Regulations for the

FOUR-YEAR

B-PHARM

DEGREE COURSE

(From 2000 Admissions onwards)

UNIVERSITY OF CALICUT

Regulations for the Four-Year B-Pharm Degree Course
(2000 admissions onwards)

1. TITLE OF THE PROGRAMME.

The programme shall be called the bachelor Degree Programme in Pharmacy (B.Pharm)

2. ELIGIBILITY FOR ADMISSION.

A candidate who has undergone any of the following courses in English medium and passed the examination with 50% marks in the aggregate of optional subjects.

1. Pre-degree examination of the University of Calicut with Physics, Chemistry and Biology/ Mathematics as optional subjects.
2. Higher Secondary examination of Govt. of Kerala with Physics, Chemistry and Biology/ Mathematics as optional subjects.
3. Any other examination with Physics, Chemistry and Biology/ Mathematics as optional subjects approved as equivalent to any of the above examinations by the University of Calicut.

Note :- In respect of candidates who have taken Physics, Chemistry, Biology and Mathematics as optional subjects, the aggregate of Physics, Chemistry and Biology or Physics, Chemistry and Mathematics which ever is higher shall be considered for the purpose of admission. For those who have passed the D-Pharm examination with 50% marks in D-Pharm final examination, the minimum equirement of 50% marks in the optional marks will be waived

3. DURATION OF THE COURSE.

The course of study for B-Pharm shall extend over a period of four academic years. Each academic year consists of not less than 200 working days.

4. MEDIUM OF INSTRUCTION.

Medium of instruction shall be English.

5. ATTENDANCE.

A candidate is required to put in atleast 80% of attendance in theory and practical subjects separately in a recognised institution approved by and affiliated to the University of Calicut.

6. COURSE OF STUDY.

The course of study for B-Pharm I, II, III and Final year shall include the respective theory and practical subjects as given below.

FIRST B-PHARM

Subject code	Subject	Hours of theory per week	Hours of practical per week
1--1	Pharmaceutical Chemistry-I (Inorganic and Physical Chemistry)	2	3
1--2	Pharmaceutical Chemistry -II (Organic Chemistry)	2	3
1--3	Pharmaceutical Analysis- I	2	6
1--4	(A) Human Anatomy	1	2
	(B) Human Physiology	2	2
1--5	Mathematics & Biostatistics	3	--
1--6	Basic Electronics & Computer Applications	2	3
	Total no.of hours/ week	14	19

SECOND B-PHARM

Subject code	Subject	Hours of theory per week	Hours of practical per week.
2--1	Pharmaceutical Chemistry-III (OrganicChemistry)	3	3
2--2	Pharmaceutics-I (Physical Pharmacy)	3	3
2--3	Pharmacognosy -I	3	3
2--4	Pharmaceutical Chemistry -IV (Bio-chemistry)	3	3
2--5	Pharmaceutical Engineering	3	3
2--6	Pathophysiology & Health Education	3	--
	Total no. of hours / week	18	15

THIRD B-PHARM

Subject code	Subject	Hours of theory per week	Hours of practical per week
3--1	Pharmaceutical Chemistry-V (Chemistry of -Natural Products)	2	3
3--2	Pharmaceutical Microbiology & Biotechnology	2	3
3--3	Pharmacology- I	2	3
3--4	Pharmaceutics- III	2	3
3--5	Pharmacognosy- II	2	3
3--6	Pharmaceutics- IV (Hospital, Community & Dispensing Pharmacy)	3	3
3--7	Pharmaceutical Jurisprudence	2	--
	Total no. of hours	15	18

FINAL B-PHARM

Subject code	Subject	Hours of theory per week	Hours of practical per week
4--1	Pharmaceutical Chemistry-VI (Medicinal Chemistry)	3	3
4--2	Pharmaceutical Analysis -II	2	3
4--3	Pharmacognosy -III	2	3
4--4	Pharmaceutics-V (Formulative & Industrial - Pharmacy)	3	6
4--5	Pharmacology-II	3	3
4--6	Pharmaceutical Industrial Management	2	--
4--7	Pharmacology-III(Clinical Pharmacy & Therapeutics)	2	--
4--8	Project Work	1	--
	Total no. of hours / week	18	18

7. SCHEME OF EXAMINATION

The examination shall be held at the end of each academic year, ordinarily in July- August. A supplementary examination shall also be held, ordinarily in January- February. The marks awarded for the examination will be as follows.

FIRST B-PHARM

Subject code	Subject	Theory				Practical		
		Exam Mark	Sessional Mark	Viva-voce Mark	Total Mark	Exam Mark	Sessional Mark	Total Mark
1	2	3	4	5	6	7	8	9
1--1	Pharmaceutical Chemistry-I (Inorganic & Physical Chemistry)	80	40	30	150	100	50	150
1--2	Pharmaceutical Chemistry-II (Organic Chemistry)	80	40	30	150	100	50	150
1--3	Pharmaceutical Analysis-I	80	40	30	150	100	50	150
1--4	(A) Human Anatomy	30	15	10	]	40	20	]
	(B) Human Physiology	50	25	20	]= 150	60	30	] = 150
1--5	Mathematics & Biostatics	70	30	--	100	--	--	--
1--6	Basic Electronics & Computer application	80	40	30	150	100	50	150
TOTAL					850			750
GRAND TOTAL 1600 MARKS								

SECOND B-PHARM

Subject code	Subject	Theory				Practicals		
		Exam mark	Sessi-onal mark	Viva voce Mark	Total mark	Exam mark	Sessi-onal mark	Total Mark
1	2	3	4	5	6	7	8	9
2--1	Pharmaceutical Chemistry-III (Organic Chemistry)	80	40	30	150	100	50	150
2--2	Pharmaceutics -I (Physical Pharmacy)	80	40	30	150	100	50	150
2--3	Pharmacognosy- I	80	40	30	150	100	50	150
2--4	Pharmaceutical Chemistry-IV (Biochemistry)	80	40	30	150	100	50	150
2--5	Pharmaceutical Engineering	80	40	30	150	100	50	150
2--6	Pathophysiology & Health-Education.	70	30	--	100	--	--	--
TOTAL								
GRAND TOTAL 1600 MARKS					850			750

THIRD B-PHARM

Subject code	Subject	Theory				Practical		
1	2	Exam mark 3	Sessi -ional Mark 4	Viva voce Mark 5	Total Mark 6	Exam Mark 7	Sessio- nal Mark 8	Total Mark 9
3--1	Pharmaceutical Chemistry-V (Chemistry of Natural Products)	80	40	30	150	100	50	150
3--2	Pharmaceutical Microbiology & Biotechnology	80	40	30	150	100	50	150
3--3	Pharmacology-I	80	40	30	150	100	50	150
3--4	Pharmaceutics-III (Biophar-maceutics & Dosage form Designs)	80	40	30	150	100	50	150
3--5	Pharmacognosy-II	80	40	30	150	100	50	150
3--6	Pharmaceutics-IV (Hospital-Community& Dispensing Pharmacy)	80	40	30	150	100	50	150
3--7	Pharm: jurisprudence	70	30	--	100	--	--	--
TOTAL GRAND TOTAL 1900 MARKS					1000			900

FINAL B-PHARM

Subject code	Subject	Theory				Practical		
1	2	Exam Mark 3	Sessi -ional Mark 4	Viva-voce Mark 5	Total Mark 6	Exam Mark 7	Sessio-nal Mark 8	Total mark 9
4--1	Pharmaceutical Chemistry-VI (Medicinal Chemistry)	80	40	30	150	100	50	150
4--2	Pharmaceutical Analysis-II	80	40	30	150	100	50	150
4--3	Pharmacognosy-III	80	40	30	150	100	50	150
4--4	Pharmaceutics-V (Formulati-ve & Industrial Pharmacy)	80	40	30	150	100	50	150
4--5	Pharmacology-II	80	40	30	150	100	50	150
4--6	Pharmaceutical Industrial-Management	70	30	--	100	--	--	--
4--7	Pharmacology-III (Clinical - Pharmacy & Therapeutics)	70	30	--	100	--	--	--
4--8	Project work	--	--	--	100	--	--	--
TOTAL GRAND TOTAL 1800 MARKS					1050			750

Note: - Duration of theory examination of each subject will be 3 hours and of practical examination will be 4 hours.

8. MINIMUM FOR A PASS.

No candidate shall be declared to have passed in any subject, unless he / she obtains-

1. 45 % marks in the University Examination and 50 % marks in the total for theory (Aggregate of University Examination Marks, Sessional Mark and Viva mark) and
2. 45 % mark in the University Examination and 50 % marks in the total for practical (Aggregate of University Examination mark and sessional marks)

9. SESSIONAL MARKS.

A. Theory : Three sessional examinations (evenly spaced) shall be conducted during the academic year. The average marks of best two examinations shall be computed out of a maximum of 40 marks and constitute the sessional in theory.

B. Practicals: Students are expected to perform the number of experiments listed in the respective syllabus. Students are required to maintain practical records for each of the practical subjects and should be produced at the time of examination. Marks shall be awarded out of maximum of 10 to each of the practical exercises and an average of those shall be computed out of a maximum of 40 marks. While awarding the sessional marks for practical experiments, the following consideration should be taken in to account.

Marks for practical experiments shall be awarded on the basis of :

- Preparedness of the candidate
- manipulative skill
- Results
- Knowledge of the experiments and

Viva-voce.

A regular record of theory and practical sessional marks shall be maintained for each student in the institution. The remaining 10 marks of practical sessional marks will be on the basis of a practical sessional examination conducted at the end of the academic year.

IMPROVEMENT OF SESSIONAL MARKS

Candidates who could not pass an examination can improve the sessional marks in theory of the subjects in which he / she failed. For improving the sessional marks, two sessional examinations will be conducted and their average will be taken in to account. Such improvement is allowed for a maximum of two times for a particular subject.

The improvement of sessional marks will not be possible for practicals.

10. candidates who have secured the minimum required for a pass in a subject shall be exempted from appearing at subsequent examination in such subject. A subject includes both theory & practical.

11. Candidates who have registered for the University examination of a class will be eligible for promotion to the next higher class. But he / she will be eligible to appear for the examination of the higher class only after passing in all subjects in the lower class.

12. AWARD OF CLASS AND DISTINCTION:

Distinction– 75 % and above of the aggregate of all subjects in the examination each year in first appearance

Class shall be awarded for I-B-Pharm / II B-Pharm and III-B-Pharm examinations as shown below

1. First class- 60 % and above of the total aggregate of the examination of each year
2. Second class- 50 % and above but less than 60 % of the total aggregate of the examination.

For calculation of the class in final year Examination, the aggregate of the marks of First, Second, Third and Final year B-Pharm will be considered. Distinction will be awarded if the candidate secures 75 % and above of the aggregate of all subjects in First, Second, Third and Final year B-Pharm in first appearance.

13. PRACTICAL TRAINING.

Every candidate shall undergo practical training in a pharmaceutical Manufacturing House or Laboratory or an approved Hospital / National Research Laboratory for a period of not less than 300 hours to be covered in not less than two months during the course. The annual vacation period after Second year, Third year or Final year may be utilised for this. B-Pharm degree will be awarded only after the training certificate from the training institute, of having undergone the training successfully is forwarded to the University by the Principal of the College.

14. AWARD OF RANKS.

Ranks and Medals shall be awarded on the basis of aggregate of all the four University Examinations. Candidates who fail in one or more subjects during the B-Pharm course shall not be eligible for award of ranks.

More over the candidates should have completed the B-Pharm course in the prescribed (minimum) number of years.

15 INDUSTRIAL TOUR.

Students of Third B-Pharm course may visit several manufacturing houses or National Research Laboratories as a supplement to the academic training and submit a report to the satisfaction of the Head of Institution.

16. PROJECT WORK.

Each candidate studying in the Final B-Pharm class will carry out a project work in any branch of Pharmaceutical Sciences. The project work is intended to initiate the student in to research work and the candidate is expected to conduct literature survey, analysis of data etc. under the supervision of a teacher At the end of the year, the project work certified by the supervising teacher will be submitted to the Head of Institution. The Head of the Institute will constitute a panel of Professors/ Associate Professors / Assistant Professors comprising one member each from Pharmaceutics, Pharmaceutical Chemistry, Pharmacognosy and Pharmacology Departments. The panel will evaluate the project work on the basis of seminars and / or Viva-voce and marks will be sent to the University by the Head of the Institution . There is no minimum mark for a pass in the project work.

17. APPROVAL OF INSTITUTION CONDUCTING THE COURSE OF STUDY.

The regular course for B-Pharm shall be conducted by an Institution approved and affiliated to the University of Calicut. The approval and affiliation will be granted only if adequate arrangements for teaching in regards to building, laboratories, library, equipments and staff patterns as laid down by the regulations of All India Council for Technical Education and Pharmacy Council of India are available. The number of admission in an institution shall not be more than 60 as laid down by the All India Council for Technical Education regulations.

1 : 1 PHARMACEUTICAL CHEMISTRY- I
(Inorganic & Physical Chemistry)

Theory 2 hours / week

A. Inorganic Chemistry

1. Atomic Structure.

Bohr's model, wave nature of electrons, Shrodinger's wave equation, Quantum numbers, Geometry of orbitals

2. Chemical Bonding.

Ionic, Co-valent, Co-ordinate & Hydrogen bonding, Vander -Waal's forces, Valence bond theory and Molecular orbital theory

3. Radioactivity.

Natural Radioactivity. Nature and characteristics of radiations from radio-active substances- Measurement of Radio-activity- Theory of Radio-active emission and disintegration - Artificial Radio-activity - Isotopes and their applications in Medicine, Pharmacy and other fields - Nuclear fission and fusion.

4. Complexation.

Classification of complexes, methods of preparation and analysis, applications.

5. Buffers.

Buffer equation and Buffer capacity - Buffers in Pharmaceutical system, their preparation and stability.

6. Limit tests.

Sources of impurities in pharmaceuticals - importances of limit tests - General procedure for limit tests for chloride, sulphate, iron, arsenic, heavy metals and lead.

7. General methods of preparation, properties, test for purity, identification tests, storage conditions, assay methods and detailed medicinal and pharmaceutical uses of the following compounds.

a. Gastro intestinal agents:

Dil. HCl, Sodium bicarbonte, Aluminium hydroxide gel, Mag. hydroxide mixture, Mag.trisilicate, Calcium carbonate, Bismuth sub carbonate, Kaolin, Activated charcoal, Sodium phosphate, Magnesium-sulphate, Magnesium carbonate, Mag.oxide.

b. Pharmaceutical aids and Necessities

Phosphoric acid, Hypophosphorous acid, Sodium bisulphite, Sodium metabisulphite, Mag. stearate, Bentonite, Talc, Sodium benzoate, Sodium lauryl sulphate, Dibasic calcium phosphate, Tribasic calcium phosphate.

c. Essential and trace ions.

Absorption, distribution and physiological role of Fe, Ca, Zn, Mn, S, and I and the following compounds. Ferrous sulphate, Ferrous gluconate, Ferrous fumarate, Ferric ammonim citrate, Calcium gluconate, Calcium lactate, Zinc sulphate, Aqueous Iodine solution, Pot. iodide.

d. Expectorants and emetics.

Ammonium chloride, Potassium iodide.

e. Topical agents.

Zinc oxide, Zinc undeconate, Zinc sulphate, Hydrogen peroxide, Sodium perborate, Solution of Iodine, Mercuric oxide, Ammoniated mercury, Boric acid, Selenium sulphide, Alums.

f. Medicinal gases.

Oxygen, Nitrous oxide, Carbon dioxide.

g. Miscellaneous compunds including dentifrices, anti- caries agents, Sedatives etc. Lithium carbonate, Sodium bromide, Barium sulphate, Sodium thiosulphate.

B. PHYSICAL CHEMISTRY

9. Behavior of gases: Kinetic theory of gases, deviation from ideal behavior and explanation.
10. The liquid state: Physical properties (Surface tension, Parachor, Viscosity, refractive index, optical rotation, dipole moments and chemical constituents.
11. Solutions: Ideal and Real solutions, Solutions of gases in liquids, Colligative properties, Partition coefficients, conductance and its measurements, Debye Huckel theory.
12. Thermodynamics: First, Second and Third laws, Zeroth law, Absolute temperature scale, Thermochemical equations, Phase equillibria and Phase rule.
13. Adsorption: Freudlich and Gibbs adbsorption, Isotherms, Langmuir theory of adsorption
14. Photochemistry: Consequences of light absorption. Jablenski diagram, Lambert- Beer law, Quantum efficiency.
15. Chemical kinetics: Zero, First and Second order reactions, Complex reactions, theories of reaction kinetics. Characteristics of homogenous and heterogeneous catalysis and acid base and enzyme catalysis.
16. Quantum mechanics: Postulates of Quantum mechanics, operators in Quantum mechanics, the Schrodinger wave equation.

Practicals 3 hours/ week

1. Limit tests for chloride, Sulphate, iron, Heavy metals, Arsenic and Lead.
2. Identification tests for cations and anions.
3. Preparation of a few medicinally important inorganic compounds.
4. Test for purity and monograph analysis of selected inorganic drugs.
5. Determination of specific gravity and weight per ml factor of liquids by using specific gravity bottle / Pyknometer.
6. Determination of Refractive index of a liquid and variation of the Refractive index with composition of mixtures and calculate the percentage composition using Refractometer.
7. Determination of Partition co-efficient of Benzoic acid between benzene and water.
8. To determine the concentration of the given solution of Sodium chloride using Phenol- water system

1 : 2 PHARMACEUTICAL CHEMISTRY - II

(Organic Chemistry)

Theory: 2 hours/ week

1. Atomic and molecular structure.

Molecular orbitals, SP_2, SP_3, and SP hybridisation. Ionic bond, covalent bond, multiple bond, polarity of bond, hydrogen bond.

2. Alkanes, Alkenes and Alkynes.
   a. Nomenclature
   b. General methods of preparation and reactions of alkanes, alkenes and alkynes (Emphasis on mechanism).
   c. Free radical substitution of alkane and mechanism
   d. Carbonium ions - formation, stability and electrophilic addition mechanism
   e. Inductive effect and hyper conjugation.
3. Alicyclic compounds.
   General methods of preparation and reaction. Stability of ring compounds. Baeyer's strain theory, structure of cyclohexane, Bicyclic compounds - Nomenclature. Properties and uses of cyclopropane.
4. Aromatic Hydrocarbons.
   a. Structure of Benzene including Kekule and Dewar structures - Aromatic character, resonance theory.
   b. Electrophilic aromatic substitution. Friedel Craft's alkylation and acylation. Activating and deactivating groups and orientation in nitration, halogenation and sulphonation Effect of orientation of substitution, steric effects.
5. Alkyl halides and Aryl halides.
   Their general methods of preparation and reactions.
6. Alcohols and phenols.
   Nomenclature - General methods of preparation and reactions of primary, secondary and tertiary alcohols. Mechanism of esterification, acidity of alcohols and phenols, Effect of substituents on acidity of phenols.
7. Carbonyl Compounds (Aldehydes and Ketones)
   Structure and nomenclature: General methods of preparation and reaction. Nucleophilic addition reaction, oxidation and reduction, carbonation, Aldol condensation, Cannizaro and departing reactions. Identification and characterisation of aldehydes and ketones.
8. Carboxylic acids.
   Mono and Dicarboxylic acids. Nomenclature, different methods of preparation and reactions. Acidity and effect of substitution on acidity. Conversion to acid chlorides, anhydrides, amides and esters and reactions of these.
9. Nitrocompunds.
   General methods of preparation and reactions.
10. Amines and Diazonium salts
    Structure and nomenclature. basicity of amines. General methods of preparation and reactions, Diazonium chloride.
11. Spectroscopic analysis of organic compounds.
    An elementary study of U-V, I.R and N.M.R spectra and their applications in the study of structures of the above mentioned class of compounds.

Practical work 3 hours/ week

Identification of simple organic compounds by systematic qualitative analysis based on tests for elements and functional groups, solubility, melting or boiling point and preparation of derivative.

Preparation of atleast 10 organic compounds of pharmaceutical importance involving processes like hydrolysis, oxidation, reduction, halogenation, nitration, sulphonation, acetylation, estrerification etc.

1 : 3 PHARMACEUTICAL ANALYSIS - I

Theory

2 hours/ week

1. Significance of quantitative analysis in quality control. Different techniques of analysis, preliminaries and definitions, Significant figures, rules for retaining significant digits, Types of errors, Mean deviation, Standard deviation, Statistical treatment of small data sets, selection of sample, Precision and accuracy, Fundamentals of volumetric analysis, Methods of expressing concentration, Primary and secondary standards.
2. Acid- Base titrations: Acid- Base concepts, Role of solvent, Relative strengths of acid and bases, Ionisation, Law of Mass action, Common-ion effect, Ionic product of water, pH, Hydrolysis of salts, Henderson - Hasselbach equation, Buffer solutions, Neutralisation curves, acid- bases indicators, Theory of Indicators, Choice of indicators, Mixed indicators, Poly protic system, Poly amine and amino acid system, Amino acid titration, Applications in assay of H_3PO_4, NaOH $CaCO_3$ etc.
3. Oxidation Reduction Titrations: Concepts of oxidation and reduction reactions, redox reactions, strengths and equivalent weights of oxidising and reducing agents, theory of redox titrations, redox indicators, cell representations, measurement of electrode potential, oxidation reduction curves, Iodimetry and Iodometry, Titrations involving ceric sulphate, Potassium iodate, potassium bromate, Pot. permanganate, Titanous chloride and Sodium 2, 6- dichlorophenol indophenol.
4. Precipitation titrations: Precipitation reactions, Solubility products, effect of acids, temperature and solvents upon the solubility of a precipitate. Argentometric titrations and titrations involving ammonium or potassium thiocyanate, mercuric nitrate and Barium sulphate indicators, Gay-Lussac method; Mohr's method, Volhard's method and Fajan's method.
5. Gravimetric analysis: Precipitation techniques, Solubility products; The colloidal state, Super saturational co-precipitation, Post-precipitation, Digestional washing of the precipitate, Filtration, Filter papers and crucibles, Ignition, Thermogravimetric curves, specific examples like Barium sulphate, Aluminium as aluminium oxide, calcium as calcium oxalate and magnesium as magnesium pyrophosphate, organic precipitants.
6. Theoretical considerations, and applications in drug analysis and quality control of the following analytical technics will be discussed.
7. Non-aqueous titrations.
8. Complexometric titrations
9. Miscellaneous methods of analysis such as : Diazotisation Titration, Kjeldahl's method of Nitrogen estimation, Karl-Fischer titration, oxygen flask combustion, gasometry.

Practicals

6 hours/ week

The students should be introduced to the main analytical tools through demonstrations. They should have a clear understanding of a typical analytical balance, the requirement of a good balance, weights, care and use of balance, methods of weighing and errors in weighing. The students should also be acquainted with the general apparatus required in various analytical procedures.

1. Standardisation of analytical weights and calibration of volumetric apparatus.
2. Acid-base titrations: Preparation and standardisation of acids and bases; Some exercises related with determination of acids and bases separately or in mixture form, some official assay procedures eg: Boric acid should also be covered.
3. Oxidation- reduction titrations: Preparation and standardisation of some redox titrants eg. Potassium permanganate, Pot. dichromate, Iodine, Sodium thiosulphate etc. Some exercises relate to determination of oxidising and reducing agents in the samples shall be covered. Exercises involving Pot. iodate, Pot.bromate, Iodine solution, titanous chloride, sodium 2,6- dichlorphenol indophenol and ceric ammonium sulphate.
4. Precipitation Titrations: Preparation and standardisation of titrants like silver nitrate and ammonium thiocyanate, Titrations according to Mohr's , Volhard's and Fajan's method.
5. Gravimetric Analysis:Preparation of Gooch crucible for fitration and use of sintered glass crucible, determination of water of hydration, some exercises related to gravimetric analysis should be covered.

1 : 4 (A) HUMAN ANATOMY

Theory: 1 Hour/ Week

1. Scope of Anatomy and basic terminology used in the subject.
2. Structure of cell, its components and their functions.
3. Elementary tissues of Human body: Epithelial, Connective, Muscular and Nervous tissues, their sub-types and characteristics.
4. Osseous System: Structure, composition and functions of skeleton. Classification of joints, Types of movements at joints, Disorders of joints.
5. Skeletal Muscles: Their gross anatomy.
6. Cardiovascular system: Basic anatomy of Heart
7. Digestive system: Gross anatomy of the Gastrointestinal tract.
8. Respiratory system: Anatomy of the Respiratory organs.
9. Endocrine system: Basic anatomy of Pituitary, Thyroid, Parathyroid, Adrenals, Pancreas, Testes and Ovary.
10. Sense organs: Basic anatomy of the eye, ear, taste buds, nose and skin.

Practical 2 Hours/ Week

1. Study of Human skeleton
2. Study of different systems with the help of charts and models.
3. Microscopic study of different tissues.

1 : 4 (B) HUMAN PHYSIOLOGY

Theory — 2 Hours/ Week

1. Scope of Physiology and basic terminology used in the subject.
2. Skeletal muscles: Physiology of muscle contraction, Physiological properties of skeletal muscles and their disorders.
3. Haemopoietic system: Composition and function of blood and its elements, their disorders, blood groups and their significance, mechanism of coagulation, disorders of platelets and coagulation.
4. Lymph and Lymphatic system: Composition, formation and circulation of lymph, disorders of and lymphatic system. Basic physiology and functions of spleen.
5. Cardiovascular system: Physiology of heart, Blood vessels and circulation. Basic understanding of cardiac cycle, heart sounds and electrocardiogram. Blood pressure and its regulation. Brief outline of cardiovascular disorders like hypertension, hypotension, arteriosclerosis, angina, myocardial infarction, congestive heart failure and cardiac arrythmias.
6. Digestive system: Functions of different parts of gastrointestinal tract including Liver, pancreas and gall bladder, various gastro intestinal secretions and their role in the absorption and digestion of food. Disorders of digestive system.
7. Respiratory system: Functions of respiration, mechanism and regulation of respiration, respiratory volumes and vital capacity.
8. Central Nervous System: Functions of different parts of brain and spinal cord, neurohumoral transmission in the central nervous system, reflex action, electroencephalogram, specialised functions of brain. Cranial nerves and their functions.
9. Autonomic Nervous System: Physiology and functions of the autonomic nervous system. Mechanism of neurohumoral transmission in the A.N.S.
10. Urinary System: Various parts, structure and functions of the kidney and urinary tract. Physiology of urine formation and acid base balance. Diseases of the urinary system.
11. Reproductive System: Male and female reproductive system and hormones, Physiology of menstruation, coitus and fertilization. Sex differentiation, Spermatogenesis and oogenesis. Pregnancy, its maintenance and parturition.
12. Endocrine System: Physiology of Pituitary, Thyroid, Parathyroid, Adrenal, Pancreas, Testes and Ovary, their hormones and functions.
13. Sense Organs: Physiology of the eye (Vision), Ear (Hearing), Taste buds, Nose (Smell) and Skin (Superficial receptors).

Practical — 2 Hours/ Week

1. Estimation of Hemoglobin in blood. Determination of Bleeding time, Clotting time, R.B.C. count Total leucocyte count, D.L.C. and E.S.R.
2. Recording of the body temperature, Pulse rate and blood pressure. Basic understanding of Electro CardioGram, PQRST wave and their significance.
3. Physiological experiments on Nerve-muscle preparation.
4. Determination of Vital capacity and experiments on Spirometry.

1 : 5 MATHEMATICS AND BIOSTATISTICS

Theory

3 Hours/ Week.

1. **Algebra**: Equations reducible to quadratics, simultaneous equations (Linear & Quadratic), Determinants, properties of solution of simultaneous equations by Cramer's rule, matrices, definitions of special kinds of matrices, arithmetic operations on matrices, inverse of a matrix, solution of simultaneous equations by matrices, Pharmaceutical applications of determinants and matrices. Evaluation of En1, En2 and En3 mensuration and its Pharmaceutical applications.

2. **Measures of Central Value**: Objectives and pre-requisites of an ideal measure, mean, mode and median.

3. **Trigonometry**: Measurement of angle, T-ratios, addition, subtraction and transformation formulae. T-ratios of multiple, submultiple, allied and certain angles. Application of logarithms in Pharmaceutical computations.

4. **Analytical Plans Geometry**: Certain co-ordinates, distance between two points, area of triangle, a locus of point, straight line; slope and intercept form, double intercept form, normal (perpendicular) form, slope point and two point form, general equation of first degree.

5. **Calculus**:

   Differential- Limits and functions, definition of differential coefficient, differentiation of standard functions, including function of a function (Chain rule), Differentiation of implicit functions, logarithmic differentiation, parametric differentiation, successive differentiation.

   Integral: Integration as inverse of differentiation, indefinite integrals of standard forms, integration by parts, substitution and partial fractions, formal evaluation of definite integrals.

6. **Differential equations**: Revision of integral calculus, definition and formation of differential equations, equations of first order and first degree, variable, separable, homogenous and linear differential equations and equations reducible to such types, linear differential equations of order greater than one with constant coefficients, complementary function and particular integral, simultaneous linear differential equations, Pharmaceutical applications.

7. **Biometrics**: Significant digits and rounding of numbers, data collections, random and non-random sampling methods, sample size, data organisation, diagrammatic representation of data, bar pie, 2-D and 3-D diagrams, measures of central tendency, measures of dispersion, Standard Deviation and standard error of means, Coefficient of variation, confidence (Fiducial) Limits Probability and events, Baeyes theorem, Probability theorems, probability distributions, elements of Binomial and Poisson distribution, normal distribution curve & properties., kurtosis and skewness, correlation and regression analysis, method of least squares, statistical inference, Student's and paired t- test, F- test and elements of ANOVA, applications of statistical concepts in Pharmaceutical Sciences.

1 : 6 BASIC ELECTRONICS AND COMPUTER APPLICATION

Theory: 2 Hours/ Week

1. Basic Electronics:

Semi conductors, p-n junctions, diodes, LED, Photodiodes and its uses, Rectifiers (half wave, full wave, with filters). Transistors, biasing, transistor amplifiers, flip-flops, Logic gates, Boolean algebra.

2. Computers:

2.1 History of Computer development and respective generation; Computer classification: Main frame, Mini and micro computers, fundamental of computer architecture.

2.2 Operating systems: Introduction to types of operating systems. Over view of MS- DOS, Windows, Unix and Linux.

2.3 Languages and packages: Conventional languages, their advantages, limitations. C and Visual Basic: Input/ Out put, Operators, Loops, decisions, functions, array and strings, pointers, files. Forms and Menu in Visual Basic.
Word processing, spread sheet, presentation and tables: Demonstration by MS- OFFICE

2.4 Principles of Database Systems: Overview of Database system, the hierarchial model, Relational model, Relational Query language, design theory and normalization.

2.5 Computer Applications in Pharmaceutical and Clinical studies.

Practical: 3 Hours/ Week.

Small programmes to demonstrate Input/ Output, Operators,Loops, decisions, functions, array and strings, pointers, files in C. Forms and menu in Visual Basics.

2 : 1 PHARMACEUTICAL CHEMISTRY - III
(Organic Chemistry)

Theory 2 hours/ week

Note: The subject is to be treated in the light of modern perspective giving stress where ever possible on the following aspects- structure, nomenclature, preparation, properties, energy of activation, transition state, resonance, stereochemistry, optical and geometric isomerism etc.

1. Stereo isomerism and Tetrahedral carbon, optical activity, chirality, chiral centres, racemic modifications and resolution of racemic mixtures, configuration, specification of R & S configuration, enantiomerism, enantiomers, diastereo isomerism, meso structure, conformational isomers, reactions of chiral molecules, elements of symmetry, asymmetric synthesis, E & Z forms
2. Stereo selective and stereospecific reactions, stereochemistry of addition of halogens to alkenes, mechanism of stereochemistry of E1 and E2 reactions, Syn and Anti elimination. SN1 and SN2 reactions.
3. Geometric isomerism, its nature and formation, rotation about bond, nomenclature of isomers, determination of configuration, stereochemistry of cyclic compounds including biphenyl and stereochemistry of nitrogen compounds.
4. Stereochemistry of biomolecules of pharmaceutical importance.

   Carbohydrates - Introduction, definition, classification,nomenclature, structure determination of glucose, fructose, stereo isomers of monosaccharides, reactions, conversion, configuration of glucose, cyclic structure of glucose, determination of ring size, conformation, Fischer projection formula and conformation, Disaccharides and poly saccharides, chemical nature of maltose, lactose, sucrose, starch, cellulose, cellulose derivatives used in pharmacy.
5. Fats and Oils.

   Introduction to chemistry of fats, oils, waxes, Occurrence and composition, hydrolysis of fats, esterification. Fats as source for pure acids and alcohols, Analytical constants of fats and oils, methods for their determination and significances, unsaturated fats, hardening of oils, hydrogenation of oils, drying, semi-drying and non-drying oils.
6. Heterocyclic compounds.

   Classification of heterocyclic compounds, nature and nomenclature, heterocyclic analogues of cyclopentadiene with one hetero atom.
7. Fused ring systems involving pyrrole, furan, thiophen, indole and benzofuran.
8. Heterocyclic analogues of benzene with one hetero atom. Pyridine.
9. Heterocyclic analogues of naphthalene with one hetero atom Quinoline, iso-quinoline, acridine.
10. Compounds with two hetero atoms in five membered ring, Pyrazole, Imidazole, Isoxazole and Oxazole.
11. Compounds with two or more hetero atoms, Pyrimidine, pyrazine, pyridazine, purines, Azepines, Oxepines and dibenz azepines.

    Tricyclic: Phenothiazines, Phenoxazines, benzodiazepines, basic structures of compounds used in pharmacy.
12. Preparation, synthesis and reactions of diphenyl-methane, diphenyl-ethane, triphenyl-methane, naphthalene, phenanthrene and anthracene.
13. Amino acids.

    Introduction, definition, classification, structure of amino acids, essential amino acids their properties, reactions and selected synthesis of amino acids.

    Peptide linkage, geometry of peptide linkages, formation, determination of structures of peptides and synthesis, formation of protein, general introduction to protein with examples.

Practicals: 3 hours/ week

I. Quantitative determination of organic compounds via functional groups such as :
   1. -OH groups (Alcoholic and phenolic)
   2. -COOH
   3 -CHO
   4. -C= O
   5. Amines and amine HCl
   6, Carbohydrate
   7. Esters

II. 1. Synthesis of compounds involving more than one step. Atleast six synthesis should be performed.

III. Oil, fat analysis
Acid value, soap value, Iodine value, detection of adulterants in oils.

2 : 2 PHARMACEUTICS - I
(Physical Pharmacy)

Theory: 2 hours/ week

1. Solubility and Distribution phenomena.
   General principles - Solvent - Solute - Interactions - Solubility of gases, liquids and non-ionic solids in liquids- Distribution of solutes between immiscible solvents.
2. Diffusion and Dissolution
   Diffusion - Fick's laws- principles in Biologic systems- dissolutions - Drug release.
3. Surface and Interfacial phenomena:
   Liquid interfaces - adsorption at liquid interfaces- adsorption at solid interfaces - Electrical properties of interfaces- Surface tension- its determination- Classification of surfactants- Detergency- Wetting agents- foaming agents- Deflocculating agents- Pharmaceutical applications of surfactants.
4. Colloids. Introduction- Types of Colloidal systems optical properties, kinetic properties of colloids- solubilisation- Electrical properties of colloids.
5. Coarse dispersions: Suspensions- Interfacial properties of suspensions-Settling of suspensions- Emulsification- theory of emulsification- physical stability- preservation & rheological properties of emulsions- Phase equillibria and emulsion formulation- special emulsion systems- semisolids and gels.
6. Rheology: Types of flow- Viscosity- Newtonian and Non-Newtonian fluids- Thixotropy- Viscometers.
7. Kinetics: Orders and rates of reaction- factors influencing reactions- Decomposition and stabilization of pharmaceuticals-kinetics of solid state- Accelerated stability analysis kinetics of drug transportation.
8. Micrometrics: Particle size- Size distribution determination of particle size- shape surface area- pore size- particle volume- permeability adsorption.
9. Introduction of Polymer Science: Polymer solutions- molecular weight averages- molecular weight determination from solution viscosity- Thickening properties - Gel formation, coacervation, Microencapsulation- pharmaceutical applications- Future trends in pharmaceutical and Biomedical uses.

Practicals: 3 hours/ week

1. Determination of Interfacial properties- surface tension- CMC- power of surfactants.
2. Experiments of viscosity- Effect of viscosity on sedimentation rate.
3. Determination of rates of reaction.
4. Particle size distribution analysis and determination of particle size.
5. Study of suspensions by controlling flocculations and stability evaluation.
6. Study of flow properties of powders- Angle of repose.
7. Study of colloids: Preparation and stability study with addition of electrolytes.
8. Study of emulsions: Stability and globule analysis.
9. Experiments pertaining to other theory chapters.

2 : 3 PHARMACOGNOSY - I

Theory

3 hours/ week

1. Methods of classification of plants.
2. Plant cell: Its structure and non-living inclusions, mitosis and meiosis- different types of plant tissues and their functions.
3. Morphology and histology of roots, stem, bark, wood, leaf, flower, fruit and seed. Modification of root and stem.
4. General survey of animal kingdom: Structure and life history of parasites as illustrated by amoebae, entamoeba, trypanosoma, plasmodium, taenia, ascaris, schistosoma, oxyuris and ancylostoma.
5. General structure and life history of insects like mosquito, house fly, mites and silk worm.
6. Definition, history, scope and development of Pharacognosy.
7. Sources of drugs: Biological, marine, mineral, plant and tissue culture as sources of drugs.
8. Classification of drugs:Eg. alphabetical, morphological, taxonomical, chemical and pharmacological.
9. Plant taxonomy: Study of the following families with special references to medicinally important plants- Apocynaceae, Solanaceae, Rutaceae, Umbelliferae, Leguminosae, Rubiaceae, Liliaceae, Gramineae, Labiatae, Cruciferae, Papaveraceae.
10. Cultivation, Collection, processing and storage of crude drugs: Factors influencing cultivation of medicinal plants. Types of soils and fertilizers of common use, pest management and natural pest control agents-plant hormones and their applications- polyploidy, mutation and hybridisation with reference to medicinal plants.
11. Quality control of crude drugs: Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation.
12. An introduction to active constituents of drugs: Their isolation, classification and properties.
13. Systematic Pharmacognostic study of the following:
    (a) Carbohydrates and derived products: Agar, guar gum, acacia, Honey, Isphagula, pectin, starch, sterculia and tragacanth.
    (b) Lipids: Bees wax, castor oil, cocoa butter, cod liver oil, hydnocarpus oil, lard, linseed oil, rice bran oil, shark liver oil and wool fat.
14. Study of drugs containing resins and resin combinations:Colophony, Podophyllum, Jalap, Cannabis, Capsicum, Myrrh, Asafoetida, Balsam of Tolu, Balsam of Peru, Benzoin, Turmeric, Ginger.
15. Study of Tannins and tannin containing drugs like Gambier, Black catechu, gall and myrobalan.
16. Volatile oils: General methods of obtaining volatile oils from plants, study of volatile oils of mentha, coriander, cinnamon, cassia, lemon peel, orange peel, lemon grass, citronella, caraway, dill, spearmint, clove, fennel, nutmeg, eucalyptus, chenopodium, cardamom, valerian, musk, palm rosa, gualtheria, sandal wood.
17. Phytochemical screening:
    (a) Preparation of Extracts.
    (b) Screening of alkaloids, saponins, cardenolides, bufadienolides, flavanoids, leucoanthocyanidins, tannins and polyphenols, anthraquinones, cyanogenetic glycosides, amino acids in plant extracts.
18. Study of fibres used in Pharmacy such as cotton, silk, wool, nylon, glass wool, polyster & asbestos.
19. Study of pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatin and natural colours.

Practicals: 6 hours/ week.

1. Morphology of plant parts indicated in theory.
2. Care, use and types of microscopes.
3. Gross identification of slides of structure and life cycle of lower plants/ animals mentioned in theory.
4. Morphology of plant parts indicated in theory.
5. preparation, microscopic examination of stem, root, and leaf of monocot and dicot
6. Structure of human parasites and insects mentioned in theory with the help of specimens.
7. Morphological characteristics of plant families mentioned in theory.
8. Microscopic measurements of cells and cell contents: Starch grains, calcium oxalate crystals and phloem fibres.
9. Determination of leaf constants such as stomatal index, stomatal number, Vein-islet number, vein-termination number and palisade ratio.
10. Identification of crude drugs belonging to carbohydrates and lipids.
11. Preparation of herbarium sheets.
12. Identification of crude drugs mentioned in theory.
13. Study of fibres and pharmaceutical aids.
14. Microscopic studies of 7 selected crude drugs and their powders mentioned under the category of volatile oils in theory and their chemical tests.
15. General chemical tests for alkaloids, glycosides, steroids, flavanoids and tannins.

2 : 4 PHARMACEUTICAL CHEMISTRY - IV
(Biochemistry)

Theory

3 hours/ week

1. Biochemical organisation of the cell and transport processes across cell membrane.
2. The concept of free energy, determination of change in free energy from equilibrium constant and reduction potential, bioenergetics, production of ATP and its biological significance.
3. Enzymes: Nomenclatures, enzyme kinetics and its mechanism of action. Mechanism of action, mechanism of inhibition, enzymes and isoenzymes in clinical diagnosis.
4. Co- enzymes: Vitamins as co-enzymes and their significance, metals as co- enzymes and their significance.
5. Carbohydrate metabolism: Conversion of polysaccharides to Glucose-1-Phosphate, Glycolysis and fermentation and their regulation, gluconeogenesis and glycogenolysis. Metabolism of galactose and galactosamine, role of sugar nucleotides in biosynthesis and pentose phosphate pathway.
6. The Citric acid cycle: Significance and reactions and energetics of the cycle. Amphibolic roles of the cycle and glyoxalic acid cycle.
7. Lipids metabolism: Oxidation of fatty acids, β-oxidation and energetics, α-oxidation, ω-oxidation, biosynthesis of ketone bodies and their utilisation, control of lipid metabolism, essential fatty acids & Eicosanoids (Prostaglandins, thrombaxanes), Phospholides and sphingolipids.
8. Biological oxidation-reduction. Redox-potential enzymes and co-enzymes involved in oxidation reduction & its control. The respiratory chain. its role in energy capture and its control, energetics of oxidative phosphorylation, inhibitors of respiratory chain and oxidative phosphorylation, mechanism of oxidative phosphorylation.
9. Nitrogen & Sulphur cycle: Nitrogen fixation, ammonia assimilation, nitrification and nitrate assimilation, sulfate reduction, incorporation of sulfur in organic compounds. Release of sulfur from organic compounds.
10. Metabolism of Ammonia and nitrogen monomers:Nitrogen balance, Biosynthesis of amino acids, catabolism of amino acids, conversion of amino acids to specialised products, assimilation of ammonia, urea cycle, metabolic disorders of urea cycle. Metabolism, biosynthesis, formation of bile pigments, hyper bilirubinemia, purine biosynthesis, purine nucleotide interconversion, pyrimidine biosynthesis and formation of deoxyribonucleotides.
11. Biosynthesis of nucleic acids: Brief introduction of genetic organisation of mammalian genome, alteration and rearrangements of genetic material, Biosynthesis of DNA and its replication, mutation, physical and chemical mutagenesis, carcinogenesis, DNA repair mechanism, Biosynthesis of RNA. 12. Regulation of gene expression.

Practicals

3 hours/ week

1. Preparation of standard buffers (Citrate, Phosphate and Carbonate) and measurement of pH.
2. Titration curve for amino acids
3. Separation of amino acids by two dimensional paper chromatography and gel electrophoresis.
4. The separation of lipids by TLC.
5. Separation of serum proteins by electrophoresis on cellulose acetate.
6. Quantitative estimation of amino acids.
7. Quantitative estimation of proteins.
8. The identification of C- terminal amino acids of a protein
9. The determination of glucose by means of the enzyme glucose oxidase.
10. The isolation & assay of glycogen from the liver and skeletal muscle of rats.
11. Enzymatic hydrolysis of glycogen by alpha and beta amylase.
12. The isolation and determination of RNA and DNA
13. Effect of temperature on the activity of alpha- amylase.
14. Estimation of SGOT, SGPT, ALP, and BRN in the serum.

2 : 5 PHARMACEUTICAL ENGINEERING

Theory 3 hours/ week

1. Fluid mechanics: Fluid statics- mano meters, Fluid dynamics- Types of flow, Reynold's number, Viscosity, concept of boundary layer, basic equations of fluid flow, valves, flow meters.
2. Materials handling: Liquid handling- Different types of pumps, reciprocating, rotary, centrifugal and diaphragm pumps. Gas handling- various types of fans, blowers and compressors. Solid handling-Storage bins, hoppers and conveyers.
3. Heat transfer: Sources and uses of heat in Pharmacy. Conduction- Fourier's law of heat conduction through variable area like pipes, spheres etc.
   Convection- Natural and forced convection. Flow of heat through liquids and equation for rate of heat transfer, concept of individual film co-efficient, overall heat transfer coefficient, log mean temperature difference.
   Radiation: Kirchoff's law, Stefan Boltzman law, Black body, Gray body, Net heat transfer between two no- black bodies by radiation.
4. Mechanical separation: (a) Filtration and centrifugation- theory of filtration, filter media, filter aids, industrial filters including filter press, filter leaf, rotary filter, edge filter etc.
   Principles of centrifugation: Industrial centrifugal filters and centrifugal sedimenters.
   (b) Size reduction and size separation: Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of a mill, types of mills including ball mill, hammer mill, fluid energy mills etc.
5. Evaporation: Factors affecting evaporation- Types of evaporators- short tube, forced circulation and film evaporators. Single effect and multiple effect evaporators.
6. Distillation. Raoult's law, Volatility, simple, steam and flash distillation. Principles of rectification, Mc.Cabe Thiele method for calculation of number of theoretical plates, azeotropic and extractive distillation.
7. Drying:Moisture content and mechanism of drying, rate of drying and time of drying. Classification and types of dryers tray, vacuum, tunnel, rotary, fluidized bed, spray and drum dryers. Principles of freeze drying.
8. Humidification:Basic concepts and definition. Wet bulb and adiabatic saturation temperature, Humidity chart and measurement of humidity. Equipments for dehumidification operations.
9. Crystallisation: Principles of crystallisation, nucleation mechanism and crystal growth, study of various types of crystallisers, tank, agitated batch, Swenson walker, vacuum, circulating magma and crystal crystalizer. Caking of crystals and its prevention.
10. Mixing: Theory of mixing, mixers for powders, pastes and liquids
11. Material of construction: General study of composition corrosion, resistant, properties and applications of the materials of construction with special reference to stainless steel & glass.
12. Industrial hazards and safety precautions: Mechanical, Chemical, Electrical, life and dust hazards, industrial dermatitis, Accident records etc.
13. Automatic process control systems:

Practicals

3 hours/ week

1. Determination of rate of filtration and study of factors affecting filtration including filter aids.
2. Determination of humidity-Use of dry bulb and wet bulb thermometers and psychrometric charts
3. Determination of overall heat transfer co-efficients.
4. Experiments based on simple, steam and azeotropic distillation.
5. Determination of rate of drying, free moisture content and equillibrium moisture content.
6. Screen analysis of powders.
7. Sedimentation in liquids.

2 : 6 PATHOPHYSIOLOGY & HEALTH EDUCATION

Theory 2 hours/ week

A. Pathophysiology

1. Basic principles of cell injury and adaptation.
   Causes of cellular injury, pathogenesis, morphology of cell injury. Intercellular alterations in lipids, proteins and carbohydrates. Cellular adaptation, atrophy, hypertrophy.
2. Basic mechanisms involved in the process of inflammation and repair.
   Alterations in vascular permeability and blood flow, migration of WBC, acute and chronic inflammation, mediators of inflammation, brief outline of the process of repair.
3. Pathophysiology of common diseases.
   Rheumatoid arthritis, gout, epilepsy, psychosis, depression, mania, hypertension, angina, CCF, atherosclerosis, myocardial infarction, diabetes, peptic ulcer, asthma, ulcerative colitis, hepatic disorders, acute and chronic renal failure, tuberculosis, urinary tract infections, sexually - transmitted diseases, anaemias and common types of neoplasms- where ever applicable the molecular basis should be discussed.

B: Health education:

a) Concept of health and disease, disease causing agents and prevention of diseases.

b) Classification of food requirements, balanced diet, nutritional deficiency disorders, their treatment and prevention, specifications for drinking water.

c) Demography and family planning:

d) Brief out line of communicable diseases, their causative agents, modes of transmission and prevention (Chicken pox, measles, influenza, diphtheria, whooping cough, tuberculosis, poliomyelitis, helminthiasis, malaria, filariasis, rabies, trachoma, tetanus, leprosy, syphilis, gonorrhoea and AIDS)

e) First aid: Emergency treatment of shock, snake bites, burns, poisoning, fractures and resuscitation methods.

3 : 1 PHARMACEUTICAL CHEMISTRY- V
(Chemistry of Natural Products)

Theory: 2 hours/ week

The following topics will be discussed with special reference to official natural products and allied semi-synthetic derivatives.

1. Discussion of naturally occurring biomolecules of the following types with special reference to their configuration, stereo chemistry, biological importance (Carbohydrates, hormones, steroids, vitamins, alkaloids)

2. Carbohydrates of higher plant origin of pharmaceutical importance.

Classification, nomenclature. method of preparation, structure, characterisation, general reactions of identification of amylose, amylopectin, cyclodextrins, cellulose derivatives, rhamnose, cymarose, deoxy sugars, gentobiose- streptose, streptobiose.

3. Peptides and proteins: properties, simple and derived proteins, conjugated proteins, a study of their chemical nature and reactions.

Elementary study of nucleoproteins, nucleosides, nucleotides and nucleic acids of pharmaceutical / biological importance.

Enzymes: Definition, classification, enzymatic activity in biological and industrial applications.

4. Alkaloids: General Extraction, General methods of determination of structure, classification and chemical nature and medicinal uses of official alkaloids, structure elucidation and synthesis of ephedrine, atropine

5. Vitamins: Classification, study of chemical nature of vitamins official in I.P, constitution and synthesis of Thiamine, Riboflavine, Ascorbic acid and Vit- D

6. Steroids: Nomenclature, tests for steroids, methods of isolation, structural features, chemistry of cholesterol, irradiation products and chemistry of ergosterol, chemistry of stigmasterol, lanosterol and chemistry of bile acids/ salts.

7. Hormones: (1) Estrogens, inter-relationship of estrone, estradiol, estriol, constitution of estrone,synthesis, preparation and medicinal uses of synthetic non-steroidal estrogenic compounds eg. Benzesterol, hexosterol, dieposterol, stilbesterol, chlortrianisane.

(2) Progestins: Skeletal structure and synthesis of progesterone, progesterone derivatives used as oral contraceptives.

(3) Androgens: Skeletal structure and synthesis of testosterone and synthetic anabolic steroids.

(4) Adrenal cortex hormones :Classification, chemical nature of cortisone, hydrocortisone, synthesis of cortisone from naturally occurring saponins, skeletal structure of important synthetic corticosteroid analogues such as prednisone, prednisolone, fluromethylone, betamethasone, dexamethasone and triamcinolone, structure activity relation ship with their medicinal uses.

(5) General introduction of proteinaceous hormones: eg. Insulin, oxytocin, vasopressin, their biological importance and chemistry of thyroxine

8. Saponins: chemical nature, tests for sapoins, structure and uses of diosgenin, sarasapogenin.

9 Prostaglandins: A preliminary discussion, introduction on the nature of these compounds and their biological importance.

10. Glycosides: Definition, introduction, structure elucidation, test, chemistry and synthesis of Amygdalin. A general study of cardiac glycosides of Digitalis purpurea and lanata, Strophanthus and Squill with the importance of aglycone and glycone part with their S.A.R.

11. Purines: Constitution and synthesis of uric acid and caffeine, inter-relation ship of caffeine, theophylline, theobromine and their medicinal importance.
12. Terpenes: Introduction, Basic isoprene rule, classification- mono, di, tri, sesqui terpenes, structure and constitution of geraniol, camphor, Alpha terpiniol, structure and inter-relation ship of limonene, dipentene and alpha terpeniol, terpene hydrate, cineole and carvone, constitution of menthol and thymol. Synthesis of Ionones (Alpha and beta)
13. Carotenoids: Intriduction, source, occurrence, skeletal structure of carotenes, conversion of beta carotene and Vitamin-A. Constitution and synthesis of Vitamin-A.

Practicals: 3 hours/ week

1. Degradation of natural products- atleast 4 compounds
2. Test for purity of some official compounds belonging to the class of natural products, atleast 5 compounds of Pharmacopoeia.
3. Assay of pure natural products and finished preparations, source materials and finished preparations of I.P. atleast 10 preparations.
4. Qualitative analysis of natural products- Identification of 10 unknown compounds to be practiced.
5. Enzyme catalysed simple reactions: Hydroxylation, dehydration, methylation, demethylation (Selected simple examples)

3 : 2 PHARMACEUTICAL MICROBIOLOGY & BIOTECHNOLOGY

2 hours/ week

(a) Microbiology

Theory

1. Introduction to the scope of microbiology
2. Structure of bacterial cell
3. Classification of microbes and their taxonomy. Actinomycetes, bacteria, rickettesiae, spirochaete, viruses and fungus .
4. Identification of microbes, stains and types of staining techniques, electron microscopy.
5. Nutrition, cultivation, isolation of bacteria, actinomycetes, fungi, viruses etc.
6. Microbial genetics and variation.
7. Control of microbes by physical, and chemical methods.
   (a) Disinfection, factors influencing disinfectants, dynamics of disinfection. Disinfectants, antiseptics and their evaluation.
   (b) Sterilization, Different methods, validation of sterilization methods & equipments.
8. Sterility testing of all Pharmaceutical products.
9. Immunity. Primary and secondary defensive mechanisms of body, microbial resistance, interferon.
10. Microbial assays of antibiotics, vitamins and aminoacids.

(b) Biotechnology:

Theory

1. Immunology and immunological preparations:
   Principles, Antigens and Haptens, Immunosystem, Cellular, humoral immunity, Immunological tolerence., antigen-antibody reactions and their applications
   Hypersensitivity, Active and passive immunisation, Vaccines, their preparations, standardisation and storage.
2. Genetic Recombination: Transformation, Conjugation, Transduction, Protoplast fusion and gene cloning and their applications. Development of hybridoma for mono clonal antibodies. Study of drugs produced by biotechnology such as Activasa, Humulin, Humstrope, HB etc.
3. Antibiotics. historical development of antibiotics, Antimicrobial spectrum and methods used for standardisation. Screening of soil for organisms producing antibiotics. Fermenter, its design, control of different parameters. Isolation of mutants, factors influencing rate of mutation. Design of fermentation process. Extraction of fermentation products with special reference to penicillins, Streptomycin, Tetracyclins and Vit-B_{12}.
4. Microbial transformation: Introduction: Types of reactions mediated by microorganisms, Design of biotransformation processes, selection of organisms, Biotransformation process and its improvements with special reference to steroids.
5. Enzyme immobilization. Techniques of immobilization of enzymes. Factors affecting enzyme kinetics, Study of enzymes such as Hyaluronidase, Penicillinase, Streptokinase, Streptodornase, Amylases, proteases etc. Immobilization of bacteria and plant cells.

Practicals

3 hours/ week.

Experiments devised to prepare various types of culture media, sub-culturing of various aerobic and anaerobic bacteria, a fungus and yeast, various staining methods, various sterilization techniques and their validation of sterilization techniques, evaluation of antiseptics and disinfectants, testing of sterility of pharmaceutical products as per I.P requirements. Microbial assay of antibiotics and vitamins.

3 : 3 PHARMACOLOGY - I

Theory

2 hours/ week

1. General Pharmacology:

a. Introduction: History of Pharmacology-Definitions of therapeutics, Posology, Pharmacokinetics, Pharmacodynamics, Pharmacometrics, Toxicology and sources of drugs.

b. Routes of drug administration and factors influencing the effect of drugs.

c. Pharmacokinetics: Absorption of drugs, Distribution and stores of drugs in the body. Biotransformation and excretion of drugs.

d. Pharmacodynamics. The dose-effect relation ship, introduction to $L.D_{50}$, $E.D_{50}$ and Therapeutic index. Mechanism of drug action, Structure Activity Relationships, drug receptors drug-receptor theories, drug receptor antagonism, faactors modifying drug action, Drug Interactions.

e. Toxicology: General study of toxicology with special reference to acute, sub-acute and chronic toxicity. Various types of toxicity. Poisoning by vaarious drugs and measures to overcome them.

f. Development of new drugs: Evaluation in animals, toxicity studies, evaluation in humans.

g. Bioassays: Principles of Bio-assays, Different types of Bio-assays. Bio-assay of Insulin, Digitalis, Adrenaline, Acetylcholine, Histamine, Oxytocin, D-tubocurarine. Radio- immuno assay- principles and applications.

h. Drug dependence: Habituation, Addiction and treatment.

2. Pharmacology of the following drugs with emphasis on- classification, mechanism of action Pharmacokinetics, Adverse effects, Contra-indications, Drug interactions, Clinical uses, preparations and dosages.

A: Drugs acting on Autonomic nervous system and somatic nervous system. Neurohumoral transmissions and receptors. Adrenergic drugs and adrenergic blocking drugs- Cholinergic drugs, Anti-muscarinic drugs, anti choline esterases, ganglionic stimulants and blockers. Neuromuscular blocking drugs.

B: Drugs acting on eye. Mydriatics, Miotics and drugs used in glaucoma.

C. 1. Hormones: Pituitary hormones, Thyroid and anti-thyroid hormones and drugs. Estrogens and Progestins, androgens and anabolic steroids, adrenocortico steroid hormones.

2. Fertility control and oral contraceptives.

D. Autocoids and their antagonists: Histamine, Antihistamine, 5-hydroxytryptamine, Anti-serotonin, Angiotensins, Kinins, Enkephalins, Prostaglandins and other poly peptides. Allergy and Allergens.

E. Immuno suppressants and Immunostimulants.

F. Pharmacology of Vitamins.

G. Heavy metals and heavy metal antagonists.

H. Enzymes in therapy - Hyaluronidase, alpha chymotrypsin, L-asparaginase, Digestive enzymes- Pepsin, papain, diastase.

I. Drugs acting on uterus.

J. Drugs affecting respiratory system- antitussives and anti-asthmatics.

K. Therapeutic gases: Oxygen, helium, Carbon dioxide and water vapour.

Practicals: 3 hours/ week

1. Study of various apparatus, Physiological solutions and recording devices used in experimental pharmacology.
2. some common and standard techniques- Bleeding and intravenous injection, intra gastric administration, procedures for rendering animals unconscious- stunning of rodents, Pithing of frogs and chemical euthanesia.
3. Effect of drugs-qualitative and quantitative - Routes of administration.
4. To study the dose - response relation ship of acetycholine on rectus abdominis muscle..
5. To study the dose- response relation ship of histamine on guinea pig ileum.
6. To study the dose- response relation ship of noradrenaline on rat anococcygeus muscle preparation.
7. To study the action of mydriatics and miotics on rabbit eye.
8. To study the effect of hepatic microsomal enzyme inducers and inhibitors on the pentobarbitone sleeping time in mice and rat.
9. Test for undue toxicity
10. Determination of LD-50 in mice.
11. To demonstrate the hydrolysis of acetylcholine by serum choline esterase (Frog rectus)
12. To demonstrate the potentiation of acetycholine by anticholine esterase agent(frog rectus).
13. To demonstrate the inhibition of acetylcholine action by d-tubocurarine (frog rectus)
14. effect of drugs on perfused frog heart- cardiac stimulants- Adrenaline, atropine, Ca^{2+} cardiac depressants- Acetylcholine, propranolol and K^{+}
15. To study the effects of drugs on normal and hypodynamic frog heart.
16. Determination of the concentrations of sulphacetamide in the blood of rabbits after injection by various routes.

3 : 4 PHARMACEUTICS - III

(Biopharmaceutics and Dosage form Designs)

Theory: 3 hours/ week

1. Introduction to Biopharmaceutics and Pharmacokinetics and clinical setting.
2. Biopharmaceutics:

2.1 Passage of drugs across biological barrier (Passive diffusion, Active transport, facilitated diffusion and Pinocytosis).

2.2 Factors influencing absorption- Physicochemical, physiological and pharmaceutical).

2.3 Drug distribution in the body, plasma protein binding.

3. Pharmacokinetics:

3.1 Significance of plasma drug concentration measurement.

3.2 Compartment model: Definition and scope.

3.3 Pharmacokinetics of drug absorption- Zero order and First order absorption rate constants using- Wagner-Nelson and Loo-Riegelman method.

3.4 Volume distribution and distribution coefficient.

3.5 Compartment Kinetics- One compartment and Two compartment models. Determination of pharmacokinetic parameters from plasma and urine data after drug administration by intra vascular and oral route.

3.6 Curve fitting (Method of Residuals), Regression procedures.

3.7 Clearance Concept. Mechanism of renal clearance, clearance ration, determination of renal clearance.

3.8 Extraction ratio, Hepatic clearance, Biliary excretion, Extra hepatic circulation.

3.9 Non-linear Pharmacokinetics with special reference to One compartment model after I.V drug administration. Michaels Mento equation, detection of non-linearity (saturation mechanism).

4. Clinical Pharmacokinetics:

4.1 Definition and scope.

4.2 Dosage adjustment in patients with and without renal and hepatic failure.

4.3 Design of single dose bio-equivalence study and relevant statistics.

4.4 Pharmacokinetic drug interactions and their significance in combination therapy.

5. Bioavailability and Bioequivalence:

5.1 Measurement of Bioavailability, C- max, T- max and Area under Curve (AUC).

5.2 Design of single dose bio-equivalence study and relevant statistics.

5.3 Review of regulatory requirements for conduction of bio-equivalence studies

Dosage form Designs:

1. Preformulation studies:

   (a) Study of physical properties of drug like physical form, particle size, shape, density, wetting, Dielectric constant, solubility, dissolution and organoleptic property and their effect on formulation, stability and bio-availability.

   (b) Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemizatrion Polymerisation etc. and their influence on formulation and stability of products.

   (c) Study of prodrugs in solving problems related to stability, bio-availability and elegancy of formulations.

2. Design, development and process validation methods for Pharmaceutical operations involved in the production of Pharmaceutical products with special reference to tablets and suspensions.
3. Stabilization and Stability testing protocol for various pharmaceutical products.

4. Performance evaluation methods.
   (a) Invitro dissolution studies for solid dosage forms.Methods,interpretation of dissolution data.
   (b) Bioavailability studies and bioavailability testing protocol and procedures.
   (c) Invivo methods of evaluation treatments.
5. GMP and quality assurance, Quality audit.
6. Design, development, production and evaluation of controlled release formulations.

Practicals: 3 hours/ week

1. Experiments designed for the estimation of various pharmacokinetic parameters with given data.
2. Analysis of biological specifications for drug content and estimation of the pharmacokinetic parameters.
3. Invitro evaluation of different dosage forms for drug release.
4. Absorption studies - invitro and in situ.
5. Statistical treatment of pharmaceutical data.
6. Preformulation studies including drug-excipient compatibility studies, effect of stabilisers, preservatives etc. in dosage form design
7. Experiments demonstrating improvement in bioavailablity through pro-drug concept.
8. Stability evaluation of various dosage forms and their expiration dating.
9. Dissolution testing and data evaluation for oral solid dosage forms.
10. Evaluation of bioequivalence of some marketed products.
11. Invivo bioavailability evaluation, plasma drug concentration & urinary excretion curves.
12. Design, development and evaluation of controlled release formulations.

3 : 5 PHARMACOGNOSY - III

Theory: 2 hours/ week

1. Study of the biological sources, cultivation, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic, macroscopic and microscopic features and specific chemical tests of the following groups of drugs containing glycosides:
   (I) Saponins: Liquorice, Ginseng, Dioscorea, Sarasaparilla and Senega.
   (II) Cardio active sterols: Digitalis, Squill, Strophanthus and thevetia.
   (III) Anthraquinone cathartics: Aloes, Senna, Rhubarb and Cascara,
   (IV) Others: Psoralea, Ammi majus, Ammi visnaga, Gentian, Saffron, Chirata, Quassia.
2. Studies of traditional drugs, common vernacular names, botanical sources, morphology, chemical nature of chief constituents, pharmacology, categories and common uses and marketed formulations of following indigenous drugs:
   Amla, Kantkari, Satavari, Tylophora, Bhilawa, Kalijiri, Bach, Rasna, Punarnava, Chitrack, Apmarg, Ghokru, Shankapushpi, Brahmi, Adusa, Arjuna, Ashoka, Menthi, Lahsur, Palash, Guggal, Gymnema, Shilajit, Nagarmotha and Neem.
3. The Holistic concept of drug administration in traditional system of medicine. Introduction to Ayurvedic preparations like arishtas, asavas, Gutikas, Tailas, Choornas, Lehyas and Bhasmas.
4. Systematic study of source, cultivation, collection, processing, commercial varieties, chemical constituents, adulterant, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following alkaloid containing drugs:
   (a) Pyridine & Piperidine: tobacco, areca and lobelia.
   (b) Tropane: belladonna, hyoscyamus, datura, duboisia, coca and withania.
   (c) Quinoline & Isoquinoline : Cinchona, ipecac, opium
   (d) Indole: Ergot, Rauwolfia, catharanthus, nuxvomica and physostigma.
   (e) Imidazole: Pilocarpine.
   (f) Steroidal: Veratrum and kurchi.
   (g) Alkaloidal amines: Ephedra and colchicum.
   (h) Glycoalkaloid: Solanum.
   (1) Purines: Coffee, tea and cola.
5. Role of medicinal and aromatic plants in national economy.
6. Biological sources, preparation, identification tests and uses of the following enzymes. Diastase, Papain, Pepsin, trypsin and pancreatin.
7. General techniques of biosynthetic studies and basic metabolic pathways. Brief introduction to biogenesis of secondary metabolites of pharmaceutical importance.
8. plant bitters and sweetners.
9. Introduction, Classification and study of different chromatographic methods and their application in evaluation of herbal drugs.

Practicals: 3 hours/ week

1. Identification of crude drugs listed in theory.
2. Microscopic study of some important glycoside containing crude drugs out lined above. Study of powdered drugs.
3. Standardisation of some traditional drug formulations.
4. Identification of crude drugs listed above.
5. Microscopic study of characters of selected drugs given in theory in entire and powdered form.
6. Chemical evaluation of powdered drugs and enzymes.
7. Chromatographic studies of some herbal constituents.

3 : 6 PHARMACEUTICS- IV
(Hospital, Community and Dispensing Pharmacy)

Theory 3 hours/ week

A. Dispensing Pharmacy and Community Pharmacy

1. Principles of Dispensing: Handling of prescriptions, Source of error in prescriptions. Forms of administratory medicines. General dispensing procedure including labelling of dispensed products. Latin terms commonly used.
2. Pharmaceutical calculations. Posology- Calculation of doses for infants, adults and elderly patients. Enlarging and reducing recipes, Percentage solutions, Allegation, Alcohol dilution, Proof spirit, Isotonic solutions, Displacement values etc.
3. Principles involved and procedures adopted in dispensing of typical prescriptions like mixtures, suspensions, solutions, emulsions, creams. ointments, powders, capsules, pastes, jellies, suppositories, ophthalmics, pastilles, lozenges, pills, lotions, liniments, inhalations, paints, sprays, tablet triturates etc.
4. Incompatibilities. Physical and chemical incompatibilities, inorganic incompatibilities of metals and their salts, non-metals, acids, alkalies, organic incompatibilities, purine bases, alkaloids Pyrazolone derivatives, amino acids, quarternary amino compounds, carbohydrates, glycosides, anaesthetics, dyes, surface active agents, correction of incompatibilities, Therapeutic incompatibility.
5. Community Pharmacy: Community Pharmaceutical services- Organisation structure of retail, whole sale- legal requirements for establishments. Maintenance of records, counselling- role of Pharmacist in community health care and education.

B: Hospital Pharmacy:

1. Organisation and structure: Organisation of hospital and hospital pharmacy, Responsibilities of a hospital pharmacist, pharmacy and therapeutic committee, budget preparation and implimentation.
2. Hospital Formulary: contents, Preparation and revision of hospital Formulary.
3. Drug store management and Inventory control.:
   (a) Organisation of Drug store, Types of materials stocked, Storage conditions.
   (b) Purchase and inventory control- principles, purchases, procedures, purchase order, procurement and stocking.
4. Drug distribution systems in hospitals.
   (a) Out patient dispensing- methods adopted.
   (b) Dispensing of drugs to inpatients. Types of drug distribution systems. Charging policy, Labeling.
   (c) Dispensing of drugs to ambulatory patients.
   (d) Dispensing of controlled drugs.
5. Central sterile Supply Unit and their management.
   Types of materials for sterilisation, sterilisation equipments, supply of sterile materials.
6. Manufacture of sterile & non-sterile products: Policy making of manufacturable items, demand and costing. personnel requirements, manufacturing practice, master formula card, production control, manufacturing records.
7. Drug information services: sources of information on drugs, diseases, treatment schedules, procurement of information, computerised services (eg. MEDLINE) Retrival of information, medication error.
8. Records and Reports: Prescription filling, drug profile, patient medication profile, case on drug interaction and adverse drug reactions, idiosyncratic cases etc.

Practicals:

6 hours/ week

1. Dispensing of prescriptions filling under the categories studied in theory, maintaining complete record of each. Translation of prescriptions, proper labelling, finishing and wrapping of articles neatly.
2. Identification and correction of Incompatibilities in prescriptions.
3. Analysis of prescriptions for drug interactions, over dosages etc.
4. Dispensing of prescriptions involving adjustment of tonicity.
5. Project report on visit to the near by community pharmacy for counselling on the rational use of drugs and aspects of health care.
6. Practicals designed on the use of computers in drug information centres, prescription filling, documentation of information on drug interactions.

3 : 7 PHARMACEUTICAL JURISPRUDENCE

Theory: 2 hours/ week

1. Definition and scope of forensic pharmacy. Pharmacist's role in drug treatment and drug usage. Pharmacist as a member of the Health Care Scheme.
2. Pharmaceutical legislation in India. Historical developments of Pharmaceutical education in India. Professional ethics in Pharmacy practice. Legal and ethical responsibilities of pharmacists.
3. Establishment and working of poison centers in Hospitals. Service benefits for inpatient, out patient and the public. Commonly used poisons and their antedotes. Frug accidents, drug poisoning and drugs in suicides.
4. Pharmacy Act 1948. General study of the Pharmacy Act with special reference to Education regulations, working of central and state pharmacy councils. Registration procedure under the Act
5. Drugs and Cosmetics Act 1940. General study of the Drugs and Cosmetics Act and Rules there under. Study of the terms " Drugs" and "Cosmetics". Definitions, provisions applicable to Import, Sale and manufacture of drugs.
   Qualifications, duties, responsibilities of drug inspectors, sampling procedure, requirements and formalities for establishing manufacturing units, Distribution houses, retail shops and blood banks important schedules applicable to their establishment. Detailed study of schedule X and Y.
6. Laws relating to use of alcohol in pharmaceutical preparations with reference to Medicinal and Toilet preparations (Excise Duties) Act 1955 and Rules 1956.
7. Drug dependence, misuse and abuse. Medicolegal analysis with special reference to Narcotic Drugs and Psychotropic Substances Act 1985.
8. Advertisements of Drugs and Cosmetics- Prohibited and exempted advertisements. Drugs and Magic Remedies (Objectionable Advertisements) Act 1955.
9. Brief study of the following Acts:
   (a) Prevention of Food Adulteration Act 1954 and Rules 1955.
   (b) Factories Act 1948.
   (c) prevention of Cruelty to Animals Act 1960.
   (d) Patent Act 1970.
   (e) States Shops and Establishments Act.1948.
   (f) Insecticides Act 1968.
   (g) Minimum Wages Act 1948.
   (h) A.I.C.T.E. Act 1987.
10. Assignments: Topics, trade names, Combination preparation, banned drugs, bannable drugs, newly introduced and out dated drugs. Drug tragedies, Committee reports on drug accidents, important case decisions published in drug cases relating to various topics covered in the subject.

4 : 1 PHARMACEUTICAL CHEMISTRY -VI
(Medicinal Chemistry)

Theory: 3 hours/ week

1. Basic principles of Medicinal Chemistry.
   Physico-chemical aspects (Optical, geometric and Bio isosterism) of drug molecules and biological actions, Drug-receptor interactions including transduction mechanism.
   Principles of drug design (Theoretical aspects), Traditional analog (QSAR) and mechanism based approaches (Introduction to graph theory, applications of Quantum mechanics, Computer aided drug designing (CADD) and molecular modeling.
2. Drug metabolism and concepts in prodrugs.
3. A detailed study of chemistry including synthesis of few compounds from each category, SAR Mechanism of action and therapeutic uses of the following classes of drugs:
   1. General and Local anaesthetics. 2. Analgesics. 3. Antipyretics.4. Non steroidal anti inflammatory agents 6. Adrenergic drugs and their blockers, 7. Cholinergic drugs and their blockers, 8.Anti-convulsants, 9.Hypnotics & Sedatives, 10.Tranquilizers,11. Antihypertensives,

   12. Antihistamines, 13. Diuretics, 14. Antidiabetics, 15. Antibiotics, 16. Sulpha drugs,
   17. Anti epileptics, 18. Anthelminthics, 19. Anti malarials, 20. Schistosomicides, 21.Anti fungals,
   22. Tuberculostatics, 23. Anti neoplastics, 24. Immunosuppressive agents and anti- HIV agents.

Practicals: 3 hours/ week

1. Exercises based on QSAR: Hansch & Free-Wilson methods.
2. Synthesis of selected drugs from the course content.
3. Establishing the Pharmacoepial standards and spectral studies of the drugs synthesised.
4. Determination of partition co-efficient, Dissociation constant and Molar refractivity of compounds for QSAR analysis.
5. Work shop on stereo model use of some selected drugs.
6. Experiments based on drug metabolism:
   (a) Preparation of S9 and microsomes from tissue homogenated and standardisation of protein.
   (b) Effect of phenobarbital pre treatment on microsomal Cytochrome P-450, Cytochrome b5 and NADPH cytochrome C- reductase and comparison of microsomes from control.
   (c) Determination of microsomal amino pyrione demethylase and p-nitro anisole p- demethylase activities.
   (d) Determination of microsomal azo- and nitro reductase activities.

4 : 2 PHARMACEUTICAL ANALYSIS- II

Theory: 2 hours/ week

A. Importance of quality control of drugs- Design of quality control laboratories. Different methods of standardisation.

B. Separation techniques: (1) Chromatography:- Fundamental principles of chromatography- adsorption, column, paper, liquid & high pressure liquid chromatography. Application of the above techniques in pharmaceutical analysis.
(2) Electrophoresis. (3) Gel filtration

C. General treatment of the theory & application of the following optical & electrical instrument methods in pharmaceutical analysis:
(a) Colorimetry, U-V , Visible absorption spectrometry- principles -different types of instruments Application in qualitative & quantitative analysis, Nephalometry and Turbidimetry.
(b) Atomic absorption spectrometry:- Principles and application to pharmaceutical analysis.
(c) Flame photometry:- A discussion about the various instruments & pharmaceutical applications
(d) Infra-red spectrophotometry:- Origin of infra-red spectra & regions. Instrumentation, Application in qualitative, structure elucidation and quantitative analysis.
(e) Nuclear Magnetic Resonance Spectroscopy:- (Elementary treatment) NMR signal, Instrumentation, practical considerations, chemical shifts, spin-spin coupling and de-coupling, structure elucidation.
(f) Mass spectrometry:-(Elementary treatment)- Theory, Instrumentation, practical considerations, structure elucidation, detection of impurities and quantitative analysis.
(g) Polarography:- Introduction, theoretical considerations, Organic polarography, dropping mercury electrodes, basic principles of polarographic instrumentation, polarographic methods of analysis, pharmaceutical applications, Amperometric titrations.
(h) Potentiometry:-Basic principles, Potentiometric determination of pH, potentiometric acid-base titrations including non-aqueous titrations, precipitation & complex formation, oxidation-reduction titrations. A discussion about the instruments with special reference to the construction and working of the various electrodes, Application in pharmaceutical analysis, Ion selective potentiometry :- Principles and applications. Karl-Fischer's method of moisture determination.
(I) Fluorimetry:- Fluorescene, Fluorimetry and spectrofluorimetry,analytical factors& applications
(j) Polarimetry:- Theory, instrumentation and applications.
(k) Thermal analysis of raw materials and dosage forms:- Differential scanning colorimetry and thermogravimetry.

Practical work: 3 hours/ week

1. Assay of selected dosage forms (covering all the different types like tablets,injections, capsules, ointments, liquid orals etc.)
2. Application of the instruments studied in the theory in pharmaceutical analysis with special reference to official procedures.

BOOKS RECOMMENDED:

(1) Text Book of Pharmaceutical analysis. K.A. Connors.
(2) Pharmaceutical chemistry, Vol-I & II, L.G. Chatton.
(3) Practical Pharmaceutical Chemistry, Vol- I & II A.S. Backet & J.B. Stenlake.
(4) Quantitative inorganic analysis. A.I. Vogel.
(5) Instrumental methods of analysis, Willard.
(6) Quantitative pharmaceutical chemistry, Jenkins et al.
(7) Isolation & Identification of drugs, E.G. Clark.
(8) Remington's Pharmaceutical Sciences.
(9) Official Books like I.P, B.P etc.

4 : 3 PHARMACOGNOSY - III

Theory: 2 hours/ week

Natural origin:

1. Chemical and spectral approaches to simple molecules of natural origin.
2. Concept of stereoisomerism taking example of natural products.
3. Chemistry, biogenesis and pharmacological activity of medicinally important monoterpenes, sesquiterpenes, diterpenes and triterpenoids.
4. Carotenoids, β-carotenoids, α- carotenes, Vitamin-A, xanthophylls of medicinal importance.
5. Glycosides: Chemistry and biosynthesis of Digitoxin, Digoxin, Hecogenin, Sennosides, Diosgenin and Sarasapogenin.
6. Alkaloids: Chemistry, biogenesis and pharmacological activity of atropine and related compounds Quinine, Reserpine, Morphine, Papaverine, Ephedrine, Ergot and Vinca alkaloids.
7. Chemistry and biogenesis of medicinally important lignans, Quassanoids and Flavanoids.
8. Chemistry and therapeutic activity of Penicillin, Streptomycin, and Tetracyclines.
9. World-wide trade in medicinal plants and derived products with special reference to Diosgenin (Dioscorea), Taxol(taxus sps), Digitalis, Tropane alkaloid containing plants, Papain, Cinchona, Ipecac, Liquorice, Ginseng, Aloe, Valerian, Rauwolfia and plants containing laxatives.
10. A brief account of plant based industries and Institutions involved in work on medicinal and aromatic plants in India. Utilization and production of phyto constituents such as quinine, calcium sennosides, podophyllotoxin, diosgenin, solasodine and tropane alkaloids.
11. Utilization of aromatic plants and derived products with special reference to sandal wood oil, mentha oil, lemon grass oil, vetiver oil, geranium oil and eucalyptus oil.
12. Historical development of plant tissue culture, types of cultures, nutritional requirements, growth and their maintenance. Applications of plant tissue culture in Pharmacognosy.
13. Chemotaxonomy of medicinal plants.
14. Marine pharmacognosy, novel medicinal agents from marine sources.
15. Natural allergens, photosensitizing agents and fungal toxins.
16. Herbaceous health foods.
17. Herbal Cosmetics on commercial scale.

Practicals: 3 hours/ week

(a) Laboratory experiments on isolation, separation and purification of various groups of chemical constituents of pharmaceutical significance.
(b) Experiments on Paper and thin layer chromatographic evaluations of herbal drug constituents.
(c) Isolation of some selected phytoconstituents studied in theory.
(d) Extraction of volatile oils and their chromatographic profile.
(e) Some experiments in plant tissue culture.

4 : 4 PHARMACEUTICS- V
(Formulative & Industrial Pharmacy)

Theory: 3 hours/ week

1. Liquid dosage forms: Introduction, types of additives used in formulations, Vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers, colours, flavours and others. Manufacturing, packaging and evaluation of clear liquids, suspensions and emulsions official in Pharmacopoeia.
2. Semisolid dosage forms: Definitions, types, mechanisms of drug penetrations, factors influencing penetration. semisolid bases and their selection. General formulation of semisolids, Clear gels manufacturing procedure, evaluation and packaging.
3. Suppositories: Ideal requirements, bases, manufacturing procedure, packaging and evaluation.
4. Extractions and Galenical products: Principle and method of extraction, preparation of infusion Tinctures, dry and soft liquid extracts.
5. Blood products and plasma substitutes: Collection and processing & storage of whole human -blood, concentrated human RBCs, dried human plasma, human fibrinogen, human thrombin and human normal immunoglobin, human fibrin, plasma substitutes- ideal requirements PVP, dextran etc. for control of Blood pressure as per I.P.
6. Pharmaceutical aerosols: Definition, propellants, general formulation, manufacturing and packaging methods and pharmaceutical applications.
7. Ophthalmic preparations: Requirements, formulation, methods of preparation, containers, evaluation.
8. Cosmeticology and cosmetic preparations: Fundamentals of cosmetic science, structure and functions of skin and hair. Formulation, preparation and packaging of cosmetics for skin, hair, dentifrice and manicure preparations like nail polish, lip-sticks, eye-lashes, baby care products etc
9. Capsules: Advantages and disadvantages of capsule dosage form. Material for production of hard gelatin capsule, size of capsules, method of capsule filling. Soft gelatin capsule shell and capsule content, importance of base absorption and minimum/gm factors in soft capsules,quality-control, stability testing and storage of capsule dosage forms.
10. Microencapsulation: Types of microcapsules, importance of microencapsulation in Pharmacy, microencapsulation by phase separation, co-acervation multi orifice, spray drying, spray congealing, polymerisation complex air suspension technique, coating pan and other techniques, evaluation of micro capsules.
11. Tablets: a) Formulation of different types of tablets, granulation technology on large scale by various techniques, physics of tablet making, different types tablet compression machinary and the equipments employed, evaluation of tablets.
    b) Coating of tablets:- Types of coating, Film forming materials, formulation of coating solution, equipments for coating, coating process, evaluation of coated tablets.
12. Parenteral products: a) Preformulation factors, routes of administration, water for injection Pyrogenecity, non-aqueous vehicles, isotonicity and methods of its adjustments.
    b) Formulation details, containers and closures and selection.
    c) Prefilling treatment, washing of containers and closures, preparation of solution and suspensions, filling and closing of ampules, vials, infusion fluids, Lyophilization and preparation of sterile powders, equipment for large scale manufacture & evaluation of parenteral products.
    d) Aseptic techniques, source of contamination and methods of prevention, Design of aseptic area, Laminar flow bench services and maintenance.
    e) Sterility testing of pharmaceuticals.

13. Surgical products: Definition, primary wound dressing, absorbents, surgical cotton, surgical gauze etc. Bandages, adhesive tape, protectives, cellulosic hemostatics, official dressings, absorbable and non- absorbable sutures, Ligatures and catguts. Medical prosthetics and organ replacement materials.
14. Packaging of pharmaceutical products: Packaging components, types specifications and methods of evaluation, stability aspects of packaging,. Packaging equipments, factors influencing choice of containers , Legal and other official requirements for containers, Package testing.

Practicals: 6 hours/ week

1. Preparation, evaluation and packing of liquid orals like solutions, suspensions and emulsions Ointments, suppositories, aerosols, eye drops, eye ointments etc.
2. Preparation of Pharmacopoeial extracts and Galenical products utilizing various methods of extraction.
3. Formulation of various types of cosmetics for skin, hair, dentifrices and manicure preparations.
4. Experiments to illustrate preparation, stabilization, physical and biological evaluation of pharmaceutical products like powders, capsules, tablets, parenterals, micro-capsules, surgical dressings etc.
5. Evaluation of materials used in pharmaceutical packaging.

4 : 5 PHARMACOLOGY - II

Theory:

3 hours/ week

Pharmacology of the following groups of drugs with emphasis on:-
Classification, Mechanism of action, Pharmacokinetics, Pharmacodynamics, Adverse effects, Drug interactions, Contra indications, Clinical uses, Preparation and dosages.

1. Drugs acting on central nervous system- Neurohumoral transmitters in CNS- General anaesthetics, Sedatives and Hypnotics, Alcohols, Analgesics, Antipyretics, Narcotic analgesics, Antiinflammatory agents., Anti-epileptics, Drugs used in Parkinsonism, CNS stimulants, Psychopharmacological agents - Antipsychotics, Antidepressants, Anti anxiety agents, Hallucinogens, Anti gout remedies.
2. Local anaesthetics.
3. Drugs acting on the gastro intestinal tract: Appetisers, Digestants, Carminatives, Appetite suppressants, Emetics, Anti emetics, Anti diarrhoeals, Cathartics, antacids, Drugs used in the treatment of Peptic ulcer.
4. Drugs affecting renal function: Metabolism of Sodium, Potassium, Hydrogen ions and Water. Diuretics and Anti diuretics.
5. Cardio vascular drugs: Cardiac glycosides, Anti arrythmic drugs, Vaso dilators and Anti anginal drugs. Anti atherosclerotic drugs, Anti hypertensive drugs.
6. Drugs acting on the blood and blood forming organs: Drugs effective in Iron deficiency anaemia Drugs effective in Megaloblastic anaemia, Aplastic anaemia, Drugs affecting coagulation of blood- Coagulants, Anticoagulants, Thrombolytic agents, Drugs affecting platelet function, Pharmacology of Shock.
7. Chemotherapy: History, bacterial resistance, mode of action of anti microbial. Sulfonamides, Quinolones, Penicillins, Cephalosporins, Tetracyclins, Chloramphenicol, Polypeptide antibiotics, Macrolide antibiotics, Aminoglycoside antibiotics.
   - Chemotherapy of fungal infections, Chemotherapy of Viral infections, Chemotherapy of Leprosy and Tuberculosis., Chemotherapy of Malaria., Chemotherapy of protozoal infections, Leishmaniasis, Giardiasis, Trichomoniasis, Trypanosomiasis, Balantidiasis.
   - Chemotherapy of Helminthiasis, Anti neoplastic agents, Antiseptics and Disinfectants.
   - Sclerosing, Melanising and Demelanising agents, Drugs used in skin diseases.

Practicals:

3 hours/ week

1. Study of Local anaesthetic property of procaine and Lignocaine by:-
   - Surface anaesthesia (Corneal reflex - rabbit)
   - Infiltration anaesthesia (Guinea pig)
   - Plexus anaesthesia (Lumbar plexus of frog)
2. Study of analgesic activity
3. Method of measuring motor activity (Rotarod)
4. Acetophotometer method.
5. Ciliary movements and modification by drugs (Frog)
6. Effect of drugs on isolated frog heart and identification of their mode of action.
7. Effect of drugs on isolated rabbit intestine and identification of their mode of action.
8. Effect of drugs on isolated rat fundus.
9. Effect of oxytocin on on rat uterus.
10. To study the diuretic activity of a compound in rat. 11. Test for Pyrogns.
12. Drugs acting on blood vessels
13. Effect of drugs on the blood pressure of anaesthetised dog, rat and cat - demonstration.
14. Bioassay of Acetylcholine (Frog rectus)
15. Bioassay of Histamine in guinea pig ileum. 16. Bioassay of Digitalis.

4 : 6 PHARMACEUTICAL INDUSTRIAL MANAGEMENT

Theory: 2 hours /week

1. Accountancy: Principles of accountancy- Ledgers- balance sheet- Cheque- Bills of exchange- Treatment, Bank account.
2. Economics: Principles of economics with special reference to Demand and Supply laws, Demand schedule- demand curves, Labour distribution- Labour problem, General conditions of labour demand- Supply- Labour welfare- Trade unions- Inland and foreign trade- Procedure for export and Import of goods- International trade- Principles of Insurance- General - Fire and Marine Insurance.
3. Pharmaceutical marketing: Functions; Buying- Selling- Transportation- Storage- Finance- Feed back information channels of distribution- Wholesale - Retail departmental-Multiple shop- Mail order business.
4. Salesmanship: Principles of sales promotion, Advertising ethics of sales- Merchandising- Literature detailing.
5. Market research: Recruitment, Training, Evaluation, Compensation- Consumer redressal.
6. Management: Administrative management: Planning organisation- staff-directing and controlling Operative management: Anticipation of problems- Preventive measures-in the management of personel, material, finance. Marketting- time- space, marging morals.
   Principles of management: Co-ordination communication, motivation, decision making, leadership- Innovation creativity- delegation of authority, responsibility, record keeping Identification of key points: Maximum thrust for development and perfection.
   Personel and material management: Eligibility-Efficiency evaluation o recruitment- service conditions- termination- performance evaluation- prizes, awards- incentives-Visible and invisible inputs- methodology of activities-performance evaluation techniques- process flow, process know how.
7. Factory organisation and management.
8. General study of Patent and trade mark Act, laws of contracts- Factory and shops Establishment l laws.

4 : 7 PHARMACOLOGY - III
(Clilnical Pharmacy and Therapeutics)

Theory: 2 hours/ week.

1. Cllinical Pharmacy: Introduction, Pharmacists in therapeutics, Role of clinical pharmacists in patient care, patient counseling and interviewing techniques, patient compliance, factors affecting compliance.
2. Drug information services: Introduction, sources of information, evaluation of journal material Storage and retrieval of information.
3. Clinical pharmacokinetics: General applications, Application to Therapeutic Drug Monitoring. - Basic concepts- Volume distribution- Elimination, Absorption, Dosage regimens, Peak and trough levels, interpretation of drug concentration data.
   Clinical applications- Estimation of serum concentration of Digoxin, Theophylline, Gentamicin, Lithium, Phenytoin, Cyclosporin, Creatinine clearance determination.
   Dosage adjustments in renal failure. Therapeutic drug monitoring- Indications for measuring drugs in blood, choice of drugs to be monitored, Timings of measurement, Measuring techniques
4. Drug interactions: Definitions, Epidemiology drugs involved in adverse drug interactions, Mechanism of drug interactions, Drug- food interactions, Drug-laboratory test interactions, Analysis of prescriptions to detect drug interactions.
5. Adverse drug reactions: Definition and classification, epidemiology, predisposing factors, mechanism of adverse drug reactions, detection and monitoring of adverse drug reactions, Drug excretion in milk, Drugs in pregnancy.
6. Principles and goals of drug therapy in children and in the elderly.
7. Design of clinical trials, Knowledge of commonly used medical terminologies- placebos, preparation of drug profiles.
8. Pharmacotherapeutics: Introduction, epidemiology and therapeutics of the important disorders of the the following organ systems and their management.
   - Cardiovascular disorders-Hypertension- Congestive heart failure- Angina- Acute Myocardial infarction - Cardiac arrythmias.
   - CNS disorders - Epilepsy and Parkinsonism, Schizophrenia- Depression.
   - Respiratory disease- Asthma.
   -Gastrointestinal disorders- Peptic ulcer- Ulcerative colitis- Hepatitis- Cirrhosis.
   -Endocrine disorders- Diabetes mellitus thyroid disorders.
   - Infectious diseases- Tuberculosis- Urinary tract infection- Enteric infection-Upper respiratory tract infection.
   -Hemopoeitic disorders- Anaemias.
   -Joint and connective tissue disorders- Rheumatic disease-Gout & Hyperuricemia..
   -Neoplastic diseases-Acute leukaemias-Hodgkin's disease and carcinoma of breast.
9. Concept of Essential drugs and rational drug use.

BOOKS RECOMMENDED

1. Cooper and Gunn's "Tutorial Pharmacy" -S.J. Carter, S. Publishers Delhi.
2. A.N. Martin, Arthur Cammarata, James swarbrick, "Physical Pharmacy" 3 rd Editiion, K.M. Varghese & Co. Mumbai 1991.
3. B. Shotton and K. Ridgway, "Physical Pharmaceutics" Oxford University Press, London,1974.
4. "Remington's Pharmaceutical sciences"A.R.Gennaro, 8th edition.Mack Publishing Co.P.A,1990
5. Loon Lachman, H.A. Lieberman & J.L. Kanig, "Theory & Practice of Industriaal Pharmacy" 3rd Edition, Loa and Febiger, Philadelphia, 1987.
6. H.C Ansel, "Introduction to Pharmaceutical Dosage Forms", 3rd (Indian edition), K.M. Varghese & Co. Mumbai 1981.
7. Cooper & Gunn's " Dispensing for Pharmaceutical Students" S.J Carter, 12th edition. CBS Publishers, Delhi 1987.
8. "Sprawl's American Pharmacy" L.W. Dittert, 7th edition, J & B. Lippincott Co., Philadelphia,1974.
9. "Bentley's Text Book of Pharmaceutics" E.A. Rawlins 8th edition ELBS Bacilliere Tindall 1977.
10. "Dispensing of Medication" J.E. Hoover, 8th edition Mack Publishing Co. Easton P.A. ,1970.
11. William E Hassan, "Hospital Pharmacy", 5th edition Lea & Febiger, Philadelphia, 1986.
12. "Modern Pharmaceutics" G.S. Bankes and C.T. Rhodes, 2nd edition, Marcel Dekker Inc. NY 1990.
13. "Pharmaceutical Dosage Forms and Drug Delivery Systems" 5th edition Lea & Febiger Philadelphia, 1990.
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