

Ordinance Governing Bachelor of Pharmacy (B .Pharm) Degree Semester Course

Syllabus / Curriculum 2009-10



KLE Academy of Higher Education & Research

**(Established under Section 3 of the UGC Act, 1956,
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VISION

To be an outstanding University of excellence ever in pursuit of newer horizons to build self reliant global citizens through assured quality educational programs.

MISSION

- To promote sustainable development of higher education consistent with statutory and regulatory requirements.
- To plan and continuously provide necessary infrastructure, learning resources required for quality education and innovations.
- To stimulate to extend the frontiers of knowledge, through faculty development and continuing education programs.
- To make research a significant activity involving staff, students and society.
- To promote industry/organization, interaction/collaborations with regional / national / international bodies.
- To establish healthy systems for communication among all stakeholders for vision oriented growth.
- To fulfill the national obligation through rural health missions.

OBJECTIVES

The objectives are to realize the following at University and its constituent institutions:

- To implement effectively the programs through creativity and innovation in teaching, learning and evaluation.
- To make existing programs more career oriented through effective system of review and redesign of curriculum.
- To impart spirit of enquiry and scientific temperament among students through research oriented activities.
- To enhance reading and learning capabilities among faculty and students and inculcate sense of life-long learning.
- To promulgate process for effective, continuous, objective oriented student performance evaluation.
- To co-ordinate periodic performance evaluation of the faculty.
- To incorporate themes to build values, civic responsibilities & sense of national integrity.
- To ensure that the academic, career & personal counseling are in- built into the system of curriculum delivery.
- To strengthen, develop and implement staff and student welfare programs.
- To adopt and implement principles of participation, transparency and accountability in governance of academic and administrative activities.
- To constantly display sensitivity and respond to changing educational, social and community demands.
- To promote public- private partnership.

INSIGNIA



The Emblem of the University is a Philosophical statement in Symbolic.

The Emblem...

A close look at the emblem unveils a pillar, a symbol of the “University of Excellence” built on strong values & principles.

The Palm and the Seven Stars...

The Palm is the palm of the teacher - the hand that acts, promises & guides the students to reach for the Seven Stars...

The Seven Stars signify the ‘Saptarishi Dnyanamandal’, the Great Bear- a constellation made of Seven Stars in the sky, each signifying a particular Domain. Our culture says: The true objective of human birth is to master these Knowledge Domains.

The Seven Stars also represent the Saptarishis, the founders of KLE Society whose selfless service and intense desire for “Dnyana Dasoha” laid the foundation for creating the knowledge called KLE Society.

Hence another significance of the raised palm is our tribute to these great Souls for making this University a possibility.

Empowering Professionals...

‘Empowering Professionals’, inscription at the base of the Emblem conveys that our Organization with its strength, maturity and wisdom forever strive to empower the student community to become globally competent professionals. It has been a guiding force for many student generations in the past and will continue to inspire many forth coming generations.

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Section I

AIMS AND OBJECTIVES

Pharmacy graduates are required to learn and acquire adequate knowledge, necessary skills to practice the Profession of Pharmacy including thorough and exhaustive knowledge of synthesis and assay of medicinal agents including mode of action, drug interactions, patient counseling and professional information exchange with physicians and other health professionals. The graduates are required to acquire an in-depth knowledge of formulations, storage and analysis of various pharmaceutical dosage forms including herbal medicines required for both large scale commercial production & research. The graduates should understand the concept of Community Pharmacy and be able to participate in rural and urban health care projects/programmes of the State and Central government. The graduates are also required to detail the physicians, community and market the medicinal agents for diagnosis, prevention and therapeutic purposes. The pharmacist should act as a bridge between Physicians and Patients and strive for better health care.

The objectives are covered under three headings namely:

- (A) Knowledge and understanding
- (B) Skills
- (C) Attitude

(A) Knowledge & Understanding

The graduates should acquire the following during their four-year B. Pharm course.

- Adequate knowledge and scientific information regarding basic concepts of Pharmaceutical chemistry, Pharmaceutics including cosmetics, Pharmacology and Pharmacognosy including herbal drugs.
- Adequate knowledge of practical aspects of synthesis, formulation and analysis of various pharmaceutical and herbal medicinal agents.
- Adequate knowledge of practical aspects of delivering a quality assured product as per Government guidelines, pharmacopoeias, WHO and ISO standards.

- Adequate knowledge of practical aspects of pharmacological screening, biological standardization and *in-vivo* drug interactions.
- Adequate knowledge of clinical pharmacy for patient counseling leading to physical and social well being of patients.
- Adequate knowledge of practical aspects of product detailing and ethical marketing of pharmaceutical products.

(B) Skills

A graduate should be able to demonstrate the following skills necessary for practice as a pharmacist.

- Able to synthesize, purify, identify and analyze medicinal/therapeutic agents.
- Able to formulate, store, dispense, analyze the prescriptions and / or manufacture the medicinal agents at commercial level.
- Able to screen various medicinal agents using animal models for pharmacological activity.
- Able to learn and apply the principles of quality assurance including legal and ethical aspects of pharmaceuticals.
- Able to extract, isolate, purify, identify and assess the therapeutic value of herbal / crude / natural products.

(C) Attitudes

The students should develop the following attitudes during their four-year B.Pharm course.

- Willing to apply the current knowledge of pharmacy in the best interest of patients and the community.
- Maintain the high standards of professional ethics in discharging professional obligations.
- Continuously upgrade professional information and to be conversant with current advances in the field of Pharmacy to serve the community better.
- Willing to participate in continuing education programmes of PCI and AICTE to upgrade knowledge and professional skills.
- To help and to participate in the implementation of National Health Programmes.

SECTION -II

REGULATIONS GOVERNING B.PHARM DEGREE SEMESTER COURSE

1. Eligibility

1.1 Candidates who have passed two year Pre-University course examination of Karnataka PUC Board or an equivalent examination of any other approved Board or University with not less than 40% marks in any combination comprising Physics, Chemistry, Mathematics or Physics, Chemistry, Biology (minimum eligibility should be based on the aggregate percentage of marks obtained from PCM or PCB) or PCMB.

Note: With respect to candidates who have studied PCMB combination, the aggregate of PCM or PCB whichever is higher shall be considered for admission to B.Pharm course.

1.2 In case of students belonging to SC/ST/or Category-I, the minimum percentage of marks for admission to B.Pharm Course shall be not less than 35% in P.U.C. or its equivalent examination (PCB/ PCM or PCMB)

1.3 Candidates who have scored less than 40% marks in (10+2) but who have completed B.Sc. Degree with Chemistry as one of the compulsory subjects in combination with any two of the following subjects, namely, Physics or Mathematics or Microbiology or Botany or Zoology or Bio-technology or Computer Sciences or Electronics securing not less than 40% marks in aggregate are eligible for admission to first year B.Pharm course (I Semester).

1.4 Candidates who have passed Diploma in Pharmacy course approved by Pharmacy Council of India shall also be eligible to this course and shall be admitted directly to III Semester (10% over and above the sanctioned intake is permitted for admissions under this category). These candidates shall to study Computer science of B. Pharm I Semester in addition to the prescribed subjects of III Semester (II year B. Pharm).

2. Duration of the course

The course of study for B.Pharm is comprised of 8 semesters of six months each and 6 semesters for those admitted to directly to III semester through lateral entry. The curricula and syllabi for the course shall be as prescribed from time to time.

3. Course of study

The course of study for B.Pharm I, II, III, IV, V, VI, VII and VIII semesters shall include the respective Theory and Practical subjects as shown in Table - I, II, III, IV, V, VI, VII and VIII respectively along with number of teaching hours for theory and practical for each subject. The number of hours to be devoted to each theory and practical subject in an academic semester shall not be less than that shown in Tables.

Medium of Instruction and Examination shall be English.

4. Attendance and progress

A candidate is required to have 75% attendance in both theory and practical subjects separately. The candidate shall be deemed eligible to appear for the respective examinations based on the attendance criteria.

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

5. Examinations

5.1 Internal Assessment/ Sessional Examination

Theory: Two examinations evenly spread during each semester shall be conducted by the affiliated colleges. The marks of the best one examination shall constitute the sessional award in theory. Provided further, the college may conduct one special theory sessional examination towards the end of the academic session for those who might have missed any one of the regular sessional examination on genuine grounds. For special theory sessional examination, the portion prescribed shall be the entire syllabus of the subject.

Practical: Students shall perform the laboratory experiments as listed in the respective semester syllabus. The number of experiments is also listed.

Internal assessment (Sessional examination) of practical of 20 marks for each subject will be based on day to day attendance, viva, laboratory record, etc.

The college shall maintain all documents of the sessional examinations i.e. work books of the students and the record of sessional award of the students.

A regular record of both theory and practical class work and sessional examinations conducted shall be maintained for each student in the department. Marks shall be awarded as per the schemes given in Table- IX to XVI.

5.2 Improvement of sessional marks

Candidates who wish to improve the sessional marks only in theory subjects can do so by appearing in the special re-sessional examinations conducted by the college. A minimum of one and maximum of two sessional examinations shall be conducted by the college out of which the marks of the best one of the two special re-sessional examinations shall be forwarded to the university at least 15 days prior to the commencement of the next University Examination. In case the marks scored by the students in the re-sessional examination are less than regular sessional examination, the Head of the department shall forward highest marks obtained from all sessional examinations of that semester.

5.3 University Examinations.

There shall be eight examinations for the entire course namely, First, Second, Third, Fourth, Fifth, Sixth, Seventh and Eighth Semester examination. The examination shall be conducted at the end of each semester. The details regarding the duration of papers, maximum marks for each paper including the sessional marks allotted to each subject is given in Table- IX to XVI.

Scheme of Theory Examination

Type of Questions	No. of Questions to be asked	No. of Questions to be answered	Marks for each Question	Total Marks
Multiple Choice Questions (MCQ)	20	20	01	20
Long Essay Questions	03	02	10	20
Short Essay Questions	05	04	05	20
Short Questions	10	10	02	20

5.4 Criteria for pass

5.4.1 Candidates who have secured a minimum of 40% marks in the Theory (including sessional marks) and Practical (including sessional marks) separately in any subject or subjects shall be declared to have passed in that subject/s and exempted from appearing in that subject/s at subsequent examination.

Theory and Practical of a particular subject are considered as individual subjects for the purpose of pass criteria.

5.4.2 Conditions under which candidates are permitted to proceed to next higher class:

a) Out of Five subjects to be studied at B. Pharm I semester course, there shall be an examination conducted by the college in respect of the following subjects for the candidates admitted on PUC / 12th Standard / Equivalent qualifications and for the candidates admitted to B.Pharm III semester on the basis of D. Pharm wherever applicable.

- i. Mathematics – Theory.
- ii. Biology – Theory and practical.
- iii. Computer Science- Theory

b) The candidates are required to score a minimum of 40% marks of the total marks prescribed for pass in all the above three subjects both in theory and practical separately including their sessional marks for a pass.

c) A candidate seeking eligibility to 5th semester should have passed in all subjects of 1st and 2nd semesters. A candidate seeking eligibility to 7th semester should have passed in all the subjects up to 4th semester.

d) A candidate who has passed in all the subjects of eight semesters of B.Pharm will be eligible for the award of B.Pharm degree and he/she has satisfactorily completed the practical training as mentioned under clause (6).

5.4.3 Declaration of Class

Class shall be awarded at the end of each semester of B.Pharm examination as shown below:

- | | |
|-----------------|---------------------------------|
| 1) Distinction | 75% and above |
| 2) First Class | 60% and above and less than 75% |
| 3) Second class | 50% and above and less than 60% |
| 4) Pass Class | 40% and above and less than 50% |

Pass class shall be awarded to such of the candidates who would have passed the examination in more than one attempt. However, this shall not be applicable to candidates who are exempted in Remedial Mathematics / Biology by the University.

6. Industrial Tour and Training

Every candidate shall undergo practical training in Pharmaceutical Manufacturing House / Approved Hospital / Recognized Research Laboratory for a period of not less than one hundred and fifty hours to be covered in not less than 45 days after completing VI semester or VIII semester.

Candidate should submit two copies of the training report duly certified by the authorities of the training center in which he / she has undergone training duly accepted and certified by the Head of the Department.

Industrial Tour:

Candidates studying in final year of the course shall visit several Pharmaceutical Manufacturing Houses/Approved Hospitals/ as a supplement to their academic training and submit a report to the satisfaction of the Head of the Department where he /she has studied.

7. Award of Degree and Ranks

Candidates who fulfill the requirements mentioned in 5.4.2(d) and (6) will be eligible for the award of degree.

Ranks and Medals shall be awarded on the basis of aggregate of all the eight university examinations. However, candidates who fail in one or more subjects during the B.Pharm courses shall not be eligible for award of ranks.

Moreover, the candidates should have completed the B.Pharm course in minimum prescribed number of years, (four years) for the award of Ranks.

Table –I**SEMESTER - I**

NO	SUBJECT	THEORY(hrs)	TUTORIAL(hrs)	PRACTICALS(hrs)
3.1.1	Remedial Mathematics/ Biology*	3/2	1	0/4
3.1.2	Human Anatomy & Physiology-I	4	1	-
3.1.3	Pharmaceutical Organic Chemistry-I	4	1	4
3.1.4	Pharmaceutical Inorganic Chemistry	4	1	4
3.1.5	Computer Science*	3	1	3
	TOTAL	18/16	5	11/15
				34/36 hrs/week.

*College Examinations only

Table –II**SEMESTER - II**

NO	SUBJECT	THEORY(hrs)	TUTORIAL(hrs)	PRACTICALS(hrs)
3.2.1	Pharmaceutical Organic Chemistry -II	4	1	4
3.2.2	Pharmaceutics	3	1	4
3.2.3	Human Anatomy & Physiology-II	4	1	4
3.2.4	Pharmacognosy-I	3	1	4
3.2.5	Constitution of India*	2	-	-
	TOTAL	16	4	16
				36 hrs/ week.

*College Examinations only

Table –III**SEMESTER - III**

NO	SUBJECT	THEORY(hrs)	TUTORIAL(hrs)	PRACTICALS(hrs)
3.3.1	Pharmaceutical Microbiology	3	1	4
3.3.2	Pharmacognosy –II	3	1	4
3.3.3	Pharmaceutical Organic Chemistry III	4	1	-
3.3.4	Pharmaceutical Analysis	3	1	4
3.3.5	Physical Pharmaceutics –I	3	1	4
	TOTAL	16	5	16
				37 hrs/ week.

Table –IV**SEMESTER - IV**

NO	SUBJECT	THEORY(hrs)	TUTORIAL(hrs)	PRACTICALS(hrs)
3.4.1	Physical Pharmaceutics –II	3	1	4
3.4.2	Pathophysiology	4	1	-
3.4.3	Pharmacognosy & Phytochemistry	4	1	-
3.4.4	Applied Biochemistry	3	1	4
3.4.5	Pharmaceutical Engineering	3	1	4
3.4.6	Environmental Studies *	2	-	-
	TOTAL	19	5	12
				36 hrs/ week.

*Class Examination only

Table –V**SEMESTER - V**

NO	SUBJECT	THEORY(hrs)	TUTORIAL(hrs)	PRACTICALS(hrs)
3.5.1	Pharmaceutical Jurisprudence & Ethics	4	1	-
3.5.2	Pharmaceutical Technology - I	3	1	4
3.5.3	Pharmaceutical Biotechnology	4	1	4
3.5.4	Chemistry of Natural Products	3	1	4
3.5.5	Pharmacology -I	4	1	-
	TOTAL	18	5	12
				35 hrs/ week.

Table –VI**SEMESTER - VI**

NO	SUBJECT	THEORY(hrs)	TUTORIAL(hrs)	PRACTICALS(hrs)
3.6.1	Medicinal Chemistry –I	4	1	-
3.6.2	Pharmacology –II	3	1	4
3.6.3	Biopharmaceutics & Pharmacokinetics	4	1	4
3.6.4	Pharmaceutical Management & Marketing	4	1	-
3.6.5	Advanced Pharmacognosy	3	1	4
	TOTAL	18	5	12
				35 hrs/ week.

Table –VII**SEMESTER - VII**

NO	SUBJECT	THEORY (hrs)	TUTORIAL (hrs)	PRACTICALS (hrs)
3.7.1	Pharmacology III	3	1	4
3.7.2	Pharmaceutical Technology -II	4	1	4
3.7.3	Hospital Pharmacy	4	1	-
3.7.4	Pharmacy Practice	4	1	-
3.7.5	Medicinal Chemistry –II	3	1	4
	TOTAL	18	5	12
				35 hrs/ week.

Table –VIII**SEMESTER - VIII**

NO	SUBJECT	THEORY(hrs)	TUTORIAL(hrs)	PRACTICALS(hrs)
3.8.1	Instrumental Methods of Analysis	4	1	4
3.8.2	Medicinal Chemistry –III	3	1	4
3.8.3	Advanced Pharmaceutics	4	1	-
3.8.4	Industrial Pharmacognosy	3	1	4
3.8.5	Pharmacotherapeutics	4	1	-
	TOTAL	18	5	12
				35 hrs/ week.

Table-IX**Scheme of Examination for B. Pharm Course- I Semester**

Code No	Subject	THEORY					PRACTICALS				Grand Total
		No. of Papers	Duration of papers (Hrs)	Sessional Maximum	Max. Marks for written papers (Uni. exam)	Total	Duration of examination (Hrs)	Sessional maximum marks	Max. Marks for Uni. practical examination	Total	
3.1.1	Remedial Mathematics Biology *	1	03	20	80	100	04	20	80	100	200/100
3.1.2	Human Anatomy & Physiology-I	1	03	20	80	100	No Practicals				100
3.1.3	Pharmaceutical Organic Chemistry-I	1	03	20	80	100	04	20	80	100	200
3.1.4	Pharmaceutical Inorganic Chemistry	1	03	20	80	100	04	20	80	100	200
3.1.5	Computer Science*	1	03	20	80	100	04	20	80	100	200

Total: Theory 300 Practical 200 Grand Total: 500

* College examinations only.

Table-X**Scheme of Examination for B.Pharm course- II Semester**

Code No	Subject	THEORY					PRACTICALS				Grand Total
		No. of Papers	Duration of papers (Hrs)	Sessional Maximum	Max. Marks for written papers (Uni. exam)	Total	Duration of examination (Hrs)	Sessional maximum marks	Max. Marks for Uni. practical examination	Total	
3.2.1	Pharmaceutical Organic Chemistry-II	1	03	20	80	100	04	20	80	100	200
3.2.2	Pharmaceutics	1	03	20	80	100	04	20	80	100	200
3.2.3	Human Anatomy & Physiology-II	1	03	20	80	100	04	20	80	100	200
3.2.4	Pharmacognosy-I	1	03	20	80	100	04	20	80	100	200
3.2.5	Constitution of India *	1	03	20	80	100	No Practicals				100

Total: Theory 400 Practical 400 Grand Total: 800

*College Examinations only

Table-XI**Scheme of Examination for B.Pharm course- III Semester**

Code No	Subject	THEORY					PRACTICALS				Grand Total
		No. of Papers	Duration of papers (Hrs)	Sessional Maximum	Max. Marks for written papers (Uni. exam)	Total	Duration of examination (Hrs)	Sessional maximum marks	Max. Marks for Uni. practical examination	Total	
3.3.1	Pharmaceutical Microbiology	1	03	20	80	100	04	20	80	100	200
3.3.2	Pharmacognosy –II	1	03	20	80	100	04	20	80	100	200
3.3.3	Pharmaceutical Organic Chemistry III	1	03	20	80	100	No Practicals				100
3.3.4	Pharmaceutical Analysis	1	03	20	80	100	04	20	80	100	200
3.3.5	Physical Pharmaceutics –I	1	03	20	80	100	04	20	80	100	200

Total: Theory 500 Practical 400 Grand Total: 900

Table-XII**Scheme of Examination for B.Pharm course- IV Semester**

Code No	Subject	THEORY					PRACTICALS				Grand Total
		No. of Papers	Duration of papers (Hrs)	Sessional Maximum	Max. Marks for written papers (Uni. exam)	Total	Duration of examination (Hrs)	Sessional maximum marks	Max. Marks for Uni. practical examination	Total	
3.4.1	Physical Pharmaceutics –II	1	03	20	80	100	04	20	80	100	200
3.4.2	Pathophysiology	1	03	20	80	100	No Practicals				100
3.4.3	Pharmacognosy & Phytochemistry	1	03	20	80	100	No Practicals				100
3.4.4	Applied Biochemistry	1	03	20	80	100	04	20	80	100	200
3.4.5	Pharmaceutical Engineering	1	03	20	80	100	04	20	80	100	200
3.4.6	Environmental Studies*	1	03	20	80	100	-	-	-	-	100

Total: Theory 500 Practical 300 Grand Total: 800

* Class Examination only

Table-XIII**Scheme of Examination for B.Pharm course- V Semester**

Code No	Subject	THEORY					PRACTICALS				Grand Total
		No. of Papers	Duration of papers (Hrs)	Sessional Maximum	Max. Marks for written papers (Uni. exam)	Total	Duration of examination (Hrs)	Sessional maximum marks	Max. Marks for Uni. practical examination	Total	
3.5.1	Pharmaceutical Jurisprudence & Ethics	1	03	20	80	100	No Practicals				100
3.5.2	Pharmaceutical Technology - I	1	03	20	80	100	04	20	80	100	200
3.5.3	Pharmaceutical Biotechnology	1	03	20	80	100	04	20	80	100	200
3.5.4	Chemistry of Natural Products	1	03	20	80	100	04	20	80	100	200
3.5.5	Pharmacology -I	1	03	20	80	100	No Practicals				100

Total: Theory 500 Practical 300 Grand Total: 800

Table-XIV**Scheme of Examination for B.Pharm course- VI Semester**

Code No	Subject	THEORY					PRACTICALS				Grand Total
		No. of Papers	Duration of papers (Hrs)	Sessional Maximum	Max. Marks for written papers (Uni. exam)	Total	Duration of examination (Hrs)	Sessional maximum marks	Max. Marks for Uni. practical examination	Total	
3.6.1	Medicinal Chemistry –I	1	03	20	80	100	No Practicals				100
3.6.2	Pharmacology –II	1	03	20	80	100	04	20	80	100	200
3.6.3	Biopharmaceutics & Pharmacokinetics	1	03	20	80	100	04	20	80	100	200
3.6.4	Pharmaceutical Management & Marketing	1	03	20	80	100	No Practicals				100
3.6.5	Advanced Pharmacognosy	1	03	20	80	100	04	20	80	100	200

Total: Theory 500 Practical 300 Grand Total: 800

Table-XV**Scheme of Study and Examination for B.Pharm course- VII Semester**

Code No	Subject	THEORY					PRACTICALS				Grand Total
		No. of Papers	Duration of papers (Hrs)	Sessional Maximum	Max. Marks for written papers (Uni. exam)	Total	Duration of examination (Hrs)	Sessional maximum marks	Max. Marks for Uni. practical examination	Total	
3.7.1	Pharmacology III	1	03	20	80	100	04	20	80	100	200
3.7.2	Pharmaceutical Technology -II	1	03	20	80	100	04	20	80	100	200
3.7.3	Hospital Pharmacy	1	03	20	80	100	No Practicals				100
3.7.4	Pharmacy Practice	1	03	20	80	100	No Practicals				100
3.7.5	Medicinal Chemistry –II	1	03	20	80	100	04	20	80	100	200

Total: Theory 500 Practical 300 Grand Total: 800

Table-XVI**Scheme of Examination for B.Pharm course- VIII Semester**

Code No	Subject	THEORY					PRACTICALS				Grand Total
		No. of Papers	Duration of papers (Hrs)	Sessional Maximum	Max. Marks for written papers (Uni. exam)	Total	Duration of examination (Hrs)	Sessional maximum marks	Max. Marks for Uni. practical examination	Total	
3.8.1	Instrumental Methods of Analysis	1	03	20	80	100	04	20	80	100	200
3.8.2	Medicinal Chemistry –III	1	03	20	80	100	04	20	80	100	200
3.8.3	Advanced Pharmaceutics	1	03	20	80	100	No Practicals				100
3.8.4	Industrial Pharmacognosy	1	03	20	80	100	04	20	80	100	200
3.8.5	Pharmacotherapeutics	1	03	20	80	100	No Practicals				100

Total: Theory 500 Practical 300 Grand Total: 800

SECTION – III

BACHELOR OF PHARMACY SEMESTER SYLLABUS

B. PHARM-I SEMESTER

3.1.1	I SEMESTER	Remedial Mathematics (Theory)	60 Hours 4Hours/week
1	<u>Algebra</u> :	Equations reducible to quadratics, simultaneous equations (linear and quadratic), Determinants, properties of, solution of simultaneous equations by Cramer's rule, matrices, definition of special kinds of matrices, arithmetic operations on matrices, inverse of a matrix, solution of simultaneous equations by matrices. Pharmaceutical applications of determinants and matrices. Evaluation of E_n , E_{n2} , and E_{n3} mensuration and its pharmaceutical applications.	10 hrs
2		Measures of Central Value Objectives and pre-requisites of an ideal measure, mean, mode and median.	10 hrs
3	<u>Trigonometry</u> :	Measurement of angle, t-ratios, addition, subtraction and transformation formulae of multiple, submultiples, allied and certain angles. Application of logarithms in pharmaceutical computations.	10 hrs
4	<u>Analytical Plane Geometry</u> :	Certain co-ordinates, distance between two points, area of triangle, a locus of point, straight line; slope and intercept form, double-intercept form, normal (perpendicular form), slope-point and two point form, general equation of first degree.	10 hrs
5	Calculus:		
	A)	<u>Differential</u> : Limits and functions, definition of differential coefficient, differentiation of standard functions including function (Chain rule). Differentiation of implicit functions, logarithmic differentiation, parametric differentiation.	10 hrs
	B)	Integral: Integration & inverse of differentiation, indefinite integrals of standard forms, integration by parts, substitution and partial fractions, formal evaluation of definite integrals.	10 hrs

Reference Books

- 1 Engineering Mathematics by B.S.Grewal.
- 2 Differential Calculus by Prof. Shantinarayana.
- 3 Integral Calculus by Prof. Shantinarayana
- 4 Statistical Methods by S.C.Gupta

3.1.1	I SEMESTER	Remedial Biology (Theory)	45 Hours 3Hours/week
1	Methods of classification of plants.		02
2	Plant Cell: Its structure and non-living inclusions; mitosis and meiosis; different types of plant tissues and their functions.		10
3	Morphology and histology of root, stem, bark, wood, leaf, flower, fruit and seed. Modification of root and stem.		15
4	General survey of animal kingdom; structure and life history of parasites - <i>Entamoeba</i> , <i>Trypanosoma</i> , <i>Plasmodium</i> , <i>Taenia</i> , <i>Ascaris</i> , <i>Schistosoma</i> , <i>Oxyuris</i> , and <i>Ancylostoma</i> .		12
5	General Structure and life history of insects like mosquito, housefly, mites and silkworm.		06

3.1.1	I SEMESTER	Remedial Biology (Practicals)	60 Hours 4 Hours/ week
1	Care, use and type of microscopes.		
2.	Morphology of plant parts indicated in theory.		
3.	Gross identification of slides of structure and life cycle of lower plants/ animals mentioned in theory.		
4.	Morphology of plant parts indicated in theory.		

Reference Books

1. Text of Botany by A.C.Dutta.
2. Invertebrate Zoology by Dhami and Dhami.

3.1.2	I SEMESTER	Human Anatomy and Physiology-I (Theory)	60 Hours 4 Hours/week
			Hours
1	Introduction	Definition, scope of Anatomy & Physiology and its related sciences. Description of body such as planes and terminologies used.	2
2	Cell Physiology	Cell components, structure of cell membrane, transport mechanism and ion channels.	6
3	Elementary tissues of the human body	Epithelial, Connective, Muscular and Nervous tissue- sub types and characteristics.	7
4	Musculo-skeletal system	Anatomy and Physiology of muscle contraction. Physiological properties of skeletal muscles and their disorders Structure, composition and functions of skeleton. Articulation and movements Disorders of bones and joints	10
5	Haemopoietic System	Haemopoiesis, composition and functions of blood. Haemoglobin and its functions. Blood groups and their significance. Physiology of blood coagulation. Common disorders of blood (anemia, leukemia, thrombocytopenia, haemophilia). Physiology and functions of spleen. Composition, formation and circulation of lymph.	11
6	Respiratory System	Anatomy and Physiology of respiratory organs. Regulation and factors affecting respiration. Respiratory volumes, vital capacity and their clinical significance.	8
7	Digestive System	Anatomy and Physiology of gastro-intestinal tract and accessory organs. Digestion and absorption – carbohydrates, fats, proteins and other nutrients.	8
8	Sensory organs	Basic anatomy and physiology of skin, eye, ear, tongue and nose.	8

Reference Books (Latest Edition)			
Sl.No	Name of the Book	Author	Publisher
01	Ross and Wilson Anatomy and Physiology in Health and Illness	A. Waugh and A. Grant	Churchill Living Stone, Edinburgh.
02	“Human Physiology” (Vol. I & Vol. II)	C.C. Chatterjee	Medical Allied Agency, Calcutta.
03	Principles of Anatomy and Physiology	G. J. Toratora,	John-Wiley & sons New York.
04	Concise Medical Physiology	S.K. Chaudhry	New Cenrtal Book Agency, Calcutta.
05	Illustrated Physiology	AB Mc Naught & R. Callander	B.I. Churchill Living Stone, New Delhi.
06	Text Book of Medical Physiology	A. C. Guyton and J.E. Hall.	W.B. Saunders company.
07	Bailey`s Text Book of Microscopic Anatomy	Douglas E., Kelly, Richard Wood and Allen C. Enders	Williams and Wilkins publishers, London.
08	Human Anatomy and Physiology	E.N. Marieb.	Addison Wesley, New York.
09	Text Book of Human Histology with Colour Atlas	Inderbir Singh.	Jaypee Brothers, New Delhi.

1. Molecular orbital theory, intramolecular and intermolecular forces, bond length and bond dissociation energy, dipole moment, polarity of bond, Hydrogen bonding, protic-aprotic solvents, acids and bases (Lowry Bronsted and Lewis theories) and introduction to isomerism. 8 hrs
2. Nomenclature of organic compounds belonging to the following classes: alkanes, alkenes, dienes, alkynes, alcohols, aldehydes, ketones, amides, amines, phenols, alkylhalides, carboxylic acids, esters, acid chlorides, cyclo alkanes and aromatic compounds. 10 hrs
3. Concept of aromaticity, Huckel's rule. 2 hrs
4. Free radical chain reactions of alkanes: mechanism, relative reactivity and stability. 2 hrs
5. Nucleophilic aliphatic substitution mechanism: Nucleophiles and leaving groups, kinetics of second and first order reaction. Mechanism of SN^1 and SN^2 reactions. Rearrangement of carbocation, SN^2 Versus SN^1 reaction. Reactivity of alkyl halides in SN^1 and SN^2 reactions. E_1 and E_2 reactions. 6 hrs
6. Electrophilic addition: Reactions at carbon-carbon double bond, hydrogenation, Markovnikov's rule, addition of hydrogen halides, addition of hydrogen bromides-peroxide effect. Electrophilic addition mechanism. Mechanism of cyclo addition reactions with examples. Addition of carbenes to alkenes, Diel's Alder reaction. 8 hrs
7. Theory of Resonance: Allyl radical as a resonance hybrid, stability and orbital picture. Resonance stabilization of allyl cations: hyper conjugation, stability of conjugated dienes, and mechanisms of 1, 2 and 1, 4 additions. 6 hrs
8. Electrophilic aromatic substitution: Effect of substituent groups, determination of orientation, determination of relative reactivity, classification of substituent groups, mechanism of nitration, sulphonation, halogenation, Friedel-Crafts alkylation and Friedel-Crafts acylation, reactivity and orientation, activating and deactivating (o,m,p-directing) groups, orientation and synthesis, orientation in di-substituted benzenes, theory of reactivity, theory of orientation, effects of halogens. 10 hrs
9. Nucleophilic addition reactions in aldehydes and ketones, mechanisms with examples. Action of Grignard reagent. Aldol condensation, Crossed aldol condensation, Claisen condensation, Cannizzaro, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, Knoevenagel and Reformatsky reactions. 8 hrs

I. Introduction to the various laboratory techniques through demonstrations involving synthesis of the following compounds.*

1. Acetanilide/Asprin (acetylation)
2. Benzanilide/Phenyl Benzoate (Benzoylation)
3. Dibenzylidene acetone (condensation)
4. Benzoic acid / Salicylic acid (Hydrolysis of esters)
5. Benzophenoxime (oxime formation)
6. m-Dinitrobenzene(Nitration)
7. Preparation of o-Chlorobenzoic acid from o-Chlorotoluene.

II. Identification of organic compounds belonging to the following classes by systematic qualitative organic analysis including preparation of derivatives.**

1. Phenols
2. Amides
3. Carbohydrates
4. Carboxylic acids
5. Aldehydes and Ketones
6. Alcohols
7. Esters
8. Amines
9. Nitro compounds
10. Anilides

III. Determination of melting point and boiling point for some important pharmaceutical Organic compounds.*

Scheme of Practical Examination

- | | |
|-----------------------|------------|
| 1. Synopsis | - 10 Marks |
| 2. Major Experiment** | - 40 Marks |
| 3. Minor Experiment* | - 20 Marks |
| 4. Viva-voce | - 10 Marks |

Total - 80 Marks

Reference Books (Latest edition)			
Sl.No	Name of the Book	Author	Publisher
01	Text Book of Organic Chemistry	T.R.Morrison and R.Boyd	Prentice Hall of India Pvt. Ltd., New Delhi.
02	Bentley and Driver's Text Book of Pharmaceutical Chemistry	L.M. Atherden	Prentice Hall of India Pvt. Ltd., New Delhi.
03	Organic Chemistry: The Fundamental Principles	I.L. Finar	Longman Publishers.
04	Fundamentals of Organic Chemistry	T.W.Graham Solomons	John Wiley & Sons Inc., USA.
05	Organic Chemistry	J.M.Catm and D.J.Carm	Saunders college of Publishing.
06	Advanced Organic Chemistry	Jerry and March	Wiley Eastern Limited, New Delhi.
07	Practical Organic Chemistry	Mann and Sounders	ELBS and Longman group Ltd.
08	Introduction to Organic Laboratory Techniques	D.L.Pavia, G.Lampman and G.D.Kriz.	ELBS and Longman group Ltd.
09	Text Book of Practical Organic Chemistry	A. I. Vogel	ELBS Longman, London.
10	Elementary Practical Organic Chemistry	A.I. Vogel	ELBS and Longman group Ltd., London.

3.1.4 I SEMESTER	Pharmaceutical Inorganic Chemistry (Theory)	60 Hours 4 Hours/week
1	Fundamentals of volumetric analysis, theory of indicators and methods of expressing concentrations (Normality, molarity, molality, percentage v/v and w/v). Characters of primary standards. Preparation, standardization and storage of various volumetric solutions like oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulfate, potassium permanganate and iodine solution.	10 hrs
2	Introduction to compendial methods related to inorganic impurities. <ul style="list-style-type: none"> a. Sources of impurities b. Standards and limits c. Tests and methods d. Principle and procedures to evaluate commonly occurring impurities viz: chlorides, sulphates, iron, heavy metals, lead and arsenic. e. Special/modified procedures for limit tests 	12 hrs
3	Inorganic pharmaceuticals: Study of general methods of preparation, properties, medicinal uses and storage conditions of official inorganic compounds belonging to the following classes (Assay methods and principles of underlined compounds to be studied). <ul style="list-style-type: none"> 3.1 Medicinal Gases: Oxygen, Nitrous oxide, Carbon dioxide 3.2 Gastrointestinal agents <ul style="list-style-type: none"> a. Acidifiers: Dilute hydrochloric acid b. Antacids: Ideal characteristics of an antacid, antacid combination therapy Aluminum hydroxide gel, Calcium carbonate, <u>Sodium bicarbonate</u>, Magnesium trisilicate, Magnesium carbonate (light and heavy), <u>Magnesium hydroxide mixture</u>. c. Cathartics: <u>Magnesium sulphate</u>, Sodium orthophosphate, Sodium sulphate. 3.3 Major intra and extra cellular electrolytes: Major physiological ions and electrolytes used for the electrolyte replacement therapy, introduction to physiological acid-base balance, electrolyte combination therapy and oral rehydration solutions (ORS). Study of Sodium chloride injection, Dextrose and Sodium chloride injection, Calcium gluconate injection. 3.4 Topical agents and Dermatological preparations: <ul style="list-style-type: none"> a. Protectives: Kaolin, Talc, Zinc oxide, Zinc stearate, Titanium dioxide. b. Antimicrobials: <u>Potassium permanganate</u>, <u>Chlorinated lime</u>, Iodine preparations, <u>Boric acid</u>, Borax. c. Silicon polymers – Dimethicone. 	2 hrs 8 hrs 10 hrs 6 hrs

3.5 Dental Products: Dentifrices, anti-caries agents, desensitizing agents: Calcium carbonate, sodium fluoride, Stannous fluoride, Zinc chloride, Zinc eugenol cement. 4 hrs

3.6 Miscellaneous agents:

- 8 hrs
- a. Expectorants : Ammonium chloride (Formal method), Potassium iodide.
 - b. Haematinics : Ferrous sulfate, Ferrous gluconate, Ferrous fumarate, Iron dextran injection, Iron and Ammonium citrate
 - c. Emetics: Copper sulphate.
 - d. Antidotes: Sodium thiosulphate, Sodium nitrite and activated Charcoal
 - e. Anti-oxidants: Sodium metabisulphite
 - f. Pharmaceutical aids: Bentonite and Barium sulphate

**3.1.4 Pharmaceutical Inorganic Chemistry (Practicals) 60 Hours
4 Hours/week**

- 1 Preparation and standardization of the following volumetric solutions (2 exercises). *
 - a. 0.1N Sodium hydroxide (NaOH)
 - b. 0.1N Potassium permanganate (KMnO₄)
 - c. 0.1N Ceric ammonium sulphate
 - d. 0.05M Di sodium Ethylenediaminetetraacetate (EDTA)
2. Assay of the following compounds (2 exercises)**
 - a. Ammonium chloride-acid base titration (Formal titration)
 - b. Boric Acid
3. Limit tests (4 exercises)
 - a. Limit test for chlorides*
 - b. Limit test for sulphates*
 - c. Limit test for Iron*
 - d. Limit test for heavy metals*
 - e. Limit test for Arsenic
 - f. Modifications in limit tests* for chloride and sulphates in Potassium permanganate, Sodium bicarbonate, Sodium benzoate and Sodium salicylate.

4. Test for identify for the following (3 exercises)*
- Sodium bicarbonate
 - Ferrous sulphate
 - Potassium chloride
 - Calcium chloride
5. Test for purity for the following (2 exercises)*
- Swelling power in Bentonite
 - Ammonium salts in Potash alum.
 - Presence of iodates in Potassium iodide
6. Preparation of inorganic pharmaceuticals (2 exercises)*
- Boric acid
 - Potash alum
 - Magnesium hydroxide.
 - Magnesium sulphate

Scheme of Practical Examination

1. Synopsis	- 10 Marks
2. Major Experiment**	- 30 Marks
3. Minor Experiment*-1 st Limit Test	- 15 Marks
4. Minor Experiment*-2 nd Test for Purity or Preparation	- 15 Marks
5. Viva-voce	- 10 Marks
	Total - 80 Marks

Reference Books (Latest edition)			
Sl.No	Name of the Book	Author	Publisher
01	Pharmaceutical Chemistry Part II: Inorganic –Volume I and II.	M.L.Schroff	National Book Centre, Calcutta.
02	Practical Pharmaceutical Chemistry Vol I & II.	A.H.Beckett & J.B. Stenlake	Stahlone Press of University of London.
03	Bentley & Drivers Text Book of Pharmaceutical Chemistry	A.Y Bentley	University Press, London.
04	Concise Inorganic Chemistry	J.D.Lee,	University Press, London.
05	Modern Inorganic Pharmaceutical Chemistry	C.A.Discher,	University Press, London.
06	Inorganic Medicinal and Pharmaceutical Chemistry	J.H.Block, E.B.Roche, T.O.Soine and C.O.Wilson,	University Press, London.
07	Analytical Chemistry-Principles	John H.Kennedy	Sunders College Publication New York.
08	Practical Pharmaceutical Chemistry Vol I & II.	A.H.Beckett & J.B. Stenlake	Stahlone Press of University of London.

3.1.5	I SEMESTER	Computer Science (Theory)	45 Hours 3Hours/week
1	<p>Introduction to computers: History and evolution of computers, Flinn’s classification of computers, digital and analogue computers, major components of digital computers, word length of a computer, microprocessor, single chip micro computers (micro controllers), large, small and super computers, user interface, hard ware, soft ware and firm ware. Operating systems. DOS, Windows. Introduction to Linux, batch processing, multi programming and multi user system. Computer network: LAN, WAN, Parallel processing.</p>		12 hrs
2	<p>Introduction to Programming: Definition of a programme, types of programming languages : machine language, , high level language, types of high level language. Decimal number system, binary number or base 2 system, conversion of a binary number to decimal number, conversion of a decimal number to a binary number. Binary addition and subtraction.</p>		12 hrs
3	<p>Language: Basics of programming: Algorithm, flow chart: 1.Introduction to C language: Development of C, Features, constants and variables, data types, operators and expressions, library functions. I/O statements: Formatted and unformatted I/O, scan (), print f (), get char () and put char () function</p> <p>Control structures: conditional and unconditional, if, for, while, switch, break and continue, go to statement. Arrays: one and multidimensional arrays, strings and string functions, bubble sort, linear and binary search. Functions: definition, different types, calling a function, passing parameters, calls by reference, and call by value, local and global variables, recursive function.</p>		15 hrs
4	<p>Computer graphics, computer application and clinical studies.</p>		06 hrs

Computer Science (Practicals)**45 Hours
3 Hours/ week**

- 1 MS DOS, Unix, MS-office commands.
2. Study of software package: MS-OFFICE.
3. Study of simple C programmes as follows:
 - Get a character and display the same using get char () and put char ().
 - Printing the reverse of an integer.
 - Printing the odd and even series of N numbers.
 - Get a string and convert the lowercase to uppercase and vice-versa using get char () and put char ().
 - Finding the occurrence of a particular character in a string.
 - Accept N words and make it as a sentence by inserting blank spaces and a full stop at the end.
 - Finding the first N terms of Fibonacci sequence.
 - Printing and multiplication tables of 2 matrices.
 - Printing and subtraction of two matrices.
 - Converting a hexadecimal number into its binary equivalent.

Sl.No	Reference Books
01	V.Rajaraman and H.V.Sahasraboudhe, Computer programming in Cobol.
02	C Programming: A Modern Approach by K N King's,W. W. Norton & C
03	The c programming language by Brian W. Kernighan and Dennis M. Ritchie, Prentice Hall.
04	Thinking in C By Bruce Eckel , Prentice Hall
05	Absolute Beginner's Guide to Computer Basics by Michael Miller, Que.
06	Introduction to Biostatistics and Computer Science by Sahaik V. I., Paradkhar A.R. and Dhavagude G., Nirali Publication.
07	NIIT Computer Books by National Institute of Information Technology.

B. PHARM-II SEMESTER

3.2.1 II SEMESTER

Pharmaceutical Organic Chemistry- II (Theory)

60 Hours (4 Hours/week)

1. Stereochemistry

1. Stereo isomerism, tetrahedral carbon, optical activity, enantiomerism, diastereo isomerism, meso-structures, elements of symmetry, chirality, chiral centers, reactions of chiral molecules, Relative and absolute configurations, specification of D and L configuration. Racemic modification and resolution of racemic mixture, conformational isomers, asymmetric synthesis. 14 hrs
2. Stereo selective and stereo specific reactions. Stereochemical mechanisms for the following reaction such as addition of halogens to alkanes. Stereo chemistry of E1 and E2 reactions, *syn* and *anti* reaction and Nucleophilic substitution reactions. 7 hrs
3. Stereochemistry of alicyclic compounds, biphenyls and oximes. 7 hrs.
4. Geometrical isomerism: its nature of formation, rotation about bonds, nomenclature of isomers, E and Z forms, determination of configuration. 2 hrs.

2. Heterocyclic Chemistry:

1. General classification of heterocyclic compounds, nature and nomenclature, reactions, synthesis and properties of the following heterocyclic systems and their derivatives. 22 hrs
 - a) Pyrrole, Furan and Thiophen
 - b) Fused ring systems involving Pyrrole, Furan, Thiophen, Indole and Benzofuran
 - c) Pyridine
 - d) Quinoline, Isoquinoline, Acridine
 - e) Pyrazole, Imidazole, Oxazole and Isoxazole.
 - f) Pyrimidine, Pyrazine, Pyridazine, Purine, Quinoxaline.
2. Structure and medicinal uses of Phenazone, Nikethamide, Isoniazid, Chloroquine, Pyrimethamine, Diazepam, Sulphadiazine, Metronidazole. 2 hrs

3. Polynuclear hydrocarbons:

6 hrs

Synthesis (Haworth's and Diel's alder), properties and reactions of Naphthelene, Phenanthrene and Anthracene. Structure and medicinal uses of Propranolol, Tolnaftate, Menadione, Naphzoline, Phenindion, Morphine and Codeine.

I. Quantitative determination of organic compounds via functional groups(major experiments)

1. Phenolic groups by bromination method
2. Alcoholic group by acetylation method
3. Carbonyl group by hydroxyl amine hydrochloride-pyridine method
4. Aldehyde group by sodium sulphite-sulphuric acid procedure
5. Amino group by bromination method
6. Aminoacid by formal titration method
7. Equivalent weight of an acid by acid-base titration
8. Ester by hydrolysis

II. Synthesis/ Preparations involving more than 1 step (minor experiments)

1. Benzilic acid from benzoin
2. p-Nitroaniline from acetanilide
3. p-Bromoaniline from acetanilide
4. Benzimidazole from *o*-phenylenediamine
5. Benzotriazole from *o*-phenylenediamine

III. Demonstration to use 3D models

1. Methane
2. Ethane
3. DL-glyceraldehyde
4. Acetylene
5. cis-alkene
6. trans-alkene
7. Inversion of configuration

Scheme of Practical Examination

1. Synopsis	-	10 Marks
2. Determination of Functional Group (Major Expt)	-	35 Marks
3. Preparation (Minor Expt)	-	25 Marks
4. Viva-voce	-	10 Marks
Total		- 80 Marks

Reference Books (Latest edition for Theory)

1. T.R.Morrison and R.Boyd, Text of Organic Chemistry, 6th edition Prentice Hall of India Pvt. Ltd., New Delhi.
2. Bentley and Driver's Text Book of Pharmaceutical Chemistry. L.M. Atherden, 8th edition
3. I.L. Finar Organic Chemistry, Vol I & II, 6th edition, Longman Publishers.
4. J.M.Catm and D.J.Carm Organic Chemistry. Saunders College of Publishing, 13th edition.
5. Brown, Organic Chemistry.
6. Jerry and March, Advanced Organic Chemistry, Wiley Eastern Limited, New Delhi 4th edition.
7. Heterocyclic Chemistry by Raj K Bansal, New Age Publications.
8. Heterocyclic Chemistry by J. A. Joule & K. Mills, Blackwell Science.

Reference Books (Latest edition for Practicals)

1. A.I. Vogel, Elementary Practical organic chemistry, ELBS and Longman group Ltd., London.
2. Mann and Saunders, Practical Organic Chemistry-, ELBS and Longman group Ltd.,
3. I.P., Govt. of India, Ministry of Health and Family welfare, 4th edition (1996) and 5th edition (2007).
4. A. I. Vogel, Text Book of practical organic chemistry, ELBS Longman, London, 4th edition.

3.2.2	II SEMESTER	Pharmaceutics (Theory)	45 Hours 3Hours/week
1	History of Pharmacy: Historical background, Development of Pharmacy profession, Pharmaceutical industry and Pharmaceutical Education in India in brief. Pharmacist Oath.		02 hrs
2	Development of Indian pharmacopoeia and introduction to other pharmacopoeia- B.P., U.S.P., European pharmacopoeia, Extra pharmacopoeia and National Formulary.		04 hrs
3	Introduction to dosage forms:		10 hrs
a)	Classification and definitions.		
b)	Prescription: Definition, parts of prescription and prescription handling. Modern prescriptions.		
c)	Posology: Definition, factors affecting dose selection, calculation of child and infant doses. Different types of weights and measures, calculation involving percentage of solutions, allegation method, proof spirit, isotonic solution (calculation based on depression of freezing point and sodium chloride equivalent method).		
4	Introduction to different types of processes: Fusion, desiccation, sublimation, Exsiccation and Ignition. Definition and application of Evaporation, Distillation, Drying, Size Reduction, Size Separation, Mixing, Homogenization and Filtration.		06 hrs
5	Galenicals: Definition, Equipments for different extraction processes: Expression, Infusion, Decoction, Maceration and Percolation. Method of preparation of Spirits, Tinctures and Extracts. Soxhlet extraction. Process including modifications.		06 hrs
6	Powders and granules: Classification with examples, advantages and disadvantages. Preparation of dusting powders and effervescent granules. Brief introduction to Physical and Chemical incompatibilities.		05 hrs
7	Biphasic dosage forms:		09 hrs
	i. Suspensions- Definition, classification, advantages and disadvantages. Diffusible and indiffusible suspensions, flocculated and deflocculated suspensions.		
	ii. Emulsion: Definition, types of emulsions, identification tests, emulsifying agents, creaming and cracking of emulsions.		
8	Suppositories and Pessaries: Definition, advantages and disadvantages, types of bases, method of preparation, displacement value, packing and storage.		03hrs

1	Syrups	Simple syrup IP Syrup of Ephedrine HCl NF
2.	Elixir Linctus	Piperazine citrate elixir BP Simple linctus BPC
3.	Solutions	Aqueous Iodine solution IP Weak iodine solution Cresol with soap solution IP** Strong solution of ammonium acetate**
4.	Liniments	Turpentine liniment IP**
5.	Gargles	Potassium chlorate gargle
6.	Mouthwash	Chlorhexidine antiseptic mouthwash
7.	Suspensions	Calamine lotion IP** Magnesium hydroxide mixture BP**
8	Emulsion	Liquid paraffin emulsion IP** Castor oil emulsion**
9.	Powders	Dusting powder Effervescent granules**
10.	Suppositories	Chloral hydrate suppositories** Boric acid suppositories**

Scheme of Practical Examination

1. Synopsis	- 10 Marks
2. Major experiment **	- 40 Marks
3. Minor experiment	- 20 Marks
4. Viva-voce	- 10 Marks
Total	- 80 Marks

Reference Books (Latest edition)			
Sl.No	Name of the Book	Author	Publisher
01	Cooper and Gunn's Dispensing for Pharmaceutical Students	Carter S.J.	CBS Publishers, New Delhi.
02	Cooper and Gunn's Tutorial Pharmacy	Carter S.J.	CBS Publishers, New Delhi.
03	Pharmaceutics- The Science of Dosage Form Design	M.E.Aulton	Churchill Livingstone, Edinburgh.
04	Bentley's Text Book of Pharmaceutics	E.A.Rawlins	English language book Society.
05	Pharmaceutical Dosage Forms and Drug Delivery Systems	H. C. Ansel et.al.	Lippincott Williams and Wilkins, New Delhi.
06	Pharmaceutical Calculations	M.J. Stoklosa and H.C. Ansel	B I Waverley Pvt. Ltd., New Delhi.
07	Remington The Science and Practice of Pharmacy, Vol: I and II	Alfonso R. Gennaro	Lippincott Williams.
08	Theory & Practice of Professional Pharmacy	S. N. Sharma N.K. Jain.	Vallabh Prakashan, Delhi.
09	Indian Pharmacopoeia 2007	Govt. of India	Published by The Controller of Publications, Delhi.
10	Martindale Extra Pharmacopoeia	--	Pharmaceutical Press, London.

**3.2.3 II SEMESTER Human Anatomy and Physiology - II (Theory) 60 Hours
(4 Hours/week)**

		Hours
1	<p>Cardiovascular System:</p> <p>Anatomy of the heart and blood vessels. Blood circulation. Conducting system of heart, cardiac cycle. Electrocardiogram and its significance. Blood pressure and its regulation. Cardiac output and its regulation. Significance of heart sounds.</p>	15
2	<p>Nervous System:</p> <p>Central nervous system: Structure of neuron, excitation and conduction of nerve impulse Anatomy of brain. Functions of cerebrum, cerebellum, thalamus, hypothalamus, midbrain, pons and medulla oblongata. Spinal cord and spinal nerves. Reflex action and reflex arc.</p> <p>Autonomic nervous system: Anatomy and functions-- sympathetic and parasympathetic nervous system. Neurotransmitters and their receptors.</p> <p>Somatic nervous system</p>	17
3	<p>Endocrine system: Anatomy and physiology of pituitary, thyroid, parathyroid, adrenal, pancreas, thymus and gonads.</p>	10
4	<p>Urinary System: Components, structure and functions of the kidney. Physiology of urine formation, acid-base balance. Renin- angiotensin system, clearance tests and micturition.</p>	09
5	<p>Reproductive System: Male and female reproductive systems and their hormones. Spermatogenesis & oogenesis. Sex differentiation Physiology of menstruation, coitus and fertilization. Pregnancy, its maintenance and parturition.</p>	09

3.2.3 Human Anatomy and Physiology (Practicals) 60 Hours
4 Hours/ week

1. Study of compound microscope.
2. Microscopic study of different tissues.
3. Identification of bones.
4. Study of different systems with the help of models.
5. Blood experiments-
 - a. Determination of Red Blood Corpuscles (RBC) count. **
 - b. Determination of White Blood Corpuscles (WBC) count. **
 - c. Estimation of Hemoglobin content.*
 - d. Determination of Differential Leukocyte Count (DLC). **
 - e. Determination of Erythrocyte Sedimentation Rate (ESR).
 - f. Determination of Blood groups.*
 - g. Determination of Bleeding & Clotting time.*
6. To record human heart rate, pulse rate and blood pressure.
7. Determination of tidal volume & vital capacity.
8. Experiments related to special senses.
9. Interpretation of graphical recordings of skeletal muscle preparation.
10. Study of family planning devices.

Scheme of Practical Examination

1 Identification	10 Marks
2. Synopsis	10 Marks
3 Major experiment **	35 Marks
4. Minor experiment*	15 Marks
5 Viva-voce	10 Marks
Total	80 Marks

Reference Books (Latest edition)			
Sl.No	Name of the Book	Author	Publisher
01	Ross and Wilson Anatomy and Physiology in Health and Illness	A. Waugh and A. Grant	Churchill Living Stone, Edinburgh.
02	Human Physiology (Vol. I & Vol. II)	C.C. Chatterjee	Medical Allied Agency, Calcutta.
03	Principles of Anatomy and Physiology	G. J. Toratora	John-Wiley & sons New York.
04	Concise Medical Physiology	S.K. Chaudhary.	New Cenrtal Book Agency, Calcutta.
05	Illustrated Physiology	AB Mc Naught & Callander R	B.I. Churchill Living Stone, New Delhi.
06	Text Book of Medical Physiology	A. C. Guyton and J.E. Hall	W.B. Saunders company.
07	Bailey's Text Book of Microscopic Anatomy	Douglas E., Kelly, Richard Wood and Allen C. Enders	Williams and Wilkins publishers, London.
08	Human Anatomy and Physiology	E.N. Marieb	Addison Wesley, New York.
09	Text Book of Human Histology with Colour Atlas	Inderbir Singh	Jaypee Brothers, New Delhi.
10	A Practical Human Anatomy & Physiology	R. K. Goyal & N.M. Patil	B.S. Shah Prakashan, Ahmadabad.

3.2.4 Pharmacognosy-I (Theory)		45 Hours 3 Hours / week
Sl. No.	Content	No. of Hours
1.	Definition, History and Scope of Pharmacognosy.	2
2.	Plant cell and ergastic cell constituents.	4
3.	Sources of crude drugs (Plant, Animal & Mineral) with examples.	2
4.	Classification of crude drugs. Alphabetical, Morphological, Taxonomical, Chemical, Pharmacological and Chemotaxonomical methods with examples.	6
5	General methods of cultivation, collection, processing and storage of crude drugs.	4
	Factors affecting the cultivation of medicinal plants.	2
	Pests and pest control.	2
6.	Adulteration of crude drugs and their types.	2
7.	Evaluation of crude drugs: Morphological, Microscopical, Physical, Chemical and Biological methods with examples.	6
8.	Carbohydrates- Definition, chemistry and classification. Study of biological source, method of production, chemical constituents, identification tests, uses, storage, adulterants and substitutes of following drugs:	3
	Agar, Acacia, Honey, Isabgol, Starch, Tragacanth, Cellulose and its products.	4
		2
9	Definition, chemistry and classification of lipids.	
	a. Study of biological source, method of production, storage, chemical constituents, chemical tests, uses, adulterants and substitutes for following drugs:	3
	Bees wax, castor oil, cod liver oil, Hydnocarpus oil and wool fat.	3
	b. Evaluation of oils and fats –	
	Acid value, saponification value, ester value, iodine value, peroxide value, acetyl value, hydroxyl value and their significance.	

1. Introduction to crude drugs
2. Study of morphology of following drugs:*
 - i. **Leaf** - Senna, Datura
 - ii. **Root** - Rauwolfia, Liquorice
 - iii. **Fruit** - Fennel, Coriander
 - iv. **Rhizome** - Ginger, Podophyllum
 - v. **Bark** - Cinchona, Cinnamon
 - vi. **Seed** - Isabgol, Nux vomica
 - vii. **Flower bud** - Clove
 - viii. **Stem** - Ephedra
3. Microscopic preparation. Staining and surface preparation
4. Study of Transverse section for following drugs:**
 - i. Datura leaf
 - ii. Rauwolfia root
 - iii. Coriander fruit
 - iv. Ginger rhizome
 - v. Cinchona bark
 - vi. Nux vomica seed
 - vii. Ephedra stem
 - viii. Clove flower bud
5. Systematic chemical analysis of drugs containing carbohydrates*

Agar, Acacia, Honey, Isabgol, Starch, Tragacanth
6. Analysis of oils and fats*
 - i. Acid value
 - ii. Saponification value
 - iii. Ester value
 - iv. Iodine value
 - v.

Scheme of Practical Examination

1. Synopsis	10 Marks
2. Practical	
a. Major**	35 Marks
b. Minor*	25 Marks
3. Viva-voce	10 Marks
Total	80 Marks

Reference Books (Latest Edition)

Sl.No.	Name of the Book	Author	Publisher
1	Text Book of Pharmacognosy	Kokate C.K., Purohit A.P and Gokhale S.P	Nirali Prakashan, Pune.
2	Anatomy of Crude Drugs	Iyengar M.A and Nayak S.G.K.	Manipal power press, Manipal.
3	Practical Pharmacognosy	Kokate C.K.	Vallabh Prakashan, Delhi.
4	Pharmacognosy	Brady R & Tyler V. E	Lea and Febiger, Philadelphia.
5	Pharmacopoeia of India	Govt. of India	Govt. of India, New Delhi.
6	Text Book of Pharmacognosy	Wallis T.E.	J.A Churchill Limited, London.
7	Phytochemical Methods	Harborne J.B.	Chapman and Hall, International Edition, London.
8	British Pharmacopoeia	Ministry of Health	Ministry of health and Social welfare, U.K.

3.2.5	II SEMESTER	Constitution Of India (Theory)	30 Hours
			2 Hours/week
1		Historic background-Developments in England since 1946 and their impact on Indian independence.	01 Hr
2		Territory and Citizenship.	01 Hr
3		Fundamental Rights-Directive principles of State Policy and Fundamental Duties.	07 Hrs
4		Union Executive and State Executive-including formation of Council of Ministers etc.	04 Hrs
5		Union and state Legislature-Composition, duration and qualification of members.	04 Hrs
6		Devolution of Powers on the Local self Govts. Ic Panchayat Raj Institutions their composition etc.	02 Hrs
7		Judiciary	02 Hrs
8		Legislative relations	02 Hrs
9		Financial relations	01 Hrs
10		Emergency Powers.	02 Hrs
11		Public Service Commissions.	01 Hrs
12		Inter-state trade & Commerce, liability of Government and security of tenure of public servants.	02 Hrs
13		Election commission of India and amendment to the Constitution.	01 Hr

B. PHARM-III SEMESTER

3.3.1	III SEMESTER	Pharmaceutical Microbiology (Theory)	45 Hours 3 Hrs/wk
1	Historical background of microbiology: Contributions of various scientists for the development of microbiology: Louis Pasteur, Paul Erlich, Robert Koch, Alexander Flemming, Edward Jenner. Pharmaceutical applications of microbiology		02
2	General classification of micro-organisms: Morphological studies on bacteria and virus.		02
3	Identification of bacteria: A] Staining techniques- Simple, Gram's, Acid fast and Special staining (flagella and spore) technique. B] Biochemical tests of bacteria – Sugar fermentation test, Catalase test, Indole test and Voges Proskauer test.		05
4	Nutritional requirements, Growth and Cultivation of bacteria. Study on important culture media required for growth of aerobic, anaerobic bacteria and fungi. Types of culture media- basal, enriched, selective, transport, storage and indicator media. Factors affecting growth of micro-organisms.		04
5	Isolation and Maintenance of pure culture of bacteria.		02
6	Disinfectants: Definitions for disinfectants, antiseptics and preservatives. Classification and mode of action of disinfectants and preservatives. Factors influencing disinfection. Evaluation of disinfectants and preservatives.		06
7	Sterilization: Principles of sterilization, definitions of 'D' value, 'Z' value & thermal death time. Study on different methods of sterilization in detail viz Physical (Moist heat, dry heat, heating with bactericide, sterilization by radiation) chemical (Gaseous method – ethylene oxide) and mechanical method (sterilization by filtration) including Equipment employed in these sterilization techniques. Validation of sterilization method using sterility indicators.		11
8	Test for sterility: Methods and media used. Sterility testing of pharmaceutical preparation.		02
9	Microbiological Assay: Assay of cephalixin and vitamin B12. General method of testing of antimicrobial activity of a new substance.		02
10	Immunology: Definition, types of immunity, structure of antigen and antibody. Immunoglobulin classes, antigen-antibody reactions. Diagnostic tests- Shick's test, ELISA test, Widal test, Wassermann test (VDRL) and Mantoux test. Vaccines- Types of vaccines, preparation of BCG vaccine and Tetanus toxoid. Different methods of cultivation of virus. General method of preparation of viral vaccine with reference to polio vaccine.		09

3.3.1 III SEMESTER Pharmaceutical Microbiology (Practicals) 60 Hours

04 Hours/ week

- 1 Sterilization of glasswares, preparation and sterilization of culture media.
2. Aseptic transfer technique*
- 3 Motility testing*
- 4 Simple staining**
- 5 Gram's staining**
- 6 Isolation of pure culture
- 7 Viable count of bacteria.
- 8 Antimicrobial activity of an unknown compound (MIC by serial dilution method).
- 9 Sterility testing of pharmaceutical product by direct inoculation method (any one injection).
- 10 Microbiological assay of antibiotic by cup plate method/Disc diffusion method.

Scheme of Practical Examination

1. Synopsis	- 10 Marks
2. Major experiment**	- 40 Marks
3. Minor experiment*	- 20 Marks
4. Viva-voce	- 10 Marks
Total	- 80 Marks

Reference Books (Latest edition)			
Sl. No	Name of the Book	Author	Publisher
01	Microbiology	Michel. J. Pelczar, JR	Tata McGraw-Hill Publishing Company, Ltd.
02	Text Book of Microbiology	Ananthanarayan & C. K. T. Panikar.	Orient Longmann Pub.
03	Introduction to Microbiology	Tortora	Harper & Row, New York.
04	Dispensing for Pharmaceutical students	Cooper & Gunn	The Kothari Book, New Delhi.
05	Bentley & Drivers Text Book of Pharmaceutical Chemistry	Bentley	Oxford University Press, New York.
06	Tutorial Pharmacy	Cooper & Gunn	CBS Publishers Distributors
07	Practical Microbiology	Gaud P.S. Gupta MGD	Nirali Prakashan
08	Pharmaceutical Microbiology	Russell, A.D. Huga W.D	Blackwell Scientific Publications
09	Immunology in Plant Sciences Vol IV	Linskens H.F. Jacksons J.F	Springer Verlag, New York
10	Industrial Microbiology	Casida. L.E.	John Wiley-Sons, INC
11	A) Indian Pharmacopoeia B) British Pharmacopoeia C) U.S.P	Govt. of India British Pharmacopoeia U.S.P	The Indian Pharmacopoeia Commission The Stationary office United State Pharmacopoeia Convention, INC.

Sl. No.	Content	No. of Hours
1.	Definition, chemistry, classification and method of analysis of Proteins. Study of biological source, method of production, chemical constituents, chemical tests, uses, storage, adulterants and substitutes for following drugs: Gelatin, Collagen and their products.	4
2.	Significance of secondary metabolites. Definition of Alkaloids, Glycosides, Resins, Tannins, Volatile oils and Carotenoids with examples	4
3.	Study of Plant biosynthesis <ol style="list-style-type: none"> Techniques of elucidation of biosynthetic pathway Basic biosynthetic pathways Shikimic acid pathway, Isoprenoid pathway. Detailed study of biosynthesis of Glycosides – Steroidal, Anthraquinone Alkaloids – Tropane, Quinoline and Indole 	5 3 3 4
4.	Definition, chemistry and classification of Resins. Study of biological source, morphology, chemical constituents, chemical tests, uses, adulterants and substitutes of following drugs: Ginger, Colophony, Podophyllum, Asafoetida, Balsam of tolu, Cannabis, Capsicum, Benzoin, Turmeric.	7
5.	Definition, chemistry and classification of Tannins. Study of biological source, morphology, chemical constituents, chemical tests, uses, adulterants and substitutes for following drugs: Black Catechu, Pale Catechu, Myrobalan, Nutgall.	4
6.	Study of fibers used in surgical dressings. Study of biological source, morphology, chemical constituents, chemical tests and uses of following fibers: Cotton, Silk, Wool, Nylon, Asbestos	4
7.	Introduction to Alternative systems of medicine. <ol style="list-style-type: none"> Basic principles of Ayurveda, Siddha, Unani, Traditional Chinese Medicine and Homoeopathy Introduction to Ayurvedic preparations and method of preparation of Asava, Arista, Gutika, Taila, Churna, Lehya and Bhasma 	2 5

1. Systematic study of composition of plant cell wall and cell contents.
2. Study of organoleptic characters of following drugs: *
Podophyllum, Capsicum, Turmeric, Myrobalan, Nutgall, Coriander.
3. Study of powder microscopy of the following drugs:**
 - i. Digitalis
 - ii. Rauwolfia
 - iii. Coriander
 - iv. Ginger
 - v. Cinchona
 - vi. Nux vomica
 - vii. Ephedra
 - viii. Clove
4. Systematic chemical analysis of following unorganized crude drugs:*
 - i. Gelatin
 - ii. Asafoetida
 - iii. Benzoin
 - iv. Colophony
 - v. Black and Pale Catechu
5. Introduction to quantitative microscopy, study of Camera lucida and calibration of ocular micrometer.
6. Determination of Stomatal number of Vinca, Vasaka. *
7. Determination of Stomatal index of Vinca, Vasaka. **

Scheme of Practical Examination

1. Synopsis	10 Marks
2. Practical	
a. Major**	35 Marks
b. Minor*	25 Marks
3. Viva-voce	10 Marks
Total	80 Marks

Reference Books (Latest edition)

Sl.No	Name of the Book	Author	Publisher
1	Text Book of Pharmacognosy	Kokate C.K., Purohit A.P and Gokhale S.P.	Nirali Prakashan, Pune.
2	Text Book of Pharmacognosy	Trease G.E and Evans W.S.	Bailliere Tindall, Eastbourne, U.K.
3	Practical Pharmacognosy	Kokate C.K.	Vallabh Prakashan, Delhi.
4	Text Book of Pharmacognosy	Brady R & Tyler V. E.	Lea and Febiger, Philadelphia
5	The Practical Evaluation of Phytopharmaceuticals	Brain K.R and Turner T.D.	Wright-Sciotechnica, Bristol
6	Text Book of Pharmacognosy	Wallis T.E.	J.A Churchill Limited, London.
7	Phytochemical Methods	Harborne J.B.	Chapman and Hall, International Edition, London.
8	Natural Products – A Laboratory guide	Raphael Ikan	Academic press, New York, USA.
9	Medicinal Natural Products (A biosynthetic approach)	Paul M, Dewick	John Wiley & Sons ltd. England.

3.3.3. Pharmaceutical Organic Chemistry – III (Theory)

60 Hours
4 Hours/week

I Nucleophilic aromatic substitutions;

10hrs

Unsaturated carbonyl compounds; Conservation of orbital symmetry and rules. Electrocyclic, Cycloaddition and sigmatropic reactions; study of neighbouring group effects; Catalysis by transition metal complexes.

II Chemistry of Biomolecules:

28hrs

Lipids:

Definition, composition and reactions of oils and fats. Analysis of oils and fats. Composition of waxes.

Carbohydrates:

Definition, classification, stereoisomers of monosaccharides, reactions of monosaccharides and interconversions.

Monosaccharides: structure, configuration, ring structure and ring size of glucose. Structure and properties of fructose (ketose)

Disaccharides: Structure and properties of sucrose, lactose and maltose.

Polysaccharides: Composition of starch, cellulose and cellulose derivatives.

Aminoacids and Proteins:

Aminoacids: Definition, classification, essential aminoacids. Synthesis and reactions of aminoacids.

Proteins: Definition, classification, primary structure and synthesis of peptides, C-terminal and N-terminal amino acid determinations (CTAA and NTAA).

Polymer chemistry: Introduction and applications of biopolymers.

2hrs

III Specific synthetic applications of the following reagents:

20hrs

Preparation, storage and applications of:

Grignard reagent, Lithium Aluminum Hydride (LAH), Lead Tetra Acetate (LTA), N-Bromosuccinimide (NBS), Selenium oxide, Sodium periodate, Perchloric acid, Phase transfer catalysts (PTC), Sodium borohydride, Palladium carbon catalyst (Pd/C),

Mechanism of the following reactions:

Fries rearrangement, Beckmann rearrangement, Birch reduction, Hofmann's hypobromite reaction, Oppenauer oxidation. MPV reduction, Arndt-Eistert synthesis.

Reference Books (Latest edition)

1. T.R.Morrison and R.Boyd, Text of Organic Chemistry, 6th edition Prentice Hall of India Pvt. Ltd., New Delhi.
2. Bentley and Driver's, Text Book of Pharmaceutical Chemistry. L.M. Atherden, 8th edition
3. I.L. Finar Organic Chemistry, Vol. I & II Longman Publishers.
4. J.M.Catm and D.J.Carm Organic Chemistry. Saunders College of Publishing, 13th edition.
5. Brown, Organic Chemistry.Brooks/Cole Publishing company.
6. Jerry and March, Advanced Organic Chemistry, Wiley Eastern Limited, New Delhi 4th edition.
7. Peppas.N.A., Langer.R.S. Biopolymers I Springer Verlag, Berlin 1993.
8. Name reactions and Reagents in organic synthesis, 2nd edition, Wiley Science.

3.3.4 III SEMESTER	Pharmaceutical Analysis (Theory)	45 Hours 3 Hours/week
1. Introduction to pharmaceutical calculations and application of statistical analysis.		4Hrs
a. Significance of statistical methods: determination of correlation co-efficient, linear regression, standard deviation and relative standard deviation and analysis of co-variance.		
b. Arithmetic mean and geometric mean.		
2. Sources of errors, types of errors and methods of minimizing errors.		2 Hrs
3. Analytical techniques: Weights and balances, Construction of calibration curves and application to linear regression.		2 Hrs
4. Titrimetric analysis: Theoretical considerations, scope and limitations.		
4.1 Nonaqueous titrations:		4 Hrs
a. Principle, solvents and indicators used.		
b. Examples of titration of Sodium benzoate and Ephedrine hydrochloride		
c. Pharmaceutical applications and advantages.		
4.2 Redox titrations:		9 Hrs
a. Concepts of oxidation & reduction, Oxidising & Reducing agents.		
b. Theory of redox reactions (Viz. Half reaction, Redox potential, calculation of Redox potential, Nernst equation & Standard potential)		
c. Strength and equivalent weights of oxidizing and reducing agents		
d. Indicators in redox titrations		
e. Cerimetry, Iodometry, Iodimetry and Bromometry.		
4.3 Complexometric titrations:		7 Hrs
a. Basic principles: Complex formation, chelation, Werner's co-ordination number, stability of complexes, titrants and titration curves of complexometric analysis, including theories of complex ions, chelating agents, properties of metal complexes with particular reference to disodium EDTA.		
b. Types of complexometric reactions.		
c. Methods of detecting end points and indicators employed.		
d. Pharmaceutical applications with suitable examples (Calcium gluconate, Magnesium sulphate).		
5. Chromatography:		9Hrs
Introduction to chromatographic techniques, principle, instrumentation, applications of instruments in drug analysis of pharmacopoeial products.		
Fundamentals of the following techniques shall be discussed with the relevant examples of pharmaceutical and natural products.		
a. Thin layer chromatography (TLC)		
b. Paper chromatography		
c. Column chromatography		
d. Gas liquid chromatography (GLC)		
e. High performance liquid chromatography (HPLC)		
f. High performance thin layer chromatography (HPTLC)		

6. Electrochemical analysis:

8 Hrs

Introduction, Dielectric cell, Electrode potential, Salt bridge, Standard potential, Reference and indicator electrodes. Measuring the relative voltage of cell.

Principle, instrumentation and applications of

- a. Potentiometry
- b. Conductometry

3.3.4 Pharmaceutical Analysis (Practicals)

60 Hours
4 Hours/week

1. Calibration of balance and volumetric apparatus.
2. Nonaqueous Titrations:
 - a. Preparation and standardization of Perchloric acid.*
 - b. Assay of Sodium benzoate, Ephedrine hydrochloride and Metronidazole tablets. **
3. Redox titrations: **
 - a. Cerimetry Ex. Ferrous sulfate
 - b. Iodometry Ex. Chlorinated lime
 - c. Iodimetry Ex. Ascorbic acid
 - d. Bromometry Ex. Isoniazid tablets
4. Potentiometric titration of Strong acid Vs Strong base using pH meter or Potentiometer Ex. HCl Vs NaOH.**
5. Chromatographic Analysis*:
 - a. Separation and Identification of amino acids by paper chromatography.
 - b. Alkaloids by thin layer chromatography.
 - c. Demonstration of column chromatography.

Scheme of Practical Examination

1. Synopsis	--	10 Marks
2. Major Experiment**	--	35 Marks
3. Minor Experiment*	--	25 Marks
4. Viva-voce	--	10 Marks
Total	--	80 Marks

Reference Books (Latest edition-Theory)

1. Quantitative analysis by V. Alexeyev. Mir Publishers, Moscow, 1st edition 1994.
2. A Text Book of Pharmaceutical Analysis by Kenneth A. Connors John Wiley and sons, 3rd edition, 1982.
3. Principles of Analytical Chemistry by John H. Kneendy. Saunders College Publishing N. Y. 2nd edition, 1990.
4. Analytical Chemistry Handbook by John Dean. Mc Graw Hill Inc. N.Y. 1st edition, 1995.
5. Introduction to Analytical Chemistry by Skoog, West and Holler, Saunders College Publishing, 6th edition. 1994.
6. Fundamentals of analytical Chemistry an introduction by Skoog, West and Holler, Saunders College Publishing, 7th edition. 1996.
7. Analytical Chemistry by R. M. Verra, CBS Publishers 2nd edition, 1991.
8. Bentley and Drivers T.B. of Pharmaceutical chemistry revised by L. M. Atherden Oxford University Press Bombay, 8th edition, 1994.
9. Pharmaceutical Analysis by T. Higuchi, CBS Publishers, New Delhi, 1st edition, 1973.

Reference Books (Latest edition-Practicals)

1. A. H. Beckett and J. B. Stenlake, Practical Pharmaceutical Chemistry, Part – I, 4th edition, CBS Publications, New Delhi, 2004.
2. B. H. Jeffery and R. C. Denny, Vogel's Text book of Quantitative Chemical Analysis, 6th edition, Pearson Education, Delhi.2004.
3. Indian Pharmacopoeia, Controller of Publications, Delhi, 1996.

3.3.5	III SEMESTER	Physical Pharmaceutics-I (Theory)	45 Hours 3 Hours/week
1	Physical properties of drug molecules:	Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determination and applications.	06
2	pH, buffers and isotonic solutions:	Sorensen's pH scale, determinations (electrometric and calorimetric), applications, buffer equation, buffer capacity, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions.	08
3	Solubility phenomena:	Solvent-solute interactions, solubility of gas in liquids, solubility of liquids in liquids (binary solutions, ideal solutions, Raoult's law, real solutions, distillation of binary mixtures, azeotropic mixtures and fractional distillation). Partially miscible liquids (conjugate mixtures), Critical solution temperatures, applications, phenol-water system, triethylamine-water system, nicotine-water system. Solubility of solids in liquids: Definitions, determinations, factors influencing the solubility.	09
4	Distribution law:	Explanation, limitations and applications, effect of molecular association, dissociation and complexation.	06
5	Kinetics and Drug Stability:	Rate and molecularity of a reaction, determination of order, factors influencing rate of reactions, half-life determination, Accelerated stability study, Shelf life.	08
6	Surface and Interfacial Phenomenon:	Liquid interface, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB value and scale, classification of surfactants, solubilization and detergency. Adsorption at solid interfaces: solid-gas and solid-liquid interfaces, adsorption isotherms, Gibb's adsorption equation, complex films, electrical properties.	08

**3.3.5 III SEMESTER Physical Pharmaceutics-I (Practicals) 60 Hours
04 Hours/week**

1. Preparation of buffers and measurement of pH using pH meter and pKa values.
2. Determination of refractive index of a liquid.
3. Determination of solubility of solids in liquid
4. Determination of partition coefficient of iodine between water and carbon tetrachloride. **
5. Determination of partition coefficient of benzoic acid between benzene and water. **
6. Determination of percentage composition of sodium chloride in water using CST method. **
7. Determination of rate constant for first order and second order reactions. **
8. Determination of HLB value of a surfactant. **

Scheme of Practical Examination

1. Synopsis	- 10 Marks
2. Major experiment**	- 40 Marks
3. Minor experiment	- 20 Marks
4. Viva-voce	- 10 Marks
Total	- 80 Marks

Reference Books (Latest edition)			
Sl.No.	Name of the Book	Author	Publisher
01	Physical Pharmacy	Alfred Martin, P. Bustamante, A.H.C. Chun.	B.I. Waverly, Pvt. Ltd., New Delhi.
02	Bentley's Text Book of Pharmaceutics	E.A. Rawlins.	English language book society.
03	Cooper and Gunn, Tutorial Pharmacy	Carter S.J.	CBS Publishers, New Delhi.
04	Remington: The Science and Practice of Pharmacy. Vol. I and II	Alfonso R Gennaro.	Lippincott Williams and Wilkins, Philadelphia, USA.
05	Physical Pharmaceutics	C.V.S. Subramanyam.	Vallabh Prakashan, New Delhi.

B. PHARM-IV SEMESTER

3.4.1	IV SEMESTER	Physical Pharmaceutics-II (Theory)	45 Hours 3 Hours/week
1	Micromeretics:	Particle size and distribution, average particle size, number and weight distribution. Methods for determining particle size, derived properties of powders- porosity, packing arrangement, densities, bulkiness and flow properties.	08
2	Viscosity and Rheology:	Newtonian systems, Law of flow, kinematic viscosity, effect of temperature, Non-Newtonian systems, pseudoplastic, dilatant and plastic flow. Thixotropy in formulation, determination of viscosity by capillary flow, falling ball and rotational viscometers.	08
3	Coarse dispersions:		07
	i.	Suspensions: Interfacial properties of suspended particles, theory of sedimentation, effect of Brownian movement, wetting of particles, controlled flocculation, flocculation in structured vehicles and rheological considerations.	
	ii.	Emulsions: Theories of emulsification, physical stability and rheological considerations.	
4	Colloids:	Definition, types, preparation, purification, stabilization of colloids, optical properties, kinetic properties, electrical properties and applications of colloids in pharmacy.	07
5	Complexation:	Classification of complexes, methods of preparation, analysis and applications.	07
6	Diffusion and dissolution:	steady state diffusion, types of diffusion, diffusion equation, diffusion cells, dissolution of tablets and capsules, Hixon-crowell cube root equation, dissolution apparatus, factors affecting dissolution.	08

3.4.1 III SEMESTER Physical Pharmaceutics-II (Practicals)

**60 Hours
04 Hours/ week**

- 1 Determination of particle size by optical microscopy. **
2. Determination of density and porosity of powder.
3. Determination of compressibility and angle of repose of powder.
4. Determination of viscosity of liquids using Ostwald's viscometer.
5. Preparation of deflocculated and flocculated suspensions and their evaluation. **
6. Preparation and stability studies of emulsions. **
7. Preparation and evaluation of hydrophobic colloids. **
- 8 Determination of stability constant of Glycine-Copper complex by pH titration method. **
- 9 Experiment involving simple diffusion using diffusion cell (demonstration)

Scheme of Practical Examination

1. Synopsis	- 10 Marks
2. Major experiment**	- 40 Marks
3. Minor experiment	- 20 Marks
4. Viva-voce	- 10 Marks
Total	- 80 Marks

Reference Books (Latest edition)			
Sl.No.	Name of the Book	Author	Publisher
01	Physical Pharmacy	Alfred Martin, P. Bustamante, A.H.C. Chun.	B.I. Waverly, Pvt. Ltd., New Delhi.
02	Bentley's Text Book of Pharmaceutics	E.A. Rawlins.	English language book society.
03	Cooper and Gunn, Tutorial Pharmacy	Carter S.J.	CBS Publishers, New Delhi.
04	Remington: The Science and Practice of Pharmacy. Vol. I and II.	Alfonso R Gennaro	Lippincott Williams and Wilkins, Philadelphia, USA.
05	Physical Pharmaceutics	C.V.S. Subramanyam	Vallabh Prakashan, New Delhi.
06	Physical Pharmaceutics	E. Shotton and K. Ridgway	Clarendon Press, Oxford.

- | | | |
|----------|---|----|
| 1 | Cell Injury and Adaptation:
Definition, etiology and pathogenesis of ischemic, hypoxic, chemical and free radical mediated cell injury. Immune mechanism of cell injury.
Types of hypersensitivity reactions.
Cellular adaptations: Atrophy, Hypertrophy, Hyperplasia, Anaplasia and Metaplasia. | 10 |
| 2 | Inflammation: Definition and types, Chemical mediators of inflammation. Vascular and cellular events during acute inflammation and its outcome. Chronic inflammatory cells and granulomatous inflammation. Systemic effects of inflammation. Brief outline of repair and factors influencing wound healing. | 5 |
| 3 | Etiology, pathogenesis, signs and symptoms of Rheumatoid arthritis, Myasthenia gravis. Epilepsy, Parkinsonism, Alzheimer's disease, Bipolar disorders and Schizophrenia, Glaucoma, Stroke, Shock, Atherosclerosis, Essential hypertension, Angina pectoris, Congestive heart failure, Myocardial infarction. Diabetes mellitus. Gastric ulceration, Crohn's disease and Ulcerative colitis, Viral hepatitis, Renal failure, COPD, Tuberculosis, Leprosy, AIDS, H1N1, Dengue and Chikungunya. | 32 |
| 4 | Neoplasia: Nomenclature and Characteristic features of neoplasm. Epidemiology of cancer, metastasis. Types of Carcinogens - mechanism of chemical, radiation and viral carcinogenesis. | 8 |
| 5 | Environmental and nutritional disorders: Air pollution and its consequences. Consequences of tobacco smoke and obesity. Injury due to acute and chronic exposure to radiation. PEM and Vitamin deficiencies. | 5 |

Reference Books (Latest Edition)			
Sl.No	Name of the Book	Author	Publisher
01	Basic Pathology	Kumar, Cotran and Robbins	M/s WB Saunders company
02	Text Book of Pathology	Harsh Mohan	M/s Jaypee Brothers Medical publishers.
03	Essential of Pathophysiology for Pharmacy	Martin M Zdanowicz	CRC Press, USA
04	Pharmacotherapy: A Pathophysiological Approach	Dipiro J.L.	Elsevier.
05	Essential Pathology	Emanuel Rubin, John L., Farber J.B.	Lipponcott Williams & Wilkins, Philadelphia.

Sl. No.	Content	No. of Hours
1.	Extraction of crude drugs	
	a. Different methods of extraction: Maceration, Percolation, Soxhlet extraction and Supercritical fluid extraction, choice of the suitable solvent and suitable method of extraction.	5
	b. Preliminary phytochemical screening of natural compounds.	4
	c. General methods used for isolation and purification of phytoconstituents.	6
2.	Introduction, classification and study of different chromatographic techniques and their applications in identification, purification and evaluation of herbal drugs with examples.	12
3.	Definition, chemistry, classification, properties, method of isolation and analysis of Glycosides.	5
	Study of biological source, morphology, chemical constituents, chemical tests, uses, adulterants and substitutes for following drugs:	
	i. Cardiac Glycosides: Digitalis, Squill, Strophanthus and Thevetia.	5
	ii. Saponin Glycosides: Liquorice, Ginseng, Dioscorea, Sarsaparilla and Senega.	4
	iii. Anthraquinone Glycosides: Aloe, Senna, Rhubarb and Cascara.	4
	iv. Flavonoid Glycosides: Lemon peel and Orange peel.	2
	v. Cyanogenetic Glycosides: Bitter almond.	2
	vi. Bitter Glycosides: Kalmegh, Gentian, Chirata, Quassia.	3
4.	Study of natural pesticides	
	Neem, Pyrethrum and Tobacco (with respect to their biological source and chemical constituents).	3
5.	Natural products used as colour pigments, biopolymers, photosensitizing agents, flavours, biofuels.	5

Reference Books (Latest edition)

Sl.No.	Name of the Book	Author	Publisher
1	Text Book of Pharmacognosy	Kokate C.K., Purohit A.P and Gokhale S.P.	Nirali Prakashan, Pune.
2	Pharmacognosy	Trease G.E and Evans W.S.	Bailliere Tindall, Eastbourne, U.K.
3	Practical Pharmacognosy	Kokate C.K.	Vallabh Prakashan, Delhi.
4	Text Book of Pharmacognosy	Brady R & Tyler V. E.	Lea and Febiger, Philadelphia.
5	Phytochemical Methods	Harborne J.B.	Chapman and Hall, International Edition, London.
6	Natural Products – A Laboratory Guide	Raphael Ikan	Academic press, New York, USA.
7	Thin Layer Chromatography A Laboratory Guide	Stahl E.	Springer-Verlag, Berlin, London.
8	Pharmacognosy and Pharmacobiotechnology	Ashutosh Kar	New Age Publications, New Delhi.

1. Introduction: Role and scope of biochemistry in pharmacy.
2. Biochemical organization of the cell and transport processes across cell membrane.
3. 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. 3hrs
4. **Enzymes & Co-enzymes:** 5hrs
Introduction, IUB classification, properties of enzymes and co-enzymes, specificity and mode of action of enzymes, factors affecting enzyme activity, activators and deactivators of enzymes. Vitamins and their biological significance. Enzyme kinetics and enzyme inhibitors. Applications of enzymes.
5. **Introduction to Biomolecules:**
Structure, classification and biological functions of carbohydrates, proteins, lipids, nucleic acids and minerals. 3hrs
Metabolic pathways: Study of energetics, significance and metabolic disorders of
 - a. **Carbohydrates:** 7hrs
 - Glycolysis
 - Kreb's cycle
 - Gluconeogenesis
 - Glycogenesis
 - Glycogenolysis
 - Galactose and galactosemia, Lactose and Lactosamine
 - Hexose monophosphate pathway (HMP)
 - Uronic acid pathway
 - b. **Lipids:** 8hrs
 - Biosynthesis of saturated and unsaturated fatty acids.
 - Oxidation of fatty acids – Saturated & Unsaturated.
 - Biosynthesis of ketone bodies and their utilization.
 - Cholesterol
 - Phospholipids and sphingolipids
 - Thromboxanes and leukotrienes

6. Amino acids:

9hrs

- Biosynthesis
- Catabolism.
- Urea cycle
- Aromatic and sulphur containing amino acids.
- Conversion of amino acids to specialized products: Creatine, Creatinine, Histamine, Dopamine, Noradrenaline, Adrenaline, 5-HT.
- Porphyrin biosynthesis, formation of bile pigments and hyperbilirubinemia.

7. Nucleic acids and Nucleotides:

8hrs

- Purine and Pyrimidine biosynthesis.
- Catabolism of Nucleotides
- Biosynthesis of DNA and its replication.
- DNA repair
- Biosynthesis of RNA
- Genetic code and Protein biosynthesis

8. Diagnostic biochemistry: Lipid profile, liver and kidney function tests and biomarkers. 2hrs

Major Experiments:

1. Preparation of standard buffers (citrate, phosphate and carbonate) and measurement of pH.
2. Titration curve for amino acids.
3. Separation of amino acids by two dimensional paper chromatography.
4. The separation of carbohydrates /lipids by TLC.
5. Estimation of Glucose in Urine by benedict's quantitative reagent (BQR).
6. Estimation of Glucose in Blood.
7. Estimation of reducing sugar by DNSA reagent method.
8. Estimation of Cholesterol by Zaks method.
9. Estimation of Creatinine.
10. Estimation of SGPT and SGOT.
11. Estimation of enzyme: salivary amylase.
12. Polymerase chain reaction (PCR) / estimation of DNA/ RNA.

Minor Experiments:

13. Identification of Carbohydrates (Glucose, Lactose, Fructose, Maltose, Sucrose, Starch).
14. Identification of Proteins (Albumin, Casein, Gelatin, Peptone).
15. Qualitative analysis of normal and abnormal urine constituents.

Scheme of Practical Examination

1. Synopsis	-- 10 Marks
2. Major Experiment	-- 35 Marks
3. Minor Experiment	-- 25 Marks
4. Viva-voce	-- 10 Marks
Total	80 Marks

Reference Books (Latest edition)

1. Biochemistry, John L. Tymoczko, Jeremy M. Berg, Lubert Stryer, Freeman and Co.
2. Harper's Illustrated Biochemistry, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Robert K. Murray, Appleton and Lange, USA.
3. Biochemistry and Molecular Biology by William H. Elliott and Daphne C. Elliot, Oxford University Press.
4. Text Book of Biochemistry, Lehninger, Replica press Pvt Ltd.
5. Biochemistry (Basic and Applied) R.A. Fursule, Dr. J.S. Kulkarni, Mrs. O.H. Agarkar, Nirali Prakashan.
6. Fundamentals of Biochemistry, By Dr. A.C.Deb.
7. Biochemistry by U.Satyanarayana and U.Chakrapani.
8. Principles of Biochemistry by Voet and Voet.
9. Text Book of Biochemistry by Dr. O.P.Agarwal, Goel Publishing House.

3.4.5 **IV SEMESTER Pharmaceutical Engineering (Theory) 45 Hours**
3 Hours/week

- | | | | |
|---|---|---|--------|
| 1 | Filtration and Centrifugation: | Theory of filtration and Kozeny's equation, classification of industrial filters, Construction and working of filter press, filter leaf, meta filter, candle filter. Filter aids. Theory and principle of centrifugation, classification of industrial centrifuges. Construction working -Centrifuges, - basket, tubular bowl, conical disc, semi continuous and continuous horizontal centrifuges. | 07 Hrs |
| 2 | Size reduction: | Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of a mill, types of mills, construction and working of ball mill, hammer mill, fluid energy mill, Edge runner and end runner mill. | 08 Hrs |
| | Size separation: | Different techniques of size separation- sieves, sieve shakers, sedimentation tanks, Mechanical classifiers, Cyclone separators, Air separators, Bag Filter. | |
| 3 | Mixing: | Theory of mixing, solid-solid, solid-liquid and liquid – liquid mixing. Equipments-tumbler mixer, V-cone, double cone, ribbon blenders, Sigma blade, planetary and zigzag mixers. Mixing devices, - Propeller, turbine, paddle mixers. Vortex formation and prevention. Homogenization and homogenizers. | 06 Hrs |
| 4 | Drying: | Moisture content and mechanism of drying, factors affecting drying. Classification and types of dryers, dryers used in pharmaceutical industries. Construction and working of tray dryer, fluidized bed dryer, drum dryer, vacuum Dryer, Freeze dryer and Spray dryer. | 06 Hrs |
| 5 | Evaporation: | Basic concept of phase equilibria, factors affecting evaporation. Classification, construction and working of film evaporator, single effect and multiple effect evaporators, theory and economy. | 05 Hrs |
| 6 | Crystallization: | Crystal habits, solubility curves, Mier's supersaturation theory, construction and working of agitated batch crystalliser, Swenson-walker, Krystal and Vaccum crystallisers. Caking of crystals. | 05 Hrs |
| 7 | Refrigeration and Air Conditioning, Dehumidification and Humidity Control: | Principle and applications of refrigeration and air conditioning. Basic concepts and definition, wet bulb and adiabatic saturation temperatures. Psychrometric chart and measurement of humidity, application of humidity and measurement. Equipments for dehumidification operations. | 05 Hrs |
| 8 | Plant Location and layout: | Lay out facilities, utilities and services, industrial hazards- chemical, mechanical and fire hazards and safety measures. | 03 Hrs |

3.4.5 IV SEMESTER Pharmaceutical Engineering (Practicals)

**60 Hours
4 Hours/week**

1. Determination of rate of drying curves, free moisture content and bound moisture content **
2. Evaporation: Factors affecting rate of evaporation*
3. Method of Crystallization and study of Crystal habit*
4. Experiment based on steam distillations*
5. Operation of Ball mill **
6. Rate of Filtration studies *
7. Particle size determination by sieve analysis **
8. Determination of mixing index by bottle method for a solid mixture **
9. Determination of mixing index by blenders for a solid mixture **
10. Determination of Solid liquid mixing efficiency *

Scheme of Practical Examination

1. Synopsis	- 10 Marks
2. Major experiment**	- 40 Marks
3. Minor experiment*	- 20 Marks
4. Viva-voce	- 10 Marks
Total	- 80 Marks

Reference Books (Latest edition)			
Sl.No.	Name of the Book	Author	Publisher
01	Cooper and Gunn's Tutorial Pharmacy	Carter S.J.	CBS Publishers, New Delhi.
02	Bentley's Text Book of Pharmaceutics	E.A.Rawlins	English language book Society.
03	Introduction to Chemical Engineering	Walter. L. Badger and Julius T. Banchero.	Mc Graw Hill Series.
04	Elementary Chemical Engineering	Max Peters	Mc Graw Hill International Book Company.
05	Chemical Engineer's Handbook	Don. W. Green and James. O. Maloney, Perry's	Mc Graw Hill Book Company.
06	Chemical Engineering, Vol I.	J. M. Coulson and J. F. Richardson.	Pergemon Press.
07	Introduction to Pharmaceutical Engineering.	A.R. Paradkar.	Nirali Prakashan, Pune.
08	Text Book of Engineering.	Sambamurthy	New age International (P) Ltd., New Delhi.
09	Pharmaceutical Engineering Principles and Practices	Subramanyam and Kusumdevi	Vallabh Prakashan, New Delhi.

B. PHARM-V SEMESTER

**3.5.1 V SEMESTER Pharmaceutical Jurisprudence and Ethics (Theory) 50Hours
3 Hours/week**

- | | | |
|----------|--|-----------|
| 1 | Introduction to Pharmaceutical legislations | 02 |
| 2 | An elaborate (practical oriented) study of the following: | |
| | a) Code of Pharmaceutical ethics | 02 |
| | b) Pharmacy Act 1948 | 04 |
| | c) Drugs and Cosmetics Act 1940 and rules 1945 | 20 |
| | d) Medicinal and Toilet Preparations (Excise Duties) Act 1955 | 04 |
| | e) Narcotic Drugs and Psychotropic Substances Act 1985 and rules | 06 |
| | f) Drugs Price Control Order and Pharmaceutical Policy 2002 | 03 |
| 3 | A brief study of the following with special reference to the main provisions | |
| | a) Drugs and Magic Remedies (Objectionable Advertisements) Act 1954 | 02 |
| | b) Prevention of Cruelty to Animals Act 1960 including study of CPSCEA guidelines, INSA & ICMR guidelines | 03 |
| | c) Factories & Minimum Wages Act 1948 | 02 |
| | d) Patents Act 1970 | 02 |
| 4 | A brief study of the various prescription/non-prescription products, Medical/surgical accessories, diagnostic aids, appliances available in the market. | |

(Individual report to be submitted by each student on any one above market survey)

Reference Books (Latest edition)			
Sl.No	Name of the Book	Author	Publisher
1	A Text Book of Forensic Pharmacy	N.K.Jain	Vallabh Prakashan, New Delhi.
2	A Text Book of Forensic Pharmacy	Mithal, B. M.	National Book Depot, Kolkatta.
3	Pharmaceutical Jurisprudence & Ethics	Dr S. P Agarwal & Rajesh Khanna	Birla Publications Pvt. Ltd.
4	D & C Act 1940	Vijay Malik	Eastern Book Company.
5	Remington: The Science and Practice of Pharmacy & Pharmaceutical Sciences Vol. I, II & III,	Marie Abate BS, Steven R Abel.	Mack Publishing Company, U.S.A.
6	Latest issues of CIMS, MIMS, PDR, DDR		
7	Latest issues of IDMA Bulletin		
8	CPSCEA and ICMR Guidelines		
9	Drugs & Cosmetics Act 1940	Nilesh Gandhi	

3.5.2 V SEMESTER Pharmaceutical Technology-I (Theory)**45Hours
3 Hours/week**

- 1 Preformulation Studies:** Study on physical properties of drug: Physical form, particle size, shape, density, wetting, dielectric constant, solubility, dissolution and organoleptic properties and their effect on formulation, stability and bioavailability. 06 hrs
- 2 Tablets:** Classification and Formulation of different types of tablets, granulation technology on large-scale by various techniques, physics of tablets making, different types of tablet compression machinery and the equipments employed, evaluation of tablets. 08 hrs
Tablet coating: Types of coating, Sugar coating, film forming materials, formulation of coating solution, equipments for coating process, evaluation of coated tablet, stability kinetics and quality assurance. 05 hrs
- 3 Capsules:** Advantages and disadvantages of capsule dosage form, material for production of hard gelatin capsule, size of capsules, methods of capsule filling, soft gelatin capsule shell and capsule content, importance of base absorption and minimum/gm factors in soft capsule, manufacture, quality control, stability testing and storage of capsule dosage forms. 06 hrs
- 4 Liquid Dosage Forms:** Introduction, types of additives used in formulations, vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers, colorants, flavors and other excipients. Manufacturing, packaging and evaluation of clear liquids, suspensions and emulsions. 07 hrs
- 5 Semisolid Dosage Forms:** Definitions, types, mechanisms of drug penetration, factors influencing penetration, ointment and gel bases and their selection. General formulation of ointments, clear gels and manufacturing procedure, evaluation and packaging. 07 hrs
- 6 Packaging of Pharmaceutical Products:** Packaging components, types, specifications and methods of evaluation, stability aspects of packaging. Packaging equipments, factors influencing choice of containers, legal and other official requirements for containers and package testing. 06 hrs

- | | | |
|---|--|---|
| 1 | Manufacture of tablets** | <ul style="list-style-type: none"> a. Formulation of Compressed tablet-wet granulation b. Tablets prepared by direct compression c. Soluble tablet d. Chewable tablet |
| 2 | Formulation and filling of hard gelatin capsules** | <ul style="list-style-type: none"> a. Aspirin capsules |
| 3 | Evaluation of Solid dosage formulations (Q.C.tests)* | <ul style="list-style-type: none"> a. Tablets b. Capsules |
| 4 | Formulation of liquid oral preparations* and evaluation by assay** | <ul style="list-style-type: none"> a. Solution: Paracetamol syrup b. Antacid suspensions - Aluminum hydroxide gel |
| 5 | Preparation of Semisolids | <ul style="list-style-type: none"> a. Salicylic acid and benzoic acid ointment* b. Diclofenac sodium gel* |
| 6 | Tablet Coating | Demonstration |

Scheme of Practical Examination

1. Synopsis	- 10 Marks
2. Major experiment **	- 40 Marks
3. Minor experiment *	- 20 Marks
4. Viva-voce	- 10 Marks
Total	- 80 Marks

Reference Books (Latest edition)			
Sl.No.	Title	Authors	Publishers
1	Remington's The Science and Practice of Pharmacy (Vol I & II)	Marie Abate BS, Steven R Abel.	Lippincott Williams & Wilkins, Maryland USA.
2	Tutorial Pharmacy	J.W. Cooper & G. Gunn.	Petman Books Ltd., London.
3	Theory and Practice of Industrial Pharmacy	Lachman L., Lieberman H.A, Kanig J.L.	Lea & Febiger, Philadelphia, U.S.A.
4	Introduction to Pharmaceutical Dosage Forms	H.C. Ansel	Lea & Febiger, Philadelphia, U.S.A.
5	Drug Delivery Systems	R.L. Juliano	Oxford University Press, Oxford.
6	Modern Pharmaceutics	Banker GS, Rhode CT	Informa Healthcare, New York.
7	Pharmaceutical Dosage Forms: Tablets (Vol I-III)	Lieberman HA, Lachman L, Sachwartz JB	Marcel Dekker Inc., New York.

3.5.3	V SEMESTER	Pharmaceutical Biotechnology (Theory)	60 Hours 4 Hours/week
			Hours
1.	<u>Applied Microbial Technology:</u>		
	Definition, Scope and Applications of Biotechnology.		2 hrs
	Study of Important groups of microorganisms and their products.		2 hrs
	Screening, Isolation, Preservation and Strain improvement of important microorganisms.		3 hrs
	Large scale production of Ethanol, Penicillin, Streptomycin, Lactic acid, Citric acid, Vitamin B2, Vitamin B12 and Vitamin C.		5 hrs
2.	<u>Enzyme Technology:</u>		
	Sources and Applications of microbial enzymes.		2 hrs
	Production, isolation, purification and characterization of important enzymes such as Amylases, Proteases, Lipases, Pencillinase, Streptokinase and Hyaluronidase		3 hrs
	Biocatalysis : Types of Biocatalysis, Advantages and disadvantages		2 hrs
	Study of Immobilization techniques for enzymes, microbial and plant cells		1 hr
3.	<u>Bioprocess Technology:</u>		
	Overview of process development of biotechnological (fermentation) products.		2 hrs
	Steps and unit operations involved in Upstream and Downstream processing.		2 hrs
	Types of fermentors, design considerations, components, control of process parameters in a fermentor.		2 hrs
			2 hrs
4.	<u>Genetic engineering:</u>		
	Advantages and Applications of genetic engineering.		2 hrs
	Recombinant DNA technology and study of steps involved.		2 hrs
	PCR (Polymerase chain reaction) and its applications,		3 hrs
	Restriction digestion, cloning strategies, transformation and ligation.		2 hr
	Protein expression systems.		1 hr
	Bioinformatics and its applications.		
5.	<u>Biologics and Biopharmaceuticals:</u>		
	Definition, Classification of Biologics and Biopharmaceuticals with examples.		2 hrs
	Drug manufacturing process, formulation and quality assurance considerations.		2 hrs
	Study of biopharmaceuticals: Insulin, Human growth hormone, Hepatitis B surface antigen, Erythropoietin and Monoclonal antibodies		4 hrs
	Overview of Vaccines, Approaches for Vaccine design, preparation, standardization, formulation and storage.		3 hrs

6. Medicinal Plant Biotechnology and Animal Cell Technology:

Salient features and applications	1 hr
Techniques for cultivation of plant and animal cells	2 hrs
Biotechnological approaches for development and improvement of phyto-pharmaceuticals.	2 hrs
Protoplast fusion, Transgenic Plants and Transgenic Animals.	2 hrs

7. Nano Medicine and Nano Biotechnology:

Introduction, products and applications	3 hrs
General techniques	1 hr

3.5.3 Pharmaceutical Biotechnology (Practicals)

60 hrs

4 hrs/week

1. Study of Morphological, Microscopic features of bacteria, Fungi, yeasts and actinomycetes.
2. Isolation of any one specific group of bacteria.
3. Isolation of fungi and actinomycetes.
4. Production and purification of citric acid by *Aspergillus niger*.
5. Isolation and fermentation of an antibiotic producing microorganism
6. Antibiotic assay of *Pencillin* and *Streptomycin*.
7. Agarose gel Electrophoresis of DNA
8. Protein Gel electrophoresis (SDS PAGE)
9. Initiation of Callus culture
10. Isolation of DNA from Onion, Cauliflower and Bacteria
11. Quantitative Estimation of DNA
12. Immobilization of Enzymes

Reference Books (Latest edition)

1. Principles of Fermentation Technology by P F Stanbury and A Whitaker, Pergamon press.
2. Industrial Microbiology by A.H. Patel, Macmillan India Ltd.
3. Industrial Biotechnology by S.N. Jogdand, Himalaya Publishing House.
4. Comprehensive Biotechnology Vol I to IV, by M.Moo young. Pergamon Press.
5. Industrial Microbiology by L.E. Casida. New Age International (P) Ltd.
6. Biopharmaceuticals by Gary Walsch John Wiley and Sons Ltd.
7. Microbiology by Pelczar MJ Jr., Chan ECS and Kreig NR. Tata McGraw Hill.
8. Biotechnology: A Text Book of Industrial Microbiology by Crueger, Wulf. Crueger, Anneliese, Sinaeur Associates.
9. Industrial Microbiology, G Reed, Prescott and Dunn's, CBS Publishers.
10. Molecular Biotechnology by S.B. Primrose. Blackwell Scientific Publishers.
11. Plant Tissue Culture Theory and Applications Bhojwani SS and Razdan, Elsevier Publication.
12. Fundamentals of Immunology by W Paul, Lippincott. Williams and Wilkins.
13. Bioinformatics: Sequence and Genome Analysis by David W. Mount, CSHL Press.
14. Handbook of Enzyme Biotechnology by Allan Wiseman, PharmaMed Press.
15. Essential Bioinformatics: by Jin Xiong, Cambridge University Press.
16. Informatics in Proteomics by Sudhir Srivastava, CRC Publishers.
17. Biocatalysis: Fundamentals & Applications by Andreas S. Bommarius , Bettina R. Riebel., Wiley VCH.
18. Biochemical Engineering Fundamentals by Bailey JE and Ollis DF, McGraw-Hill.

Sl. No.	Content	No. of Hours
1.	Standardization of Phytopharmaceuticals	
	a. WHO guidelines for assessment of herbal medicine.	3
	b. Methods of standardization with special reference to HPLC and HPTLC.	7
2.	Definition, chemistry, classification and properties of alkaloids. Method of isolation of total alkaloids.	4
	Study of biological source, morphology, chemical constituents, chemical tests, uses, adulterants and substitutes for following drugs:	
	i. Pyridine - Piperidine : Areca nut, Lobelia.	2
	ii. Tropane : Belladonna, Hyoscyamus, Datura, Duboisia.	2
	iii. Quinoline and Isoquinoline : Cinchona, Ipecac, Opium.	2
	iv. Indole : Ergot, Rauwolfia, Catharanthus, Nux-vomica.	3
	v. Imidazole : Pilocarpus.	1
	vi. Steroid : Ashwagandha, Veratrum and Kurchi.	2
	vii. Alkaloidal amine : Ephedra and Colchicum.	2
	viii. Glycoalkaloid : Solanum sp	1
	ix. Purines : Tea, Coffee.	1
3.	Definition, chemistry, classification, properties, uses, method of isolation and analysis of carotenoids : α -carotenes, β -carotenes, Lycopene, Vitamin A, Xanthophylls.	8
4.	Definition, chemistry, classification, properties of Lignans and Quassinoids.	3
5.	Chemotaxonomy –Definition, Chemotaxonomic significance of flavonoids and alkaloids with suitable examples.	2
6.	Role of medicinal and aromatic plants in national economy.	2

1. Physical parameters for standardization of phytopharmaceuticals*
 - a. Determination of moisture content
 - b. Extractive values
 - c. Ash value
 - d. Swelling Index
2. Extraction of total alkaloids from Cinchona bark. **
3. Detection of alkaloids by chemical tests. *
4. TLC profile of Cinchona alkaloids.*
5. Extraction of Phytopharmaceuticals.**
 - i. Caffeine from Tea
 - ii. Lawsone from Henna
 - iii. Pectin from Orange peel
 - iv. Starch from Potatoes
 - v. Glycyrrhizin from Liquorice
6. Macroscopic evaluation of following drugs*:
Belladonna, Hyoscyamus, Ipecac, Ergot, Catharanthus, Kurchi, Ephedra and Colchicum.

Scheme of Practical Examination

1. Synopsis	10 Marks
2. Practical	
a. Major experiment**	35 Marks
b. Minor experiment*	25 Marks
3. Viva-voce	<u>10 Marks</u>
Total	80 Marks

Reference Books (Latest edition)

Sl.No.	Name of the Book	Author	Publisher
1	Text Book of Pharmacognosy	Kokate C.K., Purohit A.P and Gokhale S.P.	Nirali Prakashan, Pune.
2	Pharmacognosy	Trease G.E and Evans W.S.	Bailliere Tindall, Eastbourne, U.K.
3	Study of Crude Drugs	Iyengar M.A.	Manipal power press, Manipal.
4	Practical Pharmacognosy	Kokate C.K.	Vallabh Prakashan, Delhi.
5	The Practical Evaluation of Phytopharmaceuticals	Brain K.R and Turner T.D.	Wright-Sciotechnica, Bristol.
6	Phytochemical Methods	Harborne J.B.	Chapman and Hall, International Edition, London.
7	United State Pharmacopoeia	USP	US Pharmacopoeia convention Inc., Rockville, USA.
8	Natural Products – A Laboratory Guide	Raphael Ikan	Academic Press, New York, USA.
9	Plant Drug Analysis	Wagner H., Bladt S., Zagainski E.M.	Springer-Verlag, Berlin, London.
10	Quality control methods of Herbal drugs	Pulok K, Mukherjee	Business Horizons, New Delhi.
11	Quality control methods for medicinal plant materials	WHO	WHO, Geneva
12	The Chemotaxonomy of Plants	Smith P. M.	Edinburgh

3.5.5	V SEMESTER	Pharmacology –I (Theory)	60 Hours (4 Hours/week)
			Hours
1	General Pharmacology		
	Pharmacokinetics		12
	<ul style="list-style-type: none"> • Routes of drug administration. • Absorption of drugs. • Bioavailability: determination and factors influencing bioavailability. • Drug distribution: Blood flow, capillary permeability, binding of drugs to plasma proteins. • Volume of distribution: Compartments in the body, apparent volume of distribution. • Drug metabolism: Kinetics of metabolism, Types of drug metabolism. • Drug elimination: Renal elimination of a drug, quantitative aspects of renal drug elimination. • Kinetics of continuous drug administration. • Factors affecting ADME of a drug. 		
2	Pharmacodynamics		08
	<ul style="list-style-type: none"> • Receptor- Types, chemistry and interaction with drugs. • Dose response relationship - graded and quantal response. • Factors modifying drug action. 		
3	Adverse drug effects		3
	Type I and Type II reactions, side effects, intolerance and idiosyncrasy.		
4	Drugs acting on CNS		20
	Neurohumoral transmission in the CNS. Pharmacology of:		
	<ul style="list-style-type: none"> • General Anaesthetics. • Alcohols and disulfiram. • Sedatives, hypnotics, anxiolytics. • Psychotropic agents: anti-psychotics, antidepressants, antimaniacs and hallucinogens. • Anti-epileptics. • Analgesics, antipyretics, anti-inflammatory and anti-gout drugs. • Opioid agonists and antagonists. • Drug Addiction and Drug Abuse. • Drugs used in neurodegenerative diseases. 		
5	Drugs acting on ANS		15
	Drugs affecting synthesis, storage and release of neurotransmitters. Pharmacology of:		
	<ul style="list-style-type: none"> • Cholinomimetics. • Anti-cholinergics. • Adrenergics. • Anti-adrenergics. • Skeletal muscle relaxants 		
6	Local anaesthetics		2

Reference Books (Latest Edition)			
Sl.No	Name of the Book	Author	Publisher
01	Essentials of Medical Pharmacology	Tripathi KD	Jaypee brothers, New Delhi.
02	Pharmacology and Pharmacotherapeutics	Satoskar R.S., Bhandarkar K. S. Nirmala N Rege	Popular Prakashan, Mumbai.
03	Goodman and Gilman's The Pharmacological basis of therapeutics.	A Goodman Gilman, T.W. Rall, ALS. Nies, P. Taylor	McGraw – Hill, New Delhi.
04	Basic and Clinical Pharmacology	Katzung, B. G.	Prentice Hall, International. New Delhi.
05	Pharmacology	M. P. Rang, M.M. Dale, J.M. Riter	Churchill Livingstone, New Delhi.
06	Modern Pharmacology	C. R. Craig and R.E. Stitzel	Little, Brown and company, Boston.
07	Lippincott's Illustrated Reviews: Pharmacology	Mycek M. J,Harvey RA and Champe PC	Lippincott Williams & Wilkins. Philladelphia.

B. PHARM-VI SEMESTER

3.6.1	VI SEMESTER	Medicinal Chemistry –I (Theory)	60 Hours 4 Hours/Week
1.	a.	Basic principles of Medicinal Chemistry: Physico-Chemical aspects of drug molecule on biological activity, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Optical and Geometrical isomers and Bioisosterism.	10 hrs
	b.	Principles of Drug Design: Drug receptor interactions, QSAR: brief account of various descriptors (lipophilic, electronic, steric, and topological) and Free Wilson approaches. Fundamentals of computer aided drug design (CADD) and molecular modeling.	6 hrs
2.		History and development of the following classes of drugs: definition, classification with examples including structure and chemical name, SAR, MOA and Synthesis of underlined compounds.	
	A)	Drugs acting at synaptic & neuro-effector junction sites	7 hrs
		Adrenergic drugs:	
	a)	Adrenergic neurotransmitters: Biosynthesis & metabolism of Noradrenaline, adrenergic receptors	
	b)	Sympathomimetic agents: <u>Isoproterenol</u> , <u>Clonidine</u> , <u>Pseudoephedrine</u> , <u>Phenylpropanolamine</u> , <u>Naphazoline</u> , <u>Xylometazoline</u> .	
	c)	Adrenergic blocking agents: <u>Phenoxybenzamine</u> , <u>Prazosine</u> , <u>Propranolol</u> , <u>Metoprolol</u> .	
		Cholinergic drugs:	7 hrs
	a)	Biosynthesis and Metabolism of Acetyl choline, Cholinergic receptors, <u>Physostigmine</u> , Parathione.	
	b)	Cholinergic blocking agents: Atropine, Scopolamine, Methscopolamine, <u>Dicyclomine</u> , Propanthelene, Chlorphenoxamine, Mecamylamine, d- Tubocurarine chloride and Decamethonium bromide	
	B)	Histamine & Antihistamines	8 hrs
	a)	Histamine receptors	
	b)	Antihistaminic agents: H ₁ -antagonists: <u>Diphenhydramine</u> , Doxylamine, Tripeleminamine, Pyrilamine, <u>Pheniramine</u> , Chlorpheniramine, <u>Promethazine</u> , Trimeprazine, Cyclizine, <u>Meclizine</u> , Cyproheptadine	
	c)	H ₂ -antagonists: <u>Cimetidine</u> , <u>Ranitidine</u> .	
	d)	Gastric Proton Pump Inhibitors: Omeprazole and Rabepazole.	
	C)	Eicosanoids:	6 hrs
		Occurrence, chemical nature, biosynthesis and medicinal applications.	
	D)	Analgesic & anti-inflammatory agents:	10 hrs
		Morphine, Codeine, Nalorphine, Noscapine, Dextromethorphan, Modifications of Morphine. <u>Aspirin</u> , Sodium salicylate, <u>Mefenamic acid</u> , <u>Ibuprofen</u> , Piroxicam, Phenacetin, <u>Acetaminophen</u> , Antipyrine, <u>Diclofenac sodium</u> , <u>Aceclofenac</u> .	
	E)	Local anesthetics:	6 hrs
		Hexylcaine, Cyclomethycaine, Piperocaine, <u>Benzocaine</u> , <u>Procaine</u> , Procainamide, <u>Lidocaine</u> , Prilocaine, Dimethisoquin, Dibucaine.	

Reference Books (Latest edition)

1. Indian Pharmacopoeia, Ministry of Health & Family welfare, Govt. of India.
2. Burger's Medicinal Chemistry and Drug Discovery, John Willey and sons.
3. Wilson & Gisvolds Text Book of Organic, Medicinal and Pharmaceutical Chemistry, Lippincott Williams and Wilkins.
4. Willium O Foye's Principles of Medicinal Chemsitry, Lippincott Williams and Wilkins.
5. Martindale, The Extra Pharmacopoeia, Pharmaceutical Press, England.
6. Organic Chemistry Drug Synthesis, Lednicer and Mitscher, Publisher:John wiley and sons.
7. Cumulative Index of Medicinal Substances (CIMS).
8. Comprehensive Medicinal Chemistry by Hansch series (Vol I-VIII), Elesevier Press.

3.6.2	VI SEMESTER	Pharmacology –II (Theory)	45 Hours 3 Hours/week
			Hours
1	Drugs acting on cardiovascular system		15
	Pharmacology of:		
	<ul style="list-style-type: none"> • Antihypertensive agents. • Antianginal agents. • Antiarrhythmic agents. • Drugs in congestive heart failure. • Coagulants, anticoagulants and antiplatelet agents. • Thrombolytics and anti-fibrinolytics. • Hypolipidemics. • Plasma expanders. 		
2	Drugs acting on Urinary system		4
	Pharmacology of diuretics and anti-diuretics.		
3	Autacoids and their Antagonists		8
	Physiological role and pathological significance of histamine, prostaglandins, 5-HT, leukotrienes, PAF and kinins.		
	Pharmacology of:		
	<ul style="list-style-type: none"> • Anti-histaminics. • Anti-serotonergics. • Anti-PAF agents. 		
4	Drugs acting on Respiratory system		4
	Pharmacology of drugs used in Bronchial asthma, COPD and cough (expectorants, antitussives and mucolytics).		
5	Drugs acting on GIT		8
	Pharmacology of :		
	<ul style="list-style-type: none"> • Antacids, anti-secretory and other anti-ulcer drugs. • Laxatives and antidiarrheal drugs. • Emetics, antiemetics and prokinetics. • Digestants and carminatives. • Appetite stimulants and suppressants. 		
6	Drugs acting on Immune system		3
	Pharmacology of:		
	Immunostimulants, immunosuppressants and DMARDS		
7	Bioassay		3
	Introduction, types, principles, advantages and disadvantages of bioassay.		

1. Study of commonly used appliances in experimental Pharmacology.
2. Study of common laboratory animals, calculation of dosage and anaesthetics used in animals.
3. Preparation of different physiological salt solutions.
4. CPCSEA guidelines and functions of IAEC.
5. Study of different routes of administration of drugs in mice/rats - To study the effect of induction of sleeping time in mice using a hypnotic. *
6. To record the dose response curve of Acetylcholine using isolated guinea pig/ rat ileum preparation. **
7. To record the dose response curve of Histamine using isolated guinea pig/ rat ileum preparation.**
8. To study the effect of antagonist on the agonist response of Acetylcholine using rat ileum preparation.
9. Effect of autonomic drugs on rabbit's eye (Simulated experiment).*
10. Study of analgesics using hot plate apparatus (Simulated experiment).*
11. Study of locomotor activity (Simulated experiment).*

Scheme of Practical Examination

1. Identification.	10 Marks
2. Synopsis	10 Marks
3. Major Experiment **	30 Marks
4. Minor experiment *	20 Marks
5. Viva- voce	10 Marks
Total	80 Marks

Reference Books (Latest edition)			
Sl.No	Name of the Book	Author	Publisher
01	Essentials of Medical Pharmacology	Tripathi K.D.	Jaypee Brothers, New Delhi.
02	Pharmacology and Pharmacotherapeutics	Satoskar R.S., Bhandarkar K. S. Nirmala N Rege	Popular Prakashan, Mumbai.
03	Goodman and Gilman's The Pharmacological basis of therapeutics	A Goodman Gilman, T.W. Rall, ALS. Nies, P. Taylor	McGraw – Hill, New Delhi.
04	Basic and Clinical Pharmacology	Katzung, B. G.	Prentice Hall, International. New Delhi.
05	Pharmacology	M. P. Rang, M.M. Dale, J.M. Ritter	Churchill Livingstone, New Delhi.
06	Modern Pharmacology	C. R. Craig and R.E. Stitzel	Little, Brown and company, Boston.
07	Lippincott's Illustrated Reviews: Pharmacology	Mycek M. J, Harvey RA and Champe PC.	Lippincott Williams & Wilkins. Philladelphia.
08	Handbook of Experimental Pharmacology	S.K.Kulkarni	Vallabha Prakshan, New Delhi.

3.6.3	VI SEMESTER	Biopharmaceutics and Pharmacokinetics (Theory)	60 Hours 4 Hours/wk
1	Introduction to Biopharmaceutics and Pharmacokinetics: Role in product development and clinical setting.		04 hrs
2	Absorption : Fate of drug after administration, routes of drug administration, drug absorption, disposition, Factors involved and their mechanisms – detailed study on physicochemical, biological and dosage form considerations in drug absorption.		12 hrs
3	Drug distribution: Definition, distribution in blood and body fluids, cellular distribution, drug penetration to CNS, placental transfer of drugs and blood flow, factors affecting drug distribution, volume of distribution, plasma protein binding.		09 hrs
4	Metabolism of drugs: Definition, brief overview of Phase I and Phase II reactions. Factors affecting biotransformation.		05 hrs
5	Excretion of Drugs: Definition, renal and nonrenal excretion, Concept of clearance-Renal clearance, Organ clearance and Hepatic clearance.		05 hrs
6	Pharmacokinetics: Introduction, compartment models, blood level curves, pharmacokinetic parameters, biological half-life, apparent volume of distribution, renal clearance, absorption rate, Area Under Curve (AUC) - their significance, Kinetics of blood levels following IV, oral, single and repeated administrations.		10 hrs
7	Bioavailability and bioequivalence: a. Measures of bioavailability, C_{max} , T_{max} and AUC. b. Design of single dose bioequivalence study and relevant statistics. c. Review of regulatory requirements for condition of bioequivalent studies.		09 hrs
8	Dosage Regimen: Multiple dosing with respect to IV and oral route, concept of loading dose, maintenance dose and accumulation index.		06 hrs

3.6.3 VI SEMESTER Biopharmaceutics and Pharmacokinetics (Practicals)

60 Hours
04 Hours/ week

- 1 Comparison of dissolution studies of two different marketed products of Paracetamol tablets. **
- 2 Comparison of dissolution studies of two different marketed products of Diclofenac film coated tablets. **
- 3 Improvement of dissolution characteristics of slightly soluble drug Ibuprofen by solid dispersion technique - fusion method **
- 4 Improvement of dissolution characteristics of slightly soluble drug Ibuprofen by solid dispersion technique - solvent evaporation method **
- 5 Calculation of AUC by different methods
 - i. Trapezoidal
 - ii. Cut & Weigh
 - iii. Graphical method (Square counting)
- 6 Calculation on **K_a, K_e, t_{1/2}, C_{max}** .. 2 data
- 7 Calculation of AUC and bioequivalence from the given data. --2 data

Scheme of Practical Examination

- | | |
|------------------------|-------------------|
| 1. Synopsis | - 10 Marks |
| 2. Major experiment ** | - 40 Marks |
| 3. Minor experiment | - 20 Marks |
| 4. Viva-voce | - 10 Marks |
| Total | - 80 Marks |

Reference Books (Latest edition)			
Sl.No	Name of the Book	Author	Publisher
01	Biopharmaceutics and Clinical Pharmacokinetics	Milo Gibaldi.	Pharma book syndicate, Hyderabad.
02	Biopharmaceutics and Pharmacokinetics	A. Treatise, D. M. Brahmankar and Sunil B. Jaiswal.	Vallabh Prakashan, Delhi.
03	Applied Biopharmaceutics and Pharmacokinetics	Shargel. L. and Yu ABC.	Connecticut, Appleton Century Crofts, USA.
04	Text Book of Biopharmaceutics and Pharmacokinetics	Dr. Shobha Rani R. Hiremath	Prism Books Pvt Ltd, Bangalore.
05	Pharmacokinetics	Gibaldi.M, Perrier.D.	Marcel Dekker Inc., New York.
06	Current Concepts in Pharmaceutical Sciences: Biopharmaceutics	Swarbrick. J.	Lea And Febiger, Philadelphia.
07	Clinical Pharmacokinetics: Concepts and Applications	Malcolm Rowland and Thomas N. Tozer.	Lea And Febiger, Philadelphia.
08	Dissolution, Bioavailability and Bioequivalence	Abdou. H. M.	Mack Publishing company, Pensylvania.
09	Biopharmaceutics and Clinical Pharmacokinetics: An Introduction	Robert.E. Notari	Marcel Dekker Inc., New York.
10	Biopharmaceutics and relevant Pharmacokinetics	John G. Wagner and M.Pernarowski	Drug Intelligence Publications, Hamilton, Illinois.
11	Biopharmaceutics and Pharmacokinetics	V. Venkateshwarlu	Pharma book syndicate, Hyderabad.
12	Biopharmaceutics and Pharmacokinetics	P.L.Madan	Jaypee brothers, Medical Publisher Ltd. New Delhi.

3.6.4 VI SEMESTER

Pharmaceutical Management & Marketing (Theory)

60 Hours
4 Hours/week

1 Management

- a) Concepts of management. Principles of management 02hrs
- b) Primary functions of management-planning, organizing, directing and controlling. 03hrs
- c) Secondary functions of management- staffing, co-ordination, communication, motivation, leadership, decision-making and innovation. 04hrs
- d) Delegation of Authority and Responsibility. 02hrs
- e) Entrepreneurship development 01hr

2. Marketing:

- a) The meaning and scope of marketing. Marketing concepts 03hrs
- Pharmaceutical Market: Quantitative and qualitative aspects, size and composition of the market, demographic descriptions and socio-psychological characteristics of the consumer. 03hrs
- b) Market segmentation 03hrs
- c) Analyzing the market-Role of market research 03hrs
- d) Prescribing habits of the physicians; patient's choice of physician and retail pharmacist. 02hrs

3. The Pharmaceutical Product

- a) Marketing mix. Product classification, Product planning, Product differentiation, Product positioning, Me-too-products, Modification of existing product. Product life cycle (PLC), effects of different elements of marketing mix different stages of PLC. 06hrs
- b) New product development- All stages from the new product idea to the stage of marketing the developed product (bulk drugs and formulations) 03hrs
- c) Branding-concept of brand, different types of brand, importance of branding. Packaging. 03hrs

- | | |
|--|-------|
| 4. Pricing: | 04hrs |
| a) Price competition-Pricing, rate contracts. | 03hrs |
| b) Non-price competition-All types of non-price competition with special emphasis on competition through research and development and quality | |
| 5. Distribution: | |
| a) The wholesaler-His role in distribution of pharmaceutical services offered to the manufacturer and the retailer. Advantages and disadvantages of distribution through the wholesaler. | 03hrs |
| b) The retailer-Classification of retail institutions, advantages and disadvantages of retail institutions, the hospital as retail outlet. | 03hrs |
| 6. Promotion: | |
| a) Communication and its importance. | 01hr |
| b) Different ways of promotion-Advertising, direct mail, professional journals, sampling, medical exhibition, window display, public relations | 04hrs |
| c) Professional sales representative- duties of PSR, purpose of detailing, selection, training, compensation and future prospects of the PSR. | 04hrs |

Reference Books (Latest edition)			
Sl.No.	Name of the Book	Author	Publisher
1	Principles of Management	P.C.Tripathi, P.N.Reddy.	Tata McGrew Hill Publishing Company
2	Pharmaceutical Marketing in India	C. Subba Rao	Asian Institute of Pharmaceutical Marketing, Hyderabad.
3	Principles of Pharmaceutical Marketing	Mickey C Smith	CRS Publishers and Distributors, New Delhi.
4	Pharmaceutical Marketing in the 21 st Century,	Mickey C Smith	Viva Books Pvt. Ltd.
5	The Management Process	Davar R. S.	Progressive Corporation Pvt. Ltd.
6	Business Administration and Management	Saksena S. C.	Sahitya Bhavan Agra, UP.

Sl No.	Content	No. of Hours
1	Definition, chemistry, classification, properties and method of isolation of volatile oils.	3
	Study of biological source, morphology, chemical constituents, chemical tests, uses, adulterants and substitutes for following drugs: Coriander, Mentha, Cinnamon, Lavender, Lemon grass, Clove, Fennel, Nutmeg, Eucalyptus, Cardamom, Gaultheria, Musk, Palmarose, Sandalwood, Valerian.	7
2	Concepts of stereoisomerism with examples of natural products.	4
3	Marine Pharmacognosy- Definition, present status and classification of important bioactive agents including their chemistry and uses.	5
4	Plant bitters and sweeteners. Natural sweeteners and their role in health care.	2
5	Herbs as health foods – Minerals, Vitamins and Nutraceuticals.	3
6	Study of traditional drugs, common vernacular names, botanical sources, morphology, chemical nature of chief constituents, uses and marketed formulations of following indigenous drugs: Amla, Brahmi, Tulsi, Kantakari, Satavari, Bilwa, Rasna, Punarnava, Apamarg, Gokhru.	5
7	Study of two important plants each used in the management of cancer, diabetes, inflammation, liver disorder and hypertension.	7
8	Historical development of plant tissue culture, types of cultures, nutritional requirements, growth and their maintenance. Applications of plant tissue culture in Pharmacognosy.	5
9	Natural allergens <ul style="list-style-type: none"> a. Classification of allergens b. Preparation of allergenic extracts c. Sensitivity testing and treatment of allergy 	4

3.6.5 Advanced Pharmacognosy (Practicals)

60 Hours
4 Hours / week

1. Evaluation of Crude Drugs:
 - i. Volatile oil content of crude drug.
 - ii. Thin layer chromatography of amino acids.*
 - iii. Thin layer chromatography of Rhubarb Extract.*
 - iv. Estimation of Carvone in Caraway Oil.*
 - v. Estimation of Aldehydes in Lemon Oil.*
 - vi. Mucilage Content of Cinnamon.*
2. Quantitative microscopy (Lycopodium spore method).*
3. Determination of length and width of phloem fibres. **
4. Determination of diameter of starch grains. **
5. Determination of Vein islet number and Vein-let termination number of Senna, Datura.**
6. Determination of Palisade ratio of Senna leaf.*
7. Preparation and sterilization of media.
8. Initiation of callus- Beet, Carrot, Ginger (Demonstration).
9. Immobilization of enzymes and study of their activity.*
10. Quantitative estimation of DNA and RNA. **

Scheme of Practical Examination

1. Synopsis	10 Marks
2. Practical	
a. Major experiment**	35 Marks
b. Minor experiment*	25 Marks
3. Viva-voce	10 Marks
Total	80 Marks

Reference Books (Latest edition)

Sl.No	Name of the Book	Author	Publisher
1	Text Book of Pharmacognosy	Kokate C.K., Purohit A.P and Gokhale S.P.	Nirali Prakashan, Pune.
2	Text Book of Pharmacognosy	Trease G.E and Evans W.S.	Bailliere Tindall, Eastbourne, U.K.
3	Anatomy of Crude Drugs	Iyengar M.A and Nayak S.G.K.	Manipal Power Press, Manipal.
4	Practical Pharmacognosy	Kokate C.K.	Vallabh Prakashan, Delhi.
5	Pharmacopoeia of India	Govt. of India	Govt. of India, New Delhi.
6	The Wealth of India, raw Materials (All volumes)	CSIR	Council of scientific and industrial research, New Delhi.
7	Indian Herbal Pharmacopoeia	IHP	CDMA, Mumbai.
8	Quality control methods of Herbal drugs	Pulok K Mukherjee	Business Horizons, New Delhi.
9	Quality control methods for medicinal plant materials		WHO, Geneva.
10	Bioactive marine natural products	Bhakuni & Rawat	Springer, Berlin.
11	Handbook of Natural products data		Elsevier USA.
12	Challenges for Flavor and Food Industries	Lindsay, Willis B T	Elsevier applied science, USA.
13	Plant Tissue Culture	Dixon IRL	Oxford, Washington.

B. PHARM-VII SEMESTER

3.7.1	VII SEMESTER	Pharmacology -III (Theory)	45 Hours 3 Hours/week
			Hours
1	Chemotherapy	<ul style="list-style-type: none">• General Principles of Chemotherapy.• Sulphonamides and co-trimoxazole.• Antibiotics- Penicillins, Cephalosporins, Chloramphenicol and Macrolides,• Quinolones, Tetracyclines, Aminoglycosides and miscellaneous antibiotics.• Chemotherapy of tuberculosis, leprosy, fungal, viral, protozoal diseases, worm infestations, urinary tract infections, sexually transmitted diseases and AIDS.• Chemotherapy of malignancy.	25
2	Pharmacology of drugs acting on Endocrine system	<ul style="list-style-type: none">• Pituitary hormones.• Thyroid and anti-thyroid drugs.• Insulin and its analogues, Oral hypoglycemic agents.• Corticosteroids.• Gonadal hormones and their antagonists.• Oxytocics and tocolytics.• Oral contraceptives.	12
3	Concepts of gene therapy.		2
4	Toxicology	<ul style="list-style-type: none">• General principles in the management of poisoning.• Incidence, signs, symptoms and treatment of poisoning due to<ul style="list-style-type: none">➤ Opium alkaloids, barbiturates, benzodiazepines, organophosphorus compounds, antidepressants and paracetamol.➤ Heavy metals and heavy metal antagonists.	6

Pharmacology-III (Practicals)

60 Hours
(4 Hours/week)

1. To estimate the strength of the test sample of Acetylcholine using a suitable isolated muscle preparation by matching bioassay. **
2. To estimate the strength of the test sample of Histamine using a suitable isolated muscle preparation by matching bioassay. **
3. To estimate the strength of the test sample of Acetylcholine using a suitable isolated muscle preparation by interpolation bioassay. **
4. To estimate the strength of the test sample of Histamine using a suitable isolated muscle preparation by interpolation bioassay. **
5. To study the anticonvulsant activity by MES method in rats. *
6. To study the locomotor activity in rats by using Actophotometer. *
7. Effect of various drugs and electrolytes on isolated normal heart (**simulated experiment**). *
8. Effect of various drugs and electrolytes on isolated hypodynamic heart (**simulated experiment**). *
9. Effect of drugs on ciliary movement (**simulated experiment**). *
10. Effect of various drugs on BP, heart rate and respiration, vasomotor reversal etc. (dog and cat) (**simulated experiment**).*

Scheme of Practical Examination

1. Identification.	10 Marks
2. Synopsis	10 Marks
2. Major Experiment**	30 Marks
3. Minor experiment*	20 Marks
4. Viva-voce	10 Marks
Total -	80 Marks

Reference Books (Latest edition)

Sl.No	Name of the Book	Author	Publisher
01	Essentials of Medical Pharmacology	Tripathi KD	Jaypee brothers, New Delhi.
02	Pharmacology and Pharmacotherapeutics	Satoskar R.S., Bhandarkar K. S. Nirmala N Rege	Popular Prakashan., Mumbai.
03	Goodman and Gilman's The Pharmacological basis of therapeutics	A Goodman Gilman, T.W. Rall, ALS. Nies, P. Taylor	McGraw – Hill, New Delhi.
04	Basic and Clinical Pharmacology	Katzung, B. G.	Prentice Hall, International.
05	Pharmacology	M. P. Rang, M.M. Dale, J.M. Ritter.	Churchill Livingstone.
06	Modern Pharmacology	C. R. Craig and R.E. Stitzel	Little Brown and company.
07	Lippincott's Illustrated Reviews: Pharmacology	Mycek M. J,Harvey RA and Champe PC	Lippincott Williams & Wilkins.

3.7.2 VII SEMESTER Pharmaceutical Technology-II (Theory)

60 Hours

4 Hours/ week

- 1 Parenteral Products:** Definition, types, advantages and limitation. Additives used in the formulation of parenterals, production facilities and controls, layout of parenterals section, design, maintenance of aseptic area, service area and production area. Formulation of injections: Solutions, Emulsions, Suspensions, Powders and Implants. Containers, closures for sterile preparations. Pharmacopoeial Quality Control Tests. 14
- 2 Ophthalmic Preparations:** Requirements, formulation of eye drops, eye lotions and eye ointments; containers, closures, sterilization and evaluation. 06
- 3 Pharmaceutical Aerosols:** Definition, propellants, containers, valves and actuators. General formulation, manufacturing, quality control, packaging methods and pharmaceutical applications. 10
- 4 Cosmetology and Cosmetic Preparations:** Structure of skin, formulation of cold cream, vanishing cream, cleansing cream, all purpose cream, protective cream, antiperspirants, deodorants and face powder. Hair structure, Shampoos, Conditioners, Shaving and after shaving products, Dentrifice and Mouthwash, Lipsticks, Nail lacquer. 10
- 5 Blood Products and Plasma Substitutes:** Collection, processing and storage of whole blood, concentrated human blood cells, dried human plasma, extraction of plasma fractions and plasma substitutes (Manufacture of Dextran). 07
- 6 Surgical Products:** Definition, primary wound dressing, absorbent surgical cotton, surgical gauzes etc., bandages, adhesive tape, protective cellulosic haemostatic, official dressings, absorbable and non-absorbable sutures and ligatures. 10

- | | | |
|---|-------------------------------------|---|
| 1 | Manufacture of Parenterals ** | a. Ascorbic acid injection I.P.
b. Calcium gluconate injection I.P.
c. Ringers lactate injection (Ingredients based on milliequivalents)
d. Oily Phenol injection |
| 2 | Ophthalmic Preparations* | a. Ciprofloxacin eye drops
b. Diclofenac sodium eye drops |
| 3 | Cosmetic preparations* | a. Lipstick.
b. Cold cream and vanishing cream.
c. Clear liquid shampoo.
d. Tooth paste and tooth powder.
e. Face & Talcum powder. |
| 4 | Evaluation of Absorbent cotton wool | As per Indian Pharmacopoeia |

Scheme of Practical Examination

1. Synopsis	- 10 Marks
2. Major experiment**	- 40 Marks
3. Minor experiment*	- 20 Marks
4. Viva-voce	- 10 Marks
Total	- 80 Marks

Reference Books (Latest edition)			
Sl. No	Name of the Book	Author	Publisher
01	Remington: The Science and Practice of Pharmacy & Pharmaceutical Sciences Vol. I, II & III.	Marie Abate BS, Steven R Abel	Mack Publishing Company, U.S.A.
02	Pharmaceutical Dosage Form-Parenteral Medication	Lachmann and Liebermann	Marcel Dekker Inc., New York.
03	Introduction to Pharmaceutical Dosage Forms	H.C. Ansel	Lea & Febiger, Philadelphia, U.S.A.
04	Drug Delivery Systems	R.C. Juliano	Oxford University Press, Oxford.
05	Theory & Practice of Industrial Pharmacy	Herbert A. Liebermann & Leon Lachman	Lea & Febiger, Philadelphia, U.S.A.
06	Cosmetics: Science and Technology	Balsam and Sagarin	John Wiley & Sons.
07	Modern Cosmetics	Thomssen E.G.	Universal Publishing Corporation.
08	A Handbook of Cosmetics	Mittal B.M. & Saha R.N.	Vallabh Prakashan, New Delhi.
09	Cooper and Gunn's Dispensing for Pharmaceutical Students	Carter S.J.	CBS Publishers, New Delhi.

3.7.3	VII SEMESTER	Hospital Pharmacy (Theory)	60 Hours 04Hours/week
1	Hospital - its organisation and functions		04
2	Hospital Pharmacy-Organisation and management		
	a) Organizational structure-Staff, infrastructure & work load statistics		05
	b) Management of materials and finance		02
	c) Roles & responsibilities of hospital pharmacist		02
3	Budget – Preparation and implementation		02
4	Hospital drug policy		15
	a) Pharmacy and Therapeutic committee (PTC) .		
	b) Hospital formulary- contents, preparation and revision of hospital formulary.		
	c) Hospital committees- Infection committee, Research and ethical committee.		
	d) Developing therapeutic guidelines.		
	e) Hospital pharmacy communication – News letter.		
5	Hospital pharmacy services		20
	a) Procurement and warehousing of drugs and pharmaceuticals.		
	b) Inventory control-Definition, various methods of inventory control- ABC, VED, EOQ, Lead-time and Safety stock.		
	c) Drug distribution in the hospital		
	i) Individual prescription method		
	ii) Floor stock method		
	iii) Unit dose drug distribution method		
	iv) Outpatient dispensing and charging policy		
	d) Central sterile supply services – Role of pharmacist.		
	e) Total parenteral nutrition.		
6	Continuing professional development programs (CPD)		02
	Education and training		

- 7 Radiopharmaceuticals – Handling and packaging** 06
- a) Radioactive isotopes, production of radioactive pharmaceuticals,
 b) Methods of isotopic tagging, preparation of radioactive in laboratory using radiation dosimetry, permissible dose, level of hazards and prevention, Application of radiopharmaceuticals.
- 8 Research in Hospital Pharmacy.** 02

Reference Books (Latest edition)			
Sl.No	Name of the Book	Author	Publisher
01	Hospital Pharmacy	William E Hassan.	KM Varghese Company, Bombay.
02	A Text Book of Hospital Pharmacy	Merchant S H, Quadry J. S.	BS Shah Prakashan.
03	Remington The Science and Practice of Pharmacy, Vol: I and II	Alfonso R. Gennaro	Lippincott Williams.
04	Handbook of Pharmacy	Rabin J Harman	The Pharmaceutical Press.
05	Text Book of Hospital and Clinical Pharmacy	Pratiba Nand, R. K. Khar	Birla Publications, Delhi.

3.7.4	VII SEMESTER	Pharmacy Practice (Theory)	60Hours 04Hrs/wk
1	Introduction to clinical pharmacy: Definition, History and Development of clinical pharmacy, scope, study of daily activities of clinical pharmacist, medication chart review, clinical review and ward round participation. Adverse drug reaction management, medication history review, TDM, drug usage evaluations, drug product selection and patient medication counseling.		10
2	Drug information: Requirements for setting up of drug information center, types of resources, answering drug information query and documentation.		04
3	Patient data analysis: Interpretation of patient data in the evaluation of disease state and its importance, interpretation of laboratory test results of liver function tests, renal function tests, pulmonary function tests, haemogram, cardiac enzymes and electrolytes.		06
4	Pharmacovigilance: Epidemiology, classification, risk factors, monitoring and detecting adverse drug reactions, assessing causality using WHO scale and reporting adverse drug reactions with examples.		06
5	Drug use in special population: Pregnancy, geriatrics, paediatrics and breast-feeding, vulnerable population.		05
6	Pharmacoepidemiology: Definiton, types and application.		04
7	Pharmacoeconomics: Introduction, types, methods and application.		04
8	Concept of essential drugs and rational drug use.		04
9	Community Pharmacy Management		06
	i) Selection of site, space, layout and design		
	ii) Staff, Materials coding and stocking		
	iii) Legal requirements		
	iv) Maintenance of various registers		
	iv) Use of computers: Business and health care soft wares		
10	Patient counselling		05
	Definition, outcomes, various stages, barriers, strategies to overcome barriers. Patient information leaflets- content, design and layouts, advisory labels.		
11	Health screening services		
	Definition, importance, methods for screening blood pressure / blood sugar / lung function and cholesterol testing.		04

Reference Books (Latest Edition)			
Sl.No	Name of the Book	Author	Publisher
01	Clinical Pharmacy and Therapeutics	Roger and Walker	Churchill Livingstone.
02	Pharmacotherapy: A Pathophysiologic Approach	Joseph Dipiro et.al.	Appleton and Lange.
03	Remington: The Science and Practice of Pharmacy, Vol: I and II.	Alfonso R. Gennaro	Lippincott Williams.
04	Clinical Pharmacy and Therapeutics	Eric T Herfindal	Lippincott Williams & Wilkins.
05	Basic skills in interpreting laboratory data.	Scott LT	American Society of Health System Pharmacists Inc.
06	Applied Therapeutics: The clinical uses of drugs.	Koda Kimble MA et.al.	
09	Health Education and Community Pharmacy	Parmar N.S.	
10	Comprehensive Pharmacy Review	Leon Shargel.	Williams and Wilkins.
11	Clinical Pharmacy Practice : Basic Concepts and Essentials	Parthasarathi, Nyfort Hanson, Dilip Nahata.	Orient Longman, Chennai.
12	Practice Standards and Definitions		The Society of Hospital Pharmacists of Australia.

History and development of the following classes of drugs: Definition, classification with examples including structure and chemical name, SAR, MOA and synthesis of underlined compounds.

1. Central Nervous System Depressants

A. General Anaesthetics:

4 hrs

1. Inhalation anaesthetics: Halothane, Methoxy flurane, Nitrous oxide.
2. Ultra short acting barbiturates: Methohexital sodium, Thiopental sodium.
3. Dissociative anaesthetics: Ketamine hydrochloride.

B. Anxiolytic sedative and hypnotic agents:

6 hrs

1. Benzodiazepines: Chlordiazepoxide, Diazepam, Alprazolam.
2. Barbiturates:
 - a. Barbital, Methabarbital, Phenobarbital,
 - b. Amobarbital, Butabarbital.
 - c. Pentobarbital, Secobarbital.
3. Miscellaneous sedative hypnotics:
 - a. Amides and imides: Glutethimide, Methaqualone.
 - b. Alcohols and their carbamates: Ethchlorvynol, Ethinamate, Meprobamate.
 - c. Aldehydes and their derivatives: Chloral hydrate, Paraldehyde.

C. Skeletal muscle relaxants: Chlorphensin, Methocarbamol.

1 hr

D. Drugs used in spasticity: Baclofen.

1 hr

E. Anticonvulsants:

5 hrs

1. Barbiturates: Phenobarbitone.
2. Hydantoin: Phenytoin sodium, Ethytoin, Methenytoin.
4. Oxazolidine diones: Trimethadone^s, Paramethadone.
5. Succinimides: Phensuximides, Methsuximide, Ethosuximide.
6. Urea and monoacylureas: Phenacetamide, Carbamazepine.
7. Miscellaneous: Primidone^s Valproic acid.
8. Benzodiazepines: Clonazepam, Diazepam.

2. Cardiovascular Agents:

14 hrs

1. Antianginal agents and vasodilators: Amyl nitrate, Nitroglycerine, Isosorbide dinitrate.
2. Antiarrhythmic drugs and Calcium antagonists:

Class I- Membrane depressant drugs: Quinidine Procainamide, Phenytoin, Tocainide.

Class II- Beta adrenergic blocking agents: Propranolol.

Class III- Repolarization prolongators: Bretylium, Amiodarone.

Class IV- Calcium channel blockers: Diltiazem, Verapamil, Nifedepine, Amlodipine.

3. Antihypertensive agents:

Beta-blockers: Timolol, Atenolol.

ACE Inhibitors: Captopril, Enalapril, Losartan potassium.

α 1 – antagonist: Prazosin

α 2- agonist: Clonidine

Miscellaneous: Reserpine, Hydralazine, Minoxidil.

4. Antihyperlipidemic agents: Clofibrate, Lovastatin.

5. Anticoagulants: Dicoumarol, Warfarin, Phenindione.

3. Diuretics:

6 hrs

1. Carbonic anhydrase inhibitors: Acetazolamide, Methazolamide.

2. Thiazide and Thiazide like diuretics: Chlorthiazide, Benzthiazide, Xipamide

3. High-ceiling or loop diuretics: Furosemide, Ethacrynic acid.

4. Potassium sparing diuretics: Spironolactone, Triamterene, Amiloride.

5. Miscellaneous: Mannitol.

4. Steroids and related drugs:

5 hrs

Steroidal nomenclature and stereochemistry, androgens and anabolic agents, estrogens, progestational agents and adrenocorticoids.

5. Medicinal properties of organometallic complexes.

1 hr

6. Current trends in photodynamic therapy: History and development.

2 hrs

3.7.5 Medicinal Chemistry –II (Practicals)

**60 Hours
4 Hours/week**

1. Monograph analysis of Aspirin, Ascorbic acid, Paracetamol, Phenobarbitone, Isonicotinic acid hydrazide, Atropine, Ibuprofen, Analgin and Acetazolamide. **
2. Synthesis and characterization of the following drugs involving two or more steps and their spectral analysis: *
Chloramine-T, Dichloramine-T, Sulphacetamide, Phenytoin, Cinnamic acid, Barbituric acid, 7-hydroxy -4- methyl coumarin, Paracetamol and Benzocaine.

Scheme of Practical Examination

1. Synopsis	10 Marks
2. Major Experiment**	35 Marks
3. Minor Experiment*	25 Marks
4. Viva-voce	10 Marks
Total	80 Marks

Reference Books (Latest edition)

1. Indian Pharmacopoeia, Ministry of Health & Family welfare, Govt. of India.
2. Burger's Medicinal Chemistry and Drug Discovery, John Willey and sons.
3. Wilson & Gisvolds Text Book of Organic & Medicinal Chemistry, Lippincott Williams and Wilkins.
4. Willium O Foye's Principles of Medicinal Chemsitry, Lippincott Williams and Wilkins.
5. Martindale, The Extra Pharmacopoeia.
6. Organic Drug Synthesis, Lednicer and Mitscher, Publisher:John wiley and sons.
7. Vogel's Text Book of Practical Organic Chemistry.
8. Comprehensive Medicinal Chemistry by Hansch series (Vol I-VIII).Elisever Press.
9. Becket A.H. and Stanlake J.B., Practical Pharmaceutical Chemistry, Vol.I & II, CBS Publishers.

B. PHARM-VIII SEMESTER

3.8.1. VIII SEMESTER Instrumental Methods of Analysis (Theory) 60 Hours 4 Hours / week

The theoretical aspects, basic instrumentation and applications of the following analytical techniques should be discussed:

- 1. Ultraviolet and visible spectrophotometry:** Theory of electronic, atomic and molecular spectra. Beer and Lambert's law- derivation and deviations. Application of Beer's law to single component and multicomponent systems. Study of chromophores, auxochromes, bathochromic shift and hypsochromic shift. Hyperchromic effect and hypochromic effect. Effect of solvent and pH on absorption spectra. Instrumentation and working: Sources of radiation, monochromators, sample cells, Detectors – Phototube, Photomultiplier tube, Barrier layer cell and Silicon Photodiode. Applications of spectrophotometric titrations. 16 Hrs

- 2. Fluorimetry:** Theory, concept of singlet and triplet electronic states, internal and external conversions, intersystem crossing, factors affecting fluorescence, quenching. Instrumentation: fluorimeter, spectrofluorimeter and applications. 7 Hrs

- 3. Infrared spectrophotometry:** Basic principles, Instrumentation: working and sample handling methods, sources of radiation, monochromators, sample cells and detectors – Bolometers, thermocouples, Golay cells. Applications: IR frequency-structure correlation, study of characteristic fundamental stretching vibrations of functional groups like alcohol, carboxyl, amide, esters, amine, aldehyde, ketone, nitril and phenol. Interpretation of IR spectra. Introduction to FTIR- Diffuse Reflectance Spectroscopy (DRS) and Attenuated Total Reflectance (ATR). 12 Hrs

- 4. Flame Photometry & Atomic Absorption Spectroscopy (AAS) Theory:** Nebulization, Flames and flame temperature, interferences, instrumentation of AAS, qualitative and quantitative applications. 8 Hrs

- 5. Brief introduction including principle, basic instrumentation and application of the following:**
 - (i) **Nuclear Magnetic Resonance spectroscopy.** 6 Hrs
 - (ii) **Mass Spectrometry** 4 Hrs
 - (iii) **X -ray Diffraction** 4 Hrs
 - (iv) **Radio immunoassay** 3 Hrs

3.8.1 Instrumental Methods of Analysis (Practicals)

60 Hours
4 Hours/week

1. Quantitative estimation of formulations containing single drug or more than one drug using instrumental methods:
 - a. Estimation of quinine sulphate by fluorimetry. **
 - b. Study of quenching effect Ex: Quenching of quinine sulphate by iodide/chlorides ions. **
 - c. Determination of absorption maxima for a given solution of the drug.*
 - d. Effect of pH on absorption spectra of sulphanilamide. *
 - e. Effect of solvents on absorption spectra of phenol.*
 - f. Determination of the isobestic point for bromothymol blue.*
 - g. Colorimetric estimation of ferrous ions using 1, 10-phenanthroline. **
 - h. Colorimetric estimation of sulphanilamide using N-1-napthylethylenediamine hydrochloride. **
 - i. Assay of dextrose injection by colorimetry. **
 - j. UV Spectrophotometric determination of *
Ibuprofen tablets, Paracetamol tablets, Albendazole tablets and Aminophylline injection.
2. Estimation of Na⁺, K⁺ ions using flame photometry.
3. Interpretation of IR spectra of compounds with different functional groups (-COOH, -COOR, -CONHR, -NH₂, -NHR, -OH, etc.).

Scheme of Practical Examination

1. Synopsis	-- 10 Marks
2. Major Experiment**	-- 40 Marks
3. Minor Experiment *	-- 20 Marks
4. Viva-voce	-- 10 Marks
Total	-- 80 Marks

Reference Books (Latest edition)

1. Willard, Merritt, Dean and Settle, Instrumental Methods of Analysis, CBS Publications.
2. Skoog and West, Pharmaceutical Analysis, Cengage Learning.
3. A.I.Vogel, Text Book of Quantitative Chemical Analysis. ELBS Publications.
4. K.A.Connors, Text Book of Pharmaceutical Analysis. John Wiley Publications.
5. P.D.Sethi, Quantitative Analysis of Drugs in Pharmaceutical Formulations, CBS Publications.
6. I.P. 1996, Ministry of Health, Govt. of India.
7. British Pharmaceutical Codex.
8. Pharmaceutical Analysis I, II and III, Schrimmer, CRC Publications.

3.8.2 VIII SEMESTER Medicinal Chemistry III (Theory)

45Hours
3 Hours/week

1. Brief introduction and concepts of Prodrugs, Combinatorial chemistry and Microwave synthesis. 2 hrs

History and development of the following classes of drugs: Definition, classification with examples including structure and chemical name, SAR, MOA and synthesis of underlined compounds.
2. **Anti-infective agents:** Isopropyl alcohol, Chlorphenol, Hydrogen peroxide and Gention violet. 2 hrs
3. **Antifungal agents:** Griseofulvin, Clotrimazole, Miconazole, Tolnaftate, Fluconazole, Amphotericin-B and Nystatin 4 hrs
4. **Urinary tract anti-infective agents:** Nalidixic acid, Norfloxacin, Ciprofloxacin, 3 hrs
5. **Antitubercular agents:** PAS, INH, Ethambutol, Cycloserine and Rifampicin. 4 hrs
6. **Antiviral and antiretroviral agents:** Acyclovir, Idoxuridine and Azathymidine 4 hrs
7. **Antiprotozoal and Anthelmintics:** Albendazole, Metronidazole, Thiabendazole and Diethyl carbamazine. 3 hrs
8. **Sulphonamides:** Sulfamethizole, Sulfisoxazole, Sulfacetamide, Sulfamethoxazole, Trimethoprim, Sulfasalazine and Dapsone. 4 hrs
9. **Antimalarials:** Chloroquin, Pamaquin, Mepacrine, Cycloguanil and Artemisinin. 4 hrs
10. **Antibiotics:**
 - Penicillins* - Penicillin G, Penicillin V, Cloxacillin, Ampicillin, Amoxycillin and Clavulanic acid. 2 hrs
 - Cephalosporins* - Cefachlor, Cefalexin, Cefixime and Cefapyridine. 2 hrs
 - Tetracyclines* - Chlortetracycline, Oxytetracycline and Doxycycline. 2 hrs
11. **Antineoplastic agents:** Cyclophosphamide, Chlorambucil, Mercaptopurine, 5- Fluorouracil, Cisplatin, Etoposide and Taxol. 5 hrs
12. **Hypoglycaemic agents:** Insulin and its derivatives, Metformin, Gliclazide, Resiglitazone 2 hrs
13. **Thyroid and Antithyroid agents:** Thyroxin, Thyronine, Propyl thiouracil and Carbimazole. 2 hrs

3.8.2 Medicinal Chemistry –III (Practicals)

60 Hours
4 Hours/week

I. Assay (Major Experiment)

1. Sulphadiazine by diazotization.
2. Chloroquine by nonaqueous titration
3. Ascorbic acid by Iodimetry.
4. Isonicotinic acid by KBrO₃ (bromimetry)
5. Benzyl penicillin by Iodometry
6. Dapsone by diazotization.

II. Preparation and Characterization (by conventional /microwave) (Minor Experiment)

1. PAS from p-nitro salicylic acid.
2. Fluorescein from Phthalic anhydride.
3. Phenothiazine from Diphenylamine
4. Sulphanilamide from Acetanilide.
5. INH from Isonicotinic acid.
6. Chlorobutanol

Scheme of Practical Examination

1. Synopsis	10 Marks
2. Major Experiment	35 Marks
3. Minor Experiment	25 Marks
4. Viva-voce	10 Marks
Total	80 Marks

Reference Books (Latest edition)

1. Indian Pharmacopoeia, Ministry of Health & Family welfare, Govt. of India.
2. Burger's Medicinal Chemistry and Drug Discovery, John Willey and sons.
3. Wilson & Gisvolds Text Book of Organic & Medicinal Chemistry, Lippincott Williams and Wilkins.
4. Willium O Foye's Principles of Medicinal Chemsitry, Lippincott Williams and Wilkins.
5. Vogel's Text Book of Practical Organic Chemistry.
6. Organic Drug Synthesis, Lednicer and Mitscher, Publisher : John wiley and sons.
7. Comprehensive Medicinal Chemistry by Hansch series (Vol I-VIII), Elisever Press.
8. Becket A.H.& Stanlake J.B., Practical Pharmaceutical Chemistry, Vol.I & II, CBS Publishers.
9. Microwave synthesis for organic synthesis by C.Oliver Kappe by Wiley VCH.

3.8.3	VIII SEMESTER	Advanced Pharmaceutics (Theory)	60 Hours 4 Hours/week
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1	Quality Assurance: Organization and personnel: Responsibilities, Training and Hygiene.	03
2	Introduction to concepts of TQM, cGMP and GLP	03
3	Manufacturing documents, Standard operating procedures, Master formula records, Batch Manufacturing record, Quality audits of manufacturing processes for Tablets and Parenterals.	08
4	Quality systems: Objectives and guidelines of USFDA, ICH and Introduction to ISO series.	04
5	WHO certification, Patents, Globalization of drug industry (GATT & WTO), Introduction to EXIM policy. Introduction to consumer and environmental protection act.	08
6	Design and Study on process validation and equipment validation of autoclave and dissolution apparatus.	04
7	Theory of controlled release drug delivery systems, release and diffusion of drugs from controlled DDS. General methods of design and evaluation.	10
8	Microencapsulation: Methods, kinetics of drug release from microcapsules technology and applications.	05
9	Transdermal Drug Delivery Systems: Theory, formulation and evaluation.	04
10	Advances in drug delivery systems: Definition, advantages, disadvantages, types, components and applications to Buccal, Nasal and Ocular delivery.	05
11	Concept, method and application of drug targeting for Nanoparticles, Liposomes and Erythrocytes.	06

Reference Books (Latest edition)			
Sl.No	Name of the Book	Author	Publisher
01	Good Laboratory Practice Regulations	S. Weinberg	Marcel and Dekker, New York.
02	Validation of Aseptic Pharmaceutical Processes	F.J Carleton & J.P Agalloco	Marcel and Dekker, New York.
03	Pharmaceutical Process Validation.	J.R. Berry and R.A. Nash	Marcel and Dekker, New York.
04	Understanding ISO 9000 and Implementing the basics to Quality.	D.H. Stamatis	Marcel and Dekker, New York.
05	“How to practice GMPs”	P.P. Sharma	Vandana Publications, New Delhi.
06	Pharmaceutical Quality Assurance.	Manohar A. Potdar	Nirali Prakashan, Mumbai.
07	Quality Assurance of Pharmaceuticals- A compendium of Guidelines and Related materials.		WHO, Geneva.
08	Introduction to ISO 9000 and Total Quality Management	Shdhan K. G	Oxford Publications, Calcutta.
09	SOP Guidelines, 2nd Ed.	D. H. Shah	Business Horizon.
10	Novel Drug Delivery Systems	Yie W. Chien	Marcel Dekker Inc., New York.
11	Controlled Drug Delivery Systems	J.R Robinson & Vincent H. Lee	Marcel Dekker Inc., New York.
12	Sustained & Controlled Drug Delivery Systems	J.R Robinson	Marcel Dekker Inc., New York.
13	Advances in Controlled & Novel Drug Delivery Systems	N.K.Jain	Vallabh Prakashan, New Delhi.
14	Microencapsulation	J.R Nixon	Marcel Dekker Inc., New York.

3.8.4**Industrial Pharmacognosy (Theory)****45 hours
3 hrs / week**

Sl. No.	Content	No. of Hrs
1.	World-wide trade in medicinal plants and derived products with special reference to Diosgenin (Dioscorea), Taxol (Taxus sp.) Digitoxin (Digitalis), Atropine (Datura), Quinine (Cinchona), Vincristine (Vinca), Glycyrrhizin (Liquorice), Ginsenosides (Ginseng), Aloin (Aloe).	7
2.	A brief account of plant based industries and institutions involved in the study of medicinal and aromatic plants in India.	2
	Industrial production and Utilization of phytoconstituents such as Curcuminoids, Gymnemic acid, Guggulosterone.	3
3.	Role of marker compounds in the evaluation of herbal drugs with special reference to HPLC and HPTLC.	4
4.	Conservation of medicinal plants. Different techniques involved in conservation of medicinal plants with their advantages and disadvantages	5
5.	Plant growth hormones and their applications.	3
	Study of Polyploidy, Mutation and Hybridization with reference to medicinal plants.	5
6.	Herbal drug development:	
	a. Methods involved in monoherbal and polyherbal formulations with their merits and demerits.	2
	b. Quality control of herbal formulations.	2
7.	Raw materials used in herbal cosmetics:	4
	i. Shampoo- Soap nut, Hibiscus.	
	ii. Hair colorants- Amla , Henna.	
	iii. Skin care- Aloe vera, Turmeric.	
8.	Introduction to Indian and International Patent laws and Trade Related Intellectual Property rights (TRIPs) related to natural products.	4
9.	Chemical and Spectral approaches to simple molecules of natural origin. Atropine, Beta-sitosterol, Lycopene, Quercetin, Rutin, Andrographolide.	4

3.8.4 Industrial Pharmacognosy (Practicals)

60 Hours
4 Hours /week

1. Spectroscopic estimation of phytoconstituents*
 - a. Estimation of Quinine sulphate by florimetry
 - b. Estimation of Caffeine by spectrophotometry
 - c. Estimation of Glycyrrhizin by spectrophotometry
 - d. Estimation of Ephedrine by colorimetry
2. Isolation of Phytopharmaceuticals: **
 - i. Curcumin from Turmeric
 - ii. Piperine from Pepper
 - iii. Nicotine picrate from Tobacco
 - iv. Oleo-resin from Ginger
 - v. Hesperidin from Orange peel
3. Preparation of Herbal Shampoos*
4. Estimation of Capsaicin in fruits of Capsicum annum using HPLC
5. Demonstration of Column chromatography
6. Project work (Collection of medicinal and aromatic plants, Preparation of herbarium sheets and monograph on one of the collected plants)

Scheme of Practical Examination

1. Synopsis	10 Marks
2. Practical	
a. Major experiment**	35 Marks
b. Minor experiment*	25 Marks
3. Viva-voce	10 Marks
Total	80 Marks

Reference Books (Latest edition)

Sl.No.	Name of the Book	Author	Publisher
1	Text Book of Pharmacognosy	Kokate C.K., Purohit A.P and Gokhale S.P	Nirali Prakashan, Pune.
2	Text Book of Pharmacognosy	Trease G.E and Evans W.S.	Bailliere Tindall, Eastbourne, U.K.
3	Medicinal Plants of India	Govt. of India	ICMR, New Delhi
4	The Wealth of India, Raw Materials (All volumes)	CSIR	Council of scientific and industrial research, New Delhi.
5	Modern Method of Plant Analysis	Peach and Tracey M. V.	Springer, Berlin.
6	Herbal Drug Industry	Choudhary R. D.	Eastern Publisher, New Delhi.
7	Indian Herbal Pharmacopeia	IHP	CDMA, Mumbai.
8	Quality Control Methods of Herbal Drugs	Pulok V Mukherjee	Business Horizons, New Delhi.
9	Quality Control Methods for Medicinal Plant Materials	WHO	WHO, Geneva.
10	Standardization of Botanicals	V. Rajpal	Eastern Publishers New Delhi.

3.8.5 VIII SEMESTER Pharmacotherapeutics (Theory)**60 hours
4 hours/ week**

1. Basic Principles of Pharmacotherapy	1 h
Individualization of drug therapy	1 h
Pharmacokinetic consideration	
Pharmacodynamic consideration	
Other factors that affect therapeutic outcomes	2 h
Approach to individualization therapy	1 h
Drug regulation and development	2 h
Adverse drug reactions and drug toxicity	2 h
Factors affecting drug therapy outcomes	1 h
2. Drug induced diseases	1 h
3. Brief introduction, definition, classification (type), epidemiology, etiology, clinical manifestations, investigations, complications, diagnosis of disease and drug treatment includes pharmacotherapy and non-pharmacotherapy such as desired outcomes, overall goal of the therapy, treatment algorithm, first line treatment, treatment in concomitant conditions liked renal failure, asthma, dislipidemia, anemia, clinical monitoring and patient care (patient education and life style modification) of the following system/diseases:	
1. Cardiovascular System: Hyperlipidemias, hypertension, congestive heart failure, ischemic heart diseases, cardiac arrhythmias.	7 h
2. Neuropsychiatry: CNS Disorders: Epilepsy, Parkinsonism.	3 h
3. Pulmonary disorders: Asthma, COPD.	3 h
4. Endocrine disorders: Diabetes mellitus, Thyroid disease.	3 h
5. Infectious Diseases: Tuberculosis, Malaria, Urinary tract infections, Gastroenteritis, Pneumonia, upper respiratory tract infections.	10 h
6. Joint and musculoskeletal: Rheumatic arthritis, SLE.	3 h
7. Hematological disorders: Anemia, drug induced hematological disorders.	3 h
8. Neoplasm: Acute leukemia and Hodgkin's disease.	3 h
9. GIT: Peptic ulcer and ulcerative colitis.	3 h
10. Liver: Hepatitis, Cirrhosis.	2 h
11. Dermatological Disorders: Acne, Psoriasis, Eczema.	4 h
12. Common ocular disorders and infections. Glaucoma	1 h
13. Immunology: HIV	2 h
14. Nutrition: Enteral nutrition, Parenteral nutrition	2 h

Reference Books (Latest Edition)

Sl.No	Name of the Book	Author	Publisher
01	Clinical Pharmacy and Therapeutics	Editors: Roger Walker and Clive Edwards	M/s Churchill Livingstone, Edinburgh
02	Hand Book of Applied Therapeutics	Mary Anne Koda-Kimble, Lloyd Young, Wayne AK, B.Joseph Guglieolmo.	M/s Lippincott Williams and Wilkins.
03	Pharmacotherapy: A Pathophysiological Approach.	Joseph T Dipiro, Robert L Talbert, Gray Cyee, Gary R Matzke, Barbara G Wells, Michael Fosey.	M/s Appleton and Lange.
04	Clinical Pharmacy and Therapeutics	Eric T Herfindal and Dick R, Gourley	Linda Lloyd Hart. M/s Williams and Wilkins.
05	Clinical Pharmacy	Dr Tipnis and Dr Amrita Bajaj.	M/s Career publisher, Nasik. Maharashtra.
06	Pharmacology and Pharmacotherapeutics	Satoskar RS, Bhandarkar SD, Nirmal N Rage	Popular Prakashan, Mumbai.
07	Goodman and Gilman's The Pharmacological basis of therapeutics	A Goodman Gilman, T.W. Rall, ALS. Nies, P. Taylor	McGraw – Hill, New Delhi.
08	Encyclopedia of Clinical Pharmacy	Joseph T Dipiro	Marcel Dekkar Inc. USA.