Academic Programme Guide

of

Bachelor of Pharmacy
(4 Year Course)

Based on Choice Based Credit System (CBCS) / Elective Course System

CHITKARA UNIVERSITY

w.e.f.
Academic Year: 2025-2026

Approved by the 28th Academic Council vide agenda item AC 28.5 dated 1st October 2025

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Chitkara University

Vision and Mission

Vision	To be a globally recognized organization promoting academic excellence through interdisciplinary applied research and to expand realms of knowledge through innovation.
Mission	• To carry out the academic processes in accordance with global standards through active teacher-student-industry participation.
	• To promote research, innovation and entrepreneurship in collaboration with industry, research laboratories and academic institutions of global repute.
	• To inculcate high moral, ethical and professional values amongst our students, faculty & staff.
	• To contribute in building skillful society.

Institute Vision and Mission

Vision	To excel as a premiere Centre of Excellence in Pharmaceutical Education, Research, Development & Innovation with Global Interaction.
Mission	• To contribute in building skillful society by preparing competent pharmacist.
	• To prepare globally recognized pharmaceutical professionals who can effectively contribute in new molecule research, formulation, preclinical and clinical growth and regulatory submissions.
	• To prepare efficient leaders providing academic and other interactions in various stages of pharmaceutical operations, marketing and distribution.
	• To provide applied, industry relevant pharmaceutical education relevant globally.
	• To enhance and impart innovation, entrepreneurship, and social skills.

1. General Information

Pharmacy as an academic discipline makes for an enriching learning experience as it perfectly combines technology and health care system. The profession of pharmacy has transformed into a crucial domain in health care management and evolved as a multidisciplinary, multifaceted curriculum. Learning and working in harmony with other members of health care are the immediate needs for the ideal role and social relevance of pharmacist in the health care system of our country. So, the academic system at Chitkara college of Pharmacy has been framed taking into consideration the responsibility of undergraduate students to meet the demands of hi tech pharmaceutical industry, at the same time ensuring that they confidently serve the requirements of patient care and pharmacy practice. Conscious efforts to inculcate research aptitude in the students through elective research projects to keep them abreast of the requirements of the industry.

Program Objectives:

1. To provide exemplary education in a stimulating environment where delivery of superb pharmaceutical knowledge is integrated with nationally and internationally recognized research data to enable students to conduct and publish cutting-edge multidisciplinary research in the discovery, utilization and evaluation of therapeutic agents.
2. To prepare competent pharmacists at various levels for India.
3. To prepare globally capable pharmaceutical scientists.
4. To become efficient leaders in various stages of pharmaceutical production, marketing and distribution.

1. Program Outcomes

The proposed outcomes for the B. Pharmacy program focus on the ability of a graduating student to develop himself/herself as a competent professional with appropriate scientific innovative skills in pharmaceutical sciences.

The student outcomes for the B. Pharmacy Program are the following:

PO 1: The Pharmacy graduates are required to learn and acquire adequate knowledge, necessary skills to practice the profession of pharmacy with adequate knowledge and scientific information regarding basic principles of Pharmaceutical & Medicinal Chemistry, Pharmaceutics including Cosmeticology, Pharmacology, Pharmacognosy including herbal medicines.

PO 2: The graduate should have adequate knowledge of synthesis & analysis of medicinal agents, their mode and mechanism of action, drug interactions, patient counselling and adequate technical information to be exchanged with the physician and other health professionals.

PO 3: Adequate knowledge of practical aspects of Synthesis of APIs & its intermediates

and analysis of various pharmaceutical dosage forms Formulation developments & quality assurance of various pharmaceutical dosage forms including those of herbal origin as per standards of official books, WHO and other regulatory agencies like USFDA, MHRA etc., pharmacological screening and biological standardization and in-vivo drug interactions, preparation & analysis of suitable plants material/extracts of medicinal importance for various herbal formulations, Clinical studies, patient counselling leading to physical and social well-being of the patients, Product detailing, marketing, distribution and selling of pharmaceutical products.

PO 4: A graduate should be able to demonstrate skills necessary for practice of a Pharmacy viz. able to synthesize, purify, identify and analyze medicinal agents, able to formulate, store, dispense, manufacture the pharmaceutical products and analyze the prescriptions, able to learn and apply the quality assurance principles in regulatory and ethical aspects, able to extract, purify, identify and understand the therapeutic value of herbal/crude/natural products, able to screen various medicinal agents using animal models for pharmacological activity.

PO 5: A graduate should develop the attitudes during the course which including willingness to apply the current knowledge of Pharmacy in the best interest of the patients and the community, maintain high standards of professional ethics in discharging professional obligations, continuously upgrade professional information and be conversant with latest advances in the field of pharmacy to serve community better, willingness to participate in continuing education programs of PCI/AICTE/ Chitkara University to upgrade the knowledge and professional skills, to help and participate in the implementation of National Health Programs.

PO 6: The graduates are required to acquire in depth knowledge of formulation, quality assurance and storage of various pharmaceutical dosage forms including herbal medicines.

PO 7: The graduates should also understand the concept of community pharmacy and be able to participate in clinical pharmacy and research.

PO 8: To understand industry relevant operations in drug discovery, Development, Pharmaceutical operations, quality assurance, business, Market development, corporate affairs and clinical practices.

PO 9: Technology Competence: The program aims to prepare competent professionals with advanced knowledge in pharmaceutical technology for process development and industry operations.

PO 10: To develop research aptitude: to acquire advanced skills in development, conduct & outcome management of research projects in optimized formulation

development & standardization in time bound manner.

PO 11: To develop Capacity for undertaking regulatory compliance responsibilities & entrepreneurship skills.

Mission:

M1: To carry out the academic processes in accordance with global standards through active teacher-student-industry participation.

M2: To promote research, innovation and entrepreneurship in collaboration with industry, research laboratories and academic institutions of global repute.

M3: To inculcate high moral, ethical and professional values amongst our students, faculty & staff.

M4: To contribute in building skillful society by preparing competent pharmacist.

M5: To prepare globally recognized pharmaceutical professional who can effectively contribute in new molecule research, formulation, preclinical and clinical growth and regulatory submissions.

M6: To become efficient leaders providing academic and other interactions in various stages of pharmaceutical operations, marketing and distribution.

The mapping of POs with University Mission is shown in **Table 2**.

PO No.	**PO Statement**	**Mission Statement**	**Vision Statement**
PO1	The Pharmacy graduates are required to learn and acquire adequate knowledge, necessary skills to practice the profession of pharmacy with adequate knowledge and scientific information regarding basic principles of Pharmaceutical & Medicinal Chemistry, Pharmaceutics including Cosmeticology, Pharmacology, Pharmacognosy including herbal medicines.	M1, M3	To be a globally recognized university, promoting academic excellence through interdisciplinary applied research and to expand realms of knowledge through innovation.
PO2	The graduate should have adequate knowledge of synthesis & analysis of medicinal agents, their mode and mechanism of action, drug interactions, patient counselling and adequate technical information to be exchanged with the physician and other health professionals.	M2, M5	
PO3	Adequate knowledge of practical aspects of Synthesis of APIs & its intermediates and analysis of various pharmaceutical dosage forms	M1, M5	

	Formulation developments & quality assurance of various pharmaceutical dosage forms including those of herbal origin as per standards of official books, WHO and other regulatory agencies like USFDA, MHRA etc., pharmacological screening and biological standardization and in-vivo drug interactions, preparation & analysis of suitable plants material/extracts of medicinal importance for various herbal formulations, Clinical studies, patient counselling leading to physical and social well-being of the patients, Product detailing, marketing, distribution and selling of pharmaceutical products.		
PO4	A graduate should be able to demonstrate skills necessary for practice of a Pharmacy viz. able to synthesize, purify, identify and analyze medicinal agents, able to formulate, store, dispense, manufacture the pharmaceutical products and analyze the prescriptions, able to learn and apply the quality assurance principles in regulatory and ethical aspects, able to extract, purify, identify and understand the therapeutic value of herbal/crude/natural products, able to screen various medicinal agents using animal models for pharmacological activity.	M5, M6	
PO5	A graduate should develop the attitudes during the course which including willingness to apply the current knowledge of Pharmacy in the best interest of the patients and the community, maintain high standards of professional ethics in discharging professional obligations, continuously upgrade professional information and be conversant with latest advances in the field of pharmacy to serve community better, willingness to participate in continuing education programs of PCI/AICTE/ Chitkara University to	M2, M4	

	upgrade the knowledge and professional skills, to help and participate in the implementation of National Health Programs.		
PO6	The graduates are required to acquire in depth knowledge of formulation, quality assurance and storage of various pharmaceutical dosage forms including herbal medicines.	M4, M6	
PO7	The graduates should also understand the concept of community pharmacy and be able to participate in clinical pharmacy and research.	M1, M3	
PO8	To understand industry relevant operations in drug discovery, Development, Pharmaceutical operations, quality assurance, business, Market development, corporate affairs and clinical practices.	M2, M6	
PO9	Technology Competence: The program aims to prepare competent professionals with advanced knowledge in pharmaceutical technology for process development and industry operations.	M4, M5	
PO10	To develop research aptitude: to acquire advanced skills in development, conduct & outcome management of research projects in optimized formulation development & standardization in time bound manner.	M2, M3	
PO11	To develop Capacity for undertaking regulatory compliance responsibilities & entrepreneurship skills.	M1, M4	

The Programme Outcomes in Bachelor of Pharmacy are well-designed based on the mission of providing the graduating students with knowledge and for expertise required for professional practices in Health and pharmaceutical services. The graduating students are prepared for demonstrating knowledge of and ability to use principles of therapeutics, quality improvement, communication, economics, health behavior, social and administrative sciences, health policy and legal issues in the practice of pharmacy. Each year, experts from different universities and pharmaceutical industry across the globe visits Chitkara College of Pharmacy, Chitkara University, Punjab to provide international exposure to students.

Aiming at developing student's personality through community service, NSS activities are offered to students to instill the idea of social welfare and to provide service to society without

bias. To enrich student's interpersonal skills, variety of extracurricular activities have been inculcated in the course curriculum in the form of national level technical and cultural festivals such as Pharma-fest, International Pharmacist Day and National Pharmacy Week respectively on a yearly basis under the student club CHAMP (Chitkara House of Aspirants and Multitalented Pharmacists). A vital role is played by CHAMP for overall progress & grooming of the student through organizing industrial visits, workshops, debate, technical quizzes and research project paper presentation competitions in events like Pharma tech Trends, Pharmacy Practice Module and international conferences. The students are motivated to participate or organize such events. These value-added activities have been designed taken into account various Programme Objectives (POs) such as PO3, PO8, PO9, PO10 and PO11.

The main aim of service training with focus on good health and well-being is accomplished by delivering sport-related events, NSS and NCC. The programme also aims to develop professional with awareness of international standards as of global health has transcended beyond the idea of confining the pharmacist's work to a specific geographical location and broadened it to the global level. PO1, PO2, PO4, PO5 and PO6 promote development of skills in graduates for pharmaceutical formulations, analytical experts, regulatory and dispensing skills for good practices in global health system.

Pharmacists have the opportunity to play an important role in both public health and global health. In particular, pharmacists can look at the varied global health practices established in medicine and use this as a framework to understand the potential role of the pharmacist within global health practice and program delivery, research, and policy. According to the Consortium of Universities for Global Health, global health should refer to the scope of a wider problem rather than a geographical location. The scope of work of pharmacists in diverse settings faces challenges of global health such as self-care & self-medication, management of diseases through medication therapy management, resistance to existing drugs or recreational drugs being abused, medicines supplied through unregistered online pharmacies, online advertising of prescription drugs, direct-to-consumer websites and the distribution of substandard & spurious, falsely-labeled, falsified or counterfeit medicines. POs are designed and oriented to meet the mission of university in professional ethics. The POs ensure that the graduating students are well equipped with pharmaceutical technical knowledge, to promote the development of trained human resource in Pharmaceutical Sciences for dissemination of quality education with highly professional and ethical attitude, strong communication and effective skills to work in a team with a multidisciplinary approach. Thus, the objective of the programme is to produce pharmacy graduates with strong fundamental concepts and high technical competence in pharmaceutical sciences and technology, who shall be able to use these tools in pharmaceutical industry and/or institutes where ever necessary for success.

3.1. 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.

3.2. 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.

3.3. Migration/Credit Transfer Policy

The following procedures will be followed for credit transfer for student under migration, studied in other Universities in India and Abroad:

"The credits earned by the student from the other universities in India or abroad shall be transferred as such. The Degree shall only be awarded to candidate subject to the condition that student earned the minimum no. of credit defined by Academic Regulation/APG of the Programme run by the Chitkara University."

In case a student undergoes international exchange programme or internship for 1 semester/ 1 year, then the courses, credits and grades earned by the student in abroad during that period should be reflected on the grade card issued by the Chitkara University. The courses will be marked as (*) on the grade card/transcript. The description of the (*) will be "credits and grades as adopted university/institute name . . . . . during international exchange programme.

The minimum credits requirement for being eligible for B. Pharmacy degree will be 228/230$/231# credits. If consolidated credits are less than 228 credits, then the student has to earn extra credits to attain minimum credits requirement for B. Pharmacy degree. The instructions regarding this will be informed to the students by the department from time to time.

* 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**.**

4. Programme Duration

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.

4.1. Medium of instruction and examinations

Medium of instruction and examination shall be in *English*.

4.2. 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. Pedagogical Aspects

Each course will be taught for 39-65 hrs. Everyday there will be three to four lecture sessions of three to four courses of 1 hours each and three-to-four-hour practical (pre-lunch and post-lunch). Activity and project hours will be other than these lecture hours depending upon the subject and relevance of the project. At least one week prior to the commencement of a particular course, the concerned faculty member or the course coordinator will circulate among the students the following pertaining to the course:

a) The course outlines containing the syllabus along with textbooks, reference books and other study material.

b) Day-to-day schedule to be followed — detailing the pace, coverage, prior reading assignments, case studies, home assignments to be perused by the students etc.

c) Various components of evaluation, such as quizzes (announced or unannounced), assignment, open book test, field work, group discussion, seminar, assignments, tests/examinations, class participation, mid-term and end term grading with relative weightage etc.

d) other matters found desirable and relevant.

6. Apprenticeship/Internship embedded degree programs (AEDP)

The preparation of students for prosperous careers in pharmacy is greatly aided by apprenticeship or internship integrated pharmacy programs. As per PCI regulations for B Pharmacy, 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.

7. Program 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 put in for each of these activities per week.

7.1. Credit assignment

7.1.1. 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.

7.2. Minimum credit requirements

The minimum credit points required for the 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.

7.3. Academic work

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

7.4. Course of study

The course of study for B. Pharm shall include Semester Wise Theory and 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
25UNI0130	The Rudiments of Artificial Intelligence		-	1
Total		32 #/34 $/36 *	4	27 #/29 $/31 *

#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	1	4
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
BP 308P	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
24UNI0124	Cyber Security (MOOC Course)	3	0	3
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	33	5	30

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 PharmacyI– 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
24UNI0125	Disaster Management (MOOC Course)	3	-	3
BP506P	Industrial Pharmacy I – Practical	4	-	2

BP507P	Pharmacology II – Practical	4	-	2
BP508P	Pharmacognosy and Phytochemistry II – Practical	4	-	2
BP 509P	Medicinal Chemistry II- Practical	4		2
	Total	33	5	30

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
BP610 P	Biopharmaceutics and Pharmacokinetics-Practical	4		2
	Total	34	6	32

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	3	1	4
BP703T	Pharmacy Practice – Theory	3	1	4
BP704T	Novel Drug Delivery System – Theory	3	1	4
AMR1201	Awareness on Antimicrobial Resistance	2	-	2
BP705P	Instrumental Methods of Analysis – Practical	4	-	2
BP706PS	Industrial Pharmacy II – Practical	4	-	2
BP707PS	Pharmacy Practice- Practical	4		2
BP708PS	Novel Drug Delivery System-Practical	4		2
	Total	30	5	26

*Non-University Examination (NUE)

Table-VIII: Course of Study for Semester VIII

Course Code	Name of the Course	No. of Hours	Tutorial	Credit Points
BP801T	Biostatistics and Research Methodology	3	1	4
BP802T	Social and Preventive Pharmacy	3	1	4
24UNI0105	Human Values and Professional Ethics	2	-	2
BP803ET	Pharma Marketing Management	3 + 3 = 6	1 + 1 = 2	4 + 4 = 8
BP804ET	Pharmaceutical Regulatory Science			
BP805ET	Pharmacovigilance			
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			
BP809EP	Cosmetic Science	3		3
BP811EP	Advanced Instrumentation Techniques	3		3
BP813PW	Project Work	12	-	6
NS101	NSS	-	-	1
	Total	26	4	31

Table-IX: Semester Wise Credits Distribution

Semester	Credit Points
I	27/29[$] /31[#]
II	29
III	24
IV	30
V	30
VI	32
VII	26
VIII	31
Extracurricular/ Co-curricular activities	01*
Total credit points for the program	230/230[$] /233[#]

* 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.

7.5. 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.

. Rules for Attendance

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.

9. Grading System

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 25 marks for the total 50 including internal assessment and end semester practical examination.

9.1. 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.

9.2. 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.

9.3. 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 Questions (MCQs)	= 20x1 = 20
OR	
Objective Type Questions (10 x 2) (Answer all the questions)	= 10x2 = 20
II. Long Answers (Answer 2 out of 3)	= 2 x 10 = 20
III. Short Answers (Answer 7 out of 9)	= 7 x 5 = 35
Total	= 75 marks

For 50 marks paper

I. Long Answers (Answer 2 out of 3)	= 2 x 10 = 20
II. Short Answers (Answer 6 out of 8)	= 6 x 5 = 30
Total	= 50 marks

For 35 marks paper

I. Long Answers (Answer 1 out of 2)	= 1 x 10 =10
II. Short Answers (Answer 5 out of 7)	= 5 x 5 = 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

9.4. Grading of performances

9.4.1. 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
80-100	O	10	Outstanding
70-79	A+	9	Excellent
60-69	A	8	Very Good
55-59	B+	7	Good
50-54	B	6	Above Average
0-49	F	0	Fail
	Ab	0	Absent

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.

9.5 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, C4 and C5 and the student's grade points in these courses are G1, G2, G3, G4 and G5, respectively, and then students' SGPA is equal to:

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

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:

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

9.6 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 VIII 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:

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

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,…. .

9.7. 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

10. <u>Promotion and Registration</u>

No student shall be admitted to any examination unless he/she fulfills the norms given in 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 successfuly 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 successfullycompleted.

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 ODD BATCH 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.

The following rule for the award of grace marks to the students was approved by the Academic Council:

Provision of Grace-Marks
The University shall award grace-marks as per following:
"One percent of the total marks of theory examination of all the semesters may be given for improving the division of a candidate. Grace marks given to a candidate in semester examination may be deducted from total grace marks to be given for improvement of the division."
A maximum of One percent of the total marks of theory examination as grace marks at the end of the each semester/year, provided that a student secures a minimum of 15% marks in the respective subject/s of the End Semester/yearly Examination.

OR

The remainder or part there of the 1% grace marks of first semester/year plus 1 percent grace-marks of second year, provided that a student secures a minimum of 15% marks in the respective subject/s of the End Semester Examination, similarly for next semesters/years.

For internal Examination:
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.

10.1. Project work
All the students shall undertake a project under the supervision of a teacher and submit a report. 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 and 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	20 Marks
Results and Discussions	20 Marks
Conclusions and Outcomes	20 Marks
Total	**75 Marks**

Evaluation of Presentation:

Presentation of work	25 Marks
Communication skills	20 Marks
Question and answer skills	30 Marks
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.

10.2. 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 and D, Hospital (Clinical Pharmacy), Clinical Research Organization, Community Pharmacy, etc. After 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.

10.3. Practice School

In the VII semester, every candidate shall undergo practice school for a period of 150 hours 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.

11. Program Overview: B. Pharmacy

The Program consists of subjects under the following categories:

Table 7: Program Scheme: **B. Pharmacy**

Year 1 Sem 1												
S. No.	**Course Name**	**Course Code**	**Level**	**Category (Type of Course)**	**Credits (Course wise)**	**Hours per Week**			**Marks Distribution**			**Total Credits (Semester wise)**
						L	**T**	**P**	**I**	**E**	**TL**	
1.	Human Anatomy and Physiology I– Theory	BP101T	100-199	DC	4	3	1		25	75	100	27/29/31
2.	Pharmaceutical Analysis I – Theory	BP102T	100-199	DC	4	3	1		25	75	100	
3.	Pharmaceutics I – Theory	BP103T	100-199	DC	4	3	1		25	75	100	
4.	Pharmaceutical Inorganic Chemistry – Theory	BP104T	100-199	DC	4	3	1		25	75	100	
5.	Communication skills – Theory *	BP105T	100-199	DC	2	2			15	35	50	
6.	Remedial Biology/Remedial Mathematics – Theory*	BP106RBT BP106RMT	100-199	DC	2	2			15	35	50	
7.	Human Anatomy and Physiology – Practical	BP107P	100-199	DC	2			4	15	35	50	
8.	Pharmaceutical Analysis I – Practical	BP108P	100-199	DC	2			4	15	35	50	
9.	Pharmaceutics I – Practical	BP109P	100-199	DC	2			4	15	35	50	

10.	Pharmaceutical Inorganic Chemistry – Practical	BP110P	100-199	DC	2			4	15	35	50	
11.	Communication skills – Practical*	BP111P	100-199	DC	1			2	10	15	25	
12.	Remedial Biology – Practical*	BP112RBP	100-199	DC	1			2	10	15	25	
13.	The Rudiments of Artificial Intelligence	25UNI0130	100-199	SEC	1				75		75	
Year 1 Sem 2												
1.	Human Anatomy and Physiology II – Theory	BP201T	100-199	DC	4	3	1		25	75	100	**29**
2.	Pharmaceutical Organic Chemistry I – Theory	BP202T	100-199	DC	4	3	1		25	75	100	
3.	Biochemistry – Theory	BP203T	100-199	DC	4	3	1		25	75	100	
4.	Pathophysiology – Theory	BP204T	100-199	DC	4	3	1		25	75	100	
5.	Computer Applications in Pharmacy – Theory *	BP205T	100-199	DC	3	3			25	50	75	
6.	Environmental sciences – Theory *	BP206T	100-199	DC	3	3			25	50	75	
7.	Human Anatomy and Physiology II – Practical	BP207P	100-199	DC	2			4	15	35	50	
8.	Pharmaceutical Organic Chemistry I– Practical	BP208P	100-199	DC	2			4	15	35	50	
9.	Biochemistry – Practical	BP209P	100-199	DC	2			4	15	35	50	

10.	Computer Applications in Pharmacy – Practical*	BP210P	100-199	DC	1			2	10	15	25	
Year 2 Sem 3												
1.	Pharmaceutical Organic Chemistry II – Theory	BP301T	200-299	DC	4	3	1		25	75	100	**24**
2.	Physical Pharmaceutics I – Theory	BP302T	200-299	DC	4	3	1		25	75	100	
3.	Pharmaceutical Microbiology – Theory	BP303T	200-299	DC	4	3	1		25	75	100	
4.	Pharmaceutical Engineering – Theory	BP304T	200-299	DC	4	3	1		25	75	100	
5.	Pharmaceutical Organic Chemistry II – Practical	BP305P	200-299	DC	2			4	15	35	50	
6.	Physical Pharmaceutics I – Practical	BP306P	200-299	DC	2			4	15	35	50	
7.	Pharmaceutical Microbiology – Practical	BP307P	200-299	DC	2			4	15	35	50	
8.	Pharmaceutical Engineering –Practical	BP 308P	200-299	DC	2			4	15	35	50	
Year 2 Sem 4												
1.	Pharmaceutical Organic Chemistry III– Theory	BP401T	200-299	DC	4	3	1		25	75	100	**30**
2.	Medicinal Chemistry I – Theory	BP402T	200-299	DC	4	3	1		25	75	100	
3.	Physical Pharmaceutics II – Theory	BP403T	200-299	DC	4	3	1		25	75	100	
4.	Pharmacology I – Theory	BP404T	200-299	DC	4	3	1		25	75	100	

5.	Pharmacognosy and Phytochemistry I– Theory	BP405T	200-299	DC	4	3	1		25	75	100	
6.	Cyber Security	24UNI0124	200-299	VA	3	3			30		30	
7.	Medicinal Chemistry I – Practical	BP406P	200-299	DC	2			4	15	35	50	
8.	Physical Pharmaceutics II – Practical	BP407P	200-299	DC	2			4	15	35	50	
9.	Pharmacology I – Practical	BP408P	200-299	DC	2			4	15	35	50	
10.	Pharmacognosy and Phytochemistry I – Practical	BP409P	200-299	DC	2			4	15	35	50	
Year 3 Sem 5												
1.	Medicinal Chemistry II – Theory	BP501T	300-399	DC	4	3	1		25	75	100	30
2.	Industrial PharmacyI– Theory	BP502T	300-399	DC	4	3	1		25	75	100	
3.	Pharmacology II – Theory	BP503T	300-399	DC	4	3	1		25	75	100	
4.	Pharmacognosy and Phytochemistry II– Theory	BP504T	300-399	DC	4	3	1		25	75	100	
5.	Pharmaceutical Jurisprudence – Theory	BP505T	300-399	DC	4	3	1		25	75	100	
6.	Disaster Management	24UNI0125	300-399	VA	3	3			30		30	
7.	Industrial Pharmacy I – Practical	BP506P	300-399	DC	2			4	15	35	50	
8.	Pharmacology II – Practical	BP507P	300-399	DC	2			4	15	35	50	
9.	Pharmacognosy and Phytochemistry II	BP508P	300-399	DC	2			4	15	35	50	

	– Practical											
10.	Medicinal Chemistry II- Practical	BP 509P	300-399	DC	2			4	15	35	50	
Year 3 Sem 6												
1.	Medicinal Chemistry III – Theory	BP601T	300-399	DC	4	3	1		25	75	100	32
2.	Pharmacology III – Theory	BP602T	300-399	DC	4	3	1		25	75	100	
3.	Herbal Drug Technology – Theory	BP603T	300-399	DC	4	3	1		25	75	100	
4.	Biopharmaceutics and Pharmacokinetics –Theory	BP604T	300-399	DC	4	3	1		25	75	100	
5.	Pharmaceutical Biotechnology – Theory	BP605T	300-399	DC	4	3	1		25	75	100	
6.	Quality Assurance –Theory	BP606T	300-399	DC	4	3	1		25	75	100	
7.	Medicinal chemistry III – Practical	BP607P	300-399	DC	2			4	15	35	50	
8.	Pharmacology III – Practical	BP608P	300-399	DC	2			4	15	35	50	
9.	Herbal Drug Technology – Practical	BP609P	300-399	DC	2			4	15	35	50	
10.	Biopharmaceutics and Pharmacokinetics-Practical	BP610 P	300-399	DC	2			4	15	35	50	
Year 4 Sem 7												
1.	Instrumental Methods of Analysis – Theory	BP701T	400-499	DC	4	3	1		25	75	100	26

2.	Industrial Pharmacy II – Theory	BP702T	400-499	DC	4	3	1		25	75	100	
3.	Pharmacy Practice – Theory	BP703T	400-499	DC	4	3	1		25	75	100	
4.	Novel Drug Delivery System – Theory	BP704T	400-499	DC	4	3	1		25	75	100	
5.	Awareness on Antimicrobial Resistance	AMR1201	400-499	DC	2	2			30		30	
6.	Instrumental Methods of Analysis – Practical	BP705P	400-499	DC	2			4	15	35	50	
7.	Industrial Pharmacy II – Practical	BP706PS	400-499	DC	2			4	15	35	50	
8.	Pharmacy Practice- Practical	BP707PS	400-499	DC	2			4	15	35	50	
9.	Novel Drug Delivery System-Practical	BP708PS	400-499	DC	2			4	15	35	50	
Year 4 Sem 8												
1.	Biostatistics and Research Methodology	BP801T	400-499	DC	4	3	1		25	75	100	
2.	Social and Preventive Pharmacy	BP802T	400-499	DC	4	3	1		25	75	100	
3.	Human Values and Professional Ethics	24UNI0105	400-499	VAC	2	2			30		30	
4.	Pharma Marketing Management	BP803ET	400-499	DC	4 + 4 = 8	3 + 3 = 6	1 + 1 =		25 + 25 =	75 + 75 = 150	100 +100 =200	
5.	Pharmaceutical Regulatory Science	BP804ET	400-499	DC								
6.	Pharmacovigilance	BP805ET	400-499	DC								

7.	Quality Control and Standardization of Herbals	BP806ET	400-499	DC			2		50			
8.	Computer Aided Drug Design	BP807ET	400-499	DC								
9.	Cell and Molecular Biology	BP808ET	400-499	DC								
10.	Cosmetic Science	BP809ET	400-499	DC								
11.	Experimental Pharmacology	BP810ET	400-499	DC								
12.	Advanced Instrumentation Techniques	BP811ET	400-499	DC								
13.	Dietary Supplements and Nutraceuticals	BP812ET	400-499	DC								
14.	Cosmetic Science	BP809EP	400-499	DC	3			4	15	35	50	
15.	Advanced Instrumentation Techniques	BP811EP	400-499	DC	3			4	10	15	25	
16.	Project Work	BP813PW	400-499	DC	6			12		100	100	
17.	NSS	NS101		AE	1							

CHAPTER - II: SYLLABUS

SEMESTER I

BP101T. HUMAN ANATOMY AND PHYSIOLOGY-I (Theory) 45 Hours

Scope: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.
Objectives: Upon completion of this course the student should be able to explain the gross morphology, structure and functions of various organs of the human body; describe the various homeostatic mechanisms and their imbalances; identify the various tissues and organs of different systems of human body; perform the various experiments related to special senses and nervous system; appreciate coordinated working pattern of different organs of each system.

Course Outcomes:
CO 01: Describe the human body's structural organization, cell communication, and homeostatic regulation.

CO 02: Explain the structure and function of the skin, bones, muscles, and joints in body movement.

CO 03: Discuss the composition, formation, and function of blood and lymph and their related disorders.

CO 04: Illustrate the structure and function of the peripheral nervous system and special sensory organs.

CO 05: Explain the anatomy and physiology of the cardiovascular system, blood circulation, and heart regulation mechanisms.

Course Content:

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) Paracrine c) Synaptic d) Endocrine
Tissue level of organization: Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.
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; Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction
Joints: Structural and functional classification, types of joints movements and its articulation

Body fluids and blood: Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system.
Lymphatic system: Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system
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.
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 heart-beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.

BP107P. HUMAN ANATOMY AND PHYSIOLOGY (Practical) 4 Hours/week

Objectives: Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.

Course Outcomes:
CO 01: Understand the construction, working, care and handling of instruments, glassware's and equipment's required for practical.
CO 02: Understand the significance of Bleeding time, Blotting time, Blood group detection, Haemoglobin detection and measurement of blood pressure and its significance in human health
CO 03: Knowledge of mechanism of White Blood Cell Count and Red Blood Cell Count of blood sample.
CO 04: Demonstration of human cardiovascular system and digestive system with the help of charts and models.

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.

Recommended Books (Latest Editions)

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brother's medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams and Wilkins Co, Riverview, MI USA
4. Text book of Medical Physiology- Arthur C, Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
6. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books (Latest Editions)

1. Physiological basis of Medical Practice-Best and Tailor. Williams and Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje, Academic Publishers Kolkata

BP102T. PHARMACEUTICAL ANALYSIS (Theory) **45 Hours**

Scope: This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs.

Objectives: Upon completion of the course student shall be able to understand the principles of volumetric and electro chemical analysis; carryout various volumetric and electrochemical titrations; develop analytical skills.

Course Outcomes:

CO 01: Develop the ideas with the fundamental of analytical chemistry.

CO 02: Construct the fundamental methodology to prepare different strength of solutions.

CO 03: Critically Predict the potential sources of mistakes and errors in analytical processes.

CO 04: Develop the fundamentals of volumetric analytical skills and electrochemical analytical techniques.

CO 05: Comprehend the research oriented basic knowledge in the analytical processes.

CO 06: Interpret and analyze the course content in terms of choice of analytical techniques

Course Content:

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 ceric ammonium sulphate

Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures

Pharmacopoeia, Sources of impurities in medicinal agents, limit tests.

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

Precipitation titrations: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.

Complexometric titration: Classification, metal ion indicators, masking and demasking reagents, 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.

Redox titrations: Concepts of oxidation and reduction; Types of redox titrations (Principles and applications); Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate.

Electrochemical methods of analysis: Conductometry- Introduction, Conductivity cell, Conductometric 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.

BP108P. PHARMACEUTICAL ANALYSIS (Practical) **4 Hours / Week**

Course Outcomes:

CO 01: Understand the apparatus and glassware used in analytical chemistry.

CO 02: Know the importance of calibration in research and analysis of compound

CO 03: Understand the principle, reaction condition and factor calculation for data analysis for various volumetric methods of analysis.

CO 04: Study the interpretation of data and computing the results.

Limit Test of the following: (1) Chloride (2) Sulphate (3) Iron (4) Arsenic
Preparation and standardization of: (1) Sodium hydroxide (2) Sulphuric acid (3) Sodium thiosulfate (4) Potassium permanganate (5) Ceric ammonium sulphate
Assay of the following compounds along with Standardization of Titrant: (1) Ammonium chloride by acid base titration (2) Ferrous sulphate by Cerimetry (3) Copper sulphate by Iodometry (4) Calcium gluconate by complexometry (5) Hydrogen peroxide by Permanganometry (6) Sodium benzoate by non-aqueous titration (7) Sodium Chloride by precipitation titration
Determination of Normality by electro-analytical methods: (1) Conductometric titration of strong acid against strong base (2) Conductometric titration of strong acid and weak acid against strong base (3) Potentiometric titration of strong acid against strong base

Recommended Books: (Latest Editions)

1. A.H. Beckett and J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I and II, Stahlone Press
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry
4. Bentley and Driver's Textbook of Pharmaceutical Chemistry
5. John H. Kennedy, Analytical chemistry principles
6. Indian Pharmacopoeia.

BP103T. PHARMACEUTICS- I (Theory)

Scope: This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.

Objectives: Upon completion of this course the student should be able to know the history of profession of pharmacy; understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations; understand the professional way of handling the prescription; preparation of various conventional dosage forms

Course Outcomes:

CO 01: Demonstrate fundamental knowledge in preparing conventional dosage forms.

CO 02: Learn the basics of the pharmacopoeias available.

CO 03: Apply knowledge of various pharmaceutical dosage calculations.

CO 04: Understand various techniques for the formulation research and evaluation of powders and liquid dosage forms.

CO 05: Identify various pharmaceutical incompatibilities.

CO 06: Gain knowledge about various semisolid dosage forms and their evaluation.

Course Content:

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 prescription, handling of Prescription and Errors in prescription.
Posology: Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.
Pharmaceutical calculations: Weights and measures – Imperial and Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.
Powders: Definition, classification, advantages and disadvantages, Simple and compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.
Liquid dosage forms: Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques. Monophasic liquids: Definitions and preparations of Gargles, Mouthwashes, 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 and stability problems and methods to overcome. Emulsions: Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation and stability problems and methods to overcome.
Suppositories: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value and its calculations, evaluation of suppositories.
Pharmaceutical incompatibilities: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.
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

BP109P. PHARMACEUTICSI (Practical)

CO 01: Explain formulation, evaluation and labelling of aromatic water, glycerides, syrups, elixirs and powder preparations.

CO 02: Perform pharmaceutical calculations to determine evaluation parameters like density, viscosity, specific gravity, angle of repose, Carr's index, Hausner ratio of preparations.

CO 03: Describe use of ingredients in formulation and category of formulation.

CO 04: Compare various monophasic preparations depending upon their formulation.

CO 05: Selection of suitable packaging material (container-cosure) for the preparation.

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 b) Iodine Throat Paint (Mandles Paint)
4. Solutions: 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 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

Recommended Books: (Latest Editions)

1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi.
2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.
3. M.E. Aulton, Pharmaceutics, The Scienceand Dosage Form Design, Churchill Livingstone, Edinburgh.
4. Indian pharmacopoeia.
5. British pharmacopoeia.
6. Lachmann. Theory and Practice of Industrial Pharmacy, Lea and Febiger Publisher, The University of Michigan.
7. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi.
8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.
9. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA.
10. Isaac Ghebre Sellassie: Pharmaceutical Pelletization Technology, Marcel Dekker, INC, New York.
11. Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, INC, New York.
12. Francoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.

BP104T. PHARMACEUTICAL INORGANIC CHEMISTRY (Theory) 45 Hours

Scope: This subject deals with the monographs of inorganic drugs and pharmaceuticals.

Objectives: Upon completion of course, student shall be able to know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals; understand the medicinal and pharmaceutical importance of inorganic compounds.

Course Outcomes:

CO 01: Understand the principles of limit tests.

CO 02: Become familiar with different classes of inorganic pharmaceuticals and their analysis.

CO 03: Identify different anions, cations, and various inorganic pharmaceuticals.

CO 04: Gain knowledge about the sources of impurities and methods to determine impurities in inorganic drugs and pharmaceuticals.

CO 05: Understand the medicinal and pharmaceutical importance of inorganic compounds in health care

CO 06: Explore a variety of inorganic drug classes.

Course Content:

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 superscripted with asterisk (*), properties and medicinal uses of inorganic compounds belonging to the following classes
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.
Dental products: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.
Gastrointestinal agents: Acidifiers: Ammonium chloride* and Dil. HCl; Antacid: Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture; Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite
Antimicrobials: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations
Miscellaneous compounds: Expectorants: Potassium iodide, Ammonium chloride*. Emetics: Copper sulphate*, Sodium potassium tartarate Haematinics: Ferrous sulphate*, Ferrous gluconate; Poison and Antidote: Sodium thiosulphate*, Activated charcoal, Sodium nitrite; Astringents: Zinc Sulphate, Potash Alum

Radiopharmaceuticals: Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half-life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions, precautions and pharmaceutical application of radioactive substances.

BP110P. PHARMACEUTICAL INORGANIC CHEMISTRY (Practical) 4 Hours / Week

Course Outcomes:

CO 01: Assess the limit tests for various ions through practical training to ensure the quality and safety of pharmaceuticals contributing in the health sector.

CO 02: Exercise the identification of different compounds through specific chemical tests as part of practical training in pharmaceutical inorganic chemistry.

CO 03: Determine the purity and quality of various pharmaceuticals, contributing to educational and research development.

CO 04: Use modified limit tests for certain ions to achieve precise results in pharmaceutical analysis, reflecting advancements in education and practical training in the pharmaceutical preparations.

CO 05: Prepare various pharmaceutical preparation such as Boric Acid, Potash Alum, and Ferrous Sulphate following standard procedures, integrating practical training into pharmaceutical education and formulation.

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.
Identification test Magnesium hydroxide Ferrous sulphate Sodium bicarbonate Calcium gluconate Copper sulphate
Test for purity: Swelling power of Bentonite, Neutralizing capacity of aluminum hydroxide gel, Determination of potassium iodate and iodine in potassium Iodide
Preparation of inorganic pharmaceuticals: Boric acid Potash alum Ferrous sulphate

Recommended Books (Latest Editions)

1. A.H. Beckett and J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I and II, Stahlone Press, 4th edition.
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd Edition
4. M.L Schroff, Inorganic Pharmaceutical Chemistry
5. Bentley and Driver's Textbook of Pharmaceutical Chemistry
6. Anand and Chatwal, Inorganic Pharmaceutical Chemistry
7. Indian Pharmacopoeia

BP105T.COMMUNICATION SKILLS (Theory) **30 Hours**

Scope: This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.

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.

Course Outcomes:

CO 01: Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation

CO 02: Communicate effectively (Verbal and Non-Verbal)

CO 03: Effectively manage the team as a team player

CO 04: Develop interview skills

CO 05: Develop Leadership qualities and essentials in research, innovation and entrepreneurship

Course content:

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, Psychological Barriers, Emotional barriers

Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment

Elements of Communication: Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), 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

Basic Listening Skills: Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations

Effective Written Communication: Introduction, When and When Not to Use Written 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
Interview Skills: Purpose of an interview, Do's and Dont's of an interview
Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery
Group Discussion: Introduction, Communication skills in group discussion, Do's and Dont's of group discussion

BP111P.COMMUNICATION SKILLS (Practical) **2 Hours / week**

Course Outcomes:

CO 01: Understand the behavioural needs for a pharmacist to function effectively in the areas of pharmaceutical operation

CO 02: Communicate effectively (Verbal and Non-Verbal)

CO 03: Effectively manage the team as a team player

CO 04: Develop interview skills

CO05: Develop Leadership qualities and essentials

The following learning modules are to be conducted using words worth® English language lab software
Basic communication covering the following topics: Meeting People Asking Questions Making Friends What did you do? Do's and Dont's
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

Recommended Books: (Latest Edition)

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011
3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, Pearson, 2013

6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010
7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals – PHI, 2011
8. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011
9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt.ltd, 2011
10. Soft skills and professional communication, Francis Peters SJ, 1stEdition, Mc Graw Hill Education, 2011
11. Effective communication, John Adair, 4thEdition, Pan Mac Millan,2009
12. Bringing out the best in people, Aubrey Daniels, 2ndEdition, Mc Graw Hill, 1999

BP 106RBT. REMEDIAL BIOLOGY (Theory) **30 Hours**

Scope: To learn and understand the components of living world, structure and functional system of plant and animal kingdom.

Objectives: Upon completion of the course, the student shall be able to know the classification and salient features of five kingdoms of life; understand the basic components of anatomy and physiology of plant; know understand the basic components of anatomy and physiology animal with special reference to human.

Course Outcomes:

CO 01: Understand and learn about cell biology, including the basic nature of plant and animal cells.

CO 02: Classify plants and animals based on classification systems.

CO 03: Explore various tissue and organ systems in plants and animals.

CO 04: Understand the theory of evolution.

Co 05: Learn the anatomy and physiology of plants and animals.

CO 06: Study the various phases in the development of plant growth.

Course content:

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, Potista, 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 and Dicotylidones.

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.

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
Excretory products and their elimination: Modes of excretion, Human excretory system- structure and function, Urine formation, Rennin angiotensin 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.
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.
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.

Text Books
Text book of Biology by S. B. Gokhale
A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.

Reference Books
A Text book of Biology by B.V. Sreenivasa Naidu b. A Text book of Biology by Naidu and Murthy
Botany for Degree students By A.C.Dutta.
Outlines of Zoology by M. Ekambaranatha ayyer and T. N. Ananthakrishnan.
A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate

BP112RBP.REMEDIAL BIOLOGY (Practical)

Course Outcomes:

CO 01: Understand the knowledge of plant structure and microscopy.
CO 02: Understand the structure and function of cells.
CO 03: Understand various tissue and organ systems in plants and animals.
CO 04: Understand the theory of evolution.

CO 05: Learn the anatomy and physiology of plants and animals.

CO 06: Study the various phases in the development of plant growth.

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

Reference Books

1. Practical human anatomy and physiology by S.R.Kale and R.R.Kale.
2. A Manual of pharmaceutical biology practical by S.B.Gokhale, C.K.Kokate and S.P.Shriwastava.
3. Biology practical manual according to National core curriculum .Biology forum of Karnataka. Prof .M.J.H.Shafi

BP 106RMT. REMEDIAL MATHEMATICS (Theory) **30 Hours**

Scope: This is an introductory course in mathematics. This subject deals with the introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and Laplace transform.

Objectives: Upon completion of the course the student shall be able to know the theory and their application in Pharmacy, solve the different types of problems by applying theory, appreciate the important application of mathematics in Pharmacy.

Course Outcomes:

CO 01: Apply mathematical concepts and principles to perform computations for Pharmaceutical Sciences.

CO 02: Create, use and analyze mathematical valuation, representations and mathematical relationships

CO 03: Communicate mathematical knowledge and understanding to help in the field of Clinical Pharmacy

CO 04: Perform abstract mathematical reasoning.

CO 05: Learn about analytical geometry.

Course Content:

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

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 adjugate 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, Cayley–Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations.

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.tx, 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 maximum or a minimum at a point. Application for a function to be a maximum or a minimum at a point. Application.

Analytical Geometry: Introduction: Signs of the Coordinates, Distance formula, Straight Line : Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line.

Integration: Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application.

Differential Equations: Some basic definitions, Order and degree, Equations 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

Recommended Books (Latest Edition)

1. Differential Calculus by Shanthinarayan
2. Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H.
3. Integral Calculus by Shanthinarayan
4. Higher Engineering Mathematics by Dr.B.S.Grewal

25UNI0130. THE RUDIMENTS OF ARTIFICIAL INTELLIGENCE (Theory) 15 Hours

Scope: This curriculum operationalizes foundational and emerging AI paradigms, unlocking learner readiness across cognitive, emotional, and smart-technology competencies. The learning journey empowers students to engage with large language models, agentic ecosystems, metaverse applications, and prompt engineering through high-impact, experiential, and green assessment methodologies.

Objectives: After completion of this course, learners will be able to:

- Decode the fundamentals of Artificial Intelligence and its evolution.
- Engage with modern LLMs such as ChatGPT, DeepSeek, and Grok for real-world applications.
- Design, test, and deploy virtual agents using prompt engineering and agentic flow frameworks.
- Critically evaluate AI's societal, academic, and industrial implications.
- Innovate with metaverse-ready digital interaction patterns.

Course Outcomes:

After completion of course, learners will be able to:

CO 01: Demonstrate analytical clarity across AI concepts and technologies.

CO 02: Architect prompt systems and intelligent agents end-to-end.

CO 03: Deploy AI thoughtfully in academic and workplace contexts

CO 04: Perform abstract mathematical reasoning.

CO 05: Engage metaverse environments with a strategic, innovation-first mindset

Course Content:

Module 1: Foundations of Artificial Intelligence (6 Hours)

Key Deliverables:

- Definition, history, and purpose of AI
- Human intelligence vs machine intelligence
- AI stages: ANI, AGI, ASI
- Core concepts: Turing Test, human-AI interaction
- Ethical and societal impact themes

Outcome: Learners gain baseline literacy for navigating AI-first ecosystems.

Module 2: Large Language Models & Generative AI (9 Hours)

Platforms Explored: ChatGPT, Gemini, DeepSeek, Grok

Focus Areas:

- Architecture and design intent of major LLMs
- Comparative intelligence frameworks
- Differentiating model capabilities, strengths & limitations

- Use cases in education, enterprise, research, and productivity

Outcome: Ability to benchmark and operationalize LLM capabilities.

Learning Resources

Primary Sources:

- OpenAI Documentation
- DeepSeek Developer Notes
- Grok/X.ai Knowledge Base
- Microsoft PVA (Agentic Flow Builder) Guides

Supplementary

- Introductory texts on AI & cognitive systems
- Industry whitepapers on metaverse adoption

SEMESTER II

BP 201T. HUMAN ANATOMY AND PHYSIOLOGY-II (Theory) 45 Hours

Scope: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

Objectives: Upon completion of this course the student should be able to explain the gross morphology, structure and functions of various organs of the human body; describe the various homeostatic mechanisms and their imbalances; identify the various tissues and organs of different systems of human body; perform the hematological tests like blood cell counts, haemoglobin estimation; bleeding/Clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume; appreciate coordinated working pattern of different organs of each system; and appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

Course Outcomes:

CO 01: Explain the organization and functions of the nervous system, including neuronal physiology, neurotransmission, and central nervous system structures.

CO 02: Describe the anatomy and physiology of the gastrointestinal tract, energetics of metabolism, and mechanisms of digestion, absorption, and related disorders.

CO 03: Illustrate the structure and functional aspects of the respiratory and urinary systems, including mechanisms of respiration, renal physiology, and their clinical relevance.

CO 04: Analyze the classification, mechanisms of action, and physiological roles of endocrine glands and hormones, and evaluate associated disorders.

CO 05: Summarize the anatomy and physiology of the reproductive system, processes of

reproduction, genetic mechanisms, and their significance in inheritance and health.

Course Content:

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)

Digestive system: Anatomy of GI Tract with special reference to anatomy and functions of stomach (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion), small intestine 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.

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.

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.

Reproductive system: Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition

Introduction to genetics: Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance.

BP 207 P. HUMAN ANATOMY AND PHYSIOLOGY (Practical) 4 Hours/week

Course Outcomes:

CO 1: Demonstrate the construction, working, care, and handling of laboratory instruments, glassware, and equipment used in physiology experiments.

CO 2: Perform experiments and demonstrations to identify structures and functions of the nervous, endocrine, digestive, respiratory, cardiovascular, urinary, and reproductive systems using models, specimens, and charts.

CO 3: Apply experimental techniques to assess physiological functions such as reflexes, sensory responses (vision, taste, smell), body temperature, lung volumes, and basal metabolic index in normal subjects.

CO 4: Analyze feedback mechanisms, neurological responses, and blood parameters (including total blood count) through practical demonstrations and laboratory techniques.

CO 5: Evaluate the clinical and applied aspects of physiology by studying family planning devices, pregnancy diagnosis, and microscopic examination of vital organs and gonads.

Objectives:

Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.

1. To study the integumentary and special senses using specimen, models, etc.,
2. To study the nervous system using specimen, models, etc.,
3. To study the endocrine system using specimen, models, etc
4. To demonstrate the general neurological examination
5. To demonstrate the function of olfactory nerve
6. To examine the different types of taste.
7. To demonstrate the visual acuity
8. To demonstrate the reflex activity
9. Recording of body temperature
10. To demonstrate positive and negative feedback mechanism.
11. Determination of tidal volume and vital capacity.
12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens.
13. Recording of basal mass index .
14. Study of family planning devices and pregnancy diagnosis test.
15. Demonstration of total blood count by cell analyser
16. Permanent slides of vital organs and gonads.

Recommended Books (Latest Editions)

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams and Wilkins Co,Riverview,MI USA
4. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.

6. Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi.
8. Practical work book of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books:

1. Physiological basis of Medical Practice-Best and Tailor. Williams and Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje, Academic Publishers Kolkata

BP202T. PHARMACEUTICAL ORGANIC CHEMISTRY –I (Theory) 45 Hours

Scope: This subject deals with classification and nomenclature of simple organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions and methods of preparation of these compounds. The syllabus also emphasizes on mechanisms and orientation of reactions.

Objectives: Upon completion of the course the student shall be able to write the structure, name and the type of isomerism of the organic compound; write the reaction, name the reaction and orientation of reactions; account for reactivity/stability of compounds, and identify/confirm the identification of organic compound.

Course Outcomes:

CO 01: Acquire knowledge about the classification and nomenclature of simple organic compounds.

CO 02: Understand the concept of structural isomerism.

CO 03: Study the chemical reactions, their mechanisms, and the orientation of carbonyl compounds, carboxylic acids, and alcohols.

CO 04: Emphasize the reactivity and stability of organic compounds.

CO 05: Gain knowledge about the identification and confirmation of organic compounds.

CO 06: Explore chemical reactions, their mechanisms, and orientations of alkanes, alkenes, alkyl halides, and aliphatic amines.

Course Content:

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained. To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences.

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.

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, 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.

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 uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.

Alcohols*: Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benz yl alcohol, Glycerol, Propylene glycol

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.

Carboxylic acids*: Acidity of carbox ylic acids, effect of substituents on acidity, inductive effect and qualitative tests for 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.

BP208P. PHARMACEUTICAL ORGANIC CHEMISTRY -I (Practical) 4 Hours / week

Course Outcomes:

CO 01: Explain the correct use of various equipment and safety measures in the laboratory.

CO 02: Calibrate thermometers and understand simple laboratory techniques.

CO 03: Understand the significance of and analyze organic compounds qualitatively, including the synthesis of derivatives.

CO 04: Understand the synthesis of different organic compounds along with their reactions and mechanisms.

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.
Minimum 5 unknown organic compounds to be analysed systematically.
Preparation of suitable solid derivatives from organic compounds
Construction of molecular models

Recommended Books (Latest Editions)

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl and Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K.Vishnoi.
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.
9. Reaction and reaction mechanism by Ahluwaliah/Chatwal.

BP203 T. BIOCHEMISTRY (Theory) **45 Hours**

Scope: Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero and autocatalytic functions of DNA.

Objectives: Upon completion of course student shell able to understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes; understand the metabolism of nutrient molecules in physiological and pathological conditions; and understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

Course Outcomes:

CO 01: Grasp the metabolic process of biomolecules and bioenergetics to understand the various physicochemical reactions inside the human body.

CO 02: Acquire knowledge of carbohydrates, lipid and amino acid metabolism in terms of health and illness (metabolic disorders).

CO 03 : Examine the genetic organization of mammalian genome; protein synthesis; replication; mutation and repair mechanism.

CO 04 : Understand the catalytic activity of enzymes and importance of isoenzymes in diagnosis of diseases.

Course Content:

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 AMP

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 gl ycogen storage diseases (GSD) Gluconeogenesis- Pathway and its significance; Hormonal regulation of blood glucose level and Diabetes mellitus.

Biological oxidation: Electron transport chain (ETC) and its mechanism; Oxidative phosphorylation and its mechanism and substrate level phosphorylation; Inhibitors ETC and oxidative phosphorylation/Uncouplers.

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, deamination and 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.

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.

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 enz ymes and isoenzymes; Coenzymes – Structure and biochemical functions.

BP 209 P. BIOCHEMISTRY (Practical) **4 Hours / Week**

Course Outcomes:

CO 01: Detection and identification of macromolecules (proteins, and carbohydrates) by various qualitative as well as quantitative tests.

CO 02: Separate, identify and characterize proteins from various samples like egg, milk, etc and understand principle behind the technique.

CO 03: Isolation of starch from potato and understand techniques as well as mechanism involved.

CO 04: Estimation of ascorbic acid in a given sample.

CO 05: Demonstrate action of salivary amylase and effect of substrate concentration and temperature on its activity.

1. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
2. Identification tests for Proteins (albumin and Casein)
3. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
4. Qualitative analysis of urine for abnormal constituents
5. Determination of blood creatinine
6. Determination of blood sugar
7. Determination of serum total cholesterol
8. Preparation of buffer solution and measurement of pH
9. Study of enz ymatic hydrolysis of starch
10. Determination of Salivary am ylase activity
11. Study the effect of Temperature on Salivary amylase activity.
12. Study the effect of substrate concentration on salivary amylase activity.

Recommended Books (Latest Editions)

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.
3. Biochemistry by Stryer.
4. Biochemistry by D. Satyanarayan and U.Chakrapani
5. Textbook of Biochemistry by Rama Rao.
6. Textbook of Biochemistry by Deb.
7. Outlines of Biochemistry by Conn and Stumpf
8. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
9. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
10. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.

11. Practical Biochemistry by Harold Varley.

BP 204T. PATHOPHYSIOLOGY (THEORY) **45 Hours**

Scope: Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes. This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge required to practice medicine safely, confidently, rationally and effectively.

Objectives: Upon completion of the subject student shall be able to describe the etiology and pathogenesis of the selected disease states; name the signs and symptoms of the diseases; and mention the complications of the diseases.

Course Outcomes:

CO 01: Describe the etiology and pathogenesis of selected disease states.

CO 0 2: Identify the signs and symptoms of diseases.

CO 03: Recognize the complications associated with diseases.

CO 04: Understand the most commonly encountered pathophysiological states and/or disease mechanisms, as well as any clinical testing requirements.

CO 0 5 Understand various diseases of bones and joints

Course content:

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, Metaplasia, Dysplasia),Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis and 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.

Cardiovascular System: Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis).

Respiratory system: Asthma, Chronic obstructive airways diseases.

Renal system: Acute and chronic renal failure.

Haematological Diseases: Iron deficiency, megaloblastic anemia (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.
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.
Infectious diseases: Meningitis, Typhoid, Leprosy, Tuberculosis
Urinary tract infections
Sexually transmitted diseases: AIDS, Syphilis, Gonorrhea

Recommended Books (Latest Editions)

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins andCotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.
2. Harsh Mohan; Text book of Pathology; 6th edition; India; Jaypee Publications; 2010.
3. Laurence B, Bruce C, Bjorn K. ; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th edition; New York; McGraw-Hill; 2011.
4. 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;
5. William and Wilkins, Baltimore;1991 [1990 printing].
6. Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston; Davidson's Principles and Practice of Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.
7. Guyton A, John .E Hall; Textbook of Medical Physiology; 12th edition; WB Saunders Company; 2010.
8. Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy: A Pathophysiological Approach; 9th edition; London; McGraw-Hill Medical; 2014.
9. V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6th edition; Philadelphia; WB Saunders Company; 1997.
10. Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3rd edition; London; Churchill Livingstone publication; 2003.

Recommended Journals

1. The Journal of Pathology. ISSN: 1096-9896 (Online)
2. The American Journal of Pathology. ISSN: 0002-9440
3. Pathology. 1465-3931 (Online)
4. International Journal of Physiology, Pathophysiology and Pharmacology. ISSN: 1944-8171 (Online)
5. Indian Journal of Pathology and Microbiology. ISSN: 0377-4929.

BP205 T. COMPUTER APPLICATIONS IN PHARMACY (Theory) 30 Hrs (2 Hrs/Week)

Scope: This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.

Objectives: Upon completion of the course the student shall be able to know the various types of application of computers in pharmacy; know the various types of databases; know the various applications of databases in pharmacy.

Course Outcomes:

CO 01: Apply the knowledge of mathematics and computing fundamentals to pharmaceutical applications for any given requirement

CO 02: Design and develop solutions to analyze pharmaceutical problems using computers.

Integrate and apply efficiently the contemporary IT tools to all Pharmaceutical related activities.

Solve and work with a professional context pertaining to ethics, social, cultural and regulations with regard to Pharmacy.

Course content:

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

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

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 monitoring; Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System.

Bioinformatics: Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery.

Computers as data analysis in Preclinical development: Chromatographic dada analysis (CDS), Laboratory Information management; System (LIMS) and Text Information Management System (TIMS)

BP210P. COMPUTER APPLICATIONS IN PHARMACY (Practical)

Course Outcomes:

CO 01: Apply the knowledge of mathematics and computing fundamentals to pharmaceutical applications for any given requirement

CO 02: Design and develop solutions to analyze pharmaceutical problems using computers

CO 03: Integrate and apply efficiently the contemporary IT tools to all Pharmaceutical related activities

CO 04: Solve and work with a professional context pertaining to ethics, social, cultural and regulations with regard to Pharmacy

1. Design a questionnaire using a word processing package to gather information about a particular disease.
2. Create a HTML web page to show personal information.
3. Retrieve the information of a drug and its adverse effects using online tools
4. Creating mailing labels Using Label Wizard, generating label in MS WORD
5. Create a database in MS Access to store the patient information with the required fields using access
6. Design a form in MS Access to view, add, delete and modify the patient record in the database
7. Generating report and printing the report from patient database
8. Creating invoice table using – MS Access
9. Drug information storage and retrieval using MS Access
10. Creating and working with queries in MS Access
11. Exporting Tables, Queries, Forms and Reports to web pages
12. Exporting Tables, Queries, Forms and Reports to XML pages

Recommended books (Latest edition):

1. Computer Application in Pharmacy – William E. Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.
2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA.
3. Bioinformatics (Concept, Skills and Applications) – S.C. Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)
4. Microsoft office Access- 2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N.Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi - 110002

BP 206 T. ENVIRONMENTAL SCIENCES (Theory) 30 hours

Scope: Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

Objectives: Upon completion of the course the student shall be able to create the awareness about environmental problems among learners; impart basic knowledge about the environment and its allied problems; develop an attitude of concern for the environment; motivate learner to participate in environment protection and environment improvement; acquire skills to help the concerned individuals in identifying and solving environmental problems and strive to attain harmony with Nature.

Course Outcomes:

On completion of this course, the students will be able to:

CO 01: Create awareness about environmental problems and develop a sense of concern for the environment.

CO 02: Learn the concept of ecosystems, including their structure and functions.

Course content:

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.

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).

Environmental Pollution: Air pollution; Water pollution; Soil pollution

Recommended Books (Latest edition):

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clanderson Press Oxford
6. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7. Down of Earth, Centre for Science and Environment.
8. Cunningham, W.P. Cooper, T.H. Gorhani, E and Hepworth, M.T. 2001, Environmental Ency**CO**pedia, Jaico Publ. House, Mumbai, 1196p.

SEMESTER III

BP301T. PHARMACEUTICAL ORGANIC CHEMISTRY –II (Theory) 45 Hours

Scope: This subject deals with general methods of preparation and reactions of some organic compounds. Reactivity of organic compounds are also studied here. The syllabus emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.

Objectives: Upon completion of the course the student shall be able to write the structure, name and the type of isomerism of the organic compound; write the reaction, name the reaction and orientation of reactions; account for reactivity/stability of compounds, prepare organic compounds.

Course Outcomes:

On completion of this course, the students will be able to:

CO 01: Explain the structure, resonance, and aromaticity of benzene based on analytical and synthetic evidence.

CO 02: Analyze the mechanisms and limitations of electrophilic substitution reactions in benzene and its derivatives.

CO 03: Understand the acidity and chemical behavior of phenols and their derivatives, along with their applications.

CO 04: Evaluate the basicity and synthetic applications of aromatic amines, including aryl diazonium salts.

CO 05: Describe the acidity, reactions, and applications of aromatic acids and polynuclear hydrocarbons.

CO 06 : Assess the chemical properties, reactions, and analytical constants of fats and oils.

Course Content:

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained. To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

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, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts 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.

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.

Fats and Oils: Fatty acids – reactions; Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils; Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.

Polynuclear hydrocarbons: Synthesis, reactions; Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives.
CyCO 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 cy**CO**propane and cy**CO**butane only

BP305P. PHARMACEUTICAL ORGANIC CHEMISTRY -II (Practical) 4 Hrs/week

Course Outcomes:

CO 01: Explain and analyze the principles behind various qualitative tests and analyze the given unknown organic compound having different functional groups.
CO 02: Explain and illustrate the principle, reaction mechanism, and applications of every experiment in pharmacy.
CO 03: Understand, explain, and apply various laboratory techniques for the synthesis of organic compounds, and the purification techniques for synthesized compounds using precipitation or recrystallization.

Experiments involving laboratory techniques: Recrystallization, Steam distillation
Determination of following oil values (including standardization of reagents): Acid value, Saponification value, Iodine value
Preparation of compounds: Benzanilide/Phenyl benzoate/Acetanilide from Aniline/Phenol/Aniline by acylation reaction; 2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/Acetanilide by halogenation (Bromination) reaction; 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid/Nitro benzene by nitration reaction; Benzoic acid from Benzyl chloride by oxidation reaction; Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction; 1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions; Benzil from Benzoin by oxidation reaction; Dibenzal acetone from Benzaldehyde by Claison Schmidt reaction; Cinnammic acid from Benzaldehyde by Perkin reaction; P-Iodo benzoic acid from P-amino benzoic acid

Recommended Books (Latest Editions)
1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar, Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl and Arun Bahl.
4. Organic Chemistry by P.L. Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K.Vishnoi.
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.

BP302T. PHYSICAL PHARMACEUTICS-I (Theory) 45Hours

Scope: The course deals with the various physica and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Objectives: Upon the completion of the course student shall be able to understand various physicochemical properties of drug molecules in the designing the dosage forms; know the principles of chemical kinetics and to use them for stability testing and determination of expiry date of formulations; demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Course Outcomes:

Upon successful completion of the course, students will be able to:

CO 01: State the physicochemical properties of drug molecules, pH, and solubility.

CO 02: Describe the concept of state of matter, changes in the state of matter.

CO 03: Understand the physical properties of solutions, buffers, isotonicity.

CO 04: Explain the innovative role of surfactants, interfacial phenomenon.

CO 05: Describe the concept of complexation.

CO 06: Describe the concept pH and its determination.

Course Content:

Solubility of drugs: Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation and 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.

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 and polymorphism.

Physicochemical properties of drug molecules: Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications

Surface and interfacial phenomenon: Liquid interface, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface.

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.

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.

BP306P. PHYSICAL PHARMACEUTICS – I (Practical)

Course Outcomes:

CO 01: Accurately determine the solubility of a drug at room temperature and analyze the implications for pharmaceutical formulation and drug delivery.

CO 02: Calculate the pKa value of a drug using the Half Neutralization and Henderson-Hasselbalch equations, and interpret its significance in drug formulation and stability.

CO 03: Determine the partition coefficient and discuss the relevance of partition coefficients in drug distribution and formulation.

CO 04: Measure the surface tension of various liquids using drop count and drop weight methods, and analyze how surface tension affects pharmaceutical formulation.

CO 05: Determine the Hydrophilic-Lipophilic Balance (HLB) number of a surfactant using the saponification method, and explain its role in surfactant selection and formulation stability.

1. Determination the solubility of drug at room temperature
2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
3. Determination of Partition co- efficient of benzoic acid in benzene and water
4. Determination of Partition co- efficient 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 number of a surfactant by saponification method
8. Determination of Freundlich and Langmuir constants using activated char coal
9. Determination of critical micellar concentration of surfactants
10. Determination of stability constant and donor 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

Recommended Books: (Latest Editions)

1. Physical Pharmacy by Alfred Martin
2. Experimental Pharmaceutics by Eugene, Parott.
3. Tutorial Pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical Calculations, Lea and Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.

7. Physical Pharmaceutics by Ramasamy C and Manavalan R.
8. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
9. Physical Pharmaceutics by C.V.S. Subramanyam
10. Test book of Physical Pharmacy, by Gaurav Jain and Roop K. Khar

BP 303 T. PHARMACEUTICAL MICROBIOLOGY (Theory) 45Hours

Scope: Study of all categories of microorganisms especially for the production of alcohol antibiotics, vaccines, vitamins enzymes etc.

Objectives: Upon completion of the subject student shall be able to understand methods of identification, cultivation and preservation of various microorganisms; understand the importance and implementation of sterilization in pharmaceutical processing and industry; learn sterility testing of pharmaceutical products; carried out microbiological standardization of Pharmaceuticals and understand the cell culture technology and its applications in pharmaceutical industries.

Course Outcomes:

Upon successful completion of the course, students will be able to:

CO 01: Define and apply specialized language and knowledge relevant to microbiological research

CO 02: Demonstrate competency in laboratory safety and in performing routine and specialized microbiological laboratory skills, including recording and analysing observations.

CO 03: Communicate scientific concepts, experimental results, and analytical arguments clearly and concisely, both verbally and in writing.

CO 04: Isolate and identify microbes using appropriate microbiological techniques.

CO 05: Design microbiology laboratory experiments with a focus on all safety considerations.

CO 06: Validate microbiological equipment and report observations accurately.

Course content:

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 and viable count). Study of different types of phase constrast microscopy, dark field microscopy and electron microscopy.

Identification of bacteria using staining techniques (simple, Gram's and 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. Equipments employed in large scale sterilization. Sterility indicators.

Study of morphology, classification, reproduction/replication and cultivation of 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 and Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.

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.

Types of spoilage, factors affecting 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.

BP 307P.PHARMACEUTICAL MICROBIOLOGY (Practical) 4 Hrs/week

Course Outcomes:

CO 01: Understand the principle, construction, and working of various instruments and demonstrate the skill to handle a microscope for the observation of microbes.

CO 02: Learn how to prepare and sterilize nutrient broth, nutrient agar, slants, stabs, and plates, and adopt the skills required for maintaining aseptic conditions, handling inoculating loops, and following sterilization and inoculation procedures.

CO 03: Isolate microorganisms using the streak plate technique and count them using the pour plate technique.

CO 04: Apply the hanging drop technique to observe bacterial motility.

CO 05: Develop the skill to observe bacterial morphology using simple staining, negative staining, and Gram staining.

CO 06: Understand and perform the direct inoculation method for sterility testing of Water for Injection

1. Introduction and study of different equipments and processing, 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. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.
4. Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical).
5. Isolation of pure culture of micro-organisms 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 test.

Recommended Books (Latest edition)

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers and Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. I.P., B.P., U.S.P.- latest editions.
10. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
11. Edward: Fundamentals of Microbiology.
12. N.K. Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
13. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

BP 304 T. PHARMACEUTICAL ENGINEERING (Theory) 45 Hours

Scope: This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

Objectives: Upon completion of the course student shall be able to know various unit operations used in Pharmaceutical industries; understand the material handling techniques; perform various processes involved in pharmaceutical manufacturing process; carry out various test to prevent environmental pollution; appreciate and comprehend significance of plant lay out design for optimum use of resources; appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

Course Outcomes:

Upon successful completion of the course, students will be able to:

CO 01: Define and explain the basic concepts and principles of pharmaceutical engineering, including unit operations and fluid mechanics.

CO 02: Apply engineering principles in the design and operation of pharmaceutical processes, such as drying, filtration, centrifugation, crystallization, and mixing.

CO 03: Analyze and interpret process parameters and data related to pharmaceutical manufacturing, such as flow rates, pressure, temperature, and mass transfer rates, to optimize process efficiency.

CO 04: Evaluate the performance and efficiency of pharmaceutical equipment and processes, identify potential issues, and propose improvements to enhance product quality and process safety.

CO 05: Design and develop pharmaceutical processes and equipment layouts, incorporating principles of scale-up, automation, and process control to meet industrial and regulatory standards.

Course content:

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 and 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 and end runner mill.
Size Separation: Objectives, applications and mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cy**CO**ne separator, Air separator, Bag filter and elutriation tank.
Heat Transfer: Objectives, applications and Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection and radiation. Heat interchangers and heat exchangers.
Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporatorand Economy of multiple effect evaporator.
Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam
distillation and molecular distillation
Drying: Objectives, applications and mechanism of drying process, measurements and 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 and 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 and Silverson Emulsifier,
Filtration: Objectives, applications, Theories and Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate and frame filter, filter leaf, rotary drum filter, Meta filter and Cartridge filter, membrane filters and Seidtz filter.
Centrifugation: Objectives, principle and applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge and super centrifuge.
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.

Recommended Books: (Latest Editions)

1. Introduction to chemical engineering – Walter L Badger and Julius Banchero, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.
3. Unit operation of chemical engineering – Mcabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition.
5. Remington practice of pharmacy- Martin, Latest edition.
6. Theory and practice of industrial pharmacy by Lachmann., Latest edition.
7. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

BP308P - PHARMACEUTICAL ENGINEERING (Practical) 4 Hours/week

Course Outcomes:

CO 01: Identify various unit operations used in pharmaceutical industries.

CO 02: Understand the material handling techniques used in pharmaceutical manufacturing.

CO 03: Perform various processes involved in pharmaceutical manufacturing.

CO 04: Conduct various tests to prevent environmental pollution in pharmaceutical industries.

CO 05: Appreciate and comprehend the significance of plant layout design for optimum use of resources.

CO 06: Apply effective resource management techniques to optimize operations.

I. Determination of radiation constant of brass, iron, unpainted and painted glass. II. Steam distillation – To calculate the efficiency of steam distillation.
III. To determine the overall heat transfer coefficient by heat exchanger. IV. Construction of drying curves (for calcium carbonate and starch).
V. Determination of moisture content and loss on drying.
VI. Determination of humidity of air – i) From wet and dry bulb temperatures –use of
Dew point method.
VII. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
VIII. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic andlogarithmic probability plots.
IX. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
X. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such othermajor equipment.
XI. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity
XII. To study the effect of time on the Rate of Crystallization.
XIII. To calculate the uniformity Index for given sample by using Double Cone Blender.

24UNI0124-CyberSecurity (Theory) **3Hours/Week**

Internet connectivity has become vital statistics for our daily life and has paved the way to network attackers as well. It is the onus of network security to defend it from the rising challenges posed by attackers. Cyber security is any action an organization or individual takes to prevent malicious use or accidental damage to the network's private data, its users, or their devices. The goal of Cyber security is to keep the network running and safe for all legitimate users along with information of different attacks and how to handle those attacks. This course will inculcate the skill in our students to infer the term cyber security and different types of cyber attacks and also how to deal with them.

Course Outcomes:

Upon successful completion of the course, students will be able to:

CO 01: Learn about the cyber security, cyber crime and type of cyber criminals.

CO 02: To understand the types of attacks on Individual, Property, Organization, Computer and Mobile network and safety measurement.

CO 03: To understand the perils as well as advantages of technology.

CO 04: Explore the usage of internet, internet policy and safety computing.

Course content:

Introduction to Cyber Crime: Definition and origins of the world, cybercrime and information security, who are cybercriminals, classification of cybercrimes, cybercrime and ITA

Cyber Offense: Categories of Cybercrime, How criminals plans the attack, social engineering, cyber stalking,

Cybercafé and cybercriminals, Botnet, Cloud computing.

COud Computing and Cyber Crime: Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and wireless computing era, Security challenges posed by mobile devices, Registry setting for Mobile Devices.

Authentication and Authorization: Authentication service security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations

Tools and Methods used in Cybercrime: Proxy Server and anonymizers, Phishing, Password cracking, Key loggers and spywares, Virus and Worms, Trojan Horse and Backdoors, Stegnography.

Attacks: DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on wireless network

Cyber security: Organizational Implications: Cost of cybercimes and IPR issues, Web Threats for Organizations, Security and Privacy Implications from Cloud computing, Social Media Marketing, Social Computing and the Associated Challenges for Organizations

Organizational guidelines for Internet Usage: Safe Computing, Guidelines and Computer Usage Policy, Incident Handling: An essential component of cyber security.

Forensic Best Practices for Organizations

Cybercrime and Cyber terrorism: Social Political, Ethical and Psychological Dimensions: Intellectual Property in the Cyberspace, The ethical dimension of cybercrime, The psychology, mindset and skills of hackers and other cybercriminals, Ethical Hackers

Cybercrime: Illustrations, examples and mini-cases: Real Life examples, mini cases

Instructional Strategies: Materials

Recommended Books: (Latest Editions)

1. Godbole N. and Belapur S., 2014, "Cyber Security", First Edition, Wiley-India
2. Duggal P., 2013,"Cyber Frauds, Cybercrimes and Laws in India"; Kindle Edition

Reference Books

1. Singer P.W. and Friedman A., 2014, "Cyber Security and Cyber War ", First Edition, Oxford Publication

SEMESTER IV

BP401T. PHARMACEUTICAL ORGANIC CHEMISTRY –III (Theory) 45 Hours

Scope: This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.

Objectives: At the end of the course, the student shall be able to understand the methods of preparation and properties of organic compounds; explain the stereo chemical aspects of organic compounds and stereo chemical reactions; know the medicinal uses and other applications of organic compounds.

Course Outcomes:

Upon successful completion of the course, students will be able to:

CO 01: Understand the basic principles of heterocyclic chemistry, including the chemistry of five- and six-membered rings.

CO 02: Learn the synthesis and medicinal uses of various organic compounds.

CO 03: Describe the detailed mechanisms for common naming reactions of heterocyclic compounds.

CO 04: Analyze the stereo-chemical features, including the conformation of geometrical isomers.

CO 05: Understand the concepts of optical isomerism, conformational isomerism, and asymmetric synthesis.

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Course Content: Note: To emphasize on definition, types, mechanisms, examples, uses/applications

Stereo isomerism: Optical isomerism – Optical activity, enantiomerism, diastereoisomerism, meso compounds; Elements of symmetry, chiral and achiral molecules; DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers; Reactions of chiral molecules; Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute. Geometrical isomerism: Nomenclature of geometrical isomers (Cis Trans, EZ, S yn 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

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. 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.

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

Recommended Books (Latest Editions)

1. Organic chemistry by I.L. Finar, Volume-I and II.
2. A text book of organic chemistry – Arun Bahl, B.S. Bahl.
3. Heterocyclic Chemistry by Raj K. Bansal
4. Organic Chemistry by Morrison and Boyd
5. Heterocyclic Chemistry by T.L. Gilchrist

BP402T. MEDICINAL CHEMISTRY – I (Theory) **45 Hours**

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Objectives: Upon completion of the course the student shall be able to understand the chemistry of drugs with respect to their pharmacological activity; understand the drug metabolic pathways, adverse effect and therapeutic value of drugs; know the Structural Activity Relationship (SAR) of different class of drugs and write the chemical synthesis of some drugs.

Course Outcomes:

Upon successful completion of the course, students will be able to:

CO 01: Correlate the pharmacology of a disease with its mitigation or cure.

CO 02: Understand the drug metabolic pathways, adverse effects, and therapeutic value of drugs.

CO 03: Analyze the structure-activity relationship (SAR) of different classes of drugs, including those affecting the autonomic nervous system (ANS).

CO 04: Identify the synthesis processes of important classes of drugs.

CO 05: Understand the mechanism pathways of different classes of medicinal compounds.

CO 06: Analyze the chemistry of drugs in relation to their pharmacological activity, including effects on the central nervous system (CNS).

Course Content: Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)

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, Bioisosterism, Optical and Geometrical isomerism.

Drug metabolism: Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects.

Drugs acting on Autonomic Nervous System: Adrenergic Neurotransmitters: Biosynthesis and catabolism of catecholamine. Adrenergic receptors (Alpha and Beta) and their distribution. Sympathomimetic agents: SAR of Sympathomimetic agents. Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, **CO**nidine, 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 blockers: Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide. Beta adrenergic blockers: SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.

Cholinergic neurotransmitters: Biosynthesis and catabolism of acetylcholine. Cholinergic receptors (Muscarinic and Nicotinic) and their distribution. Parasympathomimetic agents: SAR of Parasympathomimetic agents. Direct acting agents: Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine. Indirect acting/ Cholinesterase inhibitors (Reversible and 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, Cylcopentolate hydrochloride, Clidinium bromide, Dicy**CO**mine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

Drugs acting on Central Nervous System: 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 and imides: Glutethmide; Alcohol and their carbamate derivatives: Meprobomate, Ethchlorvynol. Aldehyde and their derivatives: Triclofos sodium, Paraldehyde). Antipsychotics: Phenothiazeines (SAR of Phenothiazeines - Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride,

Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride); Ring Analogues of Phenothiazeines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine; Fluro buterophenones: Haloperidol, Droperidol, Risperidone; Beta amino ketones: Molindone hydrochloride; Benzamides: Sulpieride. 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. General anesthetics: Inhalation anesthetics: Halothane*, Methoxyflurane, 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 Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate). Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride.

Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.

BP406P. MEDICINAL CHEMISTRY – I (Practical) 4 Hours/Week

CO 01: Understand the evolutionary significance of alkaloids from plants and other organisms and deduce their significance as medicinal molecules.

CO 02: Explain the classification, source, names, chemical structures, extraction methods, and qualitative & quantitative analysis of alkaloids.

CO 03: Explain the historical significance and contribution of alkaloids in modern drug discovery.

CO 04: Explain the historical significance and contribution of terpenoids/resins in modern drug discovery.

I Preparation of drugs/ intermediates: 1,3-pyrazole; 1,3-oxazole; Benzimidazole; Benztriazole; 2,3-diphenyl quinoxaline; Benzocaine; Phenytoin; Phenothiazine; Barbiturate.

II Assay of drugs: Chlorpromazine; Phenobarbitone; Atropine; Ibuprofen; Aspirin; Furosemide

III etermination of Partition coefficient for any two drugs

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.

7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

BP 403 T. PHYSICAL PHARMACEUTICS-II (Theory) 45Hours

Scope: The course deals with the various physica and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Objectives: Upon the completion of the course student shall be able to understand various physicochemical properties of drug molecules in the designing the dosage forms; know the principles of chemical kinetics and to use them for stability testing and determination of expiry date of formulations and demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Course Outcomes:
Upon successful completion of the course, students will be able to:

CO 01: Understand the basic principles of colloidal dispersion and their properties.

CO 02: Describe the rheological flow behavior of fluids and explain measurement techniques.

CO 03: Understand the properties and formulation of pharmaceutical suspensions, emulsions, and colloids.

CO 04: Analyze the particle size and apply methods for its determination.

CO 05: Understand the properties of powders and their relevance in pharmaceutical research.

CO 06: Apply different orders of kinetics to determine the stability of pharmaceutical formulations.

Course Content:
Colloidal dispersions: Classification of dispersed systems and their general characteristics, size and shapes of colloidal particles, classification of colloids and comparative account of their general properties. Optical, kinetic and electrical properties. Effect of electrolytes, coacervation, peptizationand protective action.
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.
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.

Micromeretics: Particle size and distribution, mean 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 and flow properties.

Drug stability: Reaction kinetics: zero, pseudo-zero, first and 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 and general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis and oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention

BP 407P. PHYSICAL PHARMACEUTICS- II (Practical) **3 Hrs/week**

Course Outcomes:

CO 01: Evaluate the viscosity, specific surface area, and particle size distribution of a given material.

CO 02: Calculate the cloud point, critical micelle concentration (CMC), and HLB value of a given surfactant.

CO 03: Calculate the energy of activation for acid hydrolysis, the order of a given reaction, and the relative strength of two acids.

CO 04: Analyze suspensions and emulsions.

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 sedimentation volume with effect of different suspending agent
7. Determination sedimentation volume with effect of different concentration of single suspending agent
8. Determination of viscosity of semisolid by using Brookfield viscometer
9. Determination of reaction rate constant first order.
10. Determination of reaction rate constant second order
11. Accelerated stability studies

Recommended Books: (Latest Editions)

1. Physical Pharmacy by Alfred Martin, Sixth edition
2. Experimental pharmaceutics by Eugene, Parott.
3. Tutorial pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical calculations, Lea and Febiger, Philadelphia.

5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, vol. 1, 2, 3. Marcel Dekkar Inc.

BP 404 T. PHARMACOLOGY-I (Theory) **45 Hrs**

Scope: The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.

Objectives: Upon completion of this course the student should be able to understand the pharmacological actions of different categories of drugs; explain the mechanism of drug action at organ system/sub cellular/macro-molecular levels; apply the basic pharmacological knowledge in the prevention and treatment of various diseases; observe the effect of drugs on animals by simulated experiments; appreciate correlation of pharmacology with other bio medical sciences.

Course Outcomes:
Upon successful completion of the course, students will be able to:

CO 01: Understand the pharmacological actions of different categories of drugs.

CO 02: Examine the mechanisms of drug action at organ system, sub-cellular, and macromolecular levels.

CO 03: Apply basic pharmacological knowledge in the prevention and treatment of various diseases.

CO 04: Observe the effects of drugs on animals through simulated experiments.

CO 05: Correlate pharmacology with other biomedical sciences.

CO 06: Understand the signal transduction mechanisms of various receptors.

Course Content:
General Pharmacology: 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. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs .Enz yme induction, enzyme inhibition, kinetics of elimination. 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. Adverse drug reactions. Drug interactions (pharmacokinetic and pharmacodynamic). Drug discovery and

clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.

Pharmacology of drugs acting on peripheral nervous system: Organization and function of ANS. Neurohumoral transmission, co-transmission and classification of neurotransmitters. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). Local anesthetic agents. Drugs used in myasthenia gravis and glaucoma

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. d. Anti-epileptics. Alcohols and disulfiram

Pharmacology of drugs acting on central nervous system: Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens. Drugs used in Parkinsons disease and Alzheimer's disease. c. CNS stimulants and nootropics. Opioid analgesics and antagonists. Drug addiction, drug abuse, tolerance and dependence.

BP 408 P. PHARMACOLOGY-I (Practical) **4Hrs/Week**

Course Outcomes:

CO 01: Understand the pharmacological actions of different categories of drugs.

CO 02: Examine the mechanisms of drug action at organ system, sub-cellular, and macromolecular levels.

CO 03: Apply basic pharmacological knowledge in the prevention and treatment of various diseases.

CO 04: Observe the effects of drugs on animals through simulated experiments.

CO 05: Correlate pharmacology with other biomedical sciences.

CO 06: Understand the signal transduction mechanisms of various receptors.

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 drugs 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 oesophagus
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 softwares and videos

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. 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 and Wilkins
5.Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology
6.K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7.Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craigand Robert,
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton and Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,

BP 405 T. PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory) 45 Hours

Scope: The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.

Objectives: Upon completion of the course, the student shall be able to know the techniques in the cultivation and production of crude drugs; to know the crude drugs, their uses and chemical nature; know the evaluation techniques for the herbal drugs; to carry out the microscopic and morphological evaluation of crude drugs.

Course Outcomes:

Upon successful completion of the course, students will be able to:

CO 01: Introduce the concepts of herbs and the science behind their use.

CO 02: Classify medicinal plants based on their properties and therapeutic uses.

CO 03: Examine the phytochemistry and pharmacology of carbohydrates, lipids, terpenes, polyphenols, and alkaloids.

CO 04: Relations between Phyto-therapy and the Understanding of Herbal drug Action, and Material Medica.

CO 05: The quality control of medicinal plants, identification of adulteration and Contamination.

Course Content:

Introduction to Pharmacognosy: (a) Definition, history, scope and development of Pharmacognosy; (b) Sources of Drugs – Plants, Animals, Marine and Tissue culture; (c) 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 classification of drugs

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.

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 hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants. Conservation of medicinal plants.

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

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

Study of biological source, chemical nature and uses of drugs of natural origin containing 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.

BP409 P. PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical) 4 Hours/Week

Course Outcomes:

CO 01: Understand the evolutionary significance of alkaloids from plants and other organisms and deduce their significance as medicinal molecules.

CO 02: Explain the classification, source, names, chemical structures, extraction methods, and qualitative & quantitative analysis of alkaloids.

CO 03: Explain the historical significance and contribution of alkaloids in modern drug discovery.

CO 04: Explain the historical significance and contribution of terpenoids/resins in modern drug discovery.

1. Analysis of crude drugs by chemical tests: (i) Tragaccanth (ii) Acacia (iii) Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil.
2. Determination of stomatal number and index
3. Determination of vein islet number, vein islet termination and paliside ratio.
4. Determination of size starch grains, calcium oxalate crystals by eye piece 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

Recommended Books: (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders and Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers and Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. Iyengar

SEMESTER V

BP501T. MEDICINAL CHEMISTRY – II (Theory) 45 Hours

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Objectives: Upon completion of the course the student shall be able to understand the chemistry of drugs with respect to their pharmacological activity; understand the drug metabolic pathways, adverse effect and therapeutic value of drugs; know the structural activity relationship of different class of drugs; study the chemical synthesis of selected drugs.

Course Outcomes:

Upon successful completion of the course, students will be able to:

CO 01: Illustrate the correlation between the pharmacology of a disease and its mitigation or cure.

CO 02: Determine the mechanism pathways and classification of different classes of medicinal compounds.

CO 03: Outline the chemical synthesis and structure-activity relationship (SAR) of different classes of drugs.

CO 04: Recognize the drug regimen used in heart diseases and antihistaminic agents.

CO 05: Deduce the chemotherapy for cancer and drugs acting on the endocrine system.

Course Content: Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)

Antihistaminic agents: Histamine, receptors and their distribution in the humanbody. H1–antagonists:Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines cuccinate, Clemastine fumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium. H2-antagonists: Cimetidine*, Famotidine, Ranitidin. Gastric Proton pump inhibitors: Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole

Anti-neoplastic agents: Alkylating agents: Meclorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa. Antimetabolites: Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine. Antibiotics: Dactinomycin, Daunorubicin, Doxorubicin, Bleom ycin Plant products: Etoposide, Vinblastin sulphate, Vincristin sulphate Miscellaneous: Cisplatin, Mitotane.

Anti-anginal: Vasodilators: Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, 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, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.
Anti-arrhythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol.
Anti-hyperlipidemic agents: Clofibrate, Lovastatin, Cholesteramine and Cholestipol.
Coagulant and Anticoagulants: Menadione, Acetomenadione, Warfarin*, Anisindione, Clopidogrel
Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.
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.
Antidiabetic agents: Insulin and its preparations. Sulfonyl ureas: 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, Cy**CO**methycaine, Piperocaine. Amino Benzoic acid derivatives: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate. Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine. Miscellaneous: Phenacaine, Diperodon, Dibucaine. *

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1to 5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

BP 509 P. MEDICINAL CHEMISTRY – II (Practical) **4 Hours/Week**

Course Outcomes:

CO 01: Synthesize various drugs from different chemical classes utilizing different laboratory techniques.
CO 02: Outline the reaction mechanism of the synthesized drugs.
CO 03: Perform identification tests of synthesized drugs.
CO 04: Conduct assay of various drugs as per IP.
CO 05: Knowledge regarding various softwares used to draw chemical structure of compounds.

I. Preparation of drugs/ intermediates

1. Benzoyl Glycine
2. 2-Methylbenzimidazole
3. 7-Hydroxy-4-Methyl coumarin
4. Benztriazole
5. Acetanilide
6. Benzocaine
7. 1,2,3,4-Tetrahydrocarbazole
8. Coumarin
9. Barbiturate
10. Lignocaine

II. Assay and I.P. Parameters of drugs

1. 1,2,3,4-Tetrahydrocarbazole
2. Benzotriazole
3. Atropine
4. Ibuprofen
5. Aspirin
6. Furosemide

III. To draw the structures and analyses of various physical and chemical properties of medicinal important heterocyclic compounds using Chemdraw software.
IV. Stereomodels of selected drugs using ball and stick model

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.

7. Organic Chemistry by I.L. Finar, Vol. II.
8. Indian Pharmacopoeia.
9. Text book of practical organic chemistry- A.I.Vogel
10. Advancer Practical Medicinal Chemistry- Ashtosh Kar; New Age Publications
11. Medicnam Chemsitry-II- Manjinder Singh and Bijo Mathew; Ereadon Publications

BP 502 T. Industrial Pharmacy (Theory) **45 Hours**

Scope: Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.

Objectives: Upon completion of the course the student shall be able to know the various pharmaceutical dosage forms and their manufacturing techniques; know various considerations in development of pharmaceutical dosage forms and formulate solid, liquid and semisolid dosage forms and evaluate them for their quality.

Course Outcomes:

Upon successful completion of the course, students will be able to:

CO 01: Understand the basic concept of preformulation studies and the physical and chemical characteristics of drugs.

CO 02: Acquire knowledge of various types of tablets, granulation processes, and formulation methods.

CO 03: Demonstrate the production, filling, and quality control tests for capsules and pellets.

CO 04: Describe liquid oral dosage forms and their evaluation methods.

CO 05: Understand various parenteral and ophthalmic products, along with their evaluation.

CO 06: Formulate various cosmetic products and perform stability studies.

Course content:

Preformulation Studies: Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances. Physical properties: Physical form (crystal and amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism. Chemical Properties: Hydrolysis, oxidation, reduction, racemisation, polymerization. BCS classification of drugs and 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.

Tablets: Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating. 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

Capsules: 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. 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

Parenteral Products: Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity. Production procedure, production facilities and controls, aseptic processing. Formulation of injections, sterile powders, large volume parenterals and lyophilized products. 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

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.

BP 506 P. Industrial PharmacyI (Practical)

Course Outcomes:

CO 01: Outline the objectives and applications of preformulation studies in the development and stability of dosage forms.

CO 02: Understand the principles involved in the formulation and evaluation of various pharmaceutical dosage forms.

CO 03: Demonstrate the formulation considerations and evaluation of granules, tablets, and capsules.

CO 04: Formulate solid, liquid, and semisolid dosage forms and evaluate them to check their quality.

CO 05: Demonstrate the formulation considerations and evaluation of ophthalmic, parenteral, and cosmetic products.

1. Preformulation studies on paracetamol/asparin/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 tables/granules
5. Preparation and evaluation of Tetracycline capsules
6. Preparation of Calcium Gluconate injection
7. Preparation of Ascorbic Acid injection
8. Qulaity 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)

Recommended Books: (Latest Editions)

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman andJ.B.Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1and2 by Liberman and Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman and Lachman
4. Modern Pharmaceutics by Gilbert S. Banker and C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman and Lachman
7. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition
8. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea andFebiger, Philadelphia, 5thedition, 2005
9. Drug stability - Principles and practice by Cartensen and C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.

BP503.T. PHARMACOLOGY-II (Theory) 45 Hours

Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition, emphasis on the basic concepts of bioassay.

Objectives: Upon completion of this course the student should be able to understand the mechanism of drug action and its relevance in the treatment of different diseases; demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments; demonstrate the various receptor actions using isolated tissue preparation and appreciate correlation of pharmacology with related medical sciences.

Course Outcomes:

Upon successful completion of the course, students will be able to:

CO 01: Understand the mechanism of drug action and its relevance in the treatment of different diseases.

CO 02: Comprehend the principles of toxicology and the treatment of various poisonings.

CO 03: Locate and isolate different organs/tissues from laboratory animals used in pharmacological experiments.

CO 04: Study various receptor actions using isolated tissue preparations.

CO 05: Correlate pharmacology with related medical sciences.

CO 06: Learn various methods of toxicity studies.

Course Content:

Pharmacology of drugs acting on cardio vascular system: Introduction to hemodynamic and electrophysiology of heart. Drugs used in congestive heart failure. Anti-hypertensive drugs. Anti-anginal drugs. Anti-arrhythmic drugs. Anti-hyperlipidemic drugs.

P**harmacology of drugs acting on cardio vascular system:** Drug used in the therapy of shock. Hematinics, coagulants and anticoagulants. Fibrinolytics and anti-platelet drugs

Plasma volume expanders

Pharmacology of drugs acting on urinary system: Diuretics and Anti-diuretics.

Autocoids and related drugs: Introduction to autacoids and classification b. Histamine, 5-HT and their antagonists. Prostaglandins, Thromboxanes and Leukotrienes. Angiotensin, Bradykinin and Substance P. e. Non-steroidal anti-inflammatory agents. Anti-gout drugs. Antirheumatic drugs.

Pharmacology of drugs acting on endocrine system: Basic concepts in endocrine pharmacology. Anterior Pituitary hormones- analogues and their inhibitors. c. 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.

Pharmacology of drugs acting on endocrine system: Androgens and Anabolic steroids. Estrogens, progesterone and oral contraceptives. Drugs acting on the uterus.

Bioassay: Principles and applications of bioassay. Types of bioassay. Bioassay of insulin, oxytocin, vasopressin, ACTH,d-tubocurarine,digitalis, histamine and 5-HT.

BP 507 P. PHARMACOLOGY-II (Practical)

CO 01: Study commonly used instruments in experimental pharmacology.

CO 02: Understand the CPCSEA guidelines and OECD guidelines.

CO 03: Learn about animal physiology and their biochemical reference values in various animal species.

CO 04: Study various routes of drug administration, anesthetic agents used to anesthetize laboratory animals, and techniques of euthanasia.

CO 05: Learn about physiological salt solutions, drug solutions, and their use in various animal experiments.

CO 06: Study methods for the collection of blood, body fluids, and urine from experimental animals.

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 Schilds 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.
15. Analgesic activity of drug using central and peripheral methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. 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 and Wilkins.
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.
6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craigand Robert.
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton and Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

BP504 T. PHARMACOGNOSY AND PHYTOCHEMISTRY II (Theory) 45Hours

Scope: The main purpose of subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and phytochemicals through plant tissue culture, drug interactions and basic principles of traditional system of medicine

Objectives: Upon completion of the course, the student shall be able to know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents; to understand the preparation and development of herbal formulation; to understand the herbal drug interactions and to carryout isolation and identification of phytoconstituents.

Course Outcomes:

This course is one of the oldest specializations in Herbal Medicines that is offered. Will learn and get experience about

CO 01: Study the basic metabolic pathways and formation of different secondary metabolites through the Shikimic acid pathway, acetate pathways, and amino acid pathway.

CO 02: Understand the general introduction, composition, chemistry, chemical classes, bio sources, therapeutic uses, and commercial applications of secondary metabolites.

CO 03: Isolate, identify, and analyze phytoconstituents, including terpenoids and steroids.

CO 04: Examine the biological activities of several compounds belonging to polyketides, terpenoids, and steroids, and their traditional use and application in the pharmaceutical and/or nutraceutical field.

CO 05: Understand the basics of phytochemistry research

Course Content:

Metabolic pathways in higher plants and their determination: a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway. b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.

General introduction, composition, chemistry and 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 and 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 and Naphthaquinones: Gentian, Artemisia, taxus, carotenoids.

Isolation, Identification and Analysis of Phytoconstituents: a) Terpenoids: Menthol, Citral, Artemisin; b) Glycosides: Glycyrhetinic acid and Rutin; c) Alkaloids: Atropine, Quinine, Reserpine, Caffeine; d) Resins: Podophyllotoxin, Curcumin.

Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine.

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.

BP 508 P. PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical) 4 Hours/Week

CO 01: Demonstrate the skill of plant material sectioning, staining, mounting, and focusing; determine the staining reagents required for specific parts of a plant.

CO 02: Identify the parts of plants based on their morphological and microscopical features.

CO 03: Draw morphological and microscopical diagrams and label the components/parts accurately.

CO 04: Conduct extractions/isolations and explain the significance of using various chemicals and physical conditions.

CO 05: Identify unorganized crude drugs using their morphological, chemical, physical, and microscopical characteristics.

1. Morphology, histology and powder characteristics and extraction and detection of: Cinchona, Cinnamon, Senna, **CO**ve, Ephedra, Fennel and Coriander
2. Exercise involving isolation and 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 phytoconstitutents by TLC
6. Analysis of crude drugs by chemical tests: (i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh

Recommended Books: (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders and Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers and Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Ed, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
9. Pharmacognosy and Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey.

BP 505 T. PHARMACEUTICAL JURISPRUDENCE (Theory) 45 Hours

Scope: This course is designed to impart basic knowledge on important legislations related to the profession of pharmacy in India.

Objectives: Upon completion of the course, the student shall be able to understand The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals; Various Indian pharmaceutical Acts and Laws; The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals and the code of ethics during the pharmaceutical practice.

Course Outcomes:

CO 01: Understand the pharmaceutical legislations and their implications in the manufacturing and marketing of pharmaceutical

CO 02: Learn about various Indian pharmaceutical Acts, laws, and schedules.

CO 03: Identify the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals.

CO 04: Understand the code of ethics in pharmaceutical practice.

Course Content:

Drugs and Cosmetics Act, 1940 and its rules 1945: 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.

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 and DMR (OA) Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties. Labeling and 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 Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, licensing authorities, controlling authorities, Drugs Inspectors

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 and Proprietary Preparations. Offences and Penalties.

Narcotic Drugs and Psychotropic substances Act-1985 and Rules: Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic and 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

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).

Pharmaceutical Legislations – A brief 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)

Recommended books: (Latest Edition)

1. Forensic Pharmacy by B. Suresh
2. Text book of Forensic Pharmacy by B.M. Mithal
3. Hand book of drug law-by M.L. Mehra
4. A text book of Forensic Pharmacy by N.K. Jain
5. Drugs and Cosmetics Act/Rules by Govt. of India publications.
6. Medicinal and Toilet preparations act 1955 by Govt. of India publications.
7. Narcotic drugs and psychotropic substances act by Govt. of India publications
8. Drugs and Magic Remedies act by Govt. of India publication
9. Bare Acts of the said laws published by Government. Reference books (Theory)

24UNI0125 Disaster Management (Theory) **2Hours/week**

Course Outcomes:

CO 01: Understand disasters, their significance, and types.

CO 02: Analyze the relationship between vulnerability, disasters, disaster prevention, and risk reduction.

CO 03: Gain a preliminary understanding of approaches to Disaster Risk Reduction (DRR).

CO 04: Enhance awareness of institutional processes related to disaster management in the country.

CO 05: Develop the ability to respond to potential disaster situations in their surroundings with due sensitivity.

Course Content:

Disasters: Classification, Causes, Impacts

- Introduction to Disasters: Concepts, and definitions (Disaster, Hazard, Vulnerability, Resilience, Risks)
- Impacts (including social, economic, political, environmental, health, psychosocial, etc. Differential impacts- in terms of caste, class, gender, age, location, disability) Classification of hazards/disasters and causes

Principles of disaster management

- Approaches to Disaster Risk reduction: Disaster cycle - its analysis, Phases, Culture of safety, prevention, mitigation and preparedness,
- Community based DRR, Components of Disaster Relief: Water, Food, Sanitation, Shelter, and Health,

Structural and non-structural measures.

Hazard Profile (India), Disaster Risk Management in India

- Hazard and Vulnerability profile of India

Institutional arrangements (Mitigation, Response and Preparedness, DM Act and Policy, Other related policies, plans, programmes and legislation), Role of Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), states, Centre, and other stake-holders.

Disaster and Development

- Inter-relationship between Disasters and Development: Factors affecting Vulnerabilities, impact of Development projects such as dams, embankments, changes in Land-use etc. urban disasters, Waste Management

Global trends in disasters and Adaptation: Global Trends, Complex emergencies, Pandemics Climate change and Adaptation, Relevance of indigenous knowledge, appropriate technology and local resources

SEMESTER VI

BP601T. MEDICINAL CHEMISTRY – III (Theory) **45 Hours**

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of rational drug design like quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry and Computer aided drug design (CADD). The subject also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important drugs.

Objectives: Upon completion of the course student shall be able to understand the importance of drug design and different techniques of drug design; understand the chemistry of drugs with respect to their biological activity; know the metabolism, adverse effects and therapeutic value of drugs and know the importance of SAR of drugs.

Course Outcomes:

CO 01: Acquire knowledge about a variety of drug classes and their pharmacological properties, along with their mechanisms.

CO 02: Understand how current drugs are designed using pharmacophore modeling and docking techniques for further research.

CO 03: Learn about antibiotics used in the chemotherapy of microbial diseases.

CO 04: Understand the structure-activity relationship of different classes of drugs.

CO 05: Understand the chemistry of antiviral, antimalarial, and antifungal agents.

CO 06: Acquire knowledge about various categories of anti-protozoal agents.

Course Content: Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted by (*)

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).

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: Cy**CO**guanil pamoate, Proguanil; Miscellaneous: Pyrimethamine, Artesunete, Artemether, Atovoquone).

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, Idoxuridine trifluoride, Acyclovir*, Gancy**CO**vir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.

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, Pentamidine Isethionate, Atovaquone, Eflornithine.

Anthelmintics: Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Ni**CO**samide, Oxamniquine, Praziquantal, Ivermectin.

Sulphonamides and Sulfones: Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxaole*, Sulphadiazine, Mefenide acetate, Sulfasalazine. Folate reductase inhibitors: Trimethoprim*, Cotrimoxazole. Sulfones: Dapsone*.

Introduction to Drug Design: Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques.

Combinatorial Chemistry: Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis.

BP607P. MEDICINAL CHEMISTRY- III (Practical) 4 Hours / week

Course Outcomes:

CO 01: Understand how to make correct use of various equipments & take safety measures while working in medicinal chemistry Laboratory.

CO 02: Develop skills involved in thin layer chromatography techniques and purification of synthesized compounds.

CO 03: Synthesize, recrystallize and understand reaction mechanisms involved in synthesis of medicinally important organic compounds.

CO 04: Interpret the spectral characterizations of synthesized compounds by IR and 1H-NMR spectroscopy.

CO 05: Understand the Lipinski rule of five used in drug designing.

I Preparation of drugs and intermediates: Sulphanilamide; 7-Hydroxy, 4-methyl coumarin; Chlorobutanol; Triphenyl imidazole; Tolbutamide; Hexamine.
II Assay of drugs: Isonicotinic acid hydrazide; Chloroquine; Metronidazole; Dapsone; Chlorpheniramine maleate; Benzyl penicillin.
III Preparation of medicinally important compounds or intermediates by Microwave irradiation technique
IV Drawing structures and reactions using chem draw®
V Determination of physicochemical properties such as logP, C logP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinskies RO5)

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

BP602 T. PHARMACOLOGY-III (Theory) 45 Hours

Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology and in addition,emphasis on the principles of toxicology and chronopharmacology.

Objectives: Upon completion of this course the student should be able to understand the mechanism of drug action and its relevance in the treatment of different infectious diseases; comprehend the principles of toxicology and treatment of various poisonings and and appreciate correlation of pharmacology with related medical sciences.

Course Outcomes:

CO 01: Explain the mechanism, therapeutic uses, and adverse effects of drugs acting on the respiratory and gastrointestinal systems.

CO 02: Describe the principles of chemotherapy and antimicrobial therapy including uses, resistance, and safety of antibiotics and related agents.

CO 03: Analyze the pharmacology of drugs used in parasitic diseases, malignancy,

sexually transmitted and urinary tract infections.

CO 04: Discuss immunopharmacological agents such as immunostimulants, immunosuppressants, monoclonal antibodies, and targeted therapies.

CO 05: Apply the concepts of chronopharmacology and toxicology to understand drug timing, toxicity types, and adverse consequences like carcinogenicity and teratogenicity.

CO 06: Demonstrate knowledge of clinical toxicology by recognizing symptoms and treatment of poisoning due to drugs and heavy metals.

Course Content:

Pharmacology of drugs acting on Respiratory system: Anti -asthmatic drugs; Drugs used in the management of COPD; Expectorants and antitussives; Nasal decongestants; and Respiratory stimulants.

Pharmacology of drugs acting on the Gastrointestinal Tract: Antiulcer agents; Drugs for constipation and diarrhoea; Appetite stimulants and suppressants; Digestants and carminatives; Emetics and anti-emetics.

Chemotherapy: General principles of chemotherapy; Sulfonamides and cotrimoxazole; Antibiotics-Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides.

Chemotherapy: Antitubercular agents; Antileprotic agents; Antifungal agents; Antiviral drugs; Anthelmintics; Antimalarial drugs; Antiamoebic agents.

Chemotherapy: Urinary tract infections and sexually transmitted diseases. Chemotherapy of malignancy.

Immunopharmacology: Immunostimulants; Immunosuppressant; Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars.

Principles of toxicology: Definition and basic knowledge of acute, subacute and chronic toxicity. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity. General principles of treatment of poisoning. Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning.

Chronopharmacology: Definition of rhythm and cycles. Biological Clock and their significance leading to chronotherapy.

BP 608 P. PHARMACOLOGY-III (Practical)

Course Outcomes:

CO 01: Apply principles of dose calculation and pharmacokinetic analysis to interpret experimental pharmacological data using computational tools like Excel.

CO 02: Demonstrate the ability to assess pharmacological effects, such as the hypoglycemic action of insulin, gastric motility, purgative and anti allergic aspects through in vivo experimentation in animal models.

CO 03: Perform biochemical estimations and toxicological assessments including liver enzyme levels, pyrogen testing, and NSAID-induced ulceration models using laboratory animals and semi-auto analyzers.

CO 04: Evaluate the safety profile of pharmaceutical substances through established toxicity tests such as acute skin/eye irritation and oral toxicity according to OECD guidelines.
CO 05: Apply appropriate biostatistical methods, including Student's t-test and Chi-square test, to analyze and interpret experimental pharmacological data.
CO 06: Demonstrate understanding of ethical and scientific considerations in designing and conducting in vivo pharmacological and toxicological experiments.

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)
15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)

*Experiments are demonstrated by simulated experiments/videos

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata McGraw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. 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 and Wilkins
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology
6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher Modern Pharmacology with clinical Applications, by Charles R.Craigand Robert,
8. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton and Company, Kolkata,
9. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,
10. N.Udupa and P.D. Gupta, Concepts in Chronopharmacology.

BP 603 T. HERBAL DRUG TECHNOLOGY (Theory) **45 hours**

Scope: This subject gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The subject also emphasizes on Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs.

Objectives: Upon completion of this course the student should be able to understand raw material as source of herbal drugs from cultivation to herbal drug product; know the WHO and ICH guidelines for evaluation of herbal drugs; know the herbal cosmetics, natural sweeteners, nutraceuticals; appreciate patenting of herbal drugs, GMP.

Course Outcomes:

CO 01: Acquire know-how and be able to carry out technical and management tasks and professional activities in the areas of transformation of medicinal herbs from cultivation to Herbal drug product.

CO 02: Understand basic principles of traditional medicinal systems with method of preparation and standardization of ayurvedic formulation

CO 03: Describe benefits of various plants as nutraceuticals in ailments and also the herb-food interaction of various plant drugs.

CO 04: Describe about herbs or natural origin drugs as raw materials for preparation of cosmetics, excipients, conventional herbal formulation and novel dosage forms like phytosomes

CO 05: Describe rules and regulation for assessment of herbal drugs and patenting of natural products

CO 06: Explain present status and prospects of herbal drug-based industry and components for Good Manufacturing Practice for Indian systems of medicine

Course content:

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.

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: Alfalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, 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 and Ephedra.

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 and perfumes.

Herbal formulations: Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes.

Evaluation of Drugs WHO and 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 and Neem.

Regulatory Issues - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs and Cosmetics Act for ASU drugs.

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 records.

BP 609 P. HERBAL DRUG TECHNOLOGY (Practical)

Course Outcomes:

CO 01: Prepare, label & evaluate herbal/TSM formulations.

CO 02: Evaluate marketed cosmetic & nutraceutical formulations

CO 03: Conduct pre- formulation parameters & understand underlying rationale

CO 04: Conduct in vitro assays for correlation with biological efficacy

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

Recommended Books: (Latest Editions)

1. Textbook of Pharmacognosy by Trease and Evans.
2. Textbook of Pharmacognosy by Tyler, Brady and Robber.
3. Pharmacognosy by Kokate, Purohit and Gokhale
4. Essential of Pharmacognosy by Dr.S.H.Ansari
5. Pharmacognosy and Phytochemistry by V.D.Rangari
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine and Homeopathy)
7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

BP 604 T. BIOPHARMACEUTICS AND PHARMACOKINETICS (Theory) 45 Hours

Scope: This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems arised therein.

Objectives: Upon completion of the course student shall be able to understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance; use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination; to understand the concepts of bioavailability and bioequivalence of drug products and their significance and understand various pharmacokinetic parameters, their significance and applications.

Course Outcomes:

After successful completion of the course student will be able to:

CO 01: Understand the concept of absorption, distribution, metabolism and elimination

CO 02: Determine various factors affecting ADME and terms related to bioavailability and bioequivalence

CO 03: Describe need for different pharmacokinetic models and differentiate between compartment and non-compartment models.

CO 04: Apply various Mathemathetical models to calculate different pharmacokinetic parameters following

different routes of administration

CO 05: Understand nonlinear kinetics and non-compartmental analysis inclusive of factors affecting non-linear pharmacokinetics

Course Content:

Introduction to Biopharmaceutics: 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 of drugs. 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 bioavailability of poorly soluble drugs.

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

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 settins.

Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.

Recommended Books: (Latest Editions)

1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.
2. Biopharmaceutics and Pharmacokinetics; By Robert F Notari
3. Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition,Prentice-Hall Inernational edition.USA
4. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal,Vallabh Prakashan Pitampura, Delhi
5. Pharmacokinetics: By Milo Glbaldi Donald, R. Mercel Dekker Inc.
6. Hand Book of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.
7. Biopharmaceutics; By Swarbrick
8. Clinical Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and
9. Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.
10. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company, Pennsylvania 1989.

11. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn, New York and Basel, 1987.
12. Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvnia

BP610P. Biopharmaceutics and pharmacokinetics (Practical) 4 Hours/week

Objectives:

Biopharmaceutics and pharmacokinetics is complimentary to the theoretical discussions of pharmacokinetic principles. There are various practicals based on physicochemical properties of drugs and dosage forms, protein binding of drugs and pharmacokinetics. This is helpful for developing an insight on the subject.

Course Outcomes:

CO 01: Understand the concept of ADME of drug in human body.

CO 02: Determine the various pharmacokinetic parameters from either plasma concentration or urinary excretion data for drug

CO 03: Apply the various regulations related to developing BA-BE study protocol for the new drug molecule.

1. Verification of Noyes Whitney law of dissolution
2. Plotting standard curve of PCM
3. Plotting standard curve of Ibuprofen
4. Plotting standard curve of Diclofenac sodium
5. Plotting standard curve of Aspirin
6. Determination of partition coefficient and dissociation constant of PCM
7. Determination of partition coefficient and dissociation constant of Ibuprofen
8. Determination of partition coefficient and dissociation constant of Diclofenac sodium
9. Determination of partition coefficient and dissociation constant of Aspirin
10. Studying effect of pH on solubility of PCM
11. Studying effect of pH on solubility of Ibuprofen
12. Studying effect of pH on solubility of Diclofenac sodium
13. Studying effect of pH on solubility of Aspirin
14. Determination of pharmacokinetic parameters of drug following 1-CBM open model after administration of 25 mg dose I.V. bolus
15. Finding concentration of drug following 1-CBM open model after administration of 25 mg dose I.V. bolus for renal disorders
16. Studying % release from PCM tablet in phosphate buffer pH, 7.4 using dissolution apparatus type II
17. In vitro dissolution of fast dissolving tablet
18. In vitro dissolution of sustained release tablet

19. Studying the effect of drug concentration on protein binding using egg albumin
20. Calculation of area under curve by Trapezoidal rule

Recommended Books (Latest Editions)

1. Notari, R.E. Biopharmaceutics and Pharmacokinetics- An Introduction. Marcel Dekker.
2. Rowland, M. and Tozer, T.N. Clinical Pharmacokinetics. Lea and Febiger, N.Y.
3. Gibaldi, M. Biopharmaceutics and Clinical Pharmacokinetics. 4th edition, 2008, PharmMed Press.
4. Shargel, L. and Yu, A. Applied Biopharmaceutics and Pharmacokinetics. Appleton and large,Norwalk.
5. Wagner, J.G. Fundamentals of Clinical Pharmacokinetics. Drug Intelligence Publications, Hamilton.
6. Stephen H. Curry, Drug Disposition and Pharmacokinetics, 3rd edition 2008, Pharm Med Press

BP 605 T. PHARMACEUTICAL BIOTECHNOLOGY (Theory) 45 Hours

Scope: Biotechnology has a long promise to revolutionize the biological sciences and technology. Biotechnology is leading to new biological revolutions in diagnosis, prevention and cure of diseases, new and cheaper pharmaceutical drugs. Biotechnology has already produced transgenic crops and animals and the future promises lot more. It is basically a research-based subject.

Objectives: Upon completion of the subject student shall be able to understanding the importance of immobilized enzymes in pharmaceutical industries; genetic engineering applications in relation to production of pharmaceuticals; importance of monoclonal antibodies in industries; appreciate the use of microorganisms in fermentation technology.

Course Outcomes:

After successful completion of the course student will be able to:

CO 01: Understand the various techniques used in modern biotechnology.

CO 02: Design research strategy with step-by-step instructions to address a research problem

CO 03:Provide examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic

Co 04: Understand concept and application of monoclonal antibody technology

CO 05: Demonstrate and provide examples on how to use microbes and mammalian cells for the production of pharmaceutical products

CO 06: Understand general principles of generating transgenic plants, animals and microbes

Course Content:

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.

Study of COning vectors, restriction endonucleases 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. Brief introduction to PCR.

Types of immunity- humoral immunity, cellular immunity a) Structure of Immunoglobulins. Structure and Function of MHC. Hypersensitivity reactions, Immune stimulation and Immune suppressions. General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity. Storage conditions and stability of official vaccines. Hybridoma technology- Production, Purification and Applications. Blood products and Plasma Substituties.

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.

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.

Recommended Books (Latest edition):

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: ASM Press Washington D.C.
2. RA Goldshy et. al.,: Kuby Immunology.
3. J.W. Goding: Mono**CO**nal Antibodies.
4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry.
5. Zaborsky: Immobilized Enzymes, CRC Press, Degraland, Ohio.
6. S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication.
7. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi

BP606T. QUALITY ASSURANCE (Theory) **45 Hours**

Scope: This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It deals with the important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.

Objectives: Upon completion of the course student shall be able to understand the cGMP aspects in a pharmaceutical industry, appreciate the importance of documentation, understand the scope of quality certifications applicable to pharmaceutical industries, and understand the responsibilities of QA and QC departments.

Course Outcomes:

After successful completion of the course student will be able to:

CO 01: Understand the importance of quality in pharmaceutical products.

CO 02: Explore the importance of Good Practices such as GMP (Good Manufacturing Practices) and GLP (Good Laboratory Practices).

CO 03: Understand the principles, procedures, and steps involved in the registration of NABL, ISO 9000, and ISO 14000.

CO 04: Understand the concept of calibration and validation of instruments in the pharmaceutical industry.

CO 05: Understand the regulatory aspects of the pharmaceutical industry.

CO 06: Learn about various purchase and maintenance specifications related to equipment and raw materials in the pharmaceutical industry.

Course content:

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 and ISO14000: Overview, Benefits, Elements, steps for registration NABL accreditation: Principles and procedures

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 materials.

Quality Control: Quality control test for containers, rubber Courses and secondary packing materials.

Good Laboratory Practices: General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities

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.

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

Recommended Books: (Latest Edition)

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.
3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I WHO Publications.
4. A guide to Total Quality Management- Kushik Maitra and Sedhan K Ghosh
5. How to Practice GMP's – P P Sharma.
6. ISO 9000 and Total Quality Management – Sadhank G Ghosh
7. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms
8. Good laboratory Practices – Marcel Deckker Series
9. ICH guidelines, ISO 9000 and 14000 guidelines

SEMESTER VII

BP701T. INSTRUMENTAL METHODS OF ANALYSIS (Theory) 45 Hours

Scope: This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Objectives: Upon completion of the course the student shall be able to understand the interaction of matter with electromagnetic radiations and its applications in drug analysis; understand the chromatographic separation and analysis of drugs and perform quantitative and qualitative analysis of drugs using various analytical instruments.

Course Outcomes:

After successful completion of the course student will be able to:

CO 01: Understand the basic theoretical knowledge of instrumentation techniques available and correlate their relevant applications.

CO 02: Understand chromatographic separation and analysis of drugs, and perform quantitative and qualitative analysis of drugs using various analytical instruments.

CO 03: Make accurate analyses and report the results in defined formats.

CO 04: Understand the professional and safety responsibilities when working in the analysis laboratory.

CO 05: Gain basic knowledge for the structural interpretation of organic and natural compounds using UV

and IR spectroscopic methods.

CO 06: Understand the basic principles of the Woodward-Fieser rule.

Course Content:

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- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode. Applications - Spectrophotometric titrations, Single component and multi component analysis

Fluorimetry: Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications

IR spectroscopy: Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations. Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications.

Flame Photometry-Principle, interferences, instrumentation and applications.

Atomic absorption spectroscopy- Principle, interferences, instrumentation and applications

Nepheloturbidometry- Principle, instrumentation and applications

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.

Gas chromatography - Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications.

High performance liquid chromatography (HPLC)-Introduction, theory, instrumentation, advantages and applications.

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.

BP705P. INSTRUMENTAL METHODS OF ANALYSIS (Practical) 4 hours/week

Course Outcomes:

CO 01: Understand the interaction of matter with electromagnetic radiation.

CO 02: Understand its applications in drug analysis.

CO 03: Understand chromatographic separation and analysis of drugs, and perform quantitative and qualitative analysis of drugs using various analytical instruments.

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 estimations 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 nephelo turbidometry
11 Separation of amino acids by paper chromatography
12 Separation of sugars by thin layer chromatography
13 Separation of plant pigments by column chromatography
14 Demonstration experiment on HPLC
15 Demonstration experiment on Gas Chromatography

Recommended Books (Latest Editions)

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy by William Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein

BP702T. INDUSTRIAL PHARMACYII (Theory) 45 Hours

Scope: This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market

Objectives: Upon completion of the course, the student shall be able to know the process of pilot plant and scale up of pharmaceutical dosage forms; understand the process of technology transfer from lab scale

to commercial batch; know different laws and acts that regulate pharmaceutical industry; understand the approval process and regulatory requirements for drug products.

Course Outcomes:

After successful completion of the course student will be able to:

CO 01: Grasp the essential aspects of pilot plant techniques, including their significance and the basic requirements involved.

CO 02: Understand the pilot plant and scale up techniques for various dosage forms in pharmaceutical industry.

CO 03: Comprehend the concept of technology transfer and its application in commercial batch production.

CO 04: Obtain learning opportunities to understand the regulatory requirements for drug product approvals and marketing.

CO 05: Aquire knowledge about total quality management, quality control, quality assurance and various certifications.

CO 06: Learn about the working and official framework of various Indian regulatory commissions.

Course Content:

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

Technology development and transfer: WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R and D to production (Process, packaging and cleaning), Granularit y of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, 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 documentation - confidentiality agreement, licensing, MoUs, legal issues

Regulatory affairs: Introduction, Historical overview of Regulatory Affairs, Regulator y 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.

Quality management systems: Quality management and Certifications: Concept of Quality, Total Quality Management, 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, GLP

Indian Regulatory Requirements: Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.

Recommended Books: (Latest Editions)

1. Regulatory Affairs from Wikipedia, the free ency**cl**opedia modified on 7th April available at http,//en.wikipedia.org/wiki/Regulatory_ Affairs.
2. International Regulatory Affairs Updates, 2005. available at http://www.iraup.com/about.php
3. Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition.
4. Regulatory Affairs brought by learning plus, inc. available at http.//www.cgmp.com/ra.htm.

BP706PS. Industrial Pharmacy-II (Practical) 4 Hours/week

Objectives:

Industrial Pharmacy is complimentary to the theoretical discussions in industrial pharmacy. There are various practicals based on formulation development and evaluation based on industrial application. This is helpful for developing an insight on the subject.

Course Outcomes:

CO 01: Understand and apply the basic formulation techniques for developing various pharmaceutical dosage forms, including tablets, capsules, and liquid formulations.

CO 02: Use and interpret evaluation techniques for assessing the quality and efficacy of pharmaceutical dosage forms, ensuring they meet established standards.

CO 03: Understand and apply the basic regulatory guidelines required for the processing and manufacturing of pharmaceutical products.

CO 04: Implement quality assurance practices and procedures in pharmaceutical production to ensure compliance with industry standards and regulatory requirements.

CO 05: Study regulatory requirements for drug approval process in India

1. Formulation and evaluation of effervescent granules.
2. Formulation and evaluation of sustained release matrix tablets.
3. Formulation of PCM capsules by Hand Filling method.
4. Formulation and evaluation of PCM capsules using manual capsule filling machine.
5. Performing drug-excipients compatibility study by IR spectroscopy.
6. Formulation and evaluation of PCM solid dispersions.
7. Formulation and evaluation of microcapsules of aspirin by phase coacervation technique.
8. Determination of partition coefficient of PCM.
9. Formulation and evaluation of mouth dissolving tablets.
10. Formulation of water for injection (WFI) using autoclave sterilization process.

11. Preparation of ascorbic acid injection and carry out ampoule filling and sealing of prepared solution.
12. Studying steps involved in freeze drying process.
13. Demonstration of UV visible double beam spectrophotometer.
14. Demonstration of various types of dissolution apparatus.
15. Formulation and evaluation of Chewable Antacid tablets.
16. Formulation and evaluation of floating hydrophilic matrix tablets.
17. Evaluation of glass container to check its sustainability for packaging in terms of powdered glass test.
18. Formulation and evaluation of PCM granules by wet granulation method.
19. Formulation and evaluation of PCM tablets.
20. Validation of tablet punching machine.

Recommended Books (Latest Editions)

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman and J.B.Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1and2 by Liberman and Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman and Lachman
4. Modern Pharmaceutics by Gilbert S. Banker and C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman and Lachman
7. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
8. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim

BP703T. PHARMACY PRACTICE (Theory) 45 Hours

Scope: In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug information, and therapeutic drug monitoring for improved patient care. In community pharmacy, students will be learning various skills such as dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling for improved patient care in the community set up.

Objectives: Upon completion of the course, the student shall be able to know various drug distribution methods in a hospital, appreciate the pharmacy stores management and inventory control, monitor drug therapy of patient through medication chart review and clinical review, obtain medication history interview and counsel the patients, identify drug related problems, detect and assess adverse drug reactions, interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states, know pharmaceutical care services, do patient counseling in community pharmacy; appreciate the concept of Rational drug therapy.

Course Outcomes:

After successful completion of the course student will be able to:

CO 01: Demonstrate knowledge of and ability to use principles of therapeutics, quality improvement, communication, economics, health behavior, social and administrative aspects, health policy and legal issues in the practice of pharmacy.

CO 02: Apply knowledge of drug distribution methods in hospital and apply it in the practice of pharmacy.

CO 03: Apply principles of drug store management and inventory control to medication use.

CO 04: Provide patient-centered care to diverse patients using the best available evidence and monitor drug therapy of patient through medication chart review, obtain medication history interview and counsel the patients, identify drug related problems.

CO 05: Exhibit professional ethics by producing safe and appropriate medication use throughout society

Course Content:

Hospital and it's organization: Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non- clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions.

Hospital pharmacy and its organization: Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.

Adverse drug reaction: Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management.

Community Pharmacy: Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store.

Drug distribution system in a hospital: Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs.

Hospital formulary: Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary.

Therapeutic drug monitoring: Need for Therapeutic Drug Monitoring, Factors to be considered during the
Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring.

Medication adherence: Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence.

Patient medication history interview: Need for the patient medication history interview, medication interview forms.

Community pharmacy management: Financial, materials, staff, and infrastructure requirements.

Pharmacy and therapeutic committee: Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation.

Drug information services: Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information.

Patient counseling: Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist.

Education and training program in the hospital: Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education.

Prescribed medication order and communication skills: Prescribed medication order-interpretation and legal requirements, and Communication skills- communication with prescribers and patients.

Budget preparation and implementation: Budget preparation and implementation

Clinical Pharmacy: Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care.

Dosing pattern and drug therapy based on Pharmacokinetic and disease pattern.

Over the counter (OTC) sales: Introduction and sale of over the counter, and Rational use of common over the counter medications.

Drug store management and inventory control: Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure.

Investigational use of drugs: Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.

Interpretation of Clinical Laboratory Tests: Blood chemistry, hematology, and urinalysis.

Recommended Books (Latest Edition):

1. Merchant S.H. and Dr. J.S.Quadry. A textbook of hospital pharmacy, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001.
2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. A textbook of Clinical Pharmacy Practice-essential concepts and skills, 1st ed. Chennai: Orient Longman Private Limited; 2004.
3. William E. Hassan. Hospital pharmacy, 5th ed. Philadelphia: Lea and Febiger; 1986.
4. Tipnis Bajaj. Hospital Pharmacy, 1st ed. Maharashtra: Career Publications; 2008.
5. Scott LT. Basic skills in interpreting laboratory data, 4thed. American Society of Health System Pharmacists Inc; 2009.
6. Parmar N.S. Health Education and Community Pharmacy, 18th ed. India: CBS Publishers and Distributers; 2008.

Journals:

1. Therapeutic drug monitoring. ISSN: 0163-4356
2. Journal of pharmacy practice. ISSN : 0974-8326
3. American journal of health system pharmacy. ISSN: 1535-2900 (online)
4. Pharmacy times (Monthly magazine)

BP 707 PS. Pharmacy Practice (Practice School) **4 Hours/week**

CO 01: Apply systematic techniques to collect comprehensive and accurate medication histories from patients in clinical settings.

CO 02: Design personalized patient counseling plans that integrate medication information, lifestyle advice, and follow-up recommendations to ensure optimal health outcomes.

CO 03: Evaluate the causality, preventability, and significance of ADRs using established criteria to determine appropriate interventions or changes in therapy.

CO 04: Analyze case data to determine the seriousness of the ADR and whether it meets the criteria for mandatory reporting.

CO 05: List key laboratory tests used to monitor specific disease states.

CO 06: Evaluate laboratory data in conjunction with clinical findings to make informed decisions about treatment efficacy, dose modifications, or additional diagnostic needs.

1. Preparation and Sterilization of 0.9% Normal Saline Injection.
2. Preparation and Sterilization of 5% Dextrose Injection.
3. Preparation and Sterilization of Isotonic Ringer Solution Injection.
4. Preparation and Identification of Tincture Of Iodine.
5. Preparation of Mandl's Throat Paint.
6. Clinical Case Study 1
7. Clinical Case Study 2
8. Clinical Case Study 3
9. Clinical Case Study 4
10. Clinical Case Study 5
11. Drug Information Services 1
12. Drug Information Services 2
13. Drug Information Services 3
14. Drug Information Services 4
15. Drug Information Services 5

Recommended Books

1. Merchant S.H. and Dr. J. S. Quadry. A textbook of hospital pharmacy, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001.
2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. A textbook of Clinical Pharmacy Practice-essential concepts and skills, 1st ed. Chennai: Orient Longman Private Limited; 2004.

3. William E. Hassan. Hospital pharmacy, 5th ed. Philadelphia: Lea and Febiger; 1986.
4. Tipnis Bajaj. Hospital Pharmacy, 1st ed. Maharashtra: Career Publications; 2008.
5. Scott LT. Basic skills in interpreting laboratory data, 4thed. American Society of Health System Pharmacists Inc; 2009.
6. Parmar N.S. Health Education and Community Pharmacy, 18th ed. India: CBS Publishers and Distributers; 2008.

BP 704T: NOVEL DRUG DELIVERY SYSTEMS (Theory) 45 Hours

Scope: This subject is designed to impart basic knowledge on the area of novel drug delivery systems.

Objectives: Upon completion of the course student shall be able to understand various approaches for development of novel drug delivery systems and to understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation.

Course Outcomes:

After successful completion of the course student will be able to:

CO 01: Understand various approaches for development and Evaluation of controlled drug delivery systems. The criteria for selection of drugs and polymers for the development of NDDS

CO 02: Design controlled release formulations based on microencapsulation, mucoadhesion or implants

CO 03: Cognize the concepts, approaches and applications related to transdermal, gastro retentive and nasopulmonary route

CO 4: Understand concepts and applications of targeted drug delivery as applicable to biomedical field, intrauterine and ocular drug delivery

Course content:

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 formulation of controlled release drug delivery systems.

Microencapsulation: Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications.

Mucosal Drug Delivery system: Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems

Implantable Drug Delivery Systems: Introduction, advantages and disadvantages, concept of implants and osmotic pump.

Transdermal Drug Delivery Systems: Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches

Gastroretentive drug delivery systems: Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high-density systems, inflatable and gastroadhesive systems and their applications
Nasopulmonary drug delivery system: Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers
Targeted drug Delivery: Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications
Ocular Drug Delivery Systems: Introduction, intra ocular barriers and methods to overcome – Preliminary study, ocular formulations and ocuserts
Intrauterine Drug Delivery Systems: Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications

Recommended Books: (Latest Editions)

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim
4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers and Distributors, New Delhi, First edition 1997 (reprint in 2001).
5. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

Journals

1. Indian Journal of Pharmaceutical Sciences (IPA)
2. Indian Drugs (IDMA)
3. Journal of Controlled Release (Elsevier Sciences)
4. Drug Development and Industrial Pharmacy (Marcel and Decker)
5. International Journal of Pharmaceutics (Elsevier Sciences)

BP708PS . NOVEL DRUG DELIVERY SYSTEMS (Practical) 4 Hours/week

Objectives:

Practical of Novel drug delivery system provides an insight of methods involved in the design, development and evaluation of various Novel drug delivery systems

Course Outcomes:

CO 01: Understand the fundamental concepts of novel drug delivery system

CO 02: Formulate and evaluate various types of novel drug delivery systems

CO3: Understand the challenges associated with conventional dosage forms and novel approaches to rectify the same

CO 4: Understanding of requirements of pharmaceutical manufacturing and its regulatory prospective

1. To prepare and evaluate sustained released bilayer tablets of Diclofenac sodium.
2. Formulation and evaluation of calcium alginate beads.
3. Development and evaluation of Bovine Serum albumin Microspheres.
4. Formulation and comparative evaluation of sustained released Diclofenac sodium Matrix Tablets.
5. Formulation and evaluation of transdermal patches.
6. Formulation and evaluation of polymer ocular films using ethyl cellulose.
7. Microencapsulation by temperature change method.
8. Formulation and evaluation of solid dispersions by melt fusion method.
9. Formulation and evaluation of Gelatin Microspheres.
10. Formulation and evaluation of calcium alginate bead of Paracetamol.
11. Formulation and evaluation of Liposomes by thin film hydration technique.
12. Formulation and evaluation of Niosomes.
13. Formulation and evaluation of thermo responsive in – situ ophthalmic gels
14. To perform spherical crystallization- An approach to enhance flow ability and Bioavailability.

Recommended Books (Latest Editions)

Laboratory Manual Of Novel Drug Delivery System by: D. G. Umalkar , G. V. Shinde , R. B. Saudagar , Rajesh K. S. , Sona P. S. Career Publications

Controlled drug delivery- Advances and concepts by: SP Vayas and Roop K Khar.

AMR1201. AWARENESS ON ANTIMICROBIAL RESISTANCE 2 Hours/week

Scope & Objective of the Course:

This course will help the students to understand the concept of antibiotic resistance, its impact on environment and health along with the basics of existing management perspectives for individual care. It will also make them understand their role as pharmacists and its impact on society's health.

The main objectives of the course are:

- To introduce the basic concepts of antibiotics and antibiotic resistance
- To understand the statistics of the incidence and prevalence of ABR
- To understand concept of "One health" related to Environment and ABR
- To aware the "future pharmacists" about the role in lowering the incidence of drug resistant infections
- To enable the students to understand the basic concept of antibiotic stewardship program at hospitals for managing ABR
- To aware the "future healthcare professionals" about the role of "human behavior" in managing ABR

Course Outcomes:

CO 01: Define the basic terminology related to AMR and ABR. Define the mode of action of antibiotics. Define the mechanism of antibiotic resistance. Understand the concept of 'One Health' in view of AMR.

CO 02: Describe the status of surveillance system for AMR in humans, animals and plants.

CO 03: Explain the key goals of global and national action plans to combat AMR.

CO 04: Understand and apply advances in antimicrobial stewardship program during on-field practice.

CO 05: Understand the need and importance of antibiotic prescriptions for diseased conditions.

1 **Introduction to AMR/ABR**
   - Definition of Antimicrobial resistance
   - Overview on resistance mechanisms
   - Spread of AMR
   - Impact on health of humans, animals and plants

2 **AMR surveillance system**
   - Introduction to GLASS
   - AMR burden in the global and national level

3 **Action plans for prevention of ABR**
   - GAP, NAP and KARSAP, WHO guidelines on AMR

4 **Role of clinical pharmacists in preventing AMR as per standard guidelines**
   - Introduction to antimicrobial Stewardship
   - Role of clinical pharmacist in infection control practices

5 **Guidelines for appropriate antimicrobial use:** Infectious disease including UTI, pneumonia, skin and soft tissue infections, CNS infections, abdominal infections, sepsis.

Text Book/Research article/Review article:

1. Antibiotics Resistance Mechanisms And New Antimicrobial Approaches, Kateryna Kon and Mahendra Rai, ISBN: 978-0-12-803642-6, Elsevier's publication
2. Antibiotic Resistance: Understanding and Responding to an Emerging Crisis, DRLICA & PERLIN, FT Press Science
3. Antibiotics And Antibiotic Resistance, Ola Sk¨old, ePDF ISBN: 978-1-118-07556-2o, Book ISBN: 978-1-118-07560-9, ePub ISBN: 978-1-118-07558-6, Wiley publishers
4. Practical Implementation of an Antibiotic Stewardship Program, Tamar F. Barlam, Melinda M. Neuhauser, Pranita D. Tamma, Kavita K. Trivedi, ISBN-13: 978-1107166172, Cambridge University Press
5. Antibiotic Resistance: Implications for Global Health and Novel Intervention Strategies: Workshop Summary, Alison Mack, David A. Relman, Eileen R. Choffnes, ISBN: 0309185343, 9780309185349; 2010 National Academies Press
6. Nathwani D, Sneddon J. Practical guide to antimicrobial stewardship in hospitals. BiomérieuxR. Disponível em: http://bsac. org. uk/wpcontent/uploads/2013/07/Stewardship-Booklet-Practical-Guide-to-Antimicrobial-Stewardship-in-Hospitals. pdf. 2015
7. Microbiology and Infection Control for Health Professionals, Lee, G & Bishop, P, 2015, 6th Edition, Pearson Prentice Hall, Frenchs Forest

Other readings & relevant websites:

1. http://www.cdc.gov/
2. https://www.who.int/gpsc/ipc/en/
3. https://www.who.int/mediacentre/news/releases/2018/antibiotic-resistance-found/en/
4. Limmathurotsakul D, Sandoe JA, Barrett DC, Corley M, Hsu LY, Mendelson M, Collignon P, Laxminarayan R, Peacock SJ, Howard P. 'Antibiotic footprint'as a communication tool to aid reduction of antibiotic consumption. The Journal of antimicrobial chemotherapy. 2019 May 10.
5. Gajdács M. The concept of an ideal antibiotic: Implications for drug design. Molecules. 2019 Jan;24(5):892.
6. Molnar A. Antimicrobial resistance awareness and games. Trends in microbiology. 2019 Jan 1;27(1):1-3.
7. Bandaru BK, Thankappan P, Nandan SR, Amudala R, Annem SK, Santosh AB. The prevalence of developmental anomalies among school children in Southern district of Andhra Pradesh, India. Journal of oral and maxillofacial pathology: JOMFP. 2019 Jan;23(1):160.
8. Alam MM, Islam M, Wahab A, Billah M. Antimicrobial Resistance Crisis and Combating Approaches. Journal of Medicine. 2019 Jan 1;20(1):38-45.
9. Omeershffudin UN, Kumar S. Bacterial DNA Adenine Methyltransferase as a Novel Drug Target for Antibiotics: Current Status and Future Drug Discovery Challenges. Int. J. Curr. Microbiol. App. Sci. 2019;8(4):2494-504.
10. Graf FE, Palm M, Warringer J, Farewell A. Inhibiting conjugation as a tool in the fight against antibiotic resistance. Drug development research. 2019 Feb;80(1):19-23.

SEMESTER VIII

BP801T. BIOSTATISITCS AND RESEARCH METHODOLOGY (Theory) 45 Hours

Scope: To understand the applications of Biostatics in Pharmacy. This subject deals with descriptive statistics, Graphics, Correlation, Regression, logistic regression Probability theory, Sampling technique, Parametric tests, non-Parametric tests, ANOVA, Introduction to Design of Experiments, Phases of Clinical trials and Observational and Experimental studies, SPSS, R and MINITAB statistical software's, analyzing the statistical data using Excel.

Objectives: Upon completion of the course the student shall be able to 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.

Course Outcomes:
After successful completion of the course student will be able to:

CO 01: Understand the applications of Biostatics in Pharmacy.

CO 02: Cognise the operation of M.S. Excel, SPSS, R-online, DoE (Design of Experiment) & MINITAB.

CO 03: Understand the basic about research and designing the methodology.

CO 04: Understand the various statistical techniques to solve statistical problems, appreciate statistical techniques in solving the problems.

Course content:

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
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 t ype, 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
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, and plagiarism.
Graphs: Histogram, Pie Chart, Cubic Graph, 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.
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
Design and Analysis of experiments:
Factorial Design: Definition, 22, 23design. Advantage of factorial design
Response Surface methodology: Central composite design, Historical design, Optimization Techniques

Recommended Books (Latest edition):

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork.
2. Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha
3. Design and Analysis of Experiments –PHI Learning Private Limited, R. Pannerselvam,
4. Design and Analysis of Experiments – Wiley Students Edition, Douglas and C. Montgomery

BP802T SOCIAL AND PREVENTIVE PHARMACY **Hours: 45**

Scope: The purpose of this course is to introduce to students a number of health issues and their challenges. This course also introduced a number of national health programmers. The roles of the pharmacist in these contexts are also discussed.

Objectives: After the successful completion of this course, the student shall be able to Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide; Have a critical way of thinking based on current healthcare development and Evaluate alternative ways of solving problems related to health and pharmaceutical issues.

Course Outcomes:
After successful completion of the course student will be able to:
CO 01: Acquire high consciousness and realization of current issues related to health and pharmaceutical problems within the country and worldwide.
CO 02: Develop a critical way of thinking based on current healthcare developments.
CO 03: Evaluate alternative ways of solving problems related to health and pharmaceutical issues.

CO 04: Study the National health intervention program for mother and child.

CO 05: Explore community services in rural, urban, and school health.

Course content:

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
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
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 immunization programme, National programme for control of blindness, Pulse polio programme.
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.
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.

Recommended Books (Latest edition):

1. Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, ISBN: 9789380704104, JAYPEE Publications
2. Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Ro y Rabindra Nath, Saha Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEE Publications
3. Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications
4. Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2nd Edition, 2012, ISBN: 9789350250440, JAYPEE Publications
5. Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS.
6. Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad

Recommended Journals:

1. Research in Social and Administrative Pharmacy, Elsevier, Ireland

24UNI0105 HUMAN RIGHTS AND VALUES **3Hours/ Week**

Scope and Objective of the Course:

The course provides a wide scope of learning and understanding of the subject and after completion of the subject the student will have the ability to develop human values and its importance in their professional life. The student will also have good knowledge of human rights.

The main objectives of the course are:

CO1: Understand specific issues and important of human rights.

CO2: Understand the importance of personal development and create positive personality.

CO3: Identify the national, social and professional values, religious values.

CO4: Understand about national integration and international cooperation.

CO5: Understand the basic fundamental rights of constitution.

CO6: Cognise about human rights.

General Concepts Introduction about human rights and value education, aim of education, concept of human values and its type

Personal development: Self -analysis, gender equality, respect to age, experience, maturity, family member, coworker. Personality development and its importance in professional world

Character formation through human values: Truthfulness, sacrifice, sincerity, self-control, tolerance, positive attitude, dignity, ethics

National values: Democracy, socialism, secularism , equality, justice, liberty, freedom

Social values: sympathy, universal brother-hood, duty towards our society

Professional Values: Knowledge thirst, sincerity towards responsibility, ethics, regularity, punctuality, and faith

Religious values: Accept and respect others believes, tolerance, understanding, faith

Fundamental rights: Introduction and importance of fundamental rights of Indian constitution

Right to Equality: Introduction and its importance, types of rights of equality, equality before law, abolition of untouchability, abolition of titles

Rights to freedom: Introduction and its importance, types of rights, freedom of speech ,freedom to reside and settle , freedom to practice any profession

Rights against exploitation and right to freedom of religion: Introduction and its importance and its effect on human life

Cultural and educational rights and rights to constitutional remedies

Right to property and right to education: Introduction and its importance, importance of education on our life

Human rights-general: Concepts of human rights and its Indian and international perspective, evolution of human rights, Universal Declaration of Human Rights, significance of the UDHR, analysis of the declaration

Therapeutic Measures: Control of mind through physical exercise, meditation

Meditation and Yoga: Introduction and its effects on human mind, types of yoga, how to control our thought through yoga and meditation.

Human rights of women and children: Social practice and constitutional safeguards, **gender** discrimination in workplace

Female feticide, physical assault and harassment, domestic violence, condition of working of women, child labour, violation by individuals, nuclear weapons and terrorism safeguard.

1. **Recommended Books (Reference Books/Textbooks):**

    a. **RB01:** Value Education and Human Rights, R.P. Shukla
    b. **TB01:** Introduction to Human Rights and Duties, Dr. T. S. N. Sastry
    c. **TB02:** Value Education and Education For Human Rights, V.C. Pandey

BP803ET. PHARMA MARKETING MANAGEMENT (Theory) 45 Hours

Scope: The pharmaceutical industry not only needs highly qualified researchers, chemists and technical people, but also requires skilled managers who can take the industry forward by managing and taking the complex decisions which are imperative for the growth of the industry. The Knowledge and Know-how of marketing management groom the people for taking a challenging role in Sales and Product management.

Course Objective: The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry.

Course Outcomes:

After successful completion of the course student will be able to:

CO 01: Understand marketing, selling, and the marketing environment.

CO 02: Analyze competitive and consumer buying behavior.

CO 03: Examine various qualitative and quantitative aspects related to the size and composition of the market.

CO 04: Study various pharmaceutical marketing channels.

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Marketing: Definition, general concepts and scope of marketing; Distinction between marketing and 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 and targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist.Analyzing the Market; Role of market research.

Product decision: Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.

Promotion: 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.
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.
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).
Emerging concepts in marketing: Vertical and Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.

Recommended Books: (Latest Editions)

1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi
2. Walker, Boyd and Larreche : Marketing Strategy- Planning and Implementation, Tata MC GrawHill, New Delhi.
3. Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill
4. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India
5. Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition)
6. Ramaswamy, U.S and Nana Kamari, S: Marketing Managemnt:Global Perspective, IndianContext,Macmilan India, New Delhi.
7. Shanker, Ravi: Service Marketing, Excell Books, New Delhi
8. Subba Rao Changanti, Pharmaceutical Marketing in India (GIFT – Excel series) Excel Publications.

P804 ET: PHARMACEUTICAL REGULATORY SCIENCE (Theory) 45Hours

Scope: This course is designed to impart the fundamental knowledge on the regulator y requirements for approval of new drugs, and drug products in regulated markets of India and other countries like US, EU, Japan, Australia etc. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products.

Objectives: Upon completion of the subject student shall be able to know about the process of drug discovery and development, know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals and know the regulatory approval process and their registration in Indian and international markets.

Course Outcomes:
After successful completion of the course student will be able to:

CO 01: Understand the stages of drug discovery, development, preclinical, non-clinical, and clinical studies.

CO 02: Develop generic drug products.

CO 03: Analyze various regulatory approval processes.

CO 04: Understand the procedure for exporting pharmaceutical products and registering Indian drug products in overseas markets.

CO 05: Develop clinical trial protocols and guidelines based on regulatory commissions.

Course content:

New Drug Discovery and development: Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.

Regulatory Approval Process: Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA.

Regulatory authorities and agencies: Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications).

Registration of Indian drug product in overseas market: Procedure for export of pharmaceutical products, technical documentation, Drug Master, Files (DMF), Common Technical Document (CTD), electronic Common Technical Document (eCTD), ASEAN Common Technical Document (ACTD)research.

Clinical trials: Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors and Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials

Regulatory Concepts: Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book

Recommended books (Latest edition):

1. Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.
2. 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.
3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences,Vol.190.
4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley and Sons. Inc.
5. FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics /edited by Douglas J. Pisano, David Mantus.
6. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143

7. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A. Rozovsky and Rodney K. Adams
8. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene
9. Drugs: From Discovery to Approval, Second Edition By Rick Ng

BP 805T: PHARMACOVIGILANCE (Theory) **45 hours**

Scope: This paper will provide an opportunity for the student to learn about development of pharmacovigilance as a science, basic terminologies used in pharmacovigilance, global scenario of Pharmacovigilance, train students on establishing pharmacovigilance programme in an organization, various methods that can be used to generate safety data and signal detection. This paper also develops the skills of classifying drugs, diseases and adverse drug reactions.

Objectives: At completion of this paper it is expected that students will be able to know why drug safety monitoring is important; history and development of pharmacovigilance; national and international scenario of pharmacovigilance; dictionaries, coding and terminologies used in pharmacovigilance; detection of new adverse drug reactions and their assessment; international standards for classification of diseases and drugs; adverse drug reaction reporting systems and communication in pharmacovigilance; methods to generate safety data during pre clinical, clinical and post approval phases of drugs' life cycle; drug safety evaluation in paediatrics, geriatrics, pregnancy and lactation; pharmacovigilance Program of India (PvPI) requirement for ADR reporting in India; ICH guidelines for ICSR, PSUR, expedited reporting, pharmacovigilance planning; CIOMS requirements for ADR reporting and writing case narratives of adverse events and their quality.

Course Outcomes:
After successful completion of the course student will be able to:

CO 01: Understand the importance of safety monitoring of medicine and the Pharmacovigilance Program of India.

CO 02: Apply methods in causality assessment, severity, and seriousness assessment.

CO 03: Identify WHO adverse reaction terminologies.

CO 04: Establish a pharmacovigilance program in a hospital.

CO 05: Understand ICH guidelines for pharmacovigilance.

CO 06: Understand drug safety evaluation in special populations.

Course Content

Introduction to Pharmacovigilance: History and development of Pharmacovigilance; Importance of safety monitoring of Medicine; WHO international drug monitoring programme; Pharmacovigilance Program of India (PvPI).

Introduction to adverse drug reactions: Definitions and classification of ADRs; Detection and reporting; Methods in Causality assessment; Severity and seriousness assessment; Predictability and preventability assessment; Management of adverse drug reactions

Basic terminologies used in pharmacovigilance: Terminologies of adverse medication related events**;** Regulatory terminologies.

Drug and disease classification: Anatomical, therapeutic and chemical classification of drugs; International classification of diseases; Daily defined doses; International Non-proprietary Names for drugs.

Drug dictionaries and coding in pharmacovigilance: WHO adverse reaction terminologies; MedDRA and Standardised MedDRA queries; WHO drug dictionary; Eudravigilance medicinal product dictionary; Information resources in pharmacovigilance; Basic drug information resources; Specialised resources for ADRs.

Establishing pharmacovigilance programme: Establishing in a hospital; Establishment and operation of drug safety department in industry; Contract Research Organisations (CROs); Establishing a national programme.

Vaccine safety surveillance: Vaccine Pharmacovigilance; Vaccination failure; Adverse events following immunization.

Pharmacovigilance methods: Passive surveillance – Spontaneous reports and case series; Stimulated reporting; Active surveillance – Sentinel sites, drug event monitoring and registries; Comparative observational studies – Cross sectional study, case control study and cohort study; Targeted clinical investigations.

Communication in pharmacovigilance: Effective communication in Pharmacovigilance; Communication in Drug Safety Crisis management; Communicating with Regulatory Agencies, Business Partners, Healthcare facilities and Media.

Safety data generation: Pre clinical phase; Clinical phase; Post approval phase (PMS).

ICH Guidelines for Pharmacovigilance: Organization and objectives of ICH; Expedited reporting; Individual case safety reports; Periodic safety update reports; Post approval expedited reporting; Pharmacovigilance planning; Good clinical practice in pharmacovigilance studies.

Pharmacogenomics of adverse drug reactions: Genetics related ADR with example focusing PK parameters.

Drug safety evaluation in special population: Paediatrics; Pregnancy and lactation; Geriatrics.

CIOMS: CIOMS Working Groups; CIOMS Form.

CDSCO (India) and Pharmacovigilance: DandC Act and Schedule Y; Differences in Indian and global pharmacovigilance requirements.

Recommended Books (Latest edition):

1. Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers.
2. Practical Drug Safety from A to Z by Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.

3. Mann's Pharmacovigilance: Elizabeth B. Andrews, Nicholas, Wiley Publishers.
4. Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, Wiley Publishers.
5. An Introduction to Pharmacovigilance: Patrick Waller,Wiley Publishers.
6. Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert,Jonesand Bartlett Publishers.
7. Textbook of Pharmacoepidemiolog edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy, Wiley.
8. A Textbook of Clinical Pharmacy Practice - Essential Concepts and Skills: G. Parthasarathi, K. NyfortHansen, M.C. Nahata
9. National Formulary of India
10. Text Book of Medicine by Yashpal Munjal
11. Text book of Pharmacovigilance: concept and practice by GP Mohanta and PK Manna
12. http://www.whoumc.org/DynPage.aspx?id=105825andmn1=7347andmn2=7259andmn3=7297
13. http://www.ich.org/
14. http://www.cioms.ch/
15. http://cdsco.nic.in/
16. http://www.who.int/vaccine_safety/en/
17. http://www.ipc.gov.in/PvPI/pv_home.html

BP 806 ET. QUALITY CONTROL AND STANDARDIZATION OF HERBALS (Theory)

Scope: In this subject the student learns about the various methods and guidelines for evaluation and standardization of herbs and herbal drugs. The subject also provides an opportunity for the student to learn cGMP, GAP and GLP in traditional system of medicines.

Objectives: Upon completion of the subject student shall be able to know WHO guidelines for quality control of herbal drugs; know Quality assurance in herbal drug industry; now the regulatory approval process and their registration in Indian and international markets and appreciate EU and ICH guidelines for quality control of herbal drugs.

Course Outcomes:
After successful completion of the course student will be able to:

CO 01: Understand various basic tests for drugs, medicinal plant materials, and dosage forms.
CO 02: Analyze quality assurance in the herbal drug industry, including cGMP, GAP, GMP, and GLP in the traditional system of medicine.
CO 03: Evaluate EU and ICH guidelines for quality control of herbal drugs.
CO 04: Understand regulatory requirements for herbal medicines.

Course Content:

Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms; WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use.

Quality assurance in herbal drug industry of cGMP, GAP, GMP and GLP in traditional system of medicine: WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines; WHO Guidelines on GACP for Medicinal Plants.

EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safet y and Efficacy of Herbal Medicines

Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products. Preparation of documents for new drug application and export registration. GMP requirements and Drugs and Cosmetics Act provisions.

Regulatory requirements for herbal medicines. WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems. Comparison of various Herbal Pharmacopoeias. Role of chemical and biological markers in standardization of herbal products.

Recommended Books: (Latest Editions

1. Pharmacognosy by Trease and Evans
2. Pharmacognosy by Kokate, Purohit and Gokhale
3. Rangari, V.D., Text book of Pharmacognosy and Phytochemistry Vol. I, Carrier Pub., 2006.
4. Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002.
5. EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products,
6. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.
7. Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8.
8. WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998.
9. WHO. The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edn. World Health Organization, Geneva, 1981.
10. WHO. Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999.
11. WHO. WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005.
12. WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.

BP 807 ET. COMPUTER AIDED DRUG DESIGN (Theory) 45 Hours

Scope: This subject is designed to provide detailed knowledge of rational drug design process and various techniques used in rational drug design process.

Objectives: Upon completion of the course, the student shall be able to understand design and discovery of lead molecules; the role of drug design in drug discovery process; the concept of QSAR and docking; various strategies to develop new drug like molecules; the design of new drug molecules using molecular modeling software.

Course Outcomes:
After successful completion of the course student will be able to:

CO 01: Understand the stages of drug discovery and development.
CO 02: Describe the history and development of QSAR.
CO 03: Explain molecular modeling and virtual screening techniques.
CO 04: Apply informatics and methods in drug design.
CO 05: Demonstrate molecular docking techniques.

Course Content:

Introduction to Drug Discovery and Development: Stages of drug discovery and development; Lead discovery and Analog Based Drug Design; Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation; Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Any three case studies.
Quantitative Structure Activity Relationship (QSAR): SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.
Molecular Modeling and virtual screening techniques: Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening, Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening. De novo drug design.
Informatics and Methods in drug design: Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.
Molecular Modeling: Introduction to molecular mechanics and quantum mechanics.Energy Minimization methods and Conformational Analysis, global conformational minima determination.

Recommended Books (Latest Editions)

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Prak Press Baltimore.
2. Martin YC. "Quantitative Drug Design" Dekker, New York.
3. Delgado JN, Remers WA eds "Wilson and Gisvolds's Text Book of Organic Medicinal and Pharmaceutical Chemistry" Lippincott, New York.
4. Foye WO "Principles of Medicinal chemistry 'Lea and Febiger.
5. Koro lkovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.
6. Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry"John Wiley and Sons, New York.
7. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
8. Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston.
9. Silverman R.B. "The organic Chemistry of Drug Design and Drug Action" Academic Press New York.

BP808ET: CELL AND MOLECULAR BIOLOGY (Elective subject) 45 Hours

Scope: Cell biology is a branch of biology that studies cells – their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function. This is done both on a microscopic and molecular level. Cell biology research encompasses both the great diversity of single-celled organisms like bacteria and protozoa, as well as the many specialized cells in multi-cellular organisms such as humans, plants, and sponges.

Objectives: Upon completion of the subject student shall be able to summarize cell and molecular biology history; summarize cellular functioning and composition; describe the chemical foundations of cell biology; summarize the DNA properties of cell biology; describe protein structure and function; describe cellular membrane structure and function; describe basic molecular genetic mechanisms; summarize the cell cycle.

Course Outcomes:
After successful completion of the course student will be able to:

CO 01: Understand the theoretical basis and applications of cell and molecular biology.

CO 02: Explain the flow of molecular information.

CO 03: Analyze the structure and functions of proteins and regularities in proteins.

Course content:

Cell and Molecular Biology: Definitions theory and basics and Applications. History and Summation. Properties of cells and cell membrane. Prokaryotic versus Eukaryotic. Cellular Reproduction. Chemical Foundations – an Introduction and Reactions (Types).

DNA and the Flow of Molecular Information: DNA Functioning; DNA and RNA; Types of RNA; Transcription and Translation.
Proteins: Defined and Amino Acids; Protein Structure. Regularities in Protein Pathways. Cellular Processes. Positive Control and significance of Protein Synthesis.
Science of Genetics: Transgenics and Genomic Analysis. Cell Cycle analysis. Mitosis and Meiosis. Cellular Activities and Checkpoints.
Cell Signals: Introduction, Receptors for Cell Signals, Signaling Pathways: Overview, Misregulation of Signaling Pathways, Protein-Kinases: Functioning.

Recommended Books (latest edition):

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers and Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. Edward: Fundamentals of Microbiology.
10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
11. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company.
12. B.R. Glick, J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: ASM Press Washington D.C.
13. RA Goldshy et. al.,: Kuby Immunology.

BP809ET. COSMETIC SCIENCE (Theory) **45Hours**

Course Outcomes:
After successful completion of the course student will be able to:

C0 01: Enumerate cosmetics as per regulations and cosmeceutical products and basic understanding of skin, hair and buccal cavity

CO 02: Understand the principles involved in the formulation of skin and hair care products.

CO 03: Cognise about Sun protection, role of herbs in cosmetics and analytical methods for cosmetics

CO 04: Understand the principles of cosmetic evaluation

CO 05: Understand cosmetic problems associated with skin, hair

Course Content:

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.

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 and deodorants- Actives and mechanism of action. Principles of formulation and building blocks of Hair care products: Conditioning shampoo, Hair conditioner, anti-dandruff shampoo. Hair oils.

Chemistry and formulation of Para-phylene diamine-based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.

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.

Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties. Soaps, and syndet bars. Evolution and skin benfits.

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.

References

1) Harry's Cosmeticology, Wilkinson, Moore, Seventh Edition, George Godwin.
2) Cosmetics – Formulations, Manufacturing and Quality Control, P.P. Sharma, 4th Edition, Vandana Publications Pvt. Ltd., Delhi.
3) Text book of cosmelicology by Sanju Nanda and Roop K. Khar, Tata Publishers.

BP809EP. COSMETIC SCIENCE (Practicals)

1. Formulation of foundation cream.
2. Formulation of skin cream with Vitamin A and E.
3. Formulation of all purpose cream.
4. Formulation and evaluation of gel for SPF determination.
5. Formulation of sunscreen lotion.
6. Formulation of lipsticks.
7. Formulation of Lip Balm.
8. Formulation of anti dandruff shampoos.

9. Formulation and evaluation of cooling dusting powder.
10. Formulation of brushless shaving cream.
11. Formulation and evaluation of anti-acne face gel.
12. Formulation of mouth wash.
13. Formulation of toothpaste.
14. Formulation and evaluation of clear liquid shampoo.
15. Formulation of tooth powder

References

1) text book of cosmetology by RM Mehta and BM Mittal.
2) Cosmetics – Formulations, Manufacturing and Quality Control, P.P. Sharma, 4th Edition, Vandana Publications Pvt. Ltd., Delhi.
3) Text book of cosmelicology by Sanju Nanda and Roop K. Khar, Tata Publishers.

BP 810 ET. PHARMACOLOGICAL SCREENING METHODS 45 Hours

Scope: This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.

Objectives: Upon completion of the course the student shall be able to appreciate the applications of various commonly used laboratory animals; appreciate and demonstrate the various screening methods used in preclinical research; appreciate and demonstrate the importance of biostatistics and research methodology and design and execute a research hypothesis independently.

Course Outcomes:

After successful completion of the course student will be able to:

CO 01: Understand CPCSEA and OECD guidelines for the maintenance, breeding, and conduct of experiments on laboratory animals.

CO 02: Analyze various preclinical screening models.

CO 03: Evaluate preclinical screening models for ANS activity and CVS activity.

CO 04: Apply research methodology and biostatistics in the selection of research topics, review of literature, research hypothesis, and study design.

Course Content:

Laboratory Animals: Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.

Preclinical screening models: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. Study of screening animal models for Diuretics, nootropics, anti-Parkinson's, antiasthmatics, Preclinical screening models: for CNS activity- analgesic, antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease.

Preclinical screening models: for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics.

Preclinical screening models: for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslepidemic, anti-aggregatory, coagulants, and anticoagulants. Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.

Research methodology and Bio-statistics: Selection of research topic, review of literature, research hypothesis and study design; pre-clinical data analysis and interpretation using Students 't' test; and One-way ANOVA. Graphical representation of data.

Recommended Books (latest edition):

1. Fundamentals of experimental Pharmacology-by M.N. Ghosh
2. Hand book of Experimental Pharmacology-S.K. Kulakarni
3. CPCSEA guidelines for laboratory animal facility.
4. Drug discovery and Evaluation by Vogel H.G.
5. Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta
6. Introduction to biostatistics and research methods by PSS Sundar Rao and J Richard

BP 811 ET. ADVANCED INSTRUMENTATION TECHNIQUES 45 Hours

Scope: This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart advanced knowledge on the principles and instrumentation of spectroscopic and chromatographic hyphenated techniques. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Objectives: Upon completion of the course the student shall be able to understand the advanced instruments used and its applications in drug analysis; understand the chromatographic separation and analysis of drugs; understand the calibration of various analytical instruments and know analysis of drugs using various analytical instruments.

Course Outcomes:

After successful completion of the course student will be able to:

CO 01: Understand the basic theoretical knowledge and structural interpretation of organic and natural

compounds using NMR and Mass Spectroscopy.

CO 02: Explain the aspects of thermal methods of analysis and X-ray diffraction.

CO 03: Understand the calibration of various analytical instruments and analyze drugs using these instruments.

CO 04: Demonstrate practical skills for the analysis of drugs and excipients using various instrumentation techniques.

CO 05: Understand extraction techniques and hyphenated techniques.

CO 06: Cognize general theoretical principles and applications of Radio Immunological Assays.

Course Content:

Nuclear Magnetic Resonance spectroscopy: Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications

Mass Spectrometry: Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications.

Thermal Methods of Analysis: Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC).

X-Ray Diffraction Methods: Origin of X-rays, basic aspects of crystals, X- ray Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications.

Calibration and validation-as per ICH and USFDA guidelines: Calibration of following Instruments; Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, Fluorimeter, Flame Photometer, HPLC and GC.

Radio immune assay: Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay.

Extraction techniques: General principle and procedure involved in the solid phase extraction and liquid-liquid extraction.

Hyphenated techniques: LC-MS/MS, GC-MS/MS, HPTLC-MS.

Recommended Books (Latest Editions)

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy by William Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi

10. Spectrophotometric identification of Organic Compounds by Silverstein

BP 811 EP Advanced Instrumental Techniques

CO 01: Understand the basic theoretical knowledge and structural interpretation of organic and natural compounds using NMR and Mass Spectroscopy.

CO 02: Explain the aspects of thermal methods of analysis and X-ray diffraction.

CO 03: Understand the calibration of various analytical instruments and analyze drugs using these instruments.

CO 04: Demonstrate practical skills for the analysis of drugs and excipients using various instrumentation techniques.

CO 05: Understand extraction techniques and hyphenated techniques.

CO 06: Cognize general theoretical principles and applications of Radio Immunological Assays.

1. To calibrate electronic balance.
2. To calibrate UV-visible spectrophotometer.
3. To calibrate IR spectrophotometer.
4. To calibrate Flame photometer.
5. To calibrate pH meter
6. To extract given sample by liquid-liquid extraction procedure.
7. Workshop on NMR.
8. Workshop on MS.
9. Workshop on IR.
10. To elucidate the structure of given sample on the basis of different spectra.
11. To elucidate the structure of unknown sample on the basis of different spectra.

Reference Books

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake

BP 812 ET. DIETARY SUPPLEMENTS AND NUTRACEUTICALS

Scope: This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.

Objective: This module aims to provide an understanding of the concepts behind the theoretical applications of dietary supplements. By the end of the course, students should be able to understand the need of supplements by the different group of people to maintain healthy life, understand the outcome of

deficiencies in dietary supplements, appreciate the components in dietary supplements and the application and appreciate the regulatory and commercial aspects of dietary supplements including health claims.

Course Outcomes:

After successful completion of the course student will be able to:

CO 01: Understand the role of functional foods, nutraceuticals, and dietary supplements.

CO 02: Explain the chemical nature and medicinal benefits of phytochemicals as nutraceuticals.

CO 03: Analyze the role and damaging reactions of free radicals.

CO 04: Role of free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage.

CO 05: Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals.

Course Content:

Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds.

Phytochemicals as nutraceuticals: Occurrence and characteristic features (chemical nature medicinal benefits) of following Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, leutin, Sulfides: Diallyl sulfides, Allyl trisulfide, Polyphenolics: Reservetrol, Flavonoids- Rutin, Naringin, Quercitin, Anthocyanidins, catechins, Flavones, Prebiotics / Probiotics: Fructo oligosaccharides, Lacto bacillum, Phyto estrogens: Isoflavones, daidzein, Geebustin, lignans, Tocopherols, Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.

Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids; Dietary fibres and complex carbohydrates as functional food ingredients.

Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals' involvement in other disorders. Free radicals' theory of ageing. Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α- Lipoic acid, melatonin. Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole. c) Functional foods for chronic disease prevention.

Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals. Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods. Pharmacopoeial Specifications for dietary supplements and nutraceuticals.

References:

1. Dietetics by Sri Lakshmi
2. Role of dietary fibres and neutraceuticals in preventing diseases by K.T Agusti and P.Faizal: BSPunblication.
3. Advanced Nutritional Therapies by Cooper. K.A., (1996).
4. The Food Pharmacy by Jean Carper, Simon and Schuster, UK Ltd., (1988).
5. Prescription for Nutritional Healing by James F.Balch and Phyllis A.Balch 2nd Edn., Avery Publishing Group, NY (1997).
6. G. Gibson and C.williams Editors 2000 Functional foods Woodhead Publ.Co.London.
7. Goldberg, I. Functional Foods. 1994. Chapman and Hall, New York.
8. Labuza, T.P. 2000 Functional Foods and Dietary Supplements: Safety, Good Manufacturing Practice (GMPs) and Shelf-Life Testing in Essentials of Functional Foods M.K. Sachmidl and T.P. Labuza eds. Aspen Press.
9. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition)
10. Shils, ME, Olson, JA, Shike, M. 1994 Modern Nutrition in Health and Disease. Eighth edition. Lea and Febiger

Semester VIII – Elective course on Pharmaceutical Product Development

Course Outcomes:

After successful completion of the course student will be able to:

CO 01: Regulations related to pre-formulation, formulation development, stability assessment, manufacturing and quality control testing.

CO 02: Study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to Tablet and capsule excipients, directly compressible vehicles, Coat materials, Excipients in parenteral and aerosols products

CO 03: Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations

Course Content:

Introduction to pharmaceutical product development, objectives, regulations related to Preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms

An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories: Solvents and solubilizers, Cylodextrins and their

applications, non-ionic surfactants and their applications, Polyethylene glycols and sorbitols, Suspending and emulsifying agents, semi solid excipients.

An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories: Tablet and capsule excipients, directly compressible vehicles, Coat materials, Excipients in parenteral and aerosols products, Excipients for formulation of NDDS Selection and application of excipients in pharmaceutical formulations with specific industrial applications.

Optimization techniques in pharmaceutical product development: A study of various optimization techniques for pharmaceutical product development with specific examples. Optimization by factorial designs and their applications.A study of QbD and its application in pharmaceutical product development.

Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations.

Recommended Books (Latest editions)

1. Pharmaceutical Statistics Practical and Clinical Applications by Stanford Bolton, CharlesBon; Marcel Dekker Inc.
2. Ency**cl**opedia of Pharmaceutical Technology, edited by James swarbrick, Third Edition, Informa Healthcare publishers.
3. Pharmaceutical Dosage Forms, Tablets, Volume II, edited by Herbert A. Lieberman andLeon Lachman; Marcel Dekker, Inc.
4. The Theory and Practice of Industrial Pharmacy, Fourth Edition, edited by Roop kKhar, S P Vyas, Farhan J Ahmad, Gaurav K Jain; CBS Publishers and Distributors Pvt. Ltd. 2013.
5. Martin's Physical Pharmacy and Pharmaceutical Sciences, Fifth Edition, edited by Patrick J. Sinko, BI Publications Pvt. Ltd.
6. Targeted and Controlled Drug Delivery, Novel Carrier S ystems by S. P. Vyas and R. K.Khar, CBS Publishers and Distributors Pvt. Ltd, First Edition 2012.
7. Pharmaceutical Dosage Forms and Drug Delivery Systems, Loyd V. Allen Jr., Nicholas B.Popovich, Howard C. Ansel, 9th Ed. 40.
8. Aulton's Pharmaceutics – The Design and Manufacture of Medicines, Michael E. Aulton,3rd Ed.
9. Remington – The Science and Practice of Pharmacy, 20th Ed.
10. Pharmaceutical Dosage Forms – Tablets Vol 1 to 3, A. Liberman, Leon Lachman andJoseph B. Schwartz
11. Pharmaceutical Dosage Forms – Disperse S ystems Vol 1 to 3, H.A. Liberman, Martin, M.R and Gilbert S. Banker.
12. Pharmaceutical Dosage Forms – Parenteral Medication Vol 1 and 2, Kenneth E. Avis and H.A. Libermann.
13. Advanced Review Articles related to the topics.

12. Assessment and Evaluation

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

12.1. 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: Schemes 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 – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP102T	Pharmaceutical Analysis I –T	10	15	1.5 Hr	25	75	3 Hrs	100
BP103T	Pharmaceutics I – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP104T	Pharmaceutical Inorganic Chemistry –T	10	15	1.5 Hr	25	75	3 Hrs	100
BP105T	Communication skills – T *	5	10	1 Hr	15	35	1.5 Hrs	50
BP106RBT BP106RMT	Remedial Biology/ Remedial Mathematics –T*	5	10	1 Hr	15	35	1.5 Hrs	50
BP107P	Human Anatomy and Physiology –P	5	10	4 Hrs	15	35	4 Hrs	50
BP108P	Pharmaceutical Analysis I –P	5	10	4 Hrs	15	35	4 Hrs	50
BP109P	Pharmaceutics I – P	5	10	4 Hrs	15	35	4 Hrs	50
BP110P	Pharmaceutical Inorganic Chemistry – P	5	10	4 Hrs	15	35	4 Hrs	50
BP111P	Communication skills – P*	5	5	2 Hrs	10	15	2 Hrs	25
BP112RBP	Remedial Biology – P*	5	5	2 Hrs	10	15	2 Hrs	25
25uni0130	The Rudiments of Artificial Intelligence				75			75
	Total	70/75$^{\$}$/80$^{\#}$	115/ 125$^{\$}$/ 130$^{\#}$	23/ 24$^{\$}$/ 28$^{\#}$ Hrs	185/ 200$^{\$}$/ 285$^{\#}$	490/ 525$^{\$}$/ 540$^{\#}$	31.5/ 33$^{\$}$/ 35$^{\#}$ Hrs	675/ 725$^{\$}$/ 835$^{\#}$

$^{\#}$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 – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP202T	Pharmaceutical Organic Chemistry I – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP203T	Biochemistry – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP204T	Pathophysiology – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP205T	Computer Applications in Pharmacy – T	10	5	1.5 Hr	25	50	2 Hrs	75
BP206T	Environmental sciences – T	10	15	1.5 Hr	25	50	2 Hrs	75
BP207P	Human Anatomy and Physiology II – P	5	10	4 Hrs	15	35	4 Hrs	50
BP208P	Pharmaceutical Organic Chemistry I– P	5	10	4 Hrs	15	35	4 Hrs	50
BP209P	Biochemistry– P	5	10	4 Hrs	15	35	4 Hrs	50
BP210P	Computer Applications in Pharmacy– P	5	5	2 Hrs	10	15	2 Hrs	25
	Total	80	125	23 Hrs	205	520	30 Hrs	725

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– T	10	15	1.5 Hr	25	75	3 Hrs	100
BP302T	Physical Pharmaceutics I– T	10	15	1.5 Hr	25	75	3 Hrs	100
BP303T	Pharmaceutical Microbiology– T	10	15	1.5 Hr	25	75	3 Hrs	100
BP304T	Pharmaceutical Engineering– T	10	15	1.5 Hr	25	75	3 Hrs	100
BP305P	Pharmaceutical Organic Chemistry II	5	10	4 Hr	15	35	4 Hrs	50
BP306P	Physical Pharmaceutics I– P	5	10	4 Hr	15	35	4 Hrs	50
BP307P	Pharmaceutical Microbiology– P	5	10	4 Hr	15	35	4 Hrs	50
BP308P	Pharmaceutical Engineering– P	5	0	4 Hr	15	35	Hrs	50
	Total	65	110	22	160	440	28 Hrs	600

Semester IV

Course code	Name of the course	Internal Assessment			End Semester Exams		Total Marks
		Continuous	Sessional Exams	Total	Marks	Duration	

		Mode	Marks	Duration				
BP401T	Pharmaceutical Organic Chemistry III – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP402T	Medicinal Chemistry I – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP403T	Physical Pharmaceutics II – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP404T	Pharmacology I – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP405T	Pharmacognosy I – T	10	15	1.5 Hr	25	75	3 Hrs	100
24UNI0124	Cyber Security– T*	5	10	1 Hr	15	35	2 Hrs	50
BP406P	Medicinal Chemistry I – P	5	10	4 Hr	15	35	4 Hrs	50
BP407P	Physical Pharmaceutics II – P	5	10	4 Hrs	15	35	4 Hrs	50
BP408P	Pharmacology I – P	5	10	4 Hrs	15	35	4 Hrs	50
BP409P	Pharmacognosy I – P	5	10	4 Hrs	15	35	4 Hrs	50
	Total	70	95	24.5 Hrs	215	515	31 Hrs	730

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 –T	10	15	1.5 Hr	25	75	3 Hrs	100
BP502T	Industrial Pharmacy I –T	10	15	1.5 Hr	25	75	3 Hrs	100
BP503T	Pharmacology II – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP504T	Pharmacognosy II – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP505T	Pharmaceutical Jurisprudence-T	10	15	1.5 Hr	25	75	3 Hrs	100
24UNI0125	Disaster Management-T*	10	20	1Hr	30	-	-	30
BP506P	Industrial Pharmacy I–P	5	10	4 Hr	15	35	4 Hrs	50
BP507P	Pharmacology II – P	5	10	4 Hr	15	35	4 Hrs	50
BP508P	Pharmacognosy II – P	5	10	4 Hr	15	35	4 Hrs	50
BP 509 P	Medicinal Chemistry-P	5	100	4 Hr	15	35	4Hrs	50
	Total	75	100	24.5 Hr	215	515	31 Hrs	730

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	1.5 Hr	25	75	3 Hrs	100
BP602T	Pharmacology III – Theory	10	15	1.5 Hr	25	75	3 Hrs	100
BP603T	Herbal Drug Technology – Theory	10	15	1.5 Hr	25	75	3 Hrs	100
	Biopharmaceutics and	10	15	1.5 Hr	25	75	3 Hrs	100

BP604T	Pharmacokinetics –Theory							
BP605T	Pharmaceutical Biotechnology – Theory	10	15	1.5 Hr	25	75	3 Hrs	100
BP606T	Quality Assurance –Theory	5	10	4 Hrs	15	35	4 Hrs	50
BP607P	Medicinal chemistry III – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP608P	Pharmacology III – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP609P	Herbal Drug Technology – Practical	10	15	1.5 Hr	25	75	3 Hrs	100
BP610 P	Biopharmaceutics and Pharmacokinetics-Practical	5	10	4 Hrs	15	35	4 Hrs	50
	Total	80	130	25 Hrs	210	590	30 Hrs	800

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-T	10	15	1.5 Hr	25	75	3 Hrs	100
BP702T	Industrial Pharmacy –T	10	15	1.5 Hr	25	75	3 Hrs	100
BP703T	Pharmacy Practice –T	10	15	1.5 Hr	25	75	3 Hrs	100
BP704T	Novel Drug Delivery System –T	10	15	1.5 Hr	25	75	3 Hrs	100
AMR1201	Awareness on Antimicrobial Resistance-T	10	20	1 Hr	30	-	-	30
BP705 P	Instrumental Methods of Analysis-P	5	10	4 Hrs	15	35	4 Hrs	50
BP706 PS	Ind. Pharmacy	5	10		15	35	3 Hrs	50
BP 707PS	Pharmacy Practices	5	10		15	35	3 Hrs	50
BP708PS	Novel drug delivery system	5	10		15	35	3 Hrs	50
	Total	65	140	12 Hrs	155	440	25 Hrs	650

* 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 – T	10	15	1.5 Hr	25	75	3 Hrs	100
BP802T	Social and Preventive Pharmacy– T	10	15	1.5 Hr	25	75	3 Hrs	100
24UNI0105	Human values and Professional Ethics -T*	10	20	1 Hr	30	-	-	30
BP803ET	Pharmaceutical Marketing –T	10 + 10 = 20	15 + 15 = 30	1 + 1 = 2 Hrs	25 + 25 = 50	75 + 75 = 150	3 + 3 = 6 Hrs	100 +100 =200
BP804ET	Pharmaceutical Regulatory Science – T							
BP805ET	Pharmacovigilance –T							
BP806ET	Quality Control and Standardization of Herbals –T							
BP807ET	Computer Aided Drug Design – T							
BP808ET	Cell and Molecular Biology – T							
BP809ET	Cosmetic Science – T							
BP810ET	Experimental Pharmacology –T							
BP811ET	Advanced Instrumentation Techniques – T							
BP811ET	Cosmetic Science-T	15			15	35	4 Hr	50
BP811EP	Advanced Instrumentation Techniques – Theory	15			15	35	4Hr	50
BP812PW	Project Work	-	-	-	-	100	4 Hrs	100
NS101	NSS							
	Total	75		06 Hrs	125	505	25.5 Hrs	630

12.2. 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**	
Attendance (Refer Table – XII)	4	2
Academic activities (Average of any 3 activities e.g. quiz, assignment, open book test, field work, 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

12.2.1. 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.

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

Question paper pattern for theory Sessional examinations

For Subjects having University Examination

I. Multiple Choice Questions (MCQs) = 10 x 1 = 10

OR

Objective Type Questions (5 x 2) (Answer all the questions) = 05 x 2 = 10

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

II. Short Answers (Answer 2 out of 3) = 2 x 5 = 10

Total = 30 marks

For Subjects having Non-University Examination

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

II. Short Answers (Answer 4 out of 6) = 4 x 5 = 20

Total = 30 marks

Question paper pattern for practical sessional examinations

I. Synopsis	=	10

II. Experiments	=	25
III. Viva voce	=	05
	Total =	40 marks

13. Examples of few questions statements pertaining to different levels of Bloom's Taxonomy

Remember

A lot of emphasis is laid on, so as to make sure that all assessment components are conducted while following different levels of Bloom's Taxonomy as mentioned in figure.

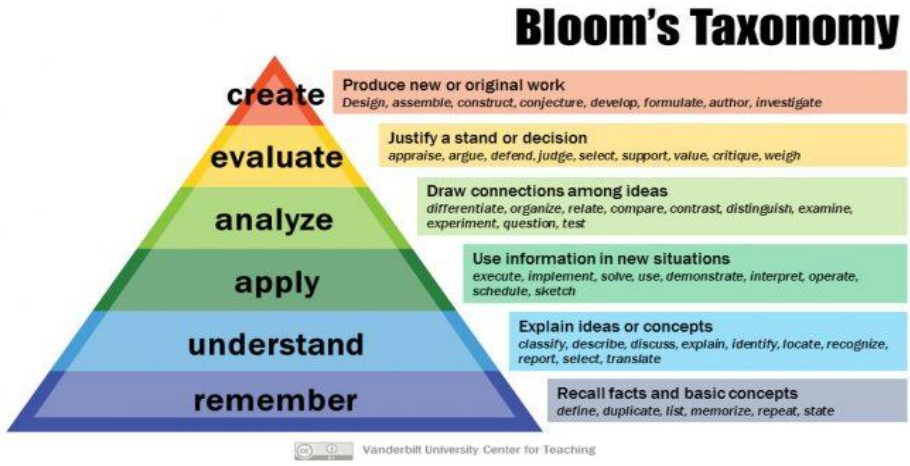

Figure 1. Bloom's Taxonomy [7]

Further a focused effort if also made to align every single Further a focused effort if also made to align every single test item in assessment components with one or the other course learning outcome.

Retrieving, recognizing, and recalling relevant knowledge from long-term memory.

Sample Questions

1. State any two pharmaceutical applications of prodrug design.
2. List the physicochemical properties of a drug molecule.

Understand

Constructing meaning from oral, written and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing and explaining.

Sample Questions

1. Explain principle of TLC and its preparation methods.
2. How the Rf value is calculated.

Applying

Carrying out or using a procedure through executing or implementing.

Sample Questions

1. One of the resource persons needs to address a huge crowd (nearly 400 members) in the auditorium. A system is to be designed in such a way that everybody attending the session should be able to hear

properly and clearly without any disturbance. Identify the suitable circuit to boost the voice signal and explain its functionality in brief.

2. A ladder 5.0 m long rests on a horizontal ground & leans against a smooth vertical wall at an angle 200 with the vertical. The weight of the ladder is 900 N and acts at its middle. The ladder is at the point of sliding, when a man weighing 750 N stands on a rung 1.5 m from the bottom of the ladder. Calculate the coefficient of friction between the ladder & the floor.

Analyzing

Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing and attributing

Sample Questions

1. A class of 10 students consists of 5 males and 5 females. We intend to train a model based on their past scores to predict the future score. The average score of females is 60 whereas that of male is 80. The overall average of the class is 70. Give two ways of predicting the score and analyze them for fitting model.

2. Return statement can only be used to return a single value. Can multiple values be returned from a function? Justify your answer.

Creating & Evaluating

Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning or producing. Making judgments based on criteria and standards through checking and critiquing

Sample Questions

1. Automatic tethering of milking machine is used to milk and is attached to the udder of a cow. A milk diary wants to automate the milking process. The milking process involves attaching the milking cups to the teats. Design a system for the same.

2. A Biotech industry needs automation for filling its product into 20 ltr bottles. Design a system to meter the flow into the bottles so that each bottle has 20 ltr of the liquid. There will be more than one filling station and the system has to monitor all the filling stations as well as keep count of the total production on a daily basis.

14. Course Handout

An elaborate document named 'Course Handout' providing details about every single course is shared with students at the beginning of every semester. This document typically has various components like –

Course Handout

Institute/School Name	Chitkara College of Pharmacy		
Department Name	Pharmacy		
Programme Name	B. Pharmacy		
Course Name	Pharmaceutical Analysis	Session	2023-24
Course Code	BP102T	Semester/Batch	1st/ 2026
L-T-P(Per Week)	L-T-P 3-1-4	Course Credits	4
Pre-requisite	Basic fundamentals of analytical chemistry and principles of electrochemical analysis of drugs	NHEQF Level[1]	4.5
Course Coordinator	Dr. Paranjeet Kaur		
SDG	SDG 9		

1. Objectives of the Course

This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs. Upon completion of the course student shall be able to understand the principles of volumetric and electro chemical analysis; carryout various volumetric and electrochemical titrations; develop analytical skills.

2. Course Learning Outcomes (CLOs)

Student should be able to:

	CLOs	Program Outcomes (PO)	NHEQF Level Descriptor[2]	No. of Lectures
CLO01	Develop the ideas with the fundamental of analytical chemistry.	PO1, PO4	Q1	**10**
CLO02	Construct the fundamental methodology to prepare different strength of solutions.	PO3	Q2	**15**
CLO03	Critically Predict the potential sources of mistakes and errors in analytical processes.	PO3 .	Q3	**5**
CLO04	Develop the fundamentals of volumetric analytical skills and electrochemical analytical techniques.	PO3.	Q4	**10**
CLO05	Comprehend the research oriented basic knowledge in the analytical processes.	PO4	Q1	**6**
CLO06	Interpret and analyze the course content in terms of choice of analytical techniques	PO5	Q3	**4**
Total Contact Hours				**50**

[1] National Higher Education Qualification Framework Level, Refer to annexure
[2] NHEQF Level Descriptor, Refer to Annexure & Learning outcomes descriptors for qualification for all levels on the NHEQF

CLO-PO Mapping

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CLO01	M	H	L	H							L
CLO02		M	H								L
CLO03			H			M			L		
CLO04			H	M		L					
CLO05			M	H		L					
CLO06			M	H	M	L					

H=High, M=Medium, L=Low

3. **Recommended Books:**

B01: A.I. Vogel, Text Book of Quantitative Inorganic analysis

B02: A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press

B03: R.M. Verma, Analytical Chemistry Theory and Practice, Third edition

B04: J Mendham, RC Denny, J D Barnes, M Thomas, B Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis

B05: John H. Kennedy, Analytical chemistry principles

BO6: Indian Pharmacopoeia

4. **Other readings and relevant websites:**

SerialNo	Link of Journals, Magazines, websites and Research Papers
1.	www.pubmed.com
2.	www.sciencedirect.com
3.	www.google.com
4.	www.googlescholar.com

5. **Recommended Tools and Platforms**

<<Mention Tools and Platforms required for the course if required>>

6. **Course Plan: Theory Plan**

Lect. No. (Hour)	Topics
1-2	Introduction
3	Introduction
4-5	Definition and scope
6-7	Different techniques of analysis; Methods of expressing concentration;
8-9	Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate,
10-12	sulphuric acid, potassium permanganate and ceric ammonium sulphate
13	Primary and secondary standards

14-15	**Errors**: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures
16-17	Pharmacopoeia, Sources of impurities in medicinal agents, limit tests
18-19	**Acid base titration**: Theories of acid base indicators, classification of acid base titrations
20-21	Theory involved in titrations of strong, weak, and very weak acids and bases,
22	Neutralization curves
23	**Non aqueous titration**: Solvents,
24	alkalimetry titration, estimation of Ephedrine HCl
25	acidimetry titration, estimation of Ephedrine HCl
26	**Complexometric titration**: Classification, masking and demasking reagents,
27	Metal ion indicators, estimation of Magnesium sulphate, and calcium gluconate.
28-29	**Precipitation titrations:** Mohr's method, Fajans method
30	Volhard's, Modified Volhard's,
31	Estimation of sodium chloride.
***ST1 (Syllabus Covered till date or as decided by Course Coordinator with due approval from Dean of the school)**	
32-33	**Gravimetry:** Principle and steps involved in gravimetric analysis.
34	Purity of the precipitate: co-precipitation and post precipitation
35	Estimation of barium sulphate.
36-37	**Basic Principles, methods and application of diazotisation titration.**
38-39	**Electrochemical methods of analysis**: Conductometry- Introduction, Conductivity cell, Conductometric titrations, applications
40-41	Potentiometry - Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode), Indicator electrodes (metal electrodes and glass electrode),
42	Methods to determine end point of potentiometric titration

43-44	Polarography - Principle, Ilkovic equation, Construction and working of dropping mercury electrode, rotating platinum electrode, applications.
45-46	Cerimetry, Iodometry, Dichromatry and bromatometry
47	Titration with potassium iodate
***ST2 (Syllabus Covered till date or as decided by Course Coordinator with due approval from Dean of the school)**	
48-50	Revision and Class test
End Term Exam	

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7. Delivery/Instructional Resources Theory Plan:

Lect. No.	Topics	Book No, CH No, Page No	TLM[3]	ALM[4]	Web References	Audio-Video
1-2	Introduction	B3 , CH 1, Page No. 3-12	Lecture, Active learning	Group Discussion		
3	Introduction	B3 , CH 1, Page No. 3-12	Discussion, Inductive teaching and learning	Group Discussion		
4-5	Definition and scope	B3 , CH 1, Page No. 3-12	Lecture, Active learning	Quiz/Test Questions		
6-7	Different techniques of analysis; Methods of expressing concentration;	B3 , CH 1, Page No. 33-41	Discussion, Inductive teaching and learning	Student-Created Ppt		
8-9	Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate,	B3 , CH 1, Page No. 33-41	Lecture, Active learning	Group Discussion		
10-12	sulphuric acid, potassium permanganate and ceric ammonium sulphate	B3 , CH 1, Page No. 33-41	Lecture, Active learning	Quiz/Test Questions		
13	Primary and secondary standards	B1, CH 10, PAGE NO. 295	Discussion, Inductive teaching and learning	Quiz/Test Questions		
14-15	**Errors**: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures	B3, CH 2 , PAGE NO. 13-32 B1, CH 4, PAGE NO. 104	Lecture, Active learning	Statement – Opinion		

[3] Teaching Learning Methods, Refer to Annexure
[4] Active Learning Methods

16-17	Pharmacopoeia, Sources of impurities in medicinal agents, limit tests	B3, CH 2 , PAGE NO. 13-32 B1, CH 4, PAGE NO. 104	Discussion, Inductive teaching and learning	Group Discussion		
18-19	**Acid base titration**: Theories of acid base indicators, classification of acid base titrations	B3, CH -7 , PAGE NO. 154-194	Lecture, Active learning	Group Discussion	7.2: Lab - Titrations - Chemistry LibreTexts	
20-21	Theory involved in titrations of strong, weak, and very weak acids and bases,	B3, CH -7 , PAGE NO. 154-194	Lecture, Active learning	Student-Created Ppt		
22	Neutralization curves	B1, CH-10, PAGE NO. 302-312	Inductive teaching and learning	Group Discussion Group Discussion		
23	**Non aqueous titration**: Solvents,	B3, CH-9, PAGE NO. 195-202 B1, CH-10, PAGE NO. 314 -317	Lecture, Active learning	Group Discussion		
24	Alkalimetry titration, estimation of Ephedrine HCl	B3, CH -7 , PAGE NO. 154-194	Discussion, Inductive teaching and learning	Quiz/Test Questions		
25	Acidimetry titration, estimation of Ephedrine HCl	B3, CH -7 , PAGE NO. 154-194	Inductive teaching and learning	Group Discussion		
26	**Complexometric titration**: Classification, masking and demasking reagents,	B3, CH 11, PAGE NO. 245-264 B1. CH 10, PAGE NO. 326-334	Lecture, Active learning	Group Discussion	Complexometric Calcium Determination (Experiment) - Chemistry LibreTexts	
27	Metal ion indicators, estimation of Magnesium sulphate, and calcium gluconate.	B1. CH 10, PAGE NO. 335- 345	Discussion, Inductive teaching and learning	Group Discussion		

28-29	**Precipitation titrations:** Mohr's method, Fajans method	B1, CH-10, PAGE NO. 345- 357 B3, CH 11, PAGE NO. 245=264	Lecture, Active learning	Group Discussion		
30	Volhard's, Modified Volhard's,	B1, CH-10, PAGE NO. 345- 357 B3, CH 11, PAGE NO. 245=264	Inductive teaching and learning	Group Discussion		
31	Estimation of sodium chloride.	B1, CH-10, PAGE NO. 345- 357 B3, CH 11, PAGE NO. 245=264	Lecture, Active learning	Quiz/Test Questions		
32-33	**Gravimetry:** Principle and steps involved in gravimetric analysis.	B1, CH-11 , PAGE NO. 398-414 B3, CH-6, PAGE NO. 113-142	Lecture, Active learning	Group Discussion		
34	Purity of the precipitate: co-precipitation and post precipitation	B1, CH-10, PAGE NO. 345- 357 B3, CH 11, PAGE NO. 245=264	Inductive teaching and learning	Group Discussion		
35	Estimation of barium sulphate.	B1, CH-10, PAGE NO. 345- 357 B3, CH 11, PAGE NO. 245=264	Lecture, Active learning	Group Discussion		

36-37	**Basic Principles, methods and application of diazotisation titration.**	B3, CH-14, PAGE NO. 305-338	Discussion, Inductive teaching and learning	Group Discussion	Diazotization - an overview | ScienceDirect Topics	
38-39	**Electrochemical methods of analysis**: Conductometry- Introduction, Conductivity cell, Conductometric titrations, applications	B3, CH-14, PAGE NO. 305-338	Lecture, Active learning	Quiz/Test Questions		
40-41	Potentiometry - Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode), Indicator electrodes (metal electrodes and glass electrode),	B3, CH-14, PAGE NO. 305-338	Discussion, Inductive teaching and learning	Student-Created Ppt		
42	Methods to determine end point of potentiometric titration	B3, CH-14, PAGE NO. 305-338	Lecture, Active learning	Group Discussion		
43-44	Polarography - Principle, Ilkovic equation, Construction and working of dropping mercury electrode, rotating platinum electrode, applications.	B3, CH-14, PAGE NO. 305-338	Lecture, Active learning	Quiz/Test Questions		
45-46	Cerimetry, Iodometry, Dichromatry and bromatometry	B1, CH-10, PAGE NO. 371, 373, 387,	Discussion, Inductive teaching and learning	Quiz/Test Questions		
47	Titration with potassium iodate	B1, CH-10, PAGE NO. 373,	Lecture, Active learning	Statement – Opinion		

8. Remedial Classes[5]

After every Sessional Test - slow learners will be identified based on their Performance and Remedial classes will be conducted for the respective students.

- Implementation of a personalized learning plan including remedial sessions and additional resources.
- Initiating tailored support mechanisms and providing extra academic assistance.
- Enforcement of personalised learning strategies and targeted academic support.
- Providing additional tutoring and resources to address learning gaps.

[5] Refer to Annexure

9. Self-Learning[6]

Assignments to promote self-learning, survey of contents from multiple sources.

S.No	Topics	CO	ALM	References/MOOCS
1	Overview of general Acid-Base reactions Neutralization reaction Complexometric reaction Gravimetric reactions	• Develop the ideas with the fundamental of analytical chemistry. • Construct the fundamental methodology to prepare different strength of solutions.	• Think / Pair / Share • Peer Review	A.I. Vogel, Text Book of Quantitative Inorganic analysis
2	Discuss in detail about: Potentimetric methods, polarography, Cerimetry, Iodometry, Dichromatry and bromatometry	• Comprehend the basic knowledge in the principles of electrochemical analytical techniques • Interpret and analyze the course content in terms of choice of analytical techniques	• Think / Pair / Share • Peer Review	A.I. Vogel, Text Book of Quantitative Inorganic analysis

10. Delivery Details of Content Beyond Syllabus[7]

Content beyond syllabus covered (if any) should be delivered to all students that would be planned, and schedule notified accordingly.

S.No	Advanced Topics, Additional Reading, Research papers and any	CO	POs	ALM	References/MOOCS
1.	Article Writing Skills	Research Skills	PO 10: To develop research aptitude: to acquire advanced skills in development, conduct & outcome management of research projects in optimized formulation	• Peer Review • Just in Time Teaching	Siddiqui MR, AlOthman ZA, Rahman N. Analytical techniques in pharmaceutical

[6] Refer to Annexure

[7] Refer to Annexure

			development & standardization in time bound manner.		analysis: A review. Arabian Journal of chemistry. 2017 Feb 1;10:S1409-21.

11. Evaluation Scheme & Components:

Assessment Type[8]	Evaluation Component[9]	Type of Component[10]	No. of Assessments[11]	% Weightage of Component	Max. Marks	Mode of Assessment
Summative	Component1	Assignment and Attendance	02*	10%	10	Offline
Summative	Component2	Sessional Tests	02**	15%	15	Offline
Summative	Component3	End Term Examination	01***	75%	75	Offline
	Total		**100%**			

Note: Details in above table are sample for the reference, The department decides the assessment policy for each course.

12. Syllabus of the Course:

Subject: Pharmaceutical Analysis I			
S.No.	**Topic(s)**	**No. of Lectures**	**Weightage %**
1	Unit 1 Pharmaceutical Analysis	**5**	**10**
2	Unit 2 Errors	**2**	**5**

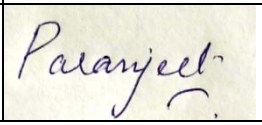
[8] Refer to Annexure 2 of NCrF
[9] Refer to Annexure
[10] Refer to Annexure
[11] Refer to Annexure

3	Unit 3 Pharmacopoeia, Sources of impurities in medicinal agents, limit tests.	**2**	**5**
4	Unit 4 Acid base titration	**6**	**10**
5	Unit 5 Precipitaion titration	**3**	**10**
6	Unit 6 Non aqueous titration	**6**	**10**
7	Unit 7 Complexometric titration	**3**	**10**
8	Unit 8 Gravimetry	**4**	**10**
9	Unit 9 Diazotization titration	**1**	**10**
10	Unit 10 Redox Titration	**5**	**10**
11	Unit 11 Electrochemical methods of Analysis	**7**	**10**

13. Academic IntegrityyPolicy:

Education at Chitkara University builds on the principle that excellence requires freedom where Honesty and integrity are its prerequisites. Academic honesty in the advancement of knowledge requires that all students and Faculty respect the integrity of one another's work and recognize the importance of acknowledging and safeguarding intellectual property. Any breach of the same will be tantamount to severe academic penalties.

This Document is approved by:

Designation	**Name**	**Signature**
Course Coordinator	Dr. Paranjeet Kaur	

Head-Academic Delivery	Dr. Pallavi Bassi	
Dean	Dr. Thakur Gurjeet Singh	
Date(DD/MM/YYYY)	26-7-2025	

15. Appendix A: Mapping of Programme Outcomes (POs) with Course Outcomes (COs):

Course Name	Course Code	Updated CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Human Anatomy and Physiology I–Theory	BP101T	CO 01: Describe the human body's structural organization, cell communication, and homeostatic regulation.	3								3		
		CO 02: Explain the structure and function of the skin, bones, muscles, and joints in body movement.	3					3					
		CO 03: Discuss the composition, formation, and function of blood and lymph and their related disorders.	3					3					
		Co 04: Illustrate the structure and function of the peripheral nervous system and special sensory organs.	3								2		
		CO 05: Explain the anatomy and physiology of the cardiovascular system, blood circulation, and heart regulation mechanisms.		2		2							
		AVG	**3**	**2**		**2**		**3**			**2.5**		
Pharmaceutical Analysis I – Theory	BP102T	CO 01: Develop the ideas with the fundamental of analytical chemistry.	3										
		CO 02: Construct the fundamental methodology to prepare different strength of solutions.	3										2
		CO 03: Critically Predict the potential sources of mistakes and errors in analytical processes.			3			2					
		CO 04: Develop the fundamentals of volumetric analytical skills and electrochemical analytical techniques.	2			2							
		CO 05: Comprehend the research oriented basic knowledge in the analytical processes.	2										2
		CO 06: Interpret and analyze the course content in terms of choice of analytical techniques			2								
		AVG	**2.5**		**2.5**	**2**		**2**					**2**

Pharmaceutics I – Theory	BP103T	CO 01: Demonstrate fundamental knowledge in preparing conventional dosage forms.	3					2					
		CO 02: Learn the basics of the pharmacopoeias available.	3										
		CO 03: Apply knowledge of various pharmaceutical dosage calculations.		3	3								
		CO 04: Understand various techniques for the formulation research and evaluation of powders and liquid dosage forms.			3	3							
		CO 05: Identify various pharmaceutical incompatibilities.									2		
		AVG	**3**	**3**	**3**	**3**		**2**			**2**		
Pharmaceutical Inorganic Chemistry – Theory	BP104T	CO 01: Understand the principles of limit tests.	3										
		CO 02: Become familiar with different classes of inorganic pharmaceuticals and their analysis.		2	2								
		CO 03: Identify different anions, cations, and various inorganic pharmaceuticals.											2
		CO 04: Gain knowledge about the sources of impurities and methods to determine impurities in inorganic drugs and pharmaceuticals.										2	
		CO 05: Understand the medicinal and pharmaceutical importance of inorganic compounds in health care									3	2	
		CO 06: Explore a variety of inorganic drug classes.	3			2							
		AVG	**3**	**2**	**2**	**2**					**3**	**2**	**2**
Communication skills – Theory	BP105T	CO 01: Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation	3		2			3	1	1	3		3
		CO 02: Communicate effectively (Verbal and Non-Verbal)	3		2			3	1	1	3		3
		CO 03: Effectively manage the team as a team player		3	3		3				1		1
		CO 04: Develop interview skills											2
		CO 05: Develop Leadership qualities and essentials in research, innovation and entrepreneurship		2		2	3		2		2		3
		AVG	**3**	**2.5**	**2.33**	**2**	**3**	**3**	**1.33**	**1**	**2.25**		**2.4**

Remedial Biology	BP106RBT	CO 01: Understand and learn about cell biology, including the basic nature of plant and animal cells.	3									2	
		CO 02: Classify plants and animals based on classification systems.	3		2							3	
		CO 03: Explore various tissue and organ systems in plants and animals.	3									3	
		CO 04: Understand the theory of evolution.	2		2							3	1
		Co 05: Learn the anatomy and physiology of plants and animals.	3									2	
		CO 06: Study the various phases in the development of plant growth.	3									2	
		AVG	**2.83**		**2**							**2.5**	**1**
Remedial Mathematics – Theory	BP106RMT	CO 01: Apply mathematical concepts and principles to perform computations for Pharmaceutical Sciences.			3								
		CO 02: Create, use and analyze mathematical valuation, representations and mathematical relationships			3						2		
		CO 03: Communicate mathematical knowledge and understanding to help in the field of Clinical Pharmacy			3							2	
		CO 04: Perform abstract mathematical reasoning.		3									
		CO 05: Learn about analytical geometry.			2								
		AVG		**3**	**2.75**						**2**	**2**	
Human Anatomy and Physiology – Practical	BP107P	CO 01: Understand the construction, working, care and handling of instruments, glassware's and equipment's required for practical.	3			2							
		CO 02: Understand the significance of Bleeding time, Blotting time, Blood group detection, Haemoglobin detection and measurement of blood pressure and its significance in human health						3			3		
		CO 03: Knowledge of mechanism of White Blood Cell Count and Red Blood	3			3							
		Cell Count of blood sample.											

		CO 04: Demonstration of human cardiovascular system and digestive system with the help of charts and models.	3								3		
		AVG	**3**			**2.5**		**3**			**3**		
Pharmaceutical Analysis I – Practical	BP108P	CO 01: Understand the apparatus and glassware used in analytical chemistry.	3			3							
		CO 02: Know the importance of calibration in research and analysis of compound	3		3								
		CO 03: Understand the principle, reaction condition and factor calculation for data analysis for various volumetric methods of analysis.				3							
		CO 04: Study the interpretation of data and computing the results.			3								
		AVG	**3**		**3**	**3**							
Pharmaceutics I – Practical	BP109P	CO 01:Explain formulation, evaluation and labelling of aromatic water, glycerides, syrups, elixirs and powder preparations.	3	3									
		CO 02: Perform pharmaceutical calculations to determine evaluation parameters like density, viscosity, specific gravity, angle of repose, Carr's index, Hausner ratio of preparations.	3	3		2					3		
		CO 03: Describe use of ingredients in formulation and category of formulation.	3	3							2		
		CO 04: Compare various monophasic preparations depending upon their formulation.	3	3		2					3		
		CO 05: Selection of suitable packaging material (container-cosure) for the preparation.	3	3									
		AVG	**3**	**3**		**2**					**2.67**		
Pharmaceutical Inorganic Chemistry – Practical	BP110P	CO 01: Assess the limit tests for various ions through practical training to ensure the quality and safety of pharmaceuticals contributing in the health sector.	2								2		
		CO 02: Exercise the identification of different compounds through specific chemical tests as part of practical training in pharmaceutical inorganic chemistry.		2	2								2
		CO 03: Determine the purity and quality of various pharmaceuticals, contributing to educational and research				3						3	

		development.											
		CO 04: Use modified limit tests for certain ions to achieve precise results in pharmaceutical analysis, reflecting advancements in education and practical training in the pharmaceutical preparations.			2	3		2					
		CO 05: Prepare various pharmaceutical preparation such as Boric Acid, Potash Alum, and Ferrous Sulphate following standard procedures, integrating practical training into pharmaceutical education and formulation.									2		
		AVG	**2**	**2**	**2**	**3**		**2**			**2**	**3**	**2**
Communication skills – Practical	BP111P	CO 01: Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation			2			3		1	3		3
		CO 02: Communicate effectively (Verbal and Non-Verbal)			2			3		1	3		3
		CO 03: Effectively manage the team as a team player		3	3		2				1		1
		CO 04: Develop interview skills											2
		CO05: Develop Leadership qualities and essentials		2		2	2				2		3
		AVG		**2.5**	**2.33**	**2**	**2**	**3**		**1**	**2.25**		**2.4**
Remedial Biology – Practical	BP112RBP	CO 01: Understand the knowledge of plant structure and microscopy.	3									2	
		CO 02: Understand the structure and function of cells.	3		2							3	
		CO 03: Understand various tissue and organ systems in plants and animals.	3									3	
		CO 04: Understand the theory of evolution.	2		2							3	
		CO 05: Learn the anatomy and physiology of plants and animals.	3									2	
		CO 06: Study the various phases in the development of plant growth.	3									2	
		AVG	**2.83**		**2**							**2.5**	
Human Anatomy and Physiology II – Theory	BP201T	CO 01: Explain the organization and functions of the nervous system, including neuronal physiology, neurotransmission, and central nervous system structures.	3								3		
		CO 02: Describe the anatomy and physiology of the	3								2		

		gastrointestinal tract, energetics of metabolism, and mechanisms of digestion, absorption, and related disorders.											
		CO 03: Illustrate the structure and functional aspects of the respiratory and urinary systems, including mechanisms of respiration, renal physiology, and their clinical relevance.	3					3					
		CO 04: Analyze the classification, mechanisms of action, and physiological roles of endocrine glands and hormones, and evaluate associated disorders.			3								
		CO 05: Summarize the anatomy and physiology of the reproductive system, processes of reproduction, genetic mechanisms, and their significance in inheritance and health.	3					3					
		AVG	**3**		**3**			**3**			**2.5**		
Pharmaceutical Organic Chemistry I – Theory	BP202T	CO 01: Acquire knowledge about the classification and nomenclature of simple organic compounds.	3										2
		CO 02: Understand the concept of structural isomerism.	3		3								
		CO 03: Study the chemical reactions, their mechanisms, and the orientation of carbonyl compounds, carboxylic acids, and alcohols.	3		3								2
		CO 04: Emphasize the reactivity and stability of organic compounds.	3		3								
		CO 05: Gain knowledge about the identification and confirmation of organic compounds.	3	2	3								2
		CO 06: Explore chemical reactions, their mechanisms, and orientations of alkanes, alkenes, alkyl halides, and aliphatic amines.	3		3								
		AVG	**3**	**2**	**3**								**2**
Biochemistry – Theory	BP203T	CO 01: Grasp the metabolic process of biomolecules and bioenergetics to understand the various physicochemical reactions inside the human body	3					2			3		3
		CO 02: Acquire knowledge of carbohydrates, lipid and amino acid metabolism in terms of health and illness (metabolic disorders)	3					2			3		3
		CO 03 : Examine the genetic organization of mammalian genome; protein synthesis; replication; mutation and repair mechanism.	3		2	2							3

		CO 04 : Understand the catalytic activity of enzymes and importance of isoenzymes in diagnosis of diseases.			2								
		AVG	**3**		**2**	**2**		**2**			**3**		**3**
Pathophysiology – Theory	BP204T	CO 01: Describe the etiology and pathogenesis of selected disease states.	3					2			2		
		CO 0 2: Identify the signs and symptoms of diseases.						3			2		
		CO 03: Recognize the complications associated with diseases.						3			2		
		CO 04: Understand the most commonly encountered pathophysiological states and/or disease mechanisms, as well as any clinical testing requirements.						2			2		
		CO 0 5 Understand various diseases of bones and joints						2			2		
		AVG	**3**					**2.4**			**2**		
Computer Applications in Pharmacy – Theory	BP205T	CO 01: Apply the knowledge of mathematics and computing fundamentals to pharmaceutical applications for any given requirement		2	3	3					2	2	3
		CO 02: Design and develop solutions to analyze pharmaceutical problems using computers.		3	2	2					3	2	2
		CO 03: Integrate and apply efficiently the contemporary IT tools to all Pharmaceutical related activities.		2	2	2					2	2	
		CO 04: Solve and work with a professional context pertaining to ethics, social, cultural and regulations with regard to Pharmacy.		3	2						2	2	
		AVG		**2.5**	**2.25**	**2.33**		**2.2**			**2.17**	**2**	**2.5**
Environmental sciences – Theory	BP206T	CO 01: Create awareness about environmental problems and develop a sense of concern for the environment.CO 01:									3	3	
		CO 02: Learn the concept of ecosystems, including their structure and functions.									3	3	
		AVG									**3**	**3**	
Human Anatomy and Physiology II –Practical	BP207P	CO 01 : Demonstrate the construction, working, care, and handling of laboratory instruments, glassware, and equipment used in physiology experiments.	3			2							
		CO 02: Perform experiments and demonstrations to identify structures and functions of the nervous, endocrine, digestive, respiratory, cardiovascular, urinary, and	3			2		3					

		reproductive systems using models, specimens, and charts.											
		CO 03: Apply experimental techniques to assess physiological functions such as reflexes, sensory responses (vision, taste, smell), body temperature, lung volumes, and basal metabolic index in normal subjects.	3		2								
		CO 04: Analyze feedback mechanisms, neurological responses, and blood parameters (including total blood count) through practical demonstrations and laboratory techniques.	2					2					
		CO 05: Evaluate the clinical and applied aspects of physiology by studying family planning devices, pregnancy diagnosis, and microscopic examination of vital organs and gonads.	2					3			2		
		AVG	**2.6**		**2**	**2**		**2.67**			**2**		
Pharmaceutical Organic Chemistry I–	BP208P	CO 01: Explain the correct use of various equipment and safety measures in the laboratory.	3		2	2							2
		CO 02: Calibrate thermometers and understand simple laboratory techniques.	3	2	2								2
		CO 03: Understand the significance of and analyze organic compounds qualitatively, including the synthesis of derivatives.	3		3								2
		CO 04: Understand the synthesis of different organic compounds along with their reactions and mechanisms.	3		3	2							2
		AVG	**3**	**2**	**2.5**	**2**							**2**
Biochemistry – Practical	BP209P	CO 01: Detection and identification of macromolecules (proteins, and carbohydrates) by various qualitative as well as quantitative tests.			2							2	
		CO 02: Separate, identify and characterize proteins from various samples like egg, milk, etc and understand principle behind the technique.				2							
		CO 03:Isolation of starch from potato and understand techniques as well as mechanism involved.			2	2						2	
		CO 04: Estimation of ascorbic acid in a given sample.			2								

		CO 05: Demonstrate action of salivary amylase and effect of substrate concentration and temperature on its activity.	2										
		AVG	**2**		**2**	**2**						**2**	
Computer Applications in Pharmacy – Practical	BP210P	CO 01: Apply the knowledge of mathematics and computing fundamentals to pharmaceutical applications for any given requirement		2	3	3					2	2	3
		CO 02: Design and develop solutions to analyze pharmaceutical problems using computers		3	2	2					3	2	2
		CO 03: Integrate and apply efficiently the contemporary IT tools to all Pharmaceutical related activities		2	2	3					2	2	
		CO 04: Solve and work with a professional context pertaining to ethics, social, cultural and regulations with regard to Pharmacy		3	2						2	2	
		AVG		**2.5**	**2.25**	**2.67**					**2.25**	**2**	**2.5**
Pharmaceutical Organic Chemistry II – Theory	BP301T	CO 01: Explain the structure, resonance, and aromaticity of benzene based on analytical and synthetic evidence.	3		2								2
		CO 02: Analyze the mechanisms and limitations of electrophilic substitution reactions in benzene and its derivatives.	3		3								2
		CO 03: Understand the acidity and chemical behavior of phenols and their derivatives, along with their applications.	3		2								2
		CO 04: Evaluate the basicity and synthetic applications of aromatic amines, including aryl diazonium salts.	3		3								2
		CO 05: Describe the acidity, reactions, and applications of aromatic acids and polynuclear hydrocarbons.	3		2								2
		CO 06 : Assess the chemical properties, reactions, and analytical constants of fats and oils.	3		2	1							2
		AVG	**3**		**2.33**	**1**							**2**
Physical Pharmaceutics I – Theory	BPT302T	CO 01: State the physicochemical properties of drug molecules, pH, and solubility.	3			2							
		CO 02: Describe the concept of state of matter, changes in the state of matter.	2			2							
		CO 03: Understand the physical properties of solutions, buffers, isotonicity.	2										

		CO 04: Explain the innovative role of surfactants, interfacial phenomenon.	3										
		CO 05: Describe the concept of complexation.	3			2							
		CO 06: Describe the concept pH and its determination.	2										
		AVG	**2.5**			**2**							
Pharmaceutical Microbiology – Theory	BP303T	CO 01: Define and apply specialized language and knowledge relevant to microbiological research	3		3								
		CO 02: Demonstrate competency in laboratory safety and in performing routine and specialized microbiological laboratory skills, including recording and analyzing observations.	3	3									
		CO 03: Communicate scientific concepts, experimental results, and analytical arguments clearly and concisely, both verbally and in writing.	2	2									
		CO 04: Isolate and identify microbes using appropriate microbiological techniques.	2			2							
		CO 05: Design microbiology laboratory experiments with a focus on all safety considerations.	3					3					
		CO 06: Validate microbiological equipment and report observations accurately.	3										
		AVG	**2.67**	**2.5**	**3**	**2**		**3**					
Pharmaceutical Engineering – Theory	BP304T	CO 01: Define and explain the basic concepts and principles of pharmaceutical engineering, including unit operations and fluid mechanics.	3								3		
		CO 02: Apply engineering principles in the design and operation of pharmaceutical processes, such as drying, filtration, centrifugation, crystallization, and mixing.	3		3						2		
		CO 03: Analyze and interpret process parameters and data related to pharmaceutical manufacturing, such as flow rates, pressure, temperature, and mass transfer rates, to optimize process efficiency.	3		3	2							

		CO 04: Evaluate the performance and efficiency of pharmaceutical equipment and processes, identify potential issues, and propose improvements to enhance product quality and process safety.	3		3	2							
		CO 05: Design and develop pharmaceutical processes and equipment layouts, incorporating principles of scale-up, automation, and process control to meet industrial and regulatory standards.	3		3	3					3		
		AVG	**3**		**3**	**2.33**					**2.67**		
Pharmaceutical Organic Chemistry II – Practical	BP305P	CO 01: Explain and analyze the principles behind various qualitative tests and analyze the given unknown organic compound having different functional groups.	3		3	2							2
		CO 02: Explain and illustrate the principle, reaction mechanism, and applications of every experiment in pharmacy.	3		2	2							2
		CO 03: Understand, explain, and apply various laboratory techniques for the synthesis of organic compounds, and the purification techniques for synthesized compounds using precipitation or recrystallization.	3		3	2							2
		AVG	**3**		**2.67**	**2**							**2**
Physical Pharmaceutics I – Practical	BP306P	CO 01: Accurately determine the solubility of a drug at room temperature and analyze the implications for pharmaceutical formulation and drug delivery.	3		2								3
		CO 02: Calculate the pKa value of a drug using the Half Neutralization and Henderson-Hasselbalch equations and interpret its significance in drug formulation and stability.	3		2								2
		CO 03: Determine the partition coefficient and discuss the relevance of partition coefficients in drug distribution and formulation.	3	2		1							2
		CO 04: Measure the surface tension of various liquids using drop count and drop weight methods and analyze how surface tension affects pharmaceutical formulation.	3	1	2	2							2
		CO 05: Determine the Hydrophilic-Lipophilic Balance (HLB) number of a surfactant using the saponification method and explain its role in surfactant selection and formulation stability.	3	2							1		2

		AVG	**3**	**1.66**	**2**	**1.5**					**1**		**2.2**
Pharmaceutical Microbiology – Practical	BP307P	CO 01: Understand the principle, construction, and working of various instruments and demonstrate the skill to handle a microscope for the observation of microbes.	3	2									
		CO 02: Learn how to prepare and sterilize nutrient broth, nutrient agar, slants, stabs, and plates, and adopt the skills required for maintaining aseptic conditions, handling inoculating loops, and following sterilization and inoculation procedures.			3			2					
		CO 03: Isolate microorganisms using the streak plate technique and count them using the pour plate technique.	3			2							
		CO 04: Apply the hanging drop technique to observe bacterial motility.	3			2							2
		CO 05: Develop the skill to observe bacterial morphology using simple staining, negative staining, and Gram staining.	3			2					2		
		CO 06: Understand and perform the direct inoculation method for sterility testing of Water for Injection	3					2				2	
		AVG	**3**	**2**	**3**	**2**		**2**			**2**	**2**	**2**
Pharmaceutical Engineering – Practical	BP308P	CO 01: Identify various unit operations used in pharmaceutical industries.	3		3	2					2	2	
		CO 02: Understand the material handling techniques used in pharmaceutical manufacturing.	3		2	2						2	2
		CO 03: Perform various processes involved in pharmaceutical manufacturing.	3		3	2						2	
		CO 04: Conduct various tests to prevent environmental pollution in pharmaceutical industries.	3		3						2	3	2
		CO 05: Appreciate and comprehend the significance of plant layout design for optimum use of resources.	3	2	3						2	2	
		CO 06: Apply effective resource management techniques to optimize operations.		3	2	2					2	2	
		AVG	**3**	**2.5**	**2.67**	**2**					**2**	**2.167**	**2**
Pharmaceutical Organic Chemistry III– Theory	BP401T	CO 01: Understand the basic principles of heterocyclic chemistry, including the chemistry of five- and six-membered rings.	3		2								2

		CO 02: Learn the synthesis and medicinal uses of various organic compounds.	3		2								2
		CO 03: Describe the detailed mechanisms for common naming reactions of heterocyclic compounds.	3		3								2
		CO 04: Analyze the stereo-chemical features, including the conformation of geometrical isomers.	3		3								2
		CO 05: Understand the concepts of optical isomerism, conformational isomerism, and asymmetric synthesis.	3		3								2
		AVG	**3**		**2.6**								**2**
Medicinal Chemistry I – Theory	BP402T	CO 01: Correlate the pharmacology of a disease with its mitigation or cure.	3		3						2		2
		CO 02: Understand the drug metabolic pathways, adverse effects, and therapeutic value of drugs.	3		2						3		3
		CO 03: Analyze the structure-activity relationship (SAR) of different classes of drugs, including those affecting the autonomic nervous system (ANS).	3		3								3
		CO 04: Identify the synthesis processes of important classes of drugs.	3		2								
		CO 05: Understand the mechanism pathways of different classes of medicinal compounds.	3	3	3								
		CO 06: Analyze the chemistry of drugs in relation to their pharmacological activity, including effects on the central nervous system (CNS).	3		3								3
		AVG	**3**	**3**	**2.67**						**2.5**		**2.75**
Physical Pharmaceutics II – Theory	BP403T	CO 01: Understand the basic principles of colloidal dispersion and their properties.	3										3
		CO 02: Describe the rheological flow behavior of fluids and explain measurement techniques.	3			2							
		CO 03: Understand the properties and formulation of pharmaceutical suspensions, emulsions, and colloids.	3	2							2		3
		CO 04: Analyze the particle size and apply methods for its determination.	3								2		

		CO 05: Understand the properties of powders and their relevance in pharmaceutical research.	2									2	
		CO 06: Apply different orders of kinetics to determine the stability of pharmaceutical formulations.	3								2	2	3
		AVG	**2.83**	**2**		**2**					**2**	**2**	**3**
Pharmacology I – Theory	BP404T	CO 01: Understand the pharmacological actions of different categories of drugs.	3		3			3				2	
		CO 02: Examine the mechanisms of drug action at organ system, sub-cellular, and macromolecular levels.	3		3			3				2	
		CO 03: Apply basic pharmacological knowledge in the prevention and treatment of various diseases.	3		3			3				2	
		CO 04: Observe the effects of drugs on animals through simulated experiments.	3								3	2	
		CO 05: Correlate pharmacology with other biomedical sciences.	3	3				2				2	
		CO 06: Understand the signal transduction mechanisms of various receptors.	3					3				2	
		AVG	**3**	**3**	**3**			**2.8**			**3**	**2**	
Pharmacognosy and Phytochemistry I– Theory	BP405T	CO 01: Introduce the concepts of herbs and the science behind their use.	2								2		
		CO 02: Classify medicinal plants based on their properties and therapeutic uses.	3										
		CO 03: Examine the phytochemistry and pharmacology of carbohydrates, lipids, terpenes, polyphenols, and alkaloids.	3	3	2							2	
		CO 04: Analyze phytotherapy principles and understand herbal drug action and material medica.	3	3	3	2							2
		CO 05: Evaluate the quality control of medicinal plants, including the identification of adulteration and contamination	3	3	3	2					2	2	2
		AVG	**2.8**	**3**	**2.67**	**2**					**2**	**2**	**2**
Medicinal Chemistry I – Practical	BP406P	CO 01: Synthesize various drugs from different chemical classes using different research techniques.	3		3	2							2
		CO 02: Outline the reaction mechanisms of the synthesized drugs.	3	3	3								2

		CO 03: Perform identification tests on synthesized drugs.	3		2	2							2
		CO 04: Prepare stereomodels of various drugs using ball-and-stick models.	2		2								2
		CO 05: Understand the chemistry of drugs in relation to their pharmacological activity.	3		3								2
		AVG	**2.8**	**3**	**2.6**	**2**							**2**
Physical Pharmaceutics II – Practical	BP407P	O 01: Evaluate the viscosity, specific surface area, and particle size distribution of a given material.	3	2									
		CO 02: Calculate the cloud point, critical micelle concentration (CMC), and HLB value of a given surfactant.	3	2								2	
		CO 03: Calculate the energy of activation for acid hydrolysis, the order of a given reaction, and the relative strength of two acids.	3	2		2					2		
		CO 04: Analyze suspensions and emulsions.	3	2	2			2					2
		AVG	**3**	**2**	**2**	**2**		**2**			**2**	**2**	**2**
Pharmacology I – Practical	BP408P	CO 01: Understand the pharmacological actions of different categories of drugs.	3		3			3				2	
		CO 02: Examine the mechanisms of drug action at organ system, sub-cellular, and macromolecular levels.	3		3			3				2	
		CO 03: Apply basic pharmacological knowledge in the prevention and treatment of various diseases.	3	3	3			3				2	
		CO 04: Observe the effects of drugs on animals through simulated experiments.	3			2					3	2	
		CO 05: Correlate pharmacology with other biomedical sciences.	3					2				2	
		CO 06: Understand the signal transduction mechanisms of various receptors.	3					3				2	
		AVG	**3**	**3**	**3**	**2**		**2.8**			**3**	**2**	
Pharmacognosy and Phytochemistry I – Practical	BP409P	CO 01: Understand the evolutionary significance of alkaloids from plants and other organisms and deduce their significance as medicinal molecules.			2	2							
		CO 02: Explain the classification, source, names, chemical structures, extraction methods, and qualitative & quantitative analysis of alkaloids.	2		3	2							

		CO 03: Explain the historical significance and contribution of alkaloids in modern drug discovery.	2										
		CO 04: Explain the historical significance and contribution of terpenoids/resins in modern drug discovery.	2										
		AVG	**2**		**2.5**	**2**							
Medicinal Chemistry II – Theory	BP501T	CO 01: Illustrate the correlation between the pharmacology of a disease and its mitigation or cure.	2					3			2		2
		CO 02: Determine the mechanism pathways and classification of different classes of medicinal compounds.	2					3			3		
		CO 03: Outline the chemical synthesis and structure-activity relationship (SAR) of different classes of drugs.	2					2			2	2	
		CO 04: Recognize the drug regimen used in heart diseases and antihistaminic agents.	3	2				3			3		2
		CO 05: Deduce the chemotherapy for cancer and drugs acting on the endocrine system.	3	2	2			3			2	2	
		AVG	**2.4**	**2**	**2**			**2.8**			**2.4**	**2**	**2**
Industrial PharmacyI– Theory	BP502T	CO 01: Understand the basic concept of preformulation studies and the physical and chemical characteristics of drugs.	3	3	2	2		2			2		
		CO 02: Acquire knowledge of various types of tablets, granulation processes, and formulation methods.	3		2						3		2
		CO 03: Demonstrate the production, filling, and quality control tests for capsules and pellets.	3		2	2		2			2	2	
		CO 04: Describe liquid oral dosage forms and their evaluation methods.	3	3				2			2		2
		CO 05: Understand various parenteral and ophthalmic products, along with their evaluation.	3		2	2					2	2	
		CO 06: Formulate various cosmetic products and perform stability studies.	3	3	2	3		2			2		2
		AVG	**3**	**3**	**2**	**2.25**		**2**			**2.17**	**2**	**2**
Pharmacology II – Theory	BP503T	CO 01: Understand the mechanism of drug action and its relevance in the treatment of different diseases.	3					3				2	3

		CO 02: Comprehend the principles of toxicology and the treatment of various poisonings.	3	3				3				2	3
		CO 03: Locate and isolate different organs/tissues from laboratory animals used in pharmacological experiments.	3					3					
		CO 04: Study various receptor actions using isolated tissue preparations.	3								3	2	
		CO 05: Correlate pharmacology with related medical sciences.	3					2				2	
		CO 06: Learn various methods of toxicity studies.	3					3				2	
		AVG	**3**	**3**				**2.8**			**3**	**2**	**3**
Pharmacognosy and Phytochemistry II– Theory	BP504T	CO 01: Study the basic metabolic pathways and formation of different secondary metabolites through the Shikimic acid pathway, acetate pathways, and amino acid pathway.		2									
		CO 02: Understand the general introduction, composition, chemistry, chemical classes, bio sources, therapeutic uses, and commercial applications of secondary metabolites.	2		2							2	
		CO 03: Isolate, identify, and analyze phytoconstituents, including terpenoids and steroids.	2	3	3						3	2	
		CO 04: Examine the biological activities of several compounds belonging to polyketides, terpenoids, and steroids, and their traditional use and application in the pharmaceutical and/or nutraceutical field.	2	3	2						2		2
		CO 05: Understand the basics of phytochemistry research	3		2	2							
		AVG	**2.25**	**2.67**	**2.25**	**2**					**2.5**	**2**	**2**
Pharmaceutical Jurisprudence – Theory	BP505T	CO 01: Understand the pharmaceutical legislations and their implications in the manufacturing and marketing of pharmaceutical	3										
		CO 02: Learn about various Indian pharmaceutical Acts, laws, and schedules.	3	2			2		2	1	3		
		CO 03: Identify the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals.		2						1			2
		CO 04: Understand the code of ethics in pharmaceutical practice.	3						2				
		AVG	**3**	**2**			**2**		**2**	**1**	**3**		**2**

Disaster Management	DM101	CO 01: Understand disasters, their significance, and types.	3								3	3	
		CO 02: Analyze the relationship between vulnerability, disasters, disaster prevention, and risk reduction.		2	3						3	3	
		CO 03: Gain a preliminary understanding of approaches to Disaster Risk Reduction (DRR).		3	3							3	
		CO 04: Enhance awareness of institutional processes related to disaster management in the country.							2		3		
		CO 05: Develop the ability to respond to potential disaster situations in their surroundings with due sensitivity.			3				3				2
		AVG	**3**	**2.5**	**3**				**2.5**		**3**	**3**	**2**
Industrial Pharmacy I – Practical	BP506P	CO 01: Outline the objectives and applications of preformulation studies in the development and stability of dosage forms.	3	2	3	2					2		2
		CO 02: Understand the principles involved in the formulation and evaluation of various pharmaceutical dosage forms.	3	2		2							
		CO 03: Demonstrate the formulation considerations and evaluation of granules, tablets, and capsules.	3		3	2					2		2
		CO 04: Formulate solid, liquid, and semisolid dosage forms and evaluate them to check their quality.	3	2									
		CO 05: Demonstrate the formulation considerations and evaluation of ophthalmic, parenteral, and cosmetic products.	3		3	3					2		2
		AVG	**3**	**2**	**3**	**2.25**					**2**		**2**
Pharmacology II – Practical	BP507P	CO 01: Study commonly used instruments in experimental pharmacology.	3								2		3
		CO 02: Understand the CPCSEA guidelines and OECD guidelines.	3			2							3
		CO 03: Learn about animal physiology and their biochemical reference values in various animal species.	3								2		
		CO 04: Study various routes of drug administration, anesthetic agents used to anesthetize laboratory animals, and techniques of euthanasia.	3	3		2					3		

		CO 05: Learn about physiological salt solutions, drug solutions, and their use in various animal experiments.	3								2		
		CO 06: Study methods for the collection of blood, body fluids, and urine from experimental animals.	3										
		AVG	**3**	**3**		**2**					**2.25**		**3**
Pharmacognosy and Phytochemistry II –Practical	BP508P	CO 01: Demonstrate the skill of plant material sectioning, staining, mounting, and focusing; determine the staining reagents required for specific parts of a plant.	2	2	3	2							2
		CO 02: Identify the parts of plants based on their morphological and microscopical features.	2	2	2	3							
		CO 03: Draw morphological and microscopical diagrams and label the components/parts accurately.		2	2	2							
		CO 04: Conduct extractions/isolations and explain the significance of using various chemicals and physical conditions.		3	3						2	2	2
		CO 05: Identify unorganized crude drugs using their morphological, chemical, physical, and microscopical characteristics.				2							2
		AVG	**2**	**2.25**	**2.5**	**2.25**					**2**	**2**	**2**
Medicinal Chemistry II – Practical	BP509P	CO 01: Synthesize various drugs from different chemical classes utilizing different laboratory techniques.	2	2		2		2			2		2
		CO 02: Outline the reaction mechanism of the synthesized drugs.		2		2		3				2	2
		CO 03: Perform identification tests of synthesized drugs.	2								3	2	
		CO 04: Conduct assay of various drugs as per IP.		2		2		2				3	2
		CO 05: Knowledge regarding various softwares used to draw chemical structure of compounds.				3						2	2
		AVG	**2**	**2**		**2.25**		**2.33**			**2.5**	**2.25**	**2**
Medicinal Chemistry III – Theory	BP601T	CO 01: Acquire knowledge about a variety of drug classes and their pharmacological properties, along with their mechanisms.	2					3			2		3
		CO 02: Understand how current drugs are designed using pharmacophore modeling and docking techniques for	2					2				2	2

		further research.											
		CO 03: Learn about antibiotics used in the chemotherapy of microbial diseases.	3	3		2		2			3	2	2
		CO 04: Understand the structure-activity relationship of different classes of drugs.	2			2		3				3	2
		CO 05: Understand the chemistry of antiviral, antimalarial, and antifungal agents.	2					3			3		
		CO 06: Acquire knowledge about various categories of anti-protozoal agents.	3					2			2	2	3
		AVG	**2.33**	**3**		**2**		**2.5**			**2.5**	**2.25**	**2.4**
Pharmacology III – Theory	BP602T	CO 01: Explain the mechanism, therapeutic uses, and adverse effects of drugs acting on the respiratory and gastrointestinal systems.	3	2	3			2			2		2
		CO 02: Describe the principles of chemotherapy and antimicrobial therapy including uses, resistance, and safety of antibiotics and related agents.	3	2	3			2			2		2
		CO 03: Analyze the pharmacology of drugs used in parasitic diseases, malignancy, sexually transmitted and urinary tract infections.	3	2	3			2			2		2
		CO 04: Discuss immunopharmacological agents such as immunostimulants, immunosuppressants, monoclonal antibodies, and targeted therapies.	3	2	2			2			2		2
		CO 05: Apply the concepts of chronopharmacology and toxicology to understand drug timing, toxicity types, and adverse consequences like carcinogenicity and teratogenicity.	3	2	3			2			2		2
		CO 06: Demonstrate knowledge of clinical toxicology by recognizing symptoms and treatment of poisoning due to drugs and heavy metals.	3	2	3			2			2		2
		AVG	**3**	**2**	**2.83**			**2**			**2**		**2**

Herbal Drug Technology – Theory	BP603T	CO 01: Acquire know-how and be able to carry out technical and management tasks and professional activities in the areas of transformation of medicinal herbs from cultivation to Herbal drug product.				2					3		
		CO 02: Understand basic principles of traditional medicinal systems with method of preparation and standardization of ayurvedic formulation		3		2							
		CO 03: Describe benefits of various plants as nutraceuticals in ailments and also the herb-food interaction of various plant drugs.	2	2	2	2					2		2
		CO 04: Describe about herbs or natural origin drugs as raw materials for preparation of cosmetics, excipients, conventional herbal formulation and novel dosage forms like phytosomes	2	2	2	2					2		2
		CO 05: Describe rules and regulation for assessment of herbal drugs and patenting of natural products	2									2	2
		CO 06: Explain present status and prospects of herbal drug-based industry and components for Good Manufacturing Practice for Indian systems of medicine	3	2							2	2	2
		AVG	**2.25**	**2.25**	**2**	**2**					**2.25**	**2**	**2**
Biopharmaceutics and Pharmacokinetics –Theory	BP604T	CO 01: Understand the concept of absorption, distribution, metabolism and elimination.	3		3						3		3
		CO 02: Determine various factors affecting ADME and terms related to bioavailability and bioequivalence	3			2					2		3
		CO 03: Describe need for different pharmacokinetic models and differentiate between compartment and non-compartment models.	3		3	3							2
		CO 04: Apply various Mathemathetical models to calculate different pharmacokinetic parameters following different routes of administration	3		3	3							2
		CO 05: Understand nonlinear kinetics and non-compartmental analysis inclusive of factors affecting non-linear pharmacokinetics.	3		2	3							2
		AVG	**3**		**2.75**	**2.75**					**1.5**		**2.4**

Pharmaceutical Biotechnology – Theory	BP605T	CO 01: Understand the various techniques used in modern biotechnology.	3	2		2							2
		CO 02: Design research strategy with step-by-step instructions to address a research problem	3	3	3	2							
		CO 03Provide examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic	3			2					3	3	
		Co 04: Understand concept and application of monoclonal antibody technology	2		3	2							
		CO 05: Demonstrate and provide examples on how to use microbes and mammalian cells for the production of pharmaceutical products	3	3								2	2
		CO 06: Understand general principles of generating transgenic plants, animals and microbes	3									2	2
		AVG	**2.83**	**2.67**	**3**	**2**					**3**	**2.333**	**2**
Quality Assurance – Theory	BP606T	CO 01: Understand the importance of quality in pharmaceutical products.	3	3									3
		CO 02: Explore the importance of Good Practices such as GMP (Good Manufacturing Practices) and GLP (Good Laboratory Practices).	3		2					2	3		
		CO 03: Understand the principles, procedures, and steps involved in the registration of NABL, ISO 9000, and ISO 14000.	3	2		2							2
		CO 04: Understand the concept of calibration and validation of instruments in the pharmaceutical industry.	3		2			2			3		2
		CO 05: Understand the regulatory aspects of the pharmaceutical industry.	3			2					2		
		CO 06: Learn about various purchase and maintenance specifications related to equipment and raw materials in the pharmaceutical industry.	3								2		3
		AVG	**3**	**2.5**	**2**	**2**		**2**		**2**	**2.5**		**2.5**
Medicinal chemistry III – Practical	BP607P	CO 01: Understand how to make correct use of various equipments & take safety measures while working in medicinal chemistry Laboratory.	2	2				3			2	2	3

		CO 02: Develop skills involved in thin layer chromatography techniques and purification of synthesized compounds.	2					2					2
		CO 03: Synthesize, recrystallize and understand reaction mechanisms involved in synthesis of medicinally important organic compounds.	3			2		2				3	3
		CO 04: Interpret the spectral characterizations of synthesized compounds by IR and 1H-NMR spectroscopy.	2	2		2					2	2	2
		CO 05: Understand the Lipinski rule of five used in drug designing.	2	2		3		3					
		AVG	**2.2**	**2**		**2.33**		**2.5**			**2**	**2.333**	**2.5**
Pharmacology III – Practical	BP608P	CO 01: Apply principles of dose calculation and pharmacokinetic analysis to interpret experimental pharmacological data using computational tools like Excel.	3		3	3		2			2		2
		CO 02: Demonstrate the ability to assess pharmacological effects, such as the hypoglycemic action of insulin, gastric motility, purgative and anti allergic aspects through in vivo experimentation in animal models.		2	3			2			2		2
		CO 03: Perform biochemical estimations and toxicological assessments including liver enzyme levels, pyrogen testing, and NSAID-induced ulceration models using laboratory animals and semi-auto analyzers	3								2		2
		CO 04: Evaluate the safety profile of pharmaceutical substances through established toxicity tests such as acute skin/eye irritation and oral toxicity according to OECD guidelines.		2	3			2	3		2		2
		CO 05: Apply appropriate biostatistical methods, including Student's t-test and Chi-square test, to analyze and interpret experimental pharmacological data.	3	2		2		2			2		2
		CO 06: Demonstrate understanding of ethical and scientific considerations in designing and conducting in vivo pharmacological and toxicological experiments.	3		3						2		2
		AVG	**3**	**2**	**3**	**1.5**		**2**	**3**		**2**		**2**
Herbal Drug Technology – Practical	BP609P	CO 01: Prepare, label & evaluate herbal/TSM formulations.				2					2		
		CO 02: Evaluate marketed cosmetic & nutraceutical formulations		2	3	2						2	2

		CO 03: Conduct pre- formulation parameters & understand underlying rationale	2	2	3	3							2
		CO 04: Conduct in vitro assays for correlation with biological efficacy	2	2	3	3							2
		AVG	**2**	**2**	**3**	**2.5**					**2**	**2**	**2**
Biopharmaceutics & Pharmacokinetics – Practical	BP610P	CO 01: Understand the concept of ADME of drug in human body.	3	2	2	3					2		
		CO 02: Determine the various pharmacokinetic parameters from either plasma concentration or urinary excretion data for drug		2		3					2		2
		CO 03: Apply the various regulations related to developing BA-BE study protocol for the new drug molecule.	3	2	2								2
		AVG	**3**	**2**	**2**	**3**					**2**		**2**
Instrumental Methods of Analysis – Theory	BP701T	CO 01: Understand the basic theoretical knowledge of instrumentation techniques available and correlate their relevant applications.	3		3	2					3		3
		CO 02: Understand chromatographic separation and analysis of drugs, and perform quantitative and qualitative analysis of drugs using various analytical instruments.	3		3							2	3
		CO 03: Make accurate analyses and report the results in defined formats.	3										
		CO 04: Understand the professional and safety responsibilities when working in the analysis laboratory.	3		3	3					2	2	
		CO 05: Gain basic knowledge for the structural interpretation of organic and natural compounds using UV and IR spectroscopic methods.	3										3
		CO 06: Understand the basic principles of the Woodward-Fieser rule.	3	3	3	3					2	3	3
		AVG	**3**	**3**	**3**	**2.67**					**2.33**	**2.333**	**3**
Industrial PharmacyII – Theory	BP702T	CO 01: Grasp the essential aspects of pilot plant techniques, including their significance and the basic requirements involved.	3		3	2					2		2
		CO 02: Understand the pilot plant and scale up techniques for various dosage forms in pharmaceutical industry.	3			2					3		3
		CO 03: Comprehend the concept of technology transfer and its application in commercial batch production.	3	3	2								2

		CO 04: Obtain learning opportunities to understand the regulatory requirements for drug product approvals and marketing.		3		2					2		
		CO 05: Aquire knowledge about total quality management, quality control, quality assurance and various certifications.	3		3						3		3
		CO 06: Learn about the working and official framework of various Indian regulatory commissions.	3	2	2						2		
		AVG	**3**	**2.67**	**2.5**	**2**					**2.4**		**2.5**
Pharmacy Practice – Theory	BP703T	CO 01: Demonstrate knowledge of and ability to use principles of therapeutics, quality improvement, communication, economics, health behavior, social and administrative aspects, health policy and legal issues in the practice of pharmacy.	3		3			3		2	3	2	2
		CO 02: Apply knowledge of drug distribution methods in hospital and apply it in the practice of pharmacy.	3	2	3						3		
		CO 03: Apply principles of drug store management and inventory control to medication use.	3	3	2						3		
		CO 04: Provide patient-centered care to diverse patients using the best available evidence and monitor drug therapy of patient through medication chart review, obtain medication history interview and counsel the patients, identify drug related problems.	3		3			3			3	2	2
		CO 05: Exhibit professional ethics by producing safe and appropriate medication use throughout society									3		
		AVG	**3**	**2.5**	**2.75**			**3**		**2**	**3**	**2**	**2**
Novel Drug Delivery System – Theory	BP704T	CO 01: Understand various approaches for development and Evaluation of controlled drug delivery systems. The criteria for selection of drugs and polymers for the development of NDDS	3	3		3					2		
		CO 02: Design controlled release formulations based on microencapsulation, mucoadhesion or implants	3	3	2	3							
		CO 03: Cognize the concepts, approaches and applications related to transdermal, gastro retentive and nasopulmonary route	3	3	2	3					2		
		CO 4: Understand concepts and applications of targeted drug delivery as applicable to biomedical field, intrauterine and ocular drug delivery	3	3	2	3					2		

		AVG	**3**	**3**	**2**	**3**					**2**		
Instrumental Methods of Analysis – Practical	BP705P	CO 01: Understand the interaction of matter with electromagnetic radiation.	3	2		2					3	2	3
		CO 02: Understand its applications in drug analysis.	3			3					3	2	3
		CO 03: Understand chromatographic separation and analysis of drugs, and perform quantitative and qualitative analysis of drugs using various analytical instruments.	3	2		3							2
		AVG	**3**	**2**		**2.67**					**3**	**2**	**2.6667**
Industrial Pharmacy – II	BP706PS	CO 01: Understand and apply the basic formulation techniques for developing various pharmaceutical dosage forms, including tablets, capsules, and liquid formulations.	3		2	2					2		2
		CO 02:Use and interpret evaluation techniques for assessing the quality and efficacy of pharmaceutical dosage forms, ensuring they meet established standards.	3	3	2						2		2
		CO 03: Understand and apply the basic regulatory guidelines required for the processing and manufacturing of pharmaceutical products.	3		2	2					2		
		CO 04: Implement quality assurance practices and procedures in pharmaceutical production to ensure compliance with industry standards and regulatory requirements.	3			2							2
		CO 05: Study regulatory requirements for drug approval process in India	3		2	2					2		2
		AVG	**3**	**3**	**2**	**2**					**2**		**2**
Pharmacy Practice - Practical	BP707PS	CO 01: Apply systematic techniques to collect comprehensive and accurate medication histories from patients in clinical settings.	3		3			3		2			
		CO 02: Design personalized patient counseling plans that integrate medication information, lifestyle advice, and follow-up recommendations to ensure optimal health outcomes.	2		3			3			3	2	2
		CO 03: Evaluate the causality, preventability, and significance of ADRs using established criteria to determine appropriate interventions or changes in therapy.	3	3	3						2		2

		CO 04: Analyze case data to determine the seriousness of the ADR and whether it meets the criteria for mandatory reporting.	3		3						3	2	2
		CO 05: List key laboratory tests used to monitor specific disease states.	3								3		
		CO 06: Evaluate laboratory data in conjunction with clinical findings to make informed decisions about treatment efficacy, dose modifications, or additional diagnostic needs.	3		3						3	2	2
		AVG	**2.83**	**3**	**3**			**3**		**2**	**2.8**	**2**	**2**
Novel Drug Delivery System-Practical	BP 708PS	CO 01: Understand thefundamental concepts of novel drug delivery system	3	3	3	3					3		3
		CO 02: Formulate and evaluate various types of novel drug delivery systems	3		3								2
		CO3: Understand the challenges associated with conventional dosage forms and novel approaches to rectify the same	3	3		3					2		
		CO 4: Understanding of requirements of pharmaceutical manufacturing and its regulatory prospectives	3		3						3		3
		AVG	**3**	**3**	**3**	**3**					**2.67**		**2.6667**
Awareness on Antimicrobial Resistance	AMR1201	CO 01: Define the basic terminology related to AMR and ABR. Define the mode of action of antibiotics. Define the mechanism of antibiotic resistance. Understand the concept of 'One Health' in view of AMR.	3		3	2					2		2
		CO 02: Describe the status of surveillance system for AMR in humans, animals and plants.	3		2			3				2	3
		CO 03: Explain the key goals of global and national action plans to combat AMR.	3	2	3						3		2
		CO 04: Understand and apply advances in antimicrobial stewardship program during on-field practice.	3								2		3
		CO 05: Understand the need and importance of antibiotic prescriptions for diseased conditions.	3		3							3	3
		AVG	**3**	**2**	**2.75**	**2**		**3**			**2.33**	**2.5**	**2.6**
Biostatistics and Research	BP801T	CO 01: Understand the applications of Biostatics in Pharmacy.	3			2					3		

Methodology		CO 02: Cognise the operation of M.S. Excel, SPSS, R-online, DoE (Design of Experiment) & MINITAB.	3	3	3	3		2					3
		CO 03: Understand the basic about research and designing the methodology.	3	3	2								2
		CO 04: Understand the various statistical techniques to solve statistical problems, appreciate statistical techniques in solving the problems.	3	3	2	3							2
		AVG	**3**	**3**	**2.33**	**2.67**		**2**			**3**		**2.3333**
Social and Preventive Pharmacy	BP802T	CO 01: Acquire high consciousness and realization of current issues related to health and pharmaceutical problems within the country and worldwide.	3			3							3
		CO 02: Develop a critical way of thinking based on current healthcare developments.	3	2		3				2			
		CO 03: Evaluate alternative ways of solving problems related to health and pharmaceutical issues.	3			3							2
		CO 04: Study the National health intervention program for mother and child.	3			2						3	2
		CO 05: Explore community services in rural, urban, and school health.	3			2							2
		AVG	**3**	**2**		**2.6**				**2**		**3**	**2.25**
Human Values and Professional Ethics	HR101	CO1:Understand specific issues and important of human rights.	2		2	-		2	3		3	2	2
		CO2: Understand the importance of personal development and create positive personality.		2	2	-		3	2		2	-	3
		CO3: Identify the national, social and professional values, religious values.	2		2	-		3	3		3	2	2
		CO4: Understand about national integration and international cooperation.	2		2	-		3	3		3	2	2
		CO5: Understand the basic fundamental rights of constitution.	2	-	2	-		2	3		3	-	2
		CO6: Cognise about human rights.	2	-	2	-		2	3		3	-	2
		AVG	**2**										
Cosmetic Science-Theory	BP809ET	Co 01: Enumerate cosmetics as per regulations and cosmeceutical products and basic understanding of skin, hair and buccal cavity	3									3	

		CO 02: Understand the principles involved in the formulation of skin and hair care products.	2	3									
		CO 03: Cognise about Sun protection, role of herbs in cosmetics and analytical methods for cosmetics			3								
		CO 04: Understand the principles of cosmetic evaluation		3	2	3							
		CO 05: Understand cosmetic problems associated with skin, hair		2	2								2
		AVG	**2.5**	**2.7**	**2.3**	**3**						**3**	**2**
Advanced Instrumentation Techniques	BP811ET	CO 01: Understand the basic theoretical knowledge and structural interpretation of organic and natural compounds using NMR and Mass Spectroscopy.	3	2	3	3					3		3
		CO 02: Explain the aspects of thermal methods of analysis and X-ray diffraction.	3									2	3
		CO 03: Understand the calibration of various analytical instruments and analyze drugs using these instruments.	3		3							2	
		CO 04: Demonstrate practical skills for the analysis of drugs and excipients using various instrumentation techniques.	3	3	3	3					2	2	
		CO 05: Understand extraction techniques and hyphenated techniques.	3								2	2	3
		CO 06: Cognize general theoretical principles and applications of Radio Immunological Assays.	3		3	3					2	2	3
		AVG	**3**	**2.5**	**3**	**3**					**2.25**	**2**	**3**
Cosmetic Science-Practical	BP809EP	CO 01: Understand the principals of formulation and manufacturing skin and hair care products	3		2	3						3	
		CO 02: Understand principles of cosmetic evaluation.	3		3	3		3			2	2	
		CO 03: Evaluate cosmetic products through in vitro testing	3		2	3		3			2	2	
		AVG	**3**		**2.33**	**3**		**3**			**2**	**2.333**	
Advanced Instrumentation Techniques-Practical	BP811EP	CO 01: Understand the operation and calibration of various analytical instruments for the separation/isolation of APIs and formulations.	3	2		2					3	2	3
		CO 02: Understand the assay of various APIs and formulations according to pharmacopoeial standards.	3	2		3					3	2	3

		CO 03: Interpret and process the data obtained through experimentation and report the results as per regulatory requirements.	3	2		3					2	3	2
		CO 04: Understand and apply appropriate safety measures while handling instruments, chemicals, and apparatus.	3	3		2					2	3	2
		AVG	**3**	**2.25**		**2.5**					**2.5**	**2.5**	**2.5**

17. Opportunities for international exposure (Placement Opportunities):

The Bachelor program in Pharmacy provides ample opportunity to a graduate to join various areas in pharmaceutical industry set up as well as in a hospital pharmacy support. The level of appointment and compensation there upon may depend upon the job profile and need for further additional post graduate specialization in specific areas. The possible positions are:

a. Research and Formulation Development Executive: Development of new formulations

b. Production Executive: Managing and supervising production of formulations

c. Project Executive (New Products): Coordinating the research, production and marketing activities in a pharmaceutical organization, deciding as to what and how to develop a new product and plan production and marketing activity as per available capacity.

d. Project Executive (New Plant): coordinating and erection, installation commissioning of production in a new plant / facility and ensuring that all installation and procedures are as per compliance norms laid out by regulatory agencies.

e. Executive (Administration and Finance)/ management Trainee: in a pharmaceutical organization.

f. Executive/Astt. Manager, Regulatory affairs: Helping the research team to compile drug master files for new drug products for registration and approval with the food and Drug authority of different countries.

g. Hospital Pharmacist: He may further diversify into Clinical Pharmacist and then specialize into Geriatric, Pediatric or other specific area in a govt or private setup in India or in other countries including USA, UK, UAE and others.

h. Sales and Marketing: He may take up a career in marketing starting as a sales person and then diversifying into Product Management, training and market research.