

SAURASHTRA UNIVERSITY



Accredited Grade "A"

by NAAC

FACULTY OF PHARMACY

Master of Pharmacy Management (MPM) (Integrated course)

Ordinances & Regulations

Effective from

June 2016

(Five and Half year full time programme)

Department of Pharmaceutical Sciences

Saurashtra University

Rajkot - 360 005

www.saurashtrauniversity.edu

Ordinances

O.MPM (Integrated)-1:

Candidate seeking admission to Master of Pharmacy Management (MPM) (integrated) should possess minimum 45 % of marks for general category and 40 % of marks for reserve category or equivalent grade as it is prescribed by the Admission Committee for Professional Courses (ACPC), Gujarat State.

OR

As provided in statute 150-A of Saurashtra University Act, Rajkot.

Direct admission on vacant seats at institution/department level:

- 1) The eligibility criteria for direct admission on seats remaining vacant in first year after counselling shall be such as may be notified from time to time.
- 2) The Academic Council of the University shall have power to amend or repeal the eligibility criteria, as per the guidelines of All India Council for Technical Education (A.I.C.T.E.) / PCI.
- 3) Candidate duly admitted in the programme shall have to gradually appear and pass in all eleven semesters and various components like theory/practical/field tour/Industrial Visit/Field work etc. prescribed in syllabus.

O.MPM (Integrated)-2:

The program of Master of Pharmacy Management (Integrated) is a double degree programme (B. Pharm + Master of Pharmacy Management) is a full time regular program. MPM should follow semester system- Choice Based Credit System (CBCS). Each semester will be of at least 90 working days. Every enrolled student will be required to take a specified load of course work in the chosen subject of specialization and also complete a project/dissertation as provided in the curriculum.

MPM (Master of Pharmacy Management) (Integrated) is a full time regular program having Duration of 11 semesters i.e. Five and Half academic years and maximum duration for completing the course is 10 years from the date of Admission.

O.MPM (Integrated)-3:

A student can apply for award of B. Pharm. degree after successful completion of Semester 1st to 8th and he/she will be eligible to receive the B.Pharm degree as well as a degree of Master of Pharmacy Management after successful completion of all the 11 semesters.

Practical Training: The student is required to undergo at their own risk and cost for practical training of 150 hrs either in (A) Pharmacy Practice (Hospital/Community pharmacy) or (B) Pharmaceutical and allied Industries spread over a period of not less than one month during vacation after second year.

Each training day shall have at least 5 hrs. covering 30 days period.

Industry training/Educational tour/ field work/ field visit etc. is compulsory and cost & risk will be bared by students themselves at their own risk and cost.

O.MPM (Integrated)-4:

The medium of instruction and examination shall be English.

O.MPM (Integrated)-5:

80 % attendance in all the components of curriculum in a term is a mandatory requirement. The term will be granted only when the student has minimum attendance of 80% in each component i.e. Theory and Practical of respective semester.

O.MPM (Integrated)-6:

The performance of student in Master of Pharmacy Management will be evaluated as per as per AICTE / PCI norms:

Internal evaluation of	-	20% of total marks of Subject
Semester end Examination by the University of -		80% of total marks of Subject

Theory and Practical component of same subject shall be considered as separate subject.

To pass any of the examination, students will be required to obtain at least 40% marks in each of the head of passing.

O.MPM (Integrated)-7:

On completion of successful study of up to sem VIII or in case of diploma to degree candidates sem III to VIII, students shall be eligible to receive B.Pharm degree and on completion of program, students shall be eligible to receive Master of Pharmacy Management degree.

O.MPM (Integrated)-8:

The programme is full time programme and candidate joining the programme shall not be eligible to join any other degree/diploma programme of this or any other University/Institute.

O.MPM (Integrated)-9:

Each of the Students will be required to join NCC/NSS/Major sports as prescribed in ordinance 182 of the University.

O.MPM (Integrated)-10:

Every candidate admitted in First year shall have to appear and pass the examination of “**Environmental Studies**” as directed by Hon. Supreme Court of India and course curriculum shall be the same as it is prescribed by the U.G.C. The examination will be conducted by the department without charging any examination fees and certificate to that effect issued by the department shall have to be appended with the application form of the University Semester-II end examination.

O.MPM (Integrated)-11:

As per direction/instruction of the University/Department, every candidate admitted to First Semester of any course will have to pass through the Thalassemia Test & Blood grouping test.

O.MPM (Integrated)-12:

Admission granted by the department/Institution to any student shall be provisional till the Enrolment /Registration/Enlistment is made by the University. In case of admission is granted on the bases of provisional eligibility certificate, the conditions & instruction given by the University should be complied within time limit fixed by the University or latest by the beginning of next Semester otherwise term kept by the such a student will be forfeited and no fees on any account will be refunded.

O.MPM (Integrated)-13:

The head of the department shall be competent to take appropriate measure against Ragging & gender problem in department/institution. The word department/institution includes

department building, sport complex, Hostel and such other components which are within the purview of the college.

In case of occurrence of any such incident, the violator shall be dealt with very seriously and appropriate stringent action be taken by the head of the department observing principle of natural justice. The head of department may appoint a committee to inquire in to the matter which submits its report to the head of department who may take further necessary action in the matter.

O.MPM (Integrated)-14:

All admitting authority (Including the University/Department /P.Gcentre/institute or centralized admission committee etc.) will have to strictly observe the provisions of reservation policy of the Govt./U.G.C./Rehabilitation Council of India etc. before admission process is under taken. The authority will ascertain quota & number of seats available for reserved class candidates and allocate to the eligible candidates. The data based information should also be provided to the university only after conclusion of entire process of admission.

O.MPM (Integrated)-15:

All the standards and norms of statutory council like AICTE and PCI shall become part of syllabus and curriculum.

R.MPM (Integrated)-1:

The eligible candidates will have to forward his/her application for admission to University examination through the head of department along with fees and forms prescribed by the University.

R.MPM (Integrated)-2:

The following are the subjects prescribed for the study of each of the semester of Master of Pharmacy Management Program (Integrated)

Teaching and Examination System

Semester – I

Subject Code	Subject	Teaching Scheme (Per Week)			Marking System (Max.)				Marking System (Min.)			
		Theory (hrs / credits)	Practical (hrs/ credits)	Total Credits	Theory		Practical		Theory		Practical	
					External	Internal	External	Internal	External	Internal	External	Internal
BP1 01	Unit Operation- I	4	3	7	80	20	80	20	32	08	32	08
BP1 02	Pharmaceutical Chem-I (Inorganic Chemistry)	4	3	7	80	20	80	20	32	08	32	08
BP1 03	Pharmaceutical Analysis – I	4	3	7	80	20	80	20	32	08	32	08
BP1 04	Human Anatomy & Physiology – I	4	3	7	80	20	80	20	32	08	32	08
BP1 05A BP1 05B	Remedial Mathematics or Remedial Biology	4	-	4	80	20	-	-	32	08	--	--
BP1 06	English & Communication Skill	2	-	2	80	20	-	-	32	08	--	--
Total Credits/ Marks				34	480	120	320	80	192	48	128	32
Total Marks					1000				400			
<i>Note : 1 credit = 1 hour teaching or practical</i>												

Semester – II

Subject Code	Subject	Teaching Scheme			Maximum Marks				Minimum Passing standards			
		Theory (hrs / credits)	Practical (hrs/credits)	Theory	Theory		Practical		Theory		Practical	
					External	Internal	External	Internal	External	Internal	External	Internal
BP 201	Physical Pharmacy	4	3	7	80	20	80	20	32	08	32	08
BP 202	Pharmaceutical Chem-II (Physical Chemistry)	4	3	7	80	20	80	20	32	08	32	08
BP 203	Pharmaceutical Analysis – II	4	3	7	80	20	80	20	32	08	32	08
BP 204	Human Anatomy Physiology – II	4	3	7	80	20	80	20	32	08	32	08
BP 205	Basics of Computer Application	3	3	6	80	20	80	20	32	08	32	08
BP 206	Environmental Studies *	-	-	-	80	20	--	--	32	08	--	--
Total Credits/Marks				34	480	120	400	100	192	48	160	40
Total Marks					1100				440			
<i>Note : 1 credit = 1 hour teaching or practical</i>												

* Internal Examination and to be evaluated internally by the Department

R.MPM (Integrated)-3:

Two Theory tests (each test of 20 marks and one hour duration or in its multiple (which will be then converted to equivalent marks of 20)) shall be conducted as per the schedule notified by the Institute for every course in a semester. For the award of the internal marks, best marks obtained in either of two tests shall be considered. In the 17th week of the semester, remedial internal exam will be arranged for the students who had not appeared/ failed in the regular internal exam of 20 marks.

R.MPM (Integrated)-4:

For the internal evaluation, one regular practical test (test is of 20 Mark or in its multiple (which will be then converted to equivalent marks of 20)) shall be conducted as per the schedule notified by department for every subject in Semester. In the 17th week of the semester, remedial internal exam will be arranged for the students who had not appeared/ failed in the regular internal exam. Assessment in practical examination shall be based on day-to-day performance, viva-voce, practical exercise and/or assignments like class-tests, quizzes, herbaria, tour-reports etc.

R.MPM (Integrated)-5:

For the external evaluation during the 18th -20th week of the semester, a Semester end examination will be conducted by the University for theory as well as practical.

The final examination of each semester shall be conducted by University for 80% of the evaluation for the each subject will be through written paper or practical test or oral test or presentation by the student or combination of these.

R.MPM (Integrated)-6:**Award of Class:**

The class division will be awarded as per below mentioned provision:

- a) The candidate obtaining the aggregate percentage from 50 to less than 60% aggregate marks obtained in all semesters together in a single attempt (up to sem VIII for B.Pharm & up to XI for Master of Pharmacy Management) will be awarded a SECOND class.

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- b) The candidate obtaining below 75% but less than equal to 60% aggregate marks obtained in all semesters together in a single attempt (VIII for B.Pharm. & XI for Master of Pharmacy Management) will be awarded FIRST class.
- c) The candidate obtaining greater than equal to 75% aggregate marks obtained in all semesters together in a single attempt—(VIII for B.Pharm. & XI for Master of Pharmacy Management) will be awarded a DISTINCTION class.

-: From Diploma to Degree:-

R.MPM (Integrated)-7:

Admission to Semester: III (For Diploma Holder who wish to join Pharmacy Management Degree Program)

Student having passed the Diploma in Pharmacy Examination of Gujarat Technological University or any other University or board of Gujarat State or any other State approved by the Pharmacy Council of India will be eligible for the admission directly to the third semester of Master of Pharmacy Management program of eleven semester program course as per following condition.

- a. For direct admission to Master of Pharmacy Management Sem-III, a student must have passed post H.S.C. Diploma Pharmacy Examination conducted by Gujarat Technological University or any other University or board of Gujarat State or any Other State authority approved by Pharmacy Council of India after (10+2) Science i.e. HSC or its equivalent examination.

R.MPM (Integrated)-8:

The Evaluation system for Pharmacy Management Degree Program) Program are as under:

- i. The evaluation system will consist of a component of internal evaluation by the Department as well as final semester end examination conducted by the Saurashtra University. The former will carry a 20% weight and later 80% weight towards the total marks obtained by the student in a given subject.
- ii. After adding the internal marks (maximum 20) with the marks secured by the student in the university examination (maximum 80), the marks will be converted to letter grade as per the following:

Grade Point	Lower Limit (A)	Upper Limit (B)	For deciding grade point, ranges	Grade Letters
1	2	3	4	5
Lowest: 4	0	39	$0 \leq P < 39$	F
Lowest: 5	40	49	$40 \leq P < 49$	E
6	50	59	$50 \leq P < 60$	D
7	60	69	$60 \leq P < 70$	C
8	70	79	$70 \leq P < 80$	B
9	80	89	$80 \leq P < 90$	A
Highest: 10	90	99	$90 \leq P \leq 100$	O

The Semester-End Grade Point Average (SGPA) and Programme-end Cumulative Grade Point Average (CGPA) are computed as follows:

Credit Points = Credit of the course (Cr) X Grade secured in the course (G)

$$\text{SGPA} = \frac{\sum \text{CrG}}{\sum \text{Cr}}$$

Where, Cr is the credit of the course I and G is the grade point secured by the student

$$\text{CGPA} = \frac{\text{Sum of all Credit Points of the entire programme}}{\text{Sum of Credits up to end of the programme}}$$

The CGPA shall be expressed to an accuracy of three decimal digits.

The percentage equivalent shall be obtained by multiplying CGPA with 10.

Award of Class:

For awarding the class, marks obtained by the candidate of sem. 1 to 7 shall be carried forwarded up to semester 8th and marks obtained by the candidate at semester 1st to 10th will be carried forwarded to semester 11th for determining the class and grade of the program.

The descriptive gradation shall be based on the scale given in the following table.

CGPA	% Equivalence (if required)	Description gradation (if required)
$7.5 \leq \text{CGPA} \leq 10$	CGPA X10	DISTINCTION
$6 \leq \text{CGPA} < 7.5$	CGPA X10	FIRST CLASS
$5 \leq \text{CGPA} < 6$	CGPA X10	SECOND CLASS
$4 \leq \text{CGPA} < 5$	CGPA X10	PASS CLASS

vii. In order to pass an examination, an examinee shall obtain:

- a. not less than 40% marks in each theory paper including the marks obtained in regularity and sessional examination.
- b. not less than 40% marks in each practical paper including the marks obtained in regularity and sessional examination.
- c. Minimum passing for any component is 40%, subject to condition of 50% aggregate requirement for semester passing. (i.e 1100 total marks student has to obtain minimum 50% marks = 550 marks for semester passing)

viii. If student aggregate is less than 50% but more than 40% in all heads, then overall semester result is fail. Student has to reappear in exam to improve aggregate. He/she can take remedial exam in the subject with grade (CC/DD). Fresh score will always be considered as the latest one.

ix. Student shall not continue his/her further study if he/she is having more than 4 backlogs including theory and practical only after the declaration of remedial exam

results, provided for the batch admitted in academic year 2016-17, student shall have to appear in remedial examination. A Remedial examination of all semesters will be conducted by the University at the time of holding examination for regular batch for all semester.

x. It is mandatory for every student to appear in sessional examination conducted by department/Institute otherwise he/she is not eligible to appear in university examination.

Department of Pharmaceutical Sciences
Saurashtra University, Rajkot
Master of Pharmacy Management (MPM) syllabus scheme
From Batch 2016 - 2017

Semester - 1

No.	Name of the subject	Code of the subject	Credits			Maximum Marks				Minimum Passing standards				
			Theory	Theory (Hrs./ credits)	Practical (Hrs./ credits)	Total	Theory		Practical		Theory		Practical	
							External	Internal	External	Internal	External	Internal	External	Internal
1	Unit Operation I	1612010701010100	04	03	07	80	20	80	20	32	08	32	08	
2	Pharmaceutical Chemistry-I (Pharmaceutical Inorganic & Physical Chemistry)	1612020701010200	04	03	07	80	20	80	20	32	08	32	08	
3	Human Anatomy & Physiology - I	1612030701010300	04	03	07	80	20	80	20	32	08	32	08	
4	Basics of Computer Application	1612040701010400	03	03	06	80	20	80	20	32	08	32	08	
5	English and Communication Skills	1612050701010500	03	--	03	80	20	---	---	32	08	---	---	
TOTAL CREDITS					30	400	100	320	80	160	40	128	32	
TOTAL MARKS						900				360				

Semester - 2

No.	Name of the subject	Code of the subject	Credits			Maximum Marks				Minimum Passing standards				
			Theory	Theory (Hrs./ credits)	Practical (Hrs./ credits)	Total	Theory		Practical		Theory		Practical	
							External	Internal	External	Internal	External	Internal	External	Internal
1	Unit operation - II	1612010701020100	04	03	07	80	20	80	20	32	08	32	08	
2	Pharmaceutical Engineering	1612020701020200	04	03	07	80	20	80	20	32	08	32	08	
3	Pharmaceutical Chemistry-II (Organic Chemistry-I)	1612030701020300	04	03	07	80	20	80	20	32	08	32	08	
4	Human Anatomy & Physiology - II	1612040701020400	04	03	07	80	20	80	20	32	08	32	08	
5	Pharmacognosy - I	1612050701020500	04	03	07	80	20	80	20	32	08	32	08	
6	Environmental Studies*	---	---	---	---	80	20	---	---	32	08	---	---	
TOTAL CREDITS					35	480	120	400	100	192	48	160	40	
TOTAL MARKS					1100				440					

* Internal and External Examination to be evaluated internally by the Department

Semester – 3

No.	Name of the subject	Code of the subject	Credits			Maximum Marks				Minimum Passing standards				
			Theory	Theory (Hrs./ credits)	Practical (Hrs./ credits)	Total	Theory		Practical		Theory		Practical	
							External	Internal	External	Internal	External	Internal	External	Internal
1	Physical Pharmacy	1612010701030100	04	03	07	80	20	80	20	32	08	32	08	
2	Pharmaceutical Chemistry-III (Organic Chemistry- II)	1612020701030200	04	03	07	80	20	80	20	32	08	32	08	
3	Pharmaceutical Analysis - I	1612030701030300	04	03	07	80	20	80	20	32	08	32	08	
4	Pathophysiology	1612040701030400	03	--	03	80	20	---	---	32	08	---	---	
5	Pharmacognosy – II	1612050701030500	04	03	07	80	20	80	20	32	08	32	08	
6	Management Process and Organizational Behavior	1612060701030600	03	--	03	80	20	---	---	32	08	---	---	
TOTAL CREDITS					30	480	120	320	80	192	48	128	32	
TOTAL MARKS					1000				400					

Semester - 4

No.	Name of the subject	Code of the subject	Credits			Maximum Marks				Minimum Passing standards			
						Theory		Practical		Theory		Practical	
			Theory	Theory (Hrs./credits)	Practical (Hrs./credits)	Total	External	Internal	External	Internal	External	Internal	External
1	Dispensing Pharmacy	1612010701040100	03	03	06	80	20	80	20	32	08	32	08
2	Forensic Pharmacy	1612020701040200	03	--	03	80	20	---	---	32	08	---	---
3	Pharmaceutical Chemistry-IV (Biochemistry-I)	1612030701040300	03	03	06	80	20	80	20	32	08	32	08
4	Pharmaceutical Analysis - II	1612040701040400	03	03	06	80	20	80	20	32	08	32	08
5	Pharmacology - I	1612050701040500	03	03	06	80	20	80	20	32	08	32	08
6	Pharmacognosy - III	1612060701040600	03	03	06	80	20	80	20	32	08	32	08
7	Micro and Macro Economics	1612070701040700	03	--	03	80	20	---	---	32	08	---	---
TOTAL CREDITS					36	560	140	400	100	224	56	160	40
TOTAL MARKS						1200				480			

Semester - 5

No.	Name of the subject	Code of the subject	Credits			Maximum Marks				Minimum Passing standards				
			Theory	Theory (Hrs./ credits)	Practical (Hrs./ credits)	Total	Theory		Practical		Theory		Practical	
							External	Internal	External	Internal	External	Internal	External	Internal
1	Pharmaceutical Microbiology I	1612010701050100	03	03	06	80	20	80	20	32	08	32	08	
2	Pharmaceutical Chemistry-V (Biochemistry-II)	1612020701050200	03	--	03	80	20	---	---	32	08	---	---	
3	Pharmaceutical Chemistry-VI (Medicinal Chemistry-I)	1612030701050300	03	03	06	80	20	80	20	32	08	32	08	
4	Pharmaceutical Analysis - III	1612040701050400	03	03	06	80	20	80	20	32	08	32	08	
5	Pharmacology - II	1612050701050500	03	03	06	80	20	80	20	32	08	32	08	
6	Pharmacognosy-IV	1612060701050600	03	03	06	80	20	80	20	32	08	32	08	
7	Pharmaceutical Marketing and drug store management	1612070701050700	03	--	03	80	20	---	---	32	08	---	---	
TOTAL CREDITS					36	560	140	400	100	224	56	160	40	
TOTAL MARKS					1200				480					

Semester - 6

No.	Name of the subject	Code of the subject	Credits			Maximum Marks				Minimum Passing standards				
			Theory	Theory (Hrs./ credits)	Practical (Hrs./ credits)	Total	Theory		Practical		Theory		Practical	
							External	Internal	External	Internal	External	Internal	External	Internal
1	Pharmaceutical Microbiology & Biotechnology II	1612010701060100	03	03	06	80	20	80	20	32	08	32	08	
2	Hospital and Community Pharmacy	1612020701060200	03	03	06	80	20	80	20	32	08	32	08	
3	Pharmaceutical Chemistry-VII (Medicinal Chemistry-II)	1612030701060300	03	03	06	80	20	80	20	32	08	32	08	
4	Pharmaceutical Analysis - IV	1612040701060400	03	03	06	80	20	80	20	32	08	32	08	
5	Pharmacology - III	1612050701060500	03	03	06	80	20	80	20	32	08	32	08	
6	Pharmacognosy-V	1612060701060600	03	--	03	80	20	---	---	32	08	---	---	
7	Financial Management	1612070701060700	03	--	03	80	20	---	---	32	08	---	---	
TOTAL CREDITS					36	560	140	400	100	224	56	160	40	
TOTAL MARKS						1200				480				

Semester - 7

No.	Name of the subject	Code of the subject	Credits			Maximum Marks				Minimum Passing standards				
			Theory	Theory (Hrs./ credits)	Practical (Hrs./ credits)	Total	Theory		Practical		Theory		Practical	
							External	Internal	External	Internal	External	Internal	External	Internal
1	Pharmaceutical Technology - I	1612010701070100	03	03	06	80	20	80	20	32	08	32	08	
2	Dosage form design - I	1612020701070200	03	03	06	80	20	80	20	32	08	32	08	
3	Pharmaceutical Chemistry-VIII (Medicinal Chemistry-III)	1612030701070300	03	03	06	80	20	80	20	32	08	32	08	
4	Pharmaceutical Analysis - V	1612040701070400	03	--	03	80	20	---	---	32	08	---	---	
5	Clinical Pharmacy - I	1612050701070500	03	--	03	80	20	---	---	32	08	---	---	
6	Pharmacognosy-VI	1612060701070600	03	03	06	80	20	80	20	32	08	32	08	
7	Material and Operation Management	1612070701070700	03	--	03	80	20	---	---	32	08	---	---	
TOTAL CREDITS					33	560	140	320	80	224	56	128	32	
TOTAL MARKS					1100				440					

Semester – 8

No.	Name of the subject	Code of the subject	Credits			Maximum Marks				Minimum Passing standards			
						Theory		Practical		Theory		Practical	
			Theory	Theory (Hrs./credits)	Practical (Hrs./credits)	Total	External	Internal	External	Internal	External	Internal	External
1	Pharmaceutical Technology – II	1612010701080100	03	03	06	80	20	80	20	32	08	32	08
2	Dosage form design – II	1612020701080200	03	--	03	80	20	---	---	32	08	---	---
3	Pharmaceutical Chemistry-IX (Medicinal Chemistry-IV)	1612030701080300	03	03	06	80	20	80	20	32	08	32	08
4	Pharmaceutical Analysis – VI	1612040701080400	03	--	03	80	20	---	---	32	08	---	---
5	Clinical Pharmacy – II	1612050701080500	03	03	06	80	20	80	20	32	08	32	08
6	Pharmacognosy-VII	1612060701080600	03	03	06	80	20	80	20	32	08	32	08
7	Human Resource Management	1612070701080700	03	--	03	80	20	---	---	32	08	---	---
TOTAL CREDITS					33	560	140	320	80	224	56	128	32
TOTAL MARKS								1100				440	

Semester – I
UNIT OPERATION - I
Subject code: 1612010701010100

Theory (4 Hours / Week; 4 Credits, 60 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
4	0	3	7	80	20	80	20

Course Objectives

- Subject gives knowledge about various unit operations used in the pharmaceutical industry with its basic mechanisms.
- The students can understand an importance of the particular process and its applicability in industry.

Students Learning Outcome

- Knowledge of Different pharmaceutical equipment's-its design, material of construction and operation; and calculation of various physical parameters
- Awareness regarding Humidity, Ventilation and Air Conditioning Systems (HVAC) system and its importance for pharmaceutical industry point of view
- Determine the basic concepts of process parameters of pharmaceutical equipment involving different unit operation
- Give ideas about Introduction to latest process control systems used in pharmaceutical industry

Sr. No	Course Contents	Total Hrs.
1	Filtration Theory and mechanism of filtration process, Types of filtration, factors influencing filtration, filter aids, filter media, industrial filter including filter press, filter leaf, rotary filter, edge filter, cartridge filters, membrane filters, mathematical problems on filtration, optimum cleaning cycle in batch filters, applications in pharmacy.	12
2	Centrifugation Principle and theory of centrifugation, industrial centrifuges-perforated basket centrifuge, sedimentation type centrifuge, continuous centrifuges etc. Applications in pharmacy.	08
3	Drying Theory and mechanism of drying, moisture content, loss on drying, rate of drying & time of drying calculations, classification of dryers, factors affecting selection of dryers, dryers used in pharmaceutical including drum dryer, spray dryer, fluidized bed dryer, tray dryer, tunnel dryer, rotary dryer vacuum dryer, Microwave, Radiant heat dryer (Infra-Red), Mathematical problems on drying,	10

	applications in pharmacy.	
4	Distillation Raoult's law and its limitation, Henry's Law, Phase diagram, volatility & relative volatility, General parts of distillator, simple steam and flash distillation, batch and continuous distillation, rectification distillation columns and their efficiency, McCabe Thiele method for calculation of number of theoretical plates, azeotropic, molecular & steam distillation, mathematical problems, applications in pharmacy.	10
5	Evaporation Basic concept of phase equilibria, factors affecting evaporation, heat transfer in evaporators, Duhring's Rule and Raoult's law, evaporators- natural circulation forced circulation & film evaporators, single effect and multiple effect evaporators, mathematic problems.	10
6	Humidity, Ventilation and Air Conditioning Systems (HVAC) Basic concepts & definitions, measurement of humidity, psychometric charts, theory and calculations of humidification processes, humidity control, applications of humidity, equipment for humidification and dehumidification operations. Types of refrigeration cycles, air conditioning, applications in pharmacy. Design of HVAC systems.	10

Semester – I
UNIT OPERATION – I
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Aim of the experiment
1	To determine specific cake resistance and resistance offered by filter media on rate of filtration.
2	To study the effect of temperature on rate of filtration.
3	To study the effect of filter aids on rate of filtration.
4	To find out optimum concentration of filter aid.
5	To study effect of viscosity on rate of filtration.
6	Demonstration of centrifuge and various dryers.
7	To study effect of temperature on evaporation.
8	To study effect of Surface area on evaporation.
9	To study effect of viscosity on evaporation.
10	To find out EMC, CMC, FMC of given powder.
11	To study effect of surface area on drying.
12	To verify Rayleigh's equation for differential distillation of acetic acid and water.
13	Comparison of efficiency of different columns used in distillation process.
14	Calculation of humidity, % RH, Humid heat, Humid Volume by dry bulb and wet bulb temperature.
15	To study formation of azeotropic mixture and to separate it using third liquid.

Note: Any other practical related to theory topic can be carried out.

References Books

- 1) Perry's Chemical Engineer's Handbook; Robert H Perry, Green D.W., Maloney J.O.; McGraw Hill Inc., New York; 7th Edition, 1998.
- 2) Copper and Gun's Tutorial Pharmacy; S. J. Carter; CBS Publication & Distribution, New Delhi; 2004
- 3) Pharmaceutical Engineering; K. Sambamurthy; New Age International Ltd., New Delhi 2002.
- 4) Pharmaceutic the Science of Dosage Form Design; M.E. Aulton; Churchill Livingstone, London; 2002.
- 5) The Theory & Practice of Industrial Pharmacy; Lachman L., Lieberman H.A., Kanjig J.L., Varghese Publishing House, Bombay; 3rd edition; 1991.
- 6) Remington: The Science and Practice of Pharmacy; Gennaro A.R.; Lippincott Williams & Wilkins, Philadelphia; 2004.
- 7) Pharmaceutics II (Unit Operations); Jani G. K.; B. S. Shah Prakashan, Ahmedabad; 2002
- 8) Pharmaceutical Engineering: Principles and Practice; Subramanyam C.V.S., Thimma J, Suresh S.S.; VallabhPrakashan, Delhi; 2004.

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- 9) Bentley's Textbook of Pharmaceutics; Rawlins E A; AITBS Pub &Dist Delhi; 2004.

Semester – I
Pharmaceutical Chemistry-I (Pharmaceutical Inorganic & Physical Chemistry)
Subject code: 1612020701010200
Theory (4 Hours / Week; 4 Credits, 60 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
04	00	03	07	08	20	80	20

Course Objective

- Introduce students to Inorganic Pharmaceutical Chemistry with emphasis on basic chemistry with respect to inorganic drugs and pharmaceuticals. Cover areas including impurities, acids, bases & buffers, gastrointestinal agents, intra and extra-cellular electrolytes, essential and trace elements, topical agents, gases and vapors, dental products etc. Highlight pharmaceutical aids used in pharmaceutical industry. In physical chemistry involves chemical kinetics, radioactivity and radiopharmaceuticals drugs used in pharmaceuticals.

Students Learning Outcomes

- The curriculum of the Department is designed to satisfy the diverse needs of these students.
- Advanced coursework and educational activities outside the traditional classroom. At graduation, chemistry majors should have a set of fundamental competencies that are knowledge-based, performance/skills-based, and affective.
- Graduates will be able to solve problems competently by identifying the essential parts of a problem and formulating a strategy for solving the problem.
- They will be able to rationally estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of the solution, and interpret their results.

Sr. No.	Course Contents	Total Hrs.
1.	Introduction to Pharmaceutical Chemistry	01
2.	Impurities in Pharmaceuticals: Sources of impurities, tests for purity and identity, limit tests for iron, arsenic, lead, heavy metals, chloride, sulphate	06

3.	An outline of method of preparation, uses, special tests if any, of the following class of inorganic pharmaceuticals included in the current pharmacopoeia:	04
A	Acids and Bases: Buffers, Waters	05
B	Gastrointestinal agents: Antacids, Protective and Adsorbents	04
C	Major intra and extra-cellular electrolytes: physiological ions, Electrolytes used for replacement therapy, acids-base balance and combination therapy	05
D	Essential and trace elements: Transition elements and their compounds of pharmaceutical importance: Iron and haematinics, WHO/ Oral Rehydration Salt (ORS)	05
E	Gases and Vapors: Anesthetics and Respiratory Stimulants	02
F	Dental products: Dentifrices, Anti-caries agents	04
G	Pharmaceutical Aids used in pharmaceutical industry : Anti-oxidants, Preservatives, Filter aids, Adsorbents, Diluents	04
H	Miscellaneous agents: Expectorants, Emetics, Poisons and Antidotes, Protective, Astringents	05
I	Radioactivity & Radiopharmaceuticals: Basic principles of Radioactivity, Radioactivity Rays and units of activity, Measurements of Radioactivity, clinical applications and dosage, hazards and precautions	05
4.	Chemical kinetics: Zero, first and second orders reactions, complex reaction, theories of reaction kinetics, characteristics of homogeneous and heterogeneous catalysts, acid base enzyme catalysis	10

Semester – I
Pharmaceutical Chemistry-I (Pharmaceutical Inorganic & Physical Chemistry)
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Content	No. of practical hours
1	The backgrounds and systematic qualitative analysis of Inorganic mixture of up to 4 radicals. Six mixtures to be analyzed, Preferably by semi-micro methods.	15
2	All identification tests for pharmacopoeial inorganic pharmaceuticals and qualitative tests for cations and anions should be covered.	06
3	Limit tests for Cl, SO ₄ , As, Heavy metals and Lead along with a Few modifications	09
4	Volumetric Analysis of few important compounds covered in Theory.	12
5	Determination of order of reaction.	03

Books Recommended (Latest Editions):

1. Inorganic Medicinal and Pharmaceutical Chemistry : J. H. Block, E. B. Roche, T. O. Soine, C. O. Wilson, Varghese Publishing House, First Indian Reprint, 1986.
2. Bentley and Driver's Textbook of Pharmaceutical Chemistry: Revised by L. M. Atherden, Oxford University Press, 8th Ed. 1969.
3. The Indian Pharmacopoeia, Latest Edition, Controller of Publications, Delhi.
4. Practical Pharmaceutical Chemistry edited by A. H. Beckett, J. B. Stenlake, CBS Publishers, and First Indian edition 1987.
5. Vogel's Qualitative Inorganic Analysis Revised by G. Svehla, Longman Gr. Ltd., 7th Ed. 1996.
6. Text book of Physical Chemistry: Samuel Glasstone, Macmillan India Limited, 2nd Ed. 1995.
7. Elements of physical chemistry; Peter Atkins, Julio de paula, Oxford University Press, 4th Ed. 2007.
8. Martin's Physical Pharmacy and Pharmaceutical Sciences; Patrick J. Sinko, Lippincott Williams and Wilkins, Latest Edition.

9. Essentials of Physical Chemistry; Arun Bahl, B.S. Bahl, G.D.Tuli, S. Chand & Company Ltd. Latest Edition.
10. Physical Chemistry, G. M. Barrow, International Student Edition, McGraw Hill.

Semester – I
HUMAN ANATOMY AND PHYSIOLOGY-I
Subject Code: 1612030701010300
Theory (4 hours/week, 4 credits, 60 hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
04	00	03	07	08	20	80	20

Course Objectives

Course objectives are to:

- Introduce students to human anatomy and physiology with emphasis on systems of body and how they are interrelated.
- Cover areas including medical terminology, basic chemistry, cell and tissue structure, and different systems of human body (integumentary, skeletal, muscular, nervous, endocrine, circulatory, lymphatic, digestive, respiratory, urinary and reproductive).
- Highlight the practical application of anatomical and physiological concepts to students.
- Study of various systems by Models / Charts / Specimens / Histology
- Learn the determination of body temperature, pulse rate, blood pressure, listening to heart sounds and demonstration of ECG.

Students Learning Outcomes:

- Study of anatomy and physiology as a gateway to careers in health related fields, athletics training etc., as a foundation to advanced scientific studies, for understanding pathology of disease and pathological changes
- To provide base for proper understanding of effects of drug on body and factors affecting various physiological processes and its effects.

Sr. No.	Course Contents	Total Hrs.
1	Introduction and Scope of Anatomy and Physiology: Structural and	4

	functional organization of various organ systems. Homeostasis, Negative and positive feedback system. Definitions of various terms used in Anatomy.	
2	Structure and function of: cell and its components with special emphasis on molecular structure of cell membrane, transporter mechanisms, mitochondria and nucleus. Transcellular, Extra-cellular and Intra-cellular fluids and their composition. Cell cycle and its significance. Mechanism of protein synthesis by cell organelles. Serosal cavities.	6
3	Elementary tissues of the body: Various elementary tissues and their subtypes with Characteristics, location and functions: epithelial tissue, muscular tissue, connective tissue and nervous tissue	4
4	Osseous system: Structure, Composition and function of skeleton. Histology of bone. Classification of joints and their function. Types of movements of joints. Brief introduction to disorders of bones and joints	5
5	Muscular system: Gross anatomy of skeletal muscles. Neuromuscular junction. Physiology of muscle contraction and its components. Properties of skeletal muscles. Brief introduction to muscle disorders.	7
6	Haemopoietic system: Introduction, composition, properties and functions of blood and its components. Haemopoiesis, Lifecycle and physiology of RBC. Blood groups and their significance. Hemostasis and fibrinolytic pathway. Brief information regarding disorders of blood.	9
7	Lymph and lymphatic system: Composition, formation, circulation and functions of lymph. Basic physiology and functions of spleen. Disorders of lymph and lymphatic system.	3
8	Cardiovascular System: Anatomy and physiology of the heart. Circulatory system including coronary circulation and pulmonary circulation. Properties of Cardiac muscle, Electrocardiogram (ECG), Blood pressure and its regulation, Basic understanding of cardiac cycle and heart sounds, cardiac output and factors affecting cardiac output. Renin Angiotensin system, Aldosterone and its significance. Brief introduction to cardiovascular disorders like hypertension, atherosclerosis, angina pectoris, myocardial ischemia and infarction, congestive cardiac failure and cardiac arrhythmias.	11
9	Body defence Mechanisms and Immunity: Basic principles of immunity, innate immunity, adaptive immunity, acquired immunity, immune interactions (cellular and humoral immunity).	5
10	Digestive system: Gross anatomy of the gastrointestinal tract. Structure and functions of various organs of alimentary canal and associated organs like liver, pancreas and gall bladder. Physiology of digestion and absorption at various parts of gastrointestinal tract including phases of gastric secretion. Brief overview of disorders of G. I. tract and associated organs.	6

Semester – I
Human Anatomy and Physiology-I
Practical (3 hours/week, 3 credits, 45 hours)

Sr. No.	Course Contents
1	Study of the human skeleton with the help of charts and models, Study of joints with the help of charts.
2	Digestive and Muscular System (Names, position, attachments and functions of various muscles) with the help of charts and models.
3	Histology of elementary tissues and various organs of Cardiovascular, Digestive and Muscular System
4	Hematology experiments- An introduction and Use and Care of Microscope
5	Study of Haemocytometry
6	Hemoglobin estimation
7	Total WBC count
8	Total RBC count
9	Differential WBC count
10	Determination of clotting time and bleeding time of blood
11	Erythrocyte Sedimentation Rate (ESR)
12	Determination of Blood Groups
13	Effect of Osmosis on RBC
14	Study of the human cardiovascular (Heart, Arterial and Venous System), Circulatory system including arterial and venous system with special reference to the names and positions of main arteries and veins, Coronary circulation, Pulmonary circulation. Determination of pulse rate, blood pressure, listening to heart sounds. Demonstration of ECG.
15	Amphibian experiments for study of properties of skeletal muscle using either demonstrations or computer simulated experiments.

*** Any experiment demonstrating theoretical concept can be added to the above list**

Books Recommended (Latest Editions):

1. William J. Larsen: Anatomy – Development, function, Clinical Correlations-Saunders (Elsevier Science)
2. Guyton A.C. and Hall J.E.: Textbook of Medical Physiology – 10th Edition– W. B. Saunders
3. Seeley R. R., Stephens T. D. and Tate P.: Anatomy and Physiology 2000 McGraw Hill Co.
4. Waugh A. and Grant A.: Ross and Wilson's Anatomy and Physiology in Health and illness — Churchill Livingstone
5. Sobotta. Atlas of Human Anatomy (2 Volumes) –Edited by Putz and R. Pabst, Lippincott, Williams and Wilkins

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6. Anne M. R. Agur & Ming J. Lee: Grant's Atlas of Anatomy –Lippincott, Williams and Wilkins
 7. Gosling T. A., Harris P. F., Whitmore I., William, Human Anatomy: Color Atlas and Text —Mosby
 8. Bullock B.L. & Henze R.L., Focus on Pathophysiology –Lippincott
 9. Martini F. Fundamentals of Anatomy and Physiology (Prentice Hall)
 10. Goyal R. K. & Mehta A. A. Human Anatomy Physiology and Health Education, (B. S. Shah Prakashan)
 11. West J. B. Best and Taylor's physiological Basis of Medical Practice (Williams and Wilkins, Baltimore)
 12. Tortora G. J. and Anagnostokos, N. P. Principles of Anatomy and Physiology (Harper and Colling Publishers, New York)
 13. Joshi Vijaya D. Preparatory Manual for Undergraduates Physiology (B.I. Churchill Livingstone)
 14. Chatterjee C. C. Human Physiology (Medical Allied Agency, Calcutta)
 15. Goyal R. K. et al.: Practical Anatomy Physiology and Biochemistry (B.S. Shah Prakashan,Ahmedabad)
 16. Garg K. et al. A Text Book of Histology (CBS Publishers, New Delhi)
 17. Lesson C. R. et al.: Text Book of Histology (W.B.Saunders Company)

Semester – I

BASICS OF COMPUTER APPLICATIONS**Subject Code: 1612040701010400****Theory (3 hours/week, 3 credits, 45 hours)**

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
03	00	03	06	08	20	80	20

Course Objectives

- Introduce students to Computer Fundamentals.
- Cover areas including application of computers in pharmacy, introduction to computer virus
- Highlight the practical application of operating systems

Students Learning Outcomes:

- Study of classifications of computers
- To provide base for proper understanding of Basics of MS Word, Excel, PowerPoint and its applications.

Sr. No.	Course Content	Hours
1	Computer Fundamentals Definition, characteristics, history, computer terminology, computer organization, input & output devices, storage devices (including latest devices), classifications of computers (including current computer systems), application of computers in pharmacy, introduction to computer virus, problems associated with virus infection and its remedies.	05
2	Operating Systems Definition, functions of an operating system, types of operating systems and their characteristics, difference between operating system and application software. <i>Windows Operating Systems</i> : Desktop, start-menu, components of control panel, accessories, components of my computer and my documents, recycle bin, printer and mouse settings, maximizing, minimizing, restoring and closing of windows, windows explorer, taskbar and its functions. Different file formats, various types of files, file extension, opening files by various programs	10
3	Basics of MS Word and its applications Word Essentials, Parts of MS Word screen, Typing and Editing, Finding and Replacing, Autocorrect and Auto text, Reusing Text and Graphics, use of spellcheck & grammar, thesaurus and scientific symbols, viewing of document by various ways, Editing Tools, Text Formatting, Text Character, Formatting	08

	Paragraphs, Formatting and Sorting Lists, Page Design and Layout, Page Margins, Page Numbers, Columns, Working with Tables, Creating and formatting of tables and sorting, merging of data in tables etc., inserting, deleting and sizing of rows and columns in tables, Opening, Saving and Protecting Documents, Locating and Managing Documents, Printing.	
4	Basics of MS Excel and its applications Introduction to EXCEL worksheet, calculations in EXCEL, preparation of templates for application in pharmaceutical chemistry, pharmaceutical technology, pharmacology and pharmacognosy (statistical treatment of data for Beers Lamberts curve, solution of problems based on physical chemistry, stability study, area under the curve, etc.) Special attention must be given to arithmetic expressions. Library functions such as logarithm, square root, sum, average, standard deviation, t-test, F-test, Chi-square test, ANOVA etc. Drawing graphs in EXCEL- line graph, histogram and pie-chart. Editing chart features such as annotation, labelling of axis, changing legends etc.	07
5	MS PowerPoint Creating and viewing a presentation, adding animations and managing slides etc.	05
6	Internet and its applications Internet – Basic terms, software and hardware requirement for internet, web browsers, internet tools, study of pharmaceutical web sites, online journals and search engines, searching through pharmaceutical databases, study of patent websites. Use of emails, mail merge and application of address book.	05
7	Introduction to the following software MS Paint, MS Access, Outlook, Adobe acrobat reader, Adobe Professional, Chemdraw, ISIS Draw, Nero Burning roam	05

Semester – I

BASICS OF COMPUTER APPLICATIONS

Practical (3 hours/week, 3 credits, 45 hours)

Sr. No.	Course Contents
	Practical exercises should be based on theoretical topics. The practical should broadly cover the following:
1	Exercises on word processing to execute various commands in preparing and editing documents.
2	Preparation of documents and implementing various formatting parameters in MS Word.
3	Working with footnotes and endnotes, referencing documents
4	Working with auto-indexing, table and figure numbering

5	Preparing and editing worksheets in MS EXCEL, Inserting formulas for different functions in MS EXCEL like sum, average, standard deviation, logarithm, square root etc.
6	Drawing various charts using pharmaceutical experimental data
7	Preparation of power point presentation with animation
8	Working with internet browsing and using search engines
9	E-mailing using address book and applying mail merge
10	Surfing various pharmaceutical web sites, online journals and patent search

Recommended Books

- 1) Taxali R.K., P.C. Software for Windows 98 made simple – 8th Edition – 2002 – Tata Mc, New Delhi.
- 2) WORD 2000, Guy Hart Davis, BPB Publications, New Delhi, 1999
- 3) MS Office: Step by Step, Joyce Cox, Prentice Hall of India, New Delhi, 2007
- 4) Accessing and Analysing Data with MS EXCEL, Cornell, Prentice Hall of India, New Delhi, 2007.
- 5) Manuals available with the software

Semester – I
ENGLISH & COMMUNICATION SKILL
Subject Code: 1612050701010500
Theory (2 Hours / Week; 2 Credits, 30 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
03	00	00	03	08	20	00	00

Objective of the Course:

- To hone basic Communication Skills (LSRW) of the students by exposing them to the key communication techniques, and thereby
- To improve Comprehension and Expressional Skills of the students required for day to day and classroom, academic and cultural situations.

Students Learning Outcomes:

- Communication Skills of the students will be sharpened with reference to Organizational Structure,
- Students will be exposed to the modern modes of communication, and will be prepared for Campus Interviews

Sr. No.	Course Contents	Total Hrs.
1	An Introduction to Communication and Key Concepts in Communication: An Introduction to Communication, Basic terms, concepts, and contexts of communication, Importance, Types and Principles of Communication	4
2	Major Communication Techniques and Styles: <ul style="list-style-type: none"> • Introduction to Communication styles and techniques • Assertive, Aggressive, Passive and Passive – Aggressive Communication • Working with different Styles 	5
3	Different Skill for Communication: <ul style="list-style-type: none"> • Listening Skills • Presentation Skills • Reading Skills • Writing Skills • Advanced Report Writing 	8
4	Grammar and Vocabulary: <ul style="list-style-type: none"> • Tenses and the Concept of Time • Active and Passive Constructions • Direct – Indirect Speeches • Prepositions and Conditionals 	4

	<ul style="list-style-type: none"> • Idioms, Confusable, One-word Substitutes, Synonyms, Antonyms 	
5	Group Communication and Group Dynamics : <ul style="list-style-type: none"> • Introduction to Group Communication • Introduction to Group Dynamics • Communication Networks within and outside the Groups • Social & Behavioural Sciences and Group Communication 	5
6	Interviews: <ul style="list-style-type: none"> • Introduction to Interviews • General preparations for an interview • Types of questions generally asked at the interviews • Types of interviews • Importance of nonverbal aspects 	4

Reference Books

- 1) Effective English for Engineers and Technologists; Dr. Rai Ajay.
- 2) Spoken English 2nd Edition; Sreevalsan M. C.
- 3) English for Technical Communication Volume 2&2 Combined; Laxminarayan R. K.
- 4) English for Technical Communication Volume 2&2 Combined; Laxminarayan R.
- 5) Longman Dictionary of Common Errors; Turton N. D.
- 6) Learning to Communicate: A Resource Book for Scientists and Technologists English 1& 2; Chellammal V.

Semester – II
UNIT OPERATION II
Subject Code: 1612010701020100
Theory (4 Hours / Week; 4 Credits, 60 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
04	00	03	07	08	20	08	20

Course Objectives

- To study unit operations like size reduction, size separation, mixing and crystallization.
- These Unit operations have applications in manufacturing and compounding of dosage forms. Some unit operations also have applications in manufacturing of bulk drugs.
- It is also intended to make students familiar with process control systems, industrial hazards and safety precautions.

Student Learning Outcome

- To develop skills with respect to applications of unit operations like size reduction, size separation, mixing and crystallization, compounding/preparation of pharmaceutical products at laboratory level.
- To understand construction and working of equipment used for unit operation
- To understand applications of these unit operations in manufacturing of drugs/dosage forms.

Sr. No	Course Contents	Total Hrs.
1	Size reduction Objectives, importance and theory of size reduction. Factors affecting, energy requirements, mechanisms and methods (dry/wet grinding) of size reductions. Principle, material of construction, applications, advantages and disadvantages of various mills like cutter mill, hammer mill, roller mill, ball mill, fluid energy mill, colloid mill. Study of latest industrial mills used in manufacturing of various dosage forms and their application.	10
2	Size separation Principles of size separation, screen and its standards as per pharmacopoeia, screening equipments including shaking & vibrating screens, gyratory screens, sedimentation type industrial separators etc. Methods of determining size distribution. Fluid classification methods like sedimentation and elutriation, Principle, material of construction, applications, advantages and disadvantages of cyclone separator, sedimentation tank, etc.	05

3	<p>Mixing</p> <p>Definition, objectives, mechanism and theory of mixing. Type of mixtures: liquid mixing, powder mixing, semi solids mixing. Principle, material of construction, applications, advantages and disadvantages of shaker mixer, propeller mixer, turbine mixer, paddle mixer, planetary mixer, double cone mixer, V mixer, sigma mixer and colloid mill, ultrasonic mixer, etc.</p>	10
4	<p>Crystallization</p> <p>Objectives, crystal lattice, types of crystal, crystal form, size and habit, formation of crystals, super saturation theory, factors affecting crystallization process and crystal growth. Study of various types of crystallizers including Swenson walker, tanks, agitated & batch, circulating magma, vacuum and crystal crystallizer etc. Methods for prevention of caking of crystals. Brief study of spherical crystallization process. Numerical problems on crystal yield.</p>	10
5	<p>Extraction and leaching</p> <p>Principle, theory and types of extraction. Solvents used for extraction, leaching and extraction equipments, small scale and large scale extraction methods, special extraction techniques-supercritical fluid extraction, applications in pharmaceutical industry.</p>	10
6	<p>Automated process control system</p> <p>Process variables - temperature, pressure, vacuum, flow level and their measurements. Elements of automatic process control systems. Elements of computer aided manufacturing. Introduction to latest process control systems used in pharmaceutical industry.</p>	08
7	<p>Industrial hazards and safety precautions</p> <p>Industrial hazards: mechanical, chemical, electrical, fire and dust hazards. Measures to prevent and combat the hazards. Accident records. Introduction to waste water system in industry.</p>	07

Semester – II
UNIT OPERATION – II
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Aim of the experiment
1	Demonstration of various types of equipments used in the unit operation mentioned in theory topics
2	To determine energy utilized by ball mill for size reduction process
3	To determine particle size distribution of given sample of granules by sieving method.
4	To determine % yield of crystals in crystallization experiment under different conditions.
5	To produce crystals using different conditions of crystallization and to study the crystal habit.
6	To perform the experiment on crystallization and plot mier's solubility curve.
7	To study the effect of speed and time on solid liquid mixing.
8	To determine the mixing efficiency of two immiscible liquid using variable speed propeller mixer.
9	To determine mixing index of a given powder mixture using double cone blender.
10	To determine the rate of mixing of solid in liquid using a magnetic stirrer at different speeds.
11	Study the effect of various factors (rate of cooling, rate of agitation, seeding, solvent, etc.) on crystallization of different salts.
12	Study of liquid-liquid and solid-liquid extraction of various materials by different extraction techniques like maceration, percolation, infusion and decoction.

Note: Any other practical related to theory topic can be carried out.

References Books

- 1) Perry's Chemical Engineer's Handbook - Robert H Perry, Green D.W., Maloney J.O., McGraw – Hill Inc., New York
- 2) Tutorial Pharmacy by Cooper & Gunn, ed. S. J. Carter, CBS Publishers & Distributors, Delhi
- 3) Pharmaceutics The Science of Dosage form Design, Aulton M E, Churchill Livingstone, London
- 4) The Theory & Practice of Industrial Pharmacy – Lachman L., Lieberman H.A. & Kanjig J.L., Varghese Publishing House, Bombay
- 5) Alfonso G. Remington: The Science & Practice of Pharmacy. Vol. I & II. Lippincott, Williams & Wilkins Philadelphia
- 6) Introduction to Chemical Engineering, W. L. Badger and J. T. Banchero, Tata McGraw-Hill Publishing Company Limited, New Delhi
- 7) Encyclopedia of Pharmaceutical Technology, James Swarbrick, Informa Healthcare, USA

- 8) Principles and Practice of Automatic Process Control, C. A. Smith and A. Corripio, John Willey & Sons, Inc., USA
- 9) Industrial Hazards and Plant Safety, Sanjoy Banerjee, Taylor and Francis, New York

Semester – II
PHARMACEUTICAL ENGINEERING
Subject Code: 1612020701020200
Theory (4 Hours / Week; 4 Credits, 60 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
04	00	03	07	08	20	08	20

Course Objectives

- To study basic mechanism of material transportation, this is used in pharmaceutical industries.
- Subject gives the guideline for handling of liquid, solid and gaseous material in various places in pharmacy.

Student Learning Outcome

- By the end of this course, the student should have a good understanding of the basic concepts of material handling in various field of pharmacy.
- Students should be able to know the appropriate instrumental requirement for measurement of various flow of fluid and shifting of solid material.

Sr. No	Course Contents	Total Hrs.
1	Introduction Pharmaceutical engineering and its significance, unit operations and unit processes. Unit systems, SI unit, CgS unit, gas constant and conversion of units. Physical quantities, dimensions and units, dimensional equations, dimensional analysis and dimensionless groups. Different types of graphical representation.	05
2	Stoichiometry General principles, material balance-tie substances, chemical reactions and molal units, rate process, steady, unsteady and equilibrium state, laws of combining weights, applications of gas laws, energy balance, fuels and combustion, etc., Mathematical problems.	12
3	Fluid flow Types of steady flow, Reynold number & its significance, types of pressure, viscosity, concept of boundary layers, total energy balance and total mechanical energy balance, losses in mechanical energy of fluids, basic equations of fluid flow, valves, flow meters, manometers. Mathematical problems.	10

4	Material handling systems Solid handling- storage, conveyers, vacuum & pneumatic conveying. Liquid handling- storage, pumps Gases- Fans, blowers and compressors. Colour coding of Pipelines, use of forklifts and pallets, store design in pharmaceutical industries.	08
5	Heat transfer Modes of heat transfer. Conduction- Fourier's law, resistances in series and parallel, use of mean area and mean temperature difference. Convection- Concept of film, overall coefficient, heat transfer by forced convection in laminar and turbulent flow, condensing vapours, evaluation of individual film coefficients. Radiation-Black body, absorptivity & emissivity. Heating of fluids, steam as heating medium, properties and uses of steam, steam traps, study of steam table. Heat exchange equipments-Heat exchangers, condensers, boilers, extended surface scraped and surface equipments etc. applications of heat transfer in industrial processes. Mathematical problems.	10
6	Mass Transfer Principle, streams in mass-transfer operations, solid/fluid and fluid/fluid mass transfer, influence of mass transfer on unit operations.	07
7	Materials of Pharmaceutical Plant Construction General study of composition, corrosion resistance, properties, factors affecting the selection of material of pharmaceutical plant construction with special reference to stainless steel and glass. Corrosion-types, causes, theories of corrosion and its prevention.	08

Semester – II
PHARMACEUTICAL ENGINEERING
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Aim of the experiment
1	To study conversion factors and use of these conversion factors.
2	To measure the pressure of gas passing through the pipeline by difference type of U tube manometer.
3	To measure the pressure of gas passing through the pipeline by difference type of inclined manometer.
4	To calibrate the given Venturimeter and to find out the co efficient of discharge.
5	To calibrate the given Orificemeter and to find out the co efficient of discharge.
6	To calibrate the given Rotameter with plummet.
7	Measurement of flow of fluids and their pressure and calculate the Reynolds number.
8	To determine the vacuum creating efficiency of ejector pump.
9	To determine the volume transfer efficiency of ejector pump.
10	To measure the velocity head of the fluid using pitot tube.
11	To determine the overall heat transfer coefficient of a given heat exchanger.
12	To determine the efficiency of given lagging material.
13	Demonstration of corrosion resistance of various materials.
14	Introduction to engineering drawing – Demonstration of orthographic and isometric projections, preparation of sheets based on orthographic projections.

Note: Any other practical related to theory topic can be carried out.

References Books

- 1) Elementary Chemical Engineering; Max S. Peters; McGraw Hill Book Company, New York; 1954.
- 2) Perry's Chemical Engineer's Handbook; Robert H Perry, Green D.W., Maloney J.O.; McGraw Hill Inc., New York; 7th Edition, 1998.
- 3) Copper and Gun's Tutorial Pharmacy; S. J. Carter; CBS Publication & Distribution, New Delhi; 2004.
- 4) Unit Operations of Chemical Engineering; McCabe Warren, Smith & Harriott; McGraw Hill Inc., New York; 5th edition; 2001.
- 5) Pharmaceutical Engineering; K. Sambamurthy; New Age International Ltd., New Delhi 2002.
- 6) Pharmaceutics the Science of Dosage Form Design; M.E. Aulton; Churchill Livingstone, London; 2002.

Semester – II
Pharmaceutical Chemistry-II (Organic Chemistry-I)
Subject code: 1612030701020300
Theory (4 Hours / Week; 4 Credits, 60 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
04	00	03	07	08	20	80	20

Course Objective

- The course is designed to make students familiar with the principles of organic chemistry as applied to pharmaceuticals and to study organic compounds used as pharmaceutical aids, therapeutic agents and diagnostic agents.

Students Learning Outcomes

- The course will help the student to have a good understanding of the history and basic concepts of organic chemistry.
- Students should be able to describe in detail synthetic approaches as well as mechanisms of action of some important organic base therapeutic and diagnostic agents.

Sr. No.	Course Contents	Total Hrs.
1.	Structure and Properties Introduction to organic chemistry, quantitative analysis of elements, determination of molecular weight and molecular formula, Atomic structure, atomic orbitals, molecular orbital theory, molecular orbitals, bonding and antibonding orbitals.	08
2.	Chemical bonding and Properties Introduction, covalent bond, hybridization and hybrid orbitals, intermolecular and intramolecular forces, bond dissociation energy, electronegativity, polarity of bonds, polarity of molecules, resonance, hyperconjugation	08
3.	Reactive intermediates of carbon	04

	Carbocation, carbanion, free radical, carbenes, nitrenes, reaction involving these intermediates	
4	<p>Structure, properties, nomenclature, preparation and reactions of the following class of functional groups</p> <ul style="list-style-type: none"> Alkanes, alkenes, alkynes, dienes, alkyl halides, alcohols, ethers, amines, Benzene, phenol, Polynuclear aromatic compounds, [naphthalene, anthracene. 	40

Semester – II
Pharmaceutical Chemistry-II (Organic chemistry-I)
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Content
1	Introduction to safe working in organic chemistry laboratory.
2	Systemic qualitative analysis of organic compounds and preparation of their derivatives {Various examples of organic compounds include, Acidic: Oxalic acid, succinic acid, tartaric acid, citric acid, benzoic acid, salicylic acid, cinnamic acid, p-nitrobenzoic acid, acetyl salicylic acid, Phthalic acid etc; Strong acidic Amphoteric: p-aminobenzoic acid, o-aminobenzoic acid, sulphanilic acid etc.; Weak acidic amphoteric: Sulphanilamide etc.; Phenolic: α -naphthol, β -naphthol, Phenol, Resorcinol, Catechol, o/m/p-nitrophenol, o/m/p-cresol etc.; Basic: Aniline, Nmethyl aniline, N,N-dimethyl aniline, o/m/p-anisidine, o/m/p toluidine, o/m/p chloroaniline, diphenyl amine, o/m/p-nitroaniline etc.; Neutral: Isopropyl alcohol, tert. Butyl alcohol, Acetophenone, benzophenone, acetaldehyde, benzaldehyde, mdinitrobenzene, nitrobenzene, o/m/p/-nitrotoluene, acetanilide, benzanilide, benzamide, acetamide, urea, thiourea, naphthalene, anthracene, chlorobenzene, bromobenzene, ethylacetate, benzyl alcohol, methanol, ethanol, diethyl ether, toluene etc.; * Salt: Sodium benzoate, Sodium salicylate }:
2.1	Preliminary test for given organic compounds. (3)
2.2	Nature identification of given organic compounds (Category: Salts, Acidics, Strong acidic amphoteric, Phenolics, Weak acidic amphoteric, Basics, Neutrals* (6)
2.3	Element detection for given organic compounds(3)
2.4	Oxidizability and bromination test for selected category(3)
2.5	Functional group test for following functional groups: <ul style="list-style-type: none"> Carboxylic acids and phenols. (3)

	<ul style="list-style-type: none">• Basic compounds and amino carboxylic acids. (3)• Aldehyde, ketone, ester, ether, alcohol, amide, acetamido, halogenated and non-halogenated hydrocarbon and nitro compounds (including nitrocarboxylic acid and nitro phenol) (6) Melting point and Boiling point determination of given organic compound (3) Derivatization of functional groups for above selected functional groups(6)
2.6	Identification of given unknown organic compounds for above compounds (9)

Books Recommended (Latest Editions):

1. Organic Chemistry, Robert T. Morrison and Robert N. Boyd, 6th Ed., Pearson Education, 2002.
2. Organic Chemistry, G. Marc Loudon, 4th Ed., Oxford University Press, 2004.
3. Organic Chemistry, Vol I and II by I. L. Finar, 6th Ed., Pearson Education, 2000.
4. Advanced Organic Chemistry, Jerry March, 4th Ed., Wiley India, 2007.
5. Vogel's textbook of practical organic chemistry, 5th Edition, Pearson Education Ltd., 2005.
6. "Experimental Organic Chemistry" L. M. Harwood, L. J. Moody, J. M. Percy, 2nd Edition, Blackwell Science, 2005.
7. Techniques and Experiment of Organic Chemistry, Addison Ault, 6th Edition, University Science Books, 1998.
8. Introduction to Organic Laboratory Techniques, A Microscale Approach, Donald L. Pavia, Gary M. Lampman, George S. Kriz, 3rd Edition, Harcourt College Pub., 4th Edition, 2007.

Semester – II
HUMAN ANATOMY AND PHYSIOLOGY-II
Subject Code: 1612040701020400
Theory (4 hours/week, 4 credits, 60 hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
04	00	03	07	08	20	80	20

Course Objectives

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

- Learn anatomy and physiology of various systems like respiratory, nervous, senses, urinary, endocrine, and reproductive.
- Know various feedback mechanisms that maintain physiological processes.
- Learn various disorders associated with disturbances in normal structural and functional alterations in various systems

Students Learning Outcomes:

- Study of anatomy and physiology as a gateway to careers in health related fields, athletics training etc., as a foundation to advanced scientific studies, or understanding pathology of disease and pathological change, provide base for proper understanding effects of drug on body and factors affecting various physiological processes and its effects.
- Overall effective maintenance of individual and community health.
- Acquisition of intellectual and motor skills.

Sr. No.	Course Contents	Total Hrs.
1	Respiratory System: Anatomy and physiology of various organs of respiratory system, pulmonary ventilation and factors affecting it, lung volumes and capacities, gas laws in relation to exchanges of oxygen and carbon dioxide, external and internal respiration including transport of gases in the blood, control and regulation of respiration, voice production, brief outline of hypoxia, asthma, COPD, emphysema, chronic bronchitis, pneumonia, tuberculosis, pulmonary oedema, sudden infant death syndrome, severe acute respiratory syndrome.	8
2	Nervous system: Organization and functions of nervous system, parts of Neuron, structural and functional classification of neurons, Neuroglia, Myelination, Gray and white matter, Graded potential, Resting membrane potential, Generation and propagation of Nerve action potential, Signal transmission at synapses, Post synaptic potentials (EPSP, IPSP) and their summation, Brief overview of various types of neurotransmitter, Overview of nervous disorders like multiple	22

	<p>sclerosis, epilepsy etc. Anatomy of spinal cord (External, Internal), Protective structures of Spinal cord and nerves, names and functions of spinal nerves, physiology of spinal cord, sensory and motor tracts, reflexes and reflex arcs, brief outline of meningitis and poliomyelitis Major parts and protective coverings of brain, blood brain barrier, CSF, medulla oblongata, pons, midbrain, reticular formation, cerebellum, thalamus, Epithalamus, subthalamus, hypothalamus, cerebral cortex, lobes of cerebrum, cerebral white matter, basal nuclei, limbic system, sensory, motor and association areas of cerebral cortex, brain waves, cranial nerves names and functions, brief outline of cerebrovascular accident, transient ischemic attack, Alzheimer's disease, Dementia, Encephalitis, Attention Deficit Hyperactivity Disorder Comparison of somatic and autonomic nervous system, Anatomy of autonomic motor pathways (preganglionic neurons, autonomic ganglia, postganglionic neurons, enteric neurons), Synthesis, release and removal of neurotransmitters (e.g. Acetylcholine, Nor adrenaline), Physiology of the ANS, comparisons of sympathetic and parasympathetic divisions of ANS.</p>	
3	<p>Special Senses: Basics Sensory modalities, Process of sensation, sensory receptors, somatic sensation, somatic sensory and motor pathways, Brief outline of Parkinson's disease, Amyotrophic lateral sclerosis. Olfactory receptors, physiology of olfaction, Anatomy of taste buds and papillae, physiology of gustation, Accessory structures of eyes, anatomy of eyeball, image</p>	6
4	<p>Urinary System: Anatomy of kidney, nephron, functions of renal system, glomerular filtration, tubular reabsorption and tubular secretion and their regulation, formation of urine, ureter, urinary bladder, urethra, brief outline of renal calculi, urinary tract infection, glomerular disease, renal failure, acid base balances and imbalances.</p>	8
5	<p>Hormones and its regulations: Hormone, its type, endocrine (pituitary gland, thyroid, parathyroid, adrenals, Pancreas, testes and ovary) and exocrine glands, their secretion, regulation of secretion, functions and disorders</p>	8
6	<p>Reproductive System: Gross Anatomy of male reproductive system and their functions, sperm and spermatogenesis, and related sex glands. Gross Anatomy of Female reproductive system and their functions, Ovum and Oogenesis, Physiology of Menstruation Family planning, various contraceptive methods, Medical termination of pregnancy (Abortion), Brief outline of erectile dysfunction (Impotence), Premenstrual syndrome, Male and female infertility, endometriosis, Benign prostatic hyperplasia.</p>	8

Semester – II
Human Anatomy and Physiology-II
Practical (3 hours/week, 3 credits, 45 hours)

Sr. No.	Course Contents
1	Biochemical analysis of urine: physical characteristics, normal constituents
2	Biochemical analysis of urine: abnormal constituents
3	Identify the constituents of urine in unknown sample
4	Study anatomy of Respiratory system using charts and models
5	Study anatomy of Nervous system using charts and models
6	Study anatomy of Ear and Eye using charts and models
7	Study anatomy of Urinary system using charts and models
8	Study anatomy of Male & Female reproductive system using charts & models
9	Study histology and functions of various organs of Respiratory system and nervous system using slides
10	Study histology and functions of various organs of slides urinary system and male and female reproductive system using slides.
11	Study of various contraceptive techniques using charts
12	Determination of body temperature and study of learning and memory (Short term and long term)
13	Determination of lung function a. Determination of lung volumes and vital capacity using Spirometer /Flowmeter b. Determination of breath holding time
14	Determination of vision acuity a. Near Point and near response b. Determination of Stereoscopic vision c. Dominance of the eye
15	Determination of other special senses a. Temperature sensations b. Sensation of taste c. Sensation of smell

*** Any experiment demonstrating theoretical concept can be added to the above list**

Books Recommended (Latest Editions):

1. Tortora Gerard. J. and Derrickson Bryan. Principles of Anatomy and Physiology (International Student Edition 13th edition- Wiley)
2. Guyton A.C. and Hall J.E. : Textbook of Medical Physiology – 10th Edition– W. B. Saunders
3. Waugh A. and Grant A.: Ross and Wilson's Anatomy and Physiology in Health illness —

- Churchill Livingstone
4. Chatterjee C. C. Human Physiology (Medical Allied Agency, Calcutta)
 5. West, J. B. Best and Taylor's physiological Basis of Medical Practice (Williams and Wilkins, Baltimore)
 6. Martini, F. Fundamentals of Anatomy and Physiology (Prentice Hall)
 7. Goyal R. K. & Mehta A.A. Human Anatomy Physiology and Health Education, (B. S. Shah Prakashan)
 8. Garg K. et al. A Text Book of Histology (CBS Publishers, New Delhi)
 9. Sobotta : Atlas of Human Anatomy (2 Volumes) –Edited by Putz and R. Pabst, Lippincott, Williams and Wilkins
 10. Anne M. R. Agur& Ming J. Lee: Grant's Atlas of Anatomy –Lippincott, Williams and Wilkins
 11. Gosling T.A., Harris P.F., Whitmore I., William, Human Anatomy: Color Atlas and Text -Mosby
 12. Joshi Vijaya D. Preparatory Manual for Undergraduates Physiology (B.I. Churchill Livingstone)
 13. Textbook of practical Physiology C.L. Ghai (Jaypee Brothers Medical publishers)
 14. Goyal R.K. et al.: Practical Anatomy Physiology and Biochemistry (B. S. Shah Prakashan, Ahmedabad)
 15. Garg K. et al. A Text Book of Histology (CBS Publishers, New Delhi)
 16. Lesson C. R. et al.: Text Book of Histology (W.B. Saunders Company)

Semester II
PHARMACOGNOSY-I
Subject Code: 1612050701020500
Theory (4Hours / Week; 4 Credits, 60Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
4	0	3	7	80	20	80	20

Objective of the course:

- This is an introductory course in Pharmacognosy, which gives basic study of natural sources such as plant. This subject has been introduced to the pharmacy course in order to make the student aware of various naturally occurring drugs and its history, sources, classification, distribution and the characters of the plants and animals.

Students Learning Outcome

- Understand different types of adulteration of crude drugs.
- Understand different evaluation methods ascertain the presence or absence of adulteration.
- Recognize the crude drugs mentioned in the course.
- Learn the pharmacognostic aspects specifically, the sources, the preparation methods and utilization of those substances obtained from the natural sources.
- Learn different classes of phytoconstituents along with their exact definition and physico-chemical properties and the preliminary chemical tests to detect those from plants / plant extracts.

Sr No	Course Contents	Total Hrs
1	Definition, history, scope and development of Pharmacognosy.	2
2	Sources of drugs: Plant, Animal, Marine, Mineral and Biotechnology	3
3	Microscopy: Various tools used in microscopy (Microscopes, micrometer, Camera Lucida, microphotography), General use of different reagent used in microscopy	3

4	Plant Kingdom: <ul style="list-style-type: none"> • Plant cell: its structure and non-living inclusions, different types of plant tissues and their functions. • Plant tissues system • Plant kingdom and its classification • Morphology of plants: Root, Stem, Leaf and Its modifications • Inflorescence and Pollination of flowers • Morphology of fruits, seeds and wood & bark 	24
5	Classification of drugs: Alphabetical, Morphological, Taxonomical, Chemical and Pharmacological. Role of chemotaxonomy in classification.	5
6	Cultivation, collection, processing and storage of crude drugs <ul style="list-style-type: none"> • Factors influencing cultivation of medicinal plants. • Types of soils and fertilizers of common use. • Plant hormones and their applications. • Polyploidy, Mutation and Hybridization with reference to medicinal plants. • Poly Houses/Green Houses for cultivation. 	10
7	Evaluation of crude drugs by organoleptic, microscopic including quantitative microscopy and qualitative microscopy, physical, chemical, biological and other methods. Adulteration of crude drugs. WHO guidelines for evaluation of Herbal drugs.	6
8	Carbohydrates and derived products: Definition, classification, Physico-chemical properties, general methods of preparation, sources and systematic Pharmacognostic study of following drugs. Monosaccharide: Honey Polysaccharides: Starch, Dextrin Gums and Mucilage: Agar, Isabgol, Guargum, Acacia, Tragacanth, Sodium Alginate, Stercuila Carbohydrate derivatives: Chitin and Pectin	7

Semester-II

PHARMACOGNOSY-I

Practical (3Hours / Week; 3 Credits, 45Hours)

Sr No	Course Contents
1.	Use, Care and types of Microscopes, Techniques in microscopy.
2.	Morphology of leaf, stem, root, flowers, fruits, bark and seeds
3.	Microscopy of plant tissues and their components.
4.	Microscopy of monocot and dicot leaf, stem, root.

5.	Microscopy of cell contents: Starch grains, Calcium oxalate crystals and Phloem
6.	Quantitative microscopy (Determination of leaf constants).
7.	Carbohydrates: Study of crude drugs for morphology and chemical test for saccharides, gum and mucilage. Isolation of Potato starch. Microscopy of Maize, wheat, potato and rice starch.
8.	Preparation of Herbarium sheet

Recommended Books:

1. Concepts in Molecular Biology, by S. C. Rastogi, Willey eastern Ltd., Mumbai.
2. A Text Book of Pharmaceutical Biology by S. Sardana, O. P. Sharma.
3. Text book of Biology by S. B. Gokhale
4. A Text book of Biology by Naidu and Murthy
5. Botany for Degree students By A.C.Dutta.
6. A manual for pharmaceutical biology practical by S. B. Gokhale and C. K. Kokate
7. Cultivation and Utilization of Medicinal Plants, Atal C. K. and Kapur B. M., RRL Jammu, 1st Edition, 1989.
8. Supplement to Cultivation and Utilization of Medicinal Plants, Handa, S.S. and Kaul, M.K., 1996. RRL, CSIR Publication, Jammu Tawi.
9. Pharmacognosy: C. K. Kokate, A. P. Purohit, S. B. Gokhale, Nirali Prakashan Pune, 42nd edition, 2008.
10. Trease and Evans Pharmacognosy. 16th Edition, William Charles Evans, W. Saunders, Edinburgh London New York Philadelphia St. Louis Sydney Toronto 2009.
11. A Text book of Pharmacognosy: C. S. Shah, J. S. Quadry, B. S. Shah Prakashan, Ahmadabad. 15th Edition, 2009.
12. Practical pharmacognosy: K. R. Khandelwal, Nirali Prakashan Pune, latest edition.

Semester – III
PHYSICAL PHARMACY
Subject Code: 1612010701030100
Theory (4 Hours / Week; 4 Credits, 60 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
4	0	3	7	80	20	80	20

Course Objectives

- To study basic physical characterization of solid, liquid and gaseous material which are used during various preparations of formulations. Applications of solid state, solubility, electrolyte and non-electrolyte solutions in preparation of various dosage forms.
- Subject gives the guidelines for micromeritics, rheology, surface tension and applications of surface and interfacial phenomenon in pharmaceutical sciences.

Students Learning Outcomes

Upon completion of the subject student shall be able to –

- Good understanding of the basic concepts of derive properties and measurements powders, rheological properties of liquids and mixing of materials in various field of pharmacy.
- To know the methods Complexation of polymer and drug material.
- Good understanding of the dispersion system including colloids, suspension, emulsion and their applications.
- To know the chemical kinetics and importance of stability in pharmaceutical sciences.

Sr. No	Course Contents	Total Hrs.
1	States of Matter Introduction, binding forces between molecules, states of matter-solids, liquids, gases, liquid crystals, glassy state, phase equilibrium and phase rule, condensed systems	05
2	Solubility and Distribution Phenomenon General principles, solvent-solute interactions, solubility of gases in liquids, solubility of liquids in liquids, solubility of solids in liquids, distribution of solutes between immiscible solvents.	06
3	Solution of Non-electrolytes and Electrolytes Properties and types of solutions, ideal and real solutions, various concentration terms, Raoult's law and it's deviations, boiling point and boiling point diagram, Colligative properties: elevation of boiling point, depression of freezing point, and osmotic pressure, problems involving molecular weight	07

	determinations, Solution of electrolytes: equivalent and specific conductance, conductometric titration, Arrhenius theory, Debye Huckel Theory, Colligative properties of electrolytes	
4	Micromeritics and Powder Rheology Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, measurement of particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders (angle of repose, carr's index and hausner ratio) porosity, packing arrangement, densities, bulkiness and flow properties.	07
5	Viscosity and Rheology Newtonian systems, Law of flow, kinematic viscosity, effect of temperature on viscosity, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, Determination of viscosity: capillary, falling ball, rotational viscometers, rheopexy, negative thixotropy, viscoelasticity, psychorheology, applications of rheology in pharmacy	08
6	Surface and Interfacial Phenomenon Surface and interfacial tension, Surface free energy, measurement of surface and interfacial tension, spreading coefficient, adsorption at liquid- interfaces, surfactants (Types, HLB scale and its applications including wetting, foaming antifoaming, and micellar solubilization), soluble monolayer and Gibbs equation, insoluble monolayer and film balance, adsorption at solid interfaces, adsorption isotherms, (Langmuir and Freundlich), Measurement of surface free area, Electrical Properties of interfaces: Nerst and Zeta Potential., Electrical double layer	07
7	Dispersion systems Colloids: Introduction and types, optical, kinetic and electrical properties of colloids, Protective colloids, stabilization of colloidal system, DLVO theory, Schulz Hardy rule, Hoffemeister series, Application in pharmacy. Importance of thermodynamic principles in solubilization Suspensions and Emulsions: Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicle, rheological considerations, emulsions; types, theories, physical stability.	12
8	Chemical Kinetics and Stability Reaction theories, rate, order and molecularity, mathematical treatment of zero, first and second order, complex reaction: reversible, parallel and side reactions, steady state and rate determining step, determination of order, Effect of temperature, Arrhenius equation and energy of activation, meaning of stability of pharmaceuticals, kinetic aspects of chemical degradation of drugs, understanding of statistical aspect of expiry period, degradation pathways, physical & chemical instability & evaluation methods, Accelerated stability	05

	studies	
9	Complexation Classification of complexes, methods of preparation and analysis, applications	03

Semester – III
PHYSICAL PHARMACY
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Aim of the experiment
1	Determination of Critical solution temperature of Phenol water system.
2	Solubility of solids.
3	Determination of surface tension of given liquid
4	Determination of critical micelle concentration of a surfactant and spreading co coefficients by stalagmometer.
5	Determination of Surface/Interfacial tension and HLB value of surfactant
6	Determination of partition coefficient of benzoic acid between water and benzene.
7	To determine angle of repose of powder and to study effect of glidants on angle of repose.
8	Determination of particle size using microscopic and Sieve analysis method.
9	Determination of derived properties of powders (Density, Porosity, Compressibility)
10	To determine effect of temperature on viscosity of given liquid.
11	To determine the viscosity of Newtonian liquid and to calculate relative, absolute and kinematic viscosity.
12	Preparation of various types of suspensions
13	Determination of their sedimentation parameters of suspensions.
14	Preparation of emulsion.
15	To find out type of emulsion and to determine stability of emulsion by Centrifugation

Note: Any other practical related to theory topic can be carried out.

References Books

- 1) Martin's Physical pharmacy by Patrick J. Sinko, Lippincott Williams & Wilkins, New York,
- 2) Pharmaceutics: The Science of Dosage Form Design, Aulton, Michael E., Churchill Livingstone.
- 3) Remington: The Science and Practice of Pharmacy, Vol-I & II, Gennaro, Alfonso R., Lippincott Williams & Wilkins, New York.

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- 4) Physicochemical Principles of Pharmacy, Florence, A. T. Atwood, D. Macmillan Press Ltd., London.
 - 5) Pharmaceutical Dosage Forms and Drug Delivery Systems, Ansel, Howard. C., Allen, Loyd V., Popovich, Nicholas G. Lippincott Williams & Wilkins, New York.
 - 6) Cooper and Gunn's Tutorial Pharmacy, ed. Carter, S. J., CBS Publishers & Distributors, Delhi.
 - 7) Bentley's textbook of Pharmaceutics by E. A. Rawlins
 - 8) Handbook of Practical Physical Pharmacy and Physical Pharmaceutics by U. B. Hadkar, Nirali Prakashan, 4/Ed., 2007, Pune
 - 9) Practical Physical Pharmacy by H.N. More and A. A. Hajare, Career Publication. 1/Ed, 2007, Nashik
 - 10) Practical Physical Pharmacy by Gaud and Gupta, Nirali Prakashan
 - 11) Practical Physical Pharmacy, Gurtoo and Kapoor.

Semester – III
Pharmaceutical Chemistry-III (Organic Chemistry-II)
Subject code: 1612020701030200
Theory (4 Hours / Week; 4 Credits, 60 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
04	00	03	07	08	20	80	20

Course Objective

- Introduce students to Organic Chemistry with emphasis on basic organic chemistry with respect to chirality, optical activity, stereoisomers, racemic mixture etc. Cover areas of organic chemistry with respect to different functional groups, like aldehyde, ketones etc. Study on nucleophilic substitution, heterocyclic compounds. Recent area of organic chemistry like nanochemistry, green chemistry and microwave synthesis.

Students Learning Outcomes

- The curriculum of the Department is designed to satisfy the diverse needs of students. Advanced coursework and educational activities outside the traditional classroom.
- At graduation, chemistry majors should have a set of fundamental competencies that are knowledge-based, performance/skills-based, and affective.
- Graduates will be able to solve problems competently by identifying the essential parts of a problem and formulating a strategy for solving the problem. They will be able to rationally estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of the solution, and interpret their results.

Sr. No.	Course Contents	Total Hrs.
1.	Stereochemistry: <ul style="list-style-type: none"> • Chirality • Optical activity (dextro and leavo rotation concept) • Stereoisomerism • Enantiomers, Diastereomers, Mesomers with physical, chemical and biological properties of the same. • Geometrical isomers and its nomenclature. Physical and chemical properties of the same • Racemic mixture and its resolution methods. 	18

	<ul style="list-style-type: none"> • Specification of configuration: Relative configuration (L and D), • Absolute configuration (R and S) (CIP Rules) • Axial Chirality: Stereochemistry of Allene, spiran and Biphenyl. • Conformational isomers: Alkanes and Cyclohexane 	
2.	Structure, properties, nomenclature, preparation and reactions of following class of functional groups <ul style="list-style-type: none"> • Aldehydes and ketones, • Carboxylic acids and their derivatives. 	18
3.	Unsaturated carbonyl compounds, Nucleophilic aromatic substitution	03
4	Heterocyclic compounds: Structure, nomenclature, chemistry, preparation and properties of <ul style="list-style-type: none"> • Furan, thiophene, pyrrol and pyridine • Pyrazole, imidazole, oxazole, isoxazole and thiazole • Pyridine and pyrimidine • Quinoline, isoquinoline and indole 	18
5.	Introduction, principles and applications of: <ul style="list-style-type: none"> • nanochemistry • microwave synthesis • green chemistry 	03

Semester – III
Pharmaceutical Chemistry-III (Organic chemistry-II)
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Content	Total Hrs.
1	<p>Qualitative analysis of unknown organic compound according to the following list of organic compounds :</p> <p>1.1 – Identification and characterization of given unknown organic compound (Salts/Acids/Strong acidic Amphoteric)</p> <p>1.2 – Identification and characterization of given unknown organic compound (Phenolics/Basics)</p> <p>1.3 – Identification and characterization of given unknown organic Compound (Neutrals)</p> <p>1.4 – Identification and characterization of given unknown organic compound (Salts/Acids/Strong acidic Amphoteric/Phenolic/Basics Neutrals)</p> <p>1.5 – Identification and characterization of given unknown organic compound (Salts/Acids/Strong acidic Amphoteric/Phenolic/Basics/Neutrals)</p> <p>List of organic compounds:</p> <p>a. Salts: Sodium benzoate, Sodium salicylate etc.</p> <p>b. Acidics: Benzoic acid, Salicylic acid, Cinnamic acid, Acetyl salicylic acid, Phthalic acid etc.</p> <p>c. Strong acidic Amphoteric: p-Aminobenzoic acid, o-Aminobenzoic acid, Sulphanilic acid etc.</p> <p>d. Weak acidic Amphoteric: Sulphanilamide etc.</p> <p>e. Phenolics: o/m/p-nitrophenol, alpha/beta-naphthol, o/m/p-cresol etc.</p>	15

	<p>f. Basics: Aniline, N-Methyl aniline, N,N-Dimethyl aniline, o/m/p-Anisidine, o/m/p-Nitroaniline, p-Chloroaniline, o/m/p toluidine etc.</p> <p>g. Neutrals: Acetophenone, Benzaldehyde, m-Dinitrobenzene, Nitrobenzene, Chlorobenzene, Bromobenzene, Acetanilide, Benzamide, Anthracene, Naphthalene, Benzophenone isopropyl alcohol, tert butyl alcohol</p>	
2	<p>Introduction and detailed demonstration to various synthetic techniques and apparatus used therein:</p> <p>2.1 Heating and cooling methods, distillation, reaction work-up, filtration and extraction.</p> <p>2.2 Purification and identification</p>	06
3	<p>3.1 Synthesis and purification of selected organic compounds:</p> <ol style="list-style-type: none"> 1. Synthesis of p-nitroacetanilide from acetanilide (Nitration) 2. Synthesis of p-bromoacetanilide from acetanilide (Halogenation) 3. Synthesis of p-nitroaniline from p-nitroacetanilide (Hydrolysis) 4. Synthesis of P-bromoaniline from p-bromoacetanilide (Hydrolysis) 5. Synthesis of benzil from benzoin (Oxidation) 6. Synthesis of benzylideneacetophenone (Chalcone) from acetophenone and benzaldehyde (Condensation reaction) 7. Synthesis of Magneson-II from p-nitroaniline (Diazotization). <p>Monitoring progress of reaction by Thin Layer Chromatography (TLC) with the help of any one of above selected reaction.</p>	21
4	Introduction to the use of stereomodels	03

Reference Book:

1. Organic Chemistry, Robert T. Morrison and Robert N. Boyd, 6th Ed., Pearson Education, 2002.
2. Organic Chemistry, G. Marc Loudon, 4th Ed., Oxford University Press, 2004.
3. Organic Chemistry, Vol I and II by I. L. Finar, 6th Ed., Pearson Education, 2000.
4. Advanced Organic Chemistry, Jerry March, 4th Ed., Wiley India, 2007.
5. Vogel's textbook of practical organic chemistry, 5th Edition, Pearson Education Ltd., 2005.

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6. "Experimental Organic Chemistry" L. M. Harwood, L. J. Moody, J. M. Percy, 2nd Edition, Blackwell Science, 2005.
 7. Techniques and Experiment of Organic Chemistry, Addison Ault, 6th Edition, University Science Books, 1998.
 8. Introduction to Organic Laboratory Techniques, A Microscale Approach, Donald L. Pavia, Gary M. Lampman, George S. Kriz, 3rd Edition, Harcourt College Pub., 4th Edition, 2007.

Semester – III
PHARMACEUTICAL ANALYSIS-I
Subject Code: 1612030701030300
Theory (4 Hours / Week; 4 Credits, 60 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
04	00	03	07	80	20	80	20

Course Objectives

- Introduce students to basics of drugs and formulation analysis with emphasis on its application in quality control and quality assurance.
- Cover areas including Acid-base titrations, Redox titrations, Argentometric or precipitation titrations, Nonaqueous titrations, Complexometric titrations, Karl-Fischer titrations, Kjeldahl method, Gravimetric analysis Students Learning.

Outcomes

- To demonstrate an understanding of the theory and applications of the most common basic methods of pharmaceutical analysis.
- Learn the practical aspects of various titration techniques with calibration of glassware and checking precision and lower limit of quantitation of titrimetric methods.

Sr. No.	Course Contents	Total hrs
1	Basics of drugs and formulation analysis Weights, balances, importance of analysis, quality control and quality assurance, analytical methods (classification, validation parameters), requirements–chemicals(types,purification,checkingpurity),glasswares (types, calibration, cleaning), sampling techniques, sampling error minimization.Units ofconcentrations.Errors science,errors minimization.	06
2	Volumetric analysis (Titrimetric analysis)	
2.1	Acid-base titrations Relative strength and its effect on titration, common ion effect, pH, Henderson-Hasselbach equation, buffers, neutralization curve, acid base indicators, theory of indicators, back titrations, biphasic titrations,	15

	Pharmacopoeial applications, hydrolysis of salts, ionic products of water and law of mass action.	
2.2	Redox titrations Theory of redox titrations, redox indicators, types of redox titrations, Iodometry, cerimetry, mercury metry, diazotization nitrite titrations, 2,6-dichlorophenolindophenol titrations, titration curve and calculations of potentials during course of titrations.	12
2.3	Argentometric or precipitation titrations Mohr's, Fajans and Volhard methods	06
2.4	Nonaqueous titrations Nonaqueous solvents, titrant and indicator. Differentiating and levelling solvents.	05
2.5	Complexometric titrations Theory of the titrations, titrant, indicators and pharmacopoeial applications.	06
2.6	Miscellaneous titrations Karl-Fischer titrations, Kjeldahl method.	03
3	Gravimetric analysis Stability, solubility products, types of precipitations, precipitation techniques, Pharmacopoeial applications	07

Semester – III
PHARMACEUTICAL ANALYSIS-I
Practical (3hours/week, 3credits, 45 hours)

Sr. No.	Practical Contents
1	Calibrations/cleaning of glasswares
2	Acid-basetitrations, Simple,backtitrations
3	Redox titrations
4	Complexometric titrations,backtitrations
5	Nonaqueous titrations
6	Argentometric titrations
7	Gravimetric assay ofPharmacopoeial drug

BooksRecommended(LatestEditions):

1. Pharmacopoeia:USP,B.P.,I.P.
2. Practical Pharm. Chemistry, Vol. I –Backett, The athlonePress of University of London.
3. Fundamentals of Analytical Chemistry– Skoog,Harcourt College Publishers.
4. Quantitative chemical analysis– Vogel A. I.,Pearson Education.
5. Text BookofPharmaceutical Analsys– K.A.Connor, John Willey&Sons,NewYork.
6. Quantitative Chemical Analysis– Ayer by Harper & Row,NewYork.
7. Text Book of Inorganic Chemistry — A.I. Vogel.
8. Principles of Instrumental Analysis by skoog, holler, Nieman, 5th edition.
9. Instrumental methods of Analysis, H.H. Willard, L.L. Meritt, J.A. Dean and F.A. Settle Wadsworth, New York
10. Pharmaceutical Analysis: Modern methods Part A, Part B, James W. Munson.

Semester – III

PATHOPHYSIOLOGY

Subject code: 1612040701030400

Theory (2 Hours / Week; 2 Credits, 30 Hours)

Teaching Scheme				Evaluation Scheme	
Theory	Tutorial	Practical	Total	Theory	
				External	Internal
3	0	0	3	80	20

Objective of the Course:

- To make students understand the concept of pathophysiology which is a prime requirement to understand the concepts of pharmacology.

Student Learning Outcomes:

- Students will be familiar with the principles of Pathophysiology underlying diseases like cellular adaptation, injury and death, inflammation and repair.
- Students will learn basic concepts of pathogenesis related to major diseases including immunological disorders.
- Students will be able to understand the adverse impact of environmental and nutritional imbalances and radiation on human.

Sr. No.	Course Contents	Total Hrs.
1	Basic concepts of Pathophysiology	01
2	Basic Principles of cellular adaptation, cell injury and cell death including necrosis and apoptosis, subcellular alterations due to injury	08
3	Inflammation: Definition, types and etiology of inflammation, Pathogenesis of acute and chronic inflammation, chemical mediators of inflammation	06
4	Pathology of Tissue Repair Process: Control of cell proliferation, Growth factors and extra cellular matrix, Cell and tissue regeneration, repairs of wound in skin, pathological aspects of repair.	05
5	Immunological Disorders: Introduction, Hypersensitivity(type I,II,III,IV with examples of diseases), allergy due to food, chemicals, drugs; Autoimmunity (Immunological tolerance, mechanism of autoimmunity); transplantation and mechanism of allograft rejection; Autoimmune diseases (Systemic Lupus erythematosus, Rheumatoid arthritis, Systemic sclerosis, Inflammatory myopathies, Mixed connective tissue disease, polyarteritis nodosa and other vasculitides), AIDS, Amyloidosis.	07
6	Environmental and nutritional diseases: Air pollution and smoking, SO ₂ , NO, NO ₂ and CO; protein calorie malnutrition, pathogenesis of starvation, vitamins, obesity.	02

7	Biological effects of radiation	01
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Text/reference Books (Latest Edition):

- Text book of Physiology by Guyton and Hall
- Pathologic basis of disease by- Cotran, Kumar, Robbins
- Text book of Pathology- Harsh Mohan

Semester III
PHARMACOGNOSY II
Subject Code: 1612050701030500
Theory (4 Hours / Week; 4 Credits, 60 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
4	0	3	7	80	20	80	20

Objective of the Course:

- The objective of the course is to make students familiar with the concept of Pharmacognosy, the scientific studies of the natural products utilized as drugs.
- To study about different Pharmacopoeia and be familiar about all monographs.
- To introduce the students to phytochemical and Pharmacognostic features of lipid and Volatile oils containing drugs.
- To introduce the students to phytochemical and Pharmacognostic features of Pharmaceutical Aids containing drugs.

Student Learning Outcomes / Objectives:

- At the end of the course, the student should understand the preliminary basis of Pharmacognosy.
- The students are expected to understand different Monographs of Pharmacopoeia.
- Differentiate between different types of the organs of medicinal plants
- Study the different volatile oil preparation and its content and evaluation.

Sr No	Course Contents	Total Hrs
1	Pharmacopoeial studies: IP, BHP, API, IHP, USP and Chinese Pharmacopoeia	4
2	Pharmaceutical Aids: Study of pharmaceutical aids like Talc, Diatomite, Kaolin, Bentonite, Gelatin	5
3	An introduction to active constituents of drugs and their classification, properties and chemical tests.	5

4	<p>Volatile Oils: Definition, classification, physicochemical properties, general methods for isolation, source, cultivation, collection, commercial varieties and systematic pharmacognostic study of volatile oils containing drugs.</p> <p>Alcohol: Coriander, Geranium, Sandal wood</p> <p>Esters and Alcohol: Rose, Mentha</p> <p>Aldehyde: Cinnamon, Cassia, Lemon peel, Orange peel, Lemongrass, Eucalyptus, Cumin</p> <p>Ketone: Caraway, Dill</p> <p>Phenol: Clove, Tulsi, Ajowan</p> <p>Ether: Star Anise, Fennel, Nutmeg, Cardamom</p> <p>Others: Gaultheria, Valerian, Vaj, Vetiver, Nagarmotha, Garlic, Saffron, Vanilla</p>	32
5	<p>Lipids: Definition, classification, physico-chemical properties, general methods of preparation, sources and systematic Pharmacognostic study of following drugs.</p> <p>Fixed oil: Castor oil, Olive oil, Hydnocarpus oil, Sesame oil, Linseed oil, Mustard oil, Rape seed oil, Rice bran oil, Cod liver oil, Shark liver oil, Karanj oil</p> <p>Fat: Lard, Cocoa butter, Kokum butter</p> <p>Wax: Beeswax, Wool fat.</p>	14

Semester-III
PHARMACOGNOSY-II
Practical (3 Hours /Week; 3Credits, 45Hours)

Sr No	Course Contents
1	Lipid: Study of crude drugs for morphology, chemical test, study of acid value, Iodine value and saponification value.
2	<p>Study the Morphology of Volatile oil containing following drugs. Perform Microscopy(TS and Powder) and TLC of underlined drugs</p> <p>Leaf drugs: <u>Mentha</u>, <u>Eucalyptus</u>, Lemongrass, Gaultheria, Tulsi, Basil, Geranium, Rosemary, Thyme</p> <p>Bark and Peel: <u>Cinnamon</u> (Ceylon and Chinese), Orange peel, Lemon peel</p> <p>Umbelliferous fruits: <u>Fennel</u>, <u>Coriander</u>, Dill, Ajowan, Caraway, Cumin, Star anise</p> <p>Flower drugs: <u>Clove</u> and Rose</p> <p>Seed and wood: <u>Cardamom</u>, Nutmeg, Sandal wood</p> <p>Rhizome: <u>Vaj</u>, Valerian, Nagarmoth, Garlic</p>

3	Demonstration of methods for isolation of volatile oil from crude drugs.
4	Isolation of Thymol / Eugenol / Menthol
5	Study of Morphology and chemical tests of Talc, Diatomite, Kaolin, Bentonite, Gelatin

Recommended Books:

1. A Text book of Pharmacognosy: C. S. Shah, J. S. Quadry, B. S. Shah
Prakashan, Ahmadabad.15th Edition, 2009.
2. Textbook of Pharmacognosy:T. E.Wallis, CBS Publishers and Distributors, New
Delhi, 5th Edition, reprinted, 2009.
3. Pharmacognosy: C.K.Kokate, A. P. Purohit, S. B. Gokhale, Nirali Prakashan Pune,
42nd edition, 2008.
4. Pharmacognosy: V. E. Tyler, L. R. Brady, J. E. Habbers, Lea and Febiger
Philadelphia, 9th Edition, 1988.
5. Trease and Evans Pharmacognosy.16th Edition, William Charles Evans, W.
Saunders, Edinburg London NewYork Philadelphia St.Louis Sydney Toronto
2009.
6. Essentials of Pharmacognosy by Ansari S.H., Birla Publications Pvt.Ltd, 4th Edition,
2011.
7. Pharmacognosy of Powdered crude drugs-M. A. Iyenger (Manipal Power Press)
8. Practical Pharmacognosy, Technique and Experiment by C. K. Kokate and S.
B.Gokhale, NiraliPrakashan, Pune, 8th edition, 2005.
9. Quality Control, Herbal Drugs, An approach to evaluation of Botanicals. Dr.Pulok K.
Mukherjee. Business Horizons PharmaceuticalPublishers;2002
10. The Practical Evaluation of Phytopharmaceutics by Brain K.R. and Turner
R.D., Wrihth-Sciencetchnics Bristol.
11. Malati G Chanhnan & A. P. G Pillai, Microscopic profile of powdered drugs
used in Indian system of medicine,Volume I, Bark drugs 2005,Institute of
Ayurvedic medicinal plant science, Gujarat Ayurved unit Jamnagar; CPTA
12. Malati G Chauhan &A. P. G Pillai, "Microscopic profile of powdered drugs used in
Indian systems of Medicine, Leaf Drugs, Vol. 2, 2007, Institute of P.G Teaching
& Research in Ayurveda, Gujarat Ayurved University, Jamnagar.
13. Malati G Chauhan & A.P.G Pillai, "Microscopic profile of Drugs used in Indian
system of Medicine, Seed drugs, Volume- 3,part- 1,2011; Publisher:Prof Malati G
Chauhan, P.G T- S.FCcell, I.P.G T.& R.A, Gujarat Ayurved University, Jamnagar.
14. Practical pharmacognosy: K.R. Khandelwal, Nirali Prakashan Pune, latest edition.

Semester – III

MANAGEMENT PROCESS AND ORGANIZATIONAL BEHAVIOR**Subject code: 1612060701030600***Theory (3 Hours / Week; 3 Credits, 45 Hours)*

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	0	3	80	20	0	0

Objective of the Course

This course will expose the students to the different functions performed by managers and the roles they have to assume for those functions. It will also provide an overview of the skills required by managers for the different roles and functions. In addition, the course will help students to understand human beings and what motivates them for higher performance in organizational settings.

The objectives of this course are:

To expose the students to the different functions performed by managers, the roles they have to play for those functions, and the knowledge and skills they have to develop for the roles through real life examples and cases;

- To help the students develop an understanding of concepts and tools like MBO and SWOT to develop proficiency in the planning of activities of an organization.
- To enable the students to appreciate the importance of entrepreneurship, innovation and leadership and to help them realize the need for collaboration and networking in the management of any functional area of management;
- To provide the necessary foundation for all other courses based on management practices across the world
- To expose the students to the environmental and organisational context, cognitive processes and dynamics of organisational behavior; and
- To enable them to manage and lead for high performance with the human being at the centre of the organisation.

Student Learning Outcomes/ Objectives

At the end of the course, the participant should have clear exposure to the functional areas of management and the roles managers assume for managerial performance.

Sr. No.	Course Contents	Total Hrs.
1	Foundations of Management <ul style="list-style-type: none"> ➤ Managing ➤ The Excellent Environment and Organizational Culture ➤ Managerial Decision Making 	08
2	Planning and Strategizing	07

	<ul style="list-style-type: none"> ➤ Planning and Strategic Management ➤ Ethics, Ethical Behaviour in Organizations and Corporate Responsibility ➤ International Management ➤ Entrepreneurship 	
3	Organizing <ul style="list-style-type: none"> ➤ Organization Structure ➤ Organizational Agility ➤ Human Resource Management, Especially with Diverse Work Force ➤ Types of Organizations and Basis for Choice of Different Types 	08
4	Leading <ul style="list-style-type: none"> ➤ Leadership ➤ Leadership Styles and Skills ➤ Theories of Leadership ➤ Teamwork and Negotiation 	07
5	Controlling <ul style="list-style-type: none"> ➤ Managerial Control ➤ Managing Technology and Innovation ➤ Creating and Managing Change 	03
6	Organizational Culture <ul style="list-style-type: none"> ➤ Organizational Theory ➤ Creating and Maintaining Organizational Culture ➤ Rewards and Recognition in Organizational Settings 	03
7	Cognitive Processes of Organizational Behavior <ul style="list-style-type: none"> ➤ Meaning and Types of Personality ➤ Nature and Dimensions of Attitude ➤ Organizational Commitment ➤ Motives, Motivation and Theories 	03
8	Dynamics of Organizational Behavior <ul style="list-style-type: none"> ➤ Cause and Effect of Stress ➤ Concept and Types of Conflict ➤ Coping Strategies for Stress and Conflict ➤ Political Implications of Power 	03
9	Contemporary Issues in Management	03

Reference Books

- 1) Wehrich Heinz and Koontz Harold (2008), Management: A Global and Entrepreneurial Perspective, Tata McGraw-Hill
- 2) Stoner, Freeman & Gilbert Jr., Management, Prentice Hall of India
- 3) Kaul, Asha, Business Communication, PHI, New Delhi.
- 4) Kaul, Asha, Effective Business Communication, PHI, New Delhi.
- 5) Chaturvedi, P.D., and Mukesh Chaturvedi, Business Communication, Pearson Education

- 6) McGrath, E.H., Basic Managerial Skills for All, PHI, New Delhi
- 7) Slocum, Helrigel, Organisational Behaviour, Thomson/Cengage
- 8) Udai Pareek (2008), Understanding Organisational Behaviour, Oxford University Press

Semester – IV**DISPENSING PHARMACY****Subject code: 1612010701040100***Theory (3 Hours / Week; 3 Credits, 45 Hours)*

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Course Objectives

- To study basic process which are used in different stage during preparation of pharmaceutical formulation.
- Subject gives the guideline for calculation of formulas, labeling, and packing of different types of pharmaceutical products and incompatibilities.

Students Learning Outcome

Upon completion of the subject student shall be able to –

- Understand the basic concepts of formulation, labeling, packing of different types of pharmaceutical dosage forms.
- Know the appropriate dose calculation and drug for patient

Sr. No	Course Contents	Total Hrs.
1	Definitions and scope, Types of dispensed products	02
2	Prescription Handling of prescriptions, Source of errors in prescriptions, Prescription writing, care required in dispensing procedures including labelling at dispensed products. etc.	05
3	Dispensing techniques Compounding and dispensing procedures, packaging, storage and stability of medicines, labelling of dispensed product.	05
4	Pharmaceutical calculations Posology: Introduction to imperial and metric system, avoirdupois and apothecaries system of weights and measures. Calculation of doses for infants, adults and elderly patients, enlarging and reducing recipes, percentage solutions, allegation, alcohol dilution, proof spirit, isotonic solutions, displacement value etc.	05

5	A detail study of the following dispensed products (Definition, characteristics, classification / types, Advantages, limitations, formulation, dispensing, labeling, packing, storage, principles, adopted & study of some prescriptions relating to following dispensed products.) a. Liquid Products – Oral and external solutions, Mixtures and Emulsions, Liniments, lotions etc. b. Semisolid Products – Ointment, Creams, Gels, Pastes c. Solid Products – Powders, Lozenges, Pastilles, Tablet triturates etc. d. Suppositories – Bases, Dispensing, Displacement value etc. e. Ophthalmic- Eye drops, Eye lotions, Eye ointments, Contact lens solutions etc. f. Oral unit dosage forms, inhalations etc.	18
6	Incompatibilities Physical, chemical and therapeutic incompatibilities observed in prescriptions of above products: (a) Identifications and correction of incompatibilities. (b) Inorganic incompatibilities including incomp. of metals and their salts, non-metals, acids, alkalis. (c) Organic incompatibilities: Purine bases, alkaloids, pyrazolone derivatives, amino acids, quaternary ammonium compounds, carbohydrates, glycosides, anesthetics, dyes, surface active agents.	10

Semester – IV
DISPENSING PHARMACY
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Aim of the experiment
1	Introduction General dispensing procedure, Weights and measures, Fundamental operations in Dispensing, Household measurements, Study of prescription in general
2	Preparation, labeling and packing of aromatic waters (e.g. chloroform and camphor), elixirs (e.g. Phenobarbitone elixirs BPC), Simple Syrup I.P. and U.S.P.
3	Preparation, labeling and packing of gargles (e.g. Potassium chloride and phenol gargle) Mouth washes (e.g. Compound sodium chloride, mouth wash B.P.) Thorat paints (e. g. Mandel's paint s) Douches (e.g. boric acid, potassium permanganate) Ear Drops (e.g. Sodium bicarbonate, Chloramphenicol)
4	Preparation, labeling and packing of suspensions containing diffusible Solids, indiffusible solids, poorly wetttable solids.
5	Preparation, labeling packing of emulsion containing fixed oil, volatile oil, both types of oil, mineral oil etc.
6	Preparation, labeling and packing of lotions (e.g. salicylic acid, Calamine and precipitate Sulphur), liniments (e. g turpentine liniment, white liniment)
7	Preparation, labeling & packing of external emulsions.
8	Preparation, labeling and packing of ointments containing Hydrocarbon Base, water miscible base, absorption base and water soluble base.
9	Preparation labeling & packing of Non-staining ointments, paste, gel, cold cream, vanishing cream etc.
10	a) To determine the mould capacity b) To determine the Displacement value c) Preparation, labeling and packing of Coca butter Suppositories containing soluble, insoluble, semisolid substances etc.
11	Preparation, labeling & packing of suppositories containing gelatoglycein, Soap glycerin and macrogol base.
12	Preparation, labeling & packing of Eutectic powder, aspirin powder, Compound Sodium Bicarbonate powder, Compound zinc Oxide-salicylic acid dusting powder and talc Dusting Powder.
13	Preparation, labeling & packing of effervescent granules (Sodium phosphate effervescent granules, antacid effervescent granules etc.)
14	Preparation, labeling & packing of tablet triturates and lozenges.
15	Identification of various types of incompatibilities in prescriptions, correction thereof and dispensing of such prescriptions.

Note: Any other practical related to theory topic can be carried out.

References Books

- 1) Pharmaceutical Practice; Diana M. Collett, MichaleE.Aulton; ELBS Pubilshers.
- 2) Dispensing for pharmaceutical students” by Copper and Gunn by S.J.Carter, 12th Edn. CBS Publishers.
- 3) “Pharmaceutical Calculations” by Mitchell J. Stklosa& Howard C.Ansel by Lippincott Williams & Wilkins.
- 4) “Pharmaceutical Dosage forms and Drug delivery systems” by Howard C. Ansel by Lippincott Williams & Wilkins.
- 5) “Pharmaceutical Practice” Edited by A.J. Winfield & R.M.E. Richardes.
- 6) “Remington: The Science and Practice of Pharmacy” Latest edn. by Mack Publishing Company.
- 7) Pharmacy Practice by Stone and Cartis.
- 8) Copper and Gun’s Tutorial Pharmacy by S.J.Carter.

Semester – IV
FORENSIC PHARMACY
Subject code: 1612020701040200
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	0	3	80	20	0	0

Course Objectives

To familiarize a student with laws that influences the working of pharmacist in drug store/chemist and druggist/pharmacy or in pharmaceutical industry or in Food and Drug Administration or in an Educational Institute.

Students Learning Outcome

Upon completion of the subject should have –

- How to become a responsible person while discharging duty as a pharmacist in different facets of pharmacy profession.
- To acquire certain knowledge related to laws that help in becoming a pharma entrepreneur.

Sr. No	Course Contents	Total Hrs.
1	Introduction a. Pharmaceutical Legislations - A brief review. b. Drugs & Pharmaceutical Industry - A brief review. c. Pharmaceutical Education - A brief review.	03
2	Brief Historical Review of drug legislation in India Advance of Allopathic system, Drug Enquiry Committee and aftermath, Drug act, Pharmacy act and Other Legislation	03
3	Code of pharmaceutical ethics given by Pharmacy Council of India General introduction to code of pharmaceutical ethics, Pharmacist in relation to his job, Pharmacist in relation to his trade Pharmacist in relation to medical profession, Pharmacist in relation to his profession, Pharmacist Oath	02
4	Pharmacy Act 1948 Introduction, Objectives, Pharmacy Council of India, State Pharmacy Council, Offences and Penalties	05
5	Drugs and Cosmetics Act 1940 and Rules 1945 Introduction, Import, Manufacturing, Sale, Labeling and Packaging of Drugs, Administration of Act, Provisions applicable to Ayurvedic, Siddhha and Unani Drugs, Provisions applicable to Homeopathic medicines, Provision applicable to Cosmetics	10

6	Medicinal and Toilet Preparations (Excise Duties) Act 1955 Introduction, Manufacturing in Bond, Outside bond, Provisions related to Ayurvedic, Homeopathic, Patent and Proprietary Preparations, Warehousing and Export of alcoholic preparations	03
7	Narcotic Drugs and Psychotropic substances Act 1985 and Rules	02
8	Drugs Price Control Order 1995	02
9	Drugs and Magic Remedies (objectionable advertisements) Act, 1954:	02
10	Medical Termination of Pregnancy Act 1970 and Rules 1975	02
11	Prevention of Cruelty to Animals Act 1960	02
12	Patent Act 1970 and Amendment rules 2005	02
13	Poisons Act 1919	02
14	Pharmaceutical Policy 2002 Introduction, Objectives of Pharmaceutical Policy 2002, Pricing of Pharmaceutical formulations with respect to Pharmaceutical Policy 2002, Quality Aspects with respect to Pharmaceutical Policy 2002, Pharma Education and Training with respect to Pharmaceutical Policy 2002	05

References Books

- 1) A textbook of Forensic Pharmacy by B. M. Mithal
- 2) A textbook of Forensic Pharmacy by N. K. Jain, VallbhPrakashan
- 3) The Patents Act 1970 with Patents Rules 1972
- 4) The Narcotic Drugs and Psychotropic Substance Act, 1985 (with the Prevention of illicit traffic in Narcotic drugs and Psychotropic Substances Act, 1988 along with Allied Rules and Orders, 1993)
- 5) The Medical Termination of Pregnancy Act 1971, along with the Medical Termination of Pregnancy Rules 1975
- 6) The drugs (price control) order 1987-alongwith new drug policy 1994 and drug (price control) order 1995
- 7) The Pharmacy Act 1948
- 8) The Poisons Act 1999
- 9) The Drugs and Cosmetics Act 1940
- 10) The Medicinal and Toilet Preparations Act 1955
- 11) Prevention of Cruelty to Animal Act 1960
- 12) Drugs and Cosmetics Act 1940 by Vijay Malik

Semester – IV
PHARMACEUTICAL CHEMISTRY-IV (BIOCHEMISTRY – I)

Subject code: 1612030701040300

Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Course Objectives

- To introduce the students to the basics of carbohydrates, lipid, enzymes, water minerals metabolism and also about biochemical organization of the cell and transport processes across cell membrane

Students Learning Outcomes

- The curriculum is designed to satisfy the diverse needs of the students. Advanced coursework and educational activities outside the traditional classroom. At graduation, chemistry majors should have a set of fundamental competencies that are knowledge-based, performance/skills-based, and affective.
- Graduates will be aware of carbohydrates, lipid, enzymes, water minerals metabolism and also about biochemical organization of the cell and transport processes across cell membrane

Sr. No.	Course Contents	Hrs
1.	Introduction to Carbohydrates, Lipids	08
2.	<p>a. Carbohydrate Metabolism: Conversion of Polysaccharides to Glucose-1-Phosphate. Glycolysis and Fermentation and their Regulation, Gluconeogenesis, Glycogenesis and Glycogenolysis, Metabolism of Galactose and Fructose. Role of Sugar Nucleosides in Biosynthesis and Pentose-Phosphate Pathway.</p> <p>b. The Citric Acid Cycle: Significance, Reaction and Energetic of the Cycle, Amphibolic Role of the Cycle and Glyoxalic Acid Cycle, Uric Acid Cycle</p> <p>c. Role of Hormones in Maintenance of Blood Sugar Level.</p>	15
3.	Lipid metabolism: oxidation of fatty acids, beta-oxidation and energetic, alpha-oxidation, omega-oxidations, biosynthesis of ketone bodies and their utilization, biosynthesis of saturated and unsaturated fatty acids, control of lipid metabolism and metabolism of cholesterol.	07
4.	Enzymes: Nomenclature, Enzyme Kinetics and its Mechanism of action, Mechanism of Inhibition, Enzymes and Iso-Enzymes in Clinical Diagnosis.	05

5.	Co-Enzymes: Vitamins as Co-Enzymes and their Significance. Metals as Co-Enzymes and their Significance.	03
6.	Water and mineral metabolism: brief introduction	03
7.	Principles & significance of following biochemical tests: a) Kidney function test b) Liver function test c) Lipid profile test	04

Semester – IV**Pharmaceutical Chemistry-IV (Biochemistry – I)****Practical (3 Hours / Week; 3 Credits, 45 Hours)**

Sr. No.	Aim of the experiment
1	To perform the identification for carbohydrates (Glucose, Maltose, Lactose, Sucrose, Fructose etc.....)
2	Detection and identification of lipids (Glycerol, Cholesterol, Oleic Acid, Stearic Acid etc.....).
3	To determine the Acid value, Iodine value and Saponification value of the given fixed oil.
4	To estimate glucose in urine by Benedict's method.
5	To determine glucose content in blood by Folin Wu method.
6	To perform biochemical analysis of flour, potato & cheese or milk or bread.
7	To determine the achromic point and chromic period of salivary amylase
8	To estimate acidity and ammonia in Urine.
9	Identification of various proteins (Gelatin, Casein, Albumin, Peptone, Creatinine etc.....)
10	To identify substances of physiological importance (Protein, Lactic Acid, HCl, Bile, Blood, Creatinine, Urea, Acetone, NaCl etc.....)
11	To estimate Creatinine in blood by colorimetric analysis.
12	To estimate total proteins in plasma by biuret method.
13	To perform estimation of chloride and phosphate in urine.
14	To perform the estimation of Calcium and Magnesium in urine.
15	Separation of Amino Acids (Proline, Glutamate, Aspartate, Glycine, Alanine etc.) by Paper Chromatography and Thin Layer Chromatography (TLC).

*** Any experiment demonstrating theoretical concept can be added to the above list**

Books Recommended (Latest Editions):

1. U.Satyanarayan, Biochemistry, Books and allied (P) Ltd. Calcutta, latest edn
2. A. L. Lehninger, Principles of biochemistry, CBS Publishers and Distributors.
3. R. K. Murray, D. K. Granner, P. A. Mayes. V.W. Rodwell, Harpers Biochemistry, Prentice hall International Inc. latest edn.

4. S. C. Rastogi, Biochemistry, Tata McGraw Hill New delhi, Latest edn.
5. M.Cohn, K.S. Roth, Biochemistry and Disease. William and Wilkins co. Baltimore, Latest edn.
6. G. F. Zubay, W. W. Parson, D. E. Vance, Principles of Biochemistry, WCB Publishers, England, latest edn.
7. S. Ramkrishnan, K. G. Prasannan, R. Rajan. Textbook of medical Biochemistry, Orient Longman Madras, Latest edn.
8. S.K. Sawhney, Randir Singh Eds, Introductory practical Biochemistry, Narosa Publishing house New Delhi.
9. G. T. Mills, G. Leaf Practical Biochemistry, John Smith and Son Ltd
10. E. E. Conn and P. K. Stumpf, Outlines of biochemistry, John Wiley and Sons, New York.

Semester – IV
Pharmaceutical Analysis-II
Subject Code: 1612040701040400
Theory (3 Hours /Week; 3Credits, 45Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Course Objectives

- Introduce students to basics of instrumental analytical methods with emphasis on its application in quality control and quality assurance.
- Cover areas including Chromatography, Electroanalytical methods, Potentiometric methods, Polarography, amperometry, biamperometry, Calorimetry, Polarimetry, Extraction techniques

Students Learning Outcomes:

- To demonstrate an understanding of the theory and applications of the most common methods of pharmaceutical analysis.
- Learn the practical aspects and importance of quantitative analysis of different compounds involving various analytical techniques.

Sr. No.	Course Contents	Hrs
1	Basics of instrumental analytical methods Advantages, limitations, validation, signal to noise ratio.	04
2	Chromatography Classification, theories, retention mechanism, separation efficiency, methodology and Pharmacopoeial applications of column, paper and thin layer chromatography.	15
3	Electro-analytical methods: Basics of electro-analytical methods	04
3.1	Conductometry: Conductances, factors affecting conductance, Kohlrausch law, conductivity cells, applications	06
3.2	Potentiometric and pH metric methods: Standard reduction potentials, various electrodes, electrodes and cell potential, applications of potentiometry and pH metric.	08
3.3	Polarography, amperometry, biamperometry: Basics of current flow in polarography, dropping mercury electrode, diffusion current, half wave potential, modifications like pulsed and differential pulse polarography, stripping voltametry, biamperometric titrations, amperometric titrations.	11
4	Calorimetry: Types, thermogravimetric analysis, differential scanning calorimetry differential thermal analysis, melting point, etc. and their applications	05
5	Polarimetry: Polarimeter, qualitative and quantitative applications	03

6	Extraction techniques: Simple extraction, multiple extractions, separation of drugs in multicomponent system. Effect of pH on extractability of drugs, continuous extractions.	03
7	Miscellaneous methods: Oxygen combustion flask method, gasometric method, etc.	01

Semester – IV
Pharmaceutical Analysis-II
Practicals (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Practical Contents
	Quantitative analysis of different compounds involving following techniques:
1	Conductometry
2	Potentiometry
3	pH metry
4	Polarimetry
5	Column chromatography
6	Thin layer chromatography
7	Paper chromatography
8	Polarography, Amperometry and Biamperometry

Books Recommended (Latest Editions):

1. Pharmacopoeia: IP, BP, USP.
2. Practical Pharm. Chemistry, Vol. I– Backett, The athlone Press of University of London.
3. Fundamentals of Analytical Chemistry– Skoog, Harcourt College Publishers.
4. Quantitative chemical analysis– Vogel A. I., Pearson Education.
5. Text Book of Pharmaceutical Analysis– K.A. Connor, John Willey & Sons, New York.
6. Textbook of Pharmaceutical Analysis– J.W. Munson, Marcel Dekker Inc., New York.
7. Principles of Instrumental Analysis by Skoog, Holler, Nieman, 5th edition.
8. Instrumental methods of Analysis, H.H. Willard, L.L. Meritt, J.A. Dean and F.A. Settle Wadsworth, New York
9. Pharmaceutical Analysis: Modern methods Part A, Part B, James W. Munson.

Semester – IV
PHARMACOLOGY-I
Subject code: 1612050701040500
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Objective of the Course:

- To make students aware about basic terminologies and principles of pharmacology in general including concepts of pharmacokinetics, pharmacodynamics, drug interactions and adverse drug reactions.
- To make students understand the actions of various drugs on body systems like ANS, PNS, and respiratory system and pharmacology of autacoids and related drugs.

Student Learning Outcomes/ Objectives:

- At the end of the course, the student will be able to understand basic concepts of pharmacology like how drug acts and how body reacts to drug at receptor and molecular level.
- In addition, Students will be aware of effect of drugs on different systems of body.

Sr. No.	Course Contents	Total Hrs.
1	General Pharmacology <ul style="list-style-type: none"> • Definition, scope and branches of Pharmacology. • Routes of drugs administration and drug delivery systems. • Pharmacokinetics of absorption, distribution, biotransformation and elimination of drugs, concept of Half-life & Bioavailability • Pharmacodynamics : Mechanisms of drugs action, drug receptors and cellular signalling systems, Dose response relationship • Factors modifying drug dosage and action • Adverse drug effects, Iatrogenic diseases. • Drug interactions: Overview 	17
2	Drugs acting on Autonomic nervous system <ul style="list-style-type: none"> • Neurohumoral transmission • Parasympathomimetics and Parasympatholytics • Sympathomimetics, adrenergic receptor and neurone blocking agents • Ganglion stimulants, blockers, Neuromuscular blocking agents 	12
3	Drugs acting on peripheral nervous system <ul style="list-style-type: none"> • Local Anesthetics • Skeletal Muscle Relaxants 	03
4	Autocoids and related drugs: <ul style="list-style-type: none"> • Histamine and antihistaminics • 5-HT and their antagonists and drug therapy of migraine • Prostaglandins, Thromboxanes, Leukotrienes and PAF. 	09

	<ul style="list-style-type: none"> • Nonsteroidal anti-inflammatory drugs and antipyretics and analgesics • Antirheumatoid and antigout drugs 	
5	Drugs Acting on Respiratory System <ul style="list-style-type: none"> • Expectorants and Antitussive • Drugs used in Bronchial asthma 	04

Semester – IV
Pharmacology-I
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Topic
1	Introduction to Experimental Pharmacology and Laboratory Animals
2	Introduction to some basic Instruments in experimental pharmacology
3	Introduction to Standard techniques of drug administration, blood collection, preparation of drug solutions, Euthanasia
4	To understand legal aspects related to experiments on animals as per CPCSEA guidelines (whole guidelines and its amendments from time to time is to be considered)
5	Alternative to animal experimentation: Use of Ex Pharma Pro software
Isolated Tissue Experiments:	
6	To record Concentration Response Curve (CRC) of Acetylcholine using rat ileum/chicken ileum.
7	To find out pD ₂ value of Acetylcholine using rat ileum/ chicken ileum.
8	To study competitive and non competitive antagonism using rat/ chicken ileum.
9	To record Concentration Response Curve (CRC) of 5-HT using rat fundus/chicken ileum.
10	To study the effect of neostigmine on Concentration Response Curve (CRC) of Acetylcholine using rat ileum/ chicken ileum.
11	To record Concentration Response Curve (CRC) of Adrenaline using rat ileum/chicken ileum/rat fundus.
12	To record Concentration Response Curve (CRC) of Noradrenaline using rat anococcygeus muscle.
In vivo Experiments	
13	To study hepatic microsomal enzyme induction & inhibition activity of drugs.
14	To evaluate local anaesthetics using different animal models
15	To find out plasma protein binding of given drug.

* All the experiments will be demonstration practicals or explained using various softwares like X – cology softwares / you tube videos, etc. like online resources

* Any experiment demonstrating theoretical concept can be added to the above list

Recommended Books:

1. Goyal R. K. Practicals in pharmacology. M/s B. S. Shah Prakashan, Ahmedabad.
2. Sheth U.K. et al –Selected topics in experimental pharmacology. The Kothari Book Depot, Mumbai.
3. Kulakarni S. K.- Handbook of experimental pharmacology. VallabhPrakashan, NewDelhi.
4. Ghosh M. N- Essential of experimental pharmacology scientific book agency, Calcutta.
5. Rang H. P., Dale M. M., et al –Pharmacology. Churchill Livingstone, USA.
6. Satokar R.S et al., Pharmacology and Pharmacotherapeutics. Popular Prakashan,Mumbai.

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7. Harval, R.A., Champe P.C. et al., Pharmacology Lippincott- Raven Company, Philadelphia, New York.
 8. Craig C.R., Stitzel, R.E- Modern Pharmacology, Little brown and Company, USA.
 9. Goodman and Gilman's –the pharmacological basis of therapeutics. Pergamon Press, Singapore.
 10. Seth, S.D. Text Book of pharmacology, B. I. Churchill
 11. Bertram G. Katzung, Basic & Clinical Pharmacology, MC Graw Hill.
 12. K.D.Tripathi, Essentials of medical Pharmacology.

Semester IV
PHARMACOGNOSY-III
Subject Code: 1612060701040600
Theory (3Hours/Week; 3 Credits, 45Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Objective of the Course:

- To make students familiar with Pharmacognostic study of Glycosides and resins containing crude drugs, utilized as medicine.

Student Learning Outcomes:

- The students are expected to learn the pharmacognostic aspects specifically, the sources, the preparation methods and utilization of Glycosides and resin containing drugs.
- Understand basic idea of extraction, isolation and separation of active phytoconstituents from medicinal plants.
- Understand concept of phytochemical screening of the phytoconstituents obtained from the natural sources.

Sr. No.	Course Contents	Total Hrs.
1	<p>Glycosides: Definition, classification, Physico-chemical properties, general methods for isolation, biological sources, agronomy (cultivation, collection), commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following drugs.</p> <p>Saponins: Liquorice, Ginseng, Dioscorea, Arjun, Aritha, Achyranthus, Brahmi, Gokhru, Methi, Satavari, Dhamaso, Gymnema, Sarsaparilla, senega</p> <p>Cardioactive Sterols: Digitalis, Squill, Strophanthus, Thevetia, Nerium</p> <p>Anthraquinone cathartics: Aloe, Senna, Rhubarb, Cascara, Cassia fistula, Cassia tora, Majith</p> <p>Bitter glycosides: Gentian, Picrorrhiza, Chirata, Kalmegh, Quassia</p> <p>Coumarins: Psoralea, Ajmoda, Bhangro, Calophyllum</p> <p>Cyanogenetic glycosides: Almond, Linseed, Prunus</p> <p>Isothiocyanate glycosides: Mustard, Black mustard</p> <p>Flavanoids: Rutagraveolens, Butea, Bhilama</p>	33

	Others: Salix	
2	Resins: Definition, classification, Physico-chemical properties, general methods for isolation, source, cultivation, collection, commercial varieties and their systematic pharmacognostic study of following drugs Acid resin: Colophony Resin Alcohol & Phenols: Balsam, Cannabis Ester Resin: Benzoin Oleo gum resin: Asafoetida, Myrrh, Guggul, Salaiguggul Oleo-resin: Ginger, Turmeric Glyco-resin: Kaladana, Podophyllum, Nishoth Other: Vidang, Capsicum	12

Semester-IV
PHARMACOGNOSY -III
Practical (3Hours/Week: 3Credits, 45 Hours)

Sr. No	Course contents
1	General methods for isolation and chemical tests of different glycoside containing drugs.
2	Study of Morphology, Microscopy and TLC of crude drugs: (T.S., Powder and TLC of underlined drugs): Anthraquinone: <u>Majith</u> , <u>Senna</u> , Aloe, Rhubarb, <i>Cassia fistula</i> , <i>Cassia tora</i> Cardioactive Sterols: <u>Digitalis (Powder)</u> , Squill, Thevetia, <u>Nerium (leaf)</u> Saponins glycosides: <u>Liquorice</u> , Achyranthus, <u>Satavar</u> , Ginseng, Dhamaso, Brahmi, Methi, Dioscorea, Sarsaparilla, senega Bitter glycosides: Gentian, <u>Chirata</u> , <u>Kalmegh</u> , Quassia Coumarins: Psoralea, Ajmoda, <u>Bhangro</u> Cyanogenetic and Isothiocyanate glycosides: Almond, <u>Linseed</u> , Mustard
3	Study of Morphology and Chemical test for following drugs: Bhilama, Palash.
4	Estimation of sennosides from senna
5	Estimation of aloin from aloe.
6	Isolation of Andrographolide from Kalmegh
7	Isolation of oleoresin, identification (Chemical test) and study of Morphology and Microscopy(TS and powder drugs)from Colophony, Balsam, Benzoin, Myrrh, Asafoetida, Guggul, <u>Ginger</u> , Turmeric, Vidang, Kaladana

Recommended Books:

1. A Textbook of Pharmacognosy: C. S. Shah, J. S. Quadry, B. S. Shah

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- Prakashan, Ahmadabad.15th Edition, 2009.
 2. Textbook of Pharmacognosy: T.E.Wallis, CBS Publishers and Distributors, New Delhi, 5th Edition, reprinted, 2009.
 3. Pharmacognosy: C.K.Kokate, A.P.Purohit, S.B.Gokhale, Nirali Prakashan Pune, 42nd edition, 2008.
 4. Trease and Evans Pharmacognosy.16th Edition, William Charles Evans, W. Saunders, Edinburg London New York Philadelphia St. Louis Sydney Toronto 2009.
 5. Essentials of Pharmacognosy by Ansari S. H., Birla Publications Pvt. Ltd., 4th Edition, 2011.
 6. Pharmacognosy of Powdered crude drugs- M.A. Iyenger. (Manipal Power Press)
 7. Practical Pharmacognosy, Technique and Experiment by C. K.Kokate and S. B. Gokhale, Nirali Prakashan, Pune, 8th edition,2005
 8. The Practical Evaluation of Phytopharmaceutics by Brain K. R. And Turner R. D. Wriugh-Sciencetchnics Bristol.
 9. Malati G Chanhan & A.P.G Pillai, Microscopic profile of powdered drugs used in Indian system of medicine, Volume I, Bark drugs 2005, Institute of Ayurvedic medicinal plant science, Gujarat Ayurved unit Jamnagar; CPTA.
 10. Malati G Chauhan & A.P.G Pillai, "Microscopic profile of powdered drugs used in Indian systems of Medicine, Leaf Drugs, Vol2 ,2007, Institute of P.G Teaching & Reaearch in Ayurveda, Gujarat Ayurved University, Jamnagar.
 11. Malati G Chauhan & A.P.G Pillai, "Microscopic profile of Drugs used in Indian system of Medicine, seed drugs, Volume- 3, part- 1, 2011; Publisher: Prof Malati G Chauhan, P.G T-S.F C cell, I.P. G T. & R.A, Gujarat Ayurved University, Jamnagar
 12. Practical pharmacognosy: K. R. Khandelwal, Nirali Prakashan Pune, latest edition

Semester – IV
MICRO AND MACRO ECONOMICS
Subject code: 1612070701040700
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	0	3	80	20	0	0

Objective of the Course

The objectives of this course are:

- To enable the students to understand the principles underlying the structure and functioning of markets;
- To help them apply economic theory for optimal decision-making at the firm level in the context of market constraints, through real-life examples from across the globe and real cases of firms;
- To provide them sufficient exposure to the world of industry, trade and commerce, so as to make them feel comfortable reading and understanding daily economic and financial news about firms, and engaging in critical discussion on economic issues affecting firms.

Student Learning Outcomes/ Objectives

At the end of the course, the student should have developed:

- An appreciation of the principles of micro-economics and their potential for firm level decision-making;
- A keen desire for reading news of economic and financial changes/developments on a regular basis, and engaging in discussion and critical evaluation of such developments.

Sr. No.	Course Contents	Total Hrs.
1	Introduction Ten Principles of Economics Firms and its Objective Micro-economics & Macro-economic Indicators	08
2	Understanding Markets Forces <ul style="list-style-type: none"> ➤ The Market Forces of Supply and Demand ➤ Elasticity, Types and Applications ➤ Supply, Demand and Government Policies 	07

	<ul style="list-style-type: none"> ➤ The Theory of Consumer Choice ➤ Demand Forecasting and Analysis 	
3	Markets and Welfare <ul style="list-style-type: none"> ➤ Consumers, Producer, and Market Efficiency ➤ Externalities and Public Goods ➤ The Design of the Tax System (with specific reference to India) 	08
4	Firm Behavior and The Organization of Industry <ul style="list-style-type: none"> ➤ The Cost of Production ➤ Market Structures o Firms in Competitive Markets o Monopoly o Oligopoly o Monopolistic Competition 	07
5	Macroeconomic Environment <ul style="list-style-type: none"> ➤ Macroeconomics Aggregates ➤ Fiscal, Monetary and Exchange Rate Policies ➤ Behavioral and Technology Functions 	05
6	The Economics of Labour Markets <ul style="list-style-type: none"> ➤ Factor Markets ➤ Earnings and Discrimination ➤ Income Inequality and Poverty 	05
7	Sector Specific Issues <ul style="list-style-type: none"> ➤ Pharmacy / Engineering ➤ Contemporary Issues 	05

Reference Books

- 1) Salvatore Dominick (Seventh Edition), Managerial Economics - Principles and Worldwide Applications (Adapted Version), Oxford University Press
- 2) D. Salvatore & Ravikesh Srivastava (Seventh Edition), Managerial Economics in a Global Economy, Oxford University Press
- 3) H. L. Ahuja (2007), Managerial Economics, S. Chand
- 4) Suma Damodaran(2006), Managerial Economics, Oxford University Press
- 5) Geetika, Piyali Ghosh, Purba Roy Choudhary (Second Edition), Managerial Economics, Mc Graw Hill
- 6) Douglas Bernheim, Michael Winston (2008), Microeconomics, Tata McGraw-Hill
- 7) Mankiw (Forth Edition), Principles of Microeconomics, Cengage Learning
- 8) Ravindra H. Dholakia and Ajay N. Oza(Second Edition), Microeconomics for Management Students, Oxford University Press
- 9) Macroeconomics – By Goodwin, Nelson & Harris, PHI Learning Pvt. Ltd
- 10) Principles of Macroeconomics – By Rangarajan & Dholakia, Tata McGraw Hill Pub.
- 11) Macroeconomics – By Olivier Blanchard, Pearson Education

Semester – V

PHARMACEUTICAL MICROBIOLOGY - I**Subject code: 1612010701050100****Theory (3 Hours / Week; 3 Credits, 45 Hours)**

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Course Objectives

- This course deals with the various aspects of microorganisms, its classification, morphology, laboratory cultivation identification and maintenance.
- To study the microbial growth including microscopy and staining techniques for identification of microorganisms.
- To study the various microbial growth controlling techniques and various other tests used for detection of microorganisms.

Students Learning Outcome**Upon completion of the subject student shall be able to –**

- Understand about the growth cycle of microorganisms including effects of various chemical agents on their growth and various staining techniques used for identification of microorganisms by using microscope.
- Describe the various methods used for controlling the growth of microorganisms in various fields of pharmaceutical industries.
- Describe various tests for detection of presence of microorganisms in sterile and non-sterile dosage forms.
- do cultivation and identification of the microorganisms in the laboratory
- Appreciate the behavior of motility and behavioral characteristics of microorganisms.

Sr. No	Course Contents	Total Hrs.
1	Introduction to Microbiology: Scope and applications to pharmaceuticals, Whittaker's five kingdom concept, classification of microbes into bacteria, rickettsia, actinomycetes, fungi, protozoa, algae and viruses. Historical developments- contributions of Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch and Paul Ehrlich	03
2	General microbiology a) Microscopy Principle and applications of compound, Dark- field, phase contrast and fluorescence microscope. Different parts of compound microscope, resolving power, magnification power, numerical aperture and working distance.	15

	<p>Electron microscopy-SEM and TEM</p> <p>b) General Structure Structure of bacterial cell, Prokaryotic and Eukaryotic Cell</p> <p>c) Structure and Taxonomy of Actinomycetes, Bacteria, Spirochetes, Rickettsia and Viruses, fungus with emphasis on pathogenic and pharmacological importance.</p> <p>d) Identification of microbes Staining Techniques</p> <p>e) Nutritional requirements</p> <ul style="list-style-type: none"> ➤ Nutrition requirements, Growth curve ➤ Introduction to various nutritional media, ➤ Cultivation and Isolation of bacteria, virus and fungus <p>f) Bacterial count techniques</p>	
3	<p>Control of microbes in pharmaceutical industry</p> <p>a. Disinfection:</p> <ul style="list-style-type: none"> ➤ Classification, mode of actions and Factor affecting Disinfection ➤ Dynamics of Disinfection ➤ Evaluation of Disinfection <p>b. Sterilization:</p> <ul style="list-style-type: none"> ➤ Introduction, significance, sensitivity of microorganisms, ➤ Detailed methods for sterilization processes. ➤ Sterilization control and sterility assurance. 	12
4	<p>Aseptic Techniques: Designing of aseptic area, sources of contamination in aseptic area, and methods of prevention, laminar air flow.</p> <p>Sterility testing of pharmaceutical products Importance, objectives, methodology as per pharmacopoeial standards, evaluation tests</p>	07
5	Microbiological assays of antibiotics, vitamins, amino acids etc.	05
6	Microbial limit tests for Pharmaceutical dosage forms as per IP	03

Semester – V

PHARMACEUTICAL MICROBIOLOGY I
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Aim of the experiment
1	To study the principle and working of microbiology laboratory equipment.
2	Preparation and sterilization of nutrient broth, nutrient agar, slants, stabs and plates.
3	To study different techniques of Inoculation of cultures.
4	A. Isolation of pure culture by streak plate technique. B. Isolation of pure culture by pour plate technique.

5	Study of Aspergillus, Penicillium and Candida species with respect to morphology (wet mount technique)
6	Observation of motility of bacteria by hanging drop technique.
7	To Observe Oligodynamic effect of metal on growth of micro-organisms.
8	Cultivation of anaerobes by stab method.
9	Identification of isolated bacteria by simple, Gram, acid fast and spore Staining.
10	Evaluation of Disinfectant by (a) agar cup method (b) Filter paper disc method.
11	Study of effect of UV light on growth of micro-organisms.
12	Determination of phenol coefficient of given disinfectant by Riedal Walker test.
13	A. To Perform sterility testing of absorbent cotton gauze. B. To Perform sterility testing of ampoules and vials having water for injection. C. To Perform sterility testing of soluble powders.
14	Estimation of potency of given antibiotic (streptomycin) by microbial assay (One & Two level fractional assay).
15	A. To Perform the spirochetes staining by negative staining method and Fontana's method. B. To Determine the viable count of micro-organisms by using Petri plate method.
16	Study of microbial limits of following as per I.P. a. Aluminum hydroxide gel. b. Starch.

Note: Any other practical related to theory topic can be carried out.

References Books

- 1) Pharmaceutical Microbiology, Edited by W.B. Hugo and A.D. Rusell Blackwell Science, United Kingdom.
- 2) Microbiology an Introduction, G. J. Tortora, B. R. Funke, Pearson Education, New Delhi.
- 3) Textbook of Microbiology, C. K. J. Paniker, Orient Longman PVT LTD., India.
- 4) Microbiology, Prescott L. M., McGraw Hill, Columbus.
- 5) Industrial Microbiology, L. E. Casida, JR., New Age International Publishers, India.
- 6) Microbiology, M. J. Pelczar, JR., E.C.S. Chan and N. R. Krieg, Tata McGraw-Hill, Inc., New York.
- 7) Fundamental Principles of Bacteriology. A.J. Sale, Tata McGraw-Hill Publishers Company Ltd., New York.
- 8) General Microbiology, Stanier R. Y., Machillan Press Ltd., Hampshire.
- 9) Microbiology A Laboratory Manual, J. G. Cappuccino, Pearson Education, New Delhi.
- 10) Remington: The Science and Practice of Pharmacy, Vol I & II, Gennaro Alfonso R., Lippincott Williams & Wilkins, New York.
- 11) Pharmaceutical Microbiology, Ashutosh Kar, New Age International publishers, New Delhi.
- 12) Indian Pharmacopoeia (Latest Edition), Indian Pharmacopoeial Commission, Ghaziabad.

- 13) Bentley's Text Book of Pharmaceutics, Edited by E. A. Rawlins, Bailliere Tindall, United Kingdom.

Semester – V
PHARMACEUTICAL CHEMISTRY-V (BIOCHEMISTRY – II)
Subject code: 1612020701050200
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme	
Theory	Tutorial	Practical	Total	Theory	
				External	Internal
3	0	0	3	80	20

Course Objectives

- Introduce students to Bio-Chemistry with emphasis on basic biological chemistry with respect to bio molecules like Protein, DNA, RNA, Nucleic acid etc.
- Cover areas including Biosynthesis of bio-molecules, Metabolism, Catabolism, Protein synthesis, Formation of bile pigments and Purine and Pyrimidine synthesis etc
- Genetic code and gene expression, brief over view of genetic engineering, PCR and its application.
- Study of energy, equilibrium constant, bioenergetics, ATP production and its biological role.

Students Learning Outcomes:

- The curriculum of the Department is designed to satisfy the diverse needs of students. Advanced coursework and educational activities outside the traditional classroom. At graduation, chemistry majors should have a set of fundamental competencies that are knowledge-based, performance/skills-based, and affective.
- Graduates will be able to solve problems competently by identifying the essential parts of a problem and formulating a strategy for solving the problem. They will be able to rationally estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of the solution, and interpret their results.

Sr. No.	Course Contents	Hrs
1.	Detailed chemistry of Proteins and nucleic acid	08
2.	Metabolism of ammonia and nitrogen containing monomers: nitrogen balance, biosynthesis of amino acids, catabolism of amino acids, conversion of amino acids to specialized products. Assimilation of ammonia, urea cycle. Metabolic disorders of urea cycle, metabolism of sulphur containing amino acids, porphyrin biosynthesis, formation of bile pigments, hyperbilirubinemia, purine biosynthesis, purine nucleotide interconversion, pyridine	12

	biosynthesis	
3.	Biosynthesis of nucleic acids. Brief introduction of genetic organization of the mammalian genome, alteration and rearrangement of genetic material, biosynthesis of DNA and its replication, DNA repair mechanism, biosynthesis of RNA	05
4.	Genetic code and protein synthesis: genetic code, components of protein synthesis and inhibition of protein synthesis. Brief account of genetic engineering and polymerase chain reactions	05
5.	Regulation of gene expression	02
6.	The Concept of free energy, Determination of Change in free energy from Equilibrium Constant and Reduction Potential, Bioenergetics, Production of ATP and its Biological Significance	02
7.	Biological oxidation, enzymes and co-enzymes involved in oxidation reduction and its control. The respiratory chain, its role in energy capture and its control, energetic of oxidative phosphorylation, inhibitors of respiratory chain and oxidative phosphorylation, mechanism of oxidative phosphorylation	08
8.	Techniques used in biochemistry: spectrophotometry, centrifugation, electrophoresis, chromatography, extraction and purification of proteins and nucleic acids	03

Books Recommended (Latest Editions):

1. U.Satyanarayan, Biochemistry, Books and allied (P) ltd. Calcutta, latest edn
2. A. L. Lehninger, Principles of biochemistry, CBS Publishers and Distributors.
3. R. K. Murray, D. K. Granner, P. A. Mayes. V.W. Rodwell, Harpers Biochemistry, Prentice hall International Inc. latest edn.
4. S. C. Rastogi, Biochemistry, Tata McGraw Hill New delhi, Latest edn.
5. M.Cohn, K.S. Roth, Biochemistry and Disease. William and Wilkins co. Baltimore, Latest edn.
6. G. F. Zubay, W. W. Parson, D. E. Vance, Principles of Biochemistry, WCB Publishers, England, latest edn.
7. S. Ramkrishnan, K. G. Prasannan, R. Rajan. Textbook of medical Biochemistry, Orient Longman Madras, Latest edn.
8. S.K. Sawhney, Randir Singh Eds, Introductory practical Biochemistry, Narosa Publishing house New Delhi.
9. G. T. Mills, G. Leaf Practical Biochemistry, John Smith and Son Ltd
10. E. E. Conn and P. K. Stumpf, Outlines of biochemistry, John Wiley and Sons, New York.

Semester – V
PHARMACEUTICAL ANALYSIS-III
Subject Code: 1612040701050400
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Course Objectives

- Introduce students to different spectroscopic methods with emphasis on its application in quality control and quality assurance.
- Cover areas including fundamental spectroscopy, UV-Visible, IR, Fluorescence, Atomic absorption and emission, Raman spectroscopy. Principles of turbidometry and Nephelometry techniques.

Students Learning Outcomes:

- To demonstrate an understanding of the theory and applications of the most basic spectroscopic methods used in pharmaceutical analysis.
- Learn the practical aspects and importance of quantitative and qualitative analysis of different drugs, pharmaceuticals and compounds involving various spectroscopic techniques.

Sr. No.	Course Contents	Hrs
1	Fundamentals of Spectroscopy Classification of spectra, Wave properties of electromagnetic radiation, Particle/photon properties Electromagnetic radiation, Electromagnetic spectrum.	06
2	UV-VIS spectroscopy Theory; Beer and Lambert's law - limitations and deviations from the law; Terminologies associated with absorption measurements; Types of transitions; Factors affecting spectral characteristics (structural and nonstructural); Effect of conjugation; Wood ward Fieser rule; Photometric titrations; Instrumentation, applications (in analysis of organic compounds and inorganic complexes), advantages and limitations of UV Visible spectroscopy; Quantitative analysis of binary mixtures of absorbing substances by simultaneous equation method;	11

	Calibration of UV Visible Spectrophotometer as per Pharmacopoeia.	
3	<p>IR spectroscopy</p> <p>Theory of absorption of Infrared radiation by molecules; Molecular vibrations; Factors influencing vibrational frequencies; Calculation of vibrational frequencies (Hooke's law); Sample handling techniques; Instrumentation (Dispersion and FTIR spectrometer) and applications of IR Spectroscopy; Calibration of IR spectrophotometer as per Pharmacopoeia</p>	08
4	<p>Fluorescence spectroscopy</p> <p>Introduction: luminescence, photoluminescence; Theory of Fluorescence and Phosphorescence; Jablonski diagram; Factors affecting fluorescence intensity (structural and nonstructural); Instrumentation, applications, advantages and limitations of fluorescence spectroscopy.</p>	05
5	<p>Atomic absorption and emission spectroscopy</p> <p>Theory, Principle, instrumentation and applications of Flame photometry. Basics of atomic spectroscopy; Principle of atomic absorption and atomic emission spectroscopy; Interferences in atomic spectroscopy; Factors affecting atomic spectroscopy like solvents, buffers, other ions, etc; Flame Photometry; Atomic emission spectroscopy with plasma and electrical discharge sources; Instrumentation (including radiation sources like hollow cathode lamp), applications, advantages and limitations of atomic absorption and atomic emission spectroscopy.</p>	09
6	Overview of scattering Spectroscopy like Raman spectroscopy, Nephelometry and Turbidimetry	06

Semester – V
Pharmaceutical Analysis- III
Practical (03 Hours/ Week; 03 Credits, 45 Hours)

Sr. No.	Practical Contents
1	Calibration of UV spectrophotometer.
2	Determination of λ_{max} , A(1cm 1%), Detection-Quantitation Limit and preparation of calibration curve (Verification of Beer's law) for any drug by UV-visible spectrophotometer.
3	Determination of the dissociation constant of indicator/ stability constant of complex.
4	Determination of isosbestic point/pKa of indicator.
5	Experiments on Spectrophotometric estimation of drugs in marketed formulations.
6	Experiments on Fluorimetric estimation of drugs.
7	Experiments on Colorimetric assay of colored drug & non-colored drug.
8	Experiments based on flame photometry.
9	Identification of API by IR spectrum.
10	Experiments based on principle of turbidometry and nephelometry.
11	Exercise on structure elucidation of simple organic compounds using UV and IR.

Books Recommended (Latest Editions):

1. Instrumental Methods of Analysis - Scoog and West.
2. Spectrometric Identification of Organic Compounds - Silverstein et., al.
3. Instrumental Method of Analysis - Willard Dean & Merrit.
4. Pharmaceutical Chemistry Vol. I & Vol. II — Becket and Stanlake
5. Pharmaceutical Analysis — Hiquchi, Bechmman, Hassan.
6. Pharmaceutical Analysis — Modern methods — Part A and B — Munson James. W.
7. Quantitative Analysis of Drugs — Garrot.
8. Quantitative Analysis of Drugs in Pharmaceutical Formulations — P. D. Sethi.
9. Application of Absorption Spectroscopy of Organic Compounds — Dyer.
10. Analytical Profiles of Drug Substances — Florey [Volume 13].
11. Spectroscopy of Organic Compound - P. 5. Kalsi, Wiely Eastern Ltd., New Delhi.
12. Absorption Spectroscopy of Organic Molecules — V. M. Parikh, Addison — Wesley Publishing Company, London.

Semester – V
PHARMACOLOGY - II
Subject code:1612050701050500
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Course Objectives

- This course is designed to provide basic instruction in the principles of pharmacology and the course will emphasize on mechanisms of drug action, adverse reactions, dose and uses of drugs in the **Therapy of Cardiovascular Disorders, Neurological Disorders, Psychiatric Disorders**, Drugs affecting Blood and blood formation and kidney. This content will provide students a knowledge with a comprehensive introduction to the fundamental Pharmacology and uses of the major classes of clinically important drugs currently used in medical practice of above diseases.

Students Learning Outcome

- At the end of the course, students will be able to understand the fundamental scientific principles of drug action, mechanisms of action, pharmacokinetics date (absorption, distribution, metabolism and elimination of drugs in the body), different dosing regimens of drugs useful in **Cardiovascular Disorders, Neurological Disorders, Psychiatric Disorders, Blood related disorders and kidney diseases**.

Etiology & Pathophysiology of following disease/disorders and pharmacology of drugs (mechanism of action, ADME, therapeutics use, and adverse effects, toxicity and possible drug interaction) of the following catagories:

Sr. No.	Course Contents	Total Hrs
1	Unit I: Cardiovascular Disorders: Drugs acting on Renin Angiotensin System and plasma kinins, Congestive Cardiac Failure, Coronary Heart Diseases, Hypertension, Arrhythmias, Angina, hyperlipidemia and atherosclerosis	15
2	Unit IIA: Drugs Acting on Central Nervous System: General Anaesthetics, Ethyl & Methyl Alcohols, Sedatives and Hypnotics, Opioid analgesics and antagonists, CNS stimulants and cognition enhancers	09
3	Unit IIB: Neurological Disorders: Epilepsy, Parkinson's disease, Migraine.	06
4	Unit III: Psychiatric Disorders: Anxiety, Depression, Mania, Schizophrenia, Alzheimer's disease	07

5	<p>Unit IV: Miscellaneous</p> <p>A. Drugs affecting Blood and blood formation: Haematinics and erthropoietin, drugs affecting coagulation, bleeding and thrombosis, hypolipidemic drugs and plasma expanders,</p> <p>B. Drugs acting on Kidney: Diuretics, Antidiuretics, Benign Prostate Hypertrophy, Renal failure</p> <p>C. Gastrointestinal Tract disorders: Drugs for Peptic Ulcer, Emesis, Constipation, Diarrhea, Gastro Esophageal Reflex Disorder (GERD)</p>	08
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References Books: (Latest Edition):

1. Tripathi KD, Essentials of Medical Pharmacology, Jaypee Brothers.
2. Satoskar R.S., Bhandarkar S.D. and Rege N.N., Pharmacology and Pharmacotherapeutics, Popular Prakashan Pvt Ltd.
3. HP Rang, MM Dale, Pharmacology, Elsevier Sciences
4. Katzung, B.G., Basic and clinical pharmacology, Prentice Hall, Int.,
5. Goodman and Gilman, Pharmacological Basis of Therapeutics, Mcgraw Hill Publishing
6. Joseph T. Dipiro, Pharmacotherapy-A Pathophysiological Approach.
7. F.S. Barar, Essentials of Pharmacotherapeutics
8. Sharma H.L. and Sharma K.K., Principles of Pharmacology, Paras Medical.
9. Paul L. Munson, Principles of Pharmacology
10. Golan David E, Principles of Pharmacology, The Pathophysiologic Basic.
11. Lewis's Pharmacology – James Crossland – Churchill Livingstone
12. Craig, Charles R., Modern Pharmacology with Clinical Applications
13. Chaudhary S.K., Quintessence of Medical Pharmacology, Central Book Agency Pvt. Ltd.

Semester – V
Pharmacology - II
Practicals (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Practicals
1	To find out Nature of Unknown Drugs (Acetylcholine , Histamine, Bacl ₂ , Physostigmine, Atropine , Mepyramine and Papaverine) using Rat/Guinea Pig/Chicken Ileum Preparation
2	To find out Nature of Unknown Drugs (Acetylcholine, Histamine , Bacl ₂ , Physostigmine, Atropine, Mepyramine and Papaverine) using Rat/Guinea Pig/Chicken Ileum Preparation
3	To find out Nature of Unknown Drugs (Acetylcholine, Histamine, Bacl ₂ , Physostigmine , Atropine, Mepyramine and Papaverine) using Rat/Guinea Pig/Chicken Ileum Preparation.
4	To find out Nature of Unknown Drugs (Acetylcholine, Histamine, Bacl₂ , Physostigmine, Atropine, Mepyramine and Papaverine) using Rat/Guinea Pig/Chicken Ileum Preparation
5	Study on the Effects of CNS Stimulant (Coffee/Tea) on Human Volunteers
Demonstration Experiments on Central Nervous System:	
6	To study the effect of pentobarbitone on righting reflex (hypnosis) in mice
7	To study the effect of chlorpromazine on the locomotor activity of mice using actophotometer
8	To study the effect of apomorphine-induced compulsive behaviour (stereotypy) in mice
9	To study the muscle relaxant property of diazepam in mice using rotarod apparatus
10	A. To study the analgesic effect of morphine/tramadol in mice using tail-flick method B. To study the analgesic effect of morphine/tramadol in mice using hot plate method C. To study the analgesic effect of morphine/tramadol in mice against acetic acid –induced writhing in mice
11	1. To study the anti-inflammatory property of indomethacin against carrageenan-induced paw oedema 2. To study the anticonvulsant activity of phenytoin against maximal electro-shok-induced convulsions in rats 3. To study the anticonvulsant property of diazepam against pentylenetetrazole-induced convulsions in mice
12	To study the antianxiety effect of diazepam in mice using elevated plus-maze apparatus
13	To study phenothiazine-induced catatonia in rats
14	Simulation Experiments on Cardiovascular System:

	A. Effects of Various Drugs on Isolated Frog Heart.
15	B. Demonstration on the Effects of Various Drugs on the Rat blood Pressure

* Any experiment demonstrating theoretical concept can be added to the above list

References Books- Practicals: (Latest Edition):

1. Kulkarni S.K.-Handbook of Experimental Pharmacology, Vallabh Prakashan
2. Ghosh M.N.-Fundamentals of experimental Pharmacology-
3. Medhi B., Prakash A.-Practical manual of experimental and clinical pharmacology, Jaypee Brothers
4. Goyal R.K., Mehta A.A.-Handbook of Experimental Pharmacology, BS Shah Prakashan
5. MC Prabhakar, Experimental Pharmacology
6. Kale S.R.-Pharmacology and Toxicology-
7. DK Basu-Essential of Pharmacology-
8. R.A. Turner-Screening methods in pharmacology (vol I & II)
9. Gerard Vogel-Drug Discovery and Evaluation in Pharmacology assay:
10. D.R. Laurence, Evaluation of Drug Activity: Pharmacometrics

References Books- Theoretical concepts: (Latest Edition):

1. Tripathi KD, Essentials of Medical Pharmacology, Jaypee Brothers.
2. Satoskar R.S., Bhandarkar S.D. and Rege N.N., Pharmacology and Pharmacotherapeutics, Popular Prakashan Pvt Ltd.
3. HP Rang, MM Dale, Pharmacology, Elsevier Sciences
4. Katzung, B.G., Basic and clinical pharmacology, Prentice Hall, Int.,
5. Goodman and Gilman, Pharmacological Basis of Therapeutics, Mcgraw Hill Publishing
6. Joseph T. Dipiro, Pharmacotherapy-A Pathophysiological Approach.
7. F.S. Barar, Essentials of Pharmacotherapeutics
8. Sharma H.L. and Sharma K.K., Principles of Pharmacology, Paras Medical.
9. Paul L. Munson, Principles of Pharmacology
10. Golan David E, Principles of Pharmacology, The Pathophysiologic Basic.
11. Lewis's Pharmacology – James Crossland – Churchill Livingstone
12. Craig, Charles R., Modern Pharmacology with Clinical Applications
13. Chaudhary S.K., Quintessence of Medical Pharmacology, Central Book Agency Pvt. Ltd.

Semester IV
PHARMACOGNOSY-III
Subject Code: 1612060701040600
Theory (3Hours/Week; 3 Credits, 45Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Objective of the Course:

- To make students familiar with Pharmacognostic study of Glycosides and resins containing crude drugs, utilized as medicine.

Student Learning Outcomes:

- The students are expected to learn the pharmacognostic aspects specifically, the sources, the preparation methods and utilization of Glycosides and resin containing drugs.
- Understand basic idea of extraction, isolation and separation of active phytoconstituents from medicinal plants.
- Understand concept of phytochemical screening of the phytoconstituents obtained from the natural sources.

Sr. No.	Course Contents	Total Hrs.
1	<p>Glycosides: Definition, classification, Physico-chemical properties, general methods for isolation, biological sources, agronomy (cultivation, collection), commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following drugs.</p> <p>Saponins: Liquorice, Ginseng, Dioscorea, Arjun, Aritha, Achyranthus, Brahmi, Gokhru, Methi, Satavari, Dhamaso, Gymnema, Sarsaparilla, senega</p> <p>Cardioactive Sterols: Digitalis, Squill, Strophanthus, Thevetia, Nerium</p> <p>Anthraquinone cathartics: Aloe, Senna, Rhubarb, Cascara, Cassia fistula, Cassia tora, Majith</p> <p>Bitter glycosides: Gentian, Picrorrhiza, Chirata, Kalmegh, Quassia</p> <p>Coumarins: Psoralea, Ajmoda, Bhangro, Calophyllum</p> <p>Cyanogenetic glycosides: Almond, Linseed, Prunus</p> <p>Isothiocyanate glycosides: Mustard, Black mustard</p> <p>Flavanoids: Rutagraveolens, Butea, Bhilama</p>	33

	Others: Salix	
2	Resins: Definition, classification, Physico-chemical properties, general methods for isolation, source, cultivation, collection, commercial varieties and their systematic pharmacognostic study of following drugs Acid resin: Colophony Resin Alcohol & Phenols: Balsam, Cannabis Ester Resin: Benzoin Oleo gum resin: Asafoetida, Myrrh, Guggul, Salaiguggul Oleo-resin: Ginger, Turmeric Glyco-resin: Kaladana, Podophyllum, Nishoth Other: Vidang, Capsicum	12

Semester-IV

PHARMACOGNOSY -III

Practical (3Hours/Week: 3Credits, 45 Hours)

Sr. No	Course contents
8	General methods for isolation and chemical tests of different glycoside containing drugs.
9	Study of Morphology, Microscopy and TLC of crude drugs: (T.S., Powder and TLC of underlined drugs): Anthraquinone: <u>Majith</u> , <u>Senna</u> , Aloe, Rhubarb, <i>Cassia fistula</i> , <i>Cassia tora</i> Cardioactive Sterols: <u>Digitalis (Powder)</u> , Squill, Thevetia, <u>Nerium (leaf)</u> Saponins glycosides: <u>Liquorice</u> , Achyranthus, <u>Satavar</u> , Ginseng, Dhamaso, Brahmi, Methi, Dioscorea, Sarsaparilla, senega Bitter glycosides: Gentian, <u>Chirata</u> , <u>Kalmegh</u> , Quassia Coumarins: Psoralea, Ajmoda, <u>Bhangro</u> Cyanogenetic and Isothiocyanate glycosides: Almond, <u>Linseed</u> , <u>Mustard</u>
10	Study of Morphology and Chemical test for following drugs: Bhilama, Palash.
11	Estimation of sennosides from senna
12	Estimation of aloin from aloe.
13	Isolation of Andrographolide from Kalmegh
14	Isolation of oleoresin, identification (Chemical test) and study of Morphology and Microscopy(TS and powder drugs)from Colophony, Balsam, Benzoin, Myrrh, Asafoetida, Guggul, <u>Ginger</u> , Turmeric, Vidang, Kaladana

Recommended Books:

13. A Textbook of Pharmacognosy: C. S. Shah, J. S. Quadry, B. S. Shah

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- Prakashan, Ahmadabad.15th Edition, 2009.
14. Textbook of Pharmacognosy: T.E.Wallis, CBS Publishers and Distributors, New Delhi, 5th Edition, reprinted, 2009.
 15. Pharmacognosy: C.K.Kokate, A.P.Purohit, S.B.Gokhale, Nirali Prakashan Pune, 42nd edition, 2008.
 16. Trease and Evans Pharmacognosy.16th Edition, William Charles Evans, W. Saunders, Edinburg London New York Philadelphia St. Louis Sydney Toronto 2009.
 17. Essentials of Pharmacognosy by Ansari S. H., Birla Publications Pvt. Ltd., 4th Edition, 2011.
 18. Pharmacognosy of Powdered crude drugs- M.A. Iyenger. (Manipal Power Press)
 19. Practical Pharmacognosy, Technique and Experiment by C. K.Kokate and S. B. Gokhale, Nirali Prakashan, Pune, 8th edition,2005
 20. The Practical Evaluation of Phytopharmaceutics by Brain K. R. And Turner R. D. Wriugh-Sciencetchnics Bristol.
 21. Malati G Chanhan & A.P.G Pillai, Microscopic profile of powdered drugs used in Indian system of medicine, Volume I, Bark drugs 2005, Institute of Ayurvedic medicinal plant science, Gujarat Ayurved unit Jamnagar; CPTA.
 22. Malati G Chauhan & A.P.G Pillai,“Microscopic profile of powdered drugs used in Indian systems of Medicine, Leaf Drugs,Vol2 ,2007, Institute of P.G Teaching & Reaearch in Ayurveda, Gujarat Ayurved University, Jamnagar.
 23. Malati G Chauhan & A.P.G Pillai,“Microscopic profile of Drugs used in Indian system of Medicine, seed drugs, Volume- 3, part- 1, 2011; Publisher: Prof Malati G Chauhan, P.G T-S.F C cell, I.P. G T. & R.A, Gujarat Ayurved University, Jamnagar
 24. Practical pharmacognosy: K. R. Khandelwal, Nirali Prakashan Pune, latest edition

Semester – V
PHARMACEUTICAL MARKETING AND DRUG STORE MANAGEMENT
Subject code: 1612070701050700
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	0	3	80	20	0	0

Objective of the Course

- Basic Understanding of Pharmaceutical marketing strategies, planning in marketing, communication and needs of pharma sector

Student Learning Outcomes/ Objectives

- At the end of the course, students will be able to understand the fundamental scientific principles of Drugs store Management and inventory control, Strategic marketing process, Consumer market and Retail and whole sale drugs store.

Sr. No.	Course Contents	Total Hrs.
1	Marketing tasks and philosophies: Marketing systems and pharma marketing environment	03
2	Consumer market: Pharmaceutical and buyer behaviour	02
3	Strategic marketing process: Industrial market, market segmentation, market measurement and forecasting.	05
4	Strategic planning in pharma marketing: Situation analysis, developing marketing. Objectives; Determining positioning and differential advantage, selecting target markets designing marketing mix for target market.	05
5	Product decisions: Product classification, product life-cycle strategies, Branding, packaging and labelling decisions	03
6	Pricing decisions: Pricing methods and strategies	02
7	Distribution decisions: Importance and functions of distribution channels, distribution channel members	05
8	Promotion decisions: Promotion mix elements	03
9	Communication in pharmaceutical industry	02
10	Drugs store Management and inventory control: Organization of drugs store, Types of materials stocked, storage conditions, purchase and inventory control principles, purchase procedures, purchase order, procurement and stocking. Quality control of drugs in hospitals.	08
11	Retail and whole sale drugs store: Organization and structure of retail and	07

	whole sale drug store, types of drug stores and design, maintenance of drug store, dispensing of proprietary products, maintenance of records of retail and wholesale.	
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Reference Books

- 1) Pharmaceutical Marketing by Subba Rao
- 2) Pharmaceutical Marketing by Dimitris and Dogramatiz
- 3) Pharmaceutical Marketing by Smith
- 4) Marketing Management, a South Asian Perspective by Kotlar
- 5) Marketing Management, Planning, Implementation and Control by Ramaswami and Namakumari.
- 6) Marketing Management and Administrative Action, Tata McGraw Hill Management Information Systems by Kenneth C. Laudon
- 7) Information Systems for Modern Management by Robert G. Murdick
- 8) Fundamentals of Information Systems, Second Edition by Ralph M. Stair and George Walter Reynolds

Semester – VI
PHARMACEUTICAL MICROBIOLOGY & BIOTECHNOLOGY II
Subject Code: 1612010701060100
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme			Evaluation Scheme			
			Theory		Practical	
Theory	Practical	Total	External	Internal	External	Internal
3	3	6	80	20	80	20

Course Objectives

To study microbial genetics and application of recombinant DNA Technology in drug design

Students Learning Outcome

Upon completion of the subject student shall be able to –

- good understanding about the microbial genetics and microbial biotransformation processes
- Understand Immunology and its derived products
- Understand the Importance of fermentation techniques and Biotechnological including blood products

Sr. No	Course Contents	Total Hrs.
1	Introduction to microbial genetics Mutation and its importance, Types of Mutation, Different mutagenic agents (Chemical, Physical, biological) Test to identify Mutants	05
2	Genetic Recombination Introduction to Gene Expression of eucaryotics and procaryotics, Recombinant DNA Technology: Transformation, conjugation, transduction, protoplast fusion and gene cloning and their applications. Development of hybridoma for monoclonal antibodies.	10
3	Study of various drug produces by biotechnology Humulin, Human growth hormone, streptokinase, activase, monoclonal antibodies etc.	02
4	Immunology a) Fundamentals of Immunology: Microbial flora, host-microbe interactions, microbial virulence, exotoxins, endotoxins. Defense mechanisms of host – specific and nonspecific. Types of Immunity. Immune response, antigens, antibodies, monoclonal antibodies	15

	<p>production and applications.</p> <p>b) Antigen - Antibody reactions: Introduction, precipitation, agglutination, compliment fixation, neutralization reactions, immunofluorescence and ELISA and other tests.</p> <p>c) Hypersensitivity reactions: Introduction, Immediate and delayed hypersensitivity, type I, II, III, IV hypersensitivity</p> <p>d) Preparation of vaccines and sera: Introduction, manufacturing and quality control. Preparation of vaccines (BCG,TAB, DPT, Polio, MMR and Rabies), toxoids (Tetanus and Diphtheria) and sera(antibacterial, antiviral, antitoxin and antivenum).</p>	
5	<p>Biotechnological and blood products</p> <p>Study of Hematopoietic growth factors, Interferon's & Interleukins, Insulin, Growth Hormones, Vaccines & Monoclonal antibody based pharmaceuticals, Recombinant coagulation factors and thrombolytic agents. Preparation, uses and storage of whole human blood, frozen plasma, blood cells, ideal requirements of plasma substitutes like dextran and PVP.</p>	06
6	<p>Fermentation Techniques:</p> <p>a. Screening of organism, preparation and preservation of master culture, design of fermentor, various parameters and media used for fermentation</p> <p>b. Recovery of fermentation products Flow-sheets penicillin, streptomycin, Vit. B₂, Vit. B₁₂</p>	07

Semester – VI
PHARMACEUTICAL MICROBIOLOGY & BIOTECHNOLOGY II
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Aim of the experiment
1	Preparation of mutant by Gradient plate method
2	Preparation of mutant by Velvet replicate method
3	Design of fermentor
4	Study of shake flask technique
5	Production of alcohol using Baker's yeast
6	Extraction of citric acid from fermented mass
7	Preparation of anticoagulant solutions, coagulant foam/sheet
8	Preparation and Standardization of vaccines
9	Determination of cell wall composition
10	Bacterial conjugation
11	Bacterial transformation
12	Microbiological testing of water
13	Bacterial Bioconjugation
14	Isolation of DNA and its purity estimation
15	Production of Fermentation products like Alcohol, Amylase and streptomycin

Note: Any other practical related to theory topic can be carried out.

References Books

- 1) Microbiology, M. J. Pelczar, JR., E.C.S. Chan and N. R. Krieg, Tata McGraw-Hill, Inc., New York.
- 2) Industrial Microbiology, L. E. Casida, JR., New Age International Publishers, India.
- 3) Fundamental Principles of Bacteriology, A. J. Sale, Tata McGraw Hill Publishers Company Ltd., New York
- 5) Bentley's Text Book of Pharmaceutics, Edited by E. A. Rawlins, BailliereTindall, United Kingdom.
- 6) Remington: The Science and Practice of Pharmacy, Vol I & II, Gennaro Alfonso R., Lippincott Williams & Wilkins, New York.
- 7) Microbiology A Laboratory Manual, J. G. Cappuccino, Pearson Education, New Delhi.
- 8) Pharmaceutical Biotechnology, AsutoshKar, New Age International publishers, New Delhi.
- 9) Pharmaceutical Biotechnology, S.S. Purohit, H. N. Kakrani, Student Edition, Jodhpur. Pharmaceutical Biotechnology Concept & Applications, Gary Walsh, John Willey & Sons Inc., New York.
- 10) Pharmaceutical Biotechnology, S. P. Vyas & V. K. Dixit, CBS Publishers & Distributors, New Delhi.

- 11) Pharmaceutical Biotechnology, Edited by M. J. Groves, Taylor & Francis, New York.
- 12) Biotechnology & Biopharmaceuticals, Roney B. Y. HO, Milo Gibaldi, John Willey & Sons Inc., New York.

Semester – VI
HOSPITAL AND COMMUNITY PHARMACY
Subject Code: 1612020701060200
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme			Evaluation Scheme			
			Theory		Practical	
Theory	Practical	Total	External	Internal	External	Internal
3	3	6	80	20	80	20

Course Objectives

- To study role of pharmacist in hospital and as a community pharmacist.
- Subject gives the guideline for different departments in hospital and their working.

Students Learning Outcome

Upon completion of the subject should have –

- Good understanding of the hospital organization and formulary.
- Students can also know what are the working procedures in hospital as a pharmacist in various departments?
- Able to know the methods of preparation and handing of sterile material in hospital.
- Able to work as a community pharmacist as a part of Health Care system.

Sr. No	Course Contents	Total Hrs.
1	Hospital Pharmacy Organization and structure Organization of hospital & hospital pharmacy. Responsibility of hospital pharmacist, Budget preparation and implementation. Pharmacy & therapeutic committee (PTC)	03
2	Hospital Formulary & Drug Information service Hospital formulary: Contents, preparation & revision of hospital formulary Drug information services: Sources of information on drugs, disease, treatments schedules, procurements of information, Poison information and service, Online service on diseases, Treatment, Dosage administration, computerized services, retrieval of information, Medication error.	05
3	Drug store management and inventory control Organization of drug store, types of material stocked, storage conditions; Purchase and inventory control-principles purchase procedures –purchase orders –procurement and stocking.	05
4	Technical services in Hospital Pharmacy Manufacture of sterile and non sterile products, Policy making of manufacturable items demand and costing, personnel requirements,	05

	manufacturing practice Master formula card, production control, manufacturing records. Aseptic Preparation of IV admixtures, cytotoxic infusions, total parenteral nutrition solution	
5	Drug distribution system in hospitals Outpatient dispensing, In patient dispensing, Ambulatory patient dispensing- methods adopted, Dispensing of controlled drugs	05
6	Hospital Biomedical Waste Management Importance, Technology available, treatment and disposal of waste.	03
7	Community Pharmacy Organization and structure of retail wholesale drug –store, Types of drugs store and design, legal requirements for establishments, Maintenance of drug store, dispensing of proprietary products, Maintenance of records of retail and wholesale. (a) Patient counselling. (b) Role and contribution of pharmacist in community health care and education.	10
8	Central Sterile Supply Unit and their Management Types of materials for sterilization, Packing of materials prior to sterilization, sterilization equipments, Supply of sterile materials.	04
9	Pharmacy Management Service Purchase procurement, storage and organization, inactive control prescription filling, pricing, insurance	03
10	Record and reports Patient Historical and medical profile, Adverse reaction, Patient treatment record and auxiliary reporting.	02

References Books

- 1) "Hospital Pharmacy" by William E. Hassan, Hanry Kimpton Publishers, London.
- 2) "Hospital Organisation and Management by Kurt Dan & Johnathan S. Ratich , CBS Publishers.
- 3) Health Education and Community Pharmacy by N.S. Parmar.
- 4) Hospital Waste Management, Principles and Guidelines by Faisal Khan.
- 5) Drug Store and Business Management by Ali and Gupta.
- 6) Modern Patient Counseling by Gaud, Toke, Rathod and Shegde.
- 7) A textbook on Hospital Pharmacy by Qadry, Goyal and Parikh.
- 8) Remington: The Science and Practice of Pharmacy, Vol-I & II, Gennaro, Alfonso R., Lippincott Williams & Wilki

Semester – VI
Pharmaceutical Chemistry-VII (Medicinal Chemistry-II)
Subject code: 1612030701060300
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
03	00	03	06	08	20	80	20

Course Objective

- Medicinal chemistry-II will provide the sound knowledge about basic principles of medicinal chemistry like development of various drugs on various basis, nature and property of various classes of drugs including Central nervous system, Hormonal drugs like steroids, anti-diabetic, anti-thyroid, thyroid and drugs affecting immune system of body. Also the students will learn chemistry, stereochemistry, nomenclature, and application of all the steroids and related hormonal drugs used in various wide spread disease. To know and learn about some specific disorders related to CNS and drug therapy in the same.

Students Learning Outcome

- Know the basic concepts of medicinal chemistry from practical and theoretical both aspect, its scope and various branches.
- To identify pharmacophoric binding sites in drug responsible to bind with receptor
- To study about which methods to apply for purification for different synthesized crude product
- To study about chemistry of individual drug molecule.
- To study about drug interactions and adverse effects.
- To study in detail about the SAR (structure activity relationship) of different classes of drugs.
- Know about the development of new drug.

Sr. No.	Course Contents	Total Hrs.
1.	Prodrugs, soft drugs, hard drugs and drug metabolism: Utility and types of prodrugs, Introduction and importance of CYP450, general pathways of Xenobiotics metabolism (functional group based classification of both phases with examples), site of drug metabolism, factors	06

	affecting drug metabolism, importance of drug metabolism in drug design	
2.	<p>Introduction, history, classification, nomenclature, mechanism of action, adverse effects, therapeutic uses, structure activity relationship (SAR) and synthetic procedures of selected drugs and recent developments of following categories to be covered. (Synthesis of drugs mentioned in each category)</p> <p>Drugs Acting on CNS:</p> <p>A. CNS stimulants: Analeptics, Antidepressants, hallucinogens SAR:- Tri-cyclic antidepressants</p> <p>Synthesis of Amphetamine, Fluoxetine, Imipramine, Amitriptyline</p> <p>B. CNS Depressants: General and local anesthetics, Sedative and hypnotics, Anxiolytics, Antiepileptics, Antipsychotics SAR:- Benzoic acid and Aniline derivatives with Local anesthetic activity, Barbiturates, Benzodiazepines, Phenothiazines, Butyrophenones</p> <p>Synthesis of Halothane, Lignocaine, Procaine, Benzocaine, Thiopental sodium, Phenobarbitone, Chlordiazepoxide, Meprobamate, Phenytoin, Sodium valproic acid, Ethosuximide, Carbamazepine, Chlormazine, Trifluperazine</p> <p>C. Opioid Analgesics and Non-Opioid Analgesics; SAR:- Morphine, Pethidine, Benzomorphan, Morphinan</p> <p>Synthesis of Pethidine, Methadone</p> <p>D. Non Steroidal Anti-Inflammatory Agents, Anti Gout and DMARDS: Synthesis of Paracetamol, Aspirin, Diclofenac, Ibuprofen, Indomethacin, Allopurinol, Mefenamic acid, Nimesulide, Naproxen</p>	24
3.	<p>Hormones and Related drugs:</p> <p>A. Antidiabetic agents: Synthesis of Glipizide, Metformin, Pioglitazone, Tolbutamide, Glimipride.</p> <p>B. Thyroid Hormones and Antithyroid Drugs Synthesis of Thyroxine, Methimazole, Carbimazole.</p> <p>C. Steroids and Therapeutically related compounds</p> <p>(i) Nomenclature and stereochemistry of steroids</p> <p>(ii) Adrenocorticoids – Mineralocorticoids, Glucocorticoids</p> <p>(iii) Estrogens, Progestins and Androgens</p> <p>(iv) SAR: Estrogens and Adrenocorticoids, Progestins, Androgens</p>	10

4.	Drugs used in Neurodegenerative diseases Alzheimer's disease, Cognition enhancers, Parkinsonism	03
5.	Drugs acting on uterine motility: oxytics	02

Semester – VI

Pharmaceutical Chemistry-VII (Medicinal Chemistry-II)

Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Content	No. of practical hours
A	<p>Separation and qualitative analysis of Organic binary mixtures containing water insoluble components having salt, acidic, phenolic, amphoteric, basic and neutral nature (Solid + Solid, Solid + liquid, Liquid + liquid and Eutectic mixtures) with derivative preparations.</p> <p>1. Salts (sodium benzoate, Sodium salicylate etc.)</p> <p>2. Acids (Benzoic acid, salicylic acid, cinnamic acid, acetyl salicylic acid etc.)</p> <p>3. Phenols (α-Naphthol, β-Naphthol, o/m/p-nitrophenol, Phenol, o/m/p-cresol etc.)</p> <p>4. Strong acidic amphoteric (P-amino benzoic acid, o-amino benzoic acid, sulphanilic acid etc.) and weak acidic amphoteric (Sulphanilamide etc.)</p> <p>5. Bases (α-Naphthylamine, o/m/ p-anisidine, diphenyl amine, o/m/p-nitroaniline, Aniline, N-methyl aniline, N,N-dimethyl aniline etc.)</p> <p>6. Neutrals (Benzophenone, Benzaldehyde, Acetophenone, Nitrobenzene, m-dinitrobenzene, acetanilide, benzamide, naphthalene etc.)</p>	33
1	Separation and qualitative analysis of organic binary mixture with derivative preparation	
2	Separation and qualitative analysis of organic binary mixture with derivative preparation	
3	Separation and qualitative analysis of organic binary mixture with derivative preparation	
4	Separation and qualitative analysis of organic binary mixture with derivative preparation	
5	Separation and qualitative analysis of organic binary mixture with derivative preparation	
6	Separation and qualitative analysis of organic binary mixture with derivative preparation	

7	Separation and qualitative analysis of organic binary mixture with derivative preparation	
8	Separation and qualitative analysis of organic binary mixture with derivative preparation	
9	Separation and qualitative analysis of organic binary mixture with derivative preparation	
10	Separation and qualitative analysis of organic binary mixture with derivative preparation	
11	Separation and qualitative analysis of organic binary mixture with derivative preparation	
B	Synthesis of some organic compounds	12
12	Aspirin	
13	Phenytoin	
14	Methyl Salicylate	
15	Paracetamol	

Text Books:

1. Foe's principles of medicinal chemistry. David A. Williams & Thomas L. Lemke. Lippincott Williams & Wilkins.
2. Wilson and Griswold's textbook of organic medicinal and Pharmaceutical Chemistry, John H. Block and John M. Beale, Jr.. Lippincott Williams & Wilkins.

Reference Books:

1. Harkishan Singh and V.K Kapoor – text book of medicinal chemistry.
2. Medicinal chemistry by ashutoshkar
3. Principles of medicinal chemistry by kadam and bothara
4. Experimental organic and medicinal chemistry by biren n., shah. S. vikas.
5. Practical organic chemistry, Hitesh G. Raval, Sunil L. Baldania, Dimal A. Shah, Nirav and Roopal Prakashan.
6. Burger's Medicinal Chemistry and Drug Discovery, Donald j Abraham, Wiley interscience.
7. Vogel's text book of practical organic chemistry.
8. Practical organic chemistry by F.G Mann and Saunders

Semester – VI
Pharmaceutical Analysis- IV

Subject Code:
1612040701060400

Theory (03 Hours/ Week; 03 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Course Objectives

- Introduce students to different chromatographic techniques with advanced hyphenation, radio assay techniques and Elisa techniques with emphasis on its application in quality control and quality assurance.
- Cover areas including chromatographic techniques, HPLC, UPLC, HPTLC, GC and other miscellaneous techniques. Radioimmunity assay techniques and Elisa techniques.

Students Learning Outcomes:

- To demonstrate an understanding of the theory and applications of different chromatographic techniques used in pharmaceutical analysis.
- Learn the practical aspects and importance of quantitative and qualitative analysis of different drugs, pharmaceuticals and compounds involving various chromatographic techniques.

Sr. No.	Course Contents	Total hrs
1	High Performance Liquid Chromatography Introduction; Theory, Classification and Principle of HPLC; Mobile phase, Stationary phases for normal and reversed phase HPLC; Instrumentation and applications of HPLC; Comparison of HPLC with GC; UPLC : Introduction, instrumentation and application	09
2	High Performance Thin Layer Chromatography Principle; Comparison with HPLC; Instrumentation, applications, advantages and limitations of HPTLC.	05
3	Gas Chromatography Introduction; Theory and Principle of Gas-Chromatography; Mobile phase, Stationary phases for GSC and GLC; Instrumentation (including temperature programming and derivatization) and applications of GC; Overview of GC-MS.	09

4	Miscellaneous Chromatographic technique Like supercritical fluid chromatography, ion-exchange chromatography, ion-pair chromatography, Affinity chromatography, Chiral chromatography, gel permeation chromatography, flash chromatography, etc....	08
5	Hyphenated Analytical techniques Introduction to Hyphenated techniques, Including GC-MS, LC-MS, LC-FTIR, LC-NMR, CE-MS, GC-IR, GC-MS/MS, LC-MS/MS, GC-AES, etc.	07
6	Radiochemical methods Introduction; Nuclear reactions and radiation; Interaction of nuclear radiation with matter; Radioactive decay; Units of radioactive decay; Measurement of radioactivity; Activity analysis; Isotopes dilution analyses; Liquid scintillation systems; Applications of radio nuclides	04
7	Radio-immuno assay (RIA) and ELISA (Immunochemical techniques) Introduction, Principle, Instrumentation and Application	03

Semester – VI
Pharmaceutical Analysis- IV
Practical (03 Hours/ Week; 03 Credits, 45 Hours)

Sr. No.	Practical Contents
1	Demonstration to HPLC.
2	Demonstration to HPTLC.
3	Demonstration to GC/ LC.
4	Separation and identification of drugs/ pharmaceuticals/ impurities/ related substances/amino acids/ herbal/ natural constituents by TLC and HPTLC methods.
5	Separation and identification of drugs/ pharmaceuticals/amino acids/ herbal/ natural constituents by paper chromatography, TLC and HPTLC methods.
6	Qualitative and Quantitative analysis of drugs and pharmaceuticals by TLC, HPTLC and HPLC methods.
7	Demonstration to radio-immuno assay (RIA)
8	Demonstration to ELISA (Immunochemical techniques)

Books Recommended (Latest Editions):

1. Instrumental Methods of Analysis - Scoog and West.
2. Spectrometric Identification of Organic Compounds - Silverstein et., al.
3. Instrumental Method of Analysis - Willard Dean & Merrit.
4. Pharmaceutical Chemistry Vol. I & Vol. II — Becket and Stanlake
5. Pharmaceutical Analysis — Hiquchi, Bechmman, Hassan.
6. Pharmaceutical Analysis — Modern methods — Part A and B — Munson James. W.
7. Quantitative Analysis of Drugs — Garrot.
8. Quantitative Analysis of Drugs in Pharmaceutical Formulations — P. D. Sethi.
9. Application of Absorption Spectroscopy of Organic Compounds — Dyer.
10. Analytical Profiles of Drug Substances — Florey [Volume 13].
11. Spectroscopy of Organic Compound - P. 5. Kalsi, Wiely Eastern Ltd., New Delhi.
12. Absorption Spectroscopy of Organic Molecules — V. M. Parikh, Addison — Wesley Publishing Company, London.

Semester – VI
PHARMACOLOGY - III
Subject code: 1612050701060500
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Course Objectives

- This course is designed to provide basic instruction in the principles of pharmacology and the course will emphasize on mechanisms of drug action, adverse reactions, dose and uses of drugs which acts on microbes, anti cancer drugs, immunosuppressants and immunostimulant drugs and drugs acting on hormones. This content will provide students a knowledge with a comprehensive introduction to the fundamental Pharmacology and uses of the major classes of clinically important drugs currently used in medical practice.

Students Learning Outcome

- At the end of the course, students will be able to understand the fundamental scientific principles of drug action and the various mechanisms by which drugs can mediate their pharmacological effect, understand the fundamental principles of pharmacokinetics that underlie the absorption, distribution, metabolism and elimination of drugs in the body and thereby affect drug effectiveness, understand the biochemical reactions that result in the metabolism of drugs within the body, understand the rationale behind designing different dosing regimens of particular drugs in specific patient populations, understand how specific patient characteristics and genetics can affect the response to a particular class of drugs, understand the scientific basis underlying how two different drugs can interact within the body and can have undesirable effects either on drug concentrations or drug clinical effects. These include drugs which act on microbes, anti cancer drugs, immunosuppressants and immunostimulant drugs and drugs acting on hormones.

Sr. No.	Course Contents	Total Hrs.
1	Antimicrobial drugs Introduction and principles of chemotherapy and general mechanism of antimicrobials.	02

	Mechanism of resistance, superinfections, Problems associated with use of antibiotics, Prophylactic use of antibiotics	
2	<p>Antimicrobial combinations, classification, mechanism of action, spectrum of activity, resistance development, adverse drug reactions, therapeutic use of followings</p> <ul style="list-style-type: none"> - Beta lactam antibiotics (Penicillin, Cephalosporins, Monobactam, Carbapenams) and Clavulanic acid - Sulphonamides and co-trimoxazole - Quinolones - Tetracyclines and Chloramphenicol - Aminoglycosides - Macrolides, Lincosamides, Glycopeptide, - Urinary antiseptics - Miscellaneous antibiotics - Anti-tubercular drugs - Antileprotic drugs - Anti-fungal agents - Anti-viral drugs - Anti-malarial drugs - Antiamoebic and antiprotozoal drugs - Anthelmintics 	24
3	Pharmacology (Classification, Mechanism of action, Adverse reactions, Contraindications, Uses and Dose) of Anti-cancer drugs	07
4	Pharmacology (Classification, Mechanism of action, Adverse reactions, Contraindications, Uses and Dose) Immunosuppressants and Immunostimulants	02
5	<p>Pharmacology of Hormones and related drugs as followings:</p> <ul style="list-style-type: none"> - Introduction - Anterior pituitary hormones - Thyroid and parathyroid hormone and thyroid inhibitors - Insulin, oral hypoglycemics and glucagon - Corticosteroids - Androgens and Drugs for erectile dysfunction - Estrogens, Progestins and oral contraceptives - Oxytocin and drugs acting on Uterus-Uterine stimulants and relaxants 	10

Pharmacology - III
Practicals: (3 Hours/Week; 3 Credits, 45 Hours)

Sr. No.	Practicals
1	Introduction and principle of Bioassay
2	To carry out bioassay of Histamine using isolated chick/rat/guinea pig ileum preparation by matching method
3	To carry out bioassay of Histamine using isolated chick/rat/guinea pig ileum preparation by interpolation method
4	To carry out bioassay of Histamine using isolated chick/rat/guinea pig ileum preparation by three point method
5	To carry out bioassay of Acetylcholine using isolated chick/rat/guinea pig ileum preparation by interpolation method
6	To carry out bioassay of Acetylcholine using isolated ileum preparation by matching method
7	To carry out bioassay of Acetylcholine using isolated ileum preparation by three point method
8	To carry out bioassay of Atropine using isolated ileum preparation by interpolation method
9	To carry out bioassay of Atropine using isolated ileum preparation by matching method
Demonstration experiments:	
10	To demonstrate effect of local anaesthetics on rats/rabbits
11	To demonstrate effect of antiulcer drugs using rats
12	To demonstrate the effect of anti-motility drugs using mice/rat
13	To demonstrate bioassay of oxytocin using rat uterus
14	To demonstrate mydriasis/miosis effect on rabbit
15	To demonstrate the effect of hypoglycemic agents on blood sugar level (metformin, glibenclamide/Insulin) using experimental animals.

*** Any experiment demonstrating theoretical concept can be added to the above list**

PHARMACOLOGY TEXT BOOKS

1. Tripathi KD, Essentials of Medical Pharmacology, 7th Edition, Jaypee Brothers, 2010.
2. Satoskar R.S., Bhandarkar S.D. and Rege N.N., Pharmacology and Pharmacotherapeutics, 21st Edition, Popular Prakashan Pvt Ltd, 2010.
3. Chaudhary S.K., Quintessence of Medical Pharmacology, 3rd Revised Edition, Central Book Agency Pvt. Ltd., 2010.
4. Sharma H.L. and Sharma K.K., 2nd Edition, Principles of Pharmacology, Paras Medical, 2011.

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5. Ghosh M.N., Fundamentals of Experimental Pharmacology, 5th Edition, Hilton & Company, 2011.
 6. Kulkarni S.K., Hand book of Experimental Pharmacology, 3rd Edition, VallabhPrakashan, 2005.
 7. Medhi B. and Prakash A., Practical manual of experimental and clinical pharmacology, 1st Edition, Jaypee Brothers, Medical Publishers, 2010.
 8. Goyal R.K.-Practicals in Pharmacology (1994-95) 1st Edn. M/s B. S. Shah Prakashan, Ahmedabad.
 9. Sheth U.K. et al-Selected topics in Experimental Pharmacology(1972)15t Edn.

PHARMACOLOGY REFERENCE BOOKS

1. Brunton L.L., Chanbner B.A., and Knollmann B.C., Goodman and Gilman's The Pharmacological Basis of Therapeutics, 12th Edition, McGraw-Hill Professional, 2010.
2. Katzung B.G., Masters S.B. and Trevor A.J., Basic and Clinical Pharmacology, 12th Edition, McGraw-Hill, 2011.
3. Rang H.P., M.M. Dale, J.M. Ritter., Flower R.J. andHenderson G., Pharmacology, 7th illustrated Edition, Elsevier Science Health Science Division, 2011.
4. Craig C.R. and Stitzel R.E., Modern Pharmacology with Clinical Applications, 6th Edition, Lippincott Williams and Wilkins, 2003.
5. Harvey R.A., Clark M.A., Finkel R, Jose A.R. and Whalen K, 5th Edition, Lipponcott's Illustrated Reviews: Pharmacology, Lippincott Williams and Wilkins, 2011.
6. Barar F.S.K., Essentials of Pharmacotherapeutics, 6th Revised Edition, S.Chand& Co. Ltd, 2011.
7. DiPiro J, Talbert R.L., Yee G., Matzke G., Wells B. and Posey L.M., Pharmacotherapy: A Pathophysiologic Approach, 8th Edition, McGraw-Hill Medical, 2011.

Semester VI
PHARMACOGNOSY-V
Subject Code: 1612060701060600
Theory (3Hours/Week; 3 Credits, 45Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	0	3	80	20	-	-

Objective of the Course:

- To make students familiar with Pharmacognostic study of Natural allergens, toxic plants. Plant sweetener and bitters and photosensitizing agents.
- To make familiar with marine pharmacognosy.
- To make familiar with herb as functional food and Plant tissue culture.

Student Learning Outcomes:

- The students are expected to learn the Herb as functional food, marine source of drugs, Natural allergens, toxic plants, Plant sweetener and bitters and photosensitizing agents.

Sr. No	Course contents	Total Hours
1	Herbal cosmetics	5
2	Natural allergens, Photosensitizing agents, Fungal toxins, Toxic plants and toxicological risk of plant drugs.	5
3	Nutraceuticals	4
4	Phytopharmacovigilance	3
5	Enzymes: Biological sources, preparation, identification test and uses of Diastase, Papain, Pepsin, Trypsin, Pancreatin, Bromelain, Ficin, Penicillinase, Hyalluronidase, Streptokinase, Urokinase.	8
6	Marine Pharmacognosy: Novel medicinal agents from marine sources	5
7	Plant sweeteners and Bitters	4
8	Pesticides and herbicides	3

9	Plant tissue culture: Introduction, basic requirements, types of culture, nutritional requirements, laboratory requirements and applications	8
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Recommended Books:

1. Text book of Pharmacognosy: Shah C. S., Quadry J. S., B. S. Shah Prakashan, Ahmadabad. 15th Edition, 2009.
2. Pharmacognosy: Kokate C. K., Purohit A. P., Gokhale S. B., Nirali Prakashan Pune, 42nd edition, 2008.
3. Trease and Evans Pharmacognosy. 16h Edition, William Charles Evans, W. Saunders, Edinburg London New York Philadelphia St. Louis Sydney Toronto 2009.
4. Kaila A.N., Textbook of industrial Pharmacognosy, C.B.S. Publisher, New Delhi.
5. Pharmacognosy and Pharmacobiotechnology by Ashutosh Kar, 2nd Edition, New Age International Pvt. Ltd.; New Delhi, 2007.
6. Pharmacognosy and Pharmacobiotechnology. James E. Robbers, Marilyn K. Speedie, Varro E. Tyler, Baltimore: Williams & Wilkins, 1996; a Wavery Company, USA.
7. Pharmacognosy: Phytochemistry Medicinal Plants by Bruneton Jean, 2nd Edition, Intercept Publications, Ltd., TEC & DOC Paris, 1999.
8. Comprehensive Biotechnology, 'The Principles, application and regulation of biotechnology in Industry, agriculture and Medicine Vol. 1-4 Alan T, Howard Dalton and Murray Mao-Young.
9. An introduction to Plant Tissue Culture Kalyan Kumar De, New Central Book Agency (P) Ltd., Calcutta
10. Plant Tissue Culture, Sharma Rajni, Campus Books International, 1st Edition, 2007.
11. A text book of Pharmacognosy and Phytochemistry, Vinod D. Rangari, vol - I & II, Latest edition.

Semester – VI
FINANCIAL MANAGEMENT
Subject code: 1612070701060700
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	0	3	80	20	0	0

Objective of the Course

- Basic Understanding of Corporate finance function, Financing decision and Function in corporate finance

Student Learning Outcomes/ Objectives

- Students will aware about Working capital estimation and management, Venture capital financing, corporate strategy, financial policy and shareholder value creating etc.

Sr. No.	Course Contents	Total Hrs.
1	Corporate finance function: Concept, scope and its relationship with other functional areas. Sources of financial information, financial institutions and markets. Objectives. Function in corporate finance- need, characteristics, classical objective functions, some real world problems, maximizing shareholders wealth. Understanding financial statements ratio analysis, cash flow statement, EVA, reporting on corporate governance. Present value time value of money as basis of financial decision-making, mathematics of finance, spreadsheet modeling in corporate finance. Risk and return concept of risk, relationship between expected return and risk, models for risk and return - CAPM, APT and multi-factor models.	08
2	Investment decision making: Estimating free cash flows, cost of capital decision rules, capital budgeting rules to projects when facing capital rationing constraints. Capital structural planning operating and financial leverage; Capital structure theories and value of firm; Capital structure planning and policy; Cost of capital, capital structure and value of firm.	07
3	Financing decision: Hybrid securities namely convertible and non-convertible debentures, deep discount bonds, warrants, secured premium notes. Asset-based financing leasing, hire purchase. Dividend policy- dividend theories, determination of dividend policy, share buyback, retention of profits, dividend policy studies in India.	08

4	Venture capital financing: Concept, developments in India, process and method of financing, fiscal incentives, debt securitization.	05
5	Working capital estimation and management: Operating cycle concept, managing cash and cash equivalents, managing inventory, managing accounts receivables, managing payables. Working capital financing trade credit, bank finance, commercial paper, factoring, money market structures and recent developments.	07
6	Valuation of M & A projects: Economics of M&A, methods of valuation NAV, PECV, MPS, EPS.	05
7	Corporate strategy, financial policy and shareholder value creating: Link between corporate strategy and financial strategy, implications for capital structure, dividend policy and capital budgeting policy of each corporate strategy.	05

Reference Books

1. Fundamentals of Financial Management by James C. Van Horne and John H. Wachowicz Jr.
 2. Financial Management: Theory and Practice by Prasanna Chandra
 3. Principles of Managerial Finance by Lawrence J Gitman
 4. Financial Management by R P Rastogi
 5. Financial Management by Ravi M. Kishore
 6. Financial Management: Principles and Practices by Dr. S N Maheshwari
 7. Financial Management by M Y Khan and P K Jain
 8. Financial Management by I M Pandey
 9. Financial Management by P V Kulkarni
 10. Principles of Corporate Finance by Richard A. Brealey and Stewart C. Myers
 11. Financial Statement Analysis by George Foster
 12. Modern Corporate Finance by Alan C Shapiro and Sheldon D. Balbirer
 13. Creating Value from Mergers and Acquisitions: The Challenges by Sudi Sudarsanam
 14. Understanding and Analyzing Balance Sheets using Excel Worksheet by RuzbehJ.Bodhanwala
- Journals and Magazines:**
15. Vikalpa (IIM, Ahmedabad)
 16. Decision (IIM, Calcutta)
 17. Vision (MDI, Gurgaon)
 18. Chartered Accountant (ICAI, New Delhi)
 19. Management Accountant (ICWAI, now ICAI)
 20. Finance and Development (IMF)
 21. Capital Market
 22. Outlook Business

Semester – VII
PHARMACEUTICAL TECHNOLOGY – I
Subject Code: 1612010701070100
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme			Evaluation Scheme			
			Theory		Practical	
Theory	Practical	Total	External	Internal	External	Internal
3	3	6	80	20	80	20

Course Objectives

The course is designed to make students familiar with the formulation, manufacturing and quality related issues of different non sterile dosage forms and various aspects of pharmaceutical packaging for all dosage forms from pharmaceutical industry point of view.

Students Learning Outcome

- The course will help the student to have a good understanding of the preparation of tablet and tablet coating, capsules & liquid dosage forms.
- Students should be able to describe in detail instrumentation /equipment's for both preparation and evaluation of final product as per standards
- Students should be aware with Extrusion and Pelletization technology
- Students should be able to describe the packaging materials for pharmaceutical products and their requirement.

Sr. No	Course Contents	Total Hrs.
1	<p>Tablet</p> <p>a) Definition, Advantages, Disadvantages</p> <p>b) Introduction to types of tablets, tablets diluents, disintegrants, Binder, Adsorbent, Lubricants, antiadherents, glidants, organolaptic additives: colours, flavours and sweetening agents, Directly compressible excipients, Co-processed excipients.</p> <p>c) Granulation methods and its influence on physical and mechanical properties, compression behaviour, Direct compression, machinery for large scale granulation and compression</p> <p>d) Tablet Presses, physics of tablet making, compression and compaction, In process controls, processing problems and remedies</p> <p>e) Evaluation (Pharmacopoeial and nonpharmacopoeial tests) with special emphasis on dissolution curve comparison</p> <p>f) process flow charts</p> <p>Tablet coating: Objectives, Film (aqueous, non- aqueous, pseudo latex</p>	20

	coating), Types of coating, Sugar and compression coating, Methods, Equipment's and Design of coating pan, defects of coated tablets and their remedies Pharmaceutical Tablet Compression Tooling: Terminology, tablet design, specification and information required, use and care of the tooling, problem solving.	
2	Capsules Hard Capsules- Definition, Advantages, Disadvantages, Ideal Requirements, Production of hard capsules, Capsules storage, Size of capsules, Formulation and methods of capsules filling, Problems and remedies, Quality control, Climate control in capsules departments, I.P. products. Soft gelatin capsules (SGCs) - Formulation of shell and capsule coat, Manufacturing process of soft gelatin capsule, Quality control. Microencapsulation- Importance of microcapsules in pharmacy, methods of preparation: phase separation coacervation, multi orifice centrifugal method, spray congealing, polymerization, air suspension technique, coating pan and other technique, evaluation of microcapsules.	10
3	Liquid dosage forms Introduction, advantages and disadvantages, types of additives used-vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers, colors, flavors etc; manufacturing, packaging and evaluation of clear liquids, suspensions and emulsions (including microemulsion and multiple emulsion) and brief outline of other liquid products such as extracts, tincture, infusion etc., I.P. Products.	05
4	Extrusion and Pelletization Introduction of pellets, Advantages, disadvantages and applications, Factors affecting pellet properties, Cold extrusion, Melt extrusion, Applications of extrusion in pharmacy (including preparation of solid solution), selective equipment's used for extrusion and pelletization, Use of MCC in pelletization, Brief study of effervescent powders and granules	05
5	Pharmaceutical Packaging Definition, Packaging components, types, specifications and methods of evaluation, stability aspects of packing. Primary and secondary packaging, packaging materials, containers and closures; and tamper-evident packaging, packaging equipments. Labeling requirements, Regulatory requirements in pharmaceutical packaging.	05

Semester – VII
PHARMACEUTICAL TECHNOLOGY – I
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Aim of the experiment
1	Demonstration of Rotary Tablet Machine and tablet coating machine.
2	Demonstration of tablet dissolution apparatus, friability apparatus and tablet disintegration apparatus.
3	To Prepare and evaluate paracetamol tablet employing wet granulation technique.
4	To Prepare and evaluate calcium lactate tablet employing direct compression technique.
5	To Prepare and evaluate tablet employing dry granulation (slugging) technique.
6	To Prepare and evaluate Aspirin effervescent tablet.
7	To Prepare and evaluate Chewable tablet.
8	Demonstration of operation procedure of Capsule Filling Machine.
9	To Prepare & Evaluate microspheres.
10	Formulation and evaluation of syrup.
11	Formulation and evaluation of oral Liquids (suspension, liniment, calamine lotion)
12	Formulation and evaluation of milk of magnesia/aluminium hydroxide gel antacid suspension.
13	To Prepare emulsion and find out the type of emulsion by measuring different evaluation parameter.
14	Preparation & Evaluation of Sodium Alginate Pellets.
15	Preparation of pellets by extrusion and spheronization.
16	Preparation of gelatin microcapsules by simple coacervation method.
17	Study of different types of packaging for solid, liquid, semisolid and parenteral products.

Note: Any other practical related to theory topic can be carried out.

References Books

- 1) The Theory & Practice of industrial pharmacy by Leon Lachman, Lea &Febiger, Varghese Publication House Bombay.
- 2) Remington's Pharmaceutical Sciences, Ed. A. R. Gennaro, Mack Publishing Co,
- 3) Modern Pharmaceutics, Edited by G. S. Banker & C.T. Rhodes, Marcel Dekker inc. N.Y.
- 4) Pharmaceutical dosage forms: Tablets, Vol.: 1, 2, 3, H.A. Lieberman, Leon, Lachman, Marcel Dekker inc. N.Y.

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- 5) *Pharmaceutics: The science of dosage form design*, Edited by M.E. Aulton. Churchill Livingstone, New York.
 - 6) *Ansel's Introduction to Pharmaceutical Dosage Form and Drug Delivery system*, H.C. Ansel, N.G. Popovich, Lippincott Williams and Wilkins, Philadelphia.
 - 7) *Indian Pharmacopoeia*, published by Indian Pharmacopoeial Commission, Ghaziabad (latest edition)
 - 8) *United States Pharmacopoeia*, United States Pharmacopoeial Convention Inc. (latest edition)
 - 9) *British Pharmacopoeia*, British Pharmacopoeia Commission Office, U.K. (latest edition)
 - 10) *Packaging of Pharmaceutical and Healthcare Products*, H. Lockhart and F.A. Paine, Blackie Academic and Professional, Glasgow.
 - 11) *Pharmaceutical Packaging Technology* edited by D.A. Dean, E. R. Evans, Taylor and Francis, New York.
 - 12) *Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control*, Sidney H. Willig, James R. Stoker Marcel Dekker Inc, New York

Semester – VII
DOSAGE FORM DESIGN – I
Subject Code: 1612020701070200
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Course Objectives

- The course is designed to make students familiar with basic parameters which are important to design of pharmaceutical dosage forms

Students Learning Outcome

- The course will help the student to have a good understanding of preformulation and stability aspects of various dosage forms.
- Students should be able to learn in detail about role of various excipients used in various formulations
- Students should be able to understand what drug does to the body and what body does to the drug.

Chapter No.	Content	Hours
01	Preformulation studies: <ul style="list-style-type: none"> • Study of physical properties of drug like physical form, particle size, shape, density, wetting, dielectric constant, dissolution and organoleptic property and their effect on Formulation, stability and bioavailability. • Study of chemical properties of drugs like hydrolysis, oxidation, reduction, polymorphisms, racemization, polymerization etc., and their Influence on formulation and stability of products. • Study of prodrugs in solving problems related to stability, bioavailability and elegance of formulations. Theoretical aspects for determining solubility and permeability of the drug, its assessment and application 	08
02	Pharmaceutical necessities: <ul style="list-style-type: none"> • Study of following adjuvant in pharmaceutical products: Natural Gums, bio-degradable polymers, semi-synthetic cellulosic derivatives, and polymers for achieving modified drug release. 	06
03	Pharmacokinetics: <ul style="list-style-type: none"> • Definition and scope, significance of plasma drug concentration measurement. • Compartment model: Phamacokinetics of drug absorption Zero 	08

	<p>order and first order absorption rate constant using Wagner-Nelson and Loo-Riegelman method.</p> <ul style="list-style-type: none"> • Volume of distribution and distribution coefficient. • Compartment kinetics-one compartment and two compartment models. Determination of pharmacokinetic parameters from plasma and urine data after drug administration by intra vascular and oral route. • Curve fitting (Method of Residuals), regression procedures. • Clearance concept, mechanism of renal clearance, clearance ratio, determination of renal clearance. • Hepatic elimination of drugs, first pass effect, extraction ratio, hepatic clearance, biliary excretion, extra hepatic circulation. • Non-linear pharmacokinetics with special reference to one compartment model after I.V. drug administration, Michaelis Menten Equation, detection of nonlinearity (Saturation mechanism). <p>Numericals related to pharmacokinetic parameters using one compartmental model.</p>	
04	<p>Biopharmaceutics:</p> <ul style="list-style-type: none"> • Introduction to biopharmaceutics and its role in formulation development. • Passage of drugs across biological barriers (passive diffusion, active transport, facilitated diffusion and pinocytosis). • Factors influencing absorption, physiochemical, physiological and pharmaceutical. • Drug distribution in the body, plasma protein binding and drug excretion 	12
05	<p>Bioavailability and Bioequivalence:</p> <ul style="list-style-type: none"> • Measures of bioavailability, C_{max}, t_{max} and area under the curve (AUC). • Design of single dose bio-equivalence study and relevant statistics. • Review of regulatory requirements for conduction of bioequivalent studies. 	06
06	<p>Introduction to BCS and dissolution study:</p> <ul style="list-style-type: none"> • Definition: BCS, BDDCS(Biopharmaceutical Drug Disposition Classification System), Dissolution mechanisms, Factors affecting dissolution, Intrinsic dissolution rate measurement, Dissolution apparatus for various dosage forms, Dissolution profile comparison using model independent method (similarity factor, dissimilarity factor). 	05

Semester – VIII
DOSAGE FORM DESIGN – I
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Aim of the experiment
1	Find out angle of repose, Carr's index, Hausner's ratio of given powder/ granules.
2	Determination of solubility of given drug at different pH.
3	To optimize the concentration of suspending agents and emulsifying agents.
4	To study the compression characteristic of different diluents.
5	Find out the effect of various binders and disintegrants on performance of tablet.
6	To evaluate the physical stability of emulsion and compare with marketed product.
7	To study the Influence of temperature on the stability of drug.
8	Perform In Vitro Dissolution of marketed tablets as per pharmacopeia.
9	Preformulation studies including drug-excipient compatibility studies.
10	Solubility enhancement of poorly water soluble drugs using selected techniques.
11	Calculation of bioavailability parameters from the given pattern of drug absorption from oral & IV formulations.
12	Preparation and evaluation of matrix tablet of BCS class I drug with erosion and diffusion based mechanisms.
13	Dissolution profile comparison using model independent method.
14	Calculation of absorption rate by residual method and Wagner Nelson method.
15	Calculation of elimination rate by urinary excretion method.

Note: Any other practical related to theory topic can be carried out.

References Books

1. Applied Biopharmaceutics and Pharmacokinetics by Leon Shargel, Susanna Wu-Pong and Andrew B. C. Yu.
2. The Theory and Practice of Industrial Pharmacy by L Lachman, H Lieberman and J Kanig.
3. Pharmaceutical Preformulation by Carstensen JT, Technomic Publishing Company, Inc., New Holland Avenue, Lancaster, Pennsylvania, USA.
4. Remington's Pharmaceutical Sciences, Mack Publishing Company, Easton, Pennsylvania.
5. Pharmacokinetics by Milo Gibaldi and Donald Perrier.
6. Handbook of Pharmaceutical excipients, Royal society of Great Britain, U.K.
7. Drug Stability, edited by J. T. Cartensen, C.T.Rhode, Marcel Dekker Inc. N.Y.
8. Pharmaceutical dissolution testing by Umesh V. Banker, Marcel Dekker Inc
9. Modern Pharmaceutics, Edited by G. S. Banker & C.T. Rhodes, Marcel Dekker inc. N.Y.
10. Pharmaceutics: The science of dosage form design, Edited by M.E. Aulton. Churchill Livingstone, New York.

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11. Ansel's Introduction to Pharmaceutical Dosage Form and Drug Delivery system, H.C. Ansel, N.G. Popovich, Lippincott Williams and Wilkins, Philadelphia.
 12. Indian Pharmacopoeia, 2007, published by Indian Pharmacopoeial Commission, Ghaziabad.
 13. United States Pharmacopoeia, 2004, Indian edition, United States Pharmacopoeial Convention Inc.

Semester – VII
Pharmaceutical Chemistry-VIII (Medicinal Chemistry-III)
Subject code: 1612030701070300
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
03	00	03	06	08	20	80	20

Course Objective

- Medicinal chemistry-III will provide the sound knowledge about development of various drugs on bases of metabolic aspect of drug and drug latentiation. Study about the types of viruses and organic and inorganic compounds/drugs acting on related viral diseases especially HIV and also development in other chemotherapeutic agents including sulphonamides, quinolones, anthelmintic, anti-protozoal agents. Introduction about micro-organisms and effect and mechanism of antibiotics in various diseases. Students will also know about drug design strategies and molecular modeling. A novel approach to computer aided drug design will make them to use computerized softwares for lead discovery and to design any new drug molecule.

Students Learning Outcome

- Know the basic concepts of chemotherapy.
- Know the mechanism of action and effects of drugs on various organs of the body.
- To study about chemistry of individual drug molecule.
- To study about drug interactions and adverse effects.
- To explore the role of metabolism in various pro-drugs, soft-drugs and hard-drugs
- To study in detail about the SAR (structure activity relationship) of different classes of drugs.
- Know about the development of new drug.
- To study separation techniques (physical and chemical) of mixture component in different physical state and identification methods of the same. Know the basic concepts of chemotherapy.

Sr. No.	Course Contents	Total Hrs.
1.	Drug Design and Development:	

	QSAR Lipophilic, electronic and steric parameters Hansch Linear Free Energy Relationship (LFER) model of QSAR Free Wilson Mathematical Model of QSAR	05
	De novo Drug Design Molecular modeling (MM) Computer Aided Drug Design (CADD)	03
	Methods of Lead Discovery Identification and Optimization of Lead	02
	Brief introduction to Combinatorial Chemistry and Parallel Synthesis	02
	Introduction, history, classification, nomenclature, mechanism of action, adverse effects, therapeutic uses, structure activity relationship (SAR) and synthetic procedures of selected drugs and recent developments of following categories to be covered. (Synthesis of drugs mentioned in each category)	
2.	Chemotherapeutic Agents:	
	A. Antibacterial agents: • SAR: Sulphonamides, fluoroquinolones • Synthesis of sulphacetamide, sulphamethoxazole, Trimethoprim, Ciprofloxacin, Ofloxacin, Norfloxacin	04
	B. β-Lactam Antibiotics: • SAR: Penicillins, Cephalosporins	04
	C. Tetracyclines, Aminoglycosides, Macrolides and Miscellaneous Antibiotics: • SAR: Aminoglycosides, Tetracyclines, Macrolides. • Synthesis of Chloramphenicol	06
	D. Antimycobacterial Agents: Synthesis: Ethambutol, Isoniazid, Pyrazinamide	03
	E. Antifungal Agents: Synthesis: Clotrimazole, Ketoconazole	02
	F. Antiprotozoal Agents: Antimalarial and Antiamoebic Agents • SAR: Quinolines • Synthesis: Chloroquine, Primaquine, Pyrimethamine.	04

	Metronidazole	
	G. Anthelmintics: Synthesis: Albendazole, Mebendazole	02
	H. Antiviral and Anti-HIV Agents: Synthesis: Amantadine	03
3.	Anti-neoplastic agents Synthesis: Chlorambucil, Cyclophosphamide, Thiotepa, Methotrexate, Fluorouracil, Tamoxifen.	05

Semester – VII**Pharmaceutical Chemistry-VIII (Medicinal Chemistry-III)****Practical (3 Hours / Week; 3 Credits, 45 Hours)**

Sr. No.	Content	No. of practical hours
1	Synthesis, Reaction monitoring and purification of following organic compounds: Anthranilic acid from phthalic anhydride Sulphanilamide from acetanilide 3-phenyl propionic acid from diethylmalonate Hippuric acid from glycine Dihydroxytryptycene from anthracene and p-benzoquinone Fluorescein from resorcinol and phthalic anhydride. Purification of synthesized fluorescein by column chromatography Microwave assisted synthesis of any two compound	33
2	Characterization of synthesized compound with the help of UV and IR Spectroscopy	06
3	Demonstration of QSAR Models (Any two exercise) Literature survey of any QSAR Model and calculation of various physicochemical parameters Perform multiple regression analysis in MS Excel Generation of Best equation.	06

Text Books:

1. Foe's principles of medicinal chemistry. David A. Williams & Thomas L. Lemke. Lippincott Williams & Wilkins.

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2. Wilson and Griswold's textbook of organic medicinal and Pharmaceutical Chemistry, John H. Block and John M. Beale, Jr.. Lippincott Williams & Wilkins.

Reference Books:

1. Harkishan Singh and V.K Kapoor – text book of medicinal chemistry.
2. Medicinal chemistry by ashutoshkar
3. Principles of medicinal chemistry by kadam and bothara
4. Experimental organic and medicinal chemistry by biren n., shah. S. vikas.
5. Practical organic chemistry, Hitesh G. Raval, Sunil L. Baldania, Dimal A. Shah, Nirav and Roopal Prakashan.
6. Burger's Medicinal Chemistry and Drug Discovery, Donald j Abraham, Wiley interscience.
7. Vogel's text book of practical organic chemistry.
8. Practical organic chemistry by F.G Mann and Saundars

Semester – VII
Pharmaceutical Analysis- V
Subject Code:
1612040701070400

Theory (03 Hours/ Week; 03 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	0	3	80	20	00	00

Course Objectives

- Introduce students to different advanced spectroscopic techniques and thermal techniques with advanced hyphenation with emphasis on its qualitative and quantitative applications.
- Cover areas including spectroscopic techniques, mass, NMR, and X-ray. Other important techniques are thermal method of analysis and electrophoresis.

Students Learning Outcomes:

- To demonstrate an understanding of the theory and applications of different spectroscopic techniques used in pharmaceutical analysis.
- Learn the importance of quantitative and qualitative applications of different drugs, pharmaceuticals and compounds involving various spectroscopic techniques.

Sr. No.	Course Contents	Hrs
1	Mass spectrometry Theory; Ionization techniques, Ion separating techniques; Different types of ions and their significance in mass spectra, Fragmentation rules and rearrangements; Instrumentation and applications of mass spectrometry.	11
2	Nuclear Magnetic Resonance spectroscopy Fundamental Principles - nuclear spin, magnetic moment; Proton NMR spectroscopy - theory, chemical shift and factors affecting chemical shift, spin-spin coupling, coupling constant, relaxation process, Instrumentation and applications of PMR; Brief overview of ¹³ C NMR	11
3	X-ray spectroscopy Introduction; Generation of X – rays; X-ray diffraction, Bragg's law; Applications of X- ray diffraction	07
4	Thermal Methods of Analysis : Theory, instrumentation and applications of Thermo Gravimetric Analysis (TGA), Differential	09

	Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) and Thermo Mechanical Analysis (TMA) with Hyphenated techniques like TGA/FTIR, DSC/FTIR	
5	Electrophoresis : Theory and principles, classifications, instrumentation, moving boundary electrophoresis, Zone Electrophoresis (ZE), Isoelectric focusing (IEF) and applications.	07

Books Recommended (Latest Editions):

1. Instrumental Methods of Analysis - Scoog and West.
2. Spectrometric Identification of Organic Compounds - Silverstein et., al.
3. Instrumental Method of Analysis - Willard Dean & Merrit.
4. Pharmaceutical Chemistry Vol. I & Vol. II — Becket and Stanlake
5. Pharmaceutical Analysis — Hiquchi, Bechmman, Hassan.
6. Pharmaceutical Analysis — Modern methods — Part A and B — Munson James. W.
7. Quantitative Analysis of Drugs — Garrot.
8. Quantitative Analysis of Drugs in Pharmaceutical Formulations — P. D. Sethi.
9. Application of Absorption Spectroscopy of Organic Compounds — Dyer.
10. Analytical Profiles of Drug Substances — Florey [Volume 13].
11. Spectroscopy of Organic Compound - P. 5. Kalsi, Wiely Eastern Ltd., New Delhi.
12. Absorption Spectroscopy of Organic Molecules — V. M. Parikh, Addison — Wesley Publishing Company, London.

Semester – VII
CLINICAL PHARMACY - I
Subject code: 1612050701070500
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme	
Theory	Tutorial	Practical	Total	Theory	
				External	Internal
3	0	0	3	80	20

Course Objectives

- Clinical Pharmacy - I will provide the sound knowledge about concept of clinical pharmacy, its scope and role of clinical pharmacist in health care team and its status in India.
- Course will enable the students to understand the complications, diagnosis and management of the common diseases.in clinical settings.

Students Learning Outcome

At completion of this subject it is expected that students will be able to understand:

- Their role as clinical pharmacist as a health care team member.
- Importance of proper prescribing, its review and required communication skills and counselling for better therapeutic efficacy.
- Needs to identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy including physiological conditions, time-course of clinical and laboratory indices of therapeutic response and adverse effects.
- Basic principles and management of poisoning in general and specific.
- Importance of therapeutic drug monitoring in individualizing the therapy in various conditions.

Sr. No.	Course Contents	Total Hrs.
1	Introduction: Development and scope of clinical pharmacy, concept of health care team, Role of clinical pharmacist as a member of health care team and his/her important functions. Clinical Pharmacy in India	02
2	Basic concepts of pharmacotherapy: a. Recording of medication history, Prescribing, ward round participation, medication therapy review, self medication, non-prescription drug usage, improving patient compliance and providing patient counselling, Communication skills- Behavioural and interpersonal, with patients and other professionals. b. Drugs used in special population: Considerations in Pediatric, Geriatric and	12

	<p>pregnant women.</p> <p>c. Interpretation of clinical laboratory tests: Hematological, pathological and biochemical investigations as markers of major organs damage and their effect on drug therapy decisions.</p> <p>d. Critical Care therapy</p>	
3	<p>Complications, Diagnosis, Prognosis and Management of the following Diseases:</p> <p>a. CNS: Epilepsy, Parkinsonism, Alzheimer, Schizophrenia, Affective disorders, Pain and Migraine, Nausea and vomiting</p> <p>b. Cardiovascular: Hypertension, Coronary heart disease, Thrombosis, Stroke, Congestive heart failure, Cardiac arrhythmias and Dyslipidemia.</p> <p>c. Renal: Acute renal failure, Chronic renal failure.</p> <p>d. Anemia</p>	23
4	<p>Clinical Toxicology: Definition of Poison and General Principles of Treatment of Poisoning with particular reference to Barbiturates, Opioids, Organophosphorus, Atropine and Heavy Metal.</p>	02
5	<p>Concept of essential drugs, Rational drug use and Fixed Dose Combinations</p>	02
6	<p>Therapeutic drug monitoring</p>	02
7	<p>Clinical Pharmacokinetics</p>	02

Books Recommended (latest edition)

1. Clinical Pharmacy and Therapeutics. Roger Walker and Clive Edwards, Churchill Livingstone Edinburgh / London.
2. Pathology & Therapeutics for Pharmacists. Russell J. Greene and Norman F. Harris. Chapman & Hall, London / Glasgow / Madras.
3. Text Book of Therapeutics: Drug and Disease Management. 7th Ed. Editors: Eric T. Herfindal and Dick R. Gurley, Williams and Wilkins, 2000
4. Davidson's Principle and Practice of Medicine, Eds. Christopher R.W. Edwards & Ian A.D. Boucher ELBS with Churchill Livingstone, Edinburgh.
5. Applied Therapeutics: The Clinical Use of Drugs Eds. Brian S. Katcher, Lloyd Yee Young, Marry Anne Koda-Kimble, Applied Therapeutics Inc.
6. Melmon and Morrelli's Clinical Pharmacology, 4th Edition. Authors: S.George Carrathers, Brian B. Hoffman, Kenneth L. Melmon and David W. Nierenberg. McGraw Hill, 2000.
7. Pharmacotherapy: A Pathophysiological Approach. J. T. Dipiro, R. L. Talbert et al, McGraw-Hill, New York.
8. A text book of Clinical Pharmacy Practice (Essential concepts and skills). G. Parthasarhi, Karin Nyfort-Hansen & Milap C Nahata. University Press impression, 2008.

Semester VII
PHARMACOGNOSY-VI
Subject Code: 1612060701070600
Theory (3 Hours/Week; 3 Credits, 45Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Objective of the Course:

- To make students familiar with Biosynthetic pathways and traditional medicinal system Ayurveda and different traditional drugs and their pharmacognostic study.

Student Learning Outcomes:

- The students are expected to learn the system of Ayurveda and they can identify different traditional drugs.
- Student can learn about different Biosynthetic pathways

THEORY

Sr. No	Course content	Total Hours
1.	<p>Biosynthetic studies and basic metabolic pathways: Brief introduction to biosynthetic pathways of secondary metabolite. Biogenesis of pharmaceutically important compounds</p> <p>Acetate mevalonate: Menthol, Vitamin-A, Diosgenin, β-amyrin, Glycyrrhetic acid, Carotenoids</p> <p>Shikimic acid: Atropine, Quinine, Reserpine, Morphine, Podophyllotoxin, Ephedrine, Colchicine, Ergot Alkaloid</p> <p>Acetate malonate: Linoleic acid, Omega-3 fatty acid</p>	15
2.	<p>Concept of Ayurveda, Ayurvedic formulations and their quality control: Introduction and principles of Ayurvedic, Unani, Siddha and Homeopathic systems of medicines. The holistic concept of Ayurvedic system of medicine. A study on different types of Ayurvedic formulations like Churna, Kwath, Gutika, Taila, Ghrita, Avaleha, Asavas, Arista, Bhasma and Pisti. Evaluation of Ayurvedic formulations.</p>	10

3.	<p>Detail study of Ayurvedic Drugs: Studies of traditional drugs, Common vernacular names, Botanical sources, Morphology, Chemical nature of chief constituents, Pharmacological categories, common uses and marketed formulations of following indigenous drugs</p> <p>Stem: Galo Leaf: Nagod Bark: Shirish Root: Chitrak, Rasna Fruit: Malkangni, Kalijiri Seed: Mucuna Flower: Dhatakpush Entire herb: Shankpushpi, Punarna Unorganised: Shilajit</p>	15
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Semester VII
PHARMACOGNOSY-VI
Practical (3 Hours/Week; 3 Credits, 45 Hours)

Sr No	Course Contents
1	Study of Morphology, Microscopy & TLC study of following crude drugs (T.S., Powder, Microscopy & TLC of underlined drugs) : <ul style="list-style-type: none"> ➤ <u>Galo</u> ➤ <u>Nagod</u> ➤ <u>Shirish</u> ➤ <u>Chitrak (red and White)</u> ➤ <u>Rasna (Pluchea & Alpinia)</u> ➤ <u>Punarnava</u> ➤ Malkangani, Kalijiri, Dhatakpushpa, Shilajit, Mucuna, Shankpushpi
2	Preparation and evaluation of Churna (Triphala & Trikatu)
3	Preparation, Physical and chemical evaluation of Ayurvedic Preparations Asavas, Arishta, Taila, Pills/Tablets
4	Preparation of Avaleha and Kwath.

Recommended Books:

1. Pharmacognosy: C. K. Kokate, A. P. Purohit, S. B. Gokhale, Nirali Prakashan Pune, 42nd edition, 2008.
2. A text book of Pharmacognosy and Phytochemistry, Vinod D. Rangari, vol-I & II, Latest edition.

3. Trease and Evans Pharmacognosy. 16th Edition, William Charles Evans, W. Saunders, Edinburg, London, New York, Philadelphia, St. Louis, Sydney, Toronto, 2013.
4. Natural Products, Vol I & II, 28th edition Agrawal O. P., Goel Publishing House, Meerut, 28th Edition, 2004.
5. Chemistry of Natural products. Bhat SV, Nagasampagi BA, Meenakshi S. Narosa Publishing House, New Delhi, 2005.
6. Medicinal Natural Products, A Biosynthetic Approach. Dewick Paul M, John Wiley and Sons, West Sussex, 2009.
7. The Ayurvedic Pharmacopoeia of India, Part I, (Vol. I–V) , part II (I & II) Govt. of India, Ministry of Health and Family Welfare, Dept. of Indian Systems of Medicine and Homeopathy, New Delhi 2008.
8. The Ayurvedic Formulary of India, Vol. I, II and III, Published by Government of India, New Delhi, 1st Edition, 2000.
9. The Wealth of India (Raw Material & Industrial Product), Published by Council of Scientific Research, New Delhi, 1st Edition, 2005.
10. Indian Medicinal Plants, Kirtikar and Basu, 1st Edition, International Book Distributors, Dehradun, 1999.
11. Compendium of Indian Medicinal Plant Vol. 1 to 6, Rastogi R. P., Mehrotra B. N., CDRI & NISCOM, 1st Edition, New Delhi, 1998
12. Indian Herbal Pharmacopoeia, 1st revised Edition, Published by RRL, Jammu and IDMA, Mumbai, 2002.
13. Quality standards of Indian medicinal plants, Volume I to XI (2003 to 2013) Editor: Neeraj Tundon & Parul Sharma; By: Medicinal plant Unit, ICMR, New Delhi.
14. Malati G Chanhan & A. P.G Pillai, Microscopic profile of powdered drugs used in Indian system of medicine, Volume I, Bark drugs 2005, Institute of Ayurvedic medicinal plant science, Gujarat ayurved unit Jamnagar; CPTA.
15. Malati G Chauhan & A.P.G Pillai, “Microscopic profile of powdered drugs used in Indian systems of Medicine, Leaf Drugs, Vol 2, 2007, Institute of P.G Teaching & Reaearch in Ayurveda, Gujarat Ayurved University, Jamnagar.
16. Malati G Chauhan & A.P.G Pillai, “ Microscopic profile of Drugs used in Indian system of Medicine, Seed drugs, Volume- 3, part- 1, 2011; Publisher: Prof Malati G Chauhan, P.G T- S.F C cell, I.P. G T. & R.A, Gujarat Ayurved University, Jamnagar.
17. Review on Indian Medicinal Plants, Vol I to XI (2004 to 2012) Editor: A K Gupta & Neeraj Tundon. By: Indian council of medicinal Research (ICMR), New Delhi.

Semester – VII
MATERIAL AND OPERATION MANAGEMENT
Subject code: 1612070701070700
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	0	3	80	20	0	0

Objective of the Course:

- Basic Understanding of Materials planning, production and operations management, Facilities planning and Layout of manufacturing /service facility.

Student Learning Outcomes/ Objectives:

- Students will understand Product layout, process layout, Integrated materials management, production and operations management etc.

Sr. No.	Course Contents	Total Hrs.
1	Integrated materials management: Concept, need, definition, and scope and advantages.	05
2	Materials planning: Need and definition, factors affecting planning, external and internal, purchasing and materials planning, techniques of planning, guidelines of planning.	05
3	Materials identification and standardization: Classification of materials, codification systems, standardization.	06
4	Inventory control: Importance and scope, costs, economic order quantity; Inventory control techniques.	04
5	Introduction to production and operations management: Evaluation of Production / operations management; Nature of production/operations management; Production function and it environment, functions of production /operations manager, organization of production function.	08
6	Facilities planning: Product selection and design, service design, process and technology selection, location of manufacturing / service facility, center of gravity and median models, dimensional analysis, Brown and Gibson model.	07
7	Layout of manufacturing /service facility: Product layout, process layout, fixed position and group layout, layout design; Relationship based and load-distance cost matrix, materials handling concepts.	05
8	Production planning and control: Aggregate production planning, materials requirement planning, operations scheduling and production, activity control for mass manufacturing, batch processing and job shop.	05

Reference Books

- 1) Operations Research by Kalavathy, S.

- 2) Operations Research by Kapoor, V.K.
- 3) Operations Research by Paneerselvam, R.
- 4) Operations Research: Theory and Applications by Sharma, J.K.
- 5) Operations Research: An Introduction by Taha, H.A.
- 6) Operations Management by Bernard Taylor
- 7) Production and Operations Management by Adam, Ronald and Ebert
- 8) Production and Operations Management by Aswathappa and Bhat.

Semester – VIII
PHARMACEUTICAL TECHNOLOGY –II
Subject Code: 1612010701080100
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme			Evaluation Scheme			
			Theory		Practical	
Theory	Practical	Total	External	Internal	External	Internal
3	3	6	80	20	80	20

Course Objectives

- The course is designed to make students familiar with the formulation, manufacturing and quality related issues of different different sterile dosage forms, Aerosol, products, semi solid dosage forms and cosmetics. They can also aware about current good manufacturing practices and pilot plant scale up techniques of pharmaceutical industry

Students Learning Outcome

- The course will help the student to have a good understanding of the preparation of understanding of the preparation of parenteral products, cosmetics, semi-solid dosage forms and their evaluation.
- Students should be aware with pilot plant scale up technology
- Students should be able to understand cGMPS from pharmaceutical industry point of view.

Sr. No	Course Contents	Total Hrs.
1	<p>Sterile Dosage Forms:</p> <p>a) Definitions, Advantages, Disadvantages, Ideal requirements and Formulation of sterile dosage forms, Water for injection-Preparation and quality control, Design and requirements for sterile products manufacturing facility: i) Environmental controls: quality of air, HEPA filters and laminar flow, class 100,1000,10000 area, monitoring of Areas, ii) Requirements of Aseptic Area</p> <p>b) Flow plan for manufacturing of sterile products by terminal sterilization process</p> <p>c) Flow plan for manufacturing of sterile products by Aseptic Process</p> <p>d) Introduction to form fill seal (FFS) technology.</p> <p>e) Sterile Products for Injection: Large volume parenterals (LVP), Small Volume parenterals (SVP), Containers & closures for sterile products, Prefilled syringes</p>	15

	f) Evaluation of sterile products g) Sterile products for ophthalmic Application: Introduction, Ophthalmic Products: classification, formulation and preparation of eye drops, ophthalmic suspension, eye lotion, ophthalmic ointments, contact lens solutions, containers and closures.	
2	Pharmaceutical Aerosols Definition, Advantages, disadvantages, Design of Aerosol: liquefied gas system, compressed gas system, barrier packs, components of aerosol, propellants: properties, classification, container for aerosol, valve assembly and components of valve, manufacturing: cold and pressure filling technique, packaging methods, pharmaceutical applications, evaluation of aerosol	10
3	Cosmetology and Cosmetic preparation Fundamentals of cosmetic science, structure and function of skin and hair. Formulation, preparation and packaging of products such as Nail Preparation, Dental Products, Lipstick, Skin care products, Shampoo, shaving cream	05
4	Semisolid dosage forms Definition, Advantages and disadvantages, types, mechanisms of drug penetration through skin, factors influencing penetration, semisolid bases, their selection and ideal requirements of bases. General formulation of semisolids, clear gels, suppositories; Manufacturing procedure, evaluation and packaging. I.P. products.	05
5	Good Manufacturing Practice for Pharmaceuticals and validation Brief Introduction to GMP (schedule M) and quality assurance, practice of GMP-Procedure (SOPs), Building, Equipment, Personnel, Components, Documentation, Containers, Labeling, Laboratory Control, Distribution Records, Recovery & Reprocessing. Introduction to validation, validation of selective unit operations (e.g. granulation, compression, mixing) used in tablet manufacturing.	05
6	Pilot Plant Scale up: An overview	05

Semester – VIII

PHARMACEUTICAL TECHNOLOGY –II

Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Aim of the experiment
1	Demonstration of ampoules filling and sealing methods and machine.
2	Preparation and evaluation Dextrose Injection.
3	Preparation and evaluation diclofenac sodium injection
4	Preparation and evaluation of any oil based injection.
5	Preparation and evaluation Ascorbic acid Injection.

6	Preparation and evaluation Calcium Gluconate Injection.
7	Preparation of A. Cold Cream, B. Vanishing Cream
8	Preparation of A. Lipstick, B. Nail Polish, C. Nail Polish Remover
9	Preparation of A. Tooth Powder, B. Tooth Paste
10	Preparation of A. Face Powder, B. Lather Shaving Cream, C. Foam Shaving Cream
11	Preparation of A. Clear Shampoo, B. Cream Shampoo
12	Preparation of eye drops & eye ointment
13	To prepare BMR (Batch Manufacturing Record) & BPR (Batch Packaging Record) for given dosage forms.
14	To prepare SOPs of manufacturing process and working of various pharmaceutical equipments.
15	To perform validation of selective unit operations.

Note: Any other practical related to theory topic can be carried out.

References Books

- 1) The Theory & Practice of industrial pharmacy, Leon Lachman, Lea & Febiger, Varghese Publication House Bombay.
- 2) Remington's Pharmaceutical Sciences , Edited by A. R. Gennaro, Mack Publishing Co,
- 3) Modern Pharmaceutics, Edited by G. S. Banker & C.T. Rhodes, Marcel Dekker inc. N.Y.
- 4) Pharmaceutical dosage forms: Parenteral, Vol.: 1, 2, 3, Leon, Lachman, K. E. Avis, Marcel Dekker inc. N.Y.
- 5) Pharmaceutics: The science of dosage form design, Edited by M.E. Aulton. Churchill Livingstone, New York.
- 6) Ansel's Introduction to Pharmaceutical Dosage Form and Drug Delivery system, H.C. Ansel, N.G. Popovich, Lippincott Williams and Wilkins, Philadelphia.
- 7) Indian Pharmacopoeia, published by Indian Pharmacopoeial commission, Ghaziabad (latest edition)
- 8) United State Pharmacopoeia, United State Pharmacopoeial convention INC. (latest edition)
- 9) British Pharmacopoeia, British Pharmacopoeia commission office, U.K. (latest edition)
- 10) Cosmetic- Formulation, Manufacturing and Quality control, P. P. Sharma, Vandana Publication Pvt. Ltd., New Delhi.
- 11) Cosmetic Science and technology, Vol-1-3, M. S. Blsam, Wiley India Pvt. Ltd.
- 12) Poucher's Perfumes, Cosmetics and Soaps, Edited by Hilda Butler, Springer, U.K.
- 13) Pharmaceutical dosage forms: Disperse systems, Vol.: 1, 2, 3, H.A. Lieberman, G. S. Banker, Marcel Dekker inc.

Semester – VIII
Dosage Form Design – II
Subject Code: 1612010701080200
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Course Objectives

- The course is designed to make students familiar with various novel & advanced drug delivery systems to overcome the problems of conventional delivery systems

Students Learning Outcome

- The course will help the student to have a good understanding of fundamentals of controlled drug delivery systems & their various types in detail
- Students should be able to learn about targeted drug delivery systems & its significance

Chapter No.	Content	Hours
01	<p>Controlled and sustained release dosage forms:</p> <ul style="list-style-type: none"> • Design of oral sustained release systems: Biological factors, Physicochemical factors Diffusional systems: -Reservoir system, Lag time, Burst effect, Matrix system, Effect of porosity and tortuosity Dissolution controlled system, Cube route dissolution equation, Diffusion layer controlled dissolution. Bioerodible and Combination of diffusion and dissolution systems. Design, development and evaluation of oral and parenteral controlled release Formulations. 	08
02	<p>Novel drug delivery system:</p> <ul style="list-style-type: none"> • Modified drug delivery systems: Fundamentals, rational of modified release drug delivery, factors influencing the design and performance, pharmacokinetic and pharmacodynamic basis for modified drug delivery systems, estimation of loading and maintenance dose. • Design and development of oral modified release dosage forms: Matrix tablets, microspheres, hydrogels, osmotic pressure controlled systems, gastro retentive systems, colon targeting. • Fabrication of parenteral drug delivery systems: Parenteral emulsions & parenteral suspensions, microspheres, liposomes, niosomes, nanoparticles. • Formulation and evaluation of Transdermal drug delivery systems. • A brief study of site specific and targeted drug delivery systems, transmucosal and ocular drug delivery systems. 	22
03	<p>Stability of pharmaceuticals:</p> <ul style="list-style-type: none"> • Kinetic principles and stability testing: Reaction rate and order, 	10

	<p>acid base catalysis, decomposition reactions and stabilization of pharmaceuticals.</p> <ul style="list-style-type: none"> • Stability of formulation, factors affecting formulation stability, MKT, climatic zones, matrixing and bracketing instability study, accelerated stability testing, real time stability. Current WHO, USFDA and stability testing as per ICH guidelines for pharmaceutical drug substances and drug products. • Product stability: Requirements, shelf-life, overages, containers, closures. • Overage calculations 	
04	<p>Clinical Pharmacokinetics:</p> <ul style="list-style-type: none"> • Definition and scope • Dosage adjustment in-patients with and without renal and hepatic failure. • Pharmacokinetic drug interactions and their significance in combination therapy 	05

References Books

1. Modern Pharmaceutics, Edited by G. S. Banker & C.T. Rhodes, Marcel Dekker inc. N.Y.
2. Pharmaceutics: The science of dosage form design, Edited by M.E. Aulton. Churchill Livingstone, New York.
3. Ansel's Introduction to Pharmaceutical Dosage Form and Drug Delivery system, H.C. Ansel, N.G. Popovich, Lippincott Williams and Wilkins, Philadelphia.
4. The Theory & Practice of industrial pharmacy, Leon Lachman, Lea & Febiger, Varghese Publication House Bombay.
5. Progress in Controlled & Novel Drug Delivery System, N.K.Jain, CBS Publication, New Delhi
6. Novel drug delivery systems Fundamentals & Developmental concepts by Y.W.Chien, Marcel Dekker Inc.
7. Controlled drug Delivery, Fundamentals & application by J.R. Robinson & Univent Lee, Marcel Dekker Inc.
8. Biopharmaceutics & Pharmacokinetics, D. M. Brahmankar & S. B. Jayswal, Vallabh Prakashan, New Delhi
9. Targeted & controlled drug delivery, S.P.Vyas, R.K. Khar, CBS Publisher, India
10. Encyclopedia of Pharmaceutical Technology, edited by James Swarbrick, James Braylan, Vol-1, 2, 3, Marcel Dekker inc. N.Y.

Semester – VIII
Pharmaceutical Chemistry-IX (Medicinal Chemistry-IV)
Subject code: 1612030701080300
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
03	00	03	06	08	20	80	20

Course Objective

- Medicinal chemistry-IV will provide the sound knowledge about the chemistry, nomenclature, structure activity relationship, mechanism and synthesis of drugs that are used to treat cardiovascular disorders, diuretics, immune-modulators etc. By study of disconnection approach one may build up synthetic pathway of complex drugs. Current need of peptides and related drugs are also needful topics that are covered in this syllabus.

Students Learning Outcome

- Know the basic concepts of medicinal chemistry from practical and theoretical aspect, its scope and various branches.
- To identify pharmacophoric binding sites in drug responsible to bind with receptor
- To study about which methods to apply for purification for different synthesized crude product
- To gain knowledge about fragmentation of complex drug molecule and to apply retrosynthesis of complex drugs/compounds.
- To study about chemistry, drug interactions and adverse effects of individual drug molecules on chemistry bases. 6. To study in detail about the SAR (structure activity relationship) of different classes of drugs.

Sr. No.	Course Contents	Total Hrs.
	Introduction, history, classification, nomenclature, mechanism of action, adverse effects, therapeutic uses, structure activity relationship (SAR) and synthetic procedures of selected drugs and recent developments of following categories to be covered. (Synthesis of drugs mentioned in each category)	

1.	Drugs acting on Cardiovascular System:	
	Cardiotonic Agents SAR: Cardiac glycosides Synthesis: Dobutamine	04
	Antihypertensive Agents SAR: ACE Inhibitors, Dihydropyridnes Synthesis: Nifedipine, Amlodipine, Atenolol, Metoprolol, Carvediol, Captopril, Hydralazine.	09
	Antiarrhythmic Agents Synthesis: Lignocaine, Flecainide.	03
	Antianginal Agents Synthesis: Glyceryltrinitrate, Isosorbidedinitrate	02
	Antihyperlipidemic agents: SAR: HMG CoA Reductase inhibitors Synthesis :Clofibrate	05
	Coagulants and Anticoagulants Synthesis of warfarin	02
	Antiplatelet Agents Synthesis of Aspirin	02
	Thrombolytic agents	01
	Plasma expanders	01
2.	Diuretics: SAR: Thiazide diuretics, 5-Sulfamoyl benzoic acid derivatives. Synthesis: Hydrochlorthiazide, Acetazolamide, Furosemide, Ethacrinic acid	05
3.	Anti-obesity drugs	02
4.	Immunomodulators	02

5.	Peptidomimetics and nucleotidomimetics	02
6.	Introduction to Synthon Approach.	03
7.	Diagnostic agents Radiopharmaceuticals, radiological contrast media (Synthesis: Diphenoxylate, diatrizoic acid)	02

Semester – VIII
Pharmaceutical Chemistry-IX (Medicinal Chemistry-IV)
Practical (3 Hours / Week; 3 Credits, 45 Hours)

Sr. No.	Content	No. of practical hours
1	Synthesis, Reaction monitoring and purification of following organic compounds: a) Methyl red from anthranilic acid b) Benzillic acid from benzoin c) Benzamide from Benzaldehyde d) m-Nitrophenol from Nitrobenzene e) p-Aminophenol from Nitrobenzene f) Chalcone from Benzaldehyde and Acetophenone g) Barbituric acid from Urea and Dimethyl malonate	33
2	Characterization of synthesized compound with the help of UV and IR Spectroscopy	12

Text Books:

1. Foe's principles of medicinal chemistry. David A. Williams & Thomas L. Lemke. Lippincott Williams & Wilkins.
2. Wilson and Griswold's textbook of organic medicinal and Pharmaceutical Chemistry, John H. Block and John M. Beale, Jr.. Lippincott Williams & Wilkins.

Reference Books:

1. Designing Organic Syntheses - A Programmed Introduction to the Synthon Approach (S. Warren)
2. Harkishan Singh and V.K Kapoor – text book of medicinal chemistry.
3. Medicinal chemistry by ashutoshkar
4. Principles of medicinal chemistry by kadam and bothara
5. Experimental organic and medicinal chemistry by biren n., shah. S. vikas.
6. Practical organic chemistry, Hitesh G. Raval, Sunil L. Baldania, Dimal A. Shah, Nirav and Roopal Prakashan.

7. Burger's Medicinal Chemistry and Drug Discovery, Donald j Abraham, Wiley interscience.
8. Vogel's text book of practical organic chemistry.
9. Practical organic chemistry by F.G Mann and Saunders

Semester – VIII
Pharmaceutical Analysis- VI
Subject Code:
1612040701080400

Theory (03 Hours/ Week; 03 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	0	3	80	20	00	00

Course Objectives

- Introduce students to quality assurance and quality control department in pharmaceutical sciences for maintaining the quality of various drugs and pharmaceuticals.
- To understand the concept of quality and various good practices in pharmacy.
- To study the recent drug regulatory guideline and issues related with patent.

Students Learning Outcomes:

- To demonstrate an understanding of the QA and QC, quality, good pharmacy practices, regulatory guidelines, and patent issues related with different drugs and pharmaceuticals.

Sr. No.	Course Contents	Hrs
1	Quality assurance and Quality Control Difference between QA and QC Basic theory Significance, Function and Responsibility	07
2	Quality as a concept Total Quality Management (TQM) International Organization for Standardization (ISO) Quality by Design (QbD) Six Sigma Process analytical technique (PAT)	10
3	Good Practice in Pharmaceutical Sciences GMP GLP GCP GPP	10
4	Regulatory Guidelines ICH	10

	USFDA WHO Guidelines for clinical trials	
5	Intellectual Property Rights Introduction Indian and Global scenario Introduction to GATT/WTO; TRIPS, Paris convention, PCT, WIPO.	08

Books Recommended (Latest Editions):

1. Drugs and Cosmetics Laws by Krishnan Arora, Professional Book Publishers, New Delhi
2. Mittal B.M., A Textbook of Forensic Pharmacy, 9th Ed., Vallabh Prakashan
3. Deshpande S.W., Drugs and Cosmetic Act.1940.
4. Gnarino Richard A, New Drug Approval Process, 3 rd Ed., Marcel Dekker Inc.
5. P. Warayan, Intellectual Property Laws, Eastern Law House.
6. Drug and Cosmetic Act 1940, Eastern Book company by Vijay Malic, 11th Ed. Patents for Medicine, by N. B. Zareri, Indian Drug Manufacturers Association (IDMA)
7. Ira R. Bery, —Introduction to the Pharmaceutical Regulatory Process□ , Drugs and Pharm Sci. Series, Vol. 144, Marcel Dekker Inc., N.Y. S. Ahuja, Modern Pharmaceutical Analysis.
8. S. Weinberg, —Good Laboratory Practice Regulation□ Drugs and Pharm. Sci. Series, Vol. 124, 3rd Ed., Maracel Dekker Inc., N.Y.
9. Syed Imtiaz Haider , —Pharmaceutical Master Validation Plan, The ultimate guide FDA, GMP and GLP Compliance□ , St. Lucie Press , 2006
10. Joseph D. Nally, —Good Manufacturing Practice For Pharmaceuticals□ , 6 edition, Informa Healthcare.
11. P. P .Sharma —How to practice GMPs□ , 3rd edition Vandana Publication. 6. P. P. Sharma —How to practice GLP□ Vandana Publication.
12. John Sharp, —Good Pharmaceutical Manufacturing Practice□ , CRC Press.
13. David M. Bliesner , — Establishing A CGMP Laboratory Audit System, A practice Guide, A John Wiley & Sons, INC Publication.
14. Quality planning and Analysis by JM Juran and FM Gryna, Tata McGrawHillIndia.
15. Total Quality Management, Dale H. Besterfield, Pearson Education, 3rd Ed., 2003.
16. Total Quality Management, Principles, Implementation & Cases, Sharma D.D., Sultan Chand & Sons, New Delhi, 2000.
17. Fundamentals of Total Quality Management, Process Analysis and Improvement by Jens.J Daulgard, Kai Kriestensen and Gopal K.Kanji. Taylor and Francis

Semester – VIII
CLINICAL PHARMACY - II
Subject code: 1612050701080500
Theory (3 Hours/Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Course Objectives

- This course is designed to impart knowledge and skills necessary for contribution to quality use of medicines. Chapters dealt cover briefly pathophysiology and mostly therapeutics of various diseases. This will enable the student to understand the risk factors and diagnosis of common diseases and their management.

Students Learning Outcome

At completion of this subject it is expected that students will be able to understand:

- The pathophysiology of selected disease states and the rationale for drug therapy;
- The controversies in drug therapy;
- The importance of preparation of individualised therapeutic plans based on diagnosis;
- Needs to identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time-course of clinical and laboratory indices of therapeutic response and adverse effects);
- Summarise the therapeutic approach to management of these diseases including reference to the latest available evidence;
- Therapy (including alternatives, time-course of clinical and laboratory indices of therapeutic response and adverse effects).
- Pathophysiology and applied Pharmacotherapeutics of diseases associated with following system/diseases with of special reference to the drug of choice.

Sr. No.	Course Content	Hours
1	Drug interactions: Types of drug interaction, Documentation and methods for minimizing clinically relevant drug interactions	2
2	Drug induced diseases (Liver, Kidney, Lung & GIT), Adverse drug reactions and Pharmacovigilance (Pharmacovigilance program in India)	3
3	Risk factors, diagnosis & prognosis, complications and management of the following diseases/conditions:	
	A. Respiratory: Bronchial asthma	2
	B. Gastrointestinal: Peptic Ulcer Disease, Inflammatory Bowel Disease, Hepatitis, Constipation and diarrhoea	4

	C. Endocrine: Diabetes mellitus, Thyroid disorders, Parathyroid disorders, Osteoporosis, Hormone replacement therapy (HRT)	7
	D. Neoplasia: Leukemia, Lymphomas, Breast Cancer, Cervical Cancer, Prostrate Cancer, Oral and lung cancers	7
	E. Infections: Tuberculosis, Urinary tract infections, Enteric infections, Meningitis, Respiratory tract infections, Septicaemia, Sexually transmitted diseases (Syphilis, Gonorrhoea), Leishmaniasis, Viral Infections (AIDS, Swine Flu, Congo Fever, Chickenguniya, Ebola fever, SARS-Sub Acute Respiratory Syndrome)	14
	F. Obesity	1
	G. Glaucoma, Cataract	2
4.	New drug discovery process, Pharmacoeconomics	3

Semester – VIII

Clinical Pharmacy - II

Practical (3 Hours/Week; 3 Credits, 45 Hours)

Sr. No.	Aim and objective
1	To audit given prescription for format of prescription, essentiality and rationality and suggest 'carry home message' (three experiments containing three prescriptions each, in totality nine prescriptions, covering various diseases or organ-systems)
2	To evaluate formulations for their essentiality and rationality and also provide 'carry home message' (Three experiments containing two formulations each for anemia)
3	To evaluate formulations for their essentiality and rationality and also provide 'carry home message' (Three experiments containing two formulations each for diarrhoea)
4	To evaluate formulations for their essentiality and rationality and also provide 'carry home message' (Three experiments containing two formulations each for cough)
5	To suggest appropriate parenteral nutrition for hospitalized patients after proper nutritional assessments in different conditions, and enlist importance of medications necessary in a pharmacy for Intensive Care Unit management.
6	To evaluate drug-drug interactions for the type of drug interaction, mechanism(s) responsible for drug interactions, possible outcomes or clinical manifestations of interaction and suggestion corrective measure to overcome or prevent the drug interaction (Drug-drug interaction case studies 1-3).
7	To evaluate drug-drug interactions for the type of drug interaction, mechanism(s) responsible for drug interactions, possible outcomes or

	clinical manifestations of interaction and suggestion corrective measure to overcome or prevent the drug interaction (Drug-drug interaction case studies 4-6).
8	To evaluate drug-drug interactions for the type of drug interaction, mechanism(s) responsible for drug interactions, possible outcomes or clinical manifestations of interaction and suggestion corrective measure to overcome or prevent the drug interaction (Drug-drug interaction case studies 7-9).
9	To evaluate cases for Interpretation of laboratory data (cases 1 & 2 with clinical and other relevant findings)
10	To evaluate cases for Interpretation of laboratory data (cases 3 & 4 with clinical and other relevant findings)
11	To evaluate two cases involving skills of pharmacist for patient counseling
12	To evaluate for dose adjustment in geriatrics, pediatrics and pregnant women (Min. three cases each)
13	To evaluate cases for Therapeutic Drug Monitoring (TDM) (case 1 & 2)
14	To evaluate cases for Therapeutic Drug Monitoring (TDM) (case 3 & 4)
15	Collecting information for a given drug (Preferably recently approved drugs) regarding adverse drug reactions, drug interactions and contraindications using authenticated sources (Recent text books, Latest Journals and online drug data bases such as Medscape)

* Any experiment demonstrating theoretical concept can be added to the above list

Books Recommended:

1. Text Book of Therapeutics: Drug and Disease Management. 8th Ed. Editors: Eric T. Herfindal and Dick R. Gurley, Williams and Wilkins, 2006
2. Clinical Pharmacy and Therapeutics. Roger Walker and Clive Edwards, Churchill Livingstone Edinburgh / London, 4th ed, 2008
3. A text book of Clinical Pharmacy Practice (Essential concepts and skills). G. Parthasarhi, Karin Nyfort-Hansen & Milap C Nahata. University Press impression, 2008
4. Pathology & Therapeutics for Pharmacists. Russell J. Greene and Norman F. Harris. Chapman & Hall, London / Glasgow / Madras.
5. Davidson's Principle and Practice of Medicine, Eds. Christopher R.W. Edwards & Ian A.D. Boucher ELBS with Churchill Livingstone, Edinburgh.
6. Applied Therapeutics: The Clinical Use of Drugs Eds. Brian S. Katcher, Lloyd Yee Young, Marry Anne Koda-Kimble, Applied Therapeutics Inc.
7. Melmon and Morrelli's Clinical Pharmacology, 4th Edition. Authors: S. George Carrathers, Brian B. Hoffman, Kenneth L. Melmon and David W. Nierenberg. McGraw Hill, 2000.
8. Pharmacotherapy: A Pathophysiological Approach. J. T. Dipiro, R. L. Talbert et al, McGraw-Hill, New York.

Semester: VIII
PHARMACOGNOSY-VII
Subject Code: 1612060701080600
Theory (3Hours/Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	3	6	80	20	80	20

Objective of the Course:

- To make students familiar WHO guideline for standardization of herbal drugs.
- Study the Phytochemistry of different class of drugs and their evaluation and estimations.

Student Learning Outcomes:

- Students can learn standardization procedure.
- They can be familiar with Schedule T
- They can be familiar with Different Morden analytical technique for phytoconstituents.
- They can aware with herbal drug utilization in Morden diseases.

Sr. No	Course contents	Total Hours
1	WHO Standardization of herbal crude drug & Preparation of Herbal Extracts and their standardization: <ul style="list-style-type: none"> • WHO Guidelines for Standardization of crude drug and monoherbal and poly herbal formulations • Introduction to different methods of preparation of plant extracts. Preparation of standardized plant extracts and principles of Garcenia, Garlic, Turmeric, Aswagandha and Amla. 	10
2	Evaluation of Phytopharmaceuticals: Phytopharmaceutical evaluation and modern analytical techniques for analysis of herbal drugs.	6
3	Isolation, identification and analysis of phytoconstituents: Terpenoids: β - carotenoids, Menthol, Citral, Artemisin, Vitamin A Glycosides: Sennosides, Diosgenin, Glycyrrhetic acid and Rutin Alkaloids: Atropine, Quinine, Reserpine, Morphine, Ephedrine, Caffeine Resin: Podophllo toxin, Curcumin	18

	Antibiotic: Penicillin, Streptomycin	
4	Herbal Drug Industry: Scope, Study of infrastructure, Staff requirement, Project profiles, Plant and equipment, Processing, Research and development and pilot scale up techniques. Quality assurance and concept of Schedule T, GMP and ISO-9000 in herbal drug industry.	6
5.	Herbal drugs for modern diseases: Recent developments of natural products used as Anticancer agents, Antidiabetics, Hepatoprotectives, Antiasthmatic, Hypolipidemic, lythotryptic, Immunomodulators, Tranquilisers, Memory enhancer, Hypnotics	5

Semester: VIII
PHARMACOGNOSY-VII
Practical (3Hours/Week; 3Credits, 45Hours)

Sr. No.	Course content
1	To find out Ash values, extractive values and moisture content of crude drugs.
2	Preparation and standardization of herbal formulation.
3	Isolation of Diosgenin from Fenugreek by preparative TLC and identification by TLC.
4	Estimation of, Diosgenin by colorimetric method.
5	Isolation of Ephedrine and identification by TLC.
6	Isolation of Triammonium Glycyrrhizinate from Glycyrrhiza. & Estimation of Glycyrrhizinic acid by colorimetric method.
7	TLC study of flavonoids of lemon peel, estimation of total flavonoids and isolation hesperidin.
8	Estimation of Total Phenolics and tannins in Trifala/ Harde.
9	Preparation and evaluation of Amla extract.
10	Preparation and evaluation of Curcuma extract.

Recommended Books:

- 1 Pharmacognosy: C. K. Kokate, A. P. Purohit, S. B. Gokhale, Nirali Prakashan Pune, 42nd edition, 2008.
- 2 Trease and Evans Pharmacognosy. 16th Edition, William Charles Evans, W. Saunders, Edinburg, London, New York, Philadelphia, St. Louis, Sydney, Toronto, 2013.
- 3 Textbook of Industrial Pharmacognosy, A. N.Kalia, CBS Publishers & Distributors Pvt. Ltd., 1st Rev. Edition, 2011.
- 4 Herbal Drug Industry, R. D Chaudhry, Eastern Publications, New Delhi.

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- 5 Natural Products as Medicinal Agents, Ed. J. L. Beal and E. Reinhard, Hippocratos Verlag Stuttgart; 1982
 - 6 Chemistry of Natural products. S. V. Bhat, B. A. Nagasampagi, S. Meenakshi, Narosa Publishing House, New Delhi, 2005.
 - 7 Medicinal plants glycosides, Sims, Toronto.
 - 8 Natural Products, Vol I & II, O.P. Agrawal, Goel Publishing House, Meerut, 28th Edition, 2004.
 - 9 Modern Methods of Plant Analysis, K. Peach and M. V. Tracey, Vol.1-4, Narosa Publisher House, New Delhi
 - 10 Practical Pharmacognosy, Technique and Experiment, C. K. Kokate and S. B. Gokhale, Nirali Prakashan, Pune, 8th edition, 2005.
 - 11 Pharmacognosy: Phytochemistry Medicinal Plants, Jean Bruneton, 2nd Edition, Intercept Publications, Ltd., Editions TEC & DOC Paris, 1999.
 - 12 Quality Control, Herbal Drugs, An approach to evaluation of Botanicals, P. K. Mukherjee, Business Horizons Pharmaceutical Publishers; 2002
 - 13 Herbal drug technology by S. S. Agrawal, Paridhavi M, Universities press, 2nd edition.

Semester – VIII
HUMAN RESOURCE MANAGEMENT
Subject code: 1612070701080700
Theory (3 Hours / Week; 3 Credits, 45 Hours)

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	Theory		Practical	
				External	Internal	External	Internal
3	0	0	3	80	20	0	0

Objective of the Course

- Basic Understanding of Acquisition of human resources, Development of human resources and Human Resource Management.

Student Learning Outcomes/ Objectives

- Student will be aware about development, maintenance of Human resource, separation process and research etc.

Sr. No.	Course Contents	Total Hrs.
1	The field of HRM: An overview, concept and functions, personnel to HRM.	05
2	The Personnel organisation: Structure of human resource development and role and responsibilities of the human resource manager.	05
3	Personnel policies: Formulation and essentials of sound personnel policies.	04
4	Acquisition of human resources: Objectives, policies and process, manpower planning, job analysis, job description, job specification, recruitment, selection, induction, placement, promotion and transfer.	06
5	Development of human resources: Determining training needs, training, and management development and performance appraisal.	08
6	Maintenance of human resources: Compensation, administrative job evaluation, designing and administering the wage and salary structure.	07
7	Separation processes: Turnover, retirement, layoff and discharge, VRS.	05
8	Research and the future: Current trends and future implications for HRM.	05

Reference Books

- 1) Human Resource Management by Aswathappa, K.
- 2) Human Resource Management Theory and Practice by Bratton, J. and Gold, J.
- 3) Human Resource Management by Dessler, G.
- 4) Human Resource Management by Flippo, E.
- 5) Managing Human Resources by Gomez-Mejia, L.
- 6) Human Resource Management by Ivantsevich, J.
- 7) Human Resource Management by Kandula, S. R.