + C3 + C4}$$

Cumulative Grade Point Average (CGPA)

The CGPA is calculated with the SGPA of all the IV semesters to two decimal points and is indicated in final grade report card/final transcript showing the grades of all IV semesters and their courses. The CGPA shall reflect the failed status in case of F grade(s), till the course(s) is/are passed. When the course(s) is/are passed by obtaining a pass grade on subsequent examination(s) the CGPA shall only reflect the new grade and not the fail grades earned earlier. The CGPA is calculated as:

$$CGPA = \frac{C1S1 + C2S2 + C3S3 + C4S4}{C1 + C2 + C3 + C4}$$

where C1, C2, C3,…. is the total number of credits for semester I, II,III,…. and S1, S2, S3,….is the SGPA of semester I,II,III,…. .

Declaration of class

The class shall be awarded on the basis of CGPA as follows: First Class with Distinction = CGPA of. 7.50 and above

First Class = CGPA of 6.00 to 7.49

Second Class = CGPA of 5.00 to 5.99

Project work

All the students shall undertake a project under the supervision of a teacher in Semester III to IV and submit a report. 4 copies of the project report shall be submitted (typed & bound copy not less than 75 pages).

The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). The projects shall be evaluated as per the criteria given below.

Evaluation of Dissertation Book:

Objective(s) of the work done	50 Marks
Methodology adopted	150 Marks
Results and Discussions	250 Marks
Conclusions and Outcomes	50 Marks
Total	500 Marks

Evaluation of Presentation:

Presentation of work	100 Marks
Communication skills	50 Marks
Question and answer skills	100 Marks
Total	250 Marks

Award of Ranks

Ranks and Medals shall be awarded on the basis of final CGPA. However, candidates who fail in one or more courses during the M.Pharm program shall not be eligible for award of ranks. Moreover, the candidates should have completed the M. Pharm program in minimum prescribed number of years, (two years) for the award of Ranks.

Award of degree

Candidates who fulfil the requirements mentioned above shall be eligible for award of degree during the ensuing convocation.

Duration for completion of the program of study

The duration for the completion of the program shall be fixed as double the actual duration of the program and the students have to pass within the said period, otherwise they have to get fresh Registration.

Revaluation I retotalling of answer papers

There is no provision for revaluation of the answer papers in any examination. However, the candidates can apply for retotalling by paying prescribed fee.

Re-admission after break of study

Candidate who seeks re-admission to the program after break of study has to get the approval from the university by paying a condonation fee.

SEMESTER – I										
Course Title	Modern Pharmaceutical Analytical Techniques									
Course code	MPH101T	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**	
		Total hours: 60T	**4**	**0**	**0**	**0**	**0**	**0**	**4**	
Pre-requisite	**Nil**	**Co-requisite**	**Nil**							
Program	Master of Pharmacy (Pharmaceutics)									
Semester	I semester of first year of the program									
Course Objectives	After completion of course student is able to know, Chemicals and Excipients. The analysis of various drugs in single and combination dosage forms. Theoretical and practical skills of the instruments.									
CO1	Compare and Utilize the Spectroscopy knowledge to Interpret various levels of molecular spectra's.									
CO2	Analyze instrumentation of N.M.R, compare 1D NMR, 2DNMR, 1HNMR and 13CNMR to Propose structures.									
CO3	Assume the principle and Importance, theory of Mass, spectroscopy, differentiate different peaks and ionization and Fragmentation rules to Predict the structure.									
CO4	Compare different Chromatographic techniques and Evaluate instrumentation, choose each technique based on sample and Develop a Validated method.									
CO5	Justify different electrophoretic techniques, X-ray crystallography and design with Importance of Electrophoresis, X-Ray Crystallography and Bioluminescence assays.									

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**UV-Visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, choice of solvents and solvent effect and Applications of UV-Visible spectroscopy. **IR spectroscopy:** Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy **Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and applications.	**11**	Students will be able to know theory& Application behind each spectroscopic technique.	2, 3,4,5
II	**NMR spectroscopy:** Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and	**11**	Students will be able to know basic concepts and theory behind NMR. & predict NMR spectra by Application to organic compounds.	3,4,5

	13CNMR. Applications of NMR spectroscopy.			
III	**Mass Spectroscopy:** Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, n chemical, field, FAB and MALDI, APCI, ESI, APPI Analysers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy	**11**	Students will be able to learn identify which Ionization technique is suitable for compounds and analyze the type of Analyzer to be used depending on the sample.	3,4,5
IV	**Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d)Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography	**11**	Students will be able to understand theory & application of different chromatographic techniques. .	3,4,5
V	**a. Electrophoresis:** Principle, Instrumentation, working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing **b. X ray Crystallography:** Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X ray diffraction.	**11**	Students will be able to Understand, Principle, Instrumentation, working conditions, factors affecting separation and applications of electrophoresis.	3,4,5
VI	**Immunological assays:** RIA (Radio immunoassay), ELISA, Bioluminescence assays.	**5**	Students will be able to know importance of RIA and ELISA techniques and their applications.	

TEXT BOOKS:

T1: Elementary Organic Spectroscopy by Y. R Sharma.

T2: Chromatography by P.D Sethi.

REFERENCE BOOKS:

R1. Spectrometric Identification of Organic compounds- Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.

R2. Principles of Instrumental Analysis- Doglas ASkoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
R3. Instrumental methods of analysis– Willards, 7th edition, CBS publishers.
R4. Practical Pharmaceutical Chemistry– Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
R5. Organic Spectroscopy- William Kemp, 3rd edition, ELBS, 1991.
R6. Quantitative Analysis of Drugs in Pharmaceutical formulation- P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
R7. Pharmaceutical Analysis- Modern methods– Part B- J W Munson, Volume 11, Marcel Dekker Series.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Compare and Utilize the Spectroscopy knowledge to Interpret various levels of molecular spectra.	PO1,PO2,PO3,PO4,PO5,PO8
2	Analyze instrumentation of N.M.R, compare 1D NMR, 2DNMR, 1HNMR and 13CNMR to Propose structures.	PO1,PO2,PO3,PO4,PO5,PO8
3	Assume the principle and Importance, theory of Mass, spectroscopy, differentiate different peaks and ionization and Fragmentation rules to Predict the structure.	PO1,PO2,PO3,PO4,PO5,PO8
4	Compare different Chromatographic techniques and Evaluate instrumentation, choose each technique based on sample and Develop a Validated method.	PO1,PO2,PO3,PO4,PO5,PO8
5	Justify different electrophoretic techniques, X-ray crystallography and design with Importance of Electrophoresis, X-Ray Crystallography and Bioluminescence assays.	PO1,PO2,PO3,PO4,PO5,PO8

SEMESTER – I									
Course Title	Drug Delivery Systems								
Course code	MPH102T	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T	**4**	**0**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy (Pharmaceutics)								
Semester	I semester of first year of the program								
Course Objectives	Upon completion of the course, student shall be able to understand The various approaches for development of novel drug delivery systems. The criteria for selection of drugs and polymers for the development of delivering system. The formulation and evaluation of Novel drug delivery systems.								
CO1	Understand principles and mechanisms of SR, CR, and Rate-Controlled Drug Systems and criteria for selection of drugs and polymers.								
CO2	Design tailored drug delivery approaches suitable for specific patient categories and apply personalized medicine concepts.								
CO3	Design, formulate, and evaluate muco - adhesive Buccal, Ocular, and Transdermal Drug Delivery Systems.								
CO4	Recognize and address the unique challenges in Protein, Peptide, and Vaccine delivery systems emphasizing their formulations and evaluations								
CO5	Analyze the cost-effectiveness, therapeutic efficacy, and patient-centric benefits of various novel drug delivery systems.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Sustained Release (SR) and Controlled Release (CR) formulations:** Introduction & basic concepts, advantages/ disadvantages, factors influencing, Physicochemical & biological approaches for SR/CR formulation, Mechanism of Drug Delivery from SR/CR formulation. Polymers: introduction, definition, classification, properties and application Dosage Forms for Personalized Medicine: Introduction, Definition, Pharmacogenetics, And Categories of Patients for Personalized Medicines: Customized drug delivery systems, Bioelectronic Medicines, 3D printing of pharmaceuticals, Tele pharmacy.	**10**	Students will be able to learn about drug delivery systems and their role in modern pharmaceuticals, analyse the impact of various factors on drug delivery.	2,3,4
II	**Rate Controlled Drug Delivery Systems**: Principles & Fundamentals, Types, Activation; Modulated Drug Delivery Systems; Mechanically	**10**	Students will be able to Compare and contrast different drug delivery routes and evaluate the suitability of specific drug delivery routes for different drugs.	2,3,4

	activated, pH activated, Enzyme activated, and Osmotic activated Drug Delivery Systems Feedback regulated Drug Delivery Systems; Principles & Fundamentals.			
III	**Gastro-Retentive Drug Delivery Systems:** Principle, concepts advantages and disadvantages, Modulation of GI transit time approaches to extend GI transit. Buccal Drug Delivery Systems: Principle of muco adhesion, advantages and disadvantages, Mechanism of drug permeation, Methods of formulation and its evaluations.	**10**	Students will be able explain the mechanisms of controlled and sustained release drug delivery. And able to analyze different formulation approaches for controlled release.	3,4,5
IV	**Ocular Drug Delivery Systems:** Barriers of drug permeation, Methods to overcome barriers.	**6**	Students will be able to learn to Compare and contrast different drug delivery routes and evaluate the suitability of specific drug delivery routes for different drugs.	2,3,4,5
V	**Transdermal Drug Delivery Systems:** Structure of skin and barriers, Penetration enhancers, Transdermal Drug Delivery Systems, Formulation and evaluation.	**10**	Students will be able to evaluate the role of nanoparticles, liposomes, and micelles in targeted drug delivery.	2,3,4,5
VI	**Protein and Peptide Delivery**: Barriers for protein delivery. Formulation and Evaluation of delivery systems of proteins and other macromolecules.	**8**	Students will be able to know about the latest developments in drug delivery research. & critically evaluate the Potential impact of new technologies in drug delivery.	2,3,4,5
VII	**Vaccine delivery systems:** Vaccines, uptake of antigens, single shot vaccines, mucosal and transdermal delivery of vaccines.	**6**	Students will be able to Identify future directions and challenges for drug delivery system design.	2,3,4,5

TEXT BOOKS:

T1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.

T2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker,Inc., New York, 1992.

T3. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).

T4. S.P.Vyas and R.K.Khar, Controlled Drug Delivery - concepts and advances, VallabhPrakashan, New Delhi, First edition 2002)

REFERENCE BOOKS:

R1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.

R2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker,Inc., New York, 1992.

R3. Encyclopaedia of controlled delivery, Editor- Edith Mathiowitz, Published by WileyInterscience Publication, John Wiley and Sons, Inc, New York! Chichester/Wenham

R4. N.K.Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).

R5. S.P.Vyas and R.K.Khar, Controlled Drug Delivery- concepts and advances, VallabhPrakashan, New Delhi, First edition 2002.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand principles and mechanisms of SR, CR, and Rate-Controlled Drug Systems and criteria for selection of drugs and polymers.	PO1,PO3,PO4,PO5,PO6,PO8
2	Design tailored drug delivery approaches suitable for specific patient categories and apply personalized medicine concepts.	PO1,PO3,PO4,PO5,PO6,PO8
3	Design, formulate, and evaluate muco-adhesive Buccal, Ocular, and Transdermal Drug Delivery Systems.	PO1,PO3,PO4,PO5,PO6,PO8
4	Recognize and address the unique challenges in Protein, Peptide, and Vaccine delivery systems emphasizing their formulations and evaluations	PO1,PO3,PO4,PO5,PO6,PO8
5	Analyze the cost-effectiveness, therapeutic efficacy, and patient-centric benefits of various novel drug delivery systems.	PO1,PO3,PO4,PO5,PO6,PO8

SEMESTER – I										
Course Title	Modern Pharmaceutics									
Course code	MPH103T	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T	**4**	**0**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy (Pharmaceutics)								
Semester	I semester of first year of the program								
Course Objectives	Upon completion of the course, student shall be able to understand The elements of reformulation studies. The Active Pharmaceutical Ingredients and Generic drug Product development Industrial Management and GMP Considerations. Optimization Techniques & Pilot Plant Scale Up Techniques Stability Testing, sterilization process & packaging of dosage forms.									
CO1	Recall and identify the fundamental concepts related to drug excipient interactions, stability testing, and theories of dispersion									
CO2	Comprehend the scope, merits, and guidelines for pharmaceutical validation and calibration									
CO3	Apply cGMP principles to ensure compliance, manage materials effectively, and implement production planning and control									
CO4	Analyze the impact of compression parameters on tablet properties and dissolution.									
CO5	Analyze the significance of data interpretation, statistical tests, and experimental results in pharmaceutical research and development.									

Unit-No	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	a. Preformation Concepts– Drug Excipient interactions different methods, kinetics of stability, Stability testing. Theories of dispersion and pharmaceutical Dispersion (Emulsion and Suspension, SMEDDS) preparation and stability large and small volume parental– physiological and formulation consideration, Manufacturing and evaluation. b. Optimization techniques in Pharmaceutical Formulation: Concept and parameters of optimization, Optimization techniques in pharmaceutical formulation and processing. Statistical design, Response surface method, Contour designs, Factorial designs and application in formulation	**20**	Students will be able to learn Drug Excipient interactions - different methods, kinetics of stability, Stability testing.	1,2,4,5
II	**Validation:** Introduction to Pharmaceutical Validation, Scope & merits of Validation, Validation and calibration of Master plan, ICH & WHO guidelines for calibration and validation of equipment, Validation of specific dosage form, Types of validation. Government regulation, Manufacturing Process Model, URS,	**10**	Students will be able to understand pharmaceutical Validation, Scope & merits of Validation, Validation and calibration of Master plan, ICH & WHO guidelines for calibration.	2,3,4,5

	DQ, IQ, OQ &P.Q. of facilities.			
III	cGMP& Industrial Management: Objectives and policies of current good manufacturing practices, layout of buildings, services, equipment's and their maintenance Production management: Production organization, materials management, handling and transportation, inventory management and control, production and planning control, Sales forecasting, budget and cost control, industrial and personal relationship. Concept of Total Quality Management.	**10**	Students will be able to learn about Production organization, materials management, handling and transportation, inventory management and control, production and planning control, Sales forecasting, budget and cost control, industrial and personal relationship.	2,3,4,5
IV	Compression and compaction: Physics of tablet compression, compression, consolidation, effect of friction, distribution of forces, compaction profiles. Solubility.	**10**	Students will be able to understand the Physics of tablet compression, compression, consolidation, effect of friction, distribution of forces, compaction profiles. Solubility.	2,3,4,5
V	Study of consolidation parameters; Diffusion parameters, Dissolution parameters and Pharmacokinetic parameters, Heckel plots, Similarity factors– f2 and f1, Higuchi and Peppas plot, Linearity Concept of significance, Standard deviation, Chi square test, students T-test, ANOVA test.	**10**	Students will be able to learn Diffusion parameters, Dissolution parameters and Pharmacokinetic parameters, Heckel plots, Similarity factors – f2 and f1, Higuchi and Peppas plot, Linearity Concept of significance, Standard deviation, Chi square test, students T-test, ANOVA test.	2,3,4,5

TEXT BOOKS:

T1. Dr. Ashok A. Hajare; Modern Pharmaceutics; Nirali Prakashan; 1st edition, 2023.

REFERENCE BOOKS:

R1. Theory and Practice of Industrial Pharmacy ByLachmann and Liebermann
R2. Pharmaceutical dosage forms:Tablets Vol. 1-3 by Leon Lachmann.
R3. Pharmaceutical Dosage forms: Disperse systems, Vol, 1-2; By Leon Lachmann.
R4. Pharmaceutical Dosage forms: Parenteral medications Vol. 1-2; By Leon Lachmann.
R5. Modern Pharmaceutics; By Gilbert and S. Banker.
R6. Remington's Pharmaceutical Sciences.
R7. Advances in Pharmaceutical Sciences Vol. 1-5; By H.S. Bean & A.H. Beckett.
R8. Physical Pharmacy; By Alfred Martin
R9. Bentley's Textbook of Pharmaceutics– by Rawlins.
R10.Goodmanufacturing practices for Pharmaceuticals: A plan for total quality control, Second edition; By Sidney H. Willing.
R11. Quality Assurance Guide; By Organization of Pharmaceutical producers of India.
R12. Drug formulation manual; By D.P.S. Kohl and D.H.Shah.Eastern publishers, New Delhi.

R13. How to practice GMPs; By P.P.Sharma.Vandhana Publications, Agra.
R14. Pharmaceutical Process Validation; By Fra. R. Berry and Robert A. Nash.
R15. Pharmaceutical Preformulations; By J.J. Wells.
R16. Applied production and operations management; By Evans, Anderson, Sweeneyand Williams.
R17. Encyclopaedia of Pharmaceutical technology, Vole I– III.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recall and identify the fundamental concepts related to drug excipient interactions, stability testing, and theories of dispersion	PO1,PO3,PO4,PO5,PO6,PO8
2	Comprehend the scope, merits, and guidelines for pharmaceutical validation and calibration	PO1,PO3,PO4,PO5,PO6,PO8
3	Apply cGMP principles to ensure compliance, manage materials effectively, and implement production planning and control	PO1,PO3,PO4,PO5,PO6,PO8
4	Analyze the impact of compression parameters on tablet properties and dissolution.	PO1,PO3,PO4,PO5,PO6,PO8
5	Analyze the significance of data interpretation, statistical tests, and experimental results in pharmaceutical research and development.	PO1,PO3,PO4,PO5,PO6,PO8

SEMESTER – I

Course Title	Regulatory Affairs								
Course code	MPH104T	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 60T	4	0	0	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy (Pharmaceutics)								
Semester	I semester of first year of the program								
Course Objectives	Upon completion of the course, it is expected that the students will be able to understand 1. The Concepts of innovator and generic drugs, drug development process 2. The Regulatory guidance's and guidelines for filing and approval process 3. Preparation of Dossiers and their submission to regulatory agencies in different countrie 4. Post approval regulatory requirements for actives and drug products 5. Submission of global documents in CTD/ eCTD formats 6. Clinical trials requirements for approvals for conducting clinical trials 7. Pharmacovigilance and process of monitoring in clinical trials								
CO1	Understand the concepts of innovator and generic drugs, differentiate between the drug development processes, and summarize the regulatory pathways for approval.								
CO2	Remember the regulatory guidelines and dossier preparation for international submissions to regulatory agencies for new drugs, generic drugs, and post-approval changes.								
CO3	Evaluate the processes, documentation, and regulatory expectations for conducting clinical trials from protocol development to safety monitoring.								
CO4	Analyze product and process related documents to identify critical quality attributes and prepare master batch records, Drug Master Files, technical reports, and other CMC regulatory documents.								
CO5	Apply ICH guidelines, CTD, and regional regulatory requirements to prepare a complete regulatory submission dossier for drug approval in the US, EU, and other global markets.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	a. Documentation in Pharmaceutical industry: Master formula record, DMF (Drug Master File), distribution records. Generic drugs product development Introduction, Hatch Waxman act and amendments, CFR (CODE OF FEDERAL REGULATION), drug product performance, in-vitro, ANDA regulatory approval process, NDA approval process, BE and drug product assessment, in–vivo, scale up process approval changes, post marketing surveillance, outsourcing BA and BE to CRO. b. Regulatory requirement for product approval: API, biologics, novel, therapies obtaining NDA, ANDA for generic drugs ways and means of US registration for foreign drugs	12	Students will be able to learn Documentation in Pharmaceutical industry & Regulatory requirement for product approval	2,3,4,5
II	CMC, post approval regulatory affairs. Regulation for combination products and medical devices' and ECTD format, industry and FDA liaison. ICH- Guidelines of ICH-Q, S E, M. Regulatory requirements of EU, MHRA, TGA and ROW countries.	12	Students will be able to Understand CMC, post approval regulatory affairs.	2,3,4,5
III	Non clinical drug development: Global submission of IND, NDA, ANDA.	12	Students will be able to know Non clinical drug	2,3,4,5

	Investigation of medicinal products dossier, dossier (IMPD) and investigator brochure (IB).		development	
IV	Clinical trials: Developing clinical trial protocols. Institutional review board/ independent ethics committee Formulation and working procedures informed Consent process and procedures. HIPAA- new, requirement to clinical study process, pharmacovigilance safety monitoring in clinical trials.	**12**	Students will be able to Learn about requirement to clinical study process, pharmacovigilance safety monitoring in clinical trials.	2,3,4,5

TEXT BOOKS:

1. Merchant S.H. and Dr.J.S.Quadry. A textbook of hospital pharmacy, 4th ed. Ahmadabad: B.S. Shah Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and IsaderKaufer,Marcel Dekker series, Vol.143 2.

REFERENCE BOOKS:

R1. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and IsaderKaufer,Marcel Dekker series, Vol.143

R2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P.Martin, Drugs and the Pharmaceutical Sciences,Vol.185, Informa Health care Publishers.

R3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD,5th edition, Drugs and the Pharmaceutical Sciences, Vol.190.

R4. Guidebook for drug regulatory submissions / Sandy Weinberg.By John Wiley &Sons.Inc.

R5. FDA regulatory affairs: a guide for prescription drugs, medical devices, and biologics/edited By Douglas J. Pisano, David Mantus.

R6. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A.Rozovsky and Rodney K. Adams.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand the concepts of innovator and generic drugs, differentiate between the drug development processes, and summarize the regulatory pathways for approval.	PO1,PO2,PO3,PO6,PO8
2	Remember the regulatory guidelines and dossier preparation for international submissions to regulatory agencies for new drugs, generic drugs, and post-approval changes.	PO1,PO2,PO3,PO6,PO8
3	Evaluate the processes, documentation, and regulatory expectations for conducting clinical trials from protocol development to safety monitoring.	PO1,PO2,PO3,PO6,PO8
4	Analyze product and process related documents to identify critical quality attributes and prepare master batch records, Drug Master Files, technical reports, and other CMC regulatory documents.	PO1,PO2,PO3,PO6,PO8
5	Apply ICH guidelines, CTD, and regional regulatory requirements to prepare a complete regulatory submission dossier for drug approval in the US, EU, and other global markets.	PO1,PO2,PO3,PO6,PO8

SEMESTER – I

Course Title	Pharmaceutics Practical- I								
Course code	MPH105P	Total credits: 12	L	T	P	S	R	O/F	C
		Total hours: 12	0	0	12	0	0	0	6
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy (Pharmaceutics)								
Semester	I semester of first year of the program								
Course Objectives	1. Upon completion of the course, it is expected that the students will be able to understand 2. Formulation and evaluation of pharmaceutical formulations. 3. Estimate the drug by spectroscopy								
CO1	The students will demonstrate comprehension of the analysis of pharmacopeial compounds and their formulations through the utilization of UV Vis spectrophotometer.								
CO2	The students will understand proficiency in executing preformulation studies for tablets, showcasing their ability to apply knowledge and analysis skills.								
CO3	The students will reveal their understanding of High-Performance Liquid Chromatography (HPLC) experiments through the application of analytical skills and knowledge, showcasing their ability to evaluate and interpret complex procedures.								
CO4	The students will establish their analytical skills by examining various drugs present in both singular and combined dosage forms, showcasing their ability to analyze and categorize pharmaceutical compositions								
CO5	The mastery of theoretical and practical skills associated with the instrument.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	1. Analysis of pharmacopeial compounds and their formulations by UV Vis spectrophotometer 2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry 3. Experiments based on HPLC 4. Experiments based on Gas Chromatography 5. Estimation of riboflavin/quinine sulphate by fluorimetry 6. Estimation of sodium/potassium by flame photometry 7. To perform In-vitro dissolution profile of CR/ SR marketed formulation 8. Formulation and evaluation of sustained release matrix tablets 9. Formulation and evaluation osmotically controlled DDS 10. Preparation and evaluation of Floating DDS- hydro dynamically balanced DDS 11. Formulation and evaluation of muco-adhesive tablets. 12. Formulation and evaluation of trans dermal patches. 13. To carry out preformulation studies of tablets. 14. Tostudy the effect of compressional		Students will be able to Learn Analysis of pharmacopeial compounds and their formulations by spectroscopic techniques	4,5,6

	force on tablets disintegration time. 16. Tostudy the effect of particle size on dissolution of a tablet. 17. Tostudy the effect of binders on dissolution of a tablet. 18. To plot Heckel plot, Higuchi and Peppas plot and determine similarity factors.			

TEXT BOOKS:

T1. A Practical Book of Pharmaceutics-I (M.Pharm), Khalil Wagh, Usman, Ahmed, S Vikas And Company (Pvt)

REFERENCE BOOKS:

R1. Pharmaceutics: Practical Manual 3Rd Edition by Abraham, Pharma Med Press

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	The students will demonstrate comprehension of the analysis of pharmacopeial compounds and their formulations through the utilization of UV Vis spectrophotometer.	PO1, PO2, PO3, PO4, PO5, PO6, PO8
2	The students will understand proficiency in executing preformulating studies for tablets, showcasing their ability to apply knowledge and analysis skills.	PO1, PO2, PO3, PO4, PO5, PO6, PO8
3	The students will reveal their understanding of High-Performance Liquid Chromatography (HPLC) experiments through the application of analytical skills and knowledge, showcasing their ability to evaluate and interpret complex procedures.	PO1, PO2, PO3, PO4, PO5, PO6, PO8
4	The students will establish their analytical skills by examining various drugs present in both singular and combined dosage forms, showcasing their ability to analyse and categorize pharmaceutical compositions	PO1, PO2, PO3, PO4, PO5, PO6, PO8
5	The mastery of theoretical and practical skills associated with the instrument.	PO1, PO2, PO3, PO4, PO5, PO6, PO8

SEMESTER – II

Course Title	Molecular Pharmaceutics (Nano Technology & Targeted DDS) (NTDS)								
Course code	MPH201T	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 60T	4	0	0	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy (Pharmaceutics)								
Semester	II semester of first year of the program								
Course Objectives	After completion of course student is able to know, 1. The various approaches for development of novel drug delivery systems. 2. The criteria for selection of drugs and polymers for the development of NTDS 3. The formulation and evaluation of novel drug delivery systems.								
CO1	Design drug delivery systems for targeting drugs to tumors and to the brain								
CO2	Prepare and evaluate nano particles and liposomes as carriers for drug targeting								
CO3	Acquire skills in formulating, preparing, and evaluating diverse nano particle-based systems								
CO4	Develop strategies for improving nasal absorption in the design of nasal drug delivery systems and optimize pulmonary delivery by the design of suitable aerosols, nebulizers and dry powder inhalers								
CO5	Apply knowledge of antisense molecules and emphasizing gene therapy approaches, expression systems, and the future potential of antisense molecules and aptamers								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	Targeted Drug Delivery Systems: Concepts, Events and biological process involved in drug targeting. Tumor targeting and Brain specific delivery.	12	Students will be able to learn Design drug delivery systems for targeting drugs to tumours and to the brain	3,4,5
II	Targeting Methods: introduction preparation and evaluation. Nano Particles & Liposomes: Types, preparation and evaluation.	12	Students will be able to Prepare and evaluate nano particles and liposomes as carriers for drug targeting	3,4,5
III	Micro Capsules / Micro Spheres: Types, preparation and evaluation, Monoclonal Antibodies; preparation and application, preparation and application of Niosomes, Aquasomes, Phytosomes, Electrosomes.	12	Students will be able to learn how to Select drugs and polymers in the design of microspheres and microcapsules for various applications	3,4,5
IV	Pulmonary Drug Delivery Systems: Aerosols, propellants, Containers Types, preparation and evaluation, Intra Nasal Route Delivery systems; Types, preparation and evaluation.	12	Students will be able to learn to Optimize pulmonary delivery by the design of suitable aerosols, nebulizers and dry powder inhalers and develop strategies for the design of nasal drug delivery systems	3,4,5
V	Nucleic acid based therapeutic delivery system: Gene therapy, introduction (ex-vivo & in-vivo	12	Students will be able to Apply gene therapy in the treatment of cancer and	3,4,5

	gene therapy). Potential target diseases for gene therapy (inherited disorder and cancer). Gene expression systems (viral and nonviral gene transfer). Liposomal gene delivery systems. Bio distribution and Pharmacokinetics. knowledge of therapeutic antisense molecules and aptamers as drugs of future.		inherited diseases	

TEXT BOOKS:

T1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.

T2. S.P.Vyas and R.K.Khar, Controlled Drug Delivery - concepts and advances, VallabhPrakashan, New Delhi, First edition 2002.

REFERENCE BOOKS:

R1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.

R2. S.P. Vyas and R.K. Khar, Controlled Drug Delivery- concepts and advances, VallabhPrakashan, New Delhi, First edition 2002.

R3. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, NewDelhi, First edition 1997 (reprint in 2001).

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Design drug delivery systems for targeting drugs to tumours and to the brain	PO1, PO2, PO3, PO4, PO5, PO6, PO8
2	Prepare and evaluate nano particles and liposomes as carriers for drug targeting	PO1, PO2, PO3, PO4, PO5, PO6, PO8
3	Acquire skills in formulating, preparing, and evaluating diverse nanoparticle-based systems	PO1, PO2, PO3, PO4, PO5, PO6, PO8
4	Develop strategies for improving nasal absorption in the design of nasal drug delivery systems and optimize pulmonary delivery by the design of suitable aerosols, nebulizers and dry powder inhalers	PO1, PO2, PO3, PO4, PO5, PO6, PO8
5	Apply knowledge of antisense molecules and emphasizing gene therapy approaches, expression systems, and the future potential of antisense molecules and aptamers.	PO1, PO2, PO3, PO4, PO5, PO6, PO8

SEMESTER – II

Course Title	Advanced Biopharmaceutics & Pharmacokinetics								
Course code	MPH202T	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 60T	4	0	0	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy (Pharmaceutics)								
Semester	II semester of first year of the program								
Course Objectives	After completion of course student is able to know, The basic concepts in biopharmaceutics and pharmacokinetics. The use raw data and derive the pharmacokinetic models and parameters the best describe the process of drug absorption, distribution, metabolism and elimination. The critical evaluation of biopharmaceutic studies involving drug product equivalency. The design and evaluation of dosage regimens of the drugs using pharmacokinetic and biopharmaceutic parameters. The potential clinical pharmacokinetic problems and application of basics of pharmacokinetic.								
CO1	Understanding the Gastrointestinal Tract (GIT) and Drug Absorption Mechanisms and Identify the factors that influence drug absorption in the gastrointestinal tract								
CO2	Apply biopharmaceutical principles to optimize drug formulation and design for improved performance and evaluate and interpret in vitro data to predict drug behavior and performance in vivo								
CO3	Apply mathematical models to describe drug ADME processes and assess the impact of drug-drug interactions on pharmacokinetics.								
CO4	Comprehend the design and conduct of bioequivalence studies and apply pharmacokinetic principles to evaluate and compare drug product performance								
CO5	Apply pharmacokinetic principles to predict drug behavior in different physiological and pathological conditions and integrate pharmacokinetic principles into clinical decision-making.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	Drug Gastrointestinal tract, Mechanism of drug absorption, Factors affecting drug absorption, pH–partition theory of drug absorption. Formulation and physicochemical factors: Dissolution rate, Dissolution process, Noyes–Whitney equation and drug dissolution, Factors affecting the dissolution rate. Gastrointestinal absorption: role of the dosage form: Solution (elixir, syrup and solution) as a dosage form, Suspension as a dosage form, Capsule as a dosage form, Tablet as a dosage form, Dissolution methods, Formulation and processing factors, Correlation of in vivo data with in vitro dissolution data. Transport model: Permeability-Solubility-Charge State and the pH Partition Hypothesis, Properties of the Gastrointestinal Tract (GIT), pH Microclimate Intracellular Complex. pH Environment, Tight-Junction	12	Students will be able to know the basic concepts in biopharmaceutics and pharmacokinetics	3,4,5
II	Biopharmaceutic considerations in drug product design and In Vitro Drug Product	12	Students will be able to know the factors	3,4,5

	Performance: Introduction, biopharmaceutic factors affecting drug bioavailability, rate-limiting steps in drug absorption, physicochemical nature of the drug formulation factors affecting drug product performance, in vitro: dissolution and drug release testing, compendial methods of dissolution, alternative methods of dissolution testing, meeting dissolution requirements, problems of variable control in dissolution testing performance of drug products. In vitro–in vivo correlation, dissolution profile comparisons, drug product stability, considerations in the design of a drug product.		affecting drug bioavailability, alternative methods of dissolution testing, meeting dissolution requirements, problems of variable control in dissolution testing performance of drug products	
III	Pharmacokinetics: Basic considerations, pharmacokinetic models, compartment modelling: one compartment model- IV bolus, IV infusion, extra-vascular. Multi compartment model: two compartment-model in brief, non-linear pharmacokinetics: cause of non-linearity, Michaelis– Menten equation, estimation of K_{max} and V_{max}. Drug interactions: introduction, the effect of protein binding interactions, the interactions, cytochrome effect of tissue-binding p450-based drug interactions, drug interactions linked to transporters.	**12**	Students will be able to know pharmacokinetic models	2,3,4
IV	Drug Product Performance, in vivo: Bioavailability and Bioequivalence: drug product performance, purpose of bioavailability studies, relative and absolute availability methods for assessing bioavailability, bioequivalence studies, design and evaluation of bioequivalence studies, study designs, crossover study designs, evaluation of the data, bioequivalence example, study submission and drug review process. biopharmaceutics classification system, methods. Permeability: In-vitro, in-situ and In-vivo methods. Generic biologics (bio similar drug products), clinical significance of bioequivalence studies, special concerns in bioavailability and bioequivalence studies, generic substitution.	**12**	Students will be able to know Bioavailability and Bioequivalence	3,4,5
V	Application of Pharmacokinetics: Modified-Release Drug Products, Targeted Drug Delivery Systems and Biotechnological Products. Introduction to Pharmacokinetics and pharmacodynamic, drug interactions. Pharmacokinetics and pharmacodynamics of	**12**	Students will be able to know Pharmacokinetics and pharmacodynamic, drug interactions. & Application of Pharmacokinetics.	3,4,5

	biotechnology drugs. Introduction, Proteins and peptides, Monoclonal antibodies, Oligonucleotides, Vaccines (immunotherapy), Gene therapies			

TEXT BOOKS:

R1. Bio pharmaceutics and Clinical Pharmacokinetics by Milo edition, Philadelphia, Lea and Febiger, 1991

R2. Biopharmaceutics and Pharmacokinetics, A. Treatise, D .M. Brahmankar and Sunil B. Jaiswal., Vallab Prakashan, Pitampura, Delhi.

REFERENCE BOOKS:

R1. Biopharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi, 4th edition, Philadelphia, Lea and Febiger, 1991

R2. Biopharmaceutics and Pharmacokinetics, A. Treatise, D .M. Brahmankar and Sunil B. Jaiswal., Vallab Prakashan, Pitampura, Delhi

R3. Applied Biopharmaceutics and Pharmacokinetics by Shargel. Land YuABC, 2ndedition, Connecticut Appleton Century Crofts, 1985

R4. Textbook of Biopharmaceutics and Pharmacokinetics, Dr.Shobha Rani R. Hiremath,Prism Book

R5. Pharmacokinetics by Milo Gibaldi and D. Perrier, 2nd edition, Marcel Dekker Inc., New York, 1982

R6. Current Concepts in Pharmaceutical Sciences: Biopharmaceutics, Swarbrick. J, LeaandFebiger, Philadelphia, 1970

R7. Clinical Pharmacokinetics, Concepts and Applications 3rd edition by Malcolm Rowland and Thom~N. Tozer, Lea and Febiger, Philadelphia, 1995

R8. Dissolution, Bioavailability and Bioequivalence, Abdou. H.M, Mack Publishing Company, Pennsylvania 1989

R9. Biopharmaceutics and Clinical Pharmacokinetics, An Introduction, 4th edition, revised and expanded by Robert. E. Notari, Marcel Dekker Inc,New York and Basel,1987.

R10. Bio pharmaceutics and Relevant Pharmacokinetics by John.G Wagner and M.Pemarowski, 1st edition, Drug Intelligence Publications, Hamilton, Illinois, 1971.

R11. Encyclopaedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James.G.Boylan, Marcel Dekker Inc, New York, 1996.

R12. Basic Pharmacokinetics,1st edition, Sunil S Jambhekar and Philip J Breen, pharmaceutical press, RPS Publishing,2009.

R13. Absorption and Drug Development- Solubility, Permeability, and Charge State, Alex Avdeef, John Wiley & Sons, Inc,2003.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understanding the Gastrointestinal Tract (GIT) and Drug Absorption Mechanisms and Identify the factors that influence drug absorption in the gastrointestinal tract	PO1, PO2, PO3, PO5, PO8
2	Apply biopharmaceutical principles to optimize drug formulation and design for improved performance and evaluate and interpret in vitro data to predict drug behavior and performance in vivo	PO1, PO2, PO3, PO5, PO8
3	Apply mathematical models to describe drug ADME processes and assess the impact of drug-drug interactions on pharmacokinetics.	PO1, PO2, PO3, PO5, PO8
4	Comprehend the design and conduct of bioequivalence studies and apply pharmacokinetic principles to evaluate and compare drug product performance	PO1, PO2, PO3, PO5, PO8
5	Apply pharmacokinetic principles to predict drug behavior in different physiological and pathological conditions and integrate pharmacokinetic principles into clinical decision-making.	PO1, PO2, PO3, PO5, PO8

SEMESTER – II

Course Title	Computer Aided Drug Development								
Course code	MPH203T	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 60T	4	0	0	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy (Pharmaceutics)								
Semester	II semester of first year of the program								
Course Objectives	After completion of course student is able to know, 1. History of Computers in Pharmaceutical Research and Development 2. Computational Modeling of Drug Disposition 3. Computers in Preclinical Development 4. Optimization Techniques in Pharmaceutical Formulation 5. Computers in Market Analysis 6. Computers in Clinical Development 7. Artificial Intelligence (AI) and Robotics 8. Computational fluid dynamics (CFD)								
CO1	Learn how to use computers for pharmaceutical research and development.								
CO2	Utilize the knowledge for computational modeling of drug disposition.								
CO3	Construct computer-aided formulation development, optimization, and screening.								
CO4	Computer-aided pharmacokinetics and pharmacodynamics characterization: analyzing the comprehensiveness.								
CO5	Invent and anticipate artificial intelligence, robotics, current challenges, and future developments.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	a. Computers in Pharmaceutical Research and Development: A General Overview: History of Computers in Pharmaceutical Research and Development. Statistical modelling in pharmaceutical research and development: Descriptive versus Mechanistic Modelling, Statistical Parameters, Estimation, Confidence Regions, Nonlinearity at the Optimum, Sensitivity Analysis, Optimal Design, Population Modelling b. Quality-by-Design in Pharmaceutical Development: Introduction, ICH Q8 guideline, Regulatory and industry views on QbD, scientifically based QbD-examples of application.	12	Students will be able to Understand the Computers in Pharmaceutical Research and Development.	3,4,5
II	Computational Modelling Of Drug Disposition: Introduction, Modelling Techniques: Drug Absorption, Solubility, Intestinal Permeation, Drug Distribution, Drug Excretion, Active Transport; P-gP, BCRP, Nucleoside Transporters, hPEPT1, ASBT, OCT, OATP, BBB-Choline Transporter.	12	Students will be able to Utilize the knowledge for Computational Modelling of Drug Disposition:	3,4,5
III	Computer-aided formulation development: Concept of optimization, Optimization parameters, Factorial	12	Students will be able to Understand the Computer-aided formulation	3,4,5

	design, Optimization technology & Screening design. Computers in Pharmaceutical Formulation: Development of pharmaceutical emulsions, micro-emulsion drug carriers Legal Protection of Innovative Uses of Computers in R&D, The Ethics of Computing in Pharmaceutical Research, Computers in Market analysis		development	
IV	a. Computer-aided biopharmaceutical characterization: Gastrointestinal absorption simulation. Introduction, Theoretical background, Model construction, Parameter sensitivity analysis, Virtual trial, Fed vs. fasted state, In vitro dissolution and in vitro in vivo correlation, Bio waiver considerations b. Computer Simulations in Pharmacokinetics and Pharmacodynamics: Introduction, Computer Simulation: Whole Organism, Isolated Tissues, Organs, Cell, Proteins and Genes. c. Computers in Clinical Development: Clinical Data Collection and Management, Regulation of Computer Systems	**12**	Students will be able to Understand the scope of Computer-aided Pharmacokinetics and Pharmaco-dynamics characterization	3,4,5
V	Artificial Intelligence (AI), Robotics and Computational fluid dynamics: General overview, Pharmaceutical Automation, Pharmaceutical applications, Advantages and Disadvantages. Current Challenges and Future Directions.	**12**	Students will be able to Understand and summarize the general Artificial Intelligence (AI), Robotics and Computational fluid dynamics	3,4,5

TEXT BOOKS:

T1. Computer Applications in Pharmaceutical Research and Development, Sean Ekins, 2006, John Wiley & Sons.

T2. Computer-Aided Applications in Pharmaceutical Technology, 1st Edition, JelenaDjuris, Woodhead Publishing.

REFERENCE BOOKS:

R1. Computer Applications in Pharmaceutical Research and Development, Sean Ekins, 2006, John Wiley & Sons.

R2. Computer-Aided Applications in Pharmaceutical Technology, 1st Edition, JelenaDjuris, Woodhead Publishing

R3. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James.G.Boylan, Marcel Dekker Inc, New York, 1996.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Learn how to use computers for pharmaceutical research and development.	PO1, PO2, PO3, PO4, PO5, PO8
2	Utilize the knowledge for computational modeling of drug disposition.	PO1, PO2, PO3, PO4, PO5, PO8
3	Construct computer-aided formulation development, optimization, and screening.	PO1, PO2, PO3, PO4, PO5, PO8
4	Computer-aided pharmacokinetics and pharmacodynamics characterization: analyzing the comprehensiveness.	PO1, PO2, PO3, PO4, PO5, PO8
5	Invent and anticipate artificial intelligence, robotics, current challenges, and future developments.	PO1, PO2, PO3, PO4, PO5, PO8

SEMESTER – II

Course Title	Cosmetics And Cosmeceuticals								
Course code	MPH204T	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 60T	4	0	0	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy (Pharmaceutics)								
Semester	II semester of first year of the program								
Course Objectives	After completion of course student is able to know, 1. Key ingredients used in cosmetics and cosmeceuticals. 2. Key building blocks for various formulations. 3. Current technologies in the market 4. Various key ingredients and basic science to develop cosmetics and cosmeceuticals 5. Scientific knowledge to develop cosmetics and cosmeceuticals with desired Safety, stability, and efficacy.								
CO1	Describe the Indian regulatory provisions related to import and manufacture of cosmetics								
CO2	Explain structure of skin and hair related to various problems								
CO3	Select building blocks for different product formulations of cosmetics and cosmeceuticals								
CO4	Select building blocks for different product formulations of cosmetics and cosmeceuticals								
CO5	Discuss the herbal ingredients used in hair care, skin care and oral care								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	Cosmetics– Regulatory: Definition of cosmetic products as per Indian regulation. Indian regulatory requirements for labelling of cosmetics Regulatory provisions relating to import of cosmetics. Misbranded and spurious cosmetics. Regulatory provisions relating to manufacture of cosmetics– Conditions for obtaining license, prohibition of manufacture and sale of certain cosmetics, loan license, offences and penalties.	12	Students will be able to Understand the cosmetic products as per Indian regulation. Understand the regulatory provisions related to the import and manufacture of cosmetics	2,3,4,5
II	Cosmetics- Biological aspects: Structure of skin relating to problems like dry skin, acne, pigmentation, prickly heat, wrinkles and body odour. Structure of hair and hair growth cycle. Common problems associated with oral cavity. Cleansing and care needs for face, eye lids, lips, hands, feet, nail, scalp, neck, body and under-arm.	12	Students will be able to Understand the Regulatory provisions relating to manufacture of cosmetics	2, 3,4,5
III	Formulation Building blocks: Building blocks for different product formulations of cosmetics/cosmeceuticals. Surfactants Classification and application. Emollients, rheological additives: classification and application. Antimicrobial used as preservatives, their merits and demerits. Factors affecting microbial preservative efficacy. Building blocks for formulation of a moisturizing cream, vanishing cream, cold cream, shampoo and toothpaste. Soaps and syndet bars. Perfumes;	12	Students will be able to learn about Structure of skin relating to problems	3,4,5

	Classification of perfumes. Perfume ingredients listed as allergens in EU regulation. Controversial ingredients: Parabens, formaldehyde liberators, dioxane.			
IV	Design of cosmeceutical products: Sun protection, sunscreens classification and regulatory aspects. Addressing dry skin, acne, sun-protection, pigmentation, prickly heat, wrinkles, body odour., dandruff, dental cavities, bleeding gums, mouth Odor and sensitive teeth through cosmeceutical formulations.	**12**	Students will be able to Understand the Structure of hair and hair growth cycle. Understand the problems associated with oral cavity	3,4,5
V	Herbal Cosmetics: Herbal ingredients used in Hair care, skin care and oral care. Review of guidelines for herbal cosmetics by private bodies like cosmos with respect to preservatives, emollients, foaming agents, emulsifiers and rheology modifiers. Challenges in formulating herbal cosmetics.	**12**	Students will be able to Recognize the role of Surfactants	2, 3,4,5

TEXT BOOKS:

T1. Cosmetics - Formulation, Manufacture and quality control, PP. Sharma, 4_{th} edition

T2. Handbook of cosmetic science and Technology A.O.Barel, M.Paye and H.I. Maibach. 3rd edition

REFERENCE BOOKS:

R1. Harry's Cosmeticology.8th edition.

R2. Poucher'sperfumecosmeticsandSoaps,10th edition.

R3. Cosmetics- Formulation, Manufacture and quality control, PP. Sharma,4th edition

R4. Handbook of cosmetic science and Technology A.O.Barel, M.Paye and H.I. Maibach. 3rdedition

R5. Cosmetic and Toiletries recent supplier's catalogue.

R6. CTFA directory

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Describe the Indian regulatory provisions related to import and manufacture of cosmetics	PO1, PO2, PO5, PO6, PO8
2	Explain structure of skin and hair related to various problems	PO1, PO2, PO5, PO6, PO8
3	Select building blocks for different product formulations of cosmetics and cosmeceuticals	PO1, PO2, PO5, PO6, PO8
4	Select building blocks for different product formulations of cosmetics and cosmeceuticals	PO1, PO2, PO5, PO6, PO8
5	Discuss the herbal ingredients used in hair care, skin care and oral care	PO1, PO2, PO5, PO6, PO8

SEMESTER – II

Course Title	Pharmaceutics Practical's- II								
Course code	MPH205P	Total credits: 6	L	T	P	S	R	O/F	C
		Total hours: 12	0	0	12	0	0	0	6
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy (Pharmaceutics)								
Semester	II semester of first year of the program								
Course Objectives	After completion of course student is able to know, Develop a novel drug delivery system. Perform pharmacokinetic and pharmacodynamic studies. Prepare and evaluate cosmetic products.								
CO1	Formulate and examine Alginate beads, microspheres, liposome, niosome etc.								
CO2	Compare dissolution of two different marketed products								
CO3	Analyse formulation data using Design Expert® Software								
CO4	Design and develop products incorporating herbal and chemical actives								
CO5	Develop and evaluate cream, shampoo and toothpaste base								

Unit-No	Content	Contact Hour	Learning Outcome	KL
I	1. To study the effect of temperature change,non-solvent addition, incompatible polymer addition in microcapsules preparation 2. Preparation and evaluation of Alginate beads 3. Formulation and evaluation of gelatine/albumin microspheres 4.Formulation and evaluation of liposome's/niosomes 5. Formulation and evaluation of spherules 6. Improvement of dissolution characteristics of slightly soluble drug by Solid dispersion technique. 7. Comparison of dissolution of two different marketed products /brands 8. Protein binding studies of a highly protein bound drug & poorly protein bound drug 9. Bioavailability studies of Paracetamol in animals. 10. Pharmacokinetic and IVIVC data analysis by WinnolineR software 11. In vitro cell studies for permeability and metabolism 12. DoE Using Design Expert® Software 13. Formulation data analysis Using Design Expert® Software 14. Quality-by-Design in Pharmaceutical Development 15. Computer Simulations in Pharmacokinetics and Pharmacodynamics 16. Computational Modelling of Drug Disposition 17. To develop Clinical Data Collection manual 18. To carry out Sensitivity Analysis, and Population Modelling.	12	Students will be able to understand the concepts of Microencapsulation and various factors effect on Micro-encapsulation and learn about various principles and procedures involved in Preparation and evaluation of various types Novel drug delivery dosage forms	3,4,5,6

	19. Development and evaluation of Creams 20. Development and evaluation of Shampoo and Toothpaste base 21. To incorporate herbal and chemical actives to develop products 22. To address Dry skin, acne, blemish, Wrinkles, bleeding gums and dandruff			

TEXT BOOKS:

T1. Bio pharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi, 4$_{th}$edition, Philadelphia, Lea and Febiger, 1991 2

T2. Bio pharmaceutics and Pharmacokinetics, A. Treatise, D .M. Brahmankar and Sunil B. Jaiswal., VallabPrakashan, Pitampura, Delhi

T3. Textbook of Bio pharmaceutics and Pharmacokinetics, Dr.Shobha Rani R. Hiremath, Prism Book

T4. Pharmacokinetics by Milo Gibaldi and D. Perrier, 2nd edition, Marcel Dekker Inc.,New York,1982

REFERENCE BOOKS:

R1. Clinical Pharmacokinetics, Concepts and Applications 3rd edition by MalcolmRowland and Thom~ N. Toner, Lea and Febiger, Philadelphia,1995 2

R2. Dissolution, Bioavailability and Bioequivalence, Abdou. H.M, Mack PublishingCompany, Pennsylvania 1989

R3. Bio pharmaceutics and Clinical Pharmacokinetics, An Introduction, 4th edition, revised and expanded by Robert. E. Notari, Marcel Dekker Inc, New York and Basel,1 987.

R4. Bio pharmaceutics and Relevant Pharmacokinetics by John. G Wagner and M.Pemarowski, 1st edition, Drug Intelligence Publications, Hamilton, Illinois, 1971 R5 Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James. G.Boylan, Marcel Dekker Inc, New York, 1996

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Formulate and examine Alginate beads, microspheres, liposome, niosome etc.	PO1, PO2, PO3, PO4, PO5, PO8
2	Compare dissolution of two different marketed products	PO1, PO2, PO3, PO4, PO5, PO8
3	Analyse formulation data using Design Expert® Software	PO1, PO2, PO3, PO4, PO5, PO8
4	Design and develop products incorporating herbal and chemical actives	PO1, PO2, PO3, PO4, PO5, PO8
5	Develop and evaluate cream, shampoo and toothpaste base	PO1, PO2, PO3, PO4, PO5, PO8

SEMESTER – III

Course Title	Research Methodology and Biostatistics								
Course code	MRM301T	Total credits: 4	L	T	P	S	R	O/F	C
		Total hours: 60T	4	0	0	0	0	0	4
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy								
Semester	III semester of Second year of the program								
Course Objectives	Upon completion of the course, the student shall be able to 1. Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment). 2. Know the various statistical techniques to solve statistical problems 3. Appreciate statistical techniques in solving the problems								
CO1	Analyse the value, scope, objectives, and requirements of research.								
CO2	Discuss the basic concepts of statistical analysis.								
CO3	Apply the basic principles of medical research and ethics.								
CO4	Understand the guidelines for the maintenance of laboratory animals and design research work.								
CO5	Create efficiency in solving practical difficulties.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	General Research Methodology: Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.	12	Students will learn about basics of research methodology	3,4,5
II	Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests(students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.	12	Students will learn about basics of statistics and its application.	3,4,5
III	Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.	12	Students will learn about medical research	3,4,5
IV	CPCSEA guidelines for laboratory animal	12	Students will learn about	3,4,5

	facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anaesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.		CPCSEA guidelines	
V	Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.	**12**	Students will learn about medical ethics	3,4,5

TEXT BOOKS:

REFERENCE BOOKS:

R1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork.

R2. Fundamental of Statistics – Himalaya Publishing House- S.C.Gupta

R3. Design and Analysis of Experiments –PHI Learning Private Limited, R. Pannerselvam,

R4. Design and Analysis of Experiments – Wiley Students Edition, Douglas and C. Montgomery

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Analyse the value, scope, objectives, and requirements of research.	PO1,PO3,PO4,PO5,PO6,PO8
2	Discuss the basic concepts of statistical analysis.	PO1,PO3,PO4,PO5,PO6,PO8
3	Apply the basic principles of medical research and ethics.	PO1,PO3,PO4,PO5,PO6,PO8
4	Understand the guidelines for the maintenance of laboratory animals and design research work.	PO1,PO3,PO4,PO5,PO6,PO8
5	Create efficiency in solving practical difficulties.	PO1,PO3,PO4,PO5,PO6,PO8

Semester III

Course Title	Journal Club								
Course code	MRM302NA	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours:	0	0	0	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy								
Semester	III semester of Second year of the program								
Course Objectives	1. To teach and develop critical appraisal skills, increase exposure to rapidly evolving literature, and help in informed clinical practice. 2. To provide a unique opportunity to promote interest in research while learning from experts about knowledge gaps and future research questions.								
CO1	Retrieve and recall essential information from scientific literature, summarizing key concepts and findings discussed in the assigned journal articles.								
CO2	Interpret and comprehend the chosen journal articles' methodologies, results, and implications, demonstrating a clear understanding of the research content.								
CO3	Apply critical analysis skills to assess the experimental design and methodologies employed in the selected journal articles, evaluating their appropriateness and validity.								
CO4	Analyze and synthesize information from multiple journal articles, comparing and contrasting methodologies, results, and conclusions to identify patterns, trends, and potential areas for further investigation.								
CO5	Evaluate the overall significance and relevance of the journal articles in the broader context of current pharmaceutical research, considering ethical implications, limitations, and potential contributions to the field.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Retrieve and recall essential information from scientific literature, summarizing key concepts and findings discussed in the assigned journal articles.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Interpret and comprehend the chosen journal articles' methodologies, results, and implications, demonstrating a clear understanding of the research content.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	Apply critical analysis skills to assess the experimental design and methodologies employed in the selected journal articles, evaluating their appropriateness and validity.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Analyse and synthesize information from multiple journal articles, comparing and contrasting methodologies, results, and conclusions to identify patterns, trends, and potential areas for further investigation.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	Evaluate the overall significance and relevance of the journal articles in the broader context of current pharmaceutical research, considering ethical implications, limitations, and potential contributions to the field.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8

Semester III	
Course Title	**DISCUSSION / PRESENTATION (PROPOSAL PRESENTATION)**

Course code	MRM303NA	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours:	0	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy								
Semester	III semester of Second year of the program								
Course Objectives	1. Develop scientific writing skills 2. Enable critical thinking ability 3. Enhance communication skills 4. Follow ethical considerations								
CO1	Identify the research problem								
CO2	Discuss research problem with team and guide for solution								
CO3	Develops protocol report with an aim and objectives								
CO4	Analyse research problem								
CO5	Develops plan of work for research project								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Identify the research problem	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Discuss research problem with team and guide for solution	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	Develops protocol report with an aim and objectives	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Analyse research problem	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	Develops plan of work for research project	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8

SEMESTER – III

Course Title	Research Work								
Course code	MRM304NA	Total credits: 14	L	T	P	S	R	O/F	C
		Total hours:	4	0	0	0	0	0	14
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy								
Semester	III semester of Second year of the program								
Course Objectives	1. Acquire research skills 2. Develop scientific writing skills 3. Enable critical thinking ability 4. Adopt application-oriented learning 5. Appreciate time management and organizational skills: 6. Enhance communication skills 7. Follow ethical considerations								
CO1	Recall key pharmaceutical concepts and principles pertinent to the M. Pharm project's research focus.								
CO2	Interpret the mechanism of action of the selected pharmaceutical agents, demonstrating a comprehensive understanding of their molecular pathways.								
CO3	Utilize advanced pharmaceutical research techniques to analyse drug formulations and assess their efficacy in practical experiments.								
CO4	Examine and synthesize experimental data to draw informed conclusions about the effectiveness and potential improvements of the formulated drugs.								
CO5	Assess pharmaceutical research's ethical and regulatory considerations, ensuring alignment with established guidelines and principles.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recall key pharmaceutical concepts and principles pertinent to the M. Pharm project's research focus.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Interpret the mechanism of action of the selected pharmaceutical agents, demonstrating a comprehensive understanding of their molecular pathways.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	Utilize advanced pharmaceutical research techniques to analyse drug formulations and assess their efficacy in practical experiments.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Examine and synthesize experimental data to draw informed conclusions about the effectiveness and potential improvements of the formulated drugs.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	Assess pharmaceutical research's ethical and regulatory considerations, ensuring alignment with established guidelines and principles.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8

Semester IV	
Course Title	**Journal Club**

Course code	MRM401NA	Total credits: 1	L	T	P	S	R	O/F	C
		Total hours:	0	0	0	0	0	0	1
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy								
Semester	IV semester of Second year of the program								
Course Objectives	1. To teach and develop critical appraisal skills, increase exposure to rapidly evolving literature, and help in informed clinical practice. 2. To provide a unique opportunity to promote interest in research while learning from experts about knowledge gaps and future research questions.								
CO1	Retrieve and recall essential information from scientific literature, summarizing key concepts and findings discussed in the assigned journal articles.								
CO2	Interpret and comprehend the chosen journal articles' methodologies, results, and implications, demonstrating a clear understanding of the research content.								
CO3	Apply critical analysis skills to assess the experimental design and methodologies employed in the selected journal articles, evaluating their appropriateness and validity.								
CO4	Analyse and synthesize information from multiple journal articles, comparing and contrasting methodologies, results, and conclusions to identify patterns, trends, and potential areas for further investigation.								
CO5	Evaluate the overall significance and relevance of the journal articles in the broader context of current pharmaceutical research, considering ethical implications, limitations, and potential contributions to the field.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Retrieve and recall essential information from scientific literature, summarizing key concepts and findings discussed in the assigned journal articles.	PO1,PO2,PO3,PO4,PO5,PO6,PO7, PO8
2	Interpret and comprehend the chosen journal articles' methodologies, results, and implications, demonstrating a clear understanding of the research content.	PO1,PO2,PO3,PO4,PO5,PO6,PO7, PO8
3	Apply critical analysis skills to assess the experimental design and methodologies employed in the selected journal articles, evaluating their appropriateness and validity.	PO1,PO2,PO3,PO4,PO5,PO6,PO7, PO8
4	Analyse and synthesize information from multiple journal articles, comparing and contrasting methodologies, results, and conclusions to identify patterns, trends, and potential areas for further investigation.	PO1,PO2,PO3,PO4,PO5,PO6,PO7, PO8
5	Evaluate the overall significance and relevance of the journal articles in the broader context of current pharmaceutical research, considering ethical implications, limitations, and potential contributions to the field.	PO1,PO2,PO3,PO4,PO5,PO6,PO7, PO8

Semester IV	
Course Title	**DISCUSSION / FINAL PRESENTATION**

Course code	MRM402NA	Total credits: 2	L	T	P	S	R	O/F	C
		Total hours:	0	0	0	0	0	0	2
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy								
Semester	IV semester of Second year of the program								
Course Objectives	1. Develop scientific writing skills 2. Enable critical thinking ability 3. Enhance communication skills 4. Follow ethical considerations								
CO1	Identify the research problem								
CO2	Discuss research problem with team and guide for solution								
CO3	Develops protocol report with an aim and objectives								
CO4	Analyse research problem								
CO5	Develops plan of work for research project								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Identify the research problem	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Discuss research problem with team and guide for solution	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	Develops protocol report with an aim and objectives	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Analyse research problem	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	Develops plan of work for research project	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8

SEMESTER – IV

Course Title	Research Work and Colloquium								
Course code	MRM403NA	Total credits: 14	L	T	P	S	R	O/F	C
		Total hours:	0	0	0	0	0	0	14
Pre-requisite	Nil	Co-requisite	Nil						
Program	Master of Pharmacy								
Semester	IV semester of Second year of the program								
Course Objectives	1. Acquire research skills 2. Develop scientific writing skills 3. Enable critical thinking ability 4. Adopt application-oriented learning 5. Appreciate time management and organizational skills: 6. Enhance communication skills 7. Follow ethical considerations								
CO1	Recall key pharmaceutical concepts and principles pertinent to the M. Pharm project's research focus.								
CO2	Interpret the mechanism of action of the selected pharmaceutical agents, demonstrating a comprehensive understanding of their molecular pathways.								
CO3	Utilize advanced pharmaceutical research techniques to analyse drug formulations and assess their efficacy in practical experiments.								
CO4	Examine and synthesize experimental data to draw informed conclusions about the effectiveness and potential improvements of the formulated drugs.								
CO5	Assess pharmaceutical research's ethical and regulatory considerations, ensuring alignment with established guidelines and principles.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recall key pharmaceutical concepts and principles pertinent to the M. Pharm project's research focus.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Interpret the mechanism of action of the selected pharmaceutical agents, demonstrating a comprehensive understanding of their molecular pathways.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	Utilize advanced pharmaceutical research techniques to analyse drug formulations and assess their efficacy in practical experiments.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Examine and synthesize experimental data to draw informed conclusions about the effectiveness and potential improvements of the formulated drugs.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	Assess pharmaceutical research's ethical and regulatory considerations, ensuring alignment with established guidelines and principles.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8

ASSAM DOWN TOWN UNIVERSITY

Curriculum and Syllabus

Master of Pharmacy

(Pharmacology)

OUTCOME BASED EDUCATION FRAMEWORK

CHOICE BASED CREDIT SYSTEM

Version: 1.01

FACULTY OF PHARMACEUTICAL SCIENCE

July, 2023

PREAMBLE

Assam down **t**own University is a premier higher educational institution which offers Bachelor, Master, and Ph.D. degree programs across various faculties. These program, collectively embodies the vision and mission of the university. All the programs offered by the Faculty of Pharmaceutical Science of Assam down **t**own University strictly follow the curriculum approved by the Pharmacy Council of India (PCI), the statutory body responsible for regulating the profession of pharmacy in India. 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 program 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 Pharmaceutical Science held on dated 08/07/2023 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

M.Pharm (Pharmacology) programme designed to enrich students' basic and advanced knowledge in the Pharmaceutical Science domain, the programme follows the courses mandated by Pharmacy Council of India (PCI) education regulations. The semester-wise course sequence and the entire M.Pharm (Pharmacology) curricula have been arranged to provide hands-on training and real-world exposure to traditional and modern practices, making graduates industry-ready. As pharmacists are true drug experts, M.Pharm (Pharmacology) students are exposed to allied science courses and core pharmaceutical courses, fostering their aptitude for research and advancements in new drug development technologies.

Rules & Syllabus for the Master of Pharmacy (M. Pharm) Course framed under Regulation of the 2014 as per by Pharmacy Council of India (PCI).

Duration of the course:

The course of study for M.Pharm (Pharmacology) shall extend over a period of four semesters (two academic years).

Specific Features of the Curriculum:

The M. Pharm curriculum is designed to align with the evolving needs of the pharmacy field and society at large. It offers a comprehensive blend of theoretical knowledge and practical applications essential for a profound understanding of pharmaceuticals, fostering the development of a wide array of skills. This curriculum is thoughtfully designed to equip students with both theoretical acumen and hands-on proficiency, catering precisely to the requirements of the dynamic industry and the broader societal demands.

ELIGIBILITY Criteria:

A Pass in the following examinations:

B. Pharm Degree examination of an Indian university established by law in India from an institution approved by Pharmacy Council of India and has scored not less than 55 % of the maximum marks (aggregate of 4 years of B.Pharm.).

Every student, selected for admission to post graduate pharmacy program in any PCI approved institution should have obtained registration with the State Pharmacy Council or should obtain the same within one month from the date of his/her admission, failing which the admission of the candidate shall be cancelled.

Note: It is mandatory to submit a migration certificate obtained from the respective university where the candidate had passed his/her qualifying degree (B.Pharm.)

Program Educational Objectives (PEOs):

PEO-1: Adtu Pharmacy graduates will be well prepared for successful careers as Pharmaceutical Professionals across diverse sectors including the pharmaceutical industry, healthcare, corporate institutions and government organizations.

PEO-2: Pharmacy graduates will be academically prepared to become Registered Pharmacists, poised to make significant contributions to the advancement of the healthcare sector.

PEO-3: The graduates will engage in professional practices to elevate their stature with a sense of responsibility and be successful in higher education, if pursued.

Programme Specific Outcomes (PSOs):

PSO1: Professional Excellence: Translate the high-level of understanding of drug action into key stages in preclinical, clinical research studies and interpret data of pharmaceutical experiments in drug discovery and modifications as per the needs of pharmaceutical industries.

PSO2: Practice in Research: Apply pharmacy knowledge and competency in research, and collaborative projects thereby contributing to the continuous advancement of pharmaceutical science.

PSO3: International Competency: Demonstrate global professional competencies by attaining interdisciplinary knowledge through specialized certifications offered on international learning platforms.

Program Outcome (POs):

PO1: Pharmacy Knowledge: Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioural, social, and administrative pharmacy sciences; and manufacturing practices.

PO2: Planning abilities: Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines.

PO3: Problem analysis: Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyse, evaluate and apply information systematically and shall make defensible decisions.

PO4: Modern tool usage: Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.

PO5: Leadership skills: Understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfilment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizens or leadership roles when appropriate to facilitate improvement in health and well- being.

PO6: Professional identity: Understand, analyse and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).

PO7: Pharmaceutical ethics: Honour personal values and apply ethical principles in professional and social contexts. Demonstrate behaviour that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.

PO8: Communication: Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions.

Career Prospects:

M.Pharm (Pharmacology) graduates are equipped to assume diverse roles, such as Industrial Pharmacist (in the field of Production and Manufacturing, Formulation Development, Quality Assurance, Quality Control, Packaging, R&D etc.), Hospital and Community Pharmacist, Medical Representative, Sales Executive, Bulk Medicine Distributor, Lecturer, Entrepreneurship, Drug Inspector, Drug Analyst etc. After completion of M. Pharm the students may go for higher studies in PhD programs.

CHAPTER –I: REGULATIONS

1. Short Title and Commencement

These regulations shall be called as "The Revised Regulations for the Master of Pharmacy (M.Pharm) Degree Program - Credit Based Semester System (CBSS) of the Pharmacy Council of India, New Delhi". They shall come into effect from the Academic Year 2016-17. The regulations framed are subject to modifications from time to time by the authorities of the university.

2. Minimum qualification for admission

A Pass in the following examinations:

B.Pharm degree examination of an Indian university established by law in India from an institution approved by Pharmacy Council of India and has scored not less than 55 % of the maximum marks (aggregate of 4 years of B.Pharm.)

Every student, selected for admission to post graduate pharmacy program in any PCI approved institution should have obtained registration with the State Pharmacy Council or should obtain the same within one month from the date of his/her admission, failing which the admission of the candidate shall be cancelled.

Note: It is mandatory to submit a migration certificate obtained from the respective university where the candidate had passed his/her qualifying degree (B.Pharm.)

3. Duration of the program

The program of study for M.Pharm **s**hall extend over a period of four semesters (two academic years). The curricula and syllabi for the program shall be prescribed from time to time by Pharmacy Council of India, New Delhi.

4. Medium of instruction and examinations

Medium of instruction and examination shall be in English.

5. Working days in each semester

Each semester shall consist of not less than 100 working days. The odd semesters shall be conducted from the month of June/July to November/December and the even semesters shall be conducted from the month of December/January to May/June in every calendar year.

6. Attendance and progress

A candidate is required to put in at least 80% attendance in individual courses considering theory and practical separately. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

7. Program/Course credit structure

As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, practical classes, seminars, assignments, etc. are measured in terms of credits. On satisfactory completion of the courses, a candidate earns credits. The amount of credit associated with a course is dependent upon the number of hours of instruction per week in that course. Similarly, the credit associated with any of the other academic, co/extra- curricular activities is dependent upon the quantum of work expected to be put in for each of these activities per week/per activity.

8. Credit assignment

8.1 Theory and Laboratory courses

Courses are broadly classified as Theory and Practical. Theory courses consist of lecture (L) and Practical (P) courses consist of hours spent in the laboratory. Credits (C) for a course is dependent on the number of hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture and a multiplier of half (1/2) for practical (laboratory) hours. Thus, for example, a theory course having four lectures per week throughout the semester carries a credit of 4. Similarly, a practical having four laboratory hours per week throughout semester carries a credit of 2.

The contact hours of seminars, assignments and research work shall be treated as that of practical courses for the purpose of calculating credits. i.e., the contact hours shall be multiplied by 1/2. Similarly, the contact hours of journal club, research work presentations and discussions with the supervisor shall be considered as theory course and multiplied by 1.

8.2 Minimum credit requirements

The minimum credit points required for the award of M. Pharm degree is 95. However based on the credit points earned by the students under the head of co-curricular activities, a student shall earn a maximum of 100 credit points. These credits are divided into Theory courses, Practical, Seminars, Assignments, Research work, Discussions with the supervisor, Journal club and Co-Curricular activities over the duration of four semesters. The credits are distributed semester-wise as shown in Table 6. Courses generally progress in sequence, building competencies and their positioning indicates certain academic maturity on the part of the learners. Learners are expected to follow the semester-wise schedule of courses given in the syllabus.

9. Academic work

A regular record of attendance both in Theory, Practical, Seminar, Assignment, and Journal club, Discussion with the supervisor, Research work presentation and Dissertation shall be maintained by the department / teaching staff of respective courses.

10. Course of study

The specialization in M.Pharm (Pharmacology) program is given in Table 1.

Table – 1: List of M.Pharm Specializations and their Code

S. No.	Specialization	Code
1.	Pharmaceutics	**MPH**
2.	Industrial Pharmacy	**MIP**
3.	Pharmaceutical Chemistry	**MPC**
4.	Pharmaceutical Analysis	**MPA**
5.	Pharmaceutical Quality Assurance	**MQA**
6.	Pharmaceutical Regulatory Affairs	**MRA**
7.	Pharmaceutical Biotechnology	**MPB**
8.	Pharmacy Practice	**MPP**
9.	Pharmacology	**MPL**
10.	Pharmacognosy	**MPG**

The course of study for M.Pharm (Pharmacology) specializations shall include Semester wise Theory & Practical as given in Table – 2 to 11. The number of hours to be devoted to each theory and practical course in any semester shall not be less than that shown in Table – 2 and Table - 3.

Table – 2: Course of study for M.Pharm (Pharmacology)

Course Code	Course	Credit Hours	Credit Points	Hrs./ wk	Marks
Semester I					
MPL101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPL102T	Advanced Pharmacology-I	4	4	4	100
MPL 103T	Pharmacological and Toxicological Screening Methods-I	4	4	4	100
MPL104T	Cellular and Molecular Pharmacology	4	4	4	100
MPL105P	Pharmacology Practical I	12	6	12	150
MPL106NA	Seminar/Assignment	7	4	7	100
Total		35	26	35	650
Semester II					
MPL201T	Advanced Pharmacology II	4	4	4	100
MPL 202T	Pharmacological and Toxicological Screening Methods-II	4	4	4	100
MPL203T	Principles of Drug Discovery	4	4	4	100
MPL204T	Experimental Pharmacology practical- II	4	4	4	100
MPL205P	Pharmacology Practical II	12	6	12	150
MPL206NA	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650

Table – 3: Course of study for M. Pharm. III Semester

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
MRM302NA	Journal club	1	1
MRM303NA	Discussion / Presentation (Proposal Presentation)	2	2
MRM304NA	Research Work	28	14
Total		35	21

* Non University Exam

Table – 4: Course of study for M. Pharm. IV Semester

Course Code	Course	Credit Hours	Credit Points

MRM401NA	Journal Club	1	1
MRM402NA	Discussion/Final Presentation	3	3
MRM403NA	Research Work and Colloquium	31	16
MRM404NA	Scholarly Activity		3
Total		35	23

Table – 5: Semester wise credits distribution

Semester	Credit Points
I	26
II	26
III	23
IV	23
Co-curricular Activities/Scholarly Activities (Attending Conference, Scientific Presentations and Scholarly Activities) Credit Points will be included in IV semester and 4 credit point will be allocated for other certificate courses	Minimum=04
Total Credit Points	100

*Credit Points for Co-curricular Activities

Table – 6: Guidelines for Awarding Credit Points for Co-curricular Activities

Name of the Activity	Maximum Credit Points Eligible / Activity
Participation in National Level Seminar/Conference/Workshop/Symposium/Training Programs (related to the specialization of the student)	01
Participation in international Level Seminar/Conference/Workshop/Symposium/ Training Programs (related to the specialization of the student)	02
Academic Award/Research Award from State Level/National Agencies	01
Academic Award/Research Award from International Agencies	02
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)	01
Research / Review Publication in International Journals (Indexed in Scopus / Web of Science)	02

Note: International Conference: Held outside India International Journal: The Editorial Board outside India

*The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University. The criteria to acquire this credit point shall be defined by the colleges from time to time.

11. Program Committee

The M. Pharm programme shall have a Programme Committee constituted by the Head of the institution in consultation with all the Heads of the departments.

The composition of the Programme Committee shall be as follows:

A teacher at the cadre of Professor shall be the Chairperson; One Teacher from each M.Pharm (Pharmacology) specialization and four student representatives (two from each academic year), nominated by the Head of the institution.

Duties of the Programme Committee:

- Periodically reviewing the progress of the classes.
- Discussing the problems concerning curriculum, syllabus and the conduct of classes.
- Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.
- Communicating its recommendation to the Head of the institution on academic matters.
- The Programme Committee shall meet at least twice in a semester preferably at the end of each sessional exam and before the end semester exam.
- Examinations/Assessments
- The schemes for internal assessment and end semester examinations are given in Table – 8.

12. End semester examinations

12.1. The End Semester Examinations for each theory and practical course through semesters I to IV shall be conducted by the respective university except for the subject with asterix symbol (*) in table I and II for which examinations shall be conducted by the subject experts at college level and the marks/grades shall be submitted to the university.

Tables – 7: Schemes for internal assessments and end semester examinations (Pharmacology-MPL)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams					
			Marks	Duration	Total	Marks	Duration	
SEMESTER I								
MPL 101T	Modern Pharmaceutical Analytical Techniques	10	15	1 Hr	25	75	3 Hrs	100
MPL102T	Advanced Pharmacology-I	10	15	1 Hr	25	75	3 Hrs	100
MPL103T	Pharmacological and Toxicological Screening Methods-I	10	15	1 Hr	25	75	3 Hrs	100
MPL104T	Cellular and Molecular Pharmacology	10	15	1 Hr	25	75	3 Hrs	100
MPL105P	Experimental Pharmacology - I	20	30	6 Hrs	50	100	6 Hrs	150
MPL106NA	Seminar /Assignment	-	-	-	-	-	-	100
Total								650
SEMESTER II								
MPL201T	Advanced Pharmacology II	10	15	1 Hr	25	75	3 Hrs	100
	Pharmacological and							

MPL102T	Toxicological Screening Methods-II	10	15	1 Hr	25	75	3 Hrs	100
MPL203T	Principles of Drug Discovery	10	15	1 Hr	25	75	3 Hrs	100
MPL204T	Clinical research and Pharma covigilance	10	15	1 Hr	25	75	3 Hrs	100
MPL205P	Experimental Pharmacology -II	20	30	6 Hrs	50	100	6 Hrs	150
MPL206NA	Seminar /Assignment	-	-	-	-	-	-	100
Total								650

Tables – 8: Schemes for internal assessments and end semester examinations (Semester III& IV)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
SEMESTER III								
MRM30 1T	Research Methodology and Biostatistics*	10	15	1 Hr	25	75	3 Hrs	100
MRM302NA	Journal club	-	-	-	25	-	-	25
MRM303NA	Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
MRM304NA	Research work*	-	-	-	-	350	1 Hr	350
Total								525
SEMESTER IV								
MRM401NA	Journal club	-	-	-	25	-	-	25
MRM402NA	Discussion / Final Presentation	-	-	-	-	75		75
MRM403NA	Research work and Colloquium	-	-	-	-	400	-	400
MRM404NA	Scholarly Activity	-	-	-	-	175	-	175
Total								675

*Non University Examination

12.2. Internal assessment: Continuous mode

The marks allocated for Continuous mode of Internal Assessment shall be awarded as per the scheme given below.

Sessional Exams

Two sessional exams shall be conducted for each theory / practical course as per the schedule fixed by the college(s). The scheme of question paper for theory and practical sessional examinations is given in the table. The average marks of two sessional exams shall be computed for internal assessment as per the requirements given in tables.

Table – 9: Scheme for awarding internal assessment: Continuous mode

Theory	
Criteria	**Maximum Marks**
Attendance (Refer Table – 28)	8
Student – Teacher interaction	2
Total	**10**
Practical	
Attendance (Refer Table – 28	10
Based on Practical Records, Regular viva voce, etc.	10
Total	**20**

Table – 10: Guidelines for the allotment of marks for attendance

Percentage of Attendance	**Theory**	**Practical**
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

13. Promotion and award of grades

A student shall be declared PASS and eligible for getting grade in a course of M.Pharm Programme if he/she secures at least 50% marks in that particular course including internal assessment.

14. Carry forward of marks

In case a student fails to secure the minimum 50% in any Theory or Practical course as specified in 12, then he/she shall reappear for the end semester examination of that course. However, his/her marks of the Internal Assessment shall be carried over and he/she shall be entitled for grade obtained by him/her on passing.

15. Improvement of internal assessment

A student shall have the opportunity to improve his/her performance only once in the sessional exam component of the internal assessment. The re-conduct of the sessional exam shall be completed before the commencement of next end semester theory examinations.

16. Re-examination of end semester examinations

Re-examination of end semester examination shall be conducted as per the schedule given in table 29. The exact dates of examinations shall be notified from time to time.

Table – 11: Tentative schedule of end semester examinations

Semester	For Regular Candidates	For Failed Candidates
I and III	November / December	May / June
II and IV	May / June	November / December

17. Allowed to keep terms (ATKT):

No student shall be admitted to any examination unless he/she fulfils the norms given in 6. ATKT rules are applicable as follows:

A student shall be eligible to carry forward all the courses of I and II semesters till the III semester examinations. However, he/she shall not be eligible to attend the courses of IV semester until all the courses of I, II and III semesters are successfully completed.

A student shall be eligible to get his/her CGPA upon successful completion of the courses of I to IV semesters within the stipulated time period as per the norms.

Note: Grade AB should be considered as failed and treated as one head for deciding ATKT. Such rules are also applicable for those students who fail to register for examination(s) of any course in any semester.

18. Grading of performances

Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the end of the semester for each course. The letter grades and their corresponding grade points are given in Table – 30.

Table – 12: Letter grades and grade points equivalent to Percentage of marks and performances

Percentage of Marks Obtained	Letter Grade	Grade Point	Performance
90.00 – 100	O	10	Outstanding
80.00 – 89.99	A	9	Excellent
70.00 – 79.99	B	8	Good
60.00 – 69.99	C	7	Fair
50.00 – 59.99	D	6	Average
Less than 50	F	0	Fail
Absent	AB	0	Fail

A learner who remains absent for any end semester examination shall be assigned a letter grade of AB and a corresponding grade point of zero. He/she should reappear for the said evaluation/examination in due course.

The Semester grade point average (SGPA)

The performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). The SGPA is the weighted average of the grade points obtained in all the courses by the student during the semester. For example, if a student takes five courses (Theory/Practical) in a semester with credits C1, C2, C3 and C4 and the student's grade points in these courses are G1, G2, G3 and G4, respectively, and then students' SGPA is equal to:

$$SGPA = \frac{C1G1 + C2G2 + C3G3 + C4G4}{C1 + C2 + C3 + C4}$$

The SGPA is calculated to two decimal points. It should be noted that, the SGPA for any semester shall take into consideration the F and ABS grade awarded in that semester. For example, if a learner has a F or ABS grade in course 4, the SGPA shall then be computed as:

$$SGPA = \frac{C1G1 + C2G2 + C3G3 + C4* ZERO}{C1 + C2 + C3 + C4}$$

Cumulative Grade Point Average (CGPA)

The CGPA is calculated with the SGPA of all the IV semesters to two decimal points and is indicated in final grade report card/final transcript showing the grades of all IV semesters and their courses. The CGPA shall reflect the failed status in case of F grade(s), till the course(s) is/are passed. When the course(s) is/are passed by obtaining a pass grade on subsequent examination(s) the CGPA

Shall only reflect the new grade and not the fail grades earned earlier. The CGPA is calculated as:

$$CGPA = \frac{C1S1 + C2S2 + C3S3 + C4S4}{C1 + C2 + C3 + C4}$$

where C1, C2, C3, is the total number of credits for semester I,II,III,…. and S1,S2, S3,….is the SGPA of semester I,II,III,…. .

Declaration of class

The class shall be awarded on the basis of CGPA as follows: First Class with Distinction = CGPA of. 7.50 And above

First Class = CGPA of 6.00 to 7.49

Second Class = CGPA of 5.00 to 5.99

Project work

All the students shall undertake a project under the supervision of a teacher in Semester III to IV and submit a report. 4 copies of the project report shall be submitted (typed & bound copy not less than 75 pages).

The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). The projects shall be evaluated as per the criteria given below.

Evaluation of Dissertation Book:

Objective(s) of the work done	50 Marks
Methodology adopted	150 Marks
Results and Discussions	250 Marks
Conclusions and Outcomes	50 Marks
Total	500 Marks

Evaluation of Presentation:

Presentation of work	100 Marks
Communication skills	50 Marks
Question and answer skills	100 Marks
Total	250 Marks

Award of Ranks

Ranks and Medals shall be awarded on the basis of final CGPA. However, candidates who fail in one or more courses during the M.Pharm (Pharmacology)program shall not be eligible for award of ranks. Moreover, the candidates should have completed the M.Pharm (Pharmacology)program in minimum prescribed number of years, (two years) for the award of Ranks.

Award of degree

Candidates who fulfil the requirements mentioned above shall be eligible for award of degree during the ensuing convocation.

Duration for completion of the program of study

The duration for the completion of the program shall be fixed as double the actual duration of the program and the students have to pass within the said period, otherwise they have to get fresh Registration.

Revaluation I Retotalling of answer papers

There is no provision for revaluation of the answer papers in any examination. However, the candidates can apply for retotalling by paying prescribed fee.

Re-admission after break of study

Candidate who seeks re-admission to the program after break of study has to get the approval from the university by paying a condonation fee.

SEMESTER – I										
Course Title	Modern Pharmaceutical Analytical Techniques									
Course code	MPL101T	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T	**4**	**0**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy (Pharmacology)								
Semester	I semester of first year of the program								
Course Objectives	After completion of course student is able to know, 1. Chemicals and Excipients 2. The analysis of various drugs in single and combination dosage forms 3. Theoretical and practical skills of the instruments								
CO1	Compare and Utilize the Spectroscopy knowledge to Interpret various levels of molecular spectra.								
CO2	Analyze instrumentation of N.M.R, compare 1D NMR, 2DNMR, 1HNMR and 13CNMR to propose structures.								
CO3	Assume the principle and Importance, theory of Mass Spectroscopy; differentiate different peaks and ionization and Fragmentation rules to predict the structure.								
CO4	Compare different Chromatographic techniques and Evaluate instrumentation, choose each technique based on sample and develop a validated method.								
CO5	Justify different electrophoretic techniques, X-ray crystallography and design with Importance of Electrophoresis, X-Ray crystallography and Bioluminescence assays.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**UV-Visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, choice of solvents and solvent effect and Applications of UV-Visible spectroscopy. **IR spectroscopy:** Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy **Spectroflurimetry:** Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and applications.	**1O**	Students will be able to know theory & Application behind each spectroscopic technique.	2, 3,4,5
II	**NMR spectroscopy:** Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline	1O	Students will be able to know basic concepts and theory behind NMR. & predict NMR spectra by Application to organic compounds.	3,4,5

	of principles of FT-NMR and13CNMR. Applications of NMR spectroscopy.			
III	**Mass Spectroscopy:** Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadruple and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy	1O	Students will be able to learn identify which Ionization technique is suitable for compounds and analyze the type of Analyzer to be used depending on the sample.	3,4,5
IV	**Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d)Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography h) Gel Chromatography	1O	Students will be able to understand theory & application of different chromatographic techniques. .	3,4,5
V	**a. Electrophoresis:** Principle, Instrumentation, working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing **b. X ray Crystallography:** Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X ray diffraction.	1O	Students will be able to Understand, Principle, Instrumentation, working conditions, factors affecting separation and applications of electrophoresis.	3,4,5
VI	**Potentiometry:** Principle, working, Ion selective Electrodes and Application of potentiometry. Thermal Techniques: Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample Preparation, experimental conditions, calibration, heating and cooling rates,	1O	Students will be able to know importance of RIA and ELISA techniques and their applications.	3,4,5

	resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. Differential Thermal Analysis (DTA): Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). TGA: Principle, Instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications**.**			

TEXT BOOKS:

REFERENCE BOOKS:

R1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.

R2. Principles of Instrumental Analysis - Douglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.

R3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.

R4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4thedition, CBS Publishers, New Delhi, 1997.

R5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.

R6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.

R7. Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol11, Marcel. Dekker Series

R8. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley easternLtd., Delhi.

R9. Textbook of Pharmaceutical Analysis, KA.Connors, 3rd Edition, John Wiley& Sons, 1982.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Compare and Utilize the Spectroscopy knowledge to Interpret various levels of molecular spectra.	PO1,PO2,PO3,PO4,PO5,PO8
2	Analyse instrumentation of N.M.R, compare 1D NMR, 2DNMR, 1HNMR and 13CNMR to Propose structures.	PO1,PO2, PO3, PO4, PO5, PO8
3	Assume the principle and Importance, theory of Mass, spectroscopy; differentiate different peaks and ionization and Fragmentation rules to Predict the structure.	PO1,PO2, PO3, PO4, PO5, PO8
4	Compare different Chromatographic techniques and Evaluate instrumentation, choose each technique based on sample and Develop a Validated method.	PO1,PO2, PO3, PO4, PO5, PO8
5	Justify different electrophoretic techniques, X-ray crystallography and design with Importance of Electrophoresis, X-Ray Crystallography and Bioluminescence assays.	PO1,PO2, PO3, PO4, PO5, PO8

SEMESTER – I									
Course Title	ADVANCED PHARMACOLOGY – I								
Course code	MPL102T	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T	**4**	**0**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy (Pharmacology)								
Semester	I semester of first year of the program								
Course Objectives	Upon completion of the course, student shall beable to: 1. Discuss the path physiology and pharmacotherapy of certain diseases 2. Explain the mechanism of drug actions at cellular and molecular level 3. Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases								
CO1	Appreciate the basic knowledge in the field of pharmacology pertaining to the drugs and its therapeutic applications.								
CO2	Elaborately learnt the recent advances in the drugs used for the treatment of various diseases.								
CO3	Understood the concepts of drug action and mechanisms involved.								
CO4	Understood the underlying mechanism of drug actions at cellular and molecular level.								
CO5	Learn the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**General Pharmacology** a. Pharmacokinetics: The dynamics of drug absorption, distribution, biotransformation and elimination. Concepts of linear and non-linear compartment models. Significance of Protein binding. b. Pharmacodynamics: Mechanism of drug action and the relationship between drug concentration and effect. Receptors, structural and functional families of receptors, quantitation of drug receptors interaction and elicited effects.	12	Students will be able to know about Pharmacokinetics & Pharmacodynamics	2,3,4,5
II	**Neurotransmission** a. General aspects and steps involved in neurotransmission. b. Neurohumoral transmission in autonomic nervous system(Detailed study about neurotransmitters- Adrenaline and Acetyl Choline). c. Neurohumoral transmission in central nervous system (Detailedstudy about neurotransmitters- histamine, serotonin, dopamine, GABA, glutamate and glycine]. d. Non adrenergic non cholinergic transmission (NANC). Co-transmission **Systemic Pharmacology** A detailed study on path physiology of diseases, mechanism ofaction, pharmacology and toxicology of existing as well as noveldrugs used in the following systems	12	Students will be able to know about Neurohumoral transmission in autonomic nervous system &Neurohumoral transmission in central nervous system	2,3,4,5

	Autonomic Pharmacology Parasympathomimetics and lytic, sympathomimetics and lytic, agents affecting neuromuscular junction			
III	**Central Nervous System Pharmacology** General and local anesthetics Sedatives and hypnotics, drugs used to treat anxiety. Depression, psychosis, mania, epilepsy, neuro-degenerative diseases. Narcotic and non-narcotic analgesics	12	Students will be able to learn about General and local anesthetics Sedatives and hypnotics, Narcotic and non-narcotic analgesics	2,3,4,5
IV	**Cardiovascular Pharmacology** Diuretics, antihypertensive, anti-ischemic, anti-arrhythmic, drugs for heart failure and hyperlipidemia. Hematinic, coagulants, anticoagulants, fibrinolytics and anti- platelet	12	Students will be able to learn mechanism, classification & Pharmacological action of Diuretics, antihypertensive, anti-ischemic, anti-arrhythmic, drugs	2,3,4,5
V	**Autocoid Pharmacology** The physiological and pathological role of Histamine, Serotonin, Kinins Prostaglandins Opioid autocoids. Pharmacology of antihistamines, 5HT antagonist	12	Students will be able to understand the physiological and pathological role of Histamine	2,3,4,5

TEXT BOOKS:

REFERENCE BOOKS:

R1. The Pharmacological Basis of Therapeutics, Goodman and Gillman‘s

R2. Principles of Pharmacology. The Pathophysiologic basis of drug Therapyby David E Golan, Armen H, TashjianJr, EhrinJ,Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers.

R3. Basic and Clinical Pharmacology by B.G Katzung

R4. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.

R5. Applied biopharmaceutics and Pharmacokinetics by Leon ShargelandAndrewB.C.Yu.

R6. Graham Smith. Oxford textbook of Clinical Pharmacology.

R7. Avery Drug Treatment

R8. Dipiro Pharmacology, Pathophysiological approach.

R9. Green Pathophysiology for Pharmacists.

R10. Robbins &Cortan Pathologic Basis of Disease, 9th Ed. (Robbins Pathology)

R11. A Complete Textbook of Medical Pharmacology by Dr. S.K Srivastavapublished by APC Avichal Publishing Company

R12. KD.Tripathi. Essentials of Medical Pharmacology.

R13. Modern Pharmacology with Clinical Applications, Craig Charles R. &StitzelRobert E., Lippincott Publishers.

R14. Clinical Pharmacokinetics &Pharmacodynamics: Concepts andApplications – Malcolm Rowland and Thomas N.Tozer, Wolters Kluwer, Lippincott Williams & Wilkins Publishers.

R15. Applied biopharmaceutics and Pharmacokinetics, Pharmacodynamics andDrug metabolism for industrial scientists.

R16. Modern Pharmacology, Craig CR. &Stitzel RE, Little Brown &Company

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Appreciate the basic knowledge in the field of pharmacology pertaining to the drugs and its therapeutic applications.	**PO1, PO3, PO4, PO5, PO7, PO8**
2	Elaborately learnt the recent advances in the drugs used for the treatment of various diseases.	**PO1, PO3, PO4, PO5,PO7,PO8**
3	Understood the concepts of drug action and mechanisms involved.	**PO1, PO3, PO4, PO5,PO7,PO8**
4	Understood the underlying mechanism of drug actions at cellular and molecular level.	**PO1, PO3, PO4, PO5,PO7,PO8**
5	Learn the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases	**PO1, PO3, PO4, PO5,PO7,PO8**

SEMESTER-I									
Course Title	Pharmacological and toxicological screening methods – I								
Course code	MPL103T	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T	**4**	**0**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy (Pharmacology)								
Semester	I semester of first year of the program								
Course Objectives	Upon completion of the course, student shall be able to 1. Appraise the regulations and ethical requirement for the usage of experimental animals. 2. Describe the various animals used in the drug discovery process and good laboratory practices in maintenance and handling of experiment alanimals 3. Describe the various newer screening methods involved in the drug discovery process 4. Appreciate and correlate the preclinical data								
CO1	Recall the crucial role of laboratory animal models both conventional and transgenic in advancing pharmacological and toxicological research, serving as invaluable tools for screening drugs and new chemical entities.								
CO2	Illustrate and demonstrate the comprehensive preclinical screening process for new substances targeting central and autonomic nervous system diseases, including Parkinsonism, Alzheimer's, and multiple sclerosis by utilizing various animal models and in vitro methods.								
CO3	Illustrate and demonstrate the comprehensive preclinical screening process for new substances targeting central and autonomic nervous system diseases, including Parkinsonism, Alzheimer's, and multiple sclerosis through the utilization of various animal models and in vitro methods, as well as exploring alternative models to ensure a thorough evaluation of potential therapeutic interventions.								
CO4	Compare and demonstrate the preclinical screening methods for various new chemical entities targeting cardiovascular, endocrine, immune, and digestive system diseases, hypertension, arrhythmia, angina pectoris, atherosclerosis, diabetes, dyslipidemia, cancer, and hepatotoxicity. Evaluation involves a combination of diverse animal models, in vitro assays, and potential alternative models to comprehensively assess the safety and efficacy of chemical entities before transitioning to clinical trials.								
CO5	Explain and analyze preclinical screening of new substances like immunomodulators, immunosuppressants and immunostimulants by various immunoassays conducted in different animal as well as in in-vitro and other possible animal alternative models.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Laboratory Animals** Common laboratory animals: Description, handling and applications of different species and strains of animals. **Transgenic animals:** Production, maintenance and applications Anaesthesia and euthanasia of experimental animals. Maintenance and breeding of laboratory animals. CPCSEA guidelines to conduct experiments on animals **Good laboratory practice.** Bioassay-Principle, scope and limitations and methods	**12**	Students will be able to know the regulations and ethical requirement for the usage of experimental animals.	2,3,4,5

II	Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models**.** General principles of preclinical screening. CNS Pharmacology: behavioral and muscle co-ordination, CNS stimulants and depressants, anxiolytics, anti-psychotics, anti-epileptics and no tropics. Drugs for neurodegenerative diseases like Parkinsonism, Alzheimer's and multiple sclerosis. Drugs acting on Autonomic Nervous	**12**	Students will be able to understand the various newer screening methods involved in the drug discovery process	2,3,4,5
III	Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Respiratory Pharmacology: anti-asthmatics, drugs for COPD and antiallergics. Reproductive Pharmacology: Aphrodisiacs andant fertility agents Analgesics, anti-inflammatory and antipyretic agents. Gastrointestinal drugs: anti-ulcer, anti -emetic, anti- diarrheal and laxatives.	**12**	Students will be able to know the various newer screening methods involved in the drug discovery process	2,3,4,5
IV	Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Cardiovascular Pharmacology: antihypertensive, antiarrhythmics, antianginal, ant atherosclerotic agents and diuretics. Drugs for metabolic disorders like anti-diabetic, antidyslipidemic agents. Anti-cancer agents. Hepatoprotective screening	**12**	Students will be able to understand the various newer screening methods involved in the drug discovery process	2,3,4,5
V	Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Immunomodulators, Immunosuppressant's and immunostimulants General principles of immunoassay: theoretical basis and optimization of immunoassay, heterogeneous and homogenous immunoassay systems. Immunoassay methods evaluation; protocol outline, objectives and preparation. Immunoassay for Dioxin and insulin Limitations of animal experimentation and alternate animal experiments. Extrapolation of in vitro data to preclinical and preclinical to humans	**12**	Students will be able to learn the various newer screening methods involved in the drug discovery process	2,3,4,5

TEXT BOOKS:

REFERENCE BOOKS:

R1. Biological standardization by J.H. Burn D.J. Finney and I.G. Goodwin
R2. Screening methods in Pharmacology by Robert Turner. A
R3. Evaluation of drugs activities by Laurence and Bachrach
R4. Methods in Pharmacology by Arnold Schwartz.
R5. Fundamentals of experimental Pharmacology by M.N.Ghosh
R6. Pharmacological experiment on intact preparations by Churchill Livingstone

R7. Drug discovery and Evaluation by Vogel H.G.
R8.Experimental Pharmacology by R.K.Goyal.
R9. Preclinical evaluation of new drugs by S.K. Guta
R10. Handbook of Experimental Pharmacology, SK.Kulkarni
R11. Practical Pharmacology and Clinical Pharmacy, SK.Kulkarni, 3rdEdition.
R12. David R.Gross. Animal Models in Cardiovascular Research, 2ndEdition, Kluwer Academic Publishers, London, UK.
R13. Screening Methods in Pharmacology, Robert A.Turner.
R14. Rodents for Pharmacological Experiments, Dr.Tapan Kumar Chatterjee.
R15. Practical Manual of Experimental and Clinical Pharmacology by BikashMedhi (Author), Ajay Prakash (Author)

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recall the crucial role of laboratory animal models both conventional and transgenic in advancing pharmacological and toxicological research, serving as invaluable tools for screening drugs and new chemical entities.	PO1. PO2, PO3, PO4, PO6, PO7, PO8
2	Illustrate and demonstrate the comprehensive preclinical screening process for new substances targeting central and autonomic nervous system diseases, including Parkinsonism, Alzheimer's, and multiple sclerosis by utilizing various animal models and in vitro methods.	PO1. PO2, PO3, PO4, PO6, PO7, PO8
3	Illustrate and demonstrate the comprehensive preclinical screening process for new substances targeting central and autonomic nervous system diseases, including Parkinsonism, Alzheimer's, and multiple sclerosis through the utilization of various animal models and in vitro methods, as well as exploring alternative models to ensure a thorough evaluation of potential therapeutic interventions.	PO1. PO2, PO3, PO4, PO6, PO7, PO8
4	Compare and demonstrate the preclinical screening methods for various new chemical entities targeting cardiovascular, endocrine, immune, and digestive system diseases, hypertension, arrhythmia, angina pectoris, atherosclerosis, diabetes, dyslipidemia, cancer, and hepatotoxicity. Evaluation involves a combination of diverse animal models, in vitro assays, and potential alternative models to comprehensively assess the safety and efficacy of chemical entities before transitioning to clinical trials.	PO1. PO2, PO3, PO4, PO6, PO7, PO8
5	Explain and analyse preclinical screening of new substances like immunomodulators, immunosuppressants and immunostimulants by various immunoassays conducted in different animal as well as in in-vitro and other possible animal alternative models.	PO1. PO2, PO3, PO4, PO6, PO7, PO8

SEMESTER-I									
Course Title	Cellular and Molecular Pharmacology								
Course code	MPL104T	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T	**3**	**1**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy (Pharmacology)								
Semester	I semester of first year of the program								
Course Objectives	Upon completion of the course, it is expected that the students will be able to 1. Explain the receptor signal transduction processes. 2. Explain the molecular pathways affected by drugs. 3. Appreciate the applicability of molecular pharmacology and biomarkers in drug discovery process. 4. Demonstrate molecular biology techniques as applicable forpharmacology								
CO1	Explain various cellular events, functions, pathways and transduction mechanisms and how a gene is expressed.								
CO2	Illustrate Cell signaling pathways based on receptors and second messengers in the cell.								
CO3	Knowledge about principles and applications of genomic; proteomic tools, gene therapy and rDNA technology.								
CO4	Understand Immunotherapeutic and application atomics in clinical practice.								
CO5	Describe principles and applications of various assays, biosimilars, cell culture techniques, application of flow cytometry.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Cell biology** Structure and functions of cell and its organelles Genome organization. Gene expression and its regulation, importance of si RNA and micro RNA, gene mapping and gene sequencing Cell cycles and its regulation. Cell death– events, regulators, intrinsic and extrinsic pathways of apoptosis. Necrosis and autophagy	**12**	Students will be able to understand the Structure and functions of cell and its organelles Genome organization. Gene expression and its regulation, importance of si RNA and micro RNA, gene mapping and gene sequencing	2,3,4,5
II	**Cell signaling** Intercellular and intracellular signaling pathways. Classification of receptor family and molecular structure ligandgated ion channels; G-protein coupled receptors, tyrosine kinas receptors and nuclear receptors. Secondary messengers: cyclic AMP, cyclic GMP, calcium ion,inositol 1,4,5-trisphosphate, (IP3), NO, and diacylglycerol. **Detailed study of following intracellular signalingpathways**: CyclicAM Psignaling pathway, mitogen-activated protein kinase (MAPK)signaling, Janus kinase	**12**	Students will be able to understand & learn Cell Signaling	2,3,4,5

	(JAK)/signal transducer and activator of transcription (STAT) signaling			
III	Principles and applications of genomic and proteomic tools DNA electrophoresis, PCR (reverse transcription and real time), Gene sequencing, micro array technique, SDS page, ELISA and Western blotting, Recombinant DNA technology and gene therapy Basic principles of recombinant DNA technology-Restriction enzymes, various types of vectors. Applications of recombinant, DNA technology. Gene therapy- Various types of gene transfer techniques, clinical applications and recent advances in gene therapy.	**12**	Students will be able to understand the Principles and applications of genomic and proteomic tools DNA electrophoresis, PCR (reverse transcription and real time), Gene sequencing, micro array technique, SDS page, ELISA and western blotting, Recombinant DNA technology	2,3,4,5
IV	**Pharmacogenomics** Gene mapping and cloning of disease gene. Genetic variation and its role in health/ pharmacology, Polymorphisms affecting drug metabolism, Genetic variation in drug transporters, Genetic variation in G protein coupled receptors, Applications of proteomics science: Genomics, proteomics, metabolomics, functionomics, nutrigenomics **Immunotherapeutic** Types of immunotherapeutic, humanization antibody therapy, Immunotherapeutics in clinical practice	12	Students will be able to know about Pharmacogenomics & Immunotherapeutic	2,3,4,5
V	**a. Cell culture techniques** Basic equipment used in cell culture lab. Cell culture media, various types of cell culture, general procedure for cell cultures; isolation of cells, subculture, cryopreservation, characterization of cells and their application. Principles and applications of cell viability assays, glucose uptake assay, Calcium influx assays, Principles and applications of flow cytometry **b. Biosimilars**	**12**	Students will be able to learn about Cell culture techniques	2,3,4,5

REFERENCE BOOKS:

R1. The Cell, A Molecular Approach. Geoffrey M Cooper.

R2. Pharmacogenomics: The Search for Individualized Therapies. Edited by J. Licinio and M -L. Wong.

R3. Handbook of Cell Signaling (Second Edition) Edited by Ralph A. et.al.

R4. Molecular Pharmacology: From DNA to Drug Discovery. John Dickensonet.al.

R5. Basic Cell Culture protocols by CherilD.Helgason and Cindy L.Miller.

R6. Basic Cell Culture (Practical Approach) by J. M. Davis (Editor).

R7. Animal Cell Culture: A Practical Approach by John R. Masters (Editor).

R8. Current protocols in molecular biology vol I to VI edited by FrederickM.Ausuvel et al.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain various cellular events, functions, pathways and transduction mechanisms and how a gene is expressed.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Illustrate Cell signalling pathways based on receptors and second messengers in the cell.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	Knowledge about principles and applications of genomic; proteomic tools, gene therapy and rDNA technology.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Understand Immunotherapeutic and application of omics in clinical practice.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	Describe principles and applications of various assays, biosimilars, cell culture techniques, application of flow cytometry.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8

SEMESTER-I									
Course Title	Pharmacological Practical –I								
Course code	MPL105P	**Total credits: 6**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 12	**0**	**0**	**12**	**0**	**0**	**0**	**6**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy (Pharmacology)								
Semester	I semester of first year of the program								
Course Objectives	Upon completion of the course, it is expected that the students will be able to understand								
CO1	Demonstrate comprehension of the analysis of Pharmacopeial compounds and their formulations through the utilization of UV Vis spectroscopy.								
CO2	Understand the importance and process importance animal experimentation.								
CO3	The students will reveal their understanding of High-Performance Liquid Chromatography (HPLC) experiments through the application of analytical skills and knowledge, showcasing their ability to evaluate and interpret complex procedures.								
CO4	Establish their analytical skills by examining different drug analysis, estimation,								
CO5	The mastery of theoretical and practical skills associated with advance analytical techniques and instruments								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. Analysis of pharmacopeial compounds and their formulations by UV Visspectrophotometer 2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry 3. Experiments based on HPLC 4. Experiments based on Gas Chromatography 5. Estimation of riboflavin/quinine sulphate by fluorimetry 6. Estimation of sodium/potassium by flame photometry **Handling of laboratory animals.** 1. Various routes of drug administration. 2. Techniques of blood sampling, anesthesia and euthanasia of experimentalanimals. 3. Functional observation battery tests (modified Irwin test) 4. Evaluation of CNS stimulant, depressant, anxiogenics and anxiolytic, anticonvulsant activity. 5. Evaluation of analgesic, anti-inflammatory, local anesthetic, mydriaticandmiotic activity. 6. Evaluation of diuretic activity. 7. Evaluation of antiulcer activity by pylorus ligation method. 8. Oral glucose tolerance test.	**12**	Students will be able to Hands-on with various spectroscopic and chromatographic techniques. Handling of laboratory animals used in Experimental Pharmacology. & Demonstrate various screening methods used in preclinical research.	2,3,4,5,6

	9. Isolation and identification of DNA from various sources (Bacteria, Cauliflower, onion, Goat liver). 10. Isolation of RNA from yeast 11. Estimation of proteins by Braford/Lowry's in biological samples. 12. Estimation of RNA/DNA by UV Spectroscopy 13. Gene amplification by PCR. 14. Protein quantification Western Blotting. 15. Enzyme based in-vitro assays (MPO, AChEs, α amylase, α glycosidase). 16. Cell viability assays (MTT/Trypan blue/SRB). 17. DNA fragmentation assay by agarose gel electrophoresis. 18. DNA damage study by Comet assay. 19. Apoptosis determination by fluorescent imaging studies. 20. Pharmacokinetic studies and data analysis of drugs given by different routes of administration using software's. 21. Enzyme inhibition and induction activity 22. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (UV) 23. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (HPLC)			

REFERENCE BOOKS:

R1. CPCSEA, OECD, ICH, USFDA, Schedule Y, EPA guidelines,

R2. Fundamentals of experimental Pharmacology by M.N.Ghosh

R3. Handbook of Experimental Pharmacology by S.K. Kulkarni.

R4. Drug discovery and Evaluation by Vogel H.G.

R5. Spectrometric Identification of Organic compounds - Robert M Silverstein.

R6. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman.

R7. Vogel's Text book of quantitative chemical analysis - Jeffery, Basset, Mendham, Denney.

R8. Basic Cell Culture protocols by Cheril D. Helgason and Cindy L.Mille.

R9. Basic Cell Culture (Practical Approach) by J. M. Davis (Editor).

R10. Animal Cell Culture: A Practical Approach by John R. Masters (Editor).

R11. Practical Manual of Experimental and Clinical Pharmacology by BikashMedhi(Author), Ajay Prakash (Author) Jaypee brothers' medical publishersPvt.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate comprehension of the analysis of Pharmacopeial compounds and their formulations through the utilization of UV Vis spectroscopy.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Understand the importance and process importance animal experimentation.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	The students will reveal their understanding of High-Performance Liquid Chromatography (HPLC) experiments through the application of analytical skills and knowledge, showcasing their ability to evaluate and interpret complex procedures.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Establish their analytical skills by examining different drug analysis, estimation,	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	The mastery of theoretical and practical skills associated with advance analytical techniques and instruments	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8

SEMESTER – II									
Course Title	Advanced pharmacology – II								
Course code	MPL201T	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T	**3**	**1**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy (Pharmacology)								
Semester	II semester of first year of the program								
Course Objectives	After completion of course student is able to know, 1. Explain the mechanism of drug actions at cellular and molecular level. 2. Discuss the Path physiology and pharmacotherapy of certain diseases. 3. Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases.								
CO1	Demonstrate an understanding of the mechanism of action of different hormones and associated drugs at the cellular and molecular levels.								
CO2	Explain the mechanism of action and adverse drug reactions associated with drugs used in protozoal infections, helminthiasis, and various antimicrobial agents, including antifungal, antiviral, and anti-TB drugs, on a cellular and molecular level as well as analyze the development of drug resistance.								
CO3	Apply knowledge to elucidate the path physiology, therapy, and adverse drug reactions of drugs used in cancer, inflammation, allergy, asthma, and COPD as well as understand the principles behind immune suppressants and immune stimulants.								
CO4	Analyze the path physiology, therapy, and adverse drug reactions of antiulcer drugs, prokinetics, antiemetic, anti-diarrheal, and drugs for constipation and irritable bowel syndrome and to evaluate the applications of chronotherapy in various diseases.								
CO5	Correlate the role of free radical generation with the etiology of various diseases and understand the importance of the protective activity of antioxidants as well as synthesize knowledge on recent advances in the treatment of neurodegenerative diseases, cancer, and diabetes.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	**Endocrine Pharmacology** Molecular and cellular mechanism of action of hormones such as growth hormone, prolactin, thyroid, insulin and sex hormones Anti-thyroid drugs, Oral hypoglycaemic agents, Oral contraceptives, Corticosteroids. Drugs affecting calcium regulation	**12**	Students will be able to Explain the mechanism of drug actions at cellular and molecular level	2,3,4,5,
II	**Chemotherapy** Cellular and molecular mechanism of actions and resistance of antimicrobial agents such as ß-lactams, amino glycosides, quinolones, Macrolideantibiotics. Antifungal, antiviral, and anti-TB drugs	**12**	Students will be able to Explain the mechanism of drug actions at cellular and molecular level	2,3,4,5,
III	**Chemotherapy** Drugs used in Protozoal Infections; Drugs used in the treatment of Helminthiasis, Chemotherapy of cancer, Immunopharmacology Cellular and	**12**	Students will be able to know the Drugs used in the treatment of Helminthiasis, Chemotherapy of cancer, Immunopharmacology	2,3,4,5,

	biochemical mediators of inflammation and immune response. Allergic or Hypersensitivity reactions. Pharmacotherapy of asthma and COPD. Immunosuppressants and Immunostimulants.			
IV	**GIT Pharmacology** Antiulcer drugs, Prokinetics, anti-emetics, anti-diarrheal and drugs for constipation and irritable bowel syndrome. Chrono-pharmacology, Biological and circadian rhythms, applications of chronotherapyin various diseases like cardiovascular disease, diabetes, asthma and peptic ulcer.	**12**	Students will be able to know the Path physiology and pharmacotherapy of certain diseases Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases	2,3,4,5,
V	**Free radicals Pharmacology** Generation of free radicals, role of free radicals in etiopathology of various diseases such as diabetes, neurodegenerative diseases and cancer. Protective activity of certain important antioxidant **Recent Advances in Treatment:** Alzheimer's disease, Parkinson's disease, Cancer, Diabetes mellitus.	**12**	Students will be able to understand generation of free radicals, role of free radicals in etiopathology of various diseases such as diabetes, neurodegenerative diseases and cancer.	2,3,4,5,

REFERENCE BOOKS:

R1. The Pharmacological basis of therapeutics- Goodman and Gill man's.

R2. Principles of Pharmacology.The Path physiologic basis of drug therapy byDavid E Golan et al.

R3. Basic and Clinical Pharmacology by B.G –Katzung.

R4. Pharmacology by H.P. Rang and M.M. Dale.

R5. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.

R6. Text book of Therapeutics, drug and disease management by E T. Herfindal and Gourley.

R7. Applied biopharmaceutics and Pharmacokinetics by Leon ShargelandAndrewB.C.Yu.

R8. Handbook of Essential Pharmacokinetics, Pharmacodynamics and DrugMetabolism for Industrial Scientists.

R9. Robbins &Cortan Pathologic Basis of Disease, 9th Ed. (RobbinsPathology).

R10. A Complete Textbook of Medical Pharmacology by Dr. S.K Srivastavapublished by APC Avichal Publishing Company.

R11. KD.Tripathi. Essentials of Medical Pharmacology.

R12. Principles of Pharmacology. The Pathophysiologic basis of drug Therapyby David E Golan, Armen H, TashjianJr, EhrinJ,Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Demonstrate an understanding of the mechanism of action of different hormones and associated drugs at the cellular and molecular levels.	PO1,PO3,PO5,PO7,PO8
2	Explain the mechanism of action and adverse drug reactions associated with drugs used in protozoal infections, helminthiasis, and various antimicrobial agents, including antifungal, antiviral, and anti-TB drugs, on a cellular and molecular level as well as analyse the development of drug resistance.	PO1,PO3,PO5,PO7,PO8
3	Apply knowledge to elucidate the path physiology, therapy, and adverse drug reactions of drugs used in cancer, inflammation, allergy, asthma, and COPD as well as understand the principles behind immunosuppressants and immunostimulants.	PO1,PO3,PO5,PO7,PO8
4	Analyse the path physiology, therapy, and adverse drug reactions of antiulcer drugs, prokinetics, antiemetic, anti-diarrheal, and drugs for constipation and irritable bowel syndrome and to evaluate the applications of chronotherapy in various diseases.	PO1,PO3,PO5,PO7,PO8
5	Correlate the role of free radical generation with the aetiology of various diseases and understand the importance of the protective activity of antioxidants as well as synthesize knowledge on recent advances in the treatment of neurodegenerative diseases, cancer, and diabetes.	PO1,PO3,PO5,PO7,PO8

SEMESTER – II									
Course Title	Pharmacological and Toxicological Screening Methods-II								
Course code	MPL202T	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T	**4**	**0**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy (Pharmacology)								
Semester	II semester of first year of the program								
Course Objectives	After completion of course student is able to, 1. Explain the various types of toxicity studies. 2. Appreciate the importance of ethical and regulatory requirements for toxicity studies. 3. Demonstrate the practical skills required to conduct the preclinical toxicity studies								
CO1	Recall the basics of toxicology as well as good laboratory practice and discuss the role of various toxicology regulatory agencies.								
CO2	Apply various guidelines by regulatory agencies to conduct toxicological assays in oral, dermal, and inhalation routes.								
CO3	Discuss and apply various guidelines by regulatory agencies to conduct reproductive and genotoxicity assays in in-vivo and in-vitro setups.								
CO4	Evaluate various aspects of investigational new drugs and safety pharmacology studies.								
CO5	Analyze toxic kinetics and alternative methods to animal toxicity testing and analyze their role in drug development.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Basic definition and types of toxicology (general, mechanistic, regulatory and descriptive) Regulatory guidelines for conducting toxicity studies OECD, ICH, EPA and Schedule Y OECD principles of Good Laboratory Practice (GLP) History, concept and its importance in drug development	**12**	Student will be able to Explain the various types of toxicity studies.	3,4,5
II	Acute, sub-acute and chronic- oral, dermal and inhalational studies as per OECD guidelines. Acute eye irritation, skin sensitization, dermal irritation & dermal toxicity studies. Test item characterization- importance and methods in regulatory toxicology studies.	**12**	Student will be able to knowthe importance of ethical and regulatory requirements for toxicity studies.	3,4,5
III	Reproductive toxicology studies, Male reproductive toxicity studies, female reproductive studies (segment I and segment III), teratogenicity studies (segment II) Genotoxicity studies (Ames Test, in vitro and in vivo Micronucleus and Chromosomal aberrations studies) In vivo carcinogenicity.	**12**	Student will be able to understand about Reproductive toxicology studies.	3,4,5
IV	IND enabling studies (IND studies)- Definition of IND, importance of IND, industry perspective, list of studies needed for IND submission. Safety pharmacology	**12**	Student will be able to understand in vitro and in vivo assessments that help define the pharmacological	3,4,5

	studies- origin, concepts and importance of safety pharmacology. Tier1- CVS, CNS and respiratory safety pharmacology, HERAssay. Tier2- GI, renal and other studies.		and toxicological properties of a drug.	
V	Toxic kinetics- Toxic kinetic evaluation in preclinical studies, saturation kinetics Importance and applications of toxic kineticstudies. Alternative methods to animal toxicity testing.	**12**	Student will be able to know Toxic kinetic evaluation in preclinical studies, saturation kinetics Importance and applications of toxicokinetic studies	3,4,5

REFERENCE BOOKS:

R1. Hand book on GLP, Quality practices for regulated non-clinical research and development (http://www.who.int/tdr/publications/documents/glp- handbook.pdf).

R2. Schedule Y Guideline: drugs and cosmetics (second amendment) rules, 2005, ministry of health and family welfare (department of health) New Delhi

R3. Drugs from discovery to approval by Rick NG.

R4. Animal Models in Toxicology, 3rd Edition, Lower and Bryan

R5. OECD test guidelines.

R6. Principles of toxicology by Karen E. Stine, Thomas M. Brown.

R7. Guidance for Industry M3(R2) Nonclinical Safety Studies for the Conduct of Human Clinical Trials and MarketingAuthorization for Pharmaceuticals (http://www.fda.gov/downloads/drugs/guidancecomplianceregulatoryinformation/guidances/ucm073246.pdf).

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recall the basics of toxicology as well as good laboratory practice and discuss the role of various toxicology regulatory agencies.	PO1,PO2,PO3,PO4,PO5,PO6,PO8
2	Apply various guidelines by regulatory agencies to conduct toxicological assays in oral, dermal, and inhalation routes.	PO1,PO2,PO3,PO4,PO5,PO6,PO8
3	Discuss and apply various guidelines by regulatory agencies to conduct reproductive and genotoxicity assays in in-vivo and in-vitro setups.	PO1,PO2,PO3,PO4,PO5,PO6,PO8
4	Evaluate various aspects of investigational new drugs and safety pharmacology studies.	PO1,PO2,PO3,PO4,PO5,PO6,PO8
5	Analyse toxicokinetics and alternative methods to animal toxicity testing and analyse their role in drug development.	PO1,PO2,PO3,PO4,PO5,PO6,PO8

SEMESTER – II									
Course Title	Principles of Drug Discovery								
Course code	MPL203T	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T	**4**	**0**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy (Pharmacology)								
Semester	II semester of first year of the program								
Course Objectives	After completion of course student is able to 1. Explain the various stages of drug discovery. 2. Appreciate the importance of the role of genomics, proteomics and bioinformatics in drug discovery Explain various targets for drug discovery. 3. Explain various lead seeking method and lead optimization. 4. Appreciate the importance of the role of computer aided drug design in drug discovery.								
CO1	Understand Drug discovery process and stages in the drug discovery program.								
CO2	Explain the basics of Targets, its identification, validation, protein structures & its modification in drug discovery approach.								
CO3	Understand develop leads and protocol to identify leads, its optimization procedures and its sources and able to differentiate lead and hits.								
CO4	Knowledge about drug designing protocols, application of QSAR in drug discovery and lead developments, its statistical methodology to validate QSAR equations.								
CO5	Understand rational drug discovery, pharmacophore identification, in silico drug synthesis using software'sprogram and significance of prodrug concepts.								

Unit-No.	Content	Contact Hour	Learning Outcome	KL
I	**An overview of modern drug discovery process:** Target identification, target validation, lead identification and lead Optimization. Economics of drug discovery. Target Discovery and validation-Role of Genomics, Proteomics and Bioinformatics. Role of Nucleic acid microarrays, Protein microarrays, Antisense technologies, siRNAs, antisenseoligonucleotides, Zinc finger proteins. Role of transgenic animals in target validation	**12**	Students will be able to Explain the basics of Targets, its identification, validation, protein structures & its modification in drug discovery approach	4,5,6
II	**Lead Identification**- combinatorial chemistry & high throughput screening, in silico lead discovery techniques, Assay development for hit identification. **Protein structure** Levels of protein structure, Domains, motifs, and folds in protein Structure. Computational prediction of protein structure: Threading and homology modeling methods. Application of NMR and X-ray crystallography in protein structure prediction	**12**	Students will be able to Understand develop leads and protocol to identify leads, its optimization procedures and its sources and able to differentiate lead and hits.	4,5,6
III	**Rational Drug Design** Traditional vs. rational drug design, Methods followed in traditional drug design, High	**12**	Student will be able to learn the importance of the role of computer aided drug design	4,5,6

	throughput screening, Concepts of Rational Drug Design, Rational Drug Design Methods: Structure and Pharmacophore based approaches, Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening		in drug discovery	
IV	**Molecular docking:** Rigid docking, flexible docking, manual docking; Docking based screening. De novo drug design. **Quantitative analysis of Structure Activity Relationship** History and development of QSAR, SAR versus QSAR, Physicochemical parameters, Hansch analysis, Fee Wilson analysis and relationship between them	**12**	Student will be able to learn Molecular docking & QSAR	4,5,6
V	QSAR Statistical methods – regression analysis, partial least square analysis (PLS) and other multivariate statistical methods. 3D-QSAR approaches like COMFA and COMSIA Pro drug design-Basic concept, Pro drugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of pro drug design and practical consideration of pro drug design	**12**	Student will be able to understand the importance of the QSAR Statistical methods in drug design	4,5,6

REFERENCE BOOKS:

1. MouldySioud. Target Discovery and Validation Reviews and Protocols: Volume 2 Emerging Molecular Targetsand Treatment Options. 2007 Humana Press Inc.
2. Darryl León. Scott MarkelIn. Silico Technologies in Drug Target Identification and Validation.2006 by Taylor and Francis Group, LLC.
3. Johanna K. DiStefano. Disease Gene Identification. Methods and Protocols. Springer New York Dordrecht Heidelberg London.

R4.Hugo Kubiny. QSAR: Hansch Analysis and Related Approaches. Methods and Principles in Medicinal Chemistry.Publisher Wiley-VCH.

R5. Klaus Gubernator, Hans-Joachim Böhm. Structure-Based Ligand Design.Methods and Principles in Medicinal Chemistry.Publisher Wiley-VCH.

R6. Abby L .Parrill.M .Rami Reddy.Rational Drug Design. Novel Methodology and Practical Applications. ACS Symposium Series; American Chemical Society: Washington, DC, 1999.

R7. J. Rick Turner. New drug development design, methodology and, analysis. John Wiley & Sons, Inc., New Jersey.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Understand Drug discovery process and stages in the drug discovery programme.	PO1, PO2, PO3, PO4, PO5, PO8
2	Explain the basics of Targets, its identification, validation, protein structures & its modification in drug discovery approach.	PO1, PO2, PO3, PO4, PO5, PO8
3	Understand develop leads and protocol to identify leads, its optimization procedures and its sources and able to differentiate lead and hits.	PO1, PO2, PO3, PO4, PO5, PO8
4	Knowledge about drug designing protocols, application of QSAR in drug discovery and lead developments, its statistical methodology to validate QSAR equations.	PO1, PO2, PO3, PO4, PO5, PO8
5	Understand rational drug discovery, pharmacophore identification, in silico drug synthesis using software programmes and significance of pro drug concepts.	PO1, PO2, PO3, PO4, PO5, PO8

SEMESTER – II									
Course Title	Clinical Research and Pharmacovigilance								
Course code	MPL 204T	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T	**4**	**0**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy (Pharmacology)								
Semester	II semester of first year of the program								
Course Objectives	After completion of course student is able to, 1. Explain the regulatory requirements for conducting clinical trial. 2. Demonstrate the types of clinical trial designs. 3. Explain the responsibilities of key players involved in clinical trials. 4. Execute safety monitoring, reporting and close-out activities. 5. Explain the principles of Pharmacovigilance. 6. Detect new adverse drug reactions and their assessment. 7. Perform the adverse drug reaction reporting systems and communication in Pharmacovigilance.								
CO1	Explain the regulatory requirements for conducting clinical trial.								
CO2	Demonstrate the types of clinical trial designs.								
CO3	Understand responsibilities of key players involved in clinical trials.								
CO4	Understand principle of Pharmacovigilance and safety monitoring system.								
CO5	Analyze new adverse drug reactions and their assessment and understand Pharmacoepidemiology.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	Regulatory Perspectives of Clinical Trials: Origin and Principles of International Conference on Harmonization - Good Clinical Practice (ICH-GCP) guidelines Ethical Committee: Institutional Review Board, Ethical Guidelines for Biomedical Research and Human Participant-Schedule Y, ICMR Informed Consent Process: Structure and content of uninformed Consent Process Ethical principles governing informed consent process	**12**	Students will be able to Explain the regulatory requirements for conducting clinical trial	4,5,6
II	Clinical Trials: Types and Design Experimental Study- RCT and Non RCT, Observation Study: Cohort, Case Control, Cross sectional Clinical Trial Study Team Roles and responsibilities of Clinical Trial Personnel: Investigator, Study Coordinator, Sponsor, Contract Research Organization and	**12**	Students will be able to Demonstrate the types of clinical trial designs	4,5,6

	its management			
III	Clinical Trial Documentation-Guidelines to the preparation of documents, Preparation of protocol, Investigator Brochure, Case Report Forms, Clinical Study Report Clinical Trial Monitoring: Safety Monitoring in CTA diverse Drug Reactions: Definition and types. Detection and reporting methods. Severity and seriousness assessment. Predictability and preventability assessment, Management of adverse drug reactions; Terminologies of ADR	**12**	Students will be able to learn Clinical Trial Documentation	4,5,6
IV	**Basic aspects, terminologies and establishment of pharmacovigilance** History and progress of pharmacovigilance, Significance of safety monitoring, Pharmacovigilance in India and international aspects, WHO international drug monitoring program, WHO and Regulatory terminologies of ADR, evaluation of medication safety, Establishing pharmacovigilance centers in Hospitals, Industry and Nationalprogram related to pharmacovigilance. Roles and responsibilities in Pharmacovigilance	**12**	Students will be able to learn Basic aspects, terminologies and establishment of pharmacovigilance	4,5,6
V	**Methods, ADR reporting and tools used in Pharmacovigilance** International classification of diseases, International Non-proprietary names for drugs, Passive and Active surveillance, Comparative observational studies, Targeted clinical investigationsand Vaccine safety surveillance. Spontaneous reporting systemand Reporting to regulatory authorities, Guidelines for ADRs reporting. Argus, Aris G Pharmacovigilance, VigiFlow, Statistical Methods for evaluating medication safety data..	**12**	Students will be able to learn Methods, ADR reporting and tools used in Pharmacovigilance	4,5,6

VI	Pharmacoepidemiology, Pharmacoeconomics, safety pharmacology	**12**	Students will be able to learn Pharmacoepidemiology, Pharmacoeconomics, safety pharmacology	4,5,6

REFERENCE BOOKS:

R1. Central Drugs Standard Control Organization- Good Clinical Practices, Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health;2001.

R2. International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996.

R3. Ethical Guidelines for Biomedical Research on Human Subjects 2000.Indian Council of Medical Research, New Delhi.

R4. Textbook of Clinical Trials edited by David Machine, Simon Day and SylvanGreen, March 2005, John Wiley and Sons.

R5. Clinical Data Management edited by R K Rondels, S A Varley, C F Webbs. Second Edition, Jan 2000, Wiley Publications.

R6. Handbook of clinical Research.Julia Lloyd and Ann Raven Ed. Churchill Livingstone.

R7. Principles of Clinical Research edited by Giovanna di Ignacio, Di Giovanna and Haynes.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Explain the regulatory requirements for conducting clinical trial.	PO1. PO2, PO3, PO4, PO5, PO8
2	Demonstrate the types of clinical trial designs.	PO1. PO2, PO3, PO4, PO5, PO8
3	Understand responsibilities of key players involved in clinical trials.	PO1. PO2, PO3, PO4, PO5, PO8
4	Understand principle of Pharmacovigilance and safety monitoring system.	PO1. PO2, PO3, PO4, PO5, PO8
5	Analyse new adverse drug reactions and their assessment and understand Pharmacoepidemiology.	PO1. PO2, PO3, PO4, PO5, PO8

SEMESTER – II									
Course Title	Pharmacology Practical- II								
Course code	MPL205P	**Total credits: 6**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 12	**0**	**0**	**12**	**0**	**0**	**0**	**6**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy (Pharmacology)								
Semester	II semester of first year of the program								
Course Objectives	After completion of course student is able to know, 1. Estimate the potency of test samples using various bioassay procedures. 2. Acquire the technique of recording Blood Pressure, Heart rate, and ECG in rats. 3. Demonstrate toxicity studies as preclinical evaluation in drug discovery and development.								
CO1	Examine the effect of drugs through different in vitro study methods.								
CO2	Estimate the effect of drugs through animal models.								
CO3	Analyze the effect of drugs using advance instrument methods.								
CO4	Design and develop ADR, clinical trial protocol								
CO5	Develop and evaluate drug mutagen city, toxicity study.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	1. To record the DRC of agonist using suitable isolated tissues preparation. 2. To study the effects of antagonist/potentiating agents on DRC of agonist using suitable isolated tissue preparation. 3. To determine to the strength of unknown sample by matching bioassay by using suitable tissue preparation. 4. To determine to the strength of unknown sample by interpolation bioassay by using suitable tissue preparation 5. To determine to the strength of unknown sample by bracketing bioassay by using suitable tissue preparation 6. To determine to the strength of unknown sample by multiple point bioassay by using suitable tissue preparation. 7. Estimation of PA2 values of various antagonists using suitable isolated tissue preparations. 8. To study the effects of various drugs on isolated heart preparations 9. Recording of rat BP, heart rate and ECG. 10. Recording of rat ECG 11. Drug absorption studies by averted rat ileum preparation. 12. Acute oral toxicity studies as per	**12**	Students will be able to Estimate the potency of test samples using various bioassay procedures. Acquire the technique of recording Blood Pressure, Heart rate, and ECG in rats. Demonstrate toxicity studies as preclinical evaluation in drug discovery and development	3,4,5,6

	OECD guidelines. 13. Acute dermal toxicity studies as per OECD guidelines. 14. Repeated dose toxicity studies- Serum biochemical, hematological, urine analysis, functional observation tests and histological studies. 15. Drug mutagen city study using mice bone-marrow chromosomal aberration test. 16. Protocol design for clinical trial.(3 Nos.) 17. Design of ADR monitoring protocol. 18. In-silico docking studies. (2 Nos.) 19. In-silico pharmacophore based screening. 20. In-silico QSAR studies. 21. ADR			

REFERENCE BOOKS:

R1. Fundamentals of experimental Pharmacology-by M.N.Ghosh.

R2. Hand book of Experimental Pharmacology-S.K.Kulkarni.

R3. Text book of in-vitro practical Pharmacology by Ian Kitchen.

R4. Bioassay Techniques for Drug Development by Atta-ur-Rahman, IqbalChoudhary and William Thomsen.

R5. Applied biopharmaceutics and Pharmacokinetics by Leon ShargelandAndrewB.C.Yu.

R6. Handbook of Essential Pharmacokinetics, Pharmacodynamics and DrugMetabolism for Industrial Scientists.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Examine the effect of drugs through different in vitro study methods.	PO1. PO2, PO3, PO4, PO5, PO6, PO7, PO8
2	Estimate the effect of drugs through animal models.	PO1. PO2, PO3, PO4, PO5, PO6, PO7, PO8
3	Analyze the effect of drugs using advance instrument methods.	PO1. PO2, PO3, PO4, PO5, PO6, PO7, PO8
4	Design and develop ADR, clinical trial protocol	PO1. PO2, PO3, PO4, PO5, PO6, PO7, PO8
5	Develop and evaluate drug mutagen city, toxicity study.	PO1. PO2, PO3, PO4, PO5, PO6, PO7, PO8

SEMESTER – III									
Course Title	**Research Methodology and Biostatistics**								
Course code	MRM301T	**Total credits: 4**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours: 60T	**4**	**0**	**0**	**0**	**0**	**0**	**4**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy								
Semester	III semester of Second year of the program								
Course Objectives	Upon completion of the course, the student shall be able to 1. Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of 1. Experiment). 2. Know the various statistical techniques to solve statistical problems 3. 3. Appreciate statistical techniques in solving the problems								
CO1	Analyze the value, scope, objectives, and requirements of research.								
CO2	Discuss the basic concepts of statistical analysis.								
CO3	Apply the basic principles of medical research and ethics.								
CO4	Understand the guidelines for the maintenance of laboratory animals and design research work.								
CO5	Create efficiency in solving practical difficulties.								

Unit-No.	**Content**	**Contact Hour**	**Learning Outcome**	**KL**
I	General Research Methodology: Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.	**12**	Students will learn about basics of research methodology	3,4,5
II	Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests(students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.	**12**	Students will learn about basics of statistics and its application.	3,4,5
III	Medical Research: History, values in medical ethics, autonomy, beneficence, non-malfeasance, double effect, conflicts between autonomy and beneficence/non-malfeasance, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control	**12**	Students will learn about medical research	3,4,5

	resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.			
IV	CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.	**12**	Students will learn about CPCSEA guidelines	3,4,5
V	Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.	**12**	Students will learn about medical ethics	3,4,5

REFERENCE BOOKS:

R1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. New York.

R2. Fundamental of Statistics – Himalaya Publishing House- S.C.Gupta.

R3. Design and Analysis of Experiments –PHI Learning Private Limited, R. Pannerselvam.

R4. Design and Analysis of Experiments – Wiley Students Edition, Douglas and C. Montgomery.

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Analyse the value, scope, objectives, and requirements of research.	PO1,PO3,PO4,PO5,PO6,PO8
2	Discuss the basic concepts of statistical analysis.	PO1,PO3,PO4,PO5,PO6,PO8
3	Apply the basic principles of medical research and ethics.	PO1,PO3,PO4,PO5,PO6,PO8
4	Understand the guidelines for the maintenance of laboratory animals and design research work.	PO1,PO3,PO4,PO5,PO6,PO8
5	Create efficiency in solving practical difficulties.	PO1,PO3,PO4,PO5,PO6,PO8

Semester III									
Course Title	**Journal Club**								
Course code	MRM302NA	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy								
Semester	III semester of Second year of the program								
Course Objectives	1. To teach and develop critical appraisal skills, increase exposure to rapidly evolving literature, and help in informed clinical practice. 2. To provide a unique opportunity to promote interest in research while learning from experts about knowledge gaps and future research questions.								
CO1	Retrieve and recall essential information from scientific literature, summarizing key concepts and findings discussed in the assigned journal articles.								
CO2	Interpret and comprehend the chosen journal articles' methodologies, results, and implications, demonstrating a clear understanding of the research content.								
CO3	Apply critical analysis skills to assess the experimental design and methodologies employed in the selected journal articles, evaluating their appropriateness and validity.								
CO4	Analyze and synthesize information from multiple journal articles, comparing and contrasting methodologies, results, and conclusions to identify patterns, trends, and potential areas for further investigation.								
CO5	Evaluate the overall significance and relevance of the journal articles in the broader context of current pharmaceutical research, considering ethical implications, limitations, and potential contributions to the field.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Retrieve and recall essential information from scientific literature, summarizing key concepts and findings discussed in the assigned journal articles.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Interpret and comprehend the chosen journal articles' methodologies, results, and implications, demonstrating a clear understanding of the research content.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	Apply critical analysis skills to assess the experimental design and methodologies employed in the selected journal articles, evaluating their appropriateness and validity.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Analyze and synthesize information from multiple journal articles, comparing and contrasting methodologies, results, and conclusions to identify patterns, trends, and potential areas for further investigation.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	Evaluate the overall significance and relevance of the journal articles in the broader context of current pharmaceutical research, considering ethical implications, limitations, and potential contributions to the field.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8

Semester III									
Course Title	**DISCUSSION / PRESENTATION (PROPOSAL PRESENTATION)**								
Course code	MRM303NA	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:	**0**	**0**	**0**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy								
Semester	III semester of Second year of the program								
Course Objectives	1. Develop scientific writing skills 2. Enable critical thinking ability 3. Enhance communication skills 4. Follow ethical considerations								
CO1	Identify the research problem								
CO2	Discuss research problem with team and guide for solution								
CO3	Develops protocol report with an aim and objectives								
CO4	Analyse research problem								
CO5	Develops plan of work for research project								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Identify the research problem	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Discuss research problem with team and guide for solution	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	Develops protocol report with an aim and objectives	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Analyse research problem	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	Develops plan of work for research project	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8

Semester III									
Course Title	**Research Work**								
Course code	MRM304NA	**Total credits: 14**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:	**4**	**0**	**0**	**0**	**0**	**0**	**14**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy								
Semester	III semester of Second year of the program								
Course Objectives	1. Acquire research skills 2. Develop scientific writing skills 3. Enable critical thinking ability 4. Adopt application-oriented learning 5. Appreciate time management and organizational skills: 6. Enhance communication skills 7. Follow ethical considerations								
CO1	Recall key pharmaceutical concepts and principles pertinent to the M. Pharm project's research focus.								
CO2	Interpret the mechanism of action of the selected pharmaceutical agents, demonstrating a comprehensive understanding of their molecular pathways.								
CO3	Utilize advanced pharmaceutical research techniques to analyze drug formulations and assess their efficacy in practical experiments.								
CO4	Examine and synthesize experimental data to draw informed conclusions about the effectiveness and potential improvements of the formulated drugs.								
CO5	Assess pharmaceutical research's ethical and regulatory considerations, ensuring alignment with established guidelines and principles.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recall key pharmaceutical concepts and principles pertinent to the M. Pharm project's research focus.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Interpret the mechanism of action of the selected pharmaceutical agents, demonstrating a comprehensive understanding of their molecular pathways.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	Utilize advanced pharmaceutical research techniques to analyse drug formulations and assess their efficacy in practical experiments.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Examine and synthesize experimental data to draw informed conclusions about the effectiveness and potential improvements of the formulated drugs.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	Assess pharmaceutical research's ethical and regulatory considerations, ensuring alignment with established guidelines and principles.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8

Semester IV									
Course Title	**Journal Club**								
Course code	MRM401NA	**Total credits: 1**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy								
Semester	IV semester of Second year of the program								
Course Objectives	1. To teach and develop critical appraisal skills, increase exposure to rapidly evolving literature, and help in informed clinical practice. 2. To provide a unique opportunity to promote interest in research while learning from experts about knowledge gaps and future research questions.								
CO1	Retrieve and recall essential information from scientific literature, summarizing key concepts and findings discussed in the assigned journal articles.								
CO2	Interpret and comprehend the chosen journal articles' methodologies, results, and implications, demonstrating a clear understanding of the research content.								
CO3	Apply critical analysis skills to assess the experimental design and methodologies employed in the selected journal articles, evaluating their appropriateness and validity.								
CO4	Analyze and synthesize information from multiple journal articles, comparing and contrasting methodologies, results, and conclusions to identify patterns, trends, and potential areas for further investigation.								
CO5	Evaluate the overall significance and relevance of the journal articles in the broader context of current pharmaceutical research, considering ethical implications, limitations, and potential contributions to the field.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Retrieve and recall essential information from scientific literature, summarizing key concepts and findings discussed in the assigned journal articles.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Interpret and comprehend the chosen journal articles' methodologies, results, and implications, demonstrating a clear understanding of the research content.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	Apply critical analysis skills to assess the experimental design and methodologies employed in the selected journal articles, evaluating their appropriateness and validity.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Analyse and synthesize information from multiple journal articles, comparing and contrasting methodologies, results, and conclusions to identify patterns, trends, and potential areas for further investigation.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	Evaluate the overall significance and relevance of the journal articles in the broader context of current pharmaceutical research, considering ethical implications, limitations, and potential contributions to the field.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8

Semester IV									
Course Title	**DISCUSSION / FINAL PRESENTATION**								
Course code	MRM402NA	**Total credits: 2**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:	**0**	**0**	**0**	**0**	**0**	**0**	**2**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy								
Semester	IV semester of Second year of the program								
Course Objectives	1. Develop scientific writing skills. 2. Enable critical thinking ability. 3. Enhance communication skills. 4. Follow ethical considerations.								
CO1	Identify the research problem								
CO2	Discuss research problem with team and guide for solution								
CO3	Develops protocol report with an aim and objectives								
CO4	Analyze research problem								
CO5	Develops plan of work for research project								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Identify the research problem	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Discuss research problem with team and guide for solution	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	Develops protocol report with an aim and objectives	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Analyse research problem	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	Develops plan of work for research project	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8

Semester IV									
Course Title	**Research Work and Colloquium**								
Course code	MRM403NA	**Total credits: 14**	**L**	**T**	**P**	**S**	**R**	**O/F**	**C**
		Total hours:	**0**	**0**	**0**	**0**	**0**	**0**	**14**
Pre-requisite	**Nil**	**Co-requisite**	**Nil**						
Program	Master of Pharmacy								
Semester	IV semester of Second year of the program								
Course Objectives	1. Acquire research skills 2. Develop scientific writing skills 3. Enable critical thinking ability 4. Adopt application-oriented learning 5. Appreciate time management and organizational skills: 6. Enhance communication skills 7. Follow ethical considerations								
CO1	Recall key pharmaceutical concepts and principles pertinent to the M. Pharm project's research focus.								
CO2	Interpret the mechanism of action of the selected pharmaceutical agents, demonstrating a comprehensive understanding of their molecular pathways.								
CO3	Utilize advanced pharmaceutical research techniques to analyze drug formulations and assess their efficacy in practical experiments.								
CO4	Examine and synthesize experimental data to draw informed conclusions about the effectiveness and potential improvements of the formulated drugs.								
CO5	Assess pharmaceutical research's ethical and regulatory considerations, ensuring alignment with established guidelines and principles.								

RELATIONSHIP BETWEEN COURSE OUTCOMES (CO) AND PROGRAM OUTCOMES

CO PO Mapping		
SN	**Course Outcome (CO)**	**Mapped Program Outcome**
1	Recall key pharmaceutical concepts and principles pertinent to the M. Pharm project's research focus.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
2	Interpret the mechanism of action of the selected pharmaceutical agents, demonstrating a comprehensive understanding of their molecular pathways.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
3	Utilize advanced pharmaceutical research techniques to analyse drug formulations and assess their efficacy in practical experiments.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
4	Examine and synthesize experimental data to draw informed conclusions about the effectiveness and potential improvements of the formulated drugs.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8
5	Assess pharmaceutical research's ethical and regulatory considerations, ensuring alignment with established guidelines and principles.	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8