

SECTION 1
GOALS OF EDUCATION AND TRAINING IN PHARMACEUTICAL SCIENCES OF
RAJIV GANDHI UNIVERSITY OF HEALTH SCIENCES, KARNATAKA.

The pharmacy curriculum shall be oriented towards educating student of B.Pharm course to:

1. Imbibe the concept of better patient health care at every face of Health related activities.
2. Should be capable of functioning independently in both rural and urban environment.
3. Appraise fellow professionals in Hospitals, Community and Industry of newer developments in pharmacy.
4. Be a part of National & International sponsored health education programmes.
5. Educate the community about disease prevention measures, community hygiene and better health.
6. Inculcate critical thinking, clarity of expression, independent thinking and scientific temperament.
7. Encourage active learning methods like group discussions, Seminars, peer interactions etc., which would enable students to develop discipline, personality, communicating skills, and other qualities, which are necessary.
8. Be able to produce and market dosage forms and be responsible in minimizing the pollution hazards, by using proper scientific and logical techniques.

Regular periodic assessment shall be done throughout the course. Examinations shall be designed with a view to assess not merely the knowledge but also practical skills, habits and values which are necessary for a pharmacy graduate to carry out the professional obligations competently.

Towards achieving these goals every pharmacy College should:

- Evolve institutional objectives, which would be in consonance with the national goals and health policies.
- Shift the role of pharmacy teachers from merely imparting knowledge to that of facilitator and motivator of student learning.
- Establish an institution for faculty development, preparation of learning resource materials and for improving evaluation methods.
- Encourage and facilitate for industry-Academic interaction.

SECTION II

AIMS AND OBJECTIVES OF B.PHARM COURSE

Aims:

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 and Patient counseling and professional information exchange with Physicians and other paramedics. The graduates are required to acquire an in-depth knowledge of formulation, 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 of State and Central government. The graduate is also required to detail the physicians and community' and market the medicinal agents for diagnosis, prevention and therapeutic purposes. The pharmacist should act as bridge between Physicians and Patients and strive for better healthcare.

Objectives:

The objectives are covered under three headings namely:

- (a) Knowledge and understanding
- (b) Skills and
- (c) Attitude

a) KNOWLEDGE & UNDERSTANDING

The graduate should acquire the following during their four year B Pharm course

1. Adequate knowledge and scientific information regarding basic principles of Pharmaceutical chemistry, Pharmaceutics including cosmetics, Pharmacology/ and Pharmacognosy including Herbal drugs
2. Adequate knowledge of practical aspects of synthesis, formulation and analysis of various pharmaceutical and Herbal medicinal agents
3. Adequate knowledge of practical aspects of delivering a quality assured product as per pharmacopoeia, WHO and ISO standards
4. Adequate knowledge of practical aspects of pharmacological screening, standardization biological and *in-vivo* drug interactions.
5. Adequate knowledge of clinical studies for patient counseling leading to physical and social well being of patients.
6. Adequate knowledge of practical aspects of product detailing and marketing of Pharmaceutical products.

b) SKILLS

A graduate should be able to demonstrate the following skills necessary for practice of a pharmacy.

1. Able to synthesize, purify, identify and analyze medicinal agents.
2. Able to formulate, store, dispense, analyze the prescriptions and / or manufacture the medicinal agents at commercial level.
3. Able to learn and apply the quality assurance principles including legal and ethical aspects involving drugs.
4. Able to extract, purify, identify and know the therapeutic value of herbal / crude / natural products.
5. Able to screen various medicinal agents using animal models for pharmacological activity.

C) ATTITUDES

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

1. Willing to apply the current knowledge of pharmacy in the best interest of patients and the community.
2. Maintain a high standard of professional ethics in discharging professional obligations.
3. Continuously upgrade professional information and be conversant with latest advances in Pharmacy field to serve the community better.
4. Willing to participate in continuing education programmes of PCI and AICTE to upgrade knowledge and professionals skills.
5. To help and to participate in the implementation of National Health programs.

Section III

REGULATIONS

I. Minimum qualification for admission to the course

1. Candidates who have passed two year P.U.C. examination of Karnataka P.U.C. Board or an equivalent examination of any other approved Board or university with not less than **40%** marks in any combination comprising P.C.M. or P.C.B. or PCMB or PC and Computer Science(PCCS) or PC and Electronics(PCE) or PC and Information Science or PC and Biotechnology.

Note: In respect of candidates who have taken P.C.M.B. combination the aggregate of P.C.M. or P.C.B. whichever is higher shall be considered for the purpose of admission.

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 an equivalent examination of any other approved Board or university in any combination comprising P.C.M. or P.C.B. or PCMB or PC and Computer Science(PCCS) or PC and Electronics(PCE) or PC and Information Science or PC and Biotechnology.
 3. Candidates who have passed D.Pharm course approved by Pharmacy Council of India shall also be eligible to this course and shall be admitted directly to II B.Pharm course 10% over and above the sanctioned intake and shall have to study Mathematics, Computer Sciences & Statistics of I B.Pharm in addition to the II B.Pharm subjects.
- Vide Notification: UA/SYN/ORD/B.PHARM/148/2003-04 dated 31.08.2005.

II. Age:

Minimum age for entry to I- B.Pharm course shall be 17 years as on 31st December of that year.

III. Duration of the course

The course of study for B.Pharm shall extend over a period of four academic years and three academic years for those admitted to second B.Pharm directly. The curricula and syllabii for the course shall be prescribed from time to time.

IV. Medium of Instruction and Examinations

Medium of Instruction and Examination shall be English.

V. Attendance and Progress

A candidate is required to put in atleast 80% attendance in theory and practical subjects separately in a recognized institution approved by and affiliated to Rajiv Gandhi University of Health Sciences, Karnataka. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

VI. Course of study

The course of study for B.Pharm I,II,III and IV year shall include the respective Theory & Practical subjects as given in table- I,II,III and IV respectively. The number of hours to be devoted to each Theory and Practical subject in an academic year shall not be less than that shown in table.

VII. Approval of institution conducting the course of study

The regular course for B.Pharm I,II,III & IV year under clause V shall be conducted by an institution approved by All India Council for Technical Education, **Pharmacy Council of India** and affiliated to Rajiv Gandhi University of Health Sciences, Karnataka. The approval and affiliation will be granted only if adequate arrangements for teaching-infrastructure facilities, accommodation, equipments, chemicals, glassware, and library, teaching and non-teaching staff are provided as required under the norms of Rajiv Gandhi University of Health Sciences, Karnataka.

VIII. Academic Work

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

Internal Assessment Marks:

- A. Theory:** Three sessional examinations evenly spread during the academic year shall be conducted by the affiliated colleges. The average marks of the best two examinations shall be computed out of a maximum of 30 marks and shall constitute the sessional award in theory. Provided further the colleges 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, the portion prescribed shall be the entire syllabus of the subject.
- B. Practical:** Students are expected to perform the number of experiments listed in the respective syllabus. The number of experiments are also listed. Marks shall be awarded out of a maximum of 10 to each of the practical exercise and an average of those shall be computed out of maximum of 10 marks. In addition, three practical sessional examinations evenly spread during each academic year shall be conducted. The average marks of the best two practical examinations shall be computed out of a maximum of 20 marks. A total of 30 marks shall constitute the sessional award in practical. While awarding the sessional marks for practical experiments, the following considerations should be taken into account.
1. Preparation of the candidate.
 2. Manipulative skills.
 3. Results of the experiment.
 4. Knowledge of the experiment.
 5. Viva voce pertaining to the experiments only.

The college shall maintain the sessional 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 in an institution imparting the course shall be maintained for each student in the institution. Marks shall be awarded as per the schemes given in tables.

IX. Examinations

There shall be four examinations namely, First year, Second year, Third year and Final year B.Pharm examination. The details regarding the duration of papers, maximum marks for each paper including the sessional marks allotted to each subject is given in tables.

X. Criteria for pass

- a) Candidates who have secured a minimum of 50% marks in the Theory (including sessionals) and Practical (including sessionals) 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.
- b) Theory and Practical of a particular subject are considered as individual subjects for the purpose of pass criteria.

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

- a) Out of seven subjects to be studied at I.B.pharm course, there shall be an examination conducted by the college in respect of the following three subjects.
 - 1. Mathematics theory.
 - 2. Biology theory and practical.
 - 3. Computer Science & Statistics for the candidates admitted on PUC/12th Standard/ Equivalent qualifications and for the candidates admitted to II.B.Pharm, admitted on the basis of D.Pharm.
- 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) Candidates of I B.Pharm are permitted to carryover all the failed subjects to II B.Pharm and appear for II B.Pharm examination concurrently along with failed subjects of I B.Pharm. However, these candidates have to pass all the failed subjects of I B.Pharm to become eligible to proceed to III B Pharm.
- d) Similarly, candidates of II B.Pharm who have completely passed all the subjects of I B.Pharm but have failed in II B.Pharm are permitted to carryover all the failed subjects of II B.pharm to III B.Pharm and appear for III B.Pharm concurrently along with failed subjects

of II B.Pharm. However, these candidates have to pass all the failed subjects of II B.Pharm to become eligible to proceed to IV B.Pharm.

e) Candidates of III B.Pharm who have completely passed all the subjects of II B.Pharm but have failed in III B.Pharm are permitted to carryover all the failed subjects of III B.Pharm and appear for IV B.Pharm examination concurrently along with failed subjects of III B.Pharm.

f) The final B.Pharm candidates can appear for all the subjects of IV B.Pharm along with the failed subjects of III B.Pharm. However they have to pass all the subjects of III B.Pharm before the announcement of IV B.Pharm results.

g) However in case of In-service candidates (those who are Registered Pharmacists and have put in minimum of 5 years working experience in either Government or Private sector), they are permitted to take admission into final year B.Pharm even if he/she is having a carryover of II year and III year B.Pharm subjects but he/she cannot appear for final B.Pharm examination till he/she passes all the subjects of II year B.Pharm.

h) A candidate who has passed in all the subjects of IV B.Pharm will be eligible for the award of B.Pharm Degree, provided he/she has passed in all the III B.Pharm subjects also in the case of carryover and he/she has satisfactorily completed the practical training as mentioned under clause XIII.

XII. Improvement of sessional marks

Candidates who wish to improve the sessional marks only in theory subjects can do so by appearing in the special resessional examinations conducted by the college. A minimum of two and maximum of three sessional examinations shall be conducted by the college out of which the average marks of the best two of the three special resessional examination 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 resessional examination are less than regular sessional examination, the Head of the Institution shall forward the marks whichever is higher (Resessional/Regular Sessional). The resessional/regular sessional marks shall be sent to the University at least 15 days prior to the next university examination.

XIII. Declaration of Class

Class shall be awarded at the end of I, II, III and final year 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%

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 Introductory Biology and Introductory Mathematics by the RGUHS Karnataka, Bangalore.

Note: The carryover facility; full carryover till final year but has to pass all subjects before taking final year Notification syn/ORD-B.Pharma/739/2004-05 dated 04-03-2005. This is applicable for OS/RS/RS2 batch of i.e. admitted up to 2003-04.

XIV. Every candidate shall undergo practical training in Pharmaceutical Manufacturing House/ Approved Hospital/ CSIR research labs for a period of not less than one hundred and fifty hours to be covered in not less than 45 days after completing III B.Pharm or IV B.Pharm course.

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 Institution.

XV. Industrial Tour

Candidates studying in final year of the course shall visit several Pharmaceutical manufacturing houses as a supplement to their academic training and submit a report to the satisfaction of the Head of the institution where he/she has studied.

XVI. Duration of the course: Maximum duration to complete the course shall be EIGHT years from the year of admission.

XVII. Tutorials to be fixed at one hour per batch per subject.

XVIII. Award of Ranks

Ranks and Medals shall be awarded on the basis of aggregate of all the four university examinations of Rajiv Gandhi University of Health Sciences, Karnataka, Bangalore. 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, for the award of Ranks.

XIX. Award of Degree

Candidates who fulfill the requirements mentioned in X(h) and XIII will be eligible for award of degree during the ensuing convocation.

XX. Migration & Transfer:

For Guidelines see PCI letter 12:07:84 PCI 662-2/87 dated: 12:06:2001/ applicable from 12:06:2001 onwards only.

Both colleges should be recognized by PCI. Total intake including transfer not to exceed 5% of sanctioned intake.

Scheme of Study and Examination for B. Pharm Course

Table V: Scheme of Study and Examination for First Year B. Pharm Course

Subject with code No.	THEORY					PRACTICALS				
	No. of Papers	Duration of examination (Hrs)	Sessional Maximum Marks	Max. Marks for written papers	Total Marks	Duration of examination (Hrs)	Sessional Maximum Marks	Max. Marks for practical papers	Total Marks	Grand Total
1.1 Human Anatomy & Physiology	1	03	30	70	100	04	30	70	100	200
1.2 Pharmaceutics	1	03	30	70	100	04	30	70	100	200
1.3 Pharmacognosy-I	1	03	30	70	100	04	30	70	100	200
1.4 Pharmaceutical Organic Chemistry – I	1	03	30	70	100	04	30	70	100	200
1.5 Pharmaceutical Inorganic Chemistry	1	03	30	70	100	04	30	70	100	200
1.6 Mathematics*	1	03	30	70	100	No Practicals				
Or Biology*	1	03	30	70	100	04	30	70	100	
1.7 Computer Science & Statistics*	1	03	30	70	100	04	30	70	100	
1.8 Kannada	1	03	30	70	100	No Practicals				
1.9 Indian Constitution	1	03	30	70	100	No Practicals				

Total: Theory 500; Practicals 500; Grand Total 1000

Table VI: Scheme of Study and Examination for Second Year B. Pharm Course

Subject with code No.	THEORY					PRACTICALS				
	No. of Papers	Duration of examination (Hrs)	Sessional Maximum Marks	Max. Marks for written papers	Total Marks	Duration of examination (Hrs)	Sessional Maximum Marks	Max. Marks for practical papers	Total Marks	Grand Total
2.1 Physical Pharmaceutics	1	03	30	70	100	04	30	70	100	200
2.2 Pharmaceutical Microbiology & Biotechnology	1	03	30	70	100	04	30	70	100	200
2.3 Pathophysiology	1	03	30	70	100	No Practicals				100
2.4 Applied Biochemistry	1	03	30	70	100	04	30	70	100	200
2.5 Pharmaceutical Organic Chemistry-II	1	03	30	70	100	04	30	70	100	200
2.6 Environmental Science	1	03	30	70	100	No Practicals				

Total: Theory 500; Practicals 400; Grand Total 900

Table VII: Scheme of Study and Examination for Third Year B. Pharm Course

Subject with code No.	THEORY					PRACTICALS				
	No. of Papers	Duration of examination (Hrs)	Sessional Maximum Marks	Max. Marks for written papers	Total Marks	Duration of examination (Hrs)	Sessional Maximum Marks	Max. Marks for practical papers	Total Marks	Grand Total
3.1 Medicinal Chemistry – I	1	03	30	70	100	04	30	70	100	200
3.2 Pharmaceutical Jurisprudence & Ethics	1	03	30	70	100	No Practicals				100
3.3 Pharmacognosy & Phytochemistry	1	03	30	70	100	04	30	70	100	200
3.4 Pharmaceutical Engineering	1	03	30	70	100	04	30	70	100	200
3.5 Pharmacology	1	03	30	70	100	04	30	70	100	200
3.6 Pharmaceutical Marketing	1	03	30	70	100	No Practicals				100

Total: Theory 600; Practicals 400; Grand Total 1000

Table VII: Scheme of Study and Examination for Fourth Year B. Pharm Course

Subject with code No.	THEORY					PRACTICALS				
	No. of Papers	Duration of examination (Hrs)	Sessional Maximum Marks	Max. Marks for written papers	Total Marks	Duration of examination (Hrs)	Sessional Maximum Marks	Max. Marks for practical papers	Total Marks	Grand Total
4.1 Pharmaceutical Technology & Biopharmaceutics	1	03	30	70	100	04	30	70	100	200
4.2 Instrumental & Biomedical Analysis	1	03	30	70	100	04	30	70	100	200
4.3 Pharmacology & Toxicology	1	03	30	70	100	04	30	70	100	200
4.4 Medicinal Chemistry-II	1	03	30	70	100	04	30	70	100	200
4.5 Industrial Pharmacognosy	1	03	30	70	100	04	30	70	100	200
4.6 Advanced Industrial Pharmacy	1	03	30	70	100	No Practicals				100

Total: Theory 600; Practicals 500; Grand Total 1100

I B. PHARM SYLLABUS

1.1 HUMAN ANATOMY AND PHYSIOLOGY (THEORY) 75 Hours

(3Hrs/wk)

Scope and Objectives: This course is designed to impart a fundamental knowledge on the structure and functions of the human body. It also helps in understanding both homeostasis mechanisms and homeostatic imbalances of various body systems

Upon completion of the course the student shall be able to:

1. Describe the structure (gross and histology) and functions of various organs of the human body;
2. Describe the various homeostatic mechanisms and their imbalances of various systems;
3. Identify the various tissues and organs of the different systems of the human body;
4. Perform the hematological tests and also record blood pressure, heart rate, pulse and respiratory volumes;
5. Appreciate coordinated working pattern of different organs of each system; and
6. Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body

Sl. No.	Course Contents	No. of Hours	Marks
1.	i) Scope of Anatomy & Physiology ii) Basic Terminologies Used: Directional Terminologies, Plains & Sections and Body Cavities	01	02
2.	i) Structure of The Cell: Structure & Function of Plasma Membrane, Cell Cycle and Transport of Substances across Cell Membrane	01	02-05
3.	i) Definition, Classification of Tissues, Location, Characteristics and Function of Epithelial, Connective, Muscular & Nervous Tissues ii) Definitions of Malignant & Benign Tumors	02	05-10
4.	i) Osseous System: Structure & Composition of Bone ii) Functions of Skeleton iii) Classification of Joints iv) Definition of Disorders: Osteoporosis, Arthritis, Rickets & Gout	02	05-10

5.	Haemopoietic System <ul style="list-style-type: none"> i) Composition & Functions of Blood ii) Haemopoiesis iii) Blood Grouping iv) Mechanisms of Blood Clotting v) Definitions of Disorders: Anaemias, Polycythaemia, Leukopenia, Leukocytosis, Leukaemia, Thrombocytopenia & Haemophilia 	06	10-15
6.	Lymphatic System <ul style="list-style-type: none"> i) Composition, Formation, Circulation & Functions of Lymph ii) Structure & Functions of Lymph Node, Spleen and Thymus Gland iii) Definitions of Disorders: Lymphoedema, Elephantiasis & Splenomegaly 	03	02-05
7.	Cardiovascular System <ul style="list-style-type: none"> i) Anatomy of Heart ii) Structure of Blood Vessels iii) Circulation: Pulmonary, Systemic (Coronary & Portal) iv) Conduction System of the Heart, Cardiac Cycle & ECG v) Blood Pressure: Mechanism of regulation, Factors determining Blood Pressure vi) Definitions of Disorders: Congestive Heart Failure, Cardiac Arrhythmias, Angina Pectoris, Myocardial Infarction, Atherosclerosis, Rheumatic Heart Disease, Hypertension & Hypotension 	09	10-15
8.	Respiratory System <ul style="list-style-type: none"> i) Anatomy & Functions of Respiratory Organs ii) Mechanisms of regulation of Respiration iii) Transport of Respiratory Gases iv) Definitions of Lung Volume & Capacities, Hypoxia and Resuscitation v) Definitions of Disorders: Asthma, COPD, Tuberculosis & Pneumonia 	05	05-10
9.	Digestive System <ul style="list-style-type: none"> i) Anatomy & Functions of Salivary Gland, Stomach, Intestine, Liver, Gall Bladder and Pancreas ii) Digestion & Absorption iii) Definitions of Disorders: Peptic Ulcer, Constipation, Diarrhea, Emesis, Liver Cirrhosis, Hepatitis, Anorexia & GERD 	06	05-10

10.	Nervous Systems i) Classification of Nervous System ii) Meninges & Cerebrospinal Fluid iii) Functional Areas of Brain: Cerebrum, Cerebellum, Pons & Medulla, Thalamus & Hypothalamus and Basal Ganglia iv) Spinal Cord: Structure & Reflexes v) Cranial Nerves & their Functions vi) Autonomic Nervous System: Anatomy & Functions of Sympathetic and Parasympathetic Nervous System vii) Somatic Nervous System viii) Definitions of Disorders: Epilepsy, Parkinson's Disease, Depression, Insomnia, Anxiety, Schizophrenia, Migraine & Alzheimer's Disease	12	10-15
11.	Urinary System i) Parts of Urinary System: Structure & Functions of Kidney and Structure of Nephron ii) Mechanism of Urine Formation & Acid-Base Balance iii) Micturition Reflex & Renal Function Test iv) Definitions of Disorders: Renal Calculi, Cystitis, Glomerulonephritis Renal Fibrosis & Urinary Incontinence	05	05-10
12.	Endocrine System Structure, Secretions & Functions of i) Hypothalamus & Pituitary Gland ii) Thyroid & Parathyroid Gland iii) Adrenal Gland iv) Pancreatic Islets v) Definitions of Disorders: Hypothyroidism, Hyperthyroidism, Cushing's Syndrome, Addison's Disease, Diabetes Mellitus, Pheochromocytoma, Gigantism, Acromegaly, Diabetes insipidus & Dwarfism	04	05-10
13.	Reproductive System i) Structure, Functions & Hormones of Male & Female Reproductive System ii) Physiology of Menstruation, Spermatogenesis & Oogenesis iii) Pregnancy & its maintenance and Parturition iv) Definitions of Disorders: Infertility, Polycystic Ovarian Disease, Erectile Dysfunction & AIDS	05	05-10

14.	Sense Organs Structure and Functioning of i) Eye ii) Ear iii) Skin iv) Taste & Smell v) Definitions of Disorders: Glaucoma, Cataract, Conjunctivitis, Psoriasis & Tinnitus	06	05-10
15.	Skeletal Muscles i) Physiology of Muscle Contraction ii) Neuro-muscular Junction iii) Properties of Skeletal Muscles iv) Muscles in Exercise v) Definitions of Disorders: Muscular Dystrophy, Myasthenia Gravis	03	02-05

HUMAN ANATOMY AND PHYSIOLOGY (PRACTICALS) 75 Hours
(3Hrs/wk)

1. Determination of Hemoglobin content of Blood**
2. Determination of R.B.C. count of Blood**
3. Determination of W.B.C. count of Blood**
4. Determination of Differential W.B.C count of Blood**
5. Determination of Blood Groups*
6. Determination of Erythrocyte Sedimentation Rate (ESR)*
7. Recording of Human Body Temperature*
8. Recording of Human Heart Rate & Pulse Rate*
9. Determination of Blood Pressure & To study the effect of Posture & Exercise on Blood Pressure*
10. Determination of Bleeding time & Clotting time*
11. Determination of Vital Capacity*
12. Understanding of ECG: PQRST Waves & its Significance*
13. Study of various Models & Specimens of Vital organs & Systems*
14. Study of Skeleton & Bones*
15. Study of Histology slides of different tissues/organs*
16. Study of different Family Planning Appliances*
17. Understanding of Pregnancy Diagnosis Tests*

**** (Major experiment) * (Minor experiment)**

SCHEME OF EXAMINATION

1. Identification	-	10 Marks
2. Synopsis	-	10 Marks
3. Major Experiment	-	25 Marks
4. Minor Experiment	-	15 Marks
5. Viva	-	10 Marks

Total	-	70 Marks
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TEXT BOOKS

1. Anne Waugh and Allison Grant, "Ross and Wilson Anatomy and Physiology in Health and Illness", Churchill Livingstone – Edinburgh, 11th edition, 2010.
2. C.C. Chatterjee, "Human Physiology (Vol. I & II)", Medical Allied Agency – Calcutta, 11th edition, 1985.
3. Sujit K. Chaudhuri, "Concise Medical Physiology", New Central Book Agency – Calcutta, 6th edition, 2008.
4. Thakaore Bhai, P. Gandhi and Harit R. Derasari, "Elements of Human Anatomy Physiology and Health Education", B.S. Shah Publishers - Ahmedabad, 4th edition 1991.
5. R.K. Goyal and N.M. Patel, "Practical Anatomy Physiology and Biochemistry", B.S. Shah Prakashan - Ahmedabad, 11th edition 2008.

REFERENCE BOOKS

1. Gerard J. Tortora and Bryan H. Derrickson, "Principles of Anatomy and Physiology", John-Wiley & Sons - New York, 13th edition, 2012.
2. Douglas E. Kelly, Richard L. Wood and Allen C. Enders, "Bailey's Text Book of Microscopic Anatomy", Williams & Wilkins Publishers - London, 18th edition, 1984.
3. Inderbir Singh, "Text Book of Human Histology with Colour Atlas", Jaypee Brothers Medical Publishers - New Delhi, 6th edition, 2011.

LIST OF MINIMUM EQUIPMENT REQUIRED

(For a batch of 20 students)

1. Compound Microscopes with oil immersion lens	20 no's
2. Haemocytometers	20 no's
3. Sahli's Haemometers	20 no's
4. Glass Slides	80 no's
5. Westergren's ESR apparatus	05 no's
6. Clinical Thermometers	05 no's
7. Sphygmomanometers	05 no's
8. Stethoscopes	05 no's
9. Hutchinson's Spirometer	01 no's

10. Permanent slides for various tissues & organs (One pair for each tissue /organ)
11. Specimens for various organs (One specimen for each organ)
12. Models for various organs & systems (One model for each organ system)
13. Skeleton & Bones (One set of skeleton and one spare set of bones)
14. Family planning appliances (One set)

1.2 PHARMACEUTICS (THEORY)

50 Hours

(2Hrs/wk)

1. **Historical background** and development of profession of pharmacy. **Development of Indian pharmacopoeia** and introduction to other pharmacopoeias such as B.P, U.S.P, European pharmacopoeia, Extra pharmacopoeia and Indian National Formulary. **4 hours; 7 marks**
2. **Weights and measures:** Different types of weights and measures, modern methods of weighing, errors in weighing. Calculations involving percentage of solutions, allegation method, proof spirit, isotonic solutions. **4 hours; 7 marks**
 - a) **Prescription:** Definition, parts of prescription, handling and sources of errors.
 - b) **Posology:** Definition, factors affecting dose selection, calculation of child and infant doses.
 - c) **Incompatibility:** Introduction to physical and chemical incompatibility. Discussion of therapeutic incompatibility with examples. **5 hours; 9 marks**
3. **Introduction to dosage forms:** classification and definitions. Theoretical aspects including commonly used vehicles, essential adjuvants like stabilizers, colorants and flavourants with relevance to monophasic liquid dosage forms. **6 hours 11 marks**
4. **Biphasic liquid dosage forms:**
 1. **Suspensions:** Definition, classification, advantages and disadvantages. Study of diffusible and in-diffusible solids, flocculated and deflocculated suspension. Settling in suspension, discussion on wetting, controlled flocculation and flocculation in structured vehicles.
 2. **Emulsions:** Definition, classification and identification of types of emulsion, mechanism of action of emulsifying agents, theories of emulsification. Formulation of emulsion; stability of emulsions. **8 hours; 14 marks**
5. **Powders and granules:** Classification, advantages and disadvantages and method of mixing of powders. Preparation of simple powders, compound powders, insufflations, dusting powders, Eutectic powders. Study of effervescent granules. **4 hours; 7 marks**
6. **Semi solid dosage forms:** Definition, types, semi-solid bases, their selection. Formulation of semi solids such as ointments, creams, pastes, gels, suppositories, packaging, and their evaluation. **8 hours; 14 marks**

7. **Galenicals:** Definition of infusion, decoction and expression. Detailed study of maceration and percolation and Soxhlet extraction. **4 hours; 7 marks**
8. **Surgical Aids:** Study of surgical dressings namely bandages, absorbent cotton and POP. Definition and types of surgical sutures and ligatures. Manufacturing, standardization and sterilization of surgical catgut. **4 hours; 7 marks**
9. **Radiopharmaceuticals:** Uses in diagnosis and treatment, methods of preparations, handling and safety precautions. **3 hours; 6 marks**

PHARMACEUTICS (PRACTICALS)
(3Hrs/wk)

75 hours

1. **Syrups:**
 - a) Simple syrup IP. *
 - b) Syrup of ephedrine hydrochloride NF.*
2. **Elixirs:**
 - a) Piperazine citrate elixir BP.*
 - b) Paracetamol paediatric elixir BPC.*
3. **Linctuses:**
 - a) Simple linctus BPC.*
 - b) Paediatric compound tolu linctus*
4. **Solutions:**
 - a) Solution of cresol with soap IP. **
 - b) Lugols solution.*
 - c) Strong solution of ammonium acetate. **
5. **Galenicals:**
 - a) Tincture of benzoin*
 - b) Spirit of camphor USP*
6. **Gargle:**
 - a) Potassium chlorate gargle.*
7. **Mouth wash:**
 - a) Antiseptic mouth wash.*
8. **Enema:**
 - a) Glycerin enema*

9. Liniments:

- a) Liniment of turpentine IP.**
- b) Liniment of camphor BPC.**

10. Lotions:

- a) Calamine lotion IP.**
- b) Benzyl benzoate lotion USP.*

11. Suspensions:

- a) Magnesium hydroxide mixture BP.**
- b) Preparation of deflocculated and flocculated suspensions and their evaluation.**

12. Emulsions:

- a) Cod liver oil emulsion.**
- b) Liquid paraffin emulsion. Preparation and evaluation**

13. Powders:

- a) Eutectic powder.*
- b) Dusting powder.*
- c) Effervescent granules.**

14. Semi solids:

- a) Simple ointment.*
- b) Zinc and Salicylic acid paste.*
- c) Diclofenac gel.**
- d) Boric acid suppository.**
- e) Lactic acid pessaries.**

**** (Major experiment) * (Minor experiment)**

SCHEME OF EXAMINATION

1. Synopsis	-10 Marks
2. Major experiment (indicated by **)	-30 Marks
3. Minor experiment (indicated by *)	-20 Marks
4. Viva voce	-10 Marks

Total

=70 Marks

PHARMACEUTICS REFERENCE BOOKS

1. Aulton ME. Pharmaceutics, The science of dosage form design. 2nd ed. Edinburgh:Churchill Livingstone;2002.
2. Bharat S. Pharmaceutics. New Delhi:Dorling Kindersley (India) Pvt Ltd;2013.
3. British Pharmacopoeia (BP), United States Pharmacopoeia (USP), Extra Pharmacopoeia, Merck Index, and British Pharmaceutical Codex (BPC).
4. Carter SJ. Cooper and Cooper and Gunn's Dispensing for pharmaceutical students. 12th ed. New Delhi:CBS Publishers;2000.
5. Carter SJ. Cooper and Gunn's Tutorial pharmacy. 6th ed. New Delhi:CBS Publishers;2000.
6. Gennaro AL. Remington: The science and practice of pharmacy, Vol I and II. 20th ed. Philadelphia:Lippincott Williams and Wilkns;2000.
7. Indian Pharmacopoeia. Delhi:The Controller of Publications;1966, 1977, 1985, 1996, 2007.
8. Loyd VA, Nicholas GP, Howard CA. Ansel's pharmaceutical dosage forms and drug delivery systems. 8th ed. Noida: BI Publications Pvt Ltd;2005.
9. Mehta RM. Dispensing Pharmacy. Delhi:Vallabh Prakashan;2013.
10. Mehta RM. Pharmaceutics I. Delhi:Vallabh Prakashan;2014.
11. Mitchell JS, Howard CA. Pharmaceutical calculations. 10th ed. New Delhi:BI Waverley Pvt Ltd;1996.
12. Rawlins EA. Bentley's textbook of pharmaceutics. 8th ed. New Delhi:Reed Elsevier India Pvt Ltd;2010.
13. Subrahmanyam CVS. Textbook of physical pharmaceutics. 2nd ed. Delhi:Vallabh Prakashan;2003.

LIST OF MINIMUM EQUIPMENTS REQUIRED

- | | | |
|----|---------------------|---------|
| 1. | Electronic balances | 02 no's |
| 2. | Homogeniser | 02 no's |
| 3. | Mechanical stirrers | 10 no's |
| 4. | Oven | 01 no |
| 5. | pH meter | 01 no |
| 6. | Suppository moulds | 20 no's |

1.3 PHARMACOGNOSY (THEORY)**50 Hours****(2Hrs/wk)**

1. Definition, History and Scope of Pharmacognosy.	2 h (5 marks)
2. Plant Taxonomy: Study of the following families with special reference to medicinally important plants - Apocynaceae, Solanaceae, Umbelliferae, Leguminosae, Rubiaceae, Liliaceae.	3 h (5 marks)
3. Classification of Crude drugs: Alphabetical, Morphological, Chemical, Pharmacological and Taxonomical methods. General aspects of Chemotaxonomy	5 h (5 marks)
4. Medicinal Plants Cultivation: a) Cultivation, collection, Processing and storage of crude drugs: Factors influencing the cultivation of medicinal plants. b) Detailed method of cultivation for the following drugs: i) Senna ii) Isapgol iii) Opium, iv) Cinchona v) Clove c) Conservation of medicinal plants.	8 h (15 marks)
5. Study of Natural Pesticides: Pyrethrum, Neem and Tobacco	2 h (2 marks)
6. Study of different types of adulteration in crude drugs with examples.	2 h (5 marks)
7. Brief study of various plant constituents and ergastic cell inclusions	2 h (4 marks)
8. Study of morphology and microscopy of different plant parts with the specific examples given below: i. Leaf: Datura, ii. Bark: Cinnamon (Cassia), iii. Rhizome: Ginger, iv. Stem: Ephedra, v. Root: Rauwolfia, i. Wood: Quassia, vii. Flower: Clove viii. Fruit: Fennel, ix Seed: Nux-Vomica	10 h (17 marks)
9. Carbohydrates: Biological source, method of production, chemical constituents, identification tests and uses of the following carbohydrates and related products i) Isapgol, ii) Guar gum, iii) Honey, iv) Acacia, v) Agar, vi) Tragacanth, vii) Pectin viii) Sterculia gum	5 h (9 marks)
10. Lipids: Biological source, method of production, chemical constituents, identification tests and uses of the following oils and fats i) Castor oil, ii) Cod liver oil, iii) Chaulmoogra oil, iv) wool fat, v) Bees wax vi) Kokum butter, vii) Olive oil , viii) Linseed oil	5 h (10 marks)

11. Resins: a) Natural occurrence, properties, classification and method of production of Resins b) Sources, diagnostic characters, active constituents and uses of: (i) Podophyllum (ii) Ginger (iii) Benzoin (iv) Asafoetida (v) Myrrh	4 h (9 marks)
12. Study of plant and animal fibers: Cotton, Wool, Jute, Silk, Hemp	2 h (4 marks)

PHARMACOGNOSY (PRACTICALS)

(3hrs/wk) 50hours

1. General morphological study of different parts of the plants*

- a) Leaf: Datura
- b) Bark: Cinnamon (Cassia),
- c) Rhizome: Ginger,
- d) Stem: Ephedra
- e) Root: Rauwolfia,
- f) Wood: Quassia
- g) Flower: Clove
- h) Fruit: Fennel,
- i) Seed: Nux Vomica

2. Transverse section of the drugs mentioned in 1**

3. Chemical tests for the identification of following drugs and their adulterants

- a) Acacia b) Agar c) Tragacanth d) Honey

4. Chemical tests for the identification of following oils and fats and their adulterants

- a) Castor oil b) Cod Liver oil c) Wool fat d) Bee's wax

5. Chemical tests for the identification of following resins and their adulterants

- a) Asafoetida b) Benzoin c) Myrrh

SCHEME OF EXAMINATION

1. Synopsis	10 marks
2. Major Experiment T S**	25 marks
3. Minor Experiment* Morphology	10 marks
4. Minor experiment* Chemical Test	15 marks
5. Viva-Voce	10 marks
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Total	70 marks
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REFERENCE BOOKS

1. Evans W.C., 2002. Trease and Evans Pharmacognosy, 15th ed. Elsevier Science Ltd, Philadelphia.
2. Kokate C.K., Purohit A.R and Gokhale S.B., 2010. Pharmacognosy 45th ed. Nirali Prakashan, Pune.
3. Shah B.S and Qadry J.S., 2005. Pharmacognosy, 12th ed. BS Shah Prakashan, Ahmedabad.
4. Wallis T.E., 1985. Textbook of Pharmacognosy, 5th ed. J.A., Churchill Limited, London.
5. Biren Shah N and Seth A.K., 2010. Text Book of Pharmacognosy and Phytochemistry, 1st ed. A Division of Reed Elsevier India Private Ltd, New Delhi.
6. Yoganarsimhan S.N., 2000. Cultivation of Medicinal & Aromatic Crops, 1st ed. Interline Publishing Private Ltd, Bangalore.
7. The Wealth of India, 2000. A Dictionary of Indian Raw Materials and Industrial products (All Volumes). NISCAIR, CSIR, New Delhi.
8. Kokate C.K., 1994. Practical Pharmacognosy, 4th ed. Vallabh Prakashan, New Delhi.
9. Khandelwal K.R., 2006. Practical Pharmacognosy Techniques and Experiments, 16th ed. Nirali Prakashan, Pune.
10. Iyengar M.A and Nayak S.G.K., 2001. Anatomy of Crude Drugs, 8th ed. Manipal Power Press, Manipal.

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Microscope with Stage	20
2. Balance	5
3. Reflux flask with condenser	5
4. Heating mantle	5
5. Water bath	10

1.4 PHARMACEUTICAL ORGANIC CHEMISTRY I (THEORY)
(3Hrs/wk)

75 Hours

1. Nomenclature of aliphatic and aromatic organic compounds belonging to the following classes: alkanes, alkenes, dienes, alkynes, alcohols, aldehydes, ketones, amides, amines, phenols, alkyl halides, carboxylic acids, esters, acid chlorides and cycloalkanes.
8hrs (7-8 Marks)
2. Structure and physical properties:
 - a) Polarity and Dipole moment, Hydrogen bonding and its applications, Inductive effect Mesomeric effect, Protic and aprotic solvents.
 - b) An introduction to Isomerism- Definition, Classification of structural and stereo isomerism
2hrs (1-2 Marks)
3. a) Definition, formation, classification and stability of free radicals
b) Free radical chain reactions of alkanes-mechanism, relative reactivity and stability.
4hrs (3-4 Marks)
4. a) Alicyclic compounds: Preparation of cycloalkanes, Bayer's strain theory, theory of Strainless ring, molecular orbital concept.
b) Concept of aromaticity (Huckel's rule). Definition, classification, Methods of synthesis (Haworth's and Diels Alder), Properties and Reaction of Poly nuclear hydrocarbons Such as Naphthalene, Anthracene and Phenanthrene.
c) Attacking reagents- Electrophiles and Nucleophiles Definition with examples.
5hrs (4-5 Marks)
5. a) Definition, formation, classification and stability of carbocations
b) Nucleophilic aliphatic substitution mechanism: nucleophiles, and leaving groups, kinetics of second and first order reaction. Mechanism and Stereochemistry of SN_2 reaction, Mechanism and Stereochemistry of SN_1 reaction. Rearrangement of carbocation, SN_2 versus SN_1 reactions, Reactivity of alkyl halides in SN_2 and SN_1 , Factors affecting SN_2 and SN_1 reaction.
8hrs (7-8 Marks)
6. Elimination reactions: Dehydrohalogenation of alkyl halides: 1, 2 elimination, kinetics, E_2 and E_1 mechanisms, E_2 versus E_1 , elimination versus substitution. Dehydration of alcohols and its mechanism, orientation and reactivity in E_1 and E_2 reactions, Saytzeff's and Hoffman's elimination.
7hrs (6-7 Marks)
7. Electrophilic addition: a) Reactions at carbon-carbon double bond, hydrogenation and its mechanism Markovnikov's rule, addition of hydrogen halides, Addition of hydrogen bromides-peroxide effect. Electrophilic addition mechanism.
b) Definition, formation, classification and stability of carbenes, Mechanism of cycloaddition reactions with examples. Addition of carbenes to alkenes, Diels Alder reaction.
5hrs (4-5 Marks)
8. Theory of resonance: Allyl radical as a resonance hybrid, stability, and orbital picture. Resonance stabilization of Allyl cations: hyper conjugation, stability of conjugated dienes, mechanisms of 1,2 and 1,4-additions with examples
6 hrs (5-6 Marks)
9. Electrophilic aromatic substitution; Definition and classification of electrophiles, effect of substituent groups, determination of orientation, and of relative reactivity, classification of substituent groups. mechanism of nitration, sulphonation, halogenation, Friedel Craft's alkylation and Friedel Craft's acylation, Reactivity and orientation, activating and deactivating (o, m, p, directing) groups, orientation and synthesis. Orientation in disubstituted benzenes, theory of reactivity and orientation, effects of halogens and Suzuki coupling reaction.
10 hrs (9-10 Marks)

10. a) Definition, formation, classification and stability of carbonanions
 b) Nucleophilic additions in aldehydes and ketones, mechanisms with examples. Reactions of Grignard reagent. Aldol and crossed Aldol condensation, Claisen condensation, Cannizzaro and crossed Cannizzaro reaction, Benzoin's, Perkins, Knoevenagels and Reformatsky reaction. **7hrs (6-7 Marks)**
11. Carboxylic acids - Ionization of carboxylic acids, acidity of constant, acidity of carboxylic acids, structure of carboxylate ion, effect of substituents on acidity of carboxylic acids, Conversion of carboxylic acids into acid chloride, ester, amide, anhydrides and Hattus coupling. **6hrs (5-6 Marks)**
12. Amines – a) Basicity of Amines, effect of substituents on basicity of aliphatic and aromatic amines
 b) Definition, formation, classification, stability and reactivity of nitrenes. Hofmann's, Beckmann's, Curtius, Smith, rearrangement with their mechanism
 c) Diazotisation and its mechanism, Sandmeyer's and Gattermann reaction, coupling reaction of Diazonium salts with phenols and amines **5hrs (4-5 Marks)**
13. Phenols – Acidity of phenols, effect of substituent on acidity of phenols. Kolbe's reaction, Reimer - Tiemann reaction, Fries rearrangement and Williamson's synthesis. **2hrs (1-2 Marks)**

PHARMACEUTICAL ORGANIC CHEMISTRY I (PRACTICALS) (3Hrs/wk)

75 hours

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

- a) Acetanilide / Aspirin (acetylation)
- b) Benzanilide / Phenyl benzoate (Benzoylation)
- c) p-Bromo acetanilide / 2,4, 6 Tribromo aniline. (Bromination)
- d) Dibenzylidene acetone (condensation)
- e) 1-Phenylazo-2-naphthol (Diazotisation)
- f) Benzoic acid / Salicylic acid (hydrolysis of ester)
- g) m-Dinitro benzene (nitration)
- h) Oxidation of Toluene to benzoic acid
- i) Benzophenone oxime (oxime formation)
- j) Benzyl benzoate and Sodium benzoate from Benzaldehyde (Cannizzaro's reaction)

2. Identification of organic compounds belonging to the following classes by systematic qualitative organic analysis including physical constant and preparation of their derivatives.**

1. Phenols, 2. Amides, 3. Carbohydrates, 4. Amines, 5. Carboxylic acids, 6. Aldehydes and ketones, 7. Alcohols, 8. Esters, 9. Hydrocarbons, 10. Anilides, 11. Nitro compounds

3. Introduction to the use of stereo models

1. Methane, 2. Ethane, 3. Ethylene, 4. Acetylene, 5. cis-Alkene, 6. trans-Alkene, 7. Inversion of configuration

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

SCHEME OF EXAMINATION: Practical and Viva Voce

1. Synopsis -	10 Marks
2. Major Experiment (Experiments indicated by **) - (Systematic Qualitative Analysis)	35 Marks
3. Minor Experiment –I (Experiments indicated by)* - (Preparation of Simple Organic Compound)	15 Marks
4. Practical viva voce -	10 Marks
Total -	70 Marks

PHARMACEUTICAL ORGANIC CHEMISTRY I TEXT BOOKS (THEORY)

1. T.R. Morrison and R. Boyd, Text of Organic Chemistry, 6th edition Prentice Hall of India Pvt. Ltd., New Delhi.
2. I.L. Finar Organic Chemistry, the Fundamentals of Chemistry. Lingman Publishers Vol-1, 6th edition.
3. A test book of organic chemistry by Arun Bhal & B.S. Bhal, S.Chand & Company Pvt Ltd. revised edition
4. Bentley and Driver's textbook of Pharmaceutical Chemistry. L.M. Atherden, 8th edition.

PHARMACEUTICAL ORGANIC CHEMISTRY I REFERENCE BOOKS (Theory)

1. T.W.Graham Solomons, Fundamentals of Organic Chemistry, John Wiley & Sons Inc., USA, 5th edition.
2. J.M.Catm and D.J.Carm Organic Chemistry. Saunders college of Publishing, 13th edition.
3. Brown, Organic Chemistry.
4. I.P., Govt. of India, Ministry of Health and Family welfare all edition including latest
5. Jerry and March, Advanced Organic Chemistry, Wiley Eastern Limited, New Delhi 4th Edition.
6. Cram and Hammer, Pine Hendrickson Organic Chemistry.
7. Alinger. Cava, Dejongh Organic Chemistry.
8. Neckers and Doyle Organic Chemistry.
9. Agrononov et. al., Problems and exercises in Organic Chemistry.
10. Practical organic chemistry by Man & Saunders.
11. Practical Organic chemistry by Ahluwalia.
12. Practical Organic chemistry by O.P. Pandey (S.Chand Publications)

PHARMACEUTICAL ORGANIC CHEMISTRY I REFERENCE BOOKS (Practical)

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. D.L.Pavia, G.Lampman and G.D.Kriz. Introduction to Organic Laboratory Techniques. 4th Edition (1996).
4. Vogel, Text Book of practical organic chemistry, ELBS Longman, London, 4th edition.

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Melting Point Apparatus	10 no's
2. Triple beam balances	10 no's
3. Physical balances	05 no's
4. Suction Pumps	01 no
5. Water Baths	10 no's
6. Hot Plates	01 no
7. Oven	01 no
8. Refrigerator	01 no
9. Distillation Unit	01 no

1.5 PHARMACEUTICAL INORGANIC CHEMISTRY (THEORY) 75 hours
(3hrs/Wk)

1. Sources and effects of impurities in Pharmacopoeial substances, importance of limit test, general principles and procedures for limit tests for chloride, sulphate, iron, arsenic, lead and heavy metals. Modified procedures for limit tests for chlorides and sulfates in Potassium permanganate, sodium bicarbonate and sodium salicylate. **10hrs (9-10 Marks)**
2. General methods of preparation, assays (marked by *), storage condition and medicinal uses of inorganic compounds belonging to the following classes.
 - 2.1 Medicinal Gases: Oxygen, Nitrous oxide, Carbon dioxide **2 hrs (1-2 Marks)**
 - 2.2 Gastrointestinal agents
Acidifiers: dilute HCl, ammonium chloride
Antacids: Classification of antacids, Ideal properties of antacids, combination therapy, Aluminium hydroxide gel*, Calcium carbonate, Sodium bicarbonate* Magnesium trisilicate, Magnesium carbonate (light and heavy), Magnesium hydroxide mixture*
Protective and adsorbents: Kaolin and Talc,
Laxatives, Purgatives and Cathartics: Magnesium sulphate and Sodium sulphate.
10 hrs (9-10 Marks)
 - 2.3 Topical agents and Dermatological preparations:
Protective: Talc, Zinc oxide*, Zinc stearate,
Antimicrobials: Potassium Permanganate*, Chlorinated lime*, Iodine preparations, Boric acid*, Borax Hydrogen peroxide* **6 hrs (5-6 Marks)**
 - 2.4 Dental products: Dentifrices, anticaries agents, desensitizing agents, calcium carbonate, sodium fluoride, Stannous fluoride, Zinc chloride, Zinc eugenol cement. **3hrs(2-3 Marks)**
 - 2.5 Miscellaneous agents:
Expectorants : Ammonium chloride* (Formal method), Potassium iodide.
Haematinics : Ferrous sulfate*, Ferrous gluconate, Ferrous Fumarate, Iron dextran injection, Iron and Ammonium citrate.
Emetics : Copper sulphate*
Antidotes : Definition, classification and mode of action-Sodium thiosulphate, Charcoal, (activated)
Pharmaceutical Aids : Definition and classification Bentonite, Barium sulphate, Magnesium stearate, Phenylmercuric acetate, Sodium benzoate
Antioxidants: definition, sodium metabisulphite **6 hrs (5-6 Marks)**
 - 2.6 Major intra and extra cellular electrolytes, major physiological ions and electrolytes used for replacement therapy, physiological acid base balance, electrolyte combination therapy, ORS, Sodium chloride injection*, Dextrose and Sodium chloride injection, Calcium gluconate injection.* **6hrs (5-6 Marks)**
3. Sources and types of errors, methods of minimizing errors, accuracy, precision. **5hrs (5-6 Marks)**
4. Fundamentals of volumetric analysis
 - 4.1 Definition of titration, titrant, titrand, equivalence point, end point, indicators , Equivalent weight, primary standard substances and their properties. Various methods of expressing concentration of primary and secondary standard substance. **4 hrs (3-4 Marks)**
 - 4.2 Neutralisation titrations: Examples of neutralization titrations, indicators choice of indicators, theory of indicators, neutralization curves, method of preparation, Standardization and Storage of oxalic acid, sodium hydroxide, hydrochloric acid

- 4.3 Theory of non aqueous titrations, classification of solvents used in non aqueous titrations, their leveling and differentiating effects. Estimation of Sodium Benzoate by non aqueous titrations. **4 hrs (3-4 Marks)**
- 4.4 Redox titrations: Principle of redox titrations, Concepts of oxidation and reduction. Redox reactions, strength and equivalent weights of oxidizing and reducing agents, Preparation, standardization and storage of various volumetric solutions such as sodium thiosulfate, potassium permanganate and Iodine solution, theory of iodometry, iodimetry, bromometry, titrations with potassium iodate, potassium bromate, 2,6-dichlorophenol indophenol. **9 hrs (9-10 Marks)**
- 4.5 Principles of precipitation titrations, different methods-Mohr's, Modified Mohr's, Volhard's, Modified Volhard's, Fajan's with example. Estimation of sodium chloride. **5 hrs (4-5 Marks)**
- 4.6 Complexometric titrations: Ligands and their classification, principles of complexometric titrations, indicators, different types of complexometric titrations, estimation of calcium gluconate. **5 hrs (4-5 Marks)**

PHARMACEUTICAL INORGANIC CHEMISTRY (PRACTICALS) 75 Hours (3hrs/wk)

(Following experiments to be covered in 25 different practical classes)

1. Limit tests (7 exercises)

1. Limit test for chlorides*
2. Limit test for sulphate*
3. Limit test for Iron*
4. Limit test for heavy metals*
5. Limit test for Arsenic
6. Modifications in limit tests* for chloride and sulphates in potassium permanganate, sodium bicarbonate, sodium benzoate

2. Assay of the following compounds including standardisation**

1. Ammonium chloride-acid base titration (Formal titration)
2. Ferrous sulphate- (redox) Ceric ammonium sulphate titration
3. Copper sulphate- (redox) Iodometry
4. Calcium gluconate-complexometry
5. Hydrogen peroxide- (redox -Permanganometry)
6. Sodium benzoate-nonaqueous titration
7. Sodium chloride-Modified Volhard's method
8. Assay of KI-KIO₃ titration
9. Assay of Zinc oxide (acid base back titration)

3. Test for identity for the following (3 exercises)

1. Sodium bicarbonate
2. Ferrous sulphate
3. Potassium chloride
4. Calcium chloride

4. Test for purity for the following (2 exercises)*

1. Swelling power in Bentonite
2. Ammonium salts in Potash alum.
3. Presence of Iodates in Potassium iodide

5. Preparation of inorganic pharmaceuticals (2 exercises)*

1. Boric acid
2. Potash alum
3. Magnesium hydroxide.
4. Magnesium sulphate

Note: ** Denotes major experiments, * Denotes minor experiments

SCHEME OF EXAMINATION: Practical and Viva Voce

1. Synopsis	10 Marks
2. Major Experiment	25 Marks
3. Minor Experiments	
a) Limit Test	13 Marks
b) Test for Purity or Preparation	12 Marks
4. Practical viva voce	10 Marks
Total	70 Marks

PHARMACEUTICAL INORGANIC CHEMISTRY TEXT BOOKS

1. M.L.Schroff, Inorganic pharmaceutical chemistry.
2. Bentley and Driver's Textbook of pharmaceutical chemistry by L.M.Atherden
3. J.H.Block, E.B.Roche, T.O.Soine and C.O.Wilson, Inorganic medicinal and pharmaceutical chemistry.
4. A.H.Beckett & J.B. Stenlake's –Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4 edition.
5. Practical Chemistry – OP Pandey, DN Bajpai and S Giri S Chand Publishers

PHARMACEUTICAL INORGANIC CHEMISTRY REFERENCE BOOKS

1. J.D.Lee, Concise Inorganic chemistry. 4 edition.
2. C.A.Discher, Modern inorganic pharmaceutical chemistry.
3. I.P.1985 and 1996, Govt. of India, Ministry of Health, 3 Editin, 1985 4 Edition 1996.
4. Ayers, Quantitative chemical analysis.
5. John H.Kennedy, Analytical chemistry-principles. Sunders college publication New York, 3rd edition.
6. Analytical chemistry – principles and techniques by Hargis. G.Larry
7. D. A. Skoog, D. M.West, Fundamental of Analytical chemistry, 6 edition.
8. Walton, Principles and methods of chemical analysis.

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Analytical Balances	10 no's
2. Physical Balances	05 no's
3. Suction Pumps –	03 no's
4. Muffle Furnace	01 no
5. Oven	01 no
6. Hot Plates –	05 no's
7. Water Baths	10 no's
8. Distillation Unit	01 no

1.6 MATHEMATICS (THEORY)
(2hrs/Wk)

50 hours

1. Matrices:- Definition of matrices, addition, subtraction, multiplication of matrices. Determinants of order two and three examples pharmaceutical applications of determinants, solution of simultaneous linear equations by Cramer's rule. **8hrs (14marks)**

2. Trigonometry:- **6 hrs (12marks)**
Relation between the sides and angles of a triangle. Inverse trigonometric functions

3. Analytical Geometry: - **6 hrs (10marks)**
Point – Distance – Examples.
Straight line: - General form of the Equation of a straight line, slope of the line, slope point form. Condition for two lines to be parallel and perpendicular, Perpendicular distance from the point to the line, angle between two lines.
Circle:- General Equation of a circle, finding centre and radius of the circle.

4. Differential Calculus: **10 hrs (19marks)**
Limit of a function, derivative of a function, Differentiation of a sum, product and quotient. Differentiation of composite functions, parametric functions, exponential functions, inverse trigonometric functions, Logarithmic differentiation.

5. Integral Calculus: **8hrs (16marks)**
Indefinite integrals, integration by substitution and integration by parts important properties of definite integrals.

6. Differential Equations: **12 hrs (19marks)**
Definition formation of differential equations, differential equations of the first order and first degree. Methods of solving ordinary differential equations: variables separable, homogenous, linear, differential equations and equations reducible to these forms, linear differential equations with constant coefficients (higher order), homogeneous linear differential equations, simultaneous linear differential equations of the first order, Pharmaceutical applications.

REFERENCE BOOK

1. Differential calculus – Shantinakaran
2. Integral calculus –Shantinakaran
3. Integral calculus - Golden Series
4. Engineering Mathematics – Grewaf
5. Trigonometry Part – I - S.L. Loncy
6. A Text Book of Mathematics for second year Pre-university - Prof. B.M. Sreenivasa Rao and S. Nagaraj
7. College Mathematics - G.K. Ranganath
8. Differential Equations - Golden Series

1.6 BIOLOGY (THEORY)
(2hrs/Wk)

50 Hours

PART A. BOTANY

- | | |
|--|--------------|
| 1. General organisation of the plant and plant cell and its inclusion | 2 hrs |
| 2. The plant tissues (Meristematic & Permanent) | 2 hrs |
| 3. The broad classification of plant kingdom | 2 hrs |
| 4. Morphology of plant parts like roots, stem and leaf and their modifications | 2 hrs |
| 5. Inflorescence, flower and its pollination | 2 hrs |
| 6. Morphology of fruits and seeds | 2 hrs |
| 7. Plant taxonomy: Study of different families viz. Leguminaceae, Umbelliferae, Solanaceae, Liliaceae, Zingiberaceae, Rubiaceae with special reference to medicinal plants. | 6 hrs |
| 8. Plant physiology: Transpiration, Photosynthesis, Respiration, Growth | 4 hrs |
| 9. The study of: 1)Fungi:eg. Yeast, Penicillin., 2)Bacteria | 3 hrs |

PART B. ZOOLOGY

- | | |
|--|--------------|
| 1. The study of Animal cell, Animal Tissue, Differences between plant and animal cell. | 4 hrs |
| 2. The detailed study of frog | 6 hrs |
| 3. The study of representatives of Pisces, Reptiles and Aves with special reference to the medicinal values. | 5 hrs |
| 4. General organisation of a mammal | 5 hrs |
| 5. The study of poisonous animals. | 5 hrs |

BIOLOGY (Practicals)

50 Hours

PART A. Botany

1. The general organization of a typical plant and morphological study of plant parts studied in theory (Roots, Stem, Leaves and their modifications) *
2. Inflorescence and Flower *
3. Fruits and seeds (Identification) *
4. Plant tissues through permanent slides * and Histological preparations of roots, stems, leaves by eosin or Saffranin stain **
5. Simple experiments on plant physiology *
6. Identification of cell inclusions *

Part – B : Zoology

1. The study of animal tissues through permanent slides *
2. The study of various systems of frog using charts and models **
3. Identification of poisonous animals *
4. Demonstration of dissection in rats *
5. Identification of representatives of animal phyla like Fish, Frog, Reptile and Mammal *

SCHEME OF EXAMINATION

1. Synopsis	-	10 marks
2. Study of any one system of frog	-	15 marks
3. Transfer section of leaf root or stem	-	15 marks
4. Minor experiment 1	-	10 marks
5. Minor experiment 2	-	10 marks
6. Viva voce	-	10 marks

Total		70 marks

REFERENCE BOOKS

1. A class book of Botany	- A C Dutta
2. Outlines of zoology	- Ekkambernath Iyer
3. Functional anatomy of a Mammal	- Tayler and Weber
4. Comparative anatomy	- Atwood
5. Bales Histology	-
6. A textbook of vertebrate zoology	- S N Prasad
7. Vertebrate zoology vol. II	- Ekkambernath Iyer

1.7 COMPUTER SCIENCE AND STATISTICS (Theory)
(3hrs/wk)

75Hours

PART A: STATISTICS

1. Definition, data frequency, distribution, Classification of data. General graphical representation of the data: histogram, Frequency curve and frequency polygon and Ogive. Semilog line graph. Use of semilog scale-examples. **8 h (10 marks)**
2. Measures of central tendency: Arithmetic mean, geometric mean and harmonic mean. Median, Mode, Calculation of quartiles and percentiles deciles. **8 h (10 marks)**
3. Measures of dispersion: Range, quartile deviation, Mean deviation, Standard deviation, variance, coefficient of variation, skewness and curtosis. **7 h (9 marks)**
4. Correlation, Regression: Linear correlation, coefficient of correlation: Karlpersons formula, spearman's rank method, curve fitting by the method of least squares: Fitting a straight line $y=a+bx$, Fitting a power curve $y=axb$, Fitting an exponential curve $y=abx$, $y=aebx$, Regression analysis for lines. **12 h (14 marks)**
5. Definition of probability: Random experiment, sample space, Addition and multiplication laws of probability (without proof), probability distribution: binomial, poisson's normal and chi-square, Student test and Pharmaceutical examples. **10 h (12 marks)**

PART B : COMPUTER SCIENCE

1. a) Computer Fundamentals **6 h (8 marks)**
Introduction, Classification of Computers (Based on all Criteria), Functional Units
Evaluational of Computer Languages, Assembler, Compiler, Interpreter.
b) Number Systems **4 h (4 marks)**
Introduction to Number Systems - Numeric and Non-Numeric Representation of Data,
Decimal, Binary (Addition, Subtraction, Multiplication, Division) and Hexadecimal
Number Systems.
2. a) Introduction to Networks **3 h (3 marks)**
i) Network Topologies - Linear, Ring, Star, Mesh, Hybrid, Types of Network - Lan,
Man, Wan
ii) Internet and Intranet, Protocols (TCP, IP, SMTP, FTP, HTTP etc.),
iii) Web pages, Browsers, Search Engines
b) Introduction to DBMS **5 h (6 marks)**
Data and Information, Database Users, Characteristics of the Database Approach,
Advantages of using DBMS, Data Models, Schemas and Instances, Database Languages
(DML, DDL)
3. a) Introduction to OS **2 h (2 marks)**
Definition and Types of Operating Systems (Unix, Windows, Mac OS)
b) Introduction to Office Packages **6 h (7 marks)**
Microsoft Word, Microsoft Excel, Microsoft PowerPoint
4. Introduction to Programming Languages – C **4 h (5 marks)**

Features and Applications of C, Character Set, Definitions and Declarations of Identifiers, Variables, constants, Keywords, Data types, Operators and Expressions, Operator Precedence Various types of standard input and output statements.

COMPUTER SCIENCE AND STATISTICS (Practicals)
(3hrs/wk)

75Hours

CYCLE – I

- 1. MS-Word** **6 Hrs**
Creating Document, Letters, Banners, Pamphlets, Newspapers, Alignment of Paragraphs and Fonts, Page Settings, Mail Merge, Creating Tables, Header Footers, Inserting Images, Files.
- 2. MS-Excel** **8 Hrs**
Creating Salary Slips, Creating Marks Cards, Creating Student/Employee Complete Data Creating Different Graphs with respect to the given data eg. Salary Slip, Employee Performance. Students Marks Cards, Calculating Sum, Average - Manual and Automatic by using tools.
- 3. MS-PowerPoint** **6 Hrs**
Creating Colorful Slides with respect to any given data or to the subject using audio and video files

CYCLE – II

- 4. C Programming Lab** **15 Hrs**
 1. Program to Find sum of even and odd numbers separately in the given list of numbers
 2. Program to find the largest and smallest of N numbers
 3. Given two numbers, program to perform arithmetic operations using switch statement.
 4. Program to generate Fibonacci Series upto N numbers using Do-while loop
 5. Program to generate Prime Numbers using for loop.
 6. Program to check whether the given number is factorial or not.
 7. Program to insert a sub-string into a given string
 8. Program to add, subtract and Multiply two MxN matrices
 9. Program to swap two numbers using functions.
 10. Program to create a simple marks card assuming appropriate conditions

CYCLE – III

- 5. Oracle / MS SQL** **15 Hrs**
- 6. Create a Database of any Size**
- 7. Create 6 Tables with respect to any subject**
- 8. Use Script language SQL / PL SQL**
- 9. Using script commands, SELECT, INSERT, UPDATE, DELETE, DROP, CREATE, RENAME**
- 10. JOIN, LEFT JOIN, RIGHT JOIN, INNER JOIN**
- 11. Create a customized report with respect to the subject assigned.**
- 12. Introduction to PERL Scripting**

STATISTICS REFERENCE BOOKS

1. P.M.Steven, and K.Andreas, Applied stastics in the Pharmaceutical Industry, 310/STE, 2001.
2. B.H.Munrao, Statistical methods for health care research, Lippinocott company publication, 4th edition 2000.
3. M.Pagano, Kimberlee, Gauvreau. Principles of Biostastics, Lib of American Publication, 10 th edition 2000.
4. B.K.Gotteti and K.S.Patricia, Statistics, Jones and Bartlet Publication London, 1994.

COMPUTER SCIENCE REFERENCE BOOKS

1. Thomas C. Bartee, Digital Computer Fundamentals - Tata Mc Graw Hill Publishing
2. Sinha - Fundametals of Computers
3. Ramez Elmasri - Shamkanth B. Navathe, Fundamentals of Database Systems
4. IVAN Bayross, SQL, PL/SQL The programming Language of Oracle

SYLLABUS FOR II YEAR B.PHARM

2.1 PHYSICAL PHARMACEUTICS (THEORY)

50 hours

1. **Distribution law:** Explanation, limitations and applications. **4 hours; 7 marks**
2. **Kinetics & drug stability:** Rates and molecularity of a reaction, determination of order, factors influencing rate of reactions, stabilization of drugs, applications of chemical kinetics to the stability testing of pharmaceuticals. Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis and oxidation. Accelerated stability testing in dating of pharmaceutical dosage forms by ICH guidelines. **8 hours; 14 marks**
3. **Interfacial phenomenon:** Liquid interfaces, adsorption at liquid/solid interfaces, adsorption isotherms, concept of contact angle, hydrophile lipophile balance, spreading coefficient, Gibb's adsorption equation and electrical properties of interfaces. **6 hours; 10 marks**
4. **Diffusion and dissolution:** Steady state diffusion, types of diffusion, diffusion equation, diffusion cells, dissolution of tablets and capsules, Hixon-Crowell cube root law, dissolution apparatus; factors affecting dissolution. **5 hours; 9 marks**
5. **Rheology:** Newtonian and Non-Newtonian systems, thixotropy, determinations of rheological properties (single and multipoint instruments). Applications to pharmacy. rheological consideration, preparation, physical stability and evaluation of suspensions. Rheology of emulsions, micro-emulsions, multiple emulsions. **9 hours; 15 marks**
6. **Micrometrics:** Particle size distribution, methods for determining particle size, shape and surface area. Derived properties of powders. Simple numerical problems. **5 hours; 9 marks**
7. **Colloids:** Definition, types, preparation, purification, stabilization of colloids, properties, optical properties, kinetic properties, electrical properties, Donnan membrane phenomenon. **5 hours; 9 marks**
8. **Complexation:** Types of complexes, metal complexes, organic molecular complexes, inclusion compounds, methods of analysis of complex. **5 hours; 9 marks**
9. **Analytical techniques :** Brief introduction and applications of newer analytical techniques – DSC, X-Ray Diffraction, X-Ray Crystallography, SEM, TEM. **3 hours; 6 marks**

PHYSICAL PHARMACEUTICS (Practicals)**75 hours**

1. Determination of viscosity of liquids using Ostwald's viscometer.*
2. Determination surface tension of liquid by drop weight method.*
3. Study of flow properties of granules viz., rate of flow, angle of repose, bulk density.*
4. Preparation, stabilization and evaluation of hydrophobic colloids.**
5. Determination of partition coefficient of benzoic acid between benzene and water.**
6. Determination of HLB number of surfactants by Griffins method.**
7. Determination of shelf life using accelerated stability studies.**
8. Determination of rate constant for first order reactions.**
9. Determination of rate constant for second order reactions.**
10. Study of particle size distribution by optical microscopy.*
11. Determination of required HLB number for the oil phase to be presented as an emulsion. Formulation and evaluation of emulsion.**
12. Determination of constants of Freundlich and Langmuir adsorption for adsorptions of acetic acid on activated charcoal.**
13. Determination of stability constant of glycine-copper complex by pH titration method.**
14. Construction of rheograms and study of rheological behaviour of biphasic systems employing multipoint viscometers. (For demonstration)

SCHEME OF EXAMINATION

1. Synopsis	-10 Marks
2. Major experiment (indicated by **)	-30 Marks
3. Minor experiment (indicated by *)	-20 Marks
4. Viva voce	-10 Marks
Total	<hr/> = 70 Marks <hr/>

PHYSICAL PHARMACEUTICS REFERENCE BOOKS

1. Carter SJ. Cooper and Gunn's Tutorial pharmacy. 6th ed. New Delhi: CBS Publishers; 2000.
2. Gennaro AL. Remington: The science and practice of pharmacy Vol I and II. 20th ed. Philadelphia: Lippincott Williams and Wilkins; 2000.
3. Martin A, Bustamante P, Chun AHC. Physical pharmacy. 4th ed. New Delhi: BI Waverly Pvt Ltd; 1995.
4. Rawlins EA. Bentley's textbook of pharmaceuticals. 8th ed. New Delhi: Reed Elsevier India Pvt Ltd; 2010.
5. Subrahmanyam CVS. Essentials of physical pharmacy. Delhi: Vallabh Prakashan; 2003.
6. Subrahmanyam CVS. Textbook of physical pharmaceuticals. 2nd ed. Delhi: Vallabh Prakashan; 2003.
7. Willard HH, Meritt LL, Dean JA, Settle FA. Instrumental Methods of Analysis. 7th ed. New Delhi: CBS Publishers & Distributors; 1986.

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Brookfield's viscometer	01no
2. Digital electronic balances	03no's
3. Digital pH meters	01no
4. Microscopes	05no's
5. Ostwald's Viscometers	15no's
6. Stage and eye piece micro meters	05no's
7. Stalagmometers	15no's

2.2 PHARMACEUTICAL MICROBIOLOGY AND BIOTECHNOLOGY (THEORY)

(3hrs/Wk)

75 hours

1. Introduction, a brief history of microbiology (spontaneous generation, theory of biogenesis, germ theory of disease, contributions of Antony Van Leeuwenhoek, Edward Jenner, Robert Koch, Louis Pasteur and Alexander Fleming), pharmaceutical importance of microorganisms. **4 hrs (2 marks)**
2. Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, culture media with emphasis on special purpose media, growth curve, continuous growth, synchronous growth, isolation and preservation [space] methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count), identification of bacteria using colony characters, staining techniques (simple, Gram's & Acid fast staining) and biochemical tests (IMViC). **12 hrs (17 marks)**
3. Study of morphology, classification, reproduction/replication and cultivation of Fungi and Virus. **4 hrs (5 marks)**
4. Study of principle, procedure, merits, demerits and applications of thermal, radiation, gaseous (ethylene oxide), filtration methods of sterilization. Brief study on sterilization indicators. Study of general methods of sterility testing including interpretation of its results. **11 hrs (15 marks)**
5. Ideal properties, classification and factors affecting the action of disinfectants. Mode of action and uses of phenols, halogens, metallic salts and aldehydes. Evaluation of bacteriostatic, bactericidal (phenol coefficient methods) properties of disinfectants and preservatives. **7 hrs (9 marks)**
6. Types of immunity, antigens and antigenic determinants, structure and formation of antibodies, classification of immunoglobulins, antigen-antibody reactions (precipitation and agglutination reactions), Types of vaccines, difference between vaccine & sera, killed vaccine & attenuated vaccine, preparation of BCG vaccine, Tetanus toxoid and Polio vaccine, immunization program and importance of booster dose, diagnostic tests viz. ELISA, Western blot, Widal and Mantoux. **12 hrs (15 marks)**
7. Introduction to fermentation technology, design and operation of a fermenter, production of streptomycin and vitamin B₁₂. Principles and methods of microbiological assays with reference to streptomycin and vitamin B₁₂. **6 hrs (7 marks)**
8. Introduction to recombinant DNA technology, tools and techniques of gene manipulation, production of recombinant insulin and hepatitis B vaccine. **5 hrs (4 marks)**
9. Types of cell lines, basic requirements, advantages, disadvantages and applications of animal cell culture. Production and applications of monoclonal antibodies. **4 hrs (5 marks)**

10. Types, techniques, applications of plant tissue culture, protoplast fusion, transgenic plants-gene transfer using vectors and physical delivery methods.

4 hrs (7 marks)

11. Study of causative organism, mode of transmission, signs and symptoms, treatment and prevention of microbial diseases like cholera, typhoid, tuberculosis, AIDS, malaria and dengue.

4 hrs (5 marks)

PHARMACEUTICAL MICROBIOLOGY AND BIOTECHNOLOGY (THEORY)

(3hrs/Wk)

75 hours

1. Study of apparatus used in experimental microbiology.
2. Sterilisation of glassware, preparation and sterilisation of media.
3. Staining techniques – Simple staining*, Gram's staining. **
4. Motility testing*
5. Total and viable count*.
6. Isolation and maintenance of pure culture*.
8. Sensitivity testing.*
9. Microbiological assay of antibiotics by cup plate method**.
10. Sterility testing by direct transfer and membrane filtration technique*.
11. Initiation of callus culture*
12. Estimation of DNA by spectroscopic method.**
13. Estimation of RNA on spectroscopic method. **

SCHEME OF EXAMINATION

- | | |
|-----------------------|-----------|
| 1. Synopsis | -10 Marks |
| 2. Major experiment** | -25 Marks |
| 3. Minor experiment* | -15 Marks |
| 4. Minor experiment* | -10 Marks |
| 5. Viva-Voce | -10 Marks |

Total

- 70 Marks

REFERENCE BOOKS

1. *Hugo and Russell's Pharmaceutical Microbiology* (2004), 7th Ed, Blackwell Publishing Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK
2. *Microbiology: an introduction* (2010) by Gerard J. Tortora, Berdell R. Funke, Christine L. Case, 10th ed., Pearson Education, Inc., San Francisco, CA 94111
3. Prescott, Harley and Klein's *Microbiology* 2 Ed, W. C Brown Publishers, 1993.
4. Pelczar Reid, *Microbiology*, 5th Ed, Tata MC Graw- Hill Publishers company, 1993.
5. Ananth Narayan and Pannicker, *Text Book of Microbiology*, 6 Ed, Orient-longman, Chennai, 1995.
6. S.P. Vyas, and Dixit *Pharmaceutical Biotechnology*, 1 Ed, CBS Publishers & distributors, New Delhi, 1998.
7. S.S Kori *Pharmaceutical Biotechnology*, .Fundamentals and Applications, 1 Ed Vallabh Prakashan, New Delhi
8. *Microbiology: A Laboratory Manual* By Cappuccino, Pearson Education India, 2005
9. Frobisher M, *Fundamentals of Microbiology*, 9 Ed, Toppan Company Ltd. Tokyo. Japan.
10. Collins C.H. *Microbiological Methods*. 6 Ed, Butterworth, London. 1989.
11. Stanier, Ingraham, *General Microbiology* 5 Ed., Wheelies and Painter. 1987.
12. Cooper & Gunn's – *Tutorial Pharmacy*, 9 Ed, CBS Publisher and Distribution, 1986.
13. Roitt, *Immunology*, 4 Ed , Harwood academic publishers, Mosby, London. 1997.
14. Bentley's *Text Book of Pharmaceutics* by Rawlins 8 Ed, ELBS publication, 1984.
15. *Pharmacopoeia of India* Govt. of India

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Autoclave	02 no's
2. Hot air oven	01no
3. B.O.D. Incubator	01no
4. Refrigerator	01no
5. Laminar air flow	01no
6. Colony counter	02no's
7. Zone reader	01no
8. Spectrophotometer	01no
9. Microscope with stage	20no's
10. Sterility testing unit	01no

2.3 PATHOPHYSIOLOGY (THEORY)

(3Hrs/wk)

75 Hours

Scope and Objectives: This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms.

Upon completion of the subject student shall be able to:

1. Describe the etiology and pathogenesis of the selected disease states;
2. Name the signs and symptoms of the diseases; and
3. Mention the complications of the diseases.

Sl. No.	Course Contents	No of Hours	Marks
1.	a) Definition of pathology, health and disease. Terminologies used in pathology. b) Basic principles of cell injury and adaptation: Causes, pathogenesis and morphology of cell injury, Cellular adaptation's-physiologic and pathologic adaptations, Cellular ageing and death, Antioxidant enzymes-superoxide dismutase, catalase and glutathione peroxidase.	01 05	10-15
2.	Inflammation: a) Definition, causes, signs ,types of inflammation and chemical-mediators. b) Pathogenesis of acute inflammation (vascular events, Cellular events, transdate, exudate, edema, phagocytosis). c) Pathogenesis of chronic-inflammation and difference between acute and chronic inflammation. d) Tissue renewal and repair: regeneration healing and fibrosis e) Wound healing: process of wound healing, types of cells, factors influencing healing of wounds.	08 01 02 02 01 02	10-15
3.	Diseases of Immunity: Components of the immune system: a) Cells involved in immune response- T and B cells, Macrophages, Dendritic cells and Natural killer cells. b) MHC proteins or transplantation antigens. c) Immune Tolerance A) Hypersensitivity: a) Hypersensitivity type I, II, III, IV	12 03 03	10-15

[illegible]

	16. Acute and chronic renal failure	01 01	
9.	Pathophysiology (causative organisms, mode of transmission, pathogenesis, signs and symptoms) of infectious diseases: Hepatitis - infective hepatitis, Sexually transmitted diseases (Syphilis, Gonorrhea), Pneumonia, Typhoid, Urinary tract infections, Tuberculosis, Leprosy, Malaria, Dysentery (Bacterial and amoebic), Dengue and Chikungunya.	13	5-10
10.	Genetics and chromosomal disorders: Mendelian disorders, Cytogenic disorders (Karyotypic abnormalities)	03	5-10

TEXT BOOKS

1. Kumar V., Abbas A.K. and Aster J., Robbins Basic Pathology, 9th Edition, Elsevier, 2012.
2. Mohan H., Textbook of Pathology, 6th Edition , Jaypee Brothers, Medical Publishers, 2010.

REFERENCE BOOKS

1. Kumar V., Abbas A.K., Fausto N. and Aster J., Robbins and Cotran Pathologic Basis of Disease, 8th Edition , Saunders, 2009.
2. Mitchell R., Kumar V., Fausto N., Abbas A.K. and Aster J., Pocket comparisons to Robbins Pathologic Basis of Disease, 8th Edition, Saunders, 2011.

2.4 APPLIED BIOCHEMISTRY (THEORY)

(3hrs/Wk)

75 hours

- 1. Bio energetics** **3hrs (2-3 Marks)**
 - a) Concept of free energy and its determination; redox potential
 - b) Energy rich compounds; ATP; Cyclic AMP; their biological significance
- 2. Biological Oxidation** **5hrs (4-5 Marks)**
 - a) Electron transport chain (its mechanism and role)
 - b) Inhibitors and Uncouplers of ETC
 - c) Oxidative phosphorylation
 - d) Substrate level phosphorylation and oxidative phosphorylation
- 3. Proteins:** **2hrs (1-2 Marks)**

Definition, classification, biological significance, properties viz, denaturation, isoelectric point.
- 4. Enzymes and Coenzymes** **13hrs (13-14 Marks)**
 - a) Definition ; Nomenclature ; IUB Classification
 - b) Properties of enzymes;
 - c) Factors effecting enzyme activity;
 - d) Enzyme kinetics (Michaelis plot ; Line Weaver Burke plot)
 - e) Enzyme Inhibition (with examples)
 - f) Iso-enzymes
 - g) Enzyme Induction; repression
 - h) Applications of enzymes
 - i) Coenzymes, categories of reactions requiring coenzymes;
 - j) Structure of coenzymes, and their biochemical role
 - k) Vitamins - water soluble, fat soluble
- 5. Carbohydrate metabolism** **13hrs (13-14 Marks)**
 - a) Introduction: Definition, classification and biological significance
 - b) Glycolysis along with significance and energetics
 - c) Glycogenesis glycogenolysis,
 - d) TCA cycle; (Amphibolic nature of TCA cycle) along with significance and energetics
 - e) Gluconeogenesis and its significance
 - f) Various shuttle systems (glycerol phosphate; Malate aspartate)
 - g) HMP Shunt Pathway and its significance
 - h) Uronic acid pathway and galactose metabolism
 - i) disorders of carbohydrate metabolism: glycogen storage diseases, Diabetes mellitus
 - j) Hormonal regulation of carbohydrate metabolism
 - k) Glucose tolerance test and blood glucose regulation.
- 6. Lipid metabolism** **10hrs (9-10 Marks)**
 - a) Introduction: Definition, classification, essential fatty acids
 - b) Oxidation of saturated (palmitic acid) fatty acids
 - c) Oxidation of unsaturated fatty acids (-linolenic acid)

- d) Oxidation of odd numbered fatty acids
- e) Formation and fate of ketone bodies
- f) Cholesterol metabolism,
- g) Biosynthesis of fatty acids (de novo)
- h) Phospholipids and sphingolipids.

7. Amino acid metabolism

12hrs (11-12 Marks)

- a) Amino acids definition, classification and significance
- b) General reactions of amino acids: Transamination, Deamination and decarboxylations of amino acids
- c) Urea cycle, deficiency symptoms of urea cycle enzymes
- d) Metabolism of sulphur containing amino acids
- e) Catabolism of tyrosine, tryptophan, phenylalanine, phenyl ketonurea alkaptonurea
- f) Synthesis & significance of biologically important substances: creatine, histamine, 5-HT, dopamine, noradrenaline, adrenaline.
- g) Porphyrins, Bile Pigments; Hyperbilirubinemia

8. Nucleotides and Nucleic acids

12hrs (11-12 Marks)

- a) Introduction: Structure and numbering of purine and pyrimidine nucleus
- b) Purine nucleotides biosynthesis
- c) Pyrimidine nucleotides biosynthesis
- d) Catabolism of purines and pyrimidines
- e) DNA structure, significance as genetic material
- f) RNA types, structure and significance
- g) DNA replication
- h) Mutation and repair of DNA
- i) Transcription or RNA synthesis
- j) Genetic code
- k) Translation or protein synthesis and its Inhibition

9. Principles and significance for following Biochemical tests

5hrs (4-5 Marks)

- a) Kidney function tests
- b) Liver function tests
- c) Lipid profile
- d) Gastric function test

APPLIED BIOCHEMISTRY (PRACTICAL)
(3hrs/Wk)

75 hours

- 1. Identification of carbohydrates (Scheme and identification)**
(glucose, fructose, lactose, maltose, sucrose)
- 2 Identification of proteins (Scheme and identification)**
(casein, albumin, gelatin, peptone)
- 3. Quantitative estimation of carbohydrates (any one method)**
DNS reagent
Anthrone Reagent
- 4. Quantitative estimation of proteins (any one method): Biuret Reagent, Lowry's Reagent**
- 5. Qualitative analysis of Urine**
 - a) For Normal constituents
 - b) Abnormal constituents
- 6. Quantitative Urine analysis**
 - a. Titrable acidity and ammonia
 - b. Estimation of reducing sugars in Urine (benedicts method)
 - c. Estimation of chlorides in Urine
 - d. Estimation of Creatinine in Urine
 - e. Estimation of calcium in Urine
- 7. Quantitative analysis of blood**
 - a. Estimation of glucose in blood (Folin-Wu method)
 - b. Estimation of creatinine in blood
 - c. Estimation of cholesterol in blood
 - d. Estimation of urea in serum
 - e. Estimation of SGOT in serum
 - f. Estimation of SGPT in serum
- 8. Enzyme**
 - a. Salivary amylase activity
 - b. Effect of temperature on enzyme (amylase) activity
 - c. Effect of pH on enzyme (amylase) activity

SCHEME OF EXAMINATION

1. Synopsis	10 Marks
2. Urine Analysis	15 Marks
3. Titrimetric Experiment	20 Marks
4. Colorimetric Experiment	15 Marks
5. Viva	10 Marks

Total

70 Marks

TEXT BOOKS

- 1) Pharmaceutical Biochemistry – KN Jayaveera et al, S Chand publishers
- 2) Text Book of Biochemistry – Harron and Mazur
- 3) Text Book of Biochemistry – Varun Kumar Malhotra
- 4) Fundamentals of Biochemistry- JL Jain et al, S Chand publishers

REFERENCE BOOKS

- 1) Harpers Review of Biochemistry – Martin
- 2) Text book of Biochemistry – Lehninger
- 3) Outlines of Biochemistry – Conn and Stump
- 4) Hawk's Physiological Chemistry- Oser
- 5) Hand Book of Basic Pharmacokinetics- Pitachel

LIST OF MINIMUM EQUIPMENTS REQUIRED

1) Colorimeter	01
2) Centrifuge	01
3) Electronic Balance	01
4) Physical/Chemical Balance	01
5) pH meter	01
6) Water bath	05
a) Temperature controlled	01
b) Ordinary	01
7) Volumetric flasks	60
8) Pipettes	20
a) Graduated --	10
b) Bulb --	10
9) Burettes	20
10) Conical flasks	20
11) China dish	20
12) Burners	20
13) Glass wares such as measuring cylinders, reagent bottles, -- glass rods, tubes etc.	
14) Folin-Wu tubes	120

2.5 PHARMACEUTICAL ORGANIC CHEMISTRY-II (THEORY)

(3hrs/wk)

75 hours

The subject is to be treated in the light of modern perspective giving stress wherever possible on the following aspects-structure, nomenclature, preparation, properties, energy of activation, transition state, resonance, stereochemistry, optical isomerism, Geometric isomerism and mechanism of reaction.

I. Stereochemistry:

14hrs (13-14 Marks)

- a) Stereo isomerism, classification of stereoisomers tetrahedral optical activity, enantiomerism, diastereoisomerism, meso structures, elements of symmetry, chirality, chiral centers, configuration, specification of D and L configuration, R and S configuration. Racemic modification and resolution of racemic mixture, conformational isomers, asymmetric synthesis. Reaction of chiral molecules.
- b) Stereo selective and stereospecific reactions with examples. **2hrs (1-2 Marks)**
- c) Geometrical isomerism, its nature of formation, rotation about bonds: nomenclature of isomers, determination of configuration, Nature of E and Z forms. **5hrs (4-5 Marks)**
- d) Stereochemistry of alicyclic compounds, allenes and biphenyls, stereochemistry of oximes. **3hrs (2-3 Marks)**

II. Heterocyclic Chemistry:

General classification of heterocyclic compounds, nature and nomenclature. reactions, synthesis and properties of the following heterocyclic systems and their derivatives.

- a) Pyrrole, Furan and Thiophene **8hrs (7-8 Marks)**
- b) Indole, Benzofuran and Benzothiophene **4hrs (3-4 Marks)**
- c) Pyridine **3hrs (2-3 Marks)**
- d) Quinoline, Isoquinoline, acridine **4hrs (3-4 Marks)**
- e) Pyrazole, Imidazole, Oxazole, Isoxazole and Thiazole **4hrs (3-4 Marks)**
- f) Pyrimidine, Pyrazine, Pyridazine, Purine, benzodiazepine and phenothiazines **4hrs (3-4 Marks)**

III Chemistry of bio molecules of pharmaceutical importance:

1. Carbohydrates:

9hrs (8-9 Marks)

Introduction, Definition, Classification, Nomenclature, Structural determination of Glucose and Fructose. Stereoisomers of monosaccharides, reactions, conversions, configuration, cyclic structures of glucose, determination of ring size in Glucose. Fischer projection formulae, and conformations. Disaccharides and polysaccharides. Chemical nature of maltose, lactose, sucrose, starch and cellulose, derivatives used in pharmacy.

2. Fats and Oils:

4hrs (3-4 Marks)

Chemistry of fats oils and waxes. Occurrence and composition. Hydrolysis of fats, Fats as sources of pure acids and alcohols. Analytical constants of fats and oils such as Saponification value, Iodine value, Acid value and Unsaponifiable matter and methods of their determination and significance. Rancidity of oils, hardening of oils, hydrogenation of oils, drying, semidrying and nondrying oils with example.

3. Proteins and Amino acids:

4hrs (3-4 Marks)

Introduction, definition, classification of proteins and amino acids their properties Zwitterions. Isoelectric point and its significance. reactions, synthesis of amino acids (Gabriel's Phthalimide, synthesis, Strecker's synthesis, Knoop's and Erlenmeyer's azalactone synthesis) and reactions. Peptide linkages, Peptide synthesis, solid phase synthesis structures of proteins, C-terminal and N-terminal analysis.

4. Protection and De-protection of groups:**3hrs (2-3 Marks)**

Introduction to protection and deprotection of functional groups examples of two protective agents each for amino, hydroxyl and carbonyl groups with their significance in organic synthesis.

5. A study and specific uses of the reagents in organic synthesis including their mechanism.**4hrs (3-4 Marks)**

- Aluminium isopropoxide – Meerwein –Ponndorf- Verley reduction, Oppenauer oxidation.
- Aluminium tertiary butoxide – Allylic bromination
- Lithium aluminium hydride – Reduction of carboxylic acid
- Periodic acid – Oxidation of 1,2 – diol to carbonyl compound
- Sodamide – Chichibian reaction.
- Sodium borohydride – Reduction of aldehyde carbonyl group
- Metachloro peroxybenzoic acid – Beyer – villiger oxidation (oxidation of ketone to esters)
- Diazo methane – Buchaner – Curtius – Schlotterbeck reaction (Aldehydes to methyl ketones)

PHARMACEUTICAL ORGANIC CHEMISTRY-II (PRACTICALS)**(3hrs/Wk)****75 hours****(Following experiments to be carried out in 25 different classes)****I. Quantitative determination of organic compounds via functional groups ****

- Phenolic group by bromination method.
- Alcoholic group by acetylation method.
- Carbonyl group by hydroxylamine hydrochloride-pyridine method.
- Aldehyde group by sodium sulphite-sulphuric acid procedure.
- Carboxyl group by acid-base method.
- Determination of acetone by sodium hypoiodide method
- Amino group by bromination method.
- Amino acid Formal titration method.

II. Analysis of oils and fats: (I.P. Method).

- Acid value.
- Saponification value.
- Iodine value.

III. Synthesis/ preparation involving more than one step*

- p-bromoaniline from acetanilide.
- p-Nitroaniline from acetanilide.
- p-Nitrophenyldrazine from p-nitroaniline.
- 3-methyl-1-phenyl-5-pyrazole from ethyl acetoacetate.
- Benzilic acid from benzoin.

6. Pthalimide from benzophenone.
7. Pthalimide from pthalic acid.
8. Synthesis of 2, 3-Diphenyl quinoxaline.
9. Benzimidazole Orthophenylene Diamine.

SCHEME OF EXAMINATION

1 Synopsis	- 10 Marks
2 Major Experiment (**)	- 30 Marks
3 Minor Experiment (*or oil analysis)	- 20 Marks
4 Viva	- 10 Marks
<hr/>	
Total	- 70 Marks
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TEXT BOOKS (Theory)

1. E. L. Eliel, John Wiley and Son, Stereochemistry of Organic Compounds. New York, 1993.
2. I. L. Finar, Organic Chemistry Vol. I and II, Sixth Edition, 2003, ELBS.
3. A text book of Organic Chemistry Arun Bhal and B.S., Bhal, S. Chand Publishers revised edition.
4. Raj K. Bansal, Heterocyclic Chemistry, New age international Ltd., New Delhi, Third Edition, 2001.
5. B. S. Bhal and Arun Bhal, S. Chand, Advanced Organic Chemistry and Company, New Delhi, 2001.
6. T. W. G. Solomans, Organic Chemistry, Sixth Edition, , John Wiley and Son, New York, 1996.

REFERENCE BOOKS (Theory)

1. R.O.C Norman and J. M. Conon, Principals of Organic Synthesis, Third Edition, 1995, ELBS,
2. R. J. Morrison and R. N. Boyd Organic Chemistry, Fifth Edition, Prentice Hall of India Pvt. Ltd., New Delhi.
3. J. A. Joule and L. K. Mills, Heterocyclic Chemistry Fourth edition, Blackwell Science Publisher, 2000.
4. S. M. Mukherji and S. P. Singh, Reaction Mechanisms in Organic Chemistry, Third Edition Macmillan publishers, 2001.
5. I. P. 1996, Govt. of India, Ministry of Health and Family Welfare, All edition including latest.
6. A. I. Vogel, Elementary Organic Chemistry, Part-3, Quantitative Organic Analysis, second edition, CBS Publishers and Distributors, New Delhi, 2000.
7. B. S. Furniss, A. J. Hannaford, P.W.G. Smith and A. R. Tatchell, Vogel's Text Book of Practical Organic Chemistry, Edited, Fifth Edition, Addison Wesley Longman, England, 1998.

8. Chemistry and Natural Products by Chatwal Vo.1 1 & 2
9. Reaction and reagents O P Agrawal, Goel Publishing House, Subhash Bazar, Meerut (U.P) India

REFERENCE BOOKS (Practical)

1. A.I. Vogel, Elementary Practical organic chemistry, ELBS and Longman group Ltd., London.
2. Mann and Sounders, Practical Organic Chemistry-ELBS and Longman group Ltd.,
3. D.L.Pavia, G.Lampman and G.D.Kriz. Introduction to Organic Laboratory Techniques.
4. I.P., Govt. of India, Ministry of Health and Family welfare, 3rd Edition (1985), 4th Edition (1996).
5. A. I. Vogel, Text Book of practical organic chemistry, ELBS Longman, London, 4th edition.

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Suction Pumps	01
2. Analytical Balances	01
3. Physical Balances	05
4. Triple Beam Balances	--
5. Water Baths, Reflux flask and condenser	10
6. Hot Plates	--
7. Mechanical Stirrers	--
8. Magnetic Stirrers with Thermostat	--
9. Distillation Unit	01
10. Refrigerator	01
11. Oven	01

2.6 ENVIRONMENTAL STUDIES (THEORY)

(2hrs/Wk)

50 hours

Unit 1 : Multidisciplinary nature of environmental studies

(2 Hrs)

Definition, scope and importance

Unit 2 : Natural Resources : Renewable and non-renewable resources :

(8 Hrs)

Natural resources and associated problems.

- a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
 - b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
 - c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
 - d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
 - e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
 - f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
- Role of an individual in conservation of natural resources.
 - Equitable use of resources for sustainable lifestyles.

Unit 3 : Ecosystems

(6 Hrs)

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem :-
 - a. Forest ecosystem
 - b. Grassland ecosystem
 - c. Desert ecosystem
 - d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 4 : Biodiversity and its conservation

(8 Hrs)

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biogeographical classification of India
- Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation
- Hot-spots of biodiversity.
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit 5 : Environmental Pollution

(8 Hrs)

Definition

- Cause, effects and control measures of :-
 - a. Air pollution
 - b. Water pollution
 - c. Soil pollution
 - d. Marine pollution
 - e. Noise pollution
 - f. Thermal pollution
 - g. Nuclear hazards
- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management: floods, earthquake, cyclone and landslides.

Unit 6 : Social Issues and the Environment

(7 Hrs)

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case Studies
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

Unit 7 : Human Population and the Environment

(6 Hrs)

- Population growth, variation among nations.
- Population explosion – Family Welfare Programme.
- Environment and human health.
- Human Rights.
- Value Education.
- HIV/AIDS.
- Women and Child Welfare.
- Role of Information Technology in Environment and human health.
- Case Studies.

Unit 8 : Field work

(Field work Equal to 5 Hrs)

- Visit to a local area to document environmental assets river/ forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc

SIX MONTHS COMPULSORY CORE MODULE COURSE IN ENVIRONMENTAL STUDIES: FOR UNDERGRADUATES

Teaching Methodologies

The core Module Syllabus for Environment Studies includes class room teaching and Field Work. The syllabus is divided into eight units covering 50 lectures. The first seven units will cover 45 lectures which are class room based to enhance knowledge skills and attitude to environment. Unit eight is based on field activities which will be covered in five lecture hours and would provide student first hand knowledge on various local environmental aspects. Field experience is one of the most effective learning tools for environmental concerns. This moves out of the scope of the text book mode of teaching into the realm of real learning in the field, where the teacher merely acts as a catalyst to interpret what the student observes or discovers in his/her own environment. Field studies are as essential as class work and form an irreplaceable synergistic tool in the entire learning process. Course material provided by UGC for class room teaching and field activities be utilized. The universities/colleges can also draw upon expertise of outside resource persons for teaching purpose. Environmental Core Module shall be integrated into the teaching programmes of all undergraduate courses.

Exam Pattern : In case of awarding the marks, the question paper should carry 100 marks. The structure of the question paper being :

Part-A, Short answer pattern	- 25 marks
Part-B, Essay type with inbuilt choice	- 50 marks
Part-C, Field Work	- 25 marks

REFERENCE BOOKS

- a) Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
- b) Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
- c) Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
- d) Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
- e) Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
- f) De A.K., Environmental Chemistry, Wiley Eastern Ltd.
- g) Down to Earth, Centre for Science and Environment (R)
- h) Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
- i) Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
- j) Heywood, V.H & Weston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
- k) Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.

- l) Mckinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
 - m) Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
 - n) Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
 - o) Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
 - p) Rao M N. & Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
 - q) Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut
 - r) Survey of the Environment, The Hindu (M)
 - s) Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
 - t) Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (R)
 - u) Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)
 - v) Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p
- (M) Magazine (R) Reference (TB) Textbook

SYLLABUS FOR III YEAR B.PHARM

3.1 MEDICINAL CHEMISTRY – I (THEORY)

(3hrs/wk)

75 Hours

I Basic Principles of Medicinal Chemistry

1hr (1Marks)

- a) History and development of Medicinal Chemistry, definition of hit, lead and drug.
1hr (1Marks)
- b) Effects of the following physicochemical properties of drug molecules on biological activity: Ionisation, hydrogen bonding, solubility, partition coefficient, logP, logD, protein binding, chelation and polar surface area.
4hrs (3-4 Marks)
- c) Receptor and drug receptor interactions.
1hr (1Marks)
- d) Drug metabolism: Biotransformation, sites of biotransformation, General pathways of drug biotransformation, role of cytochrome P-450 and monoaminoxxygenase in oxidative biotransformation, oxidative, reductive, hydrolytic and conjugation reactions with examples.
5hrs (4-5 Marks)

A study of development of the following classes of drugs including structure activity relationship (SAR), mechanism of action, synthesis of compounds superscribed by 's', chemical nomenclature, generic names, brand names (a few important marketed products) and side effects

II Central nervous system depressants

A. General Anaesthetics: Definition, mode of action

1. Inhalation anaesthetics: Halothane^s, Methoxyflurane, Nitrous oxide
2. Ultra short acting barbiturates: Methohexital sodium^s, Thiopental sodium
3. Dissociative anaesthetics: Ketamine hydrochloride
2hrs (1-2 Marks)

B. Tranquilizers, sedatives and hypnotics

1. *Major tranquilizers*: SAR of Phenothiazines, Promethazine HCl, Chlorpromazine HCl^s, Prochlorperazine, thioridazine HCl
Thioxanthenes: Chlorprothixene, thiothixine, clozapine
Fluorobutyrophenones: Haloperidol^s, Risperidone
Beta amino ketones: Molindone HCl, Benzamide surpierre
4hrs (3-4 Marks)
Minor tranquilizers: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam^s, Orazepam, Chlorazepam, Lorazepam, Flurazepam, Alprazolam^s, Triazolam^s
1hr (1Marks)
2. Barbiturates: Classification and SAR, Barbital^s, Methobarbital^s, Phenobarbital, Amobarbital^s, Butarbital, Pentobarbital, Secobarbital
2hrs (1-2 Marks)
3. Miscellaneous sedative hypnotics:
 - a) Amides and imides: Glutethimide^s, Methypylon, Methaqualone^s
 - b) Alcohols and their carbamate derivatives: Ethchlorvynol, Ethinamate, Meprobamate^s
 - c) Aldehydes and their derivatives: Chloral hydrate, Paraldehyde

C. Skeletal muscle relaxants: Chlorphenesin^s, Methocarbamol, Chlorzoxazone

D. Drugs used in spasticity: Baclofen, Buspirone 3hrs (2-3 Marks)

E Anticonvulsants: Structural requirement for anticonvulsant activity, mechanism of anticonvulsant action

1. Barbiturates: Phenobarbitone, Mepobarbitone

2. Hydantoins: Phenytoin sodium^s, Ethotoin, Mephentyoin
3. Oxazolidinediones: Trimethadione^s, Paramethadione
4. Succinimides: Phensuximide^s, Methsuximide, Ethsuximide
5. Urea and monoacyl ureas: Phenacemide, Carbamazepine^s
6. Benzodiazepines: Clonazepam^s,
7. Miscellaneous: Primidone, Valproic acid

4hrs (3-4 Marks)

III Adrenergic agents

A. Adrenergic neurotransmitters and their biosynthesis and metabolism, adrenergic receptors their distribution and actions mediated by them **1hrs (1 Marks)**

B. Sympathomimetics

1. Direct acting: SAR, Endogenous catecholamines,
 - a) Alpha adrenergic agonists: Phenylephrine^s, Methoxamine, Naphazoline, Xylometazoline^s, Oxymetazoline, Clonidine^s, Guanabenz, Methyldopa
 - b) Dual agonist/antagonist: Dobutamine
 - c) Beta adrenergic agonists: Isoproterenol^s, Metaproterenol, Terbutalin^s, Albuterol, Salbuterol, Bitolterol, Ritodrine

2. Indirect acting: Hydroxyamphetamine, Propylhexedrine

3. Mixed acting: Ephedrine, Metaraminol

4hrs (3-4 Marks)

C. Adrenolytics:

1. Alpha blockers:
 - a) Non selective: Tolazoline
 - b) Irreversible blockers: Phenoxybenzamine^s
 - c) Alpha1 blockers: Prazosin^s, Doxazosin, Tamsulosin
 - d) Alpha2 blockers: Yohimbine, Coryanthine
2. Beta blockers: SAR
 - a) Non selective blockers: Propranolol^s, Nadolol, Pindolol, Timolol, Sotalol
 - b) Beta1 blockers: Acebutolol, Atenolol, Esmolol, Metoprolol^s
 - c) Betablockers with alpha1 antagonistic activity: Labetalol, Carvedilol

4hrs (3-4 Marks)

IV Cholinergic drugs and related agents

1. Cholinergic neurotransmitter: Biosynthesis, metabolism and functions of acetylcholine
2. Cholinergic receptors: Nicotinic, muscarinic and their subtypes **1hrs (1 Marks)**

A. Cholinergic agonists:

1. Stereochemistry and SAR, Acetylcholine, Methacholine, Carbachol, Bethanechol, Pilocarpine
2. Cholinesterase inhibitors:
 - a) Reversible: Mode of action, Physostigmine, Neostigmine^s, Ambenonium, Demecarium, Edrophonium, Tacrine
 - b) Irreversible: Mode of action, Isoflurophate, Ecothiophate, Malathion, Parathion, Pralidoxime.

5hrs (4-5 Marks)

B. Cholinergic blockers: SAR

9. Postganglionic blockers: Structural considerations of solanaceous alkaloids and analogs, Atropine, Hyoscyamine, Scopolamine, Homatropine, Ipratropium
10. Synthetic agents: Clidinium, Dicyclomine^s, Glycopyrrolate, Methantheline, Propantheline, Benztropine, Procyclidine, Tropicamide^s,
11. Ganglionic blockers: Mode of action, Trimethaphan, Mecamylamine
12. Neuromuscular blockers: Mode of action, Tubocurarine, Metocurine, Gallamine, Pancuronium, Vecuronium.

6hrs (5-6 Marks)

V Local anesthetics

- A. Definition, classification, and mechanism of action
- B. SAR of lidocaine derivatives
- C. 1. Benzoic acid derivatives: Hexylcaine, Cyclomethicaine, Piperocaine
 2. Aminobenzoic acid derivatives: Benzocaine, Procaine^s, Procainamide
 3. Lidocaine derivatives (Anilides): Lidocaine^s, Prilocaine
 4. Miscellaneous: Dimethisoquin, Dibucaine **4hrs (3-4 Marks)**

VI Histamine and antihistaminic agents

- A. Histamine: receptors and its actions
- B. Antihistaminics: H1 antagonists
 - a) Aminoalkyl ethers: Diphenhydramine HCl, Bromodiphenhydramine, Doxylamine
 - b) Ethylene diamines: Tripelenamine, Pyrillamine
 - c) Propylamine derivatives: Pheniramine, Chlorpheniramine^s
 - d) Phenothiazine derivatives: Promethazine^s, Trimeprazine
 - e) Piperazine derivatives: Cyclizine, Meclizine, Cetirizine^s
 - f) Miscellaneous compounds: Phenindamine, Cyproheptadine
- C. H2 antagonists: Mechanism, Cimetidine, Ranitidine, Famotidine
- D. Gastric proton pump inhibitors: Mechanism of action, Omeprazole^s, Pantoprazole, Rabeprazole, Lansoprazole. **6hrs (5-6 Marks)**

VII Analgesic agents

- A. 1. Narcotic analgesics: Opioid receptors, SAR, Morphine, Codeine, Diacetyl morphine, Levorphanol, Dextromethorphan^s, Pentazocine, Meperidine, Loperamide, Fentanyl, Methadone^s, Propoxyphene, Tramadol
 2. Narcotic antagonists: Butorphanol, Nalorphine, Levalorphan, Naltrexone, Naloxone **4hrs (3-4 Marks)**
- B. Non narcotic analgesics
 - 1. Steroidal anti-inflammatory agents: Cortisone, Hydrocortisone, Dexamethasone, Betamethasone, Triamcinolone, Fluocinolone
 - 2. Non steroidal anti-inflammatory agents: Mechanism of action
 - a) Salicylic acid derivatives: Aspirin
 - b) N-aryl anthranilic acid derivatives: Mefenamic acid^s, Diclofenac, Aceclofenac
 - c) Aryl acetic acid derivatives: Indomethacin, Ibuprofen^s, Piroxicam^s, Naproxen^s
 - d) Aniline and paraaminophenol derivatives: Phenacetin, Acetaminophen^s
 - e) Pyrazolone and pyrazolidine dione derivatives: Antipyrin, Oxyphenbutazone, Phenylbutazone
 - f) Diaryl sulphonamides: Nimesulide^s, Rofecoxib, Valdecoxib **5hrs (4-5 Marks)**

VIII Structure and medicinal uses of important prostaglandins 1hrs (1 Marks)

IX Natural Products

- A. Alkaloids: Definition, Classification, Structural elucidation of ephedrine **2hrs (1-2 Marks)**
- B. Purines: Definition, Structural elucidation of caffeine, Interrelation among caffeine, theophylline, theobromine. **2hrs (1-2 Marks)**
- C. Terpenoids: Definition, classification, isoprene and special isoprene rule, Interrelationship among monocyclic monoterpenoids like limonene, dipentene, alpha terpenoid, alpha terpenion, terpenolene, terpin, terpene hydrate, carvone and cineone. **2hrs (1-2 Marks)**

I. Identification test and test for purity of*

1. 1 Benzocaine
2. Phenytoin sodium
3. Diclofenac sodium
4. Aminophylline
5. Aspirin
6. Caffeine
7. Paracetamol

II Assay of medicinally useful compounds (in solid dosage form)**

1. Ibuprofen by alkalimetry
2. Analgin by iodimetry
3. Ephedrine HCl/Phenobarbitone by non-aqueous titration
4. Procaine/Benzocaine by diazotisation
5. Chlorpromazine by cerimetry

III Preparation of medicinally useful compounds*

1. Phenytoin from benzoin
2. Paracetamol from p-nitrophenol
3. Benzocaine from p-aminobenzoic acid
4. 4-hydroxycoumarin from resorcinol
5. Mefenamic acid from anthranilic acid
6. Phenothiazine from diphenylamine

IV Degradation of Ephedrine to benzoic acid***V Determination of partition coefficient and log P for any two drugs******Scheme of Examination**

1 Synopsis	10 Marks
2 Major (indicated by **)	25 Marks
3 Minor (indicated by *)	15 Marks
4 Minor (indicated by *)	10 Marks
5 Practical Viva-voce	10 Marks

Total**70 Marks**

TEXT BOOKS (THEORY)

Latest editions and all volumes of

- 1 Wilson and Giswold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Wolters Kluwer.
- 2 William O Foye Principles of Medicinal Chemistry, Lea and Febiger, Philadelphia.
- 3 Medicinal Chemistry Ashutosh Kar New age international publishers, New Delhi.
- 4 Chemistry of Natural Products by Chatwal and Aanand.

REFERENCE BOOKS (THEORY)

Latest editions and all volumes of

- 1 Burger's Medicina
- 2 I Chemistry, ME Walffed Johnwiley and sons
- 3 Martindale the Extra Pharmacopoeia, JE Reynolds The pharmaceutical press, London
- 4 Beckett and Stenlake Practical Pharmaceutical Chemistry, the sthalone press, University of London
- 5 IP 2014 Govt. of India, Ministry of health
- 6 BS Furniss et al Vogel's TB of Practical Organic Chemistry including quantitative analysis, ELBS/Longman, London
- 7 Mann and Saunders Practical Organic Chemistry Longman Green and Co London
- 8 Organic Chemistry of Drug Synthesis Lednicer Mitzsher
- 9 Current Index of Medical Specialities (CIMS)
- 10 Essentials of Medicinal Chemistry Korolkovas
- 11 Natural Product Chemistry by Aggarwal

REFERENCE BOOKS (PRACTICALS)

- 1 Latest editions and all volumes of
- 2 IP
- 3 IL Finar TB of organic chemistry
- 4 AI vogel TB of Practical organic chemistry
- 5 The Organic chemistry of drug synthesis Lednicer Mitzsher
- 6 Mann and Saunders Practical organic chemistry
- 7 T Robinson Organic constituents of higher medicinal plants
- 8 CIMS

LIST OF MINIMUM EQUIPMENTS REQUIRED

1	Suction pump	01
2	Analytical balance	10
3	Water bath, reflux flask and condenser	10
4	Hot plate	01
5	Mechanical stirrer	02
6	Magnetic stirrer with thermostat	02
7	Distillation unit	01
8	Refrigerator	01
9	Fuming hood	01
10	Oven	01

3.2 PHARMACEUTICAL JURISPRUDENCE AND ETHICS (THEORY)

(2hrs/Wk)

50 Hours

1. Introduction

- a) Pharmaceutical legislations - brief review. 1hr (2 marks)

2. An elaborate (practical oriented) study of the following

- a) Code of pharmaceutical ethics. 1hr (2 marks)
b) Pharmacy act 1948. 2 hrs (4 marks)
c) Drugs and cosmetic act 1940 and rules 1945 (with special reference to schedules M,P,U,V, and Y). 20 hrs (28 marks)
d) Medicinal and toilet preparations (Excise Duties) Act 1955. 3 hrs (6 marks)
e) Medical Termination of pregnancy act year 2 hrs (4 marks)
f) Narcotic drugs and psychotropic substances act 1985 and rules. 3 hrs (6 marks)
g) Should be replaced by DPCO 2013. 2 hrs (4 marks)
h) Pharmaceutical policy 2002. 2 hrs (4 marks)
i) Right to information act. year 2 hrs (4 marks)
j) Hatch Waxman act 1984. (2 hrs 4 marks)

3. A brief study of the following with special reference to be main provisions

- a) Drugs and magic remedies (Objectionable advertisements) act 1954 2 hrs (4 marks)
b) Prevention of cruelty to animals act 1960 including study of CPSCEA guidelines 2 hrs (4 marks)
c) Indian Patents Act with special reference to pharmaceuticals along with amendment bills, process patent and product patent. a. General procedure for obtaining pharmaceutical patents, introduction to intellectual properties. Trademark, copyright, trade secrets. 4 hrs (8 marks)

4. New Drug Application, Abbreviated new drug application (ANDA) 2 hrs (4 marks)

Note: The teaching of all the above acts should cover the latest amendments.

REFERENCE BOOKS

1. CPSCEA Guidelines.
2. Gennaro AL. Remington: The science and practice of pharmacy Vol I and II. 20th ed. Philadelphia:Lippincott Williams and Wilkins;2000.
3. Helsinki Guidelines.
4. ICMR Guidelines.
5. Jain NK. A textbook of forensic pharmacy. 6th ed. New Delhi:Vallabh Prakashan,2003.
6. Jani GK. Pharmaceutical jurisprudence vol I and II. Ahmedabad:Atul Prakashan.
7. Kuchekar BS. A textbook of pharmaceutical jurisprudence. Pune:Nirali Prakashan;1994.
8. Latest issues of CIMS, MIMS, PDR, DDR.
9. Latest issues of IDMA Bulletin.
10. Mithal BM. A textbook of forensic pharmacy. Delhi:Vallabh Prakashan. Year
11. Parikshit B. IPR handbook for pharma students & researchers.
12. Saikishore. Drug regulatory affairs.
13. Subramanyam CVS, Thimmasetty J. Pharmaceutical regulatory affairs. Delhi: Vallabh Prakashan;2012.
14. Sudhakar Y. Novel drug delivery systems & regulatory affairs.
15. Suresh B. A text book of forensic pharmacy.

3.3 PHARMACOGNOSY AND PHYTOCHEMISTRY (THEORY)

(3hrs/wk)

75hours

1. Isolation and purification of phytoconstituents a) Different methods of extraction: maceration, percolation and supercritical fluid extraction. Choice of suitable solvents, processing and drying methods. b) Preliminary phytochemical screening of various secondary metabolites in plant extracts. c) Chromatographic methods applied for the isolation and purification of phytoconstituents.	10 h (12 marks)
2. Evaluation of crude drugs Organoleptic, Microscopical, Physical, Chemical, Spectroscopic and Biological methods	4 h (5 marks)
3. Biogenesis of Phytopharmaceuticals a) Techniques employed in the elucidation of biosynthetic pathways b) Detailed study of basic metabolic pathways, Shikimic acid pathway and Isoprenoid pathway c) Biosynthesis of - Tropane, Quinoline, Opium and Indole alkaloids, Anthraquinone glycosides and Steroids.	12 h (15 marks)
4. Glycosides a) Definition, properties, chemical tests, classification and general method of extraction of glycosides b) Definition, properties, chemical nature and uses of the following: i) Cardiac glycosides ii) Anthracene glycosides iii) Saponins iv) Cyanogenetic glycosides v) Flavonoids vi) Lactones and bitter glycosides vii) Isothiocyanate glycosides viii) Steroidal glycol-alkaloids c) Source, diagnostic characters, chemical constituents, uses and adulterants of i) Digitalis ii) Squill iii) Senna iv) Aloe v) Cochineal vi) Ginseng vii) Liquorice viii) Wild Cherry bark ix) Bio-flavonoids (Lemon & Orange peel) x) Gingko xi) Milk-thistle xii) Chirata xiii) Dioscorea xiv) Mustard xv) Solanum nigrum	15 h (19 marks)
5. Alkaloids a) Definition, properties, chemical tests, classification and general method of extraction of alkaloids b) Source, diagnostic characters, chemical constituents, uses and adulterants of i) Lobelia ii) Tobacco iii) Datura iv) Atropa v) Cinchona vi) Ipecac vii) Opium viii) Rauwolfia ix) Ergot x) Aconite xi) Kurchi xii) Ephedra xiii) Colchicum xiv) Tea xv) Taxus	15 h (17 marks)
6. Essential oils a) Definition, properties, chemical nature, classification and general method of extraction of volatile oils b) Source, diagnostic characters, chemical constituents and uses of: i) Clove ii) Cinnamon iii) Fennel iv) Caraway v) Eucalyptus vi) Mentha vii) Nutmeg viii) Lemon grass oil	10 h (12 marks)

c) Analysis of the following: Clove oil, Cinnamon oil, Eucalyptus oil, Mentha oil and lemon grass oil	
7. Tannins a) Definition, properties, classification, general method of extraction and estimation of tannins. b) Source, chemical constituents, chemical tests, uses and adulterants of i) Pale and Black catechu ii) Nutgal iii) Arjuna iv) Myrobalan v) Bahera	3 h (4 marks)
8. Carotenoids a) Definition, properties and classification of carotenoids. b) Source, chemical nature and uses of α and β -Carotenes, Lycopene, Xanthophyll	2 h (2 marks)
9. Marine Pharmacognosy Novel medicinal agents from marine sources	2 h (2 marks)
10. Natural allergens, photosensitizing agents and fungal toxins	2 h (12 marks)

PHARMACOGNOSY AND PHYTOCHEMISTRY (PRACTICALS)

(3hrs/wk)

75hours

1) Study of Powder microscopy of the following crude drugs*

Digitalis, Squill, Senna, Liquorice, Wild Cherry bark, Cinchona, Ipecac, Rauwolfia, Kurchi, Ephedra, Clove, Cinnamon

2) Qualitative general and specific chemical tests for the following phytoconstituents*

Alkaloids: Quinine, Atropine, Caffeine,

Glycosides: Sennosides, Aloin, Flavonoids, Saponins and Cardiac glycosides

Tannins: Tannic acid, Pale catechu and Black catechu

3) Determination of proximate values *

i) Moisture content

ii) Ash values

iii) Extractive values

4) Quantitative microscopy**

i) Determination of Stomatal number and Stomatal index

ii) Determination of Starch grains dimensions and length of fibres using eye piece micrometer and camera lucida methods

iii) Determination of percentage purity of crude drugs by using Lycopodium spore method

5) Determination of total polyphenolic content by Folin-cu method**

6) Demonstration experiments

i) Soxhlet extraction

ii) Extraction of essential oils by Clevenger's apparatus

SCHEME OF EXAMINATION

1. Synopsis	10 marks
2. Quantitative Microscopy	25 marks
3. Powder Microscopy	15 marks
4. Minor experiment	10 marks
5. Viva-Voce	10 marks
Total	70 marks

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1. Evans W.C., 2002. Trease and Evans Pharmacognosy, 15th ed. Elsevier Science Ltd, Philadelphia.
2. Kokate C.K., Purohit A.R and Gokhale S.B., 2010. Pharmacognosy 45th ed. Nirali Prakashan, Pune.
3. Tyler V.E and Brady R., 1981. Text book of Pharmacognosy, 8th ed. Lea and Febiger, Philadelphia.
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5. Jean Bruneton, 1999. Pharmacognosy, Phytochemistry & Medicinal Plants, 2nd ed. Lavoisier Publishing House, UK.
6. Pridham J.B and Swain T., 2012. Biosynthetic pathways in higher plants, 1st ed. Academic Press, New Delhi.
7. Pulok Mukherjee, 2002. Quality control of herbal drugs, 1st ed. Business horizons, New Delhi.
8. Biren Shah N and Seth A.K., 2010. Text Book of Pharmacognosy and Phytochemistry, 1st ed. A Division of Reed Elsevier India Private Ltd, New Delhi.
9. Ashutosh Kar, 2013. Essentials of Pharmacognosy, 1st ed. Ahuja Book House Pvt Ltd, Delhi.
10. Khadabadi S.S., Deore S.L and Bavskar B.A., 2010. Pharmacognosy and Phytochemistry: A Comprehensive approach, 1st ed. Pharma Med Press, Hyderabad.
11. Bhakuns and Rawat, 2005. Bioactive Marine Natural Products, 1st ed. Anmaya Publishers, New Delhi.
12. Harborne J.B., 1998. Phytochemical methods, 3rd ed. Springer (India) Pvt Ltd, New Delhi.
13. Iyengar M.A 2001. Study of Crude Drugs, 14th ed. Manipal Power Press, Manipal.
14. Iyengar M.A and Nayak S.G.K., 2001. Anatomy of Crude Drugs, 8th ed. Manipal Power Press, Manipal.
15. Iyengar M.A 2001. Pharmacognosy of Powdered Crude Drugs, 6th ed. Manipal Power Press, Manipal.

16. Kokate C.K., 1994. Practical Pharmacognosy, 4th ed. Vallabh Prakashan, New Delhi.
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18. Wallis T.E., 2011. Practical Pharmacognosy, 4th ed. Pharma Med Press, Hyderabad.
19. Indian Herbal Pharmacopoeia 1998 & 1999, Vol I & Vol II. Government of India, Ministry of Health. A Joint Publication of RRL, Jammu and IDMA, Mumbai.
20. National and International Journals- Pharmacognosy Reviews, Pharmacognosy Magazine, Journal of Natural Products, Phytotherapy Research, Phytochemistry.

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Camera lucida	20
2. Eye piece micrometer	20
3. Stage micrometer	20
4. Microscope	20
5. Clavengers apparatus	05
6. Balance (Digital)	02
7. Muffle furnace	01
8. Hot air oven	01
9. Spectrophotometer	01
10. Soxhlet apparatus	05
11. Heating mantle	10
12. Vacuum pump	02

3.4 PHARMACEUTICAL ENGINEERING (THEORY)
(3hrs/Wk)

75 hours

- 1. Stoichiometry:** Unit processes, material and energy balances, units and their conversions, dimensional formulae, dimensionless equations. **2 hours; 2 marks**
- 2. Heat transfer:** Concept of heat flow by conducting through single wall, applications of Fourier's law, forced and natural convections, surface co-efficients, study on single, multi pass heat exchangers and liquid-liquid heat interchangers, radiation, black body, Stefan-Boltzmann equation. **6 hours; 7 marks**
- 3. Evaporation:** Theory of evaporation. Evaporators – steam jacketed kettle, horizontal tube evaporator, vertical tube evaporator, climbing film evaporator, falling film evaporator, forced circulation evaporator, multiple effect evaporator. **5 hours; 6 marks**
- 4. Distillation:** Raoult's law, volatility, Rayleigh's equation, Study on principles and equipments of simple, flash, fractional, azeotropic, extractive, vacuum, steam, and molecular distillation methods. **6 hours; 7 marks**
- 5. Drying:** Theory of drying, Classification and types of dryers – Principle, construction and working of tray dryer, fluidized bed dryer, drum dryer, vacuum dryer, freeze dryer, and spray dryer. **6 hours; 7 mark**
- 6. Size reduction:** Definition, objectives, factors affecting size reduction, laws governing energy and power requirement of a mill, stress strain relationship of deformation in solids. Types of mills, construction and working of ball mill, hammer mill, fluid energy mill, edge runner mill, end runner mill, and cutter mill. **5 hours; 7 marks**
- 7. Size separation:** Definition and objectives of size separation, standard sieves as per IP. Mechanical sieve shakers, sedimentation tanks, mechanical classifiers, cyclone separators, air separators, bag filter. **4 hours; 5 marks**
- 8. Mixing:** Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing. Equipments- cylindrical, V-cone, double cone, ribbon, sigma blade, planetary, zig-zag and barrel mixers. Mixing devices, -propellers, turbines, paddles, and baffles. Vortex formation and prevention. Homogenization and study on Silverson emulsifier, Rapasonic homogenizer and colloid mill. **7 hours; 9 marks**
- 9. Material Handling Systems:** Transportation of solids: Construction and working of belt conveyor, screw, chain, pneumatic, and bucket conveyors.

Transportation of fluids: Pumps - positive displacement pumps, centrifugal pump, peristaltic pump. Cycloidal blower. **7 hours; 9 marks**
- 10. Filtration and centrifugation:** Study of Poiseuille's equation, Kozeny-Carman equation, Darcy's equation, filter aids and filter media. Construction and working of filter press, filter leaf, meta filter, drum filter, sintered glass filter, seitz filter, and

candle filter. Theory and principle of centrifugation, industrial centrifuges - basket, super, and conical disk centrifuges. **8 hours; 9 marks**

11. Crystallization: Definition, characteristics, crystal forms, crystal habits, mechanism of crystallization, solubility curves, Mier's super-saturation theory, construction and working of agitated batch crystallizer, Swenson-Walker crystallizer, Krystal crystallizer and vacuum crystallizer. Caking of crystals and its prevention.

6 hours; 7 marks

12. Humidification: Definition of humidity, humid heat, humid volume, study of psychrometric charts, wet bulb theory. Applications of humidity, control in various pharmaceutical departments like powders, capsules and tablets. **4 hours; 5 marks**

13. Materials of construction: Applications and corrosion resistance properties of stainless steel, plastic and rubber, classification and mechanism of corrosion, factors, prevention and control. **4 hours; 5 marks**

14. Ion exchange: Mechanisms, ion exchange resins, preparation and applications of ion exchange resins. Ion exchange equipment – Fixed bed ion exchange equipment, moving bed ion exchange equipment, fluidized bed ion exchange equipment.

4 hours; 5 marks

PHARMACEUTICAL ENGINEERING (PRACTICALS)

75 hours

- 01 Drying of wet granules/calcium carbonate slurry and plotting drying rate curves.**
- 02 Size reduction of granular material using ball mill and calculation of Ritinger's, Kick's and Bond's coefficients.**
- 03 Determination of particle size weight distribution of a sample using sieve shaker and derivation of various statistical parameters.*
- 04 Study of the effect of materials related factors like concentration, viscosity, filter aids on the rate of filtration using calcium carbonate suspension.*
- 05 Study of the effect of process related factors like surface area, thickness, pressure on the rate of filtration using calcium carbonate suspension.*
- 06 Determination of the mixing index for the blending of calcium carbonate and talc (or salicylic acid and lactose).**
- 07 Determination of leaching of ampoules and vials in terms of powdered glass test and water attack test.**
- 08 Determination of mixing efficiency when the propeller blade is introduced in different positions during liquid-liquid mixing.**
- 09 Measurement of homogenizing capacity of Silverson Emulsifier for mixing of immiscible liquids (liquid paraffin-water).**
- 10 Preparation of crystals of potassium nitrate by shock cooling technique and study of its crystal habit.*
- 11 Study of the effect of surface area, viscosity, concentration on the rate of evaporation*
- 12 Study the influence of centrifugal effect in separating the oil phase of turpentine liniment.**
- 13 Separation of turpentine oil from oil mixture by steam distillation process.*

- 14 Determination of water vapour permeability across packing material*
- 15 Determination of equilibrium moisture content (EMC) of substances (starch or bentonite) at different humidities at room temperature.*
- 16 Analysis of pharmaceutical packing materials: Corrugated box.*

SCHEME OF EXAMINATION

1. Synopsis	-10 Marks
2. Major experiment (indicated by **)	-30 Marks
3. Minor experiment (indicated by *)	-20 Marks
4. Viva voce	-10 Marks

Total

= 70 Marks

REFERENCE BOOKS

1. Badger WL, Banchero JT. Introduction to chemical engineering. Singapore: McGraw-Hill Book Company; 1955.
2. Carter SJ. Cooper and Gunn's Tutorial pharmacy. 6th ed. New Delhi: CBS Publishers; 2000.
3. Coulson JM, Richardson JF, Backhurst JR, Harker JH. Chemical engineering Vol 1 and 2. 2nd ed. New Delhi: Asian Book Pvt Ltd; 1998.
4. Don WG, James O. Perry's chemical engineer's handbook. Singapore: McGraw-Hill Book Company; 1984.
5. Gennaro AL. Remington: The science and practice of pharmacy Vol I and II. 20th ed. Philadelphia: Lippincott Williams and Wilkins; 2000.
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8. Rawlins EA. Bentley's textbook of pharmaceuticals. 8th ed. New Delhi: Reed Elsevier India Pvt Ltd; 2010.
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LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Autoclave	01
2. Ball Mill	01
3. Buchner filtration apparatus	01
4. Centrifuge	01
5. Desiccators	05
6. Double cone Blender	01
7. Energy meter	01
8. Permeability cups	05
9. Propeller type mechanical agitator	05
10. Refrigerator	01
11. Sieve Shaker with set of sieves	01
12. Silverson Homogeniser	03
13. Steam distillation still	01
14. Tray dryer	01
15. Vacuum Pump	01
16. Water bath	01

3.5 PHARMACOLOGY (THEORY) (3Hrs/wk)

75 Hours

Scope and Objectives: This subject will provide an opportunity for the student to learn about the drug with regard to classification, pharmacodynamic and pharmacokinetic aspects, adverse effects, uses, dose, route of administration, precautions, contraindications and interaction with other drugs. In this subject, apart from general pharmacology, drugs acting on autonomic nervous system, cardiovascular system, blood and blood forming agents, hormones, autacoids and renal system will be taught. In addition to theoretical knowledge, the basic practical knowledge relevant to therapeutics will be imparted.

Upon completion of the subject student shall be able to:

1. Understand the pharmacological aspects of drugs falling under the above mentioned chapters;
2. Handle and carry out the animal experiments;
3. Appreciate the importance of pharmacology subject as a basis of therapeutics; and
4. Correlate and apply the knowledge therapeutically.

Sl. No.	Course Contents	No of Hours	Marks
1.	General Pharmacology	15	15-20
	a. Introduction and definitions—Health, Drug, Pharmacology, Pharmacokinetics and Pharmacodynamics, Sources of drugs.	1 1	
	b. Routes of administration of drugs	2	
	c. Absorption of drug and the factors affecting them.	3	
	d. Drug distribution, metabolism and excretion	2	
	e. Mechanism of drug action—Drug-Receptor interactions and molecular & biochemical basis of drug action, additive effect, synergism, potentiation.	2	
	f. Factors modifying drug effects.	2	
	i. Patient related factors		
	ii. Drug related factors		
	g. Classification and mechanism of action of ADR.	1	
	h. Dose response relationship, structure activity relationship.	1	
	i. Definitions, Basic concepts of and mechanisms of Drug-Drug, Drug-Food interactions, classification of Drug-Drug interaction.	2	
2.	Pharmacology of drugs acting on Autonomic Nervous System	19	20-25
	a. Introduction —Neurohumoral Transmission.	1	
	b. Adrenergic Drugs	5	
	i. Adrenergic transmission, adrenergic receptors and drugs affecting adrenergic transmission.		
	ii. Classification of drugs and mechanism of action.		
	iii. Pharmacology of adrenaline (a proto type adrenergic drug) and salient features of other adrenergic drugs.		
	c. Adrenergic Blockers.	3	
	Classification, pharmacology of phenoxybenzamine (a proto		

	<p>type alpha blocker), pharmacology of propranolol (a proto type beta blocker), salient features of alpha & beta blockers.</p> <p>d. Adrenergic neuronal blockers & mechanism of action.</p> <p>e. Cholinergic Drugs</p> <ol style="list-style-type: none"> Cholinergic transmission, cholinergic receptors and drugs affecting cholinergic transmission. Classification of drugs and mechanism of action. Pharmacology of Acetylcholine (a proto type cholinergic drug). Salient features of other cholinergic drugs, including cholinesterase inhibitors and enzyme reactivators. <p>f. Anti cholinergic Drugs</p> <p>Pharmacology of atropine (a proto type anti cholinergic drug) and salient features of other anti cholinergic drugs.</p> <p>g. Ganglionic blockers and stimulants.</p> <p>h. Neuromuscular blocking agents and drugs used in myasthenia gravis.</p>	<p>1</p> <p>5</p> <p>4</p>	
3.	<p>Pharmacology of Drugs acting on Cardiovascular System</p> <p>a. Anti- hypertensives agents</p> <ol style="list-style-type: none"> Classification and mechanism of action. Pharmacology of centrally acting drugs (Clonidine and methyldopa). Classification of vasodilators including calcium channel blockers Pharmacology of drugs affecting Renin Angiotensin system. <p>b. Anti - anginal drugs</p> <p>Classification and pharmacology of anti -anginal drugs</p> <p>c. Anti-arrhythmic drugs.</p> <ol style="list-style-type: none"> Classification and mechanism of action. Pharmacology of quinidine (A proto type sodium channel blocker). Salient features of other anti-arrhythmic drugs. <p>d. Drugs used for therapy of congestive cardiac failure (CCF)</p> <ol style="list-style-type: none"> Classification and mechanism of action of drugs used for CCF, pharmacology of digoxin . Salient features of other drugs used in CCF <p>e. Drugs used in treatment of hyperlipidaemias</p> <ol style="list-style-type: none"> Classification and mechanism of action of anti-hyperlipidaemics. Pharmacology of atorvastatin (A proto type of HMG CoA reductase inhibitor). Salient features of other anti- hyperlipidaemic agents. 	<p>14</p> <p>4</p> <p>2</p> <p>3</p> <p>2</p> <p>3</p>	15-20

4.	Pharmacology of Drugs Acting on Renal System (Diuretics) and antidiuretics. <ol style="list-style-type: none"> Classification and mechanism of action of diuretics Pharmacology of furosemide. Salient features of other diuretics. Pharmacology of anti-diuretics. Uses and adverse effects of Urine acidifiers and alkalinizers 	03	5-10
5.	Pharmacology of Drugs Acting on Blood and Blood forming Agents Classification and mechanism of action & salient features of coagulants and anti-coagulants, haemopoietics, thrombolytics and antiplatelet agents.	04	5-10
6.	Pharmacology of Autocoids & their antagonists <ol style="list-style-type: none"> Histamine and antihistaminics. 5-Hydroxytryptamine and its antagonists. Lipid derived autocoids and platelet activating factor. 	04	5-10
7.	Pharmacology of Drug Acting on Respiratory Tract Drugs used in asthma and COPD, mucolytics, expectorants, antitussives, nasal decongestants.	03	2-5
8.	Pharmacology of Hormones and Hormones Antagonists <ol style="list-style-type: none"> Thyroid and antithyroid drugs: Classification, mechanism of action and salient features of thyroid and antithyroid drugs. Anti-diabetic drugs. Insulin, Insulin preparations. Oral hypoglycemic agents: Classification, mechanism of action, salient features of oral anti-diabetics including newer agents. Pharmacology of corticosteroids. Pharmacology of sex hormones and oral contraceptives. Pharmacology of oxytocin, other uterine stimulants and relaxants. 	13 2 2 3 2 2 2	10-15

PHARMACOLOGY (PRACTICALS)
(3Hrs/wk)

75 Hours

1. Regulatory perspectives of animal experiments with special reference to CPCSEA guidelines.
2. Study of laboratory animals and their handling.
3. Study of physiological salt solutions used in experimental pharmacology.
4. Study of laboratory appliances used in experimental pharmacology.
5. Study of use of anesthetics in lab animals. *
6. Study of techniques of euthanasia in lab animals.*
7. To study the routes of administration of drugs.*
8. To study the absorption of glucose/drugs using everted gut sac from rat/chick.*
9. To study the *in vitro* protein binding and displacement of bound drug using egg albumin.*
10. To record the dose response curve of histamine using isolated guinea pig/chick/rat ileum preparation.*
11. Study of agonistic effects of histaminergic drugs using isolated guinea pig /chick/rat ileum preparation. **
12. Study of antihistaminic drugs using isolated guinea pig /chick/rat ileum preparation. **
13. To record the dose response curve of acetylcholine using isolated guinea pig/chick/rat ileum preparation.*
14. Study of potentiating effects of cholinergic drugs using isolated guinea pig /chick/rat ileum preparation. **
15. Study of anticholinergic drugs using isolated guinea pig /chick/rat ileum preparation. **
16. Simulated experiments on effects of drugs on isolated heart of frog.*
17. Simulated experiments on effects of drugs on hypodynamic heart of frog.*
18. Simulated experiments on effects on B.P, HR and RR of dog.*
19. Simulated experiments on effects of mydriatic and miotic drugs on rabbit's eye. *
20. Simulated experiments on effects of local anaesthetic drugs on rabbit's eye. *
21. Simulated experiments on effects of drugs on ciliary motility of frog's esophagus. *

**** (Major experiment) * (Minor experiment)**

SCHEME OF EXAMINATION

1. Identification	-	10 Marks
2. Synopsis	-	10 Marks
3. Major Experiment	-	25 Marks
4. Minor Experiment	-	15 Marks
5. Viva	-	10 Marks
Total		= 70 Marks

TEXT BOOKS

1. Tripathi KD, Essentials of Medical Pharmacology, 7th Edition, Jaypee Brothers, 2010.
2. Satoskar R.S., Bhandarkar S.D. and Rege N.N., Pharmacology and Pharmacotherapeutics, 21st Edition, Popular Prakashan Pvt Ltd, 2010.
3. Chaudhary S.K., Quintessence of Medical Pharmacology, 3rd Revised Edition, Central Book Agency Pvt. Ltd., 2010.
4. Sharma H.L. and Sharma K.K., 2nd Edition, Principles of Pharmacology, Paras Medical, 2011.
5. Ghosh M.N., Fundamentals of Experimental Pharmacology, 5th Edition, Hilton & Company, 2011.
6. Kulkarni S.K., Hand book of Experimental Pharmacology, 3rd Edition, Vallabh Prakashan, 2005.
7. Medhi B. and Prakash A., Practical manual of experimental and clinical pharmacology, 1st Edition, Jaypee Brothers, Medical Publishers, 2010.

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

LIST OF MINIMUM EQUIPMENT REQUIRED

(For a batch of 20 students)

1. Pharmacology appliances	Sufficient
2. Sherrington's Kymograph Machine	20
3. Sherrington's Drum	20
4. Perspex bath assembly (single unit)	20
5. Aerators	20
6. Dissection trays	20
7. Dissection boards	20
8. Haemostatic arterial forceps	20
9. Hypodermic syringes and needles of size 18, 24, 26G	20
10. Computers	10
11. LCD Projector	01
12. Software package for experiments	01
13. Standard graphs for various drugs	Sufficient
14. Levers	20
15. Cannulae	20

3.6 PHARMACEUTICAL MARKETING AND MANAGEMENT (Theory)

(2hrs/wk)

50 Hours

- 1. Marketing:** **11 hours; 20 marks**
 - a) The meaning and scope of marketing.
 - b) The pharmaceutical market- quantitative and qualitative aspects, size and composition of the market, demographic descriptions and socio-psychological characteristics of the consumer, market segmentation.
 - c) Analyzing the market- role of market research.
 - d) Consumer profile- Motivation and prescribing habits of the physician, patients' choice of physician and retail pharmacist.
- 2. The Organization:** **2 hours; 4 marks**

Manufacturer- company objectives, influence of internal controls such as company policy on the company's operation, effects of government regulations and controls on marketing practices.
- 3. The Pharmaceutical Product:** **6 hours; 11 marks**
 - a) Market consideration in product development, marketing mix, product life cycle(PLC), effects of different elements of marketing mix at different stages of PLC, product classification, product planning, product differentiation, me- too products, modification of existing product.
 - b) New product development- all stages from the new product idea to the stage of marketing in developed product (Bulk drugs and formulations)
 - c) Branding- concept of brand, different types of brand, importance and reasons for branding, packaging.
- 4. Competitive Practices in the Pharmaceutical Industries:** **3 hours; 6 marks**
 - a) Price competition-Pricing, objectives, basis and strategies. Rate contracts.
 - b) Non-price competition: all types of non-price competition with special emphasis on competition through research and development, competition through quality.
- 5. Promotions:** **5 hours; 9 marks**
 - a) Communication and its importance
 - b) Different ways of promotion- Advertising, direct mail, professionals, journals, sampling, retailing, medical exhibition, public relations, Online Promotional Techniques for OTC Products
 - c) Professional sales representative- duties of PSR, purpose of detailing, selection and training, compensation and future prospects of the PSR.
- 6. Distribution:** **4 hours; 7 marks**
 - a) The wholesale- his role in distribution of pharmaceutical services offered to the manufacturer and the retailer, advantages and disadvantages of distribution through wholesaler.
 - b) The retailer- Classification of retail institution, advantages and disadvantages of retail institution, the hospital as retail outlet.
- 7. Management:** **12 hours; 20 marks**
 - a) Concepts of management, Nature of management, principles of management.

- b) Primary functions of management- planning, organizing, staffing, directing and controlling, motivation, and entrepreneurship development.
- c) Secondary functions of management: Decision- making, Leadership, innovation, delegation of authority/ responsibility.

8. Current Health Scenario in India

1 hour; 2 marks

9. Importance of Entrepreneurship

2 hours; 4 marks

10. Quality Management

Introduction to Statistical Methods, Statistical Quality Control Tools, Statistical Tools for Decision Making, Total Quality Management/Kaizen: Six Sigma, Quality Circle and CPM (Critical Path Method)

4 hours; 7 marks

REFERENCE BOOKS

1. Ashwathappa K. Production management. Mumbai:Himalaya Publishing House;2010.
2. Chary SN. Production and operation management. 2nd ed. Delhi:Tata McGraw Hill Publishing Co;2009.
3. Ghosh SK. Introduction to ISO 9000 & total quality management. Calcutta:Oxford Publishing House; **Year.**
4. Harold TA, John AR, Oliver S. Manufacturing organization and management. 4th ed. New Delhi:Prentice Hall of India Pvt Ltd;**Year.**
5. Heinz W, Harold K, Management: A global perspective. 10th ed. McGraw Hill International Edition;2007.
6. Mehra ML. GMP. 1st ed. Allahabad:University Book Agency; **Year.**
7. Mickey CS. Pharmaceutical marketing in the 21st century. New Delhi;Viva Books Pvt Ltd;2001.
8. Mickey CS. Principles of pharmaceutical marketing. 3rd ed. New Delhi;CRS Publishers and Distributors;2004.
9. Patani A. Drug & Cosmetics Act 1940. Lucknow:Eastern Book Co; **Year..**
10. Quality Assurance of Pharmaceuticals, Compendium of guidelines and related materials, vol. I, WHO Publications, Geneva.
11. Subbarao. Pharmaceutical marketing in India. Hyderabad;Asian Institute of Pharmaceutical Marketing;1998.
12. Tripathi PC, Reddy PN. Principles of management. 3rd ed. New Delhi:Tata McGraw Hill Publishing Co Ltd;2006.
13. Varma MM, Agarwal RK. Production management. Delhi:King Books Educational Publishers;**Year.**
14. WHO Experts Committee on "Specifications for Pharmaceutical Preparation" 13th, 22nd, 23rd, 24th, 34th Reports.

Websites

1. www.ich.org
2. www.ifpma.org/ich 5
3. www.fda.gov
4. www.health.gov.au/tga/
5. www.mca.gov.uk

4.1 PHARMACEUTICAL TECHNOLOGY AND BIOPHARMACEUTICS (Theory)

75 hours

1. Preformulation:

- a. Study of physicochemical characteristics of drug substances. Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms. **6 hours; 7 marks**

Tablets:

- b. Classification of tablets. Processing of tablets: Formulation, granulation methods, compression and processing problems. Equipment's and tablet tooling. **5 hours; 6 marks**
- c. Tablet coating: Types of coating, coating materials, formulation of coating materials, method of coating, equipment employed and defects in coating. **4 hours; 5 marks**
- d. In process quality control, evaluation of tablets and packaging. **2 hours; 2 marks**

2. Capsules:

- a) Hard gelatin capsules: Extraction of gelatin and production of hard gelatin capsule shells. Filling, finishing and special techniques of formulation of hard gelatin capsules. Quality control tests for capsules. **5 hours; 6 marks**
- b) Soft gelatin capsules: Nature of shell and capsule content, importance of base adsorption and minimum/gram factors, production, in process and final product quality control tests. **3 hours; 4 marks**

3. **Parenteral Preparations:** Definition, types, advantages and limitations, general formulation, vehicles, production procedure, production facilities and controls. Formulation of injections, sterile powders, emulsions and suspensions. Containers and closures pertinent to sterile preparations and quality control tests. **14 hours; 16 marks**

4. **Ophthalmic formulations:** Requirements, formulation of eye drops, eye lotion and eye ointments, containers and evaluation. **5 hours; 6 marks**

5. **Liquid orals:** Formulation and manufacturing considerations. Filling and packaging methods. **5 hours; 6 marks**

6. **Pharmaceutical aerosols:** Definition, propellants, containers, valves, types of aerosol systems, manufacture of aerosols. Evaluation of aerosols: Quality control and stability studies. **6 hours; 7 marks**

7. **Cosmetics:** Formulation and preparation of the following cosmetic preparations. Lipsticks, Shampoos, Face and Talcum powders, Nail lacquers, cold cream and vanishing cream, tooth pastes, and hair dyes and sunscreens. **10 hours; 12 marks**

8. A) Biopharmaceutics:

- a. Definition and applications, Absorption of drugs through GIT: Mechanisms and factors affecting.
- b. Bioavailability and Bioequivalence. Measurement of Bioavailability (C_{max} , T_{max} , AUC).

- B) Pharmacokinetics-Basic concepts:** Blood level curves for I.V, Constant rate infusion, Oral, I.M, and Sustained release dosage forms. **11 hours; 13 marks**

**PHARMACEUTICAL TECHNOLOGY AND BIO PHARMACEUTICS
(PRACTICALS) (3hrs/wk)**

75 Hours

- 1. Manufacture of tablets. ****
 - a) Tablets prepared by wet granulation.
 - b) Tablets prepared by direct compression.
 - c) Mouth dissolving tablet.
 - d) Chewable tablet.
- 2. Manufacture of sterile products. ****
 - a) Ampoules of ascorbic acid injection IP
 - b) Ampoules of calcium gluconate injection IP
 - c) Sodium chloride intravenous infusion IP
 - d) Vials of oxytetracycline injection IP
 - e) Eye drops
- 3. Evaluation of pharmaceutical formulations. (Q.C. tests)***
 - a) Tablets.
 - b) Capsules.
 - c) Sterile products.
- 4. Formulation of two liquid oral preparations* and evaluation by assay**.**
 - a) Preparation and evaluation of paracetamol syrup.
 - b) Preparation and evaluation of magnesium hydroxide mixture BP.
- 5. Cosmetic preparations.***
 - a) Lipsticks
 - b) Cold cream and vanishing cream
 - c) Clear liquid shampoo
 - d) Tooth paste and tooth powders
 - e) Sunscreens
- 6. Tablet coating. (demonstration)**
- 7. Demonstration of microencapsulation technique/ matrix tablets/ transdermal patches.**

SCHEME OF EXAMINATION

1. Synopsis	-10 Marks
2. Major experiment (indicated by **)	-30 Marks
3. Minor experiment (indicated by *)	-20 Marks
4. Viva voce	-10 Marks

Total

= 70 Marks

REFERENCE BOOKS

1. Aulton ME. Pharmaceutics, The science of dosage form design. 2nd ed. Edinburgh:Churchill Livingstone;2002.
2. Banker GS, Rhodes CT. Modern pharmaceutics. 4th ed. New York: Marcel Dekker Inc; 2005.
3. Carter SJ. Cooper and Gunn's Tutorial pharmacy. 6th ed. New Delhi:CBS Publishers;2000.
4. Gennaro AL. Remington: The science and practice of pharmacy, Vol I and II. 20th ed. Philadelphia:Lippincott Williams and Wilkns;2000.
5. Lachman L, Lieberman HA, Kanig JL. Theory and practice of industrial pharmacy. 3rd ed. Bombay: Varghese Publishing House; 1987.
6. Lachman L, Lieberman HA, Kenneth EA. Pharmaceutical dosage forms: Parenteral medications Vol I,II and III. New York:Marcel Dekker Inc;1992.
7. Lachman L, Lieberman HA. Pharmaceutical dosage forms: Tablets Vol I,II and III. New York:Marcel Dekker Inc;1980.
8. Loyd VA, Nicholas GP, Howard CA. Ansel's pharmaceutical dosage forms and drug delivery systems. 8th ed. Noida: BI Publications Pvt Ltd;2005.
9. Pharmacopoeias: I.P., B.P., U.S.P.
10. Rawlins EA. Bentley's textbook of pharmaceutics. 8th ed. New Delhi:Reed Elsevier India Pvt Ltd;2010.
11. Shargel L, Andrew BC, Susanna WP. Applied biopharmaceutics and pharmacokinetics. 5th ed. New York: The McGraw Hill Companies Inc;2005.
12. Sharma PP. Cosmetics – Formulation, manufacturing and quality control. 2nd ed. Delhi: Vandana Publications; 2001.
13. Subrahmanyam CVS, Thimmasetty J, Vijayendraswamy SM, Shivanand K. Laboratory manual of industrial pharmacy. Delhi:Vallabh Prakashan;2009.
14. Venkateswarlu V. Biopharmaceutics and pharmacokinetics. Hyderabad:Pharma Book Syndicate;2004.
15. Wilkinson JB, Moore RJ. Harry's cosmeticology. 7th ed. London:Longman Scientific & Technical;1989.

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Ampoule filling sealing machine	01
2. Ampoule washing machine	01
3. Capsule filling machine	01
4. Clarity test apparatus	02
5. Digital thermometers	02
6. Friability test apparatus	02
7. Lipstick moulds	10
8. Magnetic stirrers, 500 ml and 1 liter capacity	05

9. Mechanical stirrers	03
10. Monsanto's hardness testers	02
11. Ointment crimping machine	01
12. Ointment filling machine	01
13. Pfizer type hardness testers	02
14. Standard granulating sieves	2 sets
15. Tablet coating pan	01
16. Tablet disintegration test apparatus IP	01
17. Tablet dissolution test apparatus	01
18. Tablet punching machine	01
19. Tray dryer	01
20. Vial crimping machine	01

4.2 INSTRUMENTAL AND BIOMEDICAL ANALYSIS (THEORY)

(3hrs/Wk)

75 hours

The subject to be discussed with special reference to quality control and assurance of pharmaceuticals, its scope and its importance in the pharmaceutical industry. The following analytical techniques should be discussed with suitable examples.

1. Spectroscopy:

Electromagnetic radiation, Electromagnetic spectra, Quantization of energy, criteria for absorption of EMR, wavelength, frequency, wave number, Chromophores, Auxochromes, Bathochromic shift, hypsochromic shift, Hyperchromic and hypochromic effects. Theory of electronic, atomic and molecular spectra, Beer and Lambert's law, Derivation and Deviations, Effect of solvent and pH on absorption spectra, Application of Beer's law to single component analysis and multicomponent systems. **6hrs (5-6 Marks)**

Absorption Spectroscopy: UV/Visible spectroscopy, Instrumentation and working; Sources of radiation, Wavelength selectors; Filters-Prisms and Gratings, Sample cells, Detectors- Phototube, Photomultiplier tube, Barrier layer cell and Silicon photo diode. Measurement of equilibrium constant and rate constant by spectroscopy, spectrophotometric titrations **7hrs (6-7 Marks)**

IR Spectroscopy: Theory, Hook's law, vibration modes of in molecule, Instrumentation, Working and Sample handling methods, Sources of radiation, Monochromators, Sample cells and detectors- Bolometers, Thermocouples, Golay cells. IR Frequency - structure correlation, study of characteristic fundamental stretching vibrations of functional groups like Alcohol, Carboxyl, Amide, Amine, Aldehyde, and Ketone **6hrs (5-6 Marks)**

2. Fluorimetric analysis: Theory, concept of singlet and triplet electronic states, Internal and external conversions, intersystem crossing, factors affecting fluorescence, Quenching.

Instrumentation- Study of Fluorimeter, Spectrofluorimeter and Applications. Estimation of vitamin B₁₂ by fluorimetry **4hrs (3-4 Marks)**

3. Flame emission and atomic absorption spectrometry: Theory, Nebulization, flames and flame temperatures, interferences, Hollow cathode lamp, flame spectrometric techniques, applications. **4hrs (3-4 Marks)**

4. Nephelometry and Turbidimetric Analysis: Theory, General principles, Instrumentation and applications. **2hrs (1-2 Marks)**

5. Chromatography: Introduction and classification, **2hrs (1-2 Marks)**

A) Paper Chromatography: Introduction, Principle, Technique, Development, methods and applications. **2hrs (1-2 Marks)**

B) Thin layer chromatography: Introduction, principle, technique, R_f, R_X and R_m values and applications. **2hrs (1-2 Marks)**

C) Column chromatography: Adsorption column chromatography, development Techniques – Frontal analysis, Displacement analysis and elution analysis. Factors affecting column efficiency, Applications, Partition Chromatography **3hrs (2-3 Marks)**

D) HPTLC: Basic concept, difference between TLC and HPTLC **2hrs (1-2 Marks)**

E) Ion exchange chromatography: Ion exchange materials, synthetic ion exchange resins, Properties of ion exchangers, mechanism of ion exchange process, factors affecting ion exchange, applications. **3hrs (2-3 Marks)**

F) HPLC: Introduction, theory, instrumentation –Solvent treatment systems, Pumps- Reciprocating and displacement pumps, Columns, Guard column, Detectors- UV detectors, Fluorimetric detectors, Refractive index detectors and applications. **4hrs (3-4 Marks)**

G) Size exclusion chromatography: Theory, gels and applications **2hrs (1-2 Marks)**

H) Gas chromatography: Introduction, theory, instrumentation-carrier gas, types of columns, Stationary phases in gas liquid chromatography and gas solid chromatography, Detectors- Flame ionization detector, electron capture detector, thermal conductivity detector. Gas chromatogram, Derivatisation techniques like silylation, and esterification, Programmed temperature gas chromatography, Applications. **5hrs (5-6 Marks)**

I) Electrophoresis: Principles of separation, Factors affecting separation, equipment for paper and gel electrophoresis, Moving boundary electrophoresis, Isoelectric focusing electrophoresis, Applications. **3hrs (3-4 Marks)**

6. Electrometric methods:

A) Potentiometry: Electrochemical cell, construction and working of reference electrode, Normal hydrogen electrode, calomel electrode, silver-silver chloride electrode, Indicator electrodes- Glass electrode, Antimony electrode, Quinhydrone electrode, Potentiometric titrations, methods of detecting end point, applications. **6hrs (5-6 Marks)**

B) Conductometry: Introduction, conductivity cell, cell constant, conductometric titrations, Applications. **2hrs (1-2 Marks)**

7. NMR: Theory and instrumentation of ^1H NMR, applications. **2hrs (1-2 Marks)**

8. Mass Spectroscopy: Basic concept mass spectroscopy, applications **2hrs (1-2 Marks)**

9. X-ray Diffraction: Theory of X-ray diffraction, applications **2hrs (1-2 Marks)**

10. Quality assurance: Introduction, Sources of quality variation, control of quality variation, Validation methods. **4hrs (4-5 Marks)**

INSTRUMENTAL AND BIOMEDICAL ANALYSIS (PRACTICALS)

(3hrs/wk)

75 hours

Note: At least 18 experiments to be covered from the following list:

1. Calibration of UV-Visible spectrophotometer.
2. Determination of absorption maxima for a given solution of the drug.*
3. Determination of isobestic point*
4. Separation and identification of amino acids by paper chromatography*
5. Separation and identification of alkaloids by thin layer chromatography.*
6. Separation and Identification of Dyes by radial paper chromatography*
7. U.V.spectrometric determination of Ibuprofen tablets.*
8. U.V.spectrometric determination of Paracetamol tablets
9. Colorimetric estimation of Ferrous ions using 1, 10 Phenanthroline.**
10. Colorimetric estimation of Sulphanilamide using N-1-Naphthyl Ethylene Diaminedihydrochloride.**
11. Colorimetric estimation of salicylic acid.
12. Assay of Dextrose injection by colorimetry.**
13. Estimation of quinine sulphate by fluorimetry.**
14. Estimation of Riboflavine by fluorimetry.**
15. Study of quenching effect in fluorimetry : ex Quenching of Quinine fluorescence by iodide ions*.
16. Conductometric titration of Benzoic acid with NaOH**
17. Potentiometric titration of HCl with NaOH.**
18. Determination of chloride and sulphate in calcium gluconate by Nepheloturbidimetric analysis. **
19. Infrared spectral peaks identification of samples with different functional groups
20. (-COOH, -COOR, CONHR, -NH₂, -NHR, -OH, -CHO, -C=O)*
21. Determination of Sodium / Potassium by flame photometry**.

SCHEME OF EXAMINATION

- | | |
|---|------------|
| 1. Synopsis | - 10 Marks |
| 2. Major experiment (Experiment indicated by**) | - 30 Marks |
| 3. Minor experiment (Experiment indicated by*) | - 20 Marks |
| 4. Viva voce | - 10 Marks |

Total

- 70 Marks

REFERENCE BOOKS (THEORY)

1. Hobarth Willard, Lynne L. Merritt, John A. Dean & Frank A. Settle Jr, Instrumental methods of analysis, 6 edition, CBS Publishers & Distributors, New Delhi.
2. Skoog and West, Pharmaceutical Analysis,
3. Kenneth A. Connors, A Text book of Pharmaceutical analysis, 3 Edition, John Wiley & Sons, New York (1982).
4. Instrumental approach to chemical analysis – AK Srivatsava, PC Jain, S Chand publishers.
5. A.I. Vogel, Text book of Quantitative chemical analysis, ELBS/ Longman, London.
6. Stahl.E , Thin layer chromatography-A Hand book, Springer verlag, Berlin
7. Leon Lachman, Lieberman, and J.L.Kanig, Theory and practice of industrial pharmacy
8. Y.R Sharma, Organic spectroscopy

REFERENCE BOOKS (PRACTICALS)

1. Garratt. D.C. Quantitative analysis of drugs, 3 edition, CBS Publishers & Distributors, New Delhi.(2001).
2. Melean. C.E., Kiser.R.W., Problems and experiments in instrumental analysis.
3. Beckett A.H., Stenlake J.B, Practical Pharmaceutical Chemistry, 4 edition, The Athlone Press, London.
4. Kenneth A. Connors, A Text book of Pharmaceutical analysis, 3 edition , John Wiley & Sons, New York (1982),.
5. Hobarth Willard, Lynne L. Merritt, John A. Dean , Frank A. Settle Jr., Instrumental methods of analysis, 6 edition, CBS Publishers & Distributors, New Delhi.
6. Indian Pharmacopoeia, Vol I & II , , Ministry of Health & Family welfare, Govt. of India, Published by Controller of the Publications, New Delhi, 1996.
7. United States Pharmacopoeia.
8. British Pharmacopoeia.
9. Alfonso R. Gennaro, Remington's: The Science & Practice of Pharmacy, Vol I & II – Lippincotts Wiliams& Wilkins.
10. Higuchi T & Hanssen E.B., Text Book of Pharmaceutical Analysis, A Wiley Interscience Publications.
11. William Kemp, Spectroscopy methods, ELBS.
12. John R.Dyer, Applications of Absorption spectroscopy of organic compounds, Prentice Hall of India Pvt. Ltd., New Delhi.
13. R. M. Silverstein, G. Clayton, Terence C. Morill, Spectrometric identification of organic compounds, John Wiley & Sons, New York.

LIST OF MINIMUM EQUIPMENTS REQUIRED

Equipments

1. Colorimeter	01
2. UV Spectrophotometer	01
3. Fourier Transform Infra Red spectrometer	01
4. Fluorimeter	01
5. Nephelo turbidity meter	01
6. Flame photometer	01
7. Potentiometer	02
8. Conductivity meter	02
9. Analytical weighing Balance (1 mg sensitivity)	01
10. Oven	01

Apparatus

1. Volumetric flasks 10 ml, 25 ml, 50 ml and 100ml.
2. Weighing bottles
3. Pipettes – Graduated 10 ml
4. Pipettes – Bulb 1ml, 2ml, 5ml and 10 ml
5. Beakers – 100 ml, 250 ml and 500 ml
6. Separating funnels
7. TLC plates
8. Chromatographic papers
9. TLC and Paper chromatography – Development chambers.
10. Water bath

75 Hours

Upon completion of the subject student shall be able to:

1. Understand the pharmacological aspects of drugs falling under the above mentioned chapters,
2. Carry out the animal experiments confidently,
3. Appreciate the importance of pharmacology subject as a basis of therapeutics, and
4. Correlate and apply the knowledge therapeutically.

Sl. No.	Course Contents	No of Hours	Marks
1.	Bio Assays: Scope, General Principles and methods	02	5 -10
2.	Drug discovery and development a. Preclinical evaluation (regulatory toxicity studies) b. Clinical evaluation including pharmacovigilance	03	2-5
3.	Pharmacology of Drugs Acting on Central Nervous System a) General consideration (Introduction) b) Alcohol c) General anesthetics d) Sedatives and hypnotics e) Anti-Epileptics f) Psychopharmacological agents g) Classification and mechanism of action of drugs used in psychosis h) Pharmacology of chlorpromazine (a prototype drug) i) Salient features of Antipsychotics including atypical Antipsychotics. j) Drugs used in Parkinsonism and Alzheimer's disease. k) Antidepressants i. Classification and mechanism of action of drugs used in depression ii. Pharmacology of imipramine (a prototype TCA) iii. Salient features of other Antidepressants, including SSRIs and atypical antidepressants iv. Pharmacology of Lithium and other agents used in bipolar disorder. l) Anxiolytics m) Drug dependence and drug abuse	19 01 01 02 02 02 01 01 01 01 01 01 01 01 01 01 01 01	20-25
4.	Analgesics and anti-inflammatory agents a. Pain pathway, classification and mechanism of action of centrally acting analgesics b. Pharmacology of morphine (a prototype Opioid)	8 01 01	5-10

	<ul style="list-style-type: none"> c. Salient features of other opioids including antagonists d. Classification and mechanism of action of NSAIDs Pharmacology of Aspirin (a prototype NSAID) e. Salient features of other NSAIDs including COX-2 inhibitors 	<p>02</p> <p>02</p> <p>02</p>	
5.	Pharmacology of Drugs Acting on Gastro Intestinal Tract <ul style="list-style-type: none"> a. Antiulcer drugs, Antacids b. Laxatives and Purgatives c. Emetics and Antiemetics d. Appetizers, Digestants, Carminatives 	04	5-10
6.	Chemotherapy <ul style="list-style-type: none"> a. Introduction and principles of chemotherapy including general mechanisms of antimicrobials, mechanism of resistance, super infections, antimicrobial combinations. b. Classification, mechanism of action, spectrum of activity, resistance development, adverse drug reactions and therapeutic use of the following: <ul style="list-style-type: none"> 1. Sulfonamides and Co-trimoxazole 2. Penicillins and Cephalosporins 3. Tetracyclins and Chloramphenicol 4. Macrolides 5. Aminoglycosides, 6. Polyene & Polypeptide antibiotics. 7. Quinolones and Fluoroquinolones 8. Lincosamides,, Glycopeptides, urinary antiseptics 9. Antifungal agents, 10. Antiviral agents including anti-HIV 11. Chemotherapy of Tuberculosis and Leprosy 12. Chemotherapy of Malaria 13. Chemotherapy of Protozoal infections (amoebiasis, Giardiasis) 14. Pharmacology of Anthelmintic drugs 15. Chemotherapy of Cancer 	<p>31</p> <p>03</p> <p>01</p> <p>03</p> <p>02</p> <p>01</p> <p>02</p> <p>01</p> <p>01</p> <p>01</p> <p>01</p> <p>02</p> <p>02</p> <p>03</p> <p>02</p> <p>03</p> <p>01</p> <p>03</p>	20-25
7	Immunopharmacology Pharmacology of immunosuppressants and stimulants	02	2-5
8.	Principles of Toxicology General principles of treatment of acute toxicity and acute poisoning Signs, Symptoms and treatment of acute and chronic poisoning due to i) Barbiturates ii) Alcohols iii) Benzodiazepines iv) Antidepressants, v) Neuroleptics vi) Insecticides vii) Snake bite viii) Heavy metals (iron, lead, mercury, arsenic).	04	5-10
9.	Pharmacology of Local anesthetics	02	2-5

PHARMACOLOGY & TOXICOLOGY (PRACTICALS) 75 Hours (3Hrs/wk)

1. To record the dose response curve of histamine using isolated chick/rat/guinea pig ileum preparation.**
2. To carry out bioassay of Histamine using isolated chick/rat/guinea pig ileum preparation by matching method.**
3. To carry out bioassay of Histamine using isolated chick/rat/guinea pig ileum preparation by interpolation method.**
4. To carry out bioassay of Histamine using isolated chick/rat/guinea pig ileum preparation by three point method.**
5. To record the dose response curve of Acetylcholine using isolated ileum preparation.**
6. To carry out bioassay of Ach using isolated chick/rat/guinea pig ileum preparation by interpolation method.**
7. To carry out bioassay of Acetylcholine using isolated ileum preparation by matching method.**
8. To carry out bioassay of Acetylcholine using isolated ileum preparation by three-point method.**
9. To carry out MAO inhibitory activity using chick/rat liver homogenate.*
10. To carry out amylase/ α -glucosidase inhibitory activity using *invitro* technique.*
11. Study of principle, procedure involved and interpretation of given results for analgesic property of drug using analgesiometer*
12. Study of principle, procedure involved and interpretation of given results for Anti inflammatory effect of drugs using rat-paw edema method.*
13. Study of principle, procedure involved and interpretation of given results for Anti convulsant activity of drugs using MES method.*
14. Study of principle, procedure involved and interpretation of given results for Anti convulsant activity of drugs using pentylenetetrazole method.*
15. Study of principle, procedure involved and interpretation of given results for antidepressant activity of drugs using pole climbing apparatus.*
16. Study of principle, procedure involved and interpretation of given results for hypnotic and sedative property using Pentobarbitone induced sleeping time method.*
17. Study of principle, procedure involved and interpretation of given results for locomotor activity evaluation of drugs using Actophotometer.*
18. Study of principle, procedure involved and interpretation of given results for evaluation of muscle grip strength/relaxant effect of drugs using rotarod.*
19. Study of principle, procedure involved and evaluation of anthelmintic activity of drugs using earthworm as a model.

** (Major experiment)

* (Minor experiment)

SCHEME OF EXAMINATION

6. Identification	-	10 Marks
7. Synopsis	-	10 Marks
8. Major Experiment	-	25 Marks
9. Minor Experiment	-	15 Marks
10. Viva	-	10 Marks
Total	-	70 Marks

TEXT BOOKS

1. Tripathi KD, Essentials of Medical Pharmacology, 7th Edition, Jaypee Brothers, 2010.
2. Satoskar R.S., Bhandarkar S.D. and Rege N.N., Pharmacology and Pharmacotherapeutics, 21st Edition, Popular Prakashan Pvt Ltd, 2010.
3. Chaudhary S.K., Quintessence of Medical Pharmacology, 3rd Revised Edition, Central Book Agency Pvt. Ltd., 2010.
4. Sharma H.L. and Sharma K.K., 2nd Edition, Principles of Pharmacology, Paras Medical, 2011.
5. Ghosh M.N., Fundamentals of Experimental Pharmacology, 5th Edition, Hilton & Company, 2011.
6. Kulkarni S.K., Hand book of Experimental Pharmacology, 3rd Edition, Vallabh Prakashan, 2005.
7. Medhi B. and Prakash A., Practical manual of experimental and clinical pharmacology, 1st Edition, Jaypee Brothers, Medical Publishers, 2010.

REFERENCE BOOKS

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

LIST OF MINIMUM EQUIPMENT REQUIRED

(For a batch of 20 students)

1. Pharmacology appliances	Sufficient
2. Sherrington's Kymograph Machine	20
3. Sherrington's Drum	20
4. Perspex bath assembly (single unit)	20
5. Aerators	20
6. Dissection trays	20
7. Dissection boards	20

8. Haemostatic arterial forceps	20
9. Hypodermic syringes and needles of size 18, 24, 26G	20
10. Computers	10
11. LCD Projector	01
12. Software package for experiments	01
13. Standard graphs for various drugs	Sufficient
14. Levers	20
15. Cannulae	20
16. Analgesiometer (Radiant heat)	01
17. Eddy's Hot Plate	01
18. Plethysmometer	01
19. Electro-Convulsiometer	01
20. Pole climbing apparatus	01
21. Actophotometer	01
22. Rotarod apparatus (03 / 05 compartments)	01

4.4 MEDICINAL CHEMISTRY II (THEORY)
(3hrs/wk)

75 hours

- A. Introduction to QSAR:** Study of hydrophobic, Electronic & Steric parameters **2hrs (1-2 Marks)**
- B. Prodrugs:** Definition and examples **1hrs (1 Marks)**
- C. Introduction to drug discovery-** Definition of lead molecule and its identification methods viz, high throughput screening, wholesale screening, and fragment based lead generation, fast followers
- D. History and development of chemotherapeutic agents:** Structure, uses and synthesis of only those compounds that are underlined and superscripted by 's'.
1. Antifungal agents:
 - a) Antifungal antibiotics- Nystatin, Griseofulvin, Amphotericin-B, Synthetic anti fungal agents:
 - b) Substituted imidazoles: Clotrimazole, Miconazole^s, Ketoconazole, oxiconazole, Intraconazole.
 - c) Miscellaneous—Zinc propionate, Sodium caprylate, Tolnaftate^s. **4hrs (3-4 Marks)**
 2. Urinary tract anti-infectives:
 - a) Quinalones: Nalidixic acid, Cinoxacin, Norfloxacin, Ciprofloxacin^s, Pefloxacin, Ofloxacin, Sparfloxacin
 - b) Miscellaneous: Nitrofurantoin^s. **3hrs (2-3 Marks)**
 3. Antitubercular drugs:
 - a) Synthetic antitubercular agents: p-Aminosalicylic acid, Isoniazid, Ethambutol, Pyrazinamide, Ethionamide, Clofazimine, Bedaquiline
 - b) Antitubercular Antibiotics: Cycloserine, Viomycin sulfate, Capreomycin sulfate, Rifampicin.
 - c) Combination therapy for TB **4hrs (4-5 Marks)**
 4. Anti Viral Agents.
 - a) Amantidine hydrochloride, Idoxuridine, Acyclovir, Zidovudine.
 - b) Anti-AIDS: Zalcitabine, Suramin **2hrs (2-3 Marks)**
 5. Antiprotozoal agents: Emetine hydrochloride, Metronidazole^s, tinidazole, ornidazole, secnidazole, Diloxanide furoate, 8-hydroxy quinoline derivatives (clioquinol, iodoquinol). Carbarsone. **2hrs (2-3 Marks)**
 6. Anthelmintics: Piperazine, Diethyl carbamazine, Pyrantel pamoate, Thiabendazole^s, Albendazole^s, Mebendazole, **2hrs (2-3 Marks)**

E. Sulfonamides, Sulfones as antibacterial agents :

1. SAR and mode of Sulfonamides.
2. Classification of sulfonamides based on duration of action and site of action with examples. Sulfamethiazole, Sulfisoxazole^s, Sulfapyridine, Sulfamethoxazole^s, Sulfadiazine, Sulfacetamide, sulfasalazine, Phthalyl sulfathiazole.
3. Folate reductase inhibitors: Trimethoprim, Synergistic action of the combination of sulfamethoxazole and trimethoprim^s.
4. Sulfone: Dapsone^s **4hrs (4-5 Marks)**

F. Antimalarials: Etiology of malaria, History, Mechanism and SAR

1. Quinolines and analogues: 7-chloro-4-amino quinolines : Chloroquine phosphate^s, Hydroxychloroquine sulphate, Amodiaquine, 8-amino quinolines: Pamaquine, Primaquine,

9-amino acridines: Quinacrine.

2. Artimicin and its derivatives: Artiether, Artimether, Artisunate

3. Biguanides and Dihydrothiazines: Chloroguanide, Cycloguanil.

4. Miscellaneous: Mefloquine, Pyrimethamine, Trimethoprim.

6hrs (5-6 Marks)

G. Antibiotics: Classification and Mechanism of action

1. Beta lactam antibiotics: Pencillins – structures, chemical degradation, bacterial resistance. Penicillin G, Penicillin V, Cloxacillin sodium, Nafcillin sodium, Ampicillin, Amoxycillin.

2. Cephalosporins: Structure and uses of Cephalexin, Cephadrine, Cefadroxil, Cefixime, Cefapiridine, Cefuroxime

3. Monolactams: Sulfazecin, Aztreonam, Tigmonam.

4. Beta lactamase inhibitors: Clavulanic acid and its salts, Thienamycin.

5. Aminoglycosides: Structural features and Mechanism of action, Streptomycin, Amikacin, Neomycin, Kanamycin, Gentamycin, Netilmycin

6. Tetracyclines: Chemistry and SAR, tetracycline, Chlortetracycline, Methacycline, Demeclocycline, Oxytetracycline, Meclocycline, Doxycycline, Minocycline.

7. Macrolide: Structure and specific uses of Erythromycin, Azithromycin, leandomycin.

8. Lincomycins: Lincomycin, Clindamycin.

9. Polypeptides: Gramicidin, Bacitracin, Polymyxin B, Colistin.

10. Miscellaneous: Chlormphenicol^s, Vancomycin, Novobiocin.

12hrs (11-12 Marks)

H. Antineoplastic agents: Introduction, mechanism of action and classification with examples.

1. Alkylating agents: Mechlorethamine, Cyclophosphamide, Melphalan, Chlorambucil^s, Busulfan, Lomustine,

2. Antimetabolites: Mercaptopurine, Thioguanine, 5-Fluorouracil, Methotrexate^s,

3. Antibiotics: Dactinomycin, Bleomycin, Mitomycin, Streptozocin.

4. Plant products: Etoposide, Taxol, Camptothecin, Vincristine, Vinblastine.

5. Hormones: Dromostanalone, Megestrol,

6. Kinase inhibitors: Imatinibmesylate

6. Miscellaneous: Asparaginase, Cisplatin, Hydroxy urea.

7. Immunotherapy: Interferon alpha 2a and 2b.

6hrs (5-6 Marks)

I. Cardiovascular agents:

1. Antianginal agents and vasodilators: Chemical structure and specific uses of Amyl nitrite, Nitroglycerine, Isosorbidedinitrate.

2. Calcium antagonists: Brief introduction of calcium channels and their blockers. Chemical structures and uses of Verapamil, Diltiazem, Nifedipine, Nimodipine, Felodipine, Dipyridamole, Cycloandelate.

4hrs (4-5 Marks)

3. Antiarrhythmic drugs: Structure, chemical name, and classification of antiarrhythmics with examples

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

Class II- Beta adrenergic blocking agents. Tocainide, propranolol

Class III- Repolarization prolongators. Bretylium, Amiodarone

Class IV- Calcium channel blocker. Diltiazem, Verapamil

3hrs (2-3 Marks)

4. Antihypertensive agents:

Beta-blockers: Propranolol, Timolol

ACE Inhibitors: Captopril, Enalapril

Diuretics: Hydrochlorothiazide, Spironolactone

Calcium channel blockers: Nifedipine, Felodipine, Amlodipine

α_1 -Antagonist: Prazocin

α_2 -agonist: Clonidine, Guanithedine

Angiotensin –II receptor antagonist: Losartan, Valsartan

Miscellaneous: Reserpine, Hydralazine, Minoxidil

5hrs (4-5 Marks)

5. Antihyperlipidemic agents: Structure and specific uses.

Clofibrate, Lovastatin, Cholesteramine, Colestipol, Atorvastatin

2hrs (1-2 Marks)

6. Anticoagulants: Dicumorol, Warfarin^s, Phenindione.

1hr (1Marks)

7. Hypoglycemic agents: Insulin and its preparations.

Sulfonylureas–Chlorpropamide^s, Acetohexamide, Glipizide,

Biguanides-Phenformin, Metformin

Substituted benzoic acid derivatives – Meglitinides, Meglitinide, Nateglinide

Thiazolidinediones –Glitazones, Pioglitazone, Ciglitazone, Rosiglitazone

Glipitines – Sitagliptin, Anagliptin

3hrs (2-3 Marks)

8. Thyroid hormones : L-thyroxine, L-thyronine,

1hr (1Mark)

9. Antithyroid drugs: Propylthiouracil, Methimazole.

1hrs (1Mark)

10. Estrogens and progesterones- Skeletal structure and their uses

2hrs (1-2 Marks)

J. Diuretics: Introduction

1. Carbonic anhydrase inhibitors: Acetazolamide^s, Methazolamide.

2. Thiazide and Thiazide like diuretics: Chlorthiazides, Benzthiazide, Xipamide, Chlorthalidone.

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

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

5. Miscellaneous: Mannitol.

5hrs (4-5 Marks)

MEDICINAL CHEMISTRY II (PRACTICALS)
(3hrs/wk) 75 hours

Assay of

1. Sulphadiazine by diazotization.
2. Chloroquine by nonaqueoustitratio
3. Ascorbic acid by Iodimetry.
4. Isonicotinic acid by KBrO_3 (bromimetry)
5. Benzyl penicillin by Iodometry.
6. Metronidazole/Mepacrine by nonaqueous titration.
7. Furosemide by neutralization titration
8. Diethyl carbamazine by neutralization titration

Preparation of medicinally important compounds or intermediates required for synthesis of drugs.

1. PAS from p-nitro salicylic acid.
2. Dichloramine T from toluence p-sulphonamide.
3. Chloramine T from Dichloramine T.
4. Fluorescein from pthalic anhydride.
5. Eosin from Fluorescein.
6. Sulphacetamide from sulphanilamide.
7. Sulphanilamide from Acetanilide.
8. INH from γ Picoline
9. Chlorobutanol.
10. Benzotriazole.
11. 3-Diphenyl quinoline.
12. 2,4,5Triphenyl imidazole from Benzoin

Green Chemistry Synthesis

1. Microwave assisted synthesis of 1,4-dihydropyridine/pyrimidine
2. Synthesis of p-bromoacetanilide from aniline using KBr

Estimation of the functional groups in medicinally important compound.

1. Hydroxyl group in cholesterol.
2. Ketone in camphor.
3. Hydroxyl group in menthol.
4. Amide in nicotinamide.

SCHEME OF EXAMINATION

- | | |
|---|------------|
| 1. Synopsis | - 10 Marks |
| 2. Assay/Estimation (including standardization) | - 30 Marks |
| 3. Preparation including re-crystallisation and Melting Point determination | - 20 Marks |
| 4. Practical viva | - 10 Marks |

Total

- 70 Marks

TEXT BOOKS (THEORY)

1. Foye's principles of Medicinal chemistry.
2. Wilson and Griswold's, Text book of Organic and Pharmaceutical chemistry.
3. Rama RaoNadendla, Medicinal Chemistry

REFERENCE BOOKS (THEORY)

1. Burger's medicinal chemistry.
2. The Martindale's Extra Pharmacopoeia.
3. A.I.Vogel, Text Book of practical organic chemistry including the qualitative analysis.
4. A.H.Becket and J.B.Stanlake, Practical Pharmaceutical chemistry.
5. M Raghuprasad, Advanced medicinal chemistry: A laboratory guide
6. J.G.Mann and Saunders, Practical organic chemistry, ELBS Longman, London.
7. I.P.1985, Ministry of Health, Govt.of. India.
8. LedniserMitzsher, Organic drug synthesis, Vol.1 and 2.
9. I.L. Finar, Text Book organic chemistry.
10. T.Robbinson, Organic constituents of higher plants
11. Feiser and Feiser Steroids.
12. Drug design by Ariens.
13. Smith and Williams, Introduction to principles of drug design.
14. Purcell, Strategy of drug design
15. CIMS

REFERENCE BOOKS (PRACTICALS)

1. A.I.Vogel, Text Book of practical organic chemistry.
2. A.H.Beckett and Stanlake, Practical pharmaceutical chemistry.
3. J.G.Mann and Saunders, Practical organic chemistry.
4. Jayaveera KN, Practical medicinal chemistry
5. Raghuprasad M, Advanced medicinal Chemistry
6. Feiser and Feiser, Steroids.
7. IP 1985.
8. I.L.Finar, Text Book of organic chemistry.
9. CIMS.

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Suction Pumps	01
2. Analytical Balances	10
3. Physical Balances --	
4. Triple beam balances	10
5. Water Baths Reflux Flask and condensers	10
6. Hot Plates	01
7. Mechanical Stirrers	01
8. Magnetic Stirrers with Thermostat	01
9. Distillation Unit	01
10. Refrigerator	01
11. Fuming Hood	01
12. Microwave Oven	01

4.5 INDUSTRIAL PHARMACOGNOSY (THEORY)

(3hrs/wk) 50 Hrs

- 1. Introduction:** **2h**
- a) Importance and status of herbal drugs in national and international market.
 - b) A brief account of plant based industries and research institutions in India.
- 2. Phytopharmaceuticals:** **10h**
- Detail method of isolation, identification and estimation of the following: Quinine, Ca-sennosides, Diosgenin, Glycyrrhizin, Hesperidine, Andrographolides, Curcumin, Podophyllotoxin, Solasodine and Caffeine.
- 3. Quality control and Standardization of Herbal drugs:** **10h**
- a) Definition of the terms: evaluation, quality control and standardization.
 - b) Importance of standardization of raw materials, extracts and formulations with suitable examples.
 - c) Quality control methods for Herbal drugs as per WHO guidelines.
 - d) Applications of HPTLC and HPLC techniques for evaluation of crude drugs and extracts. Role of marker compounds in evaluation and chromatographic finger printing analysis.
 - e) Monographic analysis of the following drugs for Standardization: i) Vasaka ii) Gokhru iii) Ashwagandha iv) Guduchi v) Guggulipid
- 4. Herbal Cosmetics and Nutraceuticals:** **3 h**
- a) Role of following herbs in cosmetics.
 - i) Skin Care: Aloe vera, Neem, Turmeric, Saffron, Sandalwood
 - ii) Hair Care: Soapnut, Amla, Henna, Hybiscus, Bringaraj
 - b) Nutraceuticals: Source and importance of antioxidants, probiotics and polyunsaturated fatty acids. Study of nutritional value of Spirulina and Garlic
- 5. Natural sweeteners and bitters** **2 h**
- 6. Patenting and Regulatory requirements of natural products:** **3 h**
- a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy
 - b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem.
 - c) WHO guidelines for regulation of herbal medicines in South-East Asian region.
- 7. Plant Biotechnology:** **7 h**
- a) Chemodemes, Polyploidy and Hybridization and their applications in improving the quality of medicinal plants.
 - b) Tissue Culture:
 - i) Types, techniques and applications
 - ii) Methods for enhancing the production of secondary metabolites.
 - iii) Transgenic plants and their applications
- 8. Enzyme Biotechnology:** **3 h**
- a) Immobilization of cells and enzymes
 - b) Bio-transformation
 - c) Source, isolation and uses of plant enzymes: Papain, Bromelin

9. Complementary and Alternative Medicines:**5 h**

a) General introduction to Ayurveda. Siddha. Unani and Homeopathy system of medicines.

b) Method of preparation of some Ayurvedic formulations: Aristas, Asavas, Ghutika, Taila, Churna. Leha and Bhasma.

c) Determination of alcohol content in Aristas and Asavas.

10. Study of some Traditional drugs:**5 h**

Common and vernacular names, source, active constituents and uses of

i) Acorus ii) Apamarg iii) Bael iv) Brahmi v) Chirata vi) Coleus vii) Gudmar viii) Kantakari ix) Methi x) Pippali xi) Punarnava xii) Rasna xiii) Shatavari xvi) Shankapushpi xv) Shilajit

PRACTICALS**(3hrs/wk) 75 h****1. Isolation of Phytopharmaceuticals****

i) Quinine ii) Ammonium glycyrrhizinate iii) Ca-sennosides iv) Caffeine v) Hesperidin vi) Curcumin

2. Estimation of Phytopharmaceuticals**

i) Quinine iv) Caffeine v) Hesperidin vi) Curcumin

[By Fluorimetric, Spectrophotometric or Chromatographic methods]

ii) HPTLC and HPLC profiles of few drugs

3. Thin layer chromatography of Alkaloids***4. Estimation of bitters in Kalmegh******5. Determination of swelling index in mucilage containing drugs*****6. Determination of microbial contamination in plant drugs****7. Initiation of callus culture****8. Immobilization of enzymes and determination of its activity*****9. Estimation of alcohol content in traditional preparations*****10. Study of morphology of traditional drugs mentioned in theory*****SCHEME OF EXAMINATION**

1. Synopsis	10 marks
2. Identification of traditional drugs	10 marks
3. Isolation/ Estimation of phytoconstituents	25 marks
4. Minor experiment*	15 marks
5. Viva-Voce	10 marks

Total**70 marks**

REFIRENCE BOOKS

1. Chaudhri R.D., 1996. Herbal Drug Industry, 1st ed. Eastern publishers, New Delhi.
2. Rajpal V., 2002. Standardisation of Botanicals, 1st ed. Eastern publishers, New Delhi.
3. Vinod D. Rangari., 2003. Pharmacognosy and Phytochemistry, 1st ed. Career publications, Nashik.
4. Harborne J.B., 1998. Phytochemical methods, 3rd ed. Springer (India) Pvt Ltd, New Delhi.
5. Indian Pharmacopoeia 2007, Vol 3. The Indian Pharmacopoeia Commission, Ghaziabad.
6. Indian Herbal Pharmacopoeia 1998 & 1999, Vol I & Vol II. Government of India, Ministry of Health. A Joint Publication of RRL, Jammu and IDMA, Mumbai.
7. Agrawal S.S and Paridhavi M., 2007. Herbal Drug Technology, 1st ed. Universities Press (India), Hyderabad.
8. Pulok Mukherjee, 2002. Quality control of herbal drugs, 1st ed. Business horizons, New Delhi.
9. WHO-Quality control methods for Medicinal plant materials, 2011.
10. Wealth of India, 2000. A Dictionary of Indian Raw Materials & Industrial Products (All Volumes). NISCAIR, CSIR, New Delhi.
11. Kokate C.K., Purohit A.P and Gokhale S.B., 2010. Pharmacognosy, 45th ed. Nirali Prakashan, Pune.
12. Evans W.C., 2002. Trease and Evans Pharmacognosy, 15th ed. Elsevier Science Ltd, Philadelphia.
13. Ashutosh Kar, 2006. Pharmacognosy and Pharmacobiotechnology, 2nd ed. New Age International Publishers, New Delhi.
14. Veeresham C., 2004. Medicinal Plant Biotechnology, 1st ed. CBS publishers and distributors, New Delhi.
15. Vyas S.P & Dixit, 1998. Pharmaceutical Biotechnology, 1st ed. CBS Publishers & dIstrIbutors, New Delhi.
16. Gaud R.S., Gupta G.D and Gokhale, 2000. Practical Biotechnolgy 1st ed. Nirali Prakashan.
17. Indian Medicinal Plants, 1997. A Compendium of 500 species By Arya Vaidya Sala, Kottakal.
18. The Ayurvedic Pharmacopoeia of India Vol I & II, 1999. Government of India, Ministry of Health and Family Welfare, Department of ISM & H.
19. The Ayurvedic Formulary of India, 2000. Government of India, Ministry of Health and Family Welfare, Department of ISM & H.
20. National and International Journals- Phytochemistry, Pharmacognosy Reviews, Fitoterapia, Journal of Natural Products, Journal of Ethnopharmacology, Planta Medica, Phytotherapy Research

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Heating mantle	10
2. Soxhlet apparatus	10
3. TLC chamber & sprayer	10
4. Hot air oven	01
5. Water bath	20
6. Autoclave	01
7. Laminar air flow	01
8. B.O.D. Incubator	01
9. Microscope	20
10. Balance (Digital)	02
11. Spectrophotometer	01
12. Flourimeter	01
13. Reflux flasks & condensers	20
14. Distillation units	05
15. Vacuum pump	02
16. HPTLC	Desirable
17. HPLC	Desirable

4.6 ADVANCED INDUSTRIAL PHARMACY (THEORY)
(2hrs/wk) 50 Hours

1. **Biopharmaceutical classification systems** and methods to improve the bioavailability of poorly soluble drugs - solid dispersion and complexation techniques.
4 hours; 7 marks
2. **Controlled drug delivery systems:** Principle, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles.
5 hours; 9 marks
Microencapsulation: Definition, applications, air suspension, coacervation and phase separation techniques.
3 hours; 6 marks
3. a) **Novel drug delivery systems:** Concepts, advantages and disadvantages, types of drug delivery systems such as transdermal, nasal, ocular, buccal and implants with suitable examples.
6 hours; 11 marks
b) **Targeted drug delivery systems:** Concepts and approaches, advantages and disadvantages. Applications of microspheres, liposomes, niosomes, nanoparticles.
4 hours; 7 marks
4. **Pilot Plant scale up:** General considerations - including significance of personnel requirements, space requirements, raw materials and development of Master Formula Records and Batch Manufacturing Records. Pilot plant scale up considerations for tablets.
6 hours; 11 marks
5. **Pharmaceutical Packaging:** Materials used for packaging of pharmaceutical products, advantages, disadvantages and quality control tests.
4 hours; 7 marks
6. **Current Good Manufacturing Practices (cGMP):** as per D&C Act, USFDA, MHRA and TGA guidelines.
4 hours; 7 marks
7. **Validation:** Definition, types of validation, methods for process validation of pharmaceutical operations – Mixing and compression.
6 hours; 11 marks
8. **Biostatistics:** Introduction, Types of data distribution, Measures describing the central tendency distributions- average, median, mode. Measurement of the spread of data-range, variation of mean, standard deviation, variance, coefficient of variation, standard error of mean.
5 hours; 8 marks
9. **ICH guidelines and QbD:** Introduction to ICH guidelines: Quality, efficacy and safety of drugs. Introduction to the concepts of Quality by Design (QbD).
3 hours; 6 marks

REFERENCE BOOKS

1. Chien YW. Novel drug delivery systems. 2nd ed. New York:Marcel Dekker Inc;2007.
2. Jain NK. Controlled and novel drug delivery. New Delhi: CBS Publishers and Distributors;1997.
3. Nash RA, Berry IR. Pharmaceutical process validation. 2nd ed. New York: Marcel Dekker Inc;1993
4. Robinson JR, Vincent HLL. Controlled drug delivery. 2nd ed. New York: Marcel Dekker Inc;1987.
5. Sharma PP. Validation in pharmaceutical industry. Delhi:Vandana Publications;Year
6. Subrahmanyam CVS, Thimmasetty J. Pharmaceutical regulatory affairs. 1st ed. New Delhi: VallabhPrakashan;2012.
7. Vyas SP, Khar RK. Controlled drug delivery. Delhi: Vallabh Prakashan; 2002.
8. Yajaman S. Novel drug delivery systems and regulatory affairs. New Delhi:S Chand Publishing;Year

Websites:

www.ich.org, www.cdsco.nic.in

Section V

Ethics in Pharmacy

SECTION VI

NORMS AND STANDARDS

1.0 STAFF NORMS

The knowledge, Skills, Attitudes and value of staff are assets which greatly contribute to their own individual effectiveness as well as to institutional performance. In addition, to the pattern and structure of staff, staff norms should therefore, emphasize on process of recruitment, deployment and development as well as appraisal.

The norms stipulated are primarily for Pharmacy College with an annual intake of 40, 60 and **100 students**.

1.1 Weekly Worked Schedule

Student contact hours per week	:	40 hrs.
Student contact hours in formal learning	:	32 to 35 hrs.
Student centered activities (Library Studies)	:	5 to 8 hrs.
Guidance and counseling, seminars, etc.		

1.2 Annual Work Schedule

In **an academic year** there should be a minimum of **180** instructional days, excluding examination. These norms are deemed to be essential for completion of the year.

1.3 Student-Teacher Ratio

The student teacher ratio in a class will depend on

1. Teacher time required for formal instruction requiring student contact.
2. Student time devoted to formal learning requiring teacher contact and
3. Class sizes for different forms of instruction.

The desirable student to teacher ratio for Pharmacy degree programme may be 10:1. However it should not be allowed to rise beyond 15:1.

The teacher will engage in group/class sizes for formal teaching in the ratio as given below:

Theory lecture class	:	60:1
Lab. Practical	:	20:1

For an intake of 100 students, the class has to be divided in to two sections, section A with 60 and section B with 40 students. The theory and practical classes are to be conducted accordingly.

1.4 Staff Pattern-Categories

1. Principal/HOD/Director and teaching staff.
2. Technical supporting staff.
3. Library and computer center staff.
4. Administrative staff.
5. Miscellaneous staff including maintenance staff.

1.5 Teaching Staff Cadre

The cadre structure should be as follow:

1. Principal/Director/HOD.
2. Professor.
- 3. Associate Professor.**
- 4. Assistant Professor.**

1.6 Cadre Distribution-Flexibility

The distribution of faculty position in the Pharmacy institution will depend on the work loads of the different departments based on the curriculum structure Flexibility in the distribution of different faculty cadres is permitted so long as such flexibility is for meeting the specific needs of the institution in terms of job requirements and courses offered.

1.7 Leave Training Reserves

To enable institutions to sponsor teachers for staff development programmes and to allow teachers to avail leave to which they are entitled it is necessary that adequate reserve capacity of teachers is available. Each institution will have such reserve capacity in accordance with leave training reserves sanctioned by central/state governments from time to time.

1.8 Selection and Recruitment of the Teaching Staff

The positions of Professors, Associate Professor and Asst. Professors should be filled up through an open selection process. The selection agencies of the states and institution should adopt reliable and valid procedures for selecting candidates on the basis of competence knowledge, skills, attitudes and values required for the profession, adhering to the stipulation regarding qualification and experience.

1.9 Job Description and Qualifications of Staff

As prescribed by AICTE and **PCI** time to time.

1.10 Performance Appraisal System

A performance appraisal system for teachers should be setup, well integrated with institutional functioning, and this should lead to the identification of individual training and development needs. This should also enable the identification of faculty members whose performance is outstanding. Such performance and excellence should be well recognized and rewarded. All institutions should introduced system for performance appraisal conforming with guidelines formulated in this regard.

1.11 Training and Development

Teachers will be provided with opportunity to improve their qualifications through Quality Improvement Programmes (for Ph.D. in Pharmacy based areas). In addition to these, opportunities will be provided for pedagogy and professional industrial training.

Under the Quality Improvement Programme a variety of short term courses to meet training and retaining needs will be provided for all levels of Teachers in Pharmacy colleges

2.0 NORMS AND INFRASTRUCTURE

2.1 Norms for Space and Buildings

The norms for space and building have been arrived at, based on the functions, a Pharmacy institutions' offering **diploma, degree, post graduate and Ph.D programmes (Pharm D ?)** has to perform. In all cases, unit norms have been evolved taking the absolute minimum needs which are indicated as norms. As such the institutions, while envisaging their space and building requirements, must keep their perspectives for development in mind and formulate their planes accordingly.

Around the administrative buildings, class rooms and drawing halls, there is considerable movement of students and there must be adequate veranda space in this part of the college building so that classes do not disturbed. For this reason, the ratio of plinth to carpet area for the normal building may be taken as 1:4.

Classification of Building Area

The building area required for the Pharmacy institution can be classified as instructional area, administrative area, amenities area and residential area.

Instructional area will include class rooms, tutorial rooms, laboratories, computer center, library, instructional resource centre, seminar hall etc.

Administrative area comprises Principal's room, various lounge, staff rooms , administrative office, departmental offices, stores, conference room, confidential room etc.

Area for amenities consists of common rooms, recreation centre, hobby centre, offices for gymkhana, N.S.S. and Alumni Association, Co-operative stores, Dispensary, etc.

Residential area includes student hostels, staff quarters and guest house.

2.2 Building Space for Instructional Area

The course structure of any pharmacy institution offering degree programme will include lecturers, tutorials, laboratory work and seminars/colloquium. The institute must have adequate building area for all these instructional activities.

According to the model curriculum, during annual session, the total number of hours per week for which the students is to have contact with the teacher will vary between 27 to 34. In view of this, the instructional schedule is spread over a period of 34 hours a week.

The student strength in a theory class should not exceed 60, the class should be divided into smaller groups of 20 in case of junior (I & II year) classes and 15 students for the senior (III & IV year) and a teacher is assigned to each group. In case of tutorial work, these smaller groups must be accommodated in separate rooms.

The seminars/ colloquium of the senior students must be conducted with the entire class of particular discipline.

2.3 Number of rooms for Theory Classes

The number of rooms required for the theory class can be determined by applying the following relationship.

2.4 Number of Rooms for Tutorial work

The number of rooms required for the Tutorial work can be determined by applying the following relationship.

2.5 Rooms size for Theory Classes and Tutorial work

The carpet area requirement of the class rooms and tutorial rooms depends upon the number and type of seating arrangement for the students and provisions for a platform, a table and a chair for the teacher. In pharmaceutical science classes, very frequently students make use of a data book, a calculator and note book. As such he will require slightly more spacious desk as compared to the requirements of classes for students of general education. Further, as the space required for teacher will remain the same irrespective of the class strength, the per student requirement of carpet area will increase with the decrease in class strength.

Considering the above requirements and size of class room furniture and drawing tables normally used in the institution, the following carpet area norms per student are prescribed for class rooms of different size and drawing halls.

<i>Type of Rooms</i>	<i>Carpet Area</i>	<i>Requirements in Sqm</i>
Classification of Size	Minimum	Desirable
Class rooms for 40 students	48	56
Class rooms for 60 students	66	78

2.6 Laboratories

The requirements of the laboratories depend upon the programmes that are being offered by the institution and the curricula adopted for these programmes irrespective of the students population. The norms for the carpet area of the different laboratories are given in the table below. Care should be taken to provide laboratories in all allied subjects to the taught in the programme.

The size of the laboratories should be suitable for a minimum batch of 20 students. The floor area of each laboratory may be calculated at the rate of 3.0 sq.mtr. per student with the minimum of space as given:

<i>Department</i>	<i>Laboratory (Lab. Code)</i>	<i>Minimum</i>	<i>Maximum</i>
1. Pharm.Chemistry	Pharmaceutical Chemistry		
	Laboratory- (PC1) Medicinal Chemistry & Natural Products	80	100
	Pharmaceutical Chemistry	80	100
	Laboratory- (PC2) Organic and Inorganic Chemistry Balance Rooms (2) 2*20 sq.m	40	50
2. Pharmaceutics	Pharmaceutics Laboratory-I (PH1) Dispensing	80	100
	Pharmaceutics and Cosmeticology		
	Pharmaceutics Laboratory II (PH2) including Microbiology and Bio-Pharmaceutics	80	100
	Microbiology laboratory (PH3) (Desirable)	80	100
	Aseptic Room	25	35
	Physical Pharmacy (Phy. Pharm.)	80	100
	Industrial Pharmacy (Ind. Pharm.)	80	100
	Machine Room	80	100
3. Pharmaceutical Analysis	Pharmaceutical Analysis (PHA) and Biogeochemistry Instrument Room (Inst. Room) (Partly air conditioned)	80	100
4. Pharmacognosy	1. Pharm. Biology Laboratory	80	100
	2. Pharmacognosy Laboratory	80	100
5. Pharmacology	1) Human Anatomy & Physiology		
	2) Pharmacology laboratory including Anatomy, Physiology and health education smoke room	80	100
		80	100
	3) Animal Room (including feed store)	80	100
6. General	Computer room	10	100
	Water pumps room	10	20
	Gas plant (where LPG gas is not available)	30	40
	Stores-I (General)	10	20
	Store-II (for inflammable materials)	10	20

The above areas do not include the rooms of the teaching staff even though such staff rooms are attached to the laboratories. However, they do include the sitting space for the technical supporting staff and storage of laboratory consumables and instruments.

2.7 Library

Purpose:

Acquiring, storing, catalogue, indexing, issuing and returning of books, periodicals and non-print instructional material and providing reader services. Development and production of print and non-print instructional resources such as class notes, handouts, illustration, slides, filmstrips, audio-visual materials, models charts etc.

NORMS

Minimum
150 sq.mtr.

Desirable
200 sq.mtr

FACILITIES

Projection Room:

One of the class rooms to be equipped with
Projection facilities.

2.8 Museum

Every institution shall maintain a museum of crude drugs herbarium sheets/charts of the drugs and plants mentioned in the course in addition, the following is recommended.

1. Colored slides and charts of medicinal plants;
2. Display of popular patent medicines; and
3. Containers of common usages in medicines.

The following fittings will be required for the museum:

1. Showcase.
2. Cupboards.
3. Counters with lighting arrangements.
4. Literature counter on specimens.

Minimum area required for museum will be 100 sq.mtr.

2.9 Other Provision

1. Examination hall cum Auditorium.

Purpose: Conducting examinations, conference, extension lectures and function.

Area requirement: 150 sq.mtrs.

2.10 Building Space for Administrative Offices

The space to be provided for administrative office in technical institution/college will as per norms given below:

Carpet Area	(Sq.m)
Principal/Office	30
Confidential/Strong room	20
Conference room	25
Administrative room	30
Maintenance room	20

2.11 Other Space in the Department

In addition to the technical space the norms for buildings requirement in a teaching department for other purposes are as below:

Carpet Area	(Sq.m)
Head of Department	20
Facility rooms	10 Per Teacher
seminar room	30 (Desirable)
Store	10

2.12 Buildings Space for Amenities

The minimum unavoidable requirements for such amenities for normal functioning of the institute are given below along with norms for the building space.

2.13 Students Activity Centre

This will consist of provisions for the indoor games, gymnasium, dramatics and alumni centre etc. (60 sq.m)

2.14 Toilet Blocks

The college building and the hostels will be provided with adequate number of toilet blocks with urinals, lavatories and wash basins. It will also be necessary to provide separately one toilet block for women in the college buildings. Toilet area requirement is as below:

Education Building for 240 students- 24 sq.m.

2.15 Cycle and Scooter Stand

This will be provided as open or covered area as per requirement.

2.16 Other Amenities

The norms of space (Carpet area) or other miscellaneous amenities are as given below:

Carpet Area	(Sq.m)
Canteen	100 (Desirable)
Cooperative room	100 (Desirable)
NSS Office cum Stores	100 (Desirable)
Girls Common room	60 (Essential)

2.17 Play Fields

The institution must be provided with play fields so that the students can have adequate participation in games and sports for healthy and constructive activities within campus.

2.18 Building Space for Residential Area (Desirable)

The hostel requirements depend upon on a variety of factors like the location of the institution, the region from which students are admitted, local availability of accommodation and that of transport. Though, the requirement of residence for teachers and other employees of the institution also depend upon these factors but the same time it is necessary to provide an attraction to the new teacher from far off place by providing suitable accommodation at the campus.

2.19 Hostels (Desirable)

The Hostel accommodation will be provided with the norms as given below:

Location of College	Hostel Strength
Within 20km of large City	25% of Boys and 50% girls enrollment
Other Locations	50% of Boys and 100% girls enrollment

The boy's hostel will be made as a unit for 120 students while there is minimum for a girls-hostel unit. The first year students will be accommodated in triple seated rooms. The norms for the room areas will be as follow:

Carpet area	(Sq.m)
that Single room	9
Triple seated room	20

The other building space needed in hostel unit will be as per norm given below:

Carpet Area	(Sq.m)
Kitchen and Dining Hall	200
Indoor game cum Common hall	150
Medical room	50 (for all hostel)
Canteen	15
Warden office	18*
Guest rooms (2 nos)	18*

(* Four additional rooms of 9 sq.m. each within the hostel blocks)

2.20 Staff Residences

The minimum residential accommodation that should exist in the campus should be for the principal, all Heads of the Departments, all Wardens and the essential staff including a care taker, an electrician, a driver, a water supply operator and chowkidars.

The building space for residence will be as per norms given below:

Carpet Area	(Sq.m)
Principal	140 Sqm
Professor	100 Sqm
Asso. Professor/Asst.Prof	80 Sqm
Class III Staff	30 Sqm
Class IV Staff	20 Sqm

2.21 Guest House (Desirable)

To meet the needs of the guests visiting the institution for official works and the parents visiting the students it will be necessary to have a guest house having four suits with attached toilets, a common dining hall and a kitchen.

2.22 Furniture

All laboratories, library, lecture and tutorial rooms, offices, hostels and guest house etc. should be adequately furnished. No norms for furniture are being laid; however, it is expected that the furniture should conform to the requirements of a dignified institution. The institutions may equip the building with the furniture as available indigenously.

2.23 Land

It will not be desirable to set the norms of land requirements for the pharmacy college because of existing high pressure on land availability and other similar factors. If enough land is not available near a large town, the double and triple storey construction may have to be resorted to. However, it will be desirable to have the total land area so as all requirements of the building space are fully met as envisaged in these norms.

In addition it will be necessary to have additional land available within the campus for future expansion.

2.24 Laboratory Equipments

The following factors are to be considered in identifying the equipment for the laboratories and workshops.

I.Development of laboratory skills, i.e., verification, calibration, performance testing, investigation and problem solving.

II.Development of practical skills i.e., manufacturing dispensing and communication skills etc.

Laboratory models of equipments are necessary for imparting skills in the laboratories. Equipment similar to the ones used in industry are necessary for developing practical skills. Small scale and less expensive models available in the market, if found adequate for training should be preferred to large-scale and expensive equipment.

Development activities, which the pharmacy institution has to undertake, have a bearing on the equipment list. In such cases, provision may have to be made for drug store management, training in hospital-pharmacy and community services.

The number of tools/equipments/apparatus to be provided depends on the size of students group, utilization factors, capital cost and operating cost. The number of students in laboratories in any batch should not be more than 20 with one teacher. Typical layout of the labs for pharmacy programme.

a. Purpose: Demonstrating, guiding, evaluating by the teacher and investigation, discussing, measuring and testing by the students.

b. Terminology: The names of the laboratories are in accordance with the terminology used in the model curriculum.

1.25 Norms of construction & fitting

Typical laboratory for a pharmacy institution should follow following norms of construction:

1. All the laboratory should be spacious, well lit and well ventilated.
2. All laboratories should be provided with basic amenities and services like exhaust fans and fume chamber to reduce pollution wherever necessary.
3. The work branches should smooth and easily cleanable preferably made of nonabsorbent material.
4. The water taps should be non-leaking and directly installed on sinks. Drainage should be efficient and enclosed.
5. Fire extinguisher and first aid kit should be provided in each lab.
6. Preparation room (minimum 10 sq.m.) attached to the laboratories.
7. Balance room attached to concerned laboratories.

Each laboratory should have the following fittings:

1. Gas, Water and electric supply, gas plant or cylinders.
2. Shelves for keeping reagent.
3. Working surfaces.
4. Sinks.
5. Storage cabinets (lockers) for students to keep the apparatus issued to them for a year wherever required.
6. Exhaust fans and ceiling fans.
7. Fume chambers whatever necessary.
8. Black board with light.
9. Furniture (suitable arrangement for sitting of the teachers).
10. Artificial lighting wherever required for microscopic work.

1.26 Library Books and Periodicals

The teaching norms for the initial stock of books, yearly addition of the books and the number of journals to be subscribed are as given below:

Sl.No.	Item	Minimum
1	Number of Books	1500 adequate coverage of a large number of titles in all disciplines of pharmacy.
2	Annual additions of books	100 to 150 books.
3	Periodicals	15 to 20 national periodicals.

1.27 Teaching Aids

The degree in pharmacy being professional courses with sufficient practical application component will require presentation and discussion in the class room. This can be greatly facilitated by the use of overhead projector, LCDs, LEDs video and computers. Thus a institute shall have the following teaching aids such as projectors for lecture class room, computers, VCR TV and cassettes for the courses.

Staff Pattern for B.Pharm/D.Pharm/M.Pharm Courses Branch Wise

Department of Pharmaceutics	Name Of Post	With intake of 40 students	With intake of 60 students	With intake Of 100 students
1. College with B.Pharm only	Professor Asso. Professor Asst.Prof.	1 1 2	1 1 2	1 2 4
2. College with B.Pharm and M.Pharm	Professor Asso. Professor Asst.Prof	2 2 2	2 2 2	2 4 4
3. College with B.Pharm, M.Pharm & D.Pharm	Professor Asso. Professor Asst.Prof.	2 3 3	2 3 4	2 5 8
4. College with B.Pharm, D.Pharm	Professor Asso. Professor Asst.Prof.	1 2 3	1 2 4	1 2 5

Department of Pharmaceutical Chemistry	Name Of Post	With intake of 40 students	With intake of 60 students	With intake of 100 students
1. College with B.Pharm only	Professor Asso. Professor Asst.prof	1 1 2	1 1 3	1 2 5
2. College with B.Pharm and M.Pharm	Professor Asso. Professor Asst.Prof	2 2 3	2 2 4	2 4 8
3. College with B.Pharm, M.Pharm & D.Pharm	Professor Asso. Professor Asst.Prof	2 2 4	2 2 5	2 4 9
4. College with B.Pharm, D.Pharm	Professor Asso. Professor Asst.Prof	1 2 3	1 2 4	1 2 5

Department of Pharmacology	Name Of Post	With intake of 40 students	With intake of 60 students	With intake of 100 students
1. College with B.Pharm only	Professor Asso. Professor Asst.Prof.	1 1 1	1 1 2	1 2 4
2. College with B.Pharm and M.Pharm	Professor Asso. Professor Asst.Prof.	1 2 2	1 2 2	1 4 4
3. College with B.Pharm, M.Pharm & D.Pharm	Professor Asso. Professor Asst.prof.	1 2 3	1 2 4	1 2 5
4. College with B.Pharm, D.Pharm	Professor Asso. Professor Asst.Prof.	1 1 2	1 1 3	1 2 5

Department of Pharmacognosy	Name Of Post	With intake of 40 students	with intake of 60 students	With intake of 100 students
1. College with B.Pharm only	Professor Asso. Professor Asst.Prof.	1 1 1	1 1 1	1 2 2
2. College with B.Pharm and M.Pharm	Professor Asso. Professor Asst.Prof.	1 1 2	1 1 2	1 2 4
3. College with B.Pharm, M.Pharm & D.Pharm	Professor Asso. Professor Asst.Prof.	1 1 2	1 1 3	1 2 5
4. College with B.Pharm, D.Pharm	Professor Asso. Professor Asst.prof.	1 1 1	1 1 2	1 2 4

Note:Part time teaching staff for Maths,Biology and Computer Science may be appointed.

Department of Pharmacy Practice	Name Of Post	With intake of 40 students	with intake of 60 students	With intake of 100 students
1. College with B.Pharm only	Professor Asso. Professor Asst.Prof.			
2. College with B.Pharm and M.Pharm	Professor Asso. Professor Asst.Prof.			
3. College with B.Pharm, M.Pharm & D.Pharm	Professor Asso. Professor Asst.Prof.			
4. College with B.Pharm, D.Pharm	Professor Asso. Professor Asst.prof.			