

JSS UNIVERSITY

SRI SHIVARATHREESHWARA NAGAR

MYSORE – 570 015

SYLLABUS

BACHELOR OF PHARMACY (B.PHARM) COURSE

JSS University

Sri Shivarathreeshwara Nagar, Mysore – 570 015

First year B. Pharm

Sl. No.	Subject	Theory hours / week	Practical hours / week
1.1	Human Anatomy & Physiology	03	03
1.2	Pharmaceutical Organic Chemistry - I	03	03
1.3	Pharmaceutical Inorganic Chemistry	03	03
1.4	General Pharmaceutics	03	03
1.5	Biostatistics and Computer Science	03	03
	Total number of Working hours	15	15
	Grand Total		30 hours

1.1: Human Anatomy and Physiology

THEORY

75 Hours (3hrs/week)

1. **Introduction** **02 Hrs**
Definition, scope of anatomy and physiology, description of body and basic terminologies
2. **General anatomy and physiology** **04 Hrs**
Cell, cell junctions, transport mechanisms, homeostasis, ion channels, secondary messengers.
3. **Tissues** **04 Hrs**
Definition, classification of tissues, their location, characteristics and functions, electrophysiology of muscle.
4. **Human skeleton** **04 Hrs**
Structure, composition, classification and function of bones. Identification and few salient features of important bones of axial and appendicular skeleton. Classification of joints, types of movements, disorders of joints (Definitions only)
5. **Body fluids and blood** **07 Hrs**
Body fluids, composition and functions of blood including their disorders, haemopoiesis, mechanism of coagulation, bleeding and clotting disorders, blood grouping and its significance, blood transfusion, lymphatic system and reticuloendothelial system.
6. **Cardio Vascular system** **08 Hrs**
Anatomy and physiology of heart, blood circulation, cardiac output, cardiac cycle, heart rate, blood pressure, electrocardiogram, heart sounds and cardiovascular disorders. (definitions only)
7. **Digestive system** **07 Hrs**
Gross anatomy of G.I. Tract and its physiology with special reference to liver, pancreas and stomach, digestion, absorption, movements of intestine, gastrointestinal hormones, disorders and disorders of digestive system (definitions only)
8. **Respiratory system** **06 Hrs**
Anatomy of respiratory tract, mechanism of respiration, regulation of respiration lung volumes and capacities, transport of oxygen and carbondioxide, artificial respiration, resuscitation methods and disorders of respiratory system (definitions only).
9. **Urinary system** **04 Hrs**
Structure and functions of kidney and urinary tract, physiology of urine formation, micturition reflex and acid base balance. Disorders of urinary system (definitions only).

10. **Reproductive system** **07 Hrs**
Structure and function of male and female reproductive system, sex hormones, physiology and menstruation, coitus, fertilization, spermatogenesis, oogenesis, pregnancy and parturition. Disorders of reproductive system (definitions only).
11. **Endocrinology** **07 Hrs**
Introduction, chemistry and action of hormones, basic anatomy and physiology of pituitary, thyroid, parathyroid, adrenal and pancreas. Local hormones. Disorders of these glands (definitions only).
12. **Nervous system** **10 Hrs**
a. Introduction, neurons, classification and properties of nerve fibres, neuroglia, receptors, synapses and neurotransmitters.
b. Central nervous system – Structure and function of brain and spinal cord, functions of cerebrum, cerebellum, vital centers of medulla oblongata, CSF and cerebral ventricles, cranial nerves and their functions. Disorders of CNS (definitions only).
c. Autonomic nervous system-Anatomy, physiology and division of autonomic nervous system.
13. **Sense organs:** Anatomy and physiology of eye, ear, skin, nose and tongue. **05 Hrs**
Disorders related to sense organs (definitions only).

1.1: Human Anatomy and Physiology (Practical)

3 Hours/week

1. Study of compound microscope.
2. Microscopic study of different tissues.
3. Identification of bones and points of identification
4. Study of different systems with the help of models.
5. Blood experiments: General techniques in Haemocytometry
 - a. Enumeration of Red Blood Corpuscles(RBC)
 - b. Determination of White Blood Corpuscles (WBC)
 - c. Estimation of hemoglobin
 - d. Estimation of Differential Leukocyte Count(DLC)
 - e. Estimation of Erythrocyte Sedimentation Rate (ESR)
 - f. Determination of Blood groups.
 - g. Determination of Bleeding and Clotting time
6. To record human heart rate and pulse rate.
7. To study the effect of posture and exercise on blood pressure.
8. Recording of human body temperature.
9. Determination of tidal volume & vital capacity.
10. Experiments related to special senses.

Recommended Books

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson.
3. Physiological basis of Medical Practice-Best and Taylor.
4. Text book of Medical Physiology-Guyton and Hall.
5. Principles of Anatomy and Physiology by Tortora Grabowski.
6. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje
7. Textbook of Human Histology by Inderbir Singh
8. Textbook of Practical Physiology by C.L. Ghai
9. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma.

1.2: Pharmaceutical Organic Chemistry -I

THEORY

75 Hours (3hrs/week)

Nomenclature, general methods of preparation, general reactions of compounds marked * to be explained. Also to emphasize on definition, types/ classification, isomerisms, mechanisms, uses, examples

- | | | |
|---|---|---------------|
| 1 | Structure and properties | 10 Hrs |
| | a. Atomic orbitals, molecular orbitals, molecular orbital theory (LCAO). | |
| | b. Covalent bond, dipole moment, polarity of bond, polarity of molecules. | |
| | c. Intramolecular forces, intermolecular forces. | |
| | d. Boiling point, melting point, solubility- of compounds. | |
| | e. Hybridization, orbital picture of methane, ethane, ethene and ethyne. | |
| 2 | IUPAC Nomenclature of organic compounds – IUPAC rules | 02 Hrs |
| 3 | Organic intermediates | 06 Hrs |
| | a. Carbocations – structure, stability, generation, rearrangement | |
| | b. Carbanions – structure, stability, generation. | |
| | c. Carbenes – generation. | |
| | d. Free radicals – structure, stability, generation. | |
| | e. Electrophiles. | |
| | f. Nucleophiles. | |
| 4 | Aliphatic hydro carbons | |
| | a. Alkanes*/Alkenes*/Alkynes* | 10 Hrs |
| | Special emphasis on halogenation of alkanes, halogenation of methane, stability of alkenes, ozonolysis of alkenes, electrophilic addition reactions of alkenes – Markownikoff's orientation, free radical addition reaction of alkenes – anti Markownikoff's orientation. | |
| | b. Conjugated dienes* | |
| | Special emphasis on diel-alder, electrophilic addition, free radical addition reactions, allylic rearrangement | 03 Hrs |
| 5 | Cyclo alkanes* | 03 Hrs |
| | Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification | |
| 6 | Benzene | |
| | a. Analytical/ synthetic/ other evidences in the derivation of structure of benzene. Orbital picture, resonance structure, aromatic characters, huckel's rule | 03 Hrs |
| | b. Reactions of benzene – nitration, sulphonation, halogenation - reactivity of halogens, friedel crafts alkylation- reactivity of alkyl halides, limitation, friedel crafts acylation | 04 Hrs |
| | c. Substituents, effect of substituents on reactivity, orientation of mono substituted benzene compounds towards electrophilic substitution reactions | 02 Hrs |

7	Halo hydro carbons. a. Alkyl halides* Special emphasis on I. SN1 and SN2 reactions-kinetics, order of reactivity of alkyl halides, stereochemistry, rearrangement of carbocations. SN1 verses SN2 reactions. II. E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations Saytzeffs orientation, evidences. E1 verses E2 reactions.	06 Hrs
	b. Aryl halides* Special emphasis on nucleophilic aromatic substitution reactions (Bimolecular nucleophilic substitution, Benzyne mechanisms), effect of substituents on reactivity toward nucleophilic aromatic substitution reactions.	03 Hrs
8	Hydroxy compounds a. Alcohols* b. Phenols* - Acidity of phenols, effect of substituents on acidity	02 Hrs 03 Hrs
9	Ethers*	02 Hrs
10	Carbonyl compounds* (Aldehydes and ketones) Electromeric effect, aldol, crossed aldol, cannizaro, crossed cannizaro, benzoin, perkin, Knoevenagel, reformatsky reactions	05 Hrs
11	a) Carboxylic acids* Acidity of carboxylic acids, effect of substituents on acidity, inductive effect b) Carboxylic acid derivatives*	03 Hrs 02 Hrs
12	Amines* Basicity of amines, effect of substituents on basicity, synthetic uses of diazonium salts	03 Hrs
13	Acetoacetic ester/Malonic ester/ Grignard reagent Methods of preparation, synthetic uses	03 Hrs

1.2: Pharmaceutical Organic Chemistry -I (Practicals)

		3 Hours/week
	Title of the experiment	No of classes
1	Recrystallisation of organic compounds	1
2	Preparation of simple non hetero cyclic organic compounds and recrystallisation of compounds prepared. (Minimum of 07 compounds) Aspirin/Benzanilide/Phenyl benzoate/Acetanilide by acylation 2,4,6-Tribromo aniline/Para bromo acetanilide by halogenation 5-Nitro salicylic acid/Meta di nitro benzene by nitration Dibenzal acetone from benzaldehyde by Claisen Schmidt Benzoic acid from benzyl chloride by oxidation Benzoic acid/Salicylic acid by hydrolysis 1- Phenyl azo -2- naphthol from aniline by diazotization and coupling Benzophenone oxime from benzophenone	7
3	Systematic qualitative analysis of unknown organic compounds for preliminary and Lassaigns tests.	2
4	Systematic qualitative analysis of unknown organic compounds for functional groups (for preliminary / Lassaigns / solubility / functional group tests) Following classes of compounds may be analysed Phenols, amides/ urea, carbohydrates, amine, carboxylic acid, aldehyde, ketone, alcohol, carboxylic acid ester, hydrocarbon, halohydrocarbon, nitrocompound, anilide	12
5	Determination of melting and boiling points of organic compounds	1
6	Preparation of suitable solid derivatives from organic compounds	1
7	Introduction to the use of stereomodels – Methane, Ethane, Ethene, Acetylene, Benzene (Students to prepare the ball and stick stereomodels using china clay, plastic sticks individually and to explain the formation of bonds& bond angles, bond lengths, Hybridisation)	1

Recommended Books

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar, Volume-I
3. A textbook of Pharmaceutical Organic Chemistry (Mechanistic approach) by S.N. Pandeya. Volume-I
4. Organic Chemistry by P.L. Soni.
5. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
6. Reactions and Reagents by O.P. Agarwal.
7. Advanced Organic Chemistry by Arun Bahl.
8. Instant notes in Organic Chemistry from Instant notes series.
9. Practical Organic Chemistry by Mann and Saunders.
10. Introduction to Organic Laboratory Techniques by Pavia, Lampman and Kriz
11. Vogel's text book of Practical Organic Chemistry.

1.3: Pharmaceutical Inorganic Chemistry

THEORY

75 Hours (3hrs/week)

1. Aim and scope of Pharmaceutical Inorganic Chemistry **07 Hrs**
Source and effect of impurities in pharmacopoeial substances, importance of limit test, general principle and procedures for limit test, limit test for chloride, sulphate, Iron, Arsenic and Lead and heavy metals. Special procedure for limit test.
2. General methods of preparation, assay* and test for purity*, storage condition, medicinal uses of inorganic compounds belonging to the following classes:
 - 2.1. **Gastrointestinal agents:** **08 Hrs**
Acidifiers: Dil Hydrochloric Acid, Ammonium Chloride
Antacids: Aluminum Hydroxide gel, Calcium carbonate, sodium bicarbonate*, Magnesium triisilicate, Magnesium carbonate (Light and Heavy), Magnesium hydroxide mixture* Ideal properties, limitations and combinations of antacids. **Cathertics and adsorbents:** Magnesium sulphate, Sodium orthophosphate, Kaoline, Bentonite
 - 2.2 **Major extra and intracellular electrolytes:** Major physiological ions, role of sodium, potassium, calcium, magnesium, phosphate, bicarbonate ions. Electrolytes used in the replacement therapy: Sodium chloride*, Sodium chloride Injection, Sodium chloride hypertonic injection, Sodium chloride compound injection, Potassium chloride, Potassium chloride injection, Calcium Gluconate* and Calcium Gluconate injection. Electrolyte combination therapy and ORS, Physiological acid base balance. **06 Hrs**
 - 2.3 **Topical agents and dermatological preparation** **05 Hrs**
Protective: Talc, Zinc oxide, Zinc stearate, Titanium oxide
Antimicrobials: Potassium permanganate*, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations, Boric acid*, Borax.
Astringents: Zinc Sulphate, potash alum *
 - 2.4 **Dental products:** Dentifrices, role of fluoride in the treatment of dental caries, Dibasic calcium Phosphate, Calcium carbonate, Sodium fluoride, Stantium chloride, Zinc Eugenol cement. **03 Hrs**
 - 2.5 **Miscellaneous agents:**
 - a. **Expectorants and respiratory stimulants:** Potassium iodide, Ammonium carbonate **12 Hrs**
 - b. **Heamatinics:** Ferrous sulphate*, Ferrous gluconate, Ferrous fumarate, Iron dextrin injection, Iron and Ammonium citrate.
 - c. **Emetics:** Copper sulphate*, Sodium potassium tartarate
 - d. **Antidote:** Sodium thioisulphate, Activated charcoal,
 - e. **Pharmaceutical aids:** Sodium metabisulphite, Barium sulphate*
 - f. **Antioxidants and Preservatives:** Sodium nitrite, Sodium Citrate.

3. Sources of errors, types of errors, methods of minimising errors, accuracy, precision and significant figures. **03 Hrs**
4. Fundamentals of volumetric analysis, theories of Acid-Base indicators and methods of expressing concentrations. Primary and secondary standard. Preparation and standardization of various volumetric solutions like oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate, iodine and ceric ammonium sulphate solution. **06 Hrs**
 - 4.1 **Acid base titration:** classification and estimation of strong, weak, and very weak Acids and Bases. **02 Hrs**
 - 4.2 **Principles of redox titrations:** Concept of oxidation and reduction. Redox reactions, strength and equivalent weights of oxidizing and reducing agents, theory of redox titrations, cerimetry, Iodimetry, Iodometry, bromometry, titrations with potassium iodate, potassium bromate, titanous chloride, 2,6-dichlorophenol indophenol titrations. **04 Hrs**
 - 4.3 **Complexometric titrations and its classification:** Estimation of Magnesium sulphate, Calcium Gluconate and Potash Alum by complexometric method. Metal ion indicator and its mechanism. **04 Hrs**
 - 4.4 **Principles of precipitation titrations:** different methods-Mohr's, Modified Mohr's, Volhard's, Modified Volhard's, Fajans with example. Estimation of sodium chloride and Ammonium chloride. **04 Hrs**
 - 4.5 **Gravimetry:** Introduction to gravimetric method, steps involved in gravimetric method, precipitants and estimation of Barium sulphate by gravimetric method. **04 Hrs**
 - 4.6 **Non aqueous titration:** Introduction to solvents, classification and estimation of Sodium benzoate and Ephedrine HCl. **03 Hrs**
5. **Radio Pharmaceuticals:** Radio activity, Measurement radio activity. Properties of α , β , γ radiations, Half life, radio isotopes and study of radio isotopes sodium iodine I-131, Cobalt 58. **04 Hrs**

1.3: Pharmaceutical Inorganic Chemistry (Practicals)

3 Hours/week

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

1. Limit tests (7 exercises)
 1. Limit test for chlorides*
 2. Limit test for sulphate*
 3. Limit test for Iron*
 4. Limit test for heavy metals*
 5. Limit test for Arsenic
 6. Modifications in limit tests* for chloride and sulphate in potassium permanganate, sodium bicarbonate, sodium benzoate and sodium Salicylate.
2. Preparation and standardization of the following (3 exercises).
 1. 0.1 N NaOH
 2. 0.1 N KMnO₄
 3. 0.1 N Ceric ammonium sulphate
 4. 0.1 N HClO₄
 5. 0.05 M Di sodium EDTA
 6. 0.1 N Sodium thiosulphate
3. Assay of the following compounds (9 exercises)**
 1. Ammonium chloride-acid base titration (Formal titration)
 2. Ferrous sulphate- (redox) Ceric ammonium sulphate titration
 3. Copper sulphate- (redox) Iodometry
 4. Calcium gluconate-complexometry
 5. Hydrogen peroxide- (redox -Permanganometry)
 6. Sodium benzoate-nonaqueous titration
 7. Sodium chloride-Modified Volhard's method
 8. Assay of KI-KIO₃ titration
 9. Assay of Zinc oxide (acid base back titration)
 10. Assay of barium Sulphate by gravimetry
4. Test for identify for the following (2 exercises)
 1. Sodium bicarbonate
 2. Ferrous sulphate
 3. Potassium iodide.
 4. Calcium chloride

5. Test for purity for the following (2 exercises)*
 1. Swelling power in Bentonite
 2. Ammonium salts in Potash alum.
 3. Presence of Iodates in KI
6. Preparation of inorganic pharmaceuticals (2 exercises)*
 1. Boric acid
 2. Potash alum
 3. Barium sulphate.
 4. Magnesium sulphate

Recommended Books

1. M.L. Schroff, Inorganic Pharmaceutical Chemistry.
2. Bentley and Driver's Textbook of pharmaceutical chemistry by L.M. Atherden
3. J.D. Lee, Concise Inorganic chemistry. 4th edition.
4. C.A. Discher, Modern inorganic pharmaceutical chemistry.
5. J.H. Block, E.B. Roche, T.O. Soine and C.O. Wilson, Inorganic medicinal and pharmaceutical chemistry.
6. John H. Kennedy, Analytical chemistry-principles. Sanders college publication New York, 3rd edition.
7. I.P. 1996, 2007, Govt. of India, Ministry of Health. New Delhi.
8. Ayers, Quantitative chemical analysis.
9. A.H. Beckett & J.B. Stenlake's -Practical Pharmaceutical Chemistry Vol I & II, Stahl one Press of University of London, 4th edition.
10. Analytical chemistry - principles and techniques by Hargis. G. Larry
11. D. A. Skoog, D. M. West, Fundamental of Analytical chemistry, 6th edition.
12. Walton, Principles and methods of chemical analysis.

1.4 : General Pharmaceutics

THEORY

75 Hours (3hrs/week)

- 1 **Historical back ground and development of profession of pharmacy** **06 Hrs**
 - History of profession of Pharmacy in India in relation to pharmacy education, industry and organization.
 - Pharmacy as a career
 - Pharmacopoeias: Introduction to IP, BP, USP and extra pharmacopoeia. Salient features of Indian Pharmacopoeias

- 2 a) Introduction to dosage forms, classification and definitions **08 Hrs**
b) Prescription: Definition, significance, parts and handling of Prescription.
c) Posology: Definition, Factors affecting dose selection. Calculation of doses for infants & children based on age, body weight and body surface area.

- 3 **Pharmaceutical Calculations:** Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions. **06 Hrs**

4. **Powders and Granules:** Definition, classification, advantages and disadvantages, simple & compound powders – official preparations, insufflations, dusting powders, eutectic mixtures, effervescent powders and effervescent granules. **06 Hrs**

5. **Liquid Dosage forms:** Classification, Advantages & Disadvantages. General formulation aspects including adjuvants like Vehicles, Organoleptic additives & Stabilizers. **04 Hrs**

Monophasic Dosage forms: **06 Hrs**
Study of Monophasic liquids - Definition, formulation and official examples of gargles, mouthwashes, Throat paint, Eardrops, Nasal drops, Liniments and lotions, Enemas, collodions, Syrups, Elixirs and solutions.

Biphasic dosage forms: **06 Hrs**
Suspensions: Definition, advantages and disadvantages, classification, Diffusible and indiffusible suspensions – Formulation & official examples. Flocculated and Deflocculated suspension.

Emulsions: Definition, classification, test for the identification of type of emulsion, emulsifying agents, Methods of preparation & stability problems – cracking, creaming and phase inversion.
6. **Semisolid dosage form:** Definition, types, mechanism and factors affecting drug penetration, General formulation of ointments, creams, pastes and gels, their evaluation and packing. **06 Hrs**

7. **Suppositories:** Definition, types, advantages and disadvantages, types of bases, method of preparation, Displacement value & its calculations, packaging and evaluation. **05 Hrs**

- 8. Extraction:** Definition, study of different extraction processes - Expression, Infusion, Decoction, Maceration, Percolation & Soxhalation. Examples of tinctures and extracts. **08 Hrs**
- 9 Blood and its related products** **08 Hrs**
Collection, processing and storage of whole human blood, concentrated human RBC's, dried human plasma, human fibrinogen, human thrombin, human fibrin foam, plasma substitutes - ideal requirements, PVP and Dextran, control of blood products.
- 10. Incompatibilities:** Definition, Physical, Chemical and Therapeutic incompatibilities, definition, reasons and correction of incompatibilities. **06 Hrs**

1.4 : General Pharmaceutics (Practicals)

3 Hours/week

1. Syrups

- a) Simple syrup
- b) Chlorpheniramine maleate syrup

2. Elixirs

- a) Piperazine citrate elixir
- b) Paracetamol paediatric elixir

3. Solutions

- a) Strong solution of ammonium acetate
- b) Cresol with soap solution
- c) Aqueous Iodine solution
- d) Strong Iodine solution

4. Suspensions

- a) Calamine lotion
- b) Magnesium hydroxide mixture

5. Emulsions

- a) Castor oil emulsion
- b) Liquid paraffin emulsion
- c) Turpentine liniment

6. Powders and Granules

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

7. Suppositories

- a) Boric acid suppository
- b) Zinc oxide suppository

8. Semisolids

- a) Simple ointment base
- b) Sulphur ointment
- c) Cold cream
- d) Compound Zinc Paste
- e) Bentonite Gel

9. Gargles and Mouth Washes

- a) Potassium chlorate gargle
- b) Any antiseptic mouth washes

10. Tinctures

- a) Orange tincture
- b) Compound Benzoin tincture

Recommended Books

1. H.C. Ansel et al, Pharmaceutical Dosage form and Drug delivery system, Lippincott Williams and Walkins, New Delhi, 7th Edition, 2000.
2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical students, CBS publishers, New Delhi 12th Edition. 2000.
3. M.E. Aulton, Pharmaceutics, The Science& Dosage Form Design, Churchill Livingstone, Edinburgh, 2nd Edition, 2002.
4. Indian pharmacopoeia and British pharmacopoeia.
5. Theory and practice of Industrial pharmacy by Lachmann.
6. Alfonso R. Gennaro Remington: The science and practice of pharmacy, Vol I and Vol II Lipponcott Williams, 20th edition, 2000.
7. Carter S.J., Cooper and Gunn's-Tutorial pharmacy, CBS Publications, New Delhi, 6th edition, 2000.
8. E.A.Rawlins, Bentley's text book of Pharmaceutics, English language Book Society, 8th edition, 1997.

1.5: Biostatistics and Computer Science

THEORY

75 Hours (3hrs/week)

Biostatistics - Part -A

- | | | |
|----|--|---------------|
| 01 | Frequency distribution : Definition , Types of frequency distribution, Cumulative frequency
Graphical Representation : Histogram, frequency polygon, frequency curve, Semi logarithmic graph, ogive | 06 hrs |
| 02 | Measures of central tendency : Average, Types of averages - Mean, Median, Mode, Harmonic mean, Geometric mean, Quartile, deciles, percentile - Pharmaceutical examples | 08 hrs |
| 03 | Measures of dispersion : Dispersion, Range, quartile deviation, mean deviation, standard deviation, Variance, coefficient of variation, application of coefficient of variation in pharmacy, skewness, Kurtosis coefficient of skewness, Pharmaceutical problems | 08 hrs |
| 04 | Correlation : Definition, Types of correlation, Karl Pearson's coefficient of correlation, Rank difference method, Correction of tied ranks, Multiple correlation - Pharmaceuticals examples | 05 hrs |
| 05 | Regression: Curve fitting by the method of least squares, fitting the lines $y = a + bx$ and $x = a + by$, fitting the curve $y = ab^x$, fitting exponential curve, Multiple regression, difference between regression and correlation – Pharmaceutical Examples | 05 hrs |
| 06 | Probability : Trial, event, sure event, random event, Sample space, Definition of probability, mutually exclusive events, Independent event, Law's of Probability - simple problems, Binomial distribution, Normal distribution, Poisson's distribution, properties - problems | 06 hrs |
| 07 | Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples | 03 hrs |
| 08 | T- distribution : t-test between the means of Population and sample, Pooled t-test, student's t-test, Pharmaceutical examples | 04 hrs |

Computer Science – Part – B

- | | | |
|----|---|---------------|
| 09 | Number system: Binary number system, Decimal number system, Octal number system, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – First complement, second complement method, binary multiplication, binary division | 05 hrs |
| 10 | Over view of computers, Generation of computers, Types of computers – Mini, Micro, Super computer, digital, analog and hybrid computers, input devices, output devices, input/output devices – Floppy disk, CD-ROM, Pen drive, Monitor, Printers, types of printers-Impact and Non impact printers, | 08 hrs |
| 11 | Algorithm and flow chart – Pharmaceutical problems | 02 hrs |
| 12 | Hardware, software , types of software's – System, application, Custom software | 02 hrs |
| 13 | Operating system, Types of Operating systems | 02 hrs |
| 14 | Computer Network – LAN, WAN, MAN, Internet, WWW | 03 hrs |
| 15 | Programming languages – Machine language, Assembly language, High level languages | 02 hrs |
| 16 | Introduction to M.S. Office – M.S. Excel, M.S. Access-operators and Expression | 04 hrs |
| 17 | Application of computers in Pharmacy – Drug information storage and retrieval, Pharmacokinetics, Drug design, Crude drug identification, Hospital and Clinical Pharmacy, Pharmaceutical analysis | 02 hrs |

1.5: Biostatistics and Computer Science (Practicals)

3 Hours/week

01.	Introduction to M.S. Word, Mail Merge, Table Handling	6 hrs
02.	Introduction to Excel - Graphs – Histogram, Bar, Line, Pie etc	3 hrs
03.	Introduction to mathematical function - Sum, Average, Exponential, Logarithm, Round, Power , If and Else - logical function	3 hrs
04.	Calculation of Averages using excel - Mean - Individual, discrete and continuous series	3 hrs
05.	Calculation of Median and Mode using Excel - Discrete and continuous series	3 hrs
06	Calculation of Geometric mean, Harmonic mean using Excel - Individual, Discrete and continuous series	3 hrs
07	Calculation of mean deviation by direct and shortcut method using Excel - Individual, Discrete and continuous series	3 hrs
08	Calculation of Standard deviation and coefficient of variation by direct method using Excel - Individual, Discrete and continuous series	3 hrs
09	Calculation of Standard deviation and Coefficient of variation by shortcut method using Excel - Individual, Discrete and continuous series	3 hrs
10	Calculation of coefficient of correlation by direct , shortcut method and Rank difference method using Excel	3 hrs
11	Multiple correlation problem	3 hrs
12	Calculation of coefficient of Skewness using Excel	3 hrs
13	Formation of linear regression equation – calculation of predicted values	3 hrs
14	Formation of linear regression equation by calculating slope	3 hrs
15	Binomial distribution , Poisson’s distribution problems – Using excel	3 hrs
16	t-test Problem to know the significance difference between population and sample mean – Using excel	3 hrs
17	Pooled t-test Problem to know the significance difference between means of two Samples – Using excel	3 hrs
18	Student’s t-test Problem to know the significance difference between means of Control and treatment group – Using excel	3 hrs

19	Introduction to Access - Creating database, Creating table, designing table – creating forms	3 hrs
20	Creating main menu for the operations of forms	3 hrs
21	Creating sub forms	3 hrs
22.	Creating forms to operate files, Printing reports	3 hrs
23	Operating statistical software	3 hrs
24	Introduction to Power point – Slides Preparations	3 hrs

Books Recommended

1. Pharmaceutical Statistics - By Sanford Bolton – Third/Fourth Edition
2. Comdex Computer Course Kit - Vikas Guptha
3. Fundamental of Statistics - S.C.Guptha
4. Practical Problems in Statistics – D.N.Elhance and Veen Elhance
5. Microsoft Office Access – 2003 - Cary N.Prague, Michael R.Irwin
6. Statistics - Kapoor
7. Statistics Method - S.P.Guptha
8. Methods in Biostatistics – B.K.Mahajan

JSS University

Sri Shivarathreeshwara Nagar, Mysore – 570 015

Second year B. Pharm

Sl. No.	Subject	Theory hours / week	Practical hours / week
2.1	Physical Pharmaceutics	03	03
2.2	Pharmaceutical Organic Chemistry - II	03	03
2.3	Pharmaceutical Engineering	03	03
2.4	Applied Biochemistry	03	03
2.5	Pathophysiology	03	-
2.6	Pharmaceutical Jurisprudence & Management	03	-
	Total number of Working hours	15	15
	Grand Total		30 hours

2.1: Physical Pharmaceutics

THEORY

75 Hours (3hrs/week)

- 1. Matter, properties of matter** **8 Hrs**
State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols – inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid-crystalline, amorphous & polymorphism.
- 2. Solubility of drugs** **8 Hrs**
Solubility expressions, mechanisms of solute solvent interactions, ideal solubility & Scatchard-Hildebrand equation, solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, Dissolution & drug release, diffusion principles in biological systems.
- 3. Surface and interfacial phenomenon** **6 Hrs**
Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HCB classification, solubilisation, detergency adsorption at solid interface.
- 4. Micromeretics** **7 Hrs**
Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle size, optical microscopy, sieving, sedimentation measurement, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.
- 5. Rheology** **6 Hrs**
Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatants, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling ball, rotational viscometers.
- 6. Drug stability** **12 Hrs**
Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, light.

Stabilization of medicinal agents against common reactions like hydrolysis & oxidation.

Accelerated stability testing in dating of pharmaceutical dosage forms.

- 7. Colloidal dispersions** **8 Hrs**
Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Mechanism, effect of electrolytes, coacervation, peptization & protective action.
- 8. Coarse dispersion** **10 Hrs**
Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of suspensions, emulsions and theories of emulsification. Physical stability of emulsions, preservation of emulsions, rheological properties of emulsions, phase equilibria and emulsion formulation, special emulsion systems, semisolids and gels.
- 9. Complexation and protein binding** **6 Hrs**
Metal complexes, organic molecular complexes, inclusion compounds, methods of analysis, protein binding, complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.
- 10. Polymer sciences** **4 Hrs**
Historical background, pharmaceutical application of polymers, definition, polymer as thickening agent, gel formation.

2.1: Physical Pharmaceutics (Practicals)

3 Hours/week

1. To determine the solubility of drug at room temperature and express the solubility in different concentration expressions
2. Determination of surface/interfacial tension of given liquids
3. Determination of HLB value of ester surfactant by saponification method
4. Determination of critical micellar concentration of surfactants
5. Determination of Freundlich and Langmuir's constants for adsorption of acetic acid on charcoal.
6. Determination of particle size, particle size distribution using various methods of particle size analysis.
7. Determination of derived properties of powders like bulk density, true density and porosity, compressibility of powders. To determine the angle of repose and flow rate of granules.
8. Determination of viscosity of liquid using Ostwald's viscometer and Study of rheological properties of various types of systems using different viscometers
9. Determination of half life, rate constant in first order reaction.
10. Determination of half life, rate constant in second order reaction ($a=b$)
11. To study the influence of various factors on the rate of reaction.
12. Study of different types of colloids and their properties.
13. Preparation of various types of suspensions and determination of their sedimentation parameters.
14. Preparation and stability studies of emulsions.
15. Studies on different types of complexes and determination of their stability constants.

Recommended Books

1. Physical pharmacy by Alfred Martin
2. Experimental pharmaceutics by Eugene, Parott.
3. Tutorial pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical calculations, Lea & Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical dosage forms – disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical pharmaceutics by Ramasamy .C and Manavalan.R.
8. Laboratory manual of physical pharmaceutics, C.V.S.Subramanyam, J. Thimma settee

2.2: Pharmaceutical Organic Chemistry -II

THEORY

75 Hours (3hrs/week)

1. **Stereochemistry:** **15 Hrs**
 - a) Stereo Isomerism: Definition , classification with examples
 - b) Optical isomerism –
 1. Definition, optical activity, enantiomerism, diastereoisomerism, meso compounds, elements of symmetry, sequence rules, nomenclature of optical isomers (R & S, D & L systems).
 2. Reactions of chiral molecules, walden inversion.
 3. Racemic modification, resolution of racemic mixture.
 4. Asymmetric synthesis.
 - c) Geometrical isomerism – Definition, Nomenclature of geometrical isomers (EZ, Cis Trans, Syn Anti systems), methods of determination of configuration of geometrical isomers.
 - d) Conformational Isomerism – definition, Conformational Isomerism in alkanes, Cyclopentane, Cyclohexane.
 - e) Stereo isomerism in biphenyl compounds - Atropisomerism, optical activity, configuration.
 - f) Stereo specific and stereo selective reactions – Definition, examples.

2. **Synthetic tools and Named Reactions** **8 Hrs**
 - a. Catalytic hydrogenation, metal hydride reduction, Clemmensen reduction, Meerwein Ponderff Verley reduction, Birch reduction, Wolff kishner reduction.
 - b. Oppenauer-oxidation. Dakin reaction.
 - c. Beckmann rearrangement, Schmidt rearrangement.
 - d. Claisen-Schmidt reaction.

3. **Heterocyclic chemistry:** **13 Hrs**
 - a. Definition, classification of- heterocyclic compounds with examples.
 - b. Nomenclature of heterocyclic compounds.
 - c. Methods of synthesis, important reactions, Physical properties of following compounds/derivatives. Medicinal uses of derivatives of these compounds.
 - I. Pyrrole, Furan, Thiophene, Indole.
 - II. Pyrazole, Imidazole, Oxazole, Thiazole.
 - III. Pyridine, Quinoline, Isoquinoline, Acridine.
 - IV. Pyrimidine, Purine.
 - V. Phenothiazine, Azepine.

4. **Polynuclear hydrocarbons:** **7 Hrs**
- a) Definition of poly nuclear hydro carbons, classification with examples.
 - b) Methods of Synthesis, reactions of following compounds/derivatives, medicinal uses of derivatives of these compounds.
Naphthalene, Phenanthrene, Anthracene. Diphenylmethane and Triphenylmethane.
5. **Chemistry of Biomolecules.** **12 Hrs**
- a. **Carbohydrates**
 - I. Definition, classification with examples.
 - II. Glucose – structural determination (both open/ closed chain), configuration determination, ring size determination, reactions, uses in Pharmacy.
 - III. Lactose, Maltose, Sucrose-structure, reactions, uses in Pharmacy.
 - IV. Cellulose, starch - partial structure, uses of these and derivatives in Pharmacy
 - b. **Fats & Oils.** **10 Hrs**
 - I. Definition, Classification with examples, uses.
 - II. Hydrolysis, hydrogenation, saponification, rancidity- of oils, drying oils.
 - III. Analytical constants – Acid value, saponification value, iodine value, acetyl value, Reichert Meissl (RM) value – definition significance and principle involved in the determination.
 - c. **Amino acids and Proteins.** **10 Hrs**
 - Amino acids -**
 - I. Definition, classification with examples.
 - II. Methods of synthesis, physical properties, reactions.
 - Proteins –**
 - I. Definition, classification with examples, structure- primary, secondary, tertiary.
 - II. Peptide bond, geometry of peptide bond.
 - III. Synthesis of peptides.
 - IV. Determination of Peptide Structures. (C-Terminal and N-Terminal Amino acid Residue Analysis).

2.2: Pharmaceutical Organic Chemistry –II (Practical)

3 Hours/Week

Title of the experiment	No of classes
1. Quantitative determination of following classes of organic compounds 1. Alcohol by acetylation method. 2. Carbonyl compound by hydroxyl amine hydro chloride method. 3. Carboxylic acid by acid base method. 4. Ester by hydrolysis method. 5. Amino acid by formal titration. 6. Aldehyde by sodium sulfite sulphuric acid method. 7. Acetone by Sodium hypo iodite method. 8. Phenol by bromination method. (Minimum of seven Quantitative determinations)	7
2. Determination of following oil values 1. Acid value. 2. Saponification value. 3. Iodine value by pyridine bromide method. 4. Iodine value by iodine mono chloride method. (Minimum of three determinations)	3
3. Preparation of heterocyclic organic compounds. (Minimum of seven preparations) Heterocyclic compounds Listed below or any other heterocyclic compounds 1. Benzimidazole from ortho phenylene diamine. 2. 2,3–diphenyl quinoxaline from benzil 3. 7–hydroxy 4–methyl coumarin from resorcinol. 4. Benzotriazole from ortho phenylene diamine by diazotization. 5. 2,4,5-triphenyl oxazole from benzoin. 6. 2-phenyl indole from acetophenone. 7. Phenothiazine from diphenyl amine. 8. 3-methyl 1-phenyl pyrazol-5-one from ethylacetoacetate.	7
4. Separation of mixture of two organic compounds and qualitative analysis of these compounds for functional group.	6
5. Molecular modeling of Enantiomers, Diastereoisomers, meso compounds, Geometrical isomers, Conformational Isomers – chair, boat conformers of cyclohexane, Biphenyl compounds.	2

Recommended Books

1. Organic chemistry by I. L. Finar, Volume-I & II.
2. Advanced Organic Chemistry by Jerry March.
3. Stereochemistry of Carbon compounds by E. I. Eliel
4. A Guide book to mechanism in Organic Chemistry by Syker. P
5. Heterocyclic Chemistry by T.L. Gilchrist
6. Heterocyclic Chemistry by Raj K. Bansal
7. Organic Chemistry by Morrison and Boyd
8. Elementary Practical Organic Chemistry by AI Vogel, Part- III, Quantitative Organic Analysis.
9. Practical Organic Chemistry by Mann and Saunders.
10. Practical Pharmaceutical Chemistry, Volume- I & II by Beckett and J. B.Stanlake
11. Introduction to Organic Laboratory Techniques by Pavia, Lampman and Kriz
12. Indian Pharmacopoeia
13. Vogel's text book of Practical Organic Chemistry

2.3: Pharmaceutical Engineering

THEORY

75 Hours (3hrs/week)

- 1. Unit Operations and Processes. 2 Hrs**
 - Introduction to industrial processing unit operations and processes. Fundamental concept of material and energy balance, Dimensional analysis.
- 2. Materials of pharmaceutical Plant construction: - 5 Hrs**
 - General study of composition and its application
 - Factors affecting the material selection for Pharmaceutical plants.
 - Physical, Chemical and mechanical properties and uses of important materials and their alloys employed in the construction of pharmaceutical plants, heat and corrosion resistant alloys.
- 3. Corrosion and its prevention: - 3 Hrs**
 - General considerations, Classification & theories of corrosion, Factors, prevention & control of corrosion.
- 4. Industrial hazards and safety measures: - 6 Hrs**
 - Mechanical, chemical, electrical, fire and explosive hazards in pharmaceutical process, including inflammable gases and dusts explosion.
 - Safety measures in pharmaceutical plants and works.
- 5. Flow of fluids: 6 Hrs**
 - Fluid Mechanics, types of manometers, Reynolds number and its significance,
 - Distribution of velocities across a pipe, Boundary layers, Bernoulli's theorem and its applications, Orifice meter, Venturimeter, Pitot tube and Rotameter.
 - Fluid heads, Energy losses, measurement of flow of fluids.
- 6. Size Reduction: 4 Hrs**
 - Definition, objectives of size reduction, factors affecting size reduction
 - Mechanism of size reduction, Laws governing size reduction
 - Types of mills and operations of Hammer mill, Ball mill, Fluid energy mill, Edge runner mill & End runner mill. Criteria for selection of equipment.
- 7. Size Separation: 4 Hrs**
 - Standards Sieves, IP grade powder
 - Different techniques of size separation, Types of screening equipments
 - Sieves, Sieve shaker, sedimentation tanks, cyclone separator, elutriation tank, Air separator, Bag filter and particle size distribution.

- 8. Filtration:** **3 Hrs**
- Theory of filtration, filter aids, filter medias,
 - Factors affecting rate of filtration,
 - Types of industrial filters and their operation such as filter press, filter leaf, rotary drum filter, Meta filter, Candle.
- 9. Centrifugation:** **2 Hrs**
- Principles of centrifugation, Study of laboratory and large scale centrifuges and their application
- 10. Mixing:** **5 Hrs**
- Theory of mixing, factors influencing selection of mixers
 - Solid-solid, solid-liquid and liquid-liquid mixing equipments used in pharmaceutical industry- V-Cone, Ribbon and Double cone blender, Sigma blade and planetary mixers, Propellers, Turbines, Paddles, Baffles, ultrasonic mixers and homogenisers.
- 11. Heat transfer:** **6 Hrs**
- Heat transfer mechanisms.
 - Heat transfer by conduction. Fourier's law, compound resistance in series, heat flow through a cylinder
 - Natural and forced convection, convection through fluids.
 - Surface coefficients, overall heat transfer coefficients.
 - Radiation. Concepts of black and gray body, Heat interchangers, heat exchangers
 - Introduction to various types of heating media and fuels, steam as heating medium, properties and uses of steam. Steam traps, heating by electricity. Insulations types and selection of insulators.
- 12. Evaporation: -** **4 Hrs**
- Basic concept of phase equilibrium. Factors affecting evaporation,
 - Types of evaporators and its study Heat and material balances, single and multiple effect evaporators and multiple effect evaporators under reduced pressure.
- 13. Distillation: -** **6 Hrs**
- General theory applied to binary mixtures, boiling point and equilibrium diagrams and Raoults law,
 - Constant boiling mixtures (Azeotropes),
 - Rectification, construction of rectifying columns.
 - Simple distillation, Steam distillation, Flash distillation, Molecular distillation and Extractive distillation and its applications.

- 14. Drying:** **5 Hrs**
- Introduction, theory of drying ,rate of drying, Moisture content,
 - Classification of dryers including Vacuum spray, tray, Spray dryer, fluidized bed dryers,
 - Principle of freeze-drying and freeze dryers.
- 15. Crystallization: -** **6 Hrs**
- Crystal forms and crystal habit, solubility curves, super saturation theory of Crystallization, nucleation and crystal growth, material and energy balances,
 - Classification, principle under- lying the design and operation of tank crystallizer, Swenson Walker Crystallizer
 - Vacuum type crystallizers, Caking of crystals and its prevention.
- 16. Humidity and air conditioning: -** **4 Hrs**
- Definition of various terms, psychometric charts, wet bulb temperature,
 - Adiabatic saturation temperature, determination of humidity, methods of increasing and decreasing humidity, importance of humidity and its control.
 - Principles of Air conditioning and air conditioners and their application in pharmacy
- 17. Refrigeration: -** **2 Hrs**
- General considerations, coefficient of performance, compression and absorption types of refrigeration cycle,
 - Choices of refrigerate, application in pharmacy.
- 18. Plant location:** **2 Hrs**
- Layout, utilities and services.

2.3: Pharmaceutical Engineering (Practical)

3 Hours/week

1. Drying of wet granules and to plot the rate of drying curves.
2. Operation of sieve shaker and sieve analysis and deriving various statistical parameters.
3. Particle size measurement by Stoke's law.
4. Rate of filtration studies, Calculation of specific cake and filter medium resistance.
5. To determine the leaching of contents from packaging material: Ampoules and vials.
6. Analysis of pharmaceutical packaging materials-Corrugated box.
7. Mixing: Determination of mixing efficiency when propeller blade is introduced in different positions.
8. Methods of crystallization, study of crystal habit.
9. Steam distillation: collection of volatile oil (Demonstration).
10. Evaporation: factors affecting the rate of evaporation.
11. Determination of flash point of oils and solvents.
12. Uses of different commercial viscometers.

Recommended Books

1. Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition
2. Unit operation of chemical engineering –McCabe Smith, Latest edition,
3. Pharmaceutical Engineering principles and practices – C.V.S.Subrahmanyam et al. , Latest edition
4. Physical Pharmacy-Martin et al., Latest edition
5. Bentleys Pharmaceutics—Davis, Latest edition
6. Physical Pharmaceutics—Shotton, Latest edition
7. Remington Practice of Pharmacy—Martin, Latest edition
8. Cooper and Gunn's Tutorial Pharmacy, S.J. Carter., Latest edition
9. Theory and practice of Industrial Pharmacy by Lachman., Latest edition
10. Refrigeration and Air conditioning by L. Ballaney., Latest edition

2.4: Applied Biochemistry

THEORY

75 Hours (3hrs/week)

1. **Introduction to biochemistry:** **3 Hrs**
 - a. Cell organelles and its biochemical functions
 - b. Transport process across the cell membranes
2. **Bioenergetics:** **3 Hrs**
 - a. Concept of free energy: determination of free energy from equilibrium constant; Redox potential.
 - b. Energy rich compounds; ATP, Cyclic AMP and their biological significance
3. **Enzymes** **14 Hrs**
 - a. Definition; Nomenclature; IUB classification
 - b. Properties of enzymes
 - c. Factor affecting enzyme activity
 - d. Enzyme kinetics (Michaelis plot, Line Weaver Burke plot)
 - e. Enzyme inhibitors with examples
 - f. Mechanism of enzyme action and theories of enzyme action
 - g. Allosteric enzymes, Enzyme induction and repression
 - h. Isoenzymes and their diagnostic applications
 - i. Industrial, therapeutic and diagnostic applications of enzymes
 - j. Coenzymes –Structure and biochemical role (fat and water soluble vitamins)
4. **Biological oxidation** **4 Hrs**
 - a. Enzymes and co-enzymes involved in Biological oxidation.
 - b. Electron transport chain (its mechanism and role).
 - c. Oxidative phosphorylation (its mechanism) and substrate level phosphorylation
 - d. Inhibitors ETC and Uncouplers or inhibition of oxidative phosphorylation
5. **Carbohydrate metabolism** **12 Hrs**
 - a. Definition, classification, chemistry and biological role of carbohydrates
 - b. Glycolysis – energetics and significance
 - c. Citric acid cycle- energetics, amphibolic nature, anaplerosis and significance
 - d. HMP shunt and its significance
 - e. Glycogen metabolism (Glycogenolysis and glycogenesis)
 - f. Gluconeogenesis and its significance
 - g. Various shuttle systems (glycerol – phosphate & malate - aspartate)
 - h. Uronic acid pathway and its significance
 - i. Hormonal regulation of carbohydrate metabolism
 - j. Diabetes mellitus and glycogen storage diseases

- 6. Lipid metabolism** **10 Hrs**
- a. Definition, classification, chemistry and biological role of lipids
 - b. β -Oxidation of saturated and unsaturated fatty acids
 - c. Ketone bodies metabolism (Ketogenesis and ketolysis) and ketosis
 - d. Biosynthesis of fatty acids (*De novo*)
 - e. Metabolism of cholesterol (Biosynthesis and degradation)
 - f. Atherosclerosis, fatty liver and hypercholesterolemia
 - g. Phospholipids and Sphingolipids (Chemistry, biosynthesis, significance)
- 7. Amino acid metabolism** **11 Hrs**
- a. Definition, classification and biological role of amino acids
 - b. Transamination, deamination & decarboxylation.
 - c. Urea cycle and its metabolic disorders
 - d. Metabolism of sulfur containing amino acids
 - e. Catabolism of tyrosine, tryptophan, phenylalanine and their metabolic disorders
 - f. Synthesis and significance of biological substances; creatine, histamine,
 - g. 5-hydroxy Tryptophan (5-HT), dopamine, noradrenaline, adrenaline
 - h. Porphyrins, bile pigments; hyperbilirubinemia (Metabolism of heme)
- 8. Nucleic acid metabolism** **13 hrs**
- a. Definition, chemistry and biological role of nucleosides, nucleotides
 - b. Biosynthesis of purine and pyrimidine nucleotides
 - c. Catabolism of purine and pyrimidine nucleotides
 - d. Structure of DNA and significance as genetic material
 - e. RNA, structure, types and significance in protein synthesis
 - f. DNA replication, types and details on semi conservative model
 - g. Mutation and DNA repair mechanism
 - h. Transcription or RNA synthesis
 - i. Genetic code
 - j. Translation or Protein synthesis and its regulation and inhibition
- 9. Clinical biochemistry** **5 Hrs**
- a. Role of the kidney: Laboratory tests (serum creatinine, creatinine clearance, serum urea and serum uric acid)
 - b. Liver functions: Metabolic; synthetic; excretion & detoxification. Tests to evaluate the liver functions
 - c. Lipid profile tests

2.4: Applied Biochemistry (Practicals)

3 Hours/Week

Qualitative experiments

1. Qualitative analysis of carbohydrates (Glucose, fructose, lactose, maltose, sucrose).
2. Qualitative analysis of Proteins (Casein, Albumin, Gelatin, and Peptone)
3. Qualitative analysis of normal constituents of urine.
4. Qualitative analysis of abnormal constituents of urine.

Quantitative experiments

5. Quantitative estimation of carbohydrates by DNSA method.
6. Quantitative estimation of proteins by Biuret method.
7. Quantitative estimation of urine sugar by Benedict's reagent method.
8. Quantitative estimation of urine chlorides by Volhard's method.
9. Quantitative estimation of urine creatinine by Jaffe's method.
10. Quantitative estimation of urine calcium by precipitation method.
11. Quantitative estimation of blood sugar Folin-Wu tube method.
12. Quantitative estimation of blood creatinine by Jaffe's method
13. Quantitative estimation of serum cholesterol.
14. Estimation of Urea in Serum.
15. Estimation of SGOT in serum.
16. Estimation of SGPT in serum.
17. Determination of Salivary amylase activity.
18. Study the effect of pH on salivary amylase activity.
19. Study the effect of Temperature on Salivary amylase activity.
20. Preparation of buffer solutions and its pH measurements (any two)

Recommended Books

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

2.5: Pathophysiology

THEORY

75 Hours (3 Hrs/wk)

- 1. Basic principles of Cell injury and Adaptation:** **7 Hrs**
 - Introduction, definitions, Homeostasis, Components and Types of Feed back systems, Causes of cellular injury
 - Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage)
 - Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia). Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death

- 2. Basic mechanism involved in the process of inflammation and repair:** **7 Hrs**
 - Introduction, Clinical signs of inflammation, Different types of Inflammation
 - Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's
 - Mediators of inflammation
 - Basic principles of wound healing in the skin
 - Pain Pathway

- 3. Immunology:** **7 Hrs**
 - Introduction to T and B cells, MHC proteins or transplantation antigens
 - Immune tolerance – hypersensitivity (Type I, II, III, IV), Biological significance, Allergy due to food, chemicals and drugs
 - Autoimmunity – criteria for autoimmunity, Classifications of autoimmune diseases in human, Mechanism of autoimmunity
 - Transplantation and immunologic tolerance, Allograft rejections, Mechanism of rejection of allograft

- 4. Pathophysiology of common diseases associated with following systems: (Wherever possible molecular basis have to be discussed).**
 - 4.1 Cardiovascular system** **12 Hrs**
 - Hypertension, Congestive cardiac failure, Ischaemic heart diseases (Angina, Myocardial Infarction), Arrhythmias, Hyperlipidaemias, Atherosclerosis

 - 4.2 Respiratory system** **2 Hrs**
 - Asthma, Chronic Obstructive airways disease

 - 4.3 Renal system** **2 Hrs**
 - Acute and chronic renal failure

 - 4.4 Haematological diseases** **2 Hrs**
 - Different types Anaemias

4.5 Endocrine system	4 Hrs
• Diabetes, Thyroid diseases	
4.6 Nervous system	4 Hrs
• Epilepsy, Parkinson's disease, Stroke, Headache	
4.7 Psychiatric disorders	4 Hrs
• Depression, Mania, Schizophrenia, Anxiety disorders	
4.8 Gastrointestinal system	7 Hrs
• Peptic Ulcer, Inflammatory bowel diseases, Hepatitis, Jaundice, Cirrhosis	
4.9 Diseases of bones and joints	2 Hrs
• Rheumatoid Arthritis, Osteoarthritis, Gout	
4.10 Infectious diseases	10 Hrs
• Meningitis, Respiratory tract infections, Gastroenteritis, Typhoid, Leprosy, Tuberculosis, Urinary tract infections, Otitis Media	
4.11 Sexually transmitted diseases	2 Hrs
• AIDS, Gonorrhoea and Syphilis	
4.12 Oncology	3 Hrs
• Cell cycle, General biology of tumor	
• Classification, etiology and pathogenesis of neoplasm	

Recommended Books

1. Pathologic basis of disease: Cotran, Kumar, Robbins
2. Text book of Pathology: Harsh Mohan
3. Text book of Pathology: Y.M. Bhide
4. Goodman Gilman's The Pharmacological Basis of Therapeutics.
5. Best and Taylor's Physiological basis of medical practice by William and Wilkins, Baltimore.
6. Davidson's Principles and Practice of Medicine, ELBS/Churchill Livingstone.
7. Textbook of Medical Physiology: Guyton A, Hall J.E., WB Saunders Company.
8. Pharmacotherapy: A Pathophysiological Approach, Dipiro, JL Elsevier.
9. Basic Pathology: Robbins SL and Kumar V, WB Saunders Company.
10. Clinical Pharmacy and Therapeutics: Roger Walker, Churchill Livingstone publication

2.6: Pharmaceutical Jurisprudence and Management

THEORY

75 Hours (3hrs/week)

Pharmaceutical Jurisprudence

1. **Definition and scope of Forensic Pharmacy** **1 Hr**
2. **Pharmaceutical Legislation-A brief review** **2 Hrs**
 - Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee
3. **Code of Pharmaceutical ethics** **2 Hrs**
 - Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath.
4. **Pharmacy act-1948 & new Amendments** **3 Hrs**
 - Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils, Registration of Pharmacists, Offences and Penalties.
5. **Drugs and cosmetics act 1940 and rules 1945 & New Amendments** **12 Hrs**
 - Objectives, Definitions, Legal definitions of schedules to the act and rules
 - Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit.
 - Manufacture of drugs – Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license. Detailed study of schedule M, N and Y.
 - Sale of Drugs – Wholesale, Retail sale and Restricted license.
 - Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors.
 - Administration of the act and rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government analysts, Licensing authorities, controlling authorities, Drug Inspectors
6. **Medicinal and Toilet preparations (Excise Duties) Act 1955** **3 Hrs**
 - Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Offences and Penalties.
7. **Narcotic drugs and psychotropic substance act 1985 and rules** **3 Hrs**
 - Objectives, Definitions, Authorities and Officers, Prohibition, Control and Regulation, opium poppy cultivation and Production of poppy straw, manufacture, sale and export of opium, Offences and Penalties.
8. **Drugs and Magic remedies (Objectionable Advertisement) act 1955** **2 Hrs**
 - Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties.

9. **Pharmaceutical Policy 2002** **2 Hrs**
 - Objectives, Approaches in the review, Salient features
10. **Prevention of cruelty to Animals act-1960** **2 Hrs**
 - Objectives, Definitions, Institutional Animal Ethics Committee, Breeding and Stocking of Animals, Performance of Experiments, Transfer and Acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties.
11. **Drugs (price control) order-1995 & New Amendments** **2 Hrs**
 - Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, Implementation of prices Fixed/ revised.
12. **Sales promotion employees (Conditions of service) Act** **1 Hr**
- Pharmaceutical Management**
1. **Concept of Management-** **12 Hrs**
 a. Concepts of management, Principles of management
 b. Primary functions of management - planning, organizing, staffing, directing, controlling, motivation & entrepreneurship development.
 c. Secondary functions of management: decision-making, leadership, innovation, delegation of authority/responsibility.
2. **Pharmaceutical marketing Management:** **12 Hrs**
 a. Definition and scope of marketing
 b. Functions- Buying, Selling, Transportation, Storage, Finance, Feed back, Information
 c. Channels of distribution- Whole sale, Retail, Departmental store, multiple shops and mail order business
 d. Analyzing the market-market research
3. **Sales promotions and salesmanship:** **10 Hrs**
 Principles of sales promotion, Advertising, Sales ethics, Merchandising, Literature, Detailing, Recruitment, Training and Evaluation of professional sales representative.
4. **Pharmaceutical Product Development:** **06 Hrs**
 a. Market consideration in product development, Marketing mix, Product life cycle(PLC), Elements of marketing mix, Product-classification, Planning, Differentiation and modification of existing product
 b. Stages of New product development-All stages from production idea to marketing (Bulk drugs & Formulations)
 c. Branding - Concept of brand, Different types, importance and reasons for branding, packaging.

Recommended Books

1. Forensic Pharmacy by B. Suresh
2. Text book of Forensic Pharmacy by B.M. Mithal
3. Hand book of drug law-by M.L. Mehra
4. A text book of Forensic Pharmacy by N.K. Jain
5. Drugs and Cosmetics Act/Rules by Govt. of India publications.
6. Medicinal and Toilet preparations act 1955 by Govt. of India publications.
7. Narcotic drugs and psychotropic substances act by Govt. of India publications
8. Drugs and Magic Remedies act by Govt. of India publications.
9. Business management by Dinker
10. Management by James
11. Principles of Pharmaceutical marketing by Mickey C Smith
12. Manufacturing organization management by Horal T Amrine & Oliver S. Hulley
13. Pharmaceutical industrial management by G. Vidya Sagar
14. Forensic Pharmacy and Pharmaceutical business management by K. Ramkumar

JSS University

Sri Shivarathreeshwara Nagar, Mysore – 570 015

Third year B. Pharm

Sl. No.	Subject	Theory hours / week	Practical hours / week
3.1	Medicinal Chemistry -I	03	03
3.2	Pharmacology - I	03	03
3.3	Pharmacognosy & Phytochemistry	03	03
3.4	Pharmaceutical Biotechnology	03	03
3.5	Quality Assurance	03	-
3.6	Biopharmaceutics & Pharmacokinetics	03	-
	Total number of Working hours	18	12
	Grand Total		30 hours

3.1: Medicinal Chemistry – I

THEORY

75 Hours (3hrs/week)

I. Basic Principles of Medicinal Chemistry

- A. Introduction, History and development of medicinal chemistry. **2 Hrs**
Fundamental principles of drug therapy
- B. **Physicochemical properties in relation to biological action:** **6 Hrs**
Ionization, Solubility, Partition Coefficient, hydrogen bonding, protein binding, chelation, isosterism, optical and geometrical isomerism, steric effect, redox potential and surface activity.
- C. **Drug metabolism:** **6 Hrs**
General pathways of drug metabolism (different types of reaction in phase-I and phase-II with examples), factors affecting drug metabolism including stereochemical aspects, significance of drug metabolism in medicinal chemistry.

Study of classification, mechanism of action, structure activity relationship physicochemical properties and synthesis of selected drugs (only drugs marked with asterisk) on the following categories of drugs.

II. Drugs acting on CNS

- A. **General anesthetics:** Halothane*, Methoxyflurane*, Enflurane, Sevoflurane, Isoflurane, Desflurane, Methohexital sodium*, Thiomytal sodium*, Thiopental sodium, Etomidate, Propofol, Ketamine hydrochloride*. **2 Hrs**
- B. **Sedatives and Hypnotics** **3 Hrs**
Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide*, Diazepam*, Oxazepam, Chlorazepate Dipotassium, Prazepam, Lorazepam, Halazepam, Flurazepam, Alprazolam, Triazolam,
Barbiturtes: SAR of barbiturates, Barbitol*, Phenobarbital, Mephobarbital, Amobarbital, Butobarbital, Talbutal, Pentobarbital, Secobarbital,
Miscellaneous: Triclofos sodium*, Paraldehyde.
- C. **Antipsychotics** **4 Hrs**
Phenothiazines: SAR of Phenothiazines - Promazine hydrochloride*, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Mesoridazine hydrochloride, , Prochlorperazine maleate*, Trifluoperazine hydrochloride
Ring analogues of phenothiazines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine. **Fluro buterophenones:** Haloperidol, Droperidol, Risperidone.
Beta amino ketones: MolindoneHcl. **Benzamides:** Sulpieride.

D. Anticonvulsants: SAR of Anticonvulsants, mechanism of anticonvulsant action. **3 hrs**

Hydantoins: Phenytoin*, Mephentyoin, Ethotoin,

Oxazolidine diones: Trimethadione*, Paramethadione,

Succinimides: Phensuximide, Methsuximide, Ethosuximide*,

Urea and monoacylureas: Phenacemide, Carbamazepine*,

Benzodiazepines: Clonazepam.

Miscellaneous: Primidone, Valproic acid* , Gabapentin, Felbamate

E. CNS stimulants

Analeptics- Nikethamide*, Doxapram hydrochloride, Pentylentetrazole, Caffeine, Theophylline, Theobromine **1 Hr**

Psychomotor stimulants- Amphetamine, Dextroamphetamine sulphate*, Methamphetamine, Chorphentermine, Chlortermine., Phendimetrazine, Methylphenidate, Pemoline **2 Hrs**

MAO inhibitors- Phenelzine sulphate, Isocarboxazid, Tranylcypromine, Pargyline hydrochloride. **1 Hr**

Tricyclic anti-depressants - Amitriptyline hydrochloride*, Nor tryptiline, Imipramine hydrochloride*, Desipramine hydrochloride, Trimipramine maleate, Doxepin hydrochloride, Amoxapine, Fluoxetine. **2 Hrs**

III. Drugs acting on Autonomic Nervous System

A. Adrenergic Neurotransmitters: Structure and physiochemical properties, biosynthesis and metabolism. **2 Hrs**

Adrenergic receptors: alpha and beta- adrenergic receptors, their distribution in the human body.

B. Sympathomimetic agents: SAR of Sympathomimetic agents. **3 Hrs**

Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyl dopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline*, Salmeterol, Salbutamol*, Bitolterol, Albuterol, Ritodrine, Naphazoline, Tetrahydrozoline, Oxymetazoline and Xylometazoline.

Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine.

Agents with mixed mechanism: Ephedrine*, Metaraminol.

C. Adrenergic Antagonists: **3 Hrs**

Alpha adrenergic blockers: Tolazoline*, Phentolamine*, Phenoxybenzamine, Prazosin, Tetrozolin, Doxazosin, Ergotamine, Methysergide.

Beta adrenergic blockers: SAR of beta blockers, Propranolol*, Dichloroisoproterenol, Practolol, Metibranolol, Acebutolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol and Carvedilol.

D. Cholinergic drugs and related agents: 5 Hrs

Cholinergic neurotransmitters: function, structure, biosynthesis and metabolism of acetylcholine. Cholinergic receptors: muscarinic and nicotinic receptors, their distribution in the human body

Direct acting agents: SAR, Acetylcholine*, Carbachol*, Bethanechol, Methacholine, Pilocarpine,

Cholinesterase inhibitors: Physostigmine, Neostigmine, Pyridostigmine*, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Pralidoxime chloride, Isoflurophate, Echothiophate iodide, Parathione, Malathion.

E. Cholinergic Blocking agents: 4 Hrs

SAR of cholinolytic agents.

Solanaceous alkaloids and analogues: Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrogenbromide, Homatropine hydrogenbromide*, Ipratropium bromide*.

Synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, and Ethopropazine hydrochloride

IV. Drugs acting on Cardiovascular System 3 Hrs

A. Anti-anginal: Vasodilators: Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole. **Cardiotonics:** Digoxin, Digitoxin, Deslanoside.

Calcium channel blockers: Verapamil, Diltiazem hydrochloride, Nifedipine, Amlodipine, Bepridil hydrochloride, Felodipine, Nicardipine, Nimodipone.

B. Anti-arrythmic Drugs: 2 Hrs

Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride Mexiletine hydrochloride, , Lorcaïnide hydrochloride, amiodarone and Sotalol.

C. Anti-hypertensive Agents: 3 Hrs

Propranolol, timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidine monosulphate*, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil. Reserpine, Hydralazine hydrochloride

- D. Diuretics: 5 Hrs**
1. **Carbonic anhydrase inhibitors:** Acetazolamide*, Methazolamide, Dichlorphenamide.
 2. **Thiazides:** Chlorthiazide*, Hydrochlorothiazide*, Hydroflumethiazide, Cyclothiazide,
 3. **Loop diuretics:** Furosemide*, Bumetanide, Ethacrynic acid.
 4. **Potassium sparing Diuretics:** Spironolactone, Triamterene, Amiloride*
 5. **Miscellaneous:** Mannitol, and Theophylline
- E. 3 Hrs**
1. **Anti-hyperlipidemic agents:** Clofibrate, lovastatin, cholesteramine and cholestipol
 2. **Anticoagulants:** Warferin*, phenindione.
 3. **Synthetic hypoglycemic agents:** tolbutamide, metformin, glipizide, pioglitazone, acarabose
- V. 3 Hrs**
- Local Anesthetics:** SAR of Local anaesthetics; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine, Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate, Lignocaine*, Mepivacaine, Prilocaine, Etidocaine, Phenacaine, Dipiperodon, Dibucaine* and Dyclonine.
- VI. Analgesics, antipyretics and anti-inflammatory drugs 4 Hrs**
- A. Morphine and related drugs:** SAR of morphine analogues; Morphine sulphate, Codeine phosphate. Hydromorphone hydrochloride, Meperidine hydrochloride*, Alphaprodine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate, **Narcotic antagonists:** Nalorphine hydrochloride, Levallorphan tartarate and Naloxone hydrochloride,
- Anti-tussives:** Noscapine, Dextromethorphan hydrobromide and Benzonatate, Carbetapentane.
- B. Anti-inflammatory agents: 3 Hrs**
- Sodium salicylate, Aspirin, Salsalate*, Mefenamic acid, Meclofenamate sodium, Indomethacin*, Sulindac, Tolmetin sodium, Zomepriac sodium, Diclofenac sodium, Ketorolac, Ibuprofen*, Naproxen*, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Aminopyrine, Phenylbutazone* and Oxyphenbutazone.

3.1: Medicinal Chemistry – I (Practicals)

3 Hours/Week

1. Preparation of medicinally important compounds or intermediates required for synthesis of drugs (10 drugs)

1. Phenothiazine from Diphenylamine
 2. Phenytoin from Benzoin.
 3. Paracetamol from P-amino phenol.
 4. Benzocaine from PABA.
 5. 4-hydroxy coumarin from resorcinol.
 6. Mefenamic acid from anthranilic acid.
 7. 1,4 - Napthoquinone from naphthalene.
 8. 2,4,5 Triphenyl imidazole from Benzoin,
 9. Cinnamic acid from Perkin's reaction.
 10. Aryloxy acetic acid from phenols
 11. o-iodo benzoic acid from anthranilic acid
 12. Dimethyl amino propiophenone from acetophenone
2. Monograph analysis of selected drugs from course content (5 experiments)
3. Assay of Selected drugs from course content prescribed as per I.P or B.P. (8 drugs)
1. Assay of Ibuprofen by alkalimetry.
 2. Assay of Diclofenac by alkalimetry
 3. Assay of Analgin by Iodimetry.
 4. Assay of Ephedrine hydrochloride by non aqueous titrimetry.
 5. Assay of Phenobarbitone by non aqueous titrimetry.
 6. Assay of Procaine or Benzocaine by diazotization.
 7. Assay of Chlorpromazine by cerimetry.

Recommended Books

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry, 11th edition.
2. Foye's Principles of Medicinal Chemistry, 5th edition.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences, 20th edition.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia 1996 and 2007 editions.
10. Text book of practical organic chemistry- A.I.Vogel, 5th edition.

3.2: Pharmacology

THEORY

75 Hours

1. General Pharmacology

20 Hrs

- a. Introduction to Pharmacology- Definition, scope and various branches, source of drugs, dosage form and routes of drug administration.
- b. Pharmacodynamics-Mechanism of drug action, Receptors, classification and drug receptors interaction, combined effect of drugs, factors modifying drug action.
- c. Pharmacokinetics-Mechanism and principle of Absorption, Distribution, Metabolism and Excretion of drugs. Principles of basic and clinical pharmacokinetics.
- d. Pharmacogenetics
- e. Adverse drug reactions, Drug interactions
- f. Discovery and development of new drugs-Preclinical and clinical studies.

2. Pharmacology of Peripheral Nervous system

12 Hrs

- a. Neurohumoral transmission (Autonomic and somatic).
- b. Parasympathomimetics, Parasympatholytics, Sympathomimetics, Sympatholytics, Ganglionic stimulants and blockers.
- c. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).
- d. Local anesthetic agents.
- e. Drugs used in Myasthenia Gravis and Alzheimer's disease.

3. Pharmacology of Central Nervous System

21 Hrs

- a. Neurohumoral transmission in the C.N.S with special emphasis on Pharmacology of various neurotransmitters.
- b. General anesthetics.
- c. Alcohols and disulfiram.
- d. Sedatives, hypnotics and centrally acting muscle relaxants
- e. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens.
- f. Anti-epileptic drugs.
- g. Anti-parkinsonism drugs.
- h. Narcotic analgesics and antagonists.
- i. C.N.S stimulants and Nootropics.
- j. Drug addiction, drug abuse, tolerance and dependence.

- 4. Pharmacology of Cardiovascular system** **16 Hrs**
- a. Introduction of haemodynamics and Electrophysiology of heart.
 - b. Anti-hypertensive drugs.
 - c. Anti-anginal.
 - d. Anti-arrhythmic drugs.
 - e. Drugs used in congestive heart failure.
 - f. Anti-hyperlipidemic drugs.
 - g. Drug used in the therapy of shock.
 - h. Haematinics, anticoagulants and haemostatic agents
 - i. Fibrinolytics and antiplatelet drugs
 - j. Blood and plasma volume expanders.
- 5. Drugs acting on Urinary system** **3 Hrs**
- Diuretics and anti-diuretics.
- 6. Drugs acting on Respiratory system** **3 Hrs**
- a. Anti-asthmatic drugs.
 - b. Anti-tussives and expectorants.
 - c. Respiratory stimulants.
 - d. Mucolytics and nasal decongestants

3.2: Pharmacology I (Practical)

3 Hours/Week

1. a. Commonly used instruments in experimental pharmacology.
b. Common laboratory animals and anesthetics used for animal studies.
c. Some common and standard techniques. Bleeding and intravenous injection, intra-gastric administration, Procedures for rendering animal unconscious and chemical euthanasia.
2. Study of different routes of drugs administration in mice/rats.
3. To study the effect of hepatic microsomal enzyme inhibitors and inducers on the phenobarbitone sleeping time in mice.
4. Experiments on Central nervous system: Recording of spontaneous motor activity, stereotype activity, anti-catatonic activity, analgesic activity, anticonvulsant activity, anti-inflammatory activity and skeletal muscle relaxant activity of drugs.
5. Local anesthetic activity screening by suitable animal model.
6. Effect of autonomic drugs on rabbit's eye.
7. Experiments based on computer models like Expharm.
8. Statistical calculations in experimental pharmacology
 - a. Students-t-test,
 - b. ANOVA

Recommended Books

1. Pharmacology by Rang. M.P. Dale, M.M, Reter J.M.
2. Pharmacology and Pharmacotherapeutics by Satoskar R.S and Bhandarkar S.D.
3. Goodman and Gilman's, The pharmacological basis of therapeutics by Gillman G, Rall T.W., Nies A.I.S., and Taylor P.
4. Hand book of Experimental Pharmacology by Kulkarni.S.K.
5. Chronopharmacology by B. Lammer.
6. Topics of Molecular Pharmacology I and II by Nurger and Roberts.
7. Essentials of medical pharmacology by K.D.Tripathi.
8. Essentials of Pharmacotherapeutics by F. S. K. Barar.
9. Basic & Clinical Pharmacology by Katzung B.G.
10. Lippincott's illustrated Reviews- Pharmacology by Mycek M.J, Gelnet S.B and Perper M.M.
11. Fundamentals of Experimental Pharmacology by M. N. Ghosh.
12. Pharmacological Experiments on intact preparations by Macleod L.J.
13. Drug Discovery and evaluation by Vogel H.G.

3.3: Pharmacognosy & Phytochemistry

THEORY

75 Hours

1. Definition, History, present status, future scope & Development of Pharmacognosy **2 Hrs**
2. Classification of crude drugs: Alphabetical, biological, chemical, taxonomical, pharmacological, chemotaxonomical & serotaxonomical. **4 Hrs**
3. Cultivation, collection, processing & storage of crude drugs **15 Hrs**
 - General principle of cultivation & collection of vegetable drugs of commercial significance from wild & cultivated source.
 - Advantages & disadvantages of cultivation.
 - Factors influencing cultivation of medicinal plants, types of soils & fertilizers of common use.
 - Plant hormones & their applications.
 - Polyploidy, Mutation & Hybridization with special reference to Medicinal plants.
 - Collection of crude drugs.
 - Processing, storage & preservation of crude drugs.
 - Export potential of herbal drugs and medicinal plants
4. Quality Control of crude drugs. Adulteration of crude drugs & their detection by evaluation methods. **4 Hrs**
5. Conservation of medicinal plants **3 Hrs**
6. Detailed study of crude drugs, emphasis on source, cultivation, collection, preparation, storage, diagnostic characters (Macroscopic & Microscopic technique applicable) constituents chemical tests substitutes, adulterants & uses **30 Hrs**
 - a. Carbohydrates and their derived products : Agar, Gum Acacia, Gum tragacanth, Honey, Ispagol, Pectin, Starch. Bael
 - b. Tannins : Black Catechu, Myroblalan, Pale catechu, Tannin acid. Ashoka
 - c. Lipids : Castor oil. Shark liver oil, Wool fat, Bees wax, Cod liver oil, Olive oil Sesame oil, Chaulmoogra oil
 - d. Proteins : Gelatin and spirulina
 - e. Volatile oils : Mentha, Coriander, Cinnamon, Caraway, Dill, Clove, Fennel, Cardamom Lemon grass oil, Eucalyptus , Sandal wood, Citrus oil, Rasana, Lehsun

f. Saponins:	Dioscoria, Gokhru, Liquorice, Genseng, Bacopa, Centella	
g. Cardio active sterols :	Digitalis, Squill, Stropanthus and Arjuna	
h. Anthraquinones	Aloes, Senna, Rhubarb, and Cascara.	
i. Pyridine Piperidine :	Areca and Lobelia	
j. Tropane :	Belladonna, Hyoscyamus, Datura, Aswagantha	
k. Quiniline and Isoquinoline:	Cinchona, Ipecac and Opium	
l. Indole :	Ergot, Rauwolfia and Nuxvomica, Adathoda.sp.	
m. Imidazole :	Pilocarpus	
n. Steroidal :	Kurchi, Punarnava, Shankupusphi	
o. Alkaloidal amines :	Ephedra and Colchicum	
p. Purines :	Tea	
q. Resins :	Guggul, Colophony, Cannabis, Capsicum, Balsam of Tolu, Benzoin, Balsum of Peru, Asafoetida, Turmeric and Ginger.	
r. Others :	Gentian, Saffron, Pyrethrum, Lycopodium	
7.	Tumor inhibitors : Taxol, Vinca and Podophyllum	3 Hrs
8.	Anti hepatotoxic and oral hypoglycemic agents: Phyllanthus, Gymnema and Methi	3 Hrs
9.	Plant fibers used as surgical dressings: Cotton, Silk, Wool, Nylon, rayon, Alginate dressing gelatin sponge, oxidized cellulose Sutures – surgical catguts and ligatures.	6 Hrs
10.	Pharmaceutical aids : Talc, Kaolin, Bentonite, Kieselguhr	5 Hrs

3.3: Pharmacognosy & Phytochemistry (Practicals)

3 Hours/Week

01. Determination of stomatal number and stomatal index
02. Determination of dimension of starch grains.
03. Determination of length and width of phloem fibers.
04. Determination of vein islet and vein termination numbers.
05. Determination of purity of ginger powder using lycopodium spore method
06. Microscopical studies of some selected powdered drugs of single and mixture of two components. Cinchona, Cinnamon, Senna, Digitalis, Rauwolfia, Liquorice, Ipecac, Clove, Nuxvomica, Rhubarb, Squill, Ephedra, Kurchi, Fennel and Coriander
07. Microscopical studies of some selected drug:
Cinchona, Cinnamon, Datura, Senna, Digitalis, Rauwolfia, Liquorice, Clove, Ginger, Nuxvomica, Ephedra, Liquorice, Fennel and Coriander
08. Study of Morphology of drugs:
 - (i) Strophanthus (ii) Squill (iii) Rhubarb (iv) Cascara
 - (v) Ginseng (vi) Liquorice (vii) Senna (viii) Wild cherry bark
 - (ix) Bitter almonds (x) Cinchona (xi) Ipecac (xii) Rauwolfia
 - (xiii) Ergot (xiv) Nuxvomica (xv) Vinca (xvi) Aconite
 - (xvii) Kurchi (xviii) Ephedra (xix) Colchicum (xx) Fennel
09. Analysis of crude drugs by chemical tests:
 - i) Asafoetida (ii) Benzoin (iii) Acacia
 - (iv) Pale Catechu (v) Black catechu (vi) Aloes (vii) Honey

Recommended Books

1. Pharmacognosy: Varro.E.Tyler. Lynn. R. Brady, James E. Robgers.
2. Text book of pharmacognosy by T.E.Wallis.
3. Study of crude drugs by Iyerger.
4. Powder crude drugs by Iyerger
5. Chemistry of organic natural products vol. I and II by O.P. Agarwal.
6. Practical pharmaceutical chemistry by Backett and Stanlake
7. Indian herbal pharmacopoeia and British herbal pharmacopoeia
8. Anatomy of crude drugs by M.A. Iyengar
9. Text book of Pharmacognosy –Ed.3-Kokate.
10. Pharmacognosy Pharmacobiotechnology- James Bobbers, Marilyn K, Speedice & verro E. Tylor.
11. Drug plant resources of central Indian Inventory –srivastava.

3.4: Pharmaceutical Biotechnology

THEORY		75 Hours
I	Microbiology	15 Hrs
	<ol style="list-style-type: none">1. Introduction to Microbiology: Scope of Microbiology, Microbes of Medicinal interest, study of mode of Transmission & treatment of Microbial diseases like Cholera, Typhoid, Tuberculosis, Diphtheria, Tetanus, Syphilis & AIDS.2. Classification, Morphology and fine structure Bacteria, Fungi, Viruses.3. Methods of isolation and identification of bacteria - staining techniques and bio chemical reactions. Total & viable counting techniques of bacteria4. Growth and cultivation, Their Nutritional requirements.5. Media-differential, enriched, selective. Maintenance of lab culture	
II	Sterilization	10 Hrs
	<ol style="list-style-type: none">1. Detail study of different methods of sterilization including their merits and demerits.2. Detailed study of sterility testing of different pharmaceutical preparations.3. Disinfectant: study of disinfectant. Factors affecting their action and evaluation of bactericidal & Bacteriostatic.4. Principles and methods of different microbiological assays including sensitivity testing with references to ciprofloxacin, streptomycin & vitamin B₁₂.	
III	Microbial Genetics	10 Hrs
	<ol style="list-style-type: none">1. Genetic organization of Eukaryotes and Prokaryotes2. Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.3. Introduction to Microbial biotransformation, Biotransformation of steroids and production of single cell protein.	
IV	Molecular Biology and Engineering	10 Hrs
	<ol style="list-style-type: none">1. Study of cloning vectors, restricted endonucleases and DNA ligase.2. Application of r DNA technology and genetic engineering in the products:<ol style="list-style-type: none">a) Interferonb) Vaccines- hepatitis- Bc) Hormones- Insulin.	
V	Bio process technology	6 Hrs
	<ol style="list-style-type: none">1. Introduction to fermentation technology, study, design and operation of fermenter.2. Bioprocess of the following metabolites: Alcohol, Citric acid, Penicillin, Griseofulvin, Vitamin B₁₂, and Glutamic acid.	

VI	Enzyme biotechnology	6 Hrs
	<ol style="list-style-type: none"> 1. Introduction, classification and uses. 2. Techniques of immobilization. 3. Application, biosensors and their application. 4. Production of amylase, Catalase, peroxidase, lipase, Protease Streptokinase, penicillinase 5. Immobilization techniques. 	
VII	Immunology and Immune Biotechnology	15 Hrs
	<ol style="list-style-type: none"> 1. Introduction, types of Immunity, antigen and haptens, antigen- antibody reactions, complementary systems, structure and function of MHC, antigen recognition and presentation, hypersensitivity, Hypersensitivity response, immuno stimulation and suppression and Auto immune disorders. 2. Immunization – Definition, types, preparation, standardization and application of official vaccines, containerization, storage conditions and stability of official vaccines. 3. Hybridoma technology: Introduction, Techniques of production and purification of monoclonal antibodies. Application of monoclonal antibodies. 4. Immuno blotting techniques such ELISA, Western Blot, southern blot. 	
VIII	Animal Biotechnology	3 Hrs
	<p>Introduction to animal tissue culture, characters, general procedure for the maintenance of cell culture, Nutritional requirements, Primary and established cell culture and application of animal tissue culture.</p>	

3.4: Pharmaceutical Biotechnology (Practicals)

3 Hours/Week

MICROBIOLOGY:

1. Study of apparatus used in experimental microbiology.
2. **Sterilization techniques** – Glasswares, media, Room.
3. Preparation of Media.
4. **Isolation techniques**– Streak plate, Pour plate, spread plate techniques
5. **Staining techniques**- Simple staining Gram's staining, Acid fast staining, Spore staining, flagella staining, Capsule staining.
6. a) Total and viable count of Microorganisms.
7. b) Motility of the microorganism by Hanging drop method.
8. Bacteriological analysis of water by MPN techniques.
9. Sterility testing for Pharmaceutical products.
10. Microbiological assay of antibiotics.
11. Biochemical test (IMViC reactions).

BIOPROCESS:

1. Production of alcohol and wine by fermentation process.
2. Immobilization techniques – Whole cells, Enzymes
3. Isolation of protein from the microorganism.
4. Estimation of protein by Lowry's method.

BIOTECHNOLOGY

1. Isolation of plasmid by electrophoresis.
2. Isolation and estimation of DNA by spectroscopy.
3. Isolation and estimation of RNA by spectroscopy.

Recommended Books

1. Microbiology by Pelzer, Krieg and Chan.
2. Essential and applications of Microbiology by Judy Kandal.
3. Microbial Genetics by David Freifeider.
4. Microbiology by Prescott.
5. General Microbiology by R.Y. Stainer.
6. Text Book of Microbiology by Ananthanarayan and Paniker.
7. Immunology by Weir
8. Immunology by Ivan Roitt.
9. Microbiology – A laboratory manual by James g. Cappuchino.
10. Laboratory Microbiology by L. Jack Bradshaw.
11. Practical Medical Microbiology – Mackie and Mc Cartney.
12. Pharmaceutical Microbiology by Hugo and Russell.
13. Text Book of Biotechnology by Vyas and Dixit.
14. Text Book of Biotechnology by R.C. Dubey.
15. Principle of Gene Manipulation by S.B. Primrose.
16. Text book of Fermentation technology by Stanbury.
17. Industrial Microbiology by L.E. Casida.
18. Biochemical Engineering by Webb and Steel.
19. Microbial Technology by Pepler Vol .I and II.
20. Gene V and VI by Benjamin Lewin.

3.5: Quality Assurance

THEORY	75 Hours
1. Concept and philosophy of TQM, GMP, ICH guidelines, ISO 9000	08 Hrs
2. Organization and personnel: Personnel responsibilities, training, hygiene and personal records.	04 Hrs
3. Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.	05 Hrs
4. Equipments and raw materials: Equipments selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.	07 Hrs
5. Quality control test for containers, closers, caps and secondary packing materials.	06 Hrs
6. Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.	08 Hrs
7. Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.	04 Hrs
8. Warehousing: Good warehousing practice, materials management.	04 Hrs
9. Responsibilities of quality control laboratory- GLP, Standard test procedures, protocols for clinical and non - clinical testing and control on animal houses. Application of computers in quality control and quality assurance laboratory.	10 Hrs
10. Calibration and Validation: Calibration and Validation of analytical equipments, Validation of analytical procedures.	03 Hrs
11. WHO & NABL certification and licensing and accreditation procedure for drug industry. Patent regime and intellectual property rights.	08 Hrs
12. Regulatory affairs: Regulatory aspects in India, US-FDA, and European commissions and GATT policy.	08 Hrs

Recommended Books

- 1) Quality Assurance Guide by organization of Pharmaceutical Products of India.
- 2) Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.
- 3) Quality Assurance of Pharmaceuticals- A compedium of Guide lines and Related materials Vol I WHO Publications.
- 4) A guide to total Quality Management- Kushik Maitra and Sedhan K Ghosh
- 5) How to Practice GMP's – P P Sharma.
- 6) ISO 9000 and Total Quality Management – Sadhank G Ghosh
- 7) The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms
- 8) Good laboratory Practices – Marshall Deckker Series
- 9) ICH guidelines, ISO 9000
- 10) Dr. A. Pillani – the drugs and cosmetics act 1940.

3.6: Biopharmaceutics & Pharmacokinetics

THEORY		75 Hours
1.	Biopharmaceutics: Definitions, and Role in Product Development, Explanation of the Terms: Bioavailability, and Bioequivalence, Equivalence Types: Chemical, Clinical, Therapeutic, Generic, and Pharmaceutical Alternatives	5 Hrs
2.	Principles of Drugs Dissolution related to Bioavailability Dissolution of solids: Mechanisms & Models of Dissolution, Factors influencing Dissolution Rate (<i>in vitro</i> Release), Quantitative Study of Dissolution- Methods, <i>In-vitro</i> Dissolution & Interpretation of Dissolution Data. Dissolution of Tablets & Capsules. Disintegration & Factors affecting DT. <i>In vitro- In vivo</i> correlations.	15 Hrs
3.	Principles of Drug Absorption related to Bio-Availability i. Physico- Chemical Factors: Lipid Solubility, Dissociation & pH, Complexation & Surface -active agents, and Donnan Membrane Equilibrium ii. Pharmaceutical Factors: Dosage Form Types, and Formulation Variables iii. Biological Factors: Passage of Drugs through Natural Membranes, Gastric Emptying & Intestinal Transition, Blood Flow, G.I. -Metabolism & -Degradation, Interactions with Food & Co-administered Drugs, Disease State, and Route of Administration	15 Hrs
4.	Bio-Equivalency – Relevance, Procedure of bio-equivalency testing studies of diff. dosage forms	5 Hrs
5.	Pharmacokinetics Principles of Pharmacokinetics, Concepts of Compartmental Model, Characteristics of One Compartment Model, and One Compartment Model – based Pharmacokinetic Derivations (involving the concepts of (a.) Experimentally Determined Rates, (b.) Methods of Residuals, and (c.) Trapezoidal Rule) for the following modes of Drug Administration: Intra-Venous Administration (Plasma Level & Urinary Excretion Data)-Single Dose, Absorption – Related /Based Administration (Single Dose) - Absorption Rate Constant (k_a), Elimination Rate Constant (K) & Elimination Half - life ($t_{1/2}$), AUC, C_{max} , and t_p . Apparent Volume of Distribution (V_d) & Renal Clearance (Q)- Pharmacokinetic expressions for the above Administration situations.	20 Hrs
6.	Pharmacokinetics Variability -Body wt, Age, Sex, Genetic, factors disease states & dosage adjustment. Dose adjustment in obese, pediatric and geriatric patients. Dose adjustment in renal impairments.	10 Hrs
7.	Multiple dosage regimens: Concept, Accumulation, Persistent, and elimination factors. Calculation of dosage regimen following repetitive iv and oral administration	5 Hrs

Recommended Books

1. Gibaldi : “Biopharmaceutics & Clinical Pharmacokinetics,” 3rd ed., Lea Febiger, 1984.
2. Swarbrick, Ed.: “Current Concepts in Pharmaceutical Sciences (Bio-pharmaceutics),” Lea & Febiger, 1970.
3. Swarbrick, Ed.: “Current Concepts in Pharmaceutical Sciences (Dosage Form Design & Bioavailability),” Lea & Febiger, 1973.
4. Rowland & Tozer: “Clinical Pharmacokinetics (Concepts & Applications),” 3rd ed., Lea & Febiger – Waverly, 1995.
5. Mancheras et al : “Biopharmaceutics of Orally Administered Drugs,” Ellis Horwood (series in Pharmaceutical Technology), 1995
6. Niazi: “Biopharmaceutics & Clinical Pharmacokinetics,” Appleton- Century Crofts , 1979.
7. Notari: “Biopharmaceutics & Clinical Pharmacokinetics (an introduction),” 4th ed. (Revised & Expanded), Marcel Dekker, 1987.
8. Shargel & Yu: “Applied Biopharmaceutics & Pharmacokinetics,” 4th ed., Appleton & Lange, 1999.
9. Gibaldi & Perrier : “Pharmacokinetics,” 2nd ed. (Revised & Expanded), Marcel Dekker (series in Text-Books & Monographs: Swarbrick, Ed., vol.15), 1982.
10. Welling & Tse, Eds: “Pharmacokinetics,” 2nd ed., Marcel Dekker, 1995.
11. Wagner: “Fundamentals of Clinical Pharmacokinetics,” Drug Intelligence Publication
12. Wagner: “Pharmacokinetics for the Pharmaceutical Scientist,” Technomic Publishing
13. Pecile & Resigno: “Pharmacokinetics,” Plenum Press.
14. Ritschel: Hand Book of Basic Pharmacokinetics, Drug Intelligence Publication
15. Winter: Basic Clinical Pharmacokinetics, Applied Therapeutics.
16. Brahmankar & Jaiswal: Biopharmaceutics & Pharmacokinetics (A Treatise), Vallabh Prakashan, 1995.
17. Venkateshwarlu: Fundamentals of Biopharmaceutics & Pharmacokinetics, Paras Publishing, 2000.

JSS University

Sri Shivarathreeswara Nagar, Mysore – 570 015

Fourth year B. Pharm

Sl. No.	Subject	Theory hours / week	Practical hours / week
4.1	Medicinal Chemistry -II	03	03
4.2	Pharmacology - II	03	03
4.3	Advanced Pharmacognosy	03	03
4.4	Formulative and Industrial Pharmacy	03	03
4.5	Instrumental Method of Analysis	03	03
4.6	Pharmacy Practice	03	-
	Total number of Working hours	18	15
	Grand Total		33 hours

4.1: Medicinal Chemistry – II

Theory

75 hours.

- I. Principles of drug design**
- A Classical Methods:** - Traditional analog Quantitative Structure Activity Relationship (QSAR). **2 Hrs**
- B Modern Methods:** Application of quantum mechanics, computer aided drug designing (CADD) and molecular modeling. **3 Hrs**
- II. Drug latentiation and Prodrugs:** Basic concepts and application of prodrugs design. **3 Hrs**
- III. Combinatorial Chemistry:** History and development; solid phase and solution phase methods; Applications of combinatorial chemistry. **2 Hrs**
- Classification, mode of action (biochemical and molecular basis wherever applicable)**
Structure activity relationship including physiochemical and stereo chemical properties and synthesis of selected drugs (Drugs marked with asterisk only) in the following categories.
- IV. Anti-infective agents**
- A. Local anti-infective agents:** Ethyl alcohol, Isopropyl alcohol, Formaldehyde, Sodium glutaraldehyde solution, Liquified phenol, Hexachlorophene*, Eugenol, Hexyl resorcinol, Anthralin, Hydrous benzoylperoxide, Halazone*, Benzalkonium chloride*, Methylbenzethonium chloride*, Cetylpyridinium chloride, Chlorhexidine gluconate*, Gentianviolet, Methylene blue, Thiomersal, Methyl paraben and Sodium benzoate. **4 Hrs**
- B. Antifungal agents:** **3 Hrs**
- 1. Antifungal antibiotics:** Amphotericin-B, Nystatin, Natamycin and Griseofulvin
 - 2. Synthetic Antifungal agents:** Clotrimazole, Econazole nitrate, Butoconazole, Oxiconazole nitrate, Tioconazole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*, Cyclopiroxolamine.
- C. Urinary tract anti-infective agents**
- Quinolones:** SAR of quinolones. Nalidixic Acid*, Cinoxacin, Norfloxacin, Enoxacin, Ciprofloxacin, Ofloxacin, Lomefloxacin, Sparfloxacin, **2 Hrs**
- Miscellaneous:** Furazolidine, Nitrofurantoin* and Methanamine.
- D. Anti-tubercular Agents** **2 Hrs**
- 1. Synthetic anti tubercular agents:** INH*, Ethionamide, ethambutol, Pyrazinamide, Para amino salicylic acid*
 - 2. Anti tubercular antibiotics** Rifampicin, Rifabutin, Cycloserine* and Sterile capreomycin sulphate.

E.	Anti-protozoal Agents: Metronidazole*, Diloxanide*, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine, Dimercaprol*	1 Hr
F.	Anthelmintics: Piperazine salts*, Diethylcarbamazine citrate*, Thiabendazole*, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantel and Ivermectin.	1 Hr
G.	Anti-scabious and Anti-pedicular Agents: Benzyl Benzoate*, Lindane* (Gamaxene), Crothamiton* and Permethrin.	1 Hr
V.	Antimalarials: Etiology of malaria, SAR	4 Hrs
1.	Quinolines: Quinine sulphate, Chloroquine phosphate*, Hydroxy chloroquine sulphate, Amodiaquine hydrochloride*, Primaquine phosphate, Quinacrine hydrochloride, Mefloquine	
2.	Biguanides and dihydro triazines: , Cycloguanil pamoate, proguanil	
3.	Miscellaneous: Pyrimethamine, Trimethoprim and Sulfadoxine	
VI.	Antibiotics Historical background, current status , Nomenclature, stereochemistry, Structure activity relationship, chemical degradation classification and important products of the following classes.	
	Penicillins	4 Hrs
	Cephalosporins	2 Hrs
	Aminoglycosides	2 Hrs
	Tetracyclines	2 Hrs
	Macrolide antibiotics	1 Hr
	Lincomycins and polypeptides	2 Hrs
	Chloromphenicol*	1 Hr
VII.	Antiviral agents: types of virus; stages of viral infection; targets for prevention of viral infections. Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Foscarnet sodium, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Ribavirin, Saquinavir, Indinavir and Ritonavir.	3 Hrs
VIII.	Anti-neoplastic agents	5 Hrs
1.	Alkylating agents: Meclorothamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa, Procarbazine	
2.	Antimetabolites: Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine	
3.	Antibiotics: Dactinomycin, Daunorubicin hydrochloride, Doxorubicin hydrochloride, Idarubicin hydrochloride, Bleomycin sulphate, Mitomycin, Plicamycin	
4.	Plant products: Etoposide, Vinblastin sulphate, Vincristin sulphate	
5.	Miscellaneous: Cisplatin, Hydroxy urea, Pipobroman, Mitotane and Dromostanolone propionate.	

- IX. Sulphonamides and Sulphones** **4 Hrs**
1. Historical development, chemistry, classification and SAR of sulfonamides: Sulphamethizole, sulfisoxazole, sulphamethizine, sulfacetamide sodium*, sulphapyridine, sulfamethoxazole*, sulphadiazine, mixed sulfonamides, mafenide acetate, silver sulfadiazine, sulfasalazine
 2. Folate reductase inhibitors: Trimethoprim*, cotrimoxazole.
 3. Sulfones: Dapsone* and solapsone.
- X. Antihistaminic agents:** Histamine, receptors and their distribution in the human body **6 Hrs**
- H₁ – antagonists:** Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamine Succinate, Carbinoxamine maleate, Clemastine fumarate, Diphenylpyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride*, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride*, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Acrivastine, Cromolyn sodium
- H₂-antagonists:** Cimetidine*, Famotidine, Ranitidine, Nizatidine
- Gastric Proton pump inhibitors:** Omeprazole and Lansoprazole.
- XI. Prostaglandins and other eicosanoids:** History and discovery; eicosanoid biosynthesis; drug action mediated by eicosanoids; design of eicosanoid drugs; eicosanoids approved for human clinical use. **5 Hrs**
- XII. Chemistry of Bio-molecules of Pharmaceutical importance** **10 Hrs**
- A) **Alkaloids:** Classification, general methods of structural elucidation. Structural elucidation of atropine, morphine and ephedrine.
 - B) **Terpenoids:** Classification, general methods of determining the structure, chemistry and uses of citral, menthol, thymol, camphor, alpha-terpineol and alpha-pinene.
 - C). **Purines:** A brief account of chemistry and structural elucidation of uric acid, caffeine. Interrelationship of methyl xanthines.

4.1: Medicinal Chemistry – II (Practicals)

3 Hours/Week

I) Assay of medicinal compounds (at least 5 experiments)

1. Sulpha drug by diazotisation.
2. Chloroquine by non aqueous titration.
3. Ascorbic acid by iodimetry
4. Isonicotinic acid hydrazide by bromometry
5. Benzyl penicillin by iodometry.
6. Metronidazole by non aqueous titration.
7. Dapsone by diazotisation.

II) a) Preparation of medicinally important compounds or intermediates required for synthesis of drugs. (At least 08 experiments)

1. 2-methyl benzimidazole from o-phenylene diamine.
2. 2,3, diphenyl - Quinaxaline from o-phenylene diamine
3. Benzotriazole from o-phenylene diamine.
4. PAS from p-nitro salicylic acid
5. Fluorescein from phthalic anhydride
6. Eosin from Fluorescein
7. Sulphacetamide from Sulphanilamide
8. Sulphanilamide from Acetanilide.
9. Methaqualone from anthranilic acid
10. Benzyl alcohol by cannizoro's reaction.
11. INH from Gamma picoline
12. Chlorobutanol.

- b) Preparation of medicinally important compounds or intermediates required for synthesis of drugs by Microwave irradiation technique. (02 experiments)**
- c) Monograph analysis of selected drugs from course content (5 experiments)**
- d) Determination of partition co-efficient, dissociation constant and molar refractivity of compounds for QSAR analysis (at least 3 experiments).**
- e) Degradation of medicinally important natural compounds (caffeine or ephedrine)**

Recommended Books

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry, 11th edition.
2. Foye's Principles of Medicinal Chemistry, 5th edition.
3. Burger's Medicinal Chemistry, Vol I to IV, 4th edition.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences, 20th edition.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia 1996 and 2007 editions.
10. Text book of practical organic chemistry- A.I.Vogel, 5th edition.

4.2: Pharmacology – II

Theory	75 hours.
I. Pharmacology of Endocrine system	19 Hrs
a. Basic concepts in endocrine pharmacology.	
b. Hypothalamic and pituitary hormones.	
c. Thyroid hormones and antithyroid drugs, parathormone, calcitonin and vitamin-D.	
d. Insulin, Oral hypoglycemic agents and glucagon.	
e. ACTH and corticosteroids.	
f. Androgens and anabolic steroids.	
g. Estrogens, progesterone and oral contraceptives.	
h. Drugs acting on the uterus.	
II. Pharmacology of Drugs acting on the Gastrointestinal Tract	08 Hrs
a. Antacids, anti-secretory and antiulcer drugs.	
b. Laxatives and antidiarrheal drugs.	
c. Appetite stimulants and suppressants.	
d. Digestants and carminatives	
e. Emetics and antiemetics.	
III. Chemotherapy	24 Hrs
a. General Principles of chemotherapy.	
b. Sulfonamides and co-trimoxazole.	
c. Antibiotics- Penicillins, Cephalosporins, Chloramphenicol, Macrolides, Quinolines and Fluoroquinolins, Quinolones, Tetracyclines, Aminoglycosides and Miscellaneous Antibiotics.	
d. Chemotherapy of tuberculosis, leprosy, fungal diseases, viral diseases, AIDS, protozoal diseases, worm infestations, urinary tract infections and sexually transmitted diseases.	
e. Chemotherapy of malignancy	
IV. Autacoids and their Antagonists	
a. Histamine, 5-HT and their antagonists.	
b. Prostaglandins, Thromboxanes and Leukotrienes.	
c. Pentagastrin, Cholecystokinin, Angiotensin, Bradykinin and Substance P.	
d. Analgesic, anti-pyretic, anti-inflammatory and anti-gout drugs.	

V. Principles of Toxicology	6 Hrs
a. Definition of poison, general principles of treatment of poisoning.	
b. Heavy metals and their antagonists.	
c. Definition for acute, sub acute and chronic toxicity, genotoxicity, carcinogenicity, teratogenicity and mutagenicity studies.	
VI. Chronopharmacology	2 Hrs
Definition of rhythm and cycles. Biological clock and their significance leading to chronotherapy.	
VII. Bioassay	4 Hrs
Principles and methods of bioassay. Bioassay of insulin, oxytocin, vasopressin, ACTH, histamine and 5-HT.	
VIII. Immunopharmacology: Immunostimulants and immunosuppressants.	3 Hrs

4.2: Pharmacology – II (Practicals)

3 Hours/Week

1. Introduction to in-vitro pharmacology and physiological salt solutions.
2. **Experiments on isolated preparations:**
 - a. To record CRC of acetylcholine by using suitable muscle preparations.
 - b. Study of agonistic and antagonistic effects of drugs using suitable muscle preparations.
 - c. To record the CRC of 5HT on rat fundus preparation.
 - d. To record CRC of nor adrenaline on rat anococcygeus muscle preparation.
 - e. To estimate the strength of the test sample of agonist/ drug (e.g. Acetylcholine, Histamine, 5HT, Oxytocin) using a suitable isolated muscle preparation employing matching bioassay, interpolation bioassay, three point bioassay and four point bioassay.
3. **Pharmacology of gastrointestinal tract:**

To study the Antiulcer activity of various drugs by shay rat model.
4. Estimation of bioavailability parameters viz AUC, T_{max} , K_{el} from blood and urine samples in human volunteers or laboratory animals.

Recommended Books

1. Modern Pharmacology by Craig C.R. and Stitzel R.R.
2. Fundamentals of experimental Pharmacology by Ghosh M. N.
3. Basic and clinical Pharmacology by Katzung B.G.
4. Clinical Pharmacology by Laurence D.R. and Bennet P.N.
5. Lippincott's illustrated Reviews- Pharmacology by Mycek M.J, Gelnet S.B and Perper M.M.
6. Pharmacology by Rang M.P., Dale M.M., Reter J.M.
7. Pharmacology and Pharmacotherapeutics by Satoskar R.S. and Bhandarkar S.D.
8. Goodman and Gilman's, The pharmacological basis of therapeutics by Gillman G, Rall T.W., Nies A.I.S., and Taylor P.
9. Hand book of Experimental Pharmacology by S.K. Kulakarni.
10. Chronopharmacology by B. Lammer.
11. Topics of Molecular Pharmacology I and II by Nurger and Roberts.
12. Essentials of Medical Pharmacology by K.D. Tripathi.
13. Pharmacological Experiments on isolated preparations by Macleod L.J.

4.3: Advanced Pharmacognosy

THEORY

75 Hours

1. Modern methods of extraction, application of latest techniques like Spectroscopy, Chromatography and Electrophoresis in the isolation, purification and identification of crude drugs. **11 Hrs**
2. a) Introduction to plant physiology and plant biochemistry with special reference to basic metabolic pathways. **08 Hrs**
b) Introduction to biogenesis of secondary metabolites like Atropine, Morphine and Steroidal glycosides.
c) Study of utilization of radio active isotopes in the investigation of Biogenetic studies.
3. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India, Industrial production and estimation of phytocostituents, **08 Hrs**
Sennosides, cardiac glycosides, Vinca, Menthol, Quinine, Citric acid, Diosgenin, Tropane alkaloids. Glycyrrhizin, Rutin, Phyllanthin and Asiaticoside
4. Pharmacotherapeutics of Natural products **08 Hrs**
 - Biosynthesis of Penicillin, Streptomycin, Floxacins and Rifamycin
 - Antiviral and Anti-HIV drugs
5. Herbal formulation development and standardization **10 Hrs**
 - a. Preparation and stability testing of Herbal extracts
 - b. Role of Herbs in Cosmetics
 - Hair care preparation - Henna , Amla, Hibiscus
 - Skin Care preparation – Aloe vera, Turmeric, Sandal wood
 - c. Nutraceuticals
 - d. WHO and ICH Guidelines for the assessment of Herbal Medicine and Cosmetics
6. Basic principles involved in the alternative system of medicine **08 Hrs**
 - Ayurveda, Siddha, Unani and Homeopathy
 - Preparation and standardization of Ayurvedic formulations i.e., Aristas, Asawas
 - Ghutika, Churna, Lehya and Bhasma.

7. Natural allergens, hallucinogenic, teratogenic and Adverse Drug Reactions of fungal and plant toxins **05 Hrs**
- Natural allergens
 - Classification of allergens
 - Preparation of allergenic extracts
 - Sensitivity testing and treatment of allergy
8. Plant tissue culture: **06 Hrs**
- Historical development, nutritional requirements, growth and their maintenance, applications of plant tissue culture in Pharmacy and Pharmacognosy, and types of cultures related to cell suspension culture, callus culture, hairy root culture and protoplast culture
9. Enzyme Biotechnology **06 Hrs**
- Introduction, general methods of isolation, purification and application of immobilized enzyme in drug analysis.
 - Biological sources, methods of separation, chemical nature and uses of:
 - a. Papain b. Pepsin c. Trypsin
 - d. Pancreatin e. Asparaginase f. Pectinase
10. Biological screening of plant constituents **05 Hrs**
- 1. Anti-inflammatory activity
 - 2. Antioxidant activity
 - 3. Hepatoprotective activity
 - 4. Hypoglycemic activity

4.3: Advanced Pharmacognosy (Practical)

3 Hours/Week

1. Monographic analysis
 - a) Castor oil
 - b) Shark liver oil
 - c) Honey
 - d) Starch
2. Exercise involving isolation of active principles
 - a) Caffeine - from tea dust.
 - b) Citric acid - from lemon
 - c) Casein - from milk.
 - d) Starch - from potato.
3. Marine Pharmacognosy
Identification of biologically active compounds from marine organisms.
4. Chemical assays
 - Aldehyde content of volatile oil
 - Acid value of fixed oil
 - Phenol content of volatile oil
 - Alkaloidal assay of belladonna
 - Eugenol assay of belladonna leaf
 - Cineole content of eucalyptus oil
6. Physical evaluation of powdered drugs
 - Determination of moisture content (Loss on drying)
 - Extractive values
 - Ash values
 - Swelling factors
7. Demonstration of experiments in plant tissue culture.
8. Extraction of volatile oils.
9. Identification of natural product using TLC and paper chromatographic profiles.
10. Preparation and standardization of Ayurveda formulations.
11. Preparation and standardization of herbal products.
12. Preparation of herbal cosmetics
13. Demonstration of experiments in column chromatography.

Recommended Books

1. Pharmacognosy by Trease and Evans 14th and 15th edition.
2. Pharmacognosy Pharmacobiotechnology- James Bobbers, Marilyn K, Speedice & Verro E. Tylor.
3. Herbal Drug Industry R.D.Chowdary.
4. The formulation and preparation of cosmetic, fragrances and flavours.
5. Remington's Pharmaceutical sciences.
6. WHO Guidelines – website <http://www/who.int/druginformation>
7. Standardization of botanicals.
8. Quality Control Herbal Drugs - Pulok K.Mukherjee.
9. Pharmacognosy and Phytochemistry I edition, vol- I &II by Vinod. D. Rangari
10. Practical Pharmacognosy, III edition, C.K. Kokate.

4.4: Formulative and Industrial Pharmacy

THEORY

75 Hours

- 1. Preformulation Studies:** Study of physical/physicochemical properties of drugs like physical form, particle size, shape, density, wetting, dielectric constant, solubility, dissolution, organoleptic properties and their effect on formulation, stability & bioavailability. **5 Hrs**

Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemisation, polymerization etc. and their influence on formulation.
- 2. Tablets:** Classification of different types of tablets, tablets equipments, granulation technology on large scale by various techniques. Tablets tooling, different types of tablets compression machinery, processing problem of tablets and evaluation of tablets. **8 Hrs**

Coating of tablets: Types of coating, Sugar coating, film forming materials, formulation of coating solution, equipment for coating, film defects and evaluation of coated tablets.
- 3. Capsules:** Advantages & disadvantages of capsule dosage form, extraction of gelatin, production of hard gelatin capsules, size of capsules and method of capsule filling. Soft gelatin capsule, Nature of capsule shell & capsule content, importance of base adsorption, minimum gm factors in soft capsules, production, quality control, stability testing and storage of capsule dosage forms. **6 Hrs**
- 4. Parenteral Products:** Preformulation factors, routes of administration, water for injection, pyrogenicity, non-aqueous vehicles, isotonicity & methods of its adjustment. Formulation details, containers and closures and their selection. **8 Hrs**

Prefilling treatment, washing the container and closers, preparation of solution and suspension, filling, closing of ampoules, vials infusion fluids, lyophilization, preparation of sterile powders, equipment for large scale manufacture and evaluation of parenteral products.

Aseptic techniques: Source of contamination, methods of prevention, design of aseptic area, laminar flow bench, air handling units, services and maintenance.
- 5. Microencapsulation:** Types of microcapsules and their importance, microencapsulation by co-acervation phase separation, multi orifice centrifugation, spray drying, spray congealing, polymerization, air suspension, pan coating & other techniques, evaluation of microcapsules. **8 Hrs**
- 6. Herbal Formulations:** Herbal tablets, capsules and liquid orals: selection of ingredients, formulation, quality control, stability studies **4 Hrs**
- 7. Ophthalmic Formulations:** Requirements, formulation of eye drops, eye ointments and introduction to oocusers, containers and evaluation. **4 Hrs**

8. **Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems, manufacture of aerosol, quality control and stability studies. **8 Hrs**
9. **Controlled Delivery Systems:** Principle, Advantages & disadvantages, selection of drug candidates, various approaches to design controlled release formulations, graphical presentation of sustained release, prolonged action, repeated release, controlled release, pulsatile release pharmaceuticals. **4 Hrs**
10. **Novel Drug Delivery Systems:** Transdermal delivery systems, osmotic drug delivery systems, buccal drug delivery systems. **4 Hrs**
11. **Cosmetics:** Formulation and preparation of the following cosmetic preparations: Lipsticks, shampoos, face and talcum powders, nail lacquers, tooth pastes and hair dyes. **8 Hrs**
12. **Stability Studies:** Basic concept and objectives of stability study. **8 Hrs**
13. Order of reaction and their application in predicting shelf life and half life of accelerated stability studies. Importance of accelerated stability study. Effect of various environment/processing on stability of the formulation and techniques for stabilization of products against the same. Regulatory requirements related to stability testing with emphasis on ICH Guidelines, matrixing / bracketing techniques, climatic zone, impurities in stability study, photo stability testing etc. **8 Hrs**

4.4: Formulative and Industrial Pharmacy (Practicals)

3 Hours/Week

1. Preformulation studies on prepared granules
2. Manufacture and evaluation of granules
 - a) ordinary compressed tablet- wet granulation
 - b) tablets prepared by direct compression
 - c) soluble tablet
 - d) chewable tablet
3. Formulation and filling of hard gelatin tablets
4. Manufacture of parenteral
 - a) Ascorbic acid injection
 - b) Calcium gluconate injection
 - c) Sodium chloride injection
 - d) Dextrose and sodium chloride injection/infusion
5. Preparation of microcapsules
 - a) Non-solvent method
 - b) Salt-addition method
6. Cosmetic preparations
 - a) Lipsticks
 - b) Cold cream and vanishing cream
 - c) Clear liquid shampoo
 - d) Tooth paste and tooth powder
7. Tablet coating (demo)

Recommended Books

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

4.5: Instrumental Methods of Analysis

THEORY

75 Hours

1. **UV/Visible spectroscopy**
 - 1.1 Theory of atomic and molecular spectra, Electronic transitions, Beer and Lambert's law, Derivation and deviations, Applications of Beer law to single and multi component systems, Chromophores, Auxochromes, Spectral shifts, Solvent effect on absorption spectra.
Instrumentation - Sources of radiation, wavelength selectors, sample cells, Detectors- Barrier layer cell, Photo tube, Photomultiplier tube, Silicon Photodiode.
Applications - Spectrophotometric titrations, Measurement of equilibrium constant and rate constant. **10 Hrs**
 - 1.2 **IR spectroscopy** – Introduction, Fundamental modes of vibrations in poly atomic molecules. Sample handling, Instrumentation - Sources of radiation, wavelength selectors, sample cells, Detectors – Golay cell, Bolometer, Thermocouple, Thermister, Pyrroelectric detector. Structure - frequency correlation with examples. **4 Hrs**
 - 1.3 **Atomic absorption spectroscopy** - Introduction, Theory, instrumentation, and applications. **2 Hrs**
2.
 - 2.1 **Fluorimetry** – Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching. Instrumentation and applications **3 Hrs**
 - 2.2 **Atomic emission spectroscopy** – Flame emission spectroscopy - Introduction, Theory, Instrumentation, Interferences and applications **3 Hrs**
3. **Nephelometry and Turbidimetry** – Theory, Instrumentation and applications. **2 Hrs**
4. **NMR Spectroscopy** - Principles, Instrumentation and applications. **3 Hrs**
5. **Mass Spectroscopy** - Principles, Fragmentation, Instrumentation, applications. **2 Hrs**
6. **X- Ray diffraction studies** – Introduction, diffraction methods and applications. **2 Hrs**
7. **Chromatography** – Introduction, classifications, various principles of separation, Rate theory and plate theory, concept of band broadening, Van Deemter equation **3 Hrs**
 - 7.1 **Adsorption and partition column chromatography** – Methodology, advantages, disadvantages and applications **2 Hrs**
 - 7.2 **Thin layer chromatography** – Introduction, Principle, Methodology, Stahl's triangle, Rf values, advantages, disadvantages and applications. **2 Hrs**

- 7.3 High Performance Thin Layer Chromatography (HPTLC) – 2 Hrs**
Introduction, instrumentation, advantages, application.
- 7.4 Paper chromatography – 2 Hrs**
Introduction, Principle, Methodology, developmental techniques, advantages, disadvantages, applications.
- 7.5 Ion exchange chromatography – 3 Hrs**
Introduction, Definition, classification, ion exchange resins, properties, mechanism of ion exchange process, Factors affecting ion exchange, methodology, applications.
- 7.6 High Performance Liquid Chromatography (HPLC) – 4 Hrs**
Introduction, theory, instrumentation, advantages and applications.
- 7.7 Gas Chromatography - 5 Hrs**
Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications.
- 7.8 Electrophoresis - 3 Hrs**
Principle of separation, Classification, equipment for moving boundary electrophoresis, gel, paper electrophoresis and applications.
- 7.9 Gel Filtration Chromatography – 2 Hrs**
Introduction, technique, factors affecting, Applications.
- 8. Electro chemical methods of analysis**
- 8.1 Conductometry - 3 Hrs**
Introduction, Conductivity cell, Conductometric titrations, applications.
- 8.2 Potentiometry – 4 Hrs**
Electrochemical cell, construction and working of reference and indicator electrodes, methods to determine end point of titration.
- 8.3 Polarography – 3 Hrs**
Introduction, dropping mercury electrode, construction, working, advantages and disadvantages, ilkovic equation, polarographic maxima, application.
- 9. Quality assurance – 4 Hrs**
Introduction, Importance of quality control, computation of analytical data, sources of quality variation, control of quality variation, validation methods and Total quality management.

4.5: Instrumental Methods of Analysis (Practicals)

3 Hours/Week

1. Separation & identification of amino acids by paper chromatography
2. Separation & identification of alkaloids by TLC
3. Separation & identification of dyes by radial paper chromatography
4. Conductometric titration of Benzoic acid with NaOH
5. Potentiometric titration of HCl with NaOH
6. Estimation of Quinine sulphate by fluorimetry
7. Estimation of riboflavin by fluorimetry
8. Study of quenching effects in fluorimetry by iodide ions
9. Determination of absorption maxima of a compound
10. Colorimetric estimation of ferrous ions using 1, 10 - phenanthroline
11. Colorimetric estimation of Sulphanilamide using BM reagent
12. Assay of Dextrose injection by colorimetry
13. UV spectrometric determination of Ibuprofen
14. Determination of Chloride and Sulphate by Nepheloturbidometry
15. Kinetics of Aspirin hydrolysis
16. Determination of Sodium/Potassium by flame photometry
17. Determination of water content by Karl Fischer electrometric titration method
18. IR interpretation of samples with different functional groups
19. IR, NMR, Mass spectral interpretation of some organic compounds
20. Estimation of organic compound by HPLC method
21. Estimation of organic compound by GC method

Recommended Books

1. Instrumental methods of analysis by Hobarth Willard, Lynne L Merritt and John A Dean, 7th edition, CBC publishers, New Delhi.
2. Kenneth A Connors, A Text Book of Pharmaceutical Analysis, 3rd edition, John Wiley and sons, New York (1982)
3. William Kemp, Spectroscopical methods, ELBS.
4. Indian Pharmacopoeia.
5. United States Pharmacopoeia.
6. British Pharmacopoeia.
7. Higuchi T and Hanssen E.B., Text Book of Pharmaceutical Analysis, A Wiley Interscience Publications.
8. Instrumental methods of chemical analysis by Gurudeep Chatwal and Sham Anand, Himalaya publishing house, 2002.
9. Instrumental methods of chemical analysis by B. K. Sharma, 10th edition, GOEL publishing house, 2002.
10. Principles of instrumental analysis by Douglas A Skoog, F. James Holler, 5th edition, Eastern press, Bangalore, 1998
11. Practical pharmaceutical chemistry by Beckett A. H. and Stenlake J. B., 4th edition, CBS publishers, New Delhi, 1997
12. Spectrometric identification of organic compounds by Robert M Silverstein, G. Clayton and Terence C. Morill, 6th edition, John Wiley and Sons, 2004
13. Quantitative analysis of drugs in Pharmaceutical formulation – P. D. Sethi, 3rd edition, CBS Publishers, New Delhi, 1997.

4.6: Pharmacy Practice

THEORY

75 Hours

Hospital Pharmacy

1. **Hospital and it's organization** **4 Hrs**
Definition of hospital; Classification of hospital- Primary, Secondary and Tertiary hospitals; Classification based on clinical and non- clinical basis; Organization Structure of a Hospital; Medical staffs involved in the hospital and their functions.
2. **Hospital pharmacy and it's organization** **4 Hrs**
Definition of Hospital pharmacy; its organization structure, responsibilities and functions of hospital pharmacists.
3. **Pharmacy and therapeutic committee (PTC)** **3 Hrs**
Pharmacy and therapeutics committee organization and functions; policies of the pharmacy and therapeutic committee in the formulary drug classification, inpatient prescription, outpatient prescription, Adverse drug reaction reporting, research, automatic stop order, emergency drug list preparation.
4. **Budget preparation and implementation.** **2 Hrs**
5. **Hospital formulary (HF)** **3 Hrs**
Definition of hospital formulary; contents of HF; differentiation of HF and Drug list; preparation and revision of hospital formulary; and addition and deletion of drug from HF.
6. **Drug store management and inventory control** **6 Hrs**
 - A) Organization of drug store, types of materials stocked and storage conditions.
 - B) Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking.
 - C) Economic order quantity; Reorder quantity level; Methods used for the analysis of the drug expenditure.
7. **Drug distribution system in a hospital**
 - A) Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labeling.
 - B) Dispensing of drugs to ambulatory patients.
 - C) Dispensing of controlled drugs.
8. **Nuclear pharmacy** **4 Hrs**
Introduction to radiopharmaceuticals. Production of radiopharmaceuticals, isotope tagging, preparation of radioisotopes in laboratory using radiation dosimetry and radioisotope generators. Permissible radiation dose level, radiation hazards, their prevention and specifications for radioactive laboratory.

9. **Education and training program in the hospital** **3 Hrs**
Role of pharmacist in the education and training program; minimum standards for the hospital to conduct the education and training program; internal and external training program.

10. **Role of pharmacist in the interdepartmental communication.** **1 Hr**

Clinical Pharmacy

11 A) **Introduction to Clinical Pharmacy** **8 Hrs**
Concept of clinical pharmacy; functions and responsibilities of clinical pharmacist.

- B) **Introduction to daily activities of a clinical pharmacist**
- Drug therapy monitoring - **medication chart review, clinical review, pharmacist intervention**
 - Ward round participation
 - Adverse drug reaction management
 - Drug and poison information
 - Medication history
 - Patient counseling and pharmaceutical care

12. **Drug information services**
Drug information centre, sources of information on drugs, computerised services (e.g. MEDLINE), storage and retrieval of information.

Adverse drug reaction **5 Hrs**
Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, drug interaction- beneficial interactions, adverse interactions, pharmacokinetic drug interactions; methods for detecting drug interactions, spontaneous case reports and record linkage studies. Case control studies specific examples: Phenytoin with phenothiazines and phenylbutazones, antidiabetics with corticosteroids.

14. **Patient counseling** **2 Hrs**
Definition of patient counseling; steps involved in patient counseling; Special cases that require the pharmacist

15. **Patient medication history interview** **1 Hr**
Need for the patient medication history interview, medication interview forms

16. **Communication skill in pharmacy** **3 Hrs**
Principles and elements involved in communication, barriers involved of communication, listening skills, questioning skills.

17. **Medication adherence** **2 Hrs**
Causes of medication non- adherence; pharmacist role in the medication adherence; monitoring of patient medication adherence.

- | | | |
|--|---|--------------|
| 18. Therapeutic drug monitoring (TDM) | Need for TDM, Factors to be considered during the TDM, Indian scenario for TDM. | 4 Hrs |
| 19. Design and conduct of clinical trials | | 2 Hrs |
| Community Pharmacy | | |
| 20. Introduction to Community Pharmacy | Organization and structure of retail and wholesale drug store, types and design of drug store, legal requirements for establishment and maintenance of a drug store, dispensing of proprietary products, maintenance of records of retail and wholesale, role of pharmacist in community health care education. | 5 Hrs |
| 21. Prescribed medication order - interpretation and legal requirements | Communication skills- communication with prescribers and patients. | 2 Hrs |
| 22. Community pharmacy management | Financial, materials, staff, infrastructure requirements, drug information resources, computers. | 4 Hrs |
| 23. Over the counter (OTC) sales | Rational use of common OTC medications (vitamins and tonics, iron preparations, analgesics, NSAIDS, cough mixtures, anti-diarrhoeal preparations). | 2 Hrs |
| 24. Services to the nursing homes/clinics. | | 1 Hr |
| 25. Code of ethics for community pharmacy. | | 1 Hr |

Recommended Books

1. Hospital Pharmacy by William E. Hassan.
2. A textbook of Hospital Pharmacy by S.H. Merchant and J.S. Quadry.
3. Clinical Pharmacy and Hospital Drug Management by David H Lawson and R Michael E. Richards.
4. Clinical Pharmacy by Tipnis Bajaj.
5. Remington's Pharmaceutical Sciences.
6. A textbook of Clinical Pharmacy Practice- essential concepts and skills by Dr. G. Parthasarathi.
7. A textbook of Professional Pharmacy by N.K. Jain and S.N. Sharma.
8. Textbook of Biopharmaceutics and Clinical Pharmacokinetics by Sartaray Hiage.
9. Clinical pharmacokinetics concept and application by Malcolm.
10. Cooper and Gunn's, Dispensing for Pharmaceutical students by S. J. Carter.
11. Dispensing of Medication by Robert E. King
12. Health Education and Community Pharmacy by Parmar N.S., CBS publishers.

Two weeks of training in hospital pharmacy or community pharmacy during the vacation. A detail report about the work done should be submitted during the reopening.