GOA UNIVERSITY
P.O TALEIGAO PLATEAU
GOA – 403 206

SYLLABUS FOR B.PHARM.

APPROVED BY THE BOARD OF STUDIES
FOR THE ACADEMIC YEAR 2011-12

PURPOSE

A student after completing the B.Pharm course shall be called as a pharmacist and shall be capable of meeting requirements of manufacture & marketing of drugs in industry and to work in sectors of pharmacy practice.

For manufacturing, they will be in a position to handle methods of drug manufacturing, drug selection, standardization, quality control, drug store management and such other requirements.

For practising pharmacy, they will be qualified persons for drug dispensing, patient counselling and such other activities.

As they are also expected to provide service with globalization perspective, it is imperative that they have sound knowledge of drug manufacturing techniques.

The main aim of this course is to produce qualified technologist who have the capacity of producing drugs and also to control and maintain the quality by employing techniques with state of art technologies.

The student will be trained in manufacturing of drug formulations with modern drug manufacturing techniques, taught concepts in Good Manufacturing Practices, Good Laboratory Practices for the control of the quality of drugs and shall be made conversant with drugs and cosmetics act and regulations.

For Pharmacy Practice, the student shall be trained and made required competent for Providing effective medication therapy management, Maintain and improve professional performance and Contribute to improve effectiveness of the health-care system and public health.

PRE-REQUISITES

The course of study for B. Pharm shall extend over a period of eight semesters (four academic years). Each semester consists of not less than 120 working days.

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I B. PHARM

SEMESTER I

1.1.1 PHARMACEUTICS - I

(DISPENSING & GENERAL PHARMACY)

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPICS	NUMBER OF HOURS
1	Definitions --Dispensing , Compounding and Pharmaceutics.	1
2	Drugs, sources of drugs, drug products, performance in Therapy. Introduction and classification of dosage forms, routes of administration. To discuss --aromatic waters, glycerites and syrups.	2
3	Prescription and its parts, responding to prescription, calculations involved in compounding and dispensing— Weights and measures, percentage calculations, allegation methods, proof strengths, concentrations and dilutions, isotonic solutions. Fundamental operations in compounding and dispensing, containers and closures for dispensed products, labeling of dispensed medicines, latin terms, prescription pricing and records.	6
4	Incompatibilities in prescriptions – study of various types of incompatibilities – physical, chemical and therapeutics – and their method of correction.	4
5	Posology, calculation of doses for infants and children.	2
6	Compounding and dispensing aspects of : A. Solutions : Dilution of solutions for oral use and external use, mouthwashes, gargles, solutions instilled into body cavities – nasal drops and sprays, enemas. B. Suspensions : Thickening agents, compounding of suspensions for oral and external use. C. Emulsions and creams : Emulsifying agents, choice of emulsifying agents, HLB values, emulsion for oral and external use, creams – general compounding procedure, dilution of creams.	2 2 4

Sr. No	TOPICS	NUMBER OF HOURS
	D. Ointments, Pastes and Gels : Bases, other additives and preparations. Plasters and poultices.	5
	E. Compounding of Powders and Granules : Divided and bulk powders, granules, effervescent granules.	2
	F. Pastilles, Lozenges & Pills : Historical discussions and academic importance.	1
	G. Suppositories and Pessaries : Bases, other additives, displacement value, moulds-preparation.	3
7	Understanding of : Ayurvedic, Homeopathic, Military Pharmacy, Veterinary Pharmacy, Nutrition and Supplements, Dental Pharmacy, Sports Medicines, Marine and Space Medicines, Podiatric Medicines.	2

BOOKS RECOMMENDED:

1) IP, BP, USP-NF, NFI, BNF, BPC, PC, extra pharmacopoeia.

2) Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. - ergrits edition – by L.X. Allen Jr., N.G. Popovich, HC Ansel.

3) Pharmaceutical Practice – edited by D.M. Collet, M.E. Aulton.

4) Cooper and Guns – Dispensing for Pharmaceutical Students. – - 12th edition edited by S.J. Carter.

5) Prescription Pharmacy – Sprowls.

6) Pharmceutical Calculation – Stoklosa.

7) Pharmceutical Calculations – Zatz.

8) Remington's Pharmaceutical Sciences – A.R. Gennaro.

9) Dispensing of Medications – Hoover.

1.1.1 PHARMACEUTICS - I (PRACTICALS)

3 Hours/ Week

Compounding and dispensing of the following preparations :

1) Powders and Granules – Oral Rehydration Salt, Isapgol Granules, Effervescent Granules of Sodium Sulphate.

2) Solutions – Lugol's solution, Pediatric Ferrous Sulphate Oral Solutions, Zinc Sulphate and Zinc Chloride Mouthwash.

3) Suspensions – Pediatric Kaolin mixtures, Inhalation containing Menthol and Eucalyptus oil.

4) Emulsions – Emulsion for internal use containing acacia, White Liniment, Benzyl Benzoate application.

5) Ointments – Sulphur Ointment, Whitfield's Ointment.

6) Suppositories – use of displacement value, suppository with fatty base and suppository with PEG base.

7) Incompatibilities – One example under each category – involving latin terms, Apothecary systems with conversions.

8) Aromatic waters – Concentrated Dill water, Gripe water.

9) Syrup – Simple Syrup IP, Artificial Syrup.

10) Glycerites – Tannic Acid Glycerite, Boric Acid Glycerite.

BOOKS RECOMMENDED:

1. IP, BP, USP-NF, NFI, BNF, BPC, PC, extra pharmacopoeia.

2. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems.
   - ergrits edition – by L.X. Allen Jr., N.G. Popoxich, HC Ansd.

3. Pharmaceutical Practice – edited by D.M. Collet, M.E. Aulton.

4. Cooper and Guns – Dispensing for Pharmaceutical Students. –
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7. Pharmceutical Calculations – Zatz.

8. Remington's Pharmaceutical Sciences – A.R. Gennaro.

9. Dispensing of Medications – Hoover.

BACK

I B. PHARM

SEMESTER I

1.1.2 PHARMACEUTICAL ORGANIC CHEMISTRY- I

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1.	**IUPAC nomenclature of organic compounds belonging to the following classes** Alkanes, Alkenes, Dienes, Alkynes, Alcohols, Aldehydes, Ketones, Carboxylic acids, Sulphonic acids, Esters, Acid halides, Amides, Acid anhydrides, Ethers, Amines and Cycloalkanes with one or more than one functional groups.	5
2.	**A brief review of the following concepts in organic chemistry** Atomic Structure:- Ionic bond, Covalent bond, concept of formal charge on individual atoms in a molecule, Hydrogen bond; intramolecular and intermolecular, Orbital theory: Atomic orbitals hybridization (sp^3, sp^2 and sp), sigma (σ) and pi (π) bonds, Heterolysis and homolysis of covalent bond (A^+B^- and $A^{\cdot}B^{\cdot}$) Reagents: - Nucleophiles and Electrophiles. Factors affecting electron availability in bonds and effect in bonds and individual atoms, inductive effect (+I and -I), Resonance effect, Hyperconjugation, Tautomerism, Energetics and kinetics of reactions: energy profile diagram, kinetically controlled and equilibrium controlled products.	2
3.	**Stereochemistry** Definition of **c**onstitutional , configurational and conformational isomers. Methods of representation – Dotted line wedge, Fischer, Saw horse, Newman, geometric isomerism and optical isomerism. Steric effect - steric hindrance, steric acceleration, and steric inhibition to resonance.	3
4.	**Transient reaction intermediates** Carbocations, carbanions and free radicals- Generation, structure, stability and reactions. Brief description of nucleophilic substitution at saturated carbon SN1 and SN2 reactions – Stereochemistry. Variables – substrate structure, nature of nucleophile, nature of leaving group, solvent.	8

Sr. No.	TOPICS	NUMBER OF HOURS
5.	**Alkenes** General methods of preparation, E1 and E2 mechanisms and stereochemistry, Saytzeff and Hofmann rules, factors which facilitate elimination at the expense of substitution, Ei and E1cB mechanisms, Addition reactions- mechanisms and stereochemistry – addition of hydrogen, halogens, hydrogen halides, hydroxylation, hydroboration-. oxidation, oxymercuration-demercuration, ozonolysis Regioselectivity, Markownikoff and Anti-Markownikoff rules. Determination of position of unsaturation, conjugated diene, addition, Diels Alder reaction	8
6.	**Alkynes** General methods of preparation, difference between terminal alkyne and internal alkyne, addition reactions – addition of hydrogen, halogens, hydrogen halides, water, hydroboration-oxidation and ozonolysis.	4
7.	**Benzene and aromaticity** Huckel rule, Resonance in benzene derivatives, Mechanism of electrophilic aromatic substitution – halogenation, nitration, sulphonation and Friedel crafts reactions, Orientation in monosubstituted benzene modern interpretation, mechanism of nucleophilic aromatic substitution – addition- elimination and elimination-addition (reaction involving benzyne intermediate)	6

BOOKS RECOMMENDED:

1. Robert Thornton Morrison, Robert Neilson Boyd and Saibal Kanti Bhattacharjee Organic
Chemistry by publisher Dorling Kindersley (India) Pvt. Ltd. Licensees of Pearson Education in South Asia.

2. Finar : "Organic Chemistry," Vol.1 (The Fundamental Principles), ELBS Longman.

3. Finar : "Organic Chemistry," Vol.2 (Stereochemistry & The Chemistry of Natural Products), ELBS Longman- Pearson Education Asia Pvt.Ltd.

4. Peter Sykes, A guide book to Mechanisms in Organic Chemistry, Pearson Education.

5. Stanley Pine, Organic Chemistry, McGraw-Hill Companies.

6. Paula Yurkanis Bruice, Organic Chemistry, Pearson Education.

7. T.W. Graham Solomons and Craig B. Frhyle Organic Chemistry, Wiley-India.

8. Paula Yurkanis Bruice, K.J. Rajendra Prasad, Essential Organic Chemistry, Pearson Education.

9. Ernest Eliel, Stereochemistry of Organic Compound.

10. Francis A. Carey and Richard J. Sundberg, Advanced Organic Chemistry, Part A: Structure and Mechanisms.

11. Francis A. Carey and Richard J. Sundberg Advanced Organic Chemistry, Part B: Reactions & Synthesis.

12. Michael Smith, Michael B. Smith and Jerry March March's Advanced Organic Chemistry: Reactions, Mechanisms.

13. L. G. Wade and M. S. Singh, Organic Chemistry by Publisher Doerling Kindersley (India) Pvt. Ltd. Licensees of Pearson education in South Asia.

14. Pine, Hendrickson, Cram and Hammond, Organic Chemistry, McGraw-Hill Companies.

15. Allinger, Cava, De Jough, Johnson, Lebel, Stevens, Organic Chemistry, Worth.

16. Streitweiser and Heathcock, Organic Chemistry, Academic Press.

17. John McMurry, Fundamentals of Organic Chemistry, Mary Finch.

1.1.2 PHARMACEUTICAL ORGANIC CHEMISTRY- I (PRACTICALS)

3 Hours/Week

1. Explain safety involved in handling chemicals.
2. Organic Spotting:

   Qualitative analyses of some functional organic compounds – aspects to be covered are

   i. Preliminary examination of organic compounds: Solids & Liquids.

   ii. Grouping of organic compounds based on solubility division.

   iii. Detection of (N,S,Cl,Br & I) in the given organic compounds.

   iv. Determination of melting & boiling point in the given organic samples.

   v. Functional group analysis in the given organic compounds for Carboxylic acid (–COOH) Group and Phenolic (-OH) groups.

   vi. Functional group analysis for Alcoholic (–OH) group.

   vii. Functional group analysis for CHO group.

   viii. Functional group analysis for NH_2 group.

   ix. Functional group analysis for Ketone.

   x. Functional group analysis for Carbohydrate.

   xi. a) To distinguish between Primary, Secondary, Tertiary Amines.

   b) To distinguish between Aliphatic & Aromatic Amines.

   xii. Distinguish between Primary, Secondary, Tertiary Alcohols.

To include characterization of elemental functional groups and characterization by derivatization to known compounds.

BOOKS RECOMMENDED:

1. Practical Organic Chemistry by F. G. Mann et al, Publishers Orient Longman.

2. An introductory course in Practical Organic Chemistry by F. D. Crenstone et al.

3. A textbook of Practical Chemistry for B.Sc. by V. Nadkerny Popular Prakashan

4. Introduction to Organic Laboratory Techniques contemporary approach. by D.L. Pavia Publisher Saunders Golden Sunburst.

5. Furniss B.S. & others – Vogel's Textbook of Practical Organic Chemistry Publisher ELBS

BACK

I B. PHARM

SEMESTER I

1.1.3 PHARMACEUTICAL INORGANIC CHEMISTRY

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPICS	NUMBER OF HOURS
1	Introduction to pharmacopoeia Monograph, Sources and effect of impurities in pharmaceutical substances, Limit tests of Cationic and anionic impurities of pharmaceutical substance.	7
	General methods of preparation ,general classification ,properties, identification tests and special tests if any, assays*,storage condition and medicinal uses of inorganic compounds belonging to the following classes **2.1 Medicinal Gases** Oxygen , Nitrous oxide , Carbon dioxide **2.2 Gastrointestinal agents:** Antacids Aluminum hydroxide gel , Sodium bicarbonate*, Magnesium trisilicate , Magnesium carbonate(light & heavy) and zinc oxide* Protective and adsorbents Kaolin and Talc Cathartics Magnesium Sulphate* **2.3 Electrolytes** used for replacement therapy, physiological acid base balance (compounds of Na, K, Ca) **2.4 Topical agents and dermatological preparations** Protectives Talc, Zinc oxide, Zinc stearate, Titanium dioxide. Antimicrobials Potassium Permanganate*, Chlorinated lime*, Iodine preparations, Boric acid*, Borax. **2.5 Miscellaneous agents** Expectorants Ammonium chloride*, Potassium iodide. Haematinics Ferrous sulphate*, Ferrous gluconate, Ferrous fumatate, Iron dextran injection, iron and Ammonium citrate.	2 4 5 6 6

Sr. No	TOPICS	NUMBER OF HOURS
	Emetics Copper sulpahte* Poisons and antidotes Sodium Thiosulphate, Charcoal (activated) Pharmaceutical Aids Bentonite , Sodium metabisulphite , Barium sulphate	
3.	Radiopharmaceuticals Introduction, fundamentals of radioactivity, properties of radiation, effects of radiation on biological system, unit and measurement of radioactivity(Geiger Muller Counter, Scintillation counter). Radiopharmaceuticals : production, properties, applications. Application of radioisotopes as Therapeutic & Diagnostic agents.	6

BOOKS RECOMMENDED:

1. Bentley and Driver's textbook of Pharmaceutical Chemistry
2. Inorganic Medicinal and Pharmaceutical Chemistry by J.H. Block, E.B. Roche, T.O.Soine and C.O.Wilson.
3. Practical Pharmaceutical Chemistry by A.H.Beckett and J.B.Stenlake Vol. I
4. Pharmaceutical Chemistry by M.L.Schroff.
5. Concise Inorganic Chemistry by J.D.Lee
6. Pharmaceutical Chemistry-Inorganic by G.R.Chatwal
7. Indian Pharmacopoeia 1996,2007

1.1.3 PHARMACEUTICAL INORGANIC CHEMISTRY (PRACTICALS)

1. Semi-micro qualitative analysis of Inorganic compounds containing four radicals.
2. Limit tests (Chloride, Sulphate, Iron, Heavy metals, Arsenic).
3. Preparation of inorganic pharmaceuticals and identification
   Boric acid, Zinc Sulphate , Alum ,Magnesium Sulphate , Heavy Magnesium Carbonate.

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I B. PHARM

SEMESTER I

1.1.4 ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY- I (THEORY)

TOTAL HOURS:36

Sr. No	TOPICS	NUMBER OF HOURS
1	Detailed structure of cell membrane and transmembrane movement of substances. Concepts of receptors proteins , ion channels, resting membrane potential, action potential.	6
2	**Haematology** Components of blood Physical characteristics of blood functions of blood. Erythropoesis and formation of blood cells. Synthesis of haemoglobin and RBC life cycle. Properties and functions of RBC, WBC, Platelets. Coagulation of blood, Blood groups and blood types. Definition and etiology of following diseases in detail: Anaemias and types of anaemia, polycythemia leucopenia, Leuckocytosis, Leukemia, Thrombocytopenia , HDN, hemophilia.	10
3	**Lymphatic system** Structural components and functions of lymphatic system, Lymphatic organs and tissues (Thymus,lymph nodes,spleen,lymphatic nodules) Organization of lymph vessels, (capillaries,lymph trunk and ducts) Formation and flow of lymph **Immunity** Definition and etiology of following diseases in detail: AIDS, Autoimmune disease (Rheumatoid arthritis, Grave's disease, Rheumatic fever, hypersensitivity (Allergy)	10
4	**Skeletal muscle** Neuromuscular junction and its transmission, Mechanism of contraction of skeletal muscle. Energy metabolism in the muscle, types of muscle contractions, muscle tone, exercise and skeletal muscle , Definition and etiology of following diseases in detail: spasticity, tetany , myasthenia gravis, arthritis, gout, fibromyalgia muscular dystrophy.	10

BOOKS RECOMMENDED:

1. Bentley and Driver’s textbook of Pharmaceutical Chemistry
2. Practical Pharmaceutical Chemistry by A.H.Beckett and J.B.Stenlake Vol. I
3. Pharmaceutical Chemistry-Inorganic by G.R.Chatwal
4. Advanced practical inorganic chemistry by Gurdeep Raj
5. Chemistry Practicals by Dr.B.L. Malik
6. Indian Pharmacopoeia 1996,2007,2010

1.1.4 ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY -I (PRACTICALS)

3 Hours/Week

1. Hematology
   a. Red Blood Cell (RBC) Count
   b. Total Leukocyte Count
   c. Differential Leukocyte (WBC) Count
   d. Hemoglobin content of blood
   e. Bleeding & Clotting Time
   f. Blood groups
   g. Erythrocyte Sedimentation Rate (ESR)/ Hematocrit (Demonstration)

2. Study of Human Skeleton

BOOKS RECOMMENDED:

1. V. G. Ranade, P. N. Joshi & Shalini Pradhan
A Text book of Practical Physiology 3r d Edition 1982 , P.V.G. Prakashan, Pune 30

BACK

I B. PHARM

SEMESTER I

1.1.5 HEALTH EDUCATION & ENVIRONMENTAL STUDIES (THEORY)

TOTAL HOURS:36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**Concept of Health & Disease** Air/water/soil borne –Effect of these diseases on human health. Prevention/cause/ effect/ treatment.	8
2	**Epidemiology** Dynamics of disease transmission. Immunization schedule	2
3	**Institutional Health Care** World Organizations , Govt. & NGOs	1
4	**Nutrition and Health** Nutritional aspects of proteins/carbohydrates/fats/minerals/vitamins. Food materials(Naturals & Artificial). Effects of Fast Food/Obesity.	3
5	**Environment and Health** Effect of environment on health. Migration/unsustainable development/urbanization and effect on health-diseases-HIV/AIDS.	7
6	**Ecosystems** Introduction, type features and function of different ecosystems-Forest Grassland, Desert and Aquatic. Biodiversity & its conservation with special reference to India.	7
7	**Environmental pollution** Air, Water, Soil, Marine, Noise, Thermal, Nuclear introduction, causes and control measures. Noise Pollution Hazardous Wastes , Chemical , Microorganism , Biomedical Waste.	5
8	**Law related to Environmental Protection** Air (Prevention and control of pollution) Act 1987Water Prevention & Control of Pollution Act 1974, Environmental Protection Act 1986, Provisions applicable to drugs and cosmetics	3

BOOKS RECOMMENDED:

1. Health Education and Community Pharmacy – NS Parmar

2. Handbook of Environmental Laws, Acts, Guidelines, Compliances & Standards Vol. I & II. R.K. Trivedy, Pharma Book Syndicate, Hyderabad.

3. Relevant Acts & Rules published by Govt. of India with latest amendments.

4. Text Book of Environmental Sciences & Technology by Reddy M. Anji.

5. Principles of Environmental Studies, C Manoharachary, P. Jayaranama Reddy, Pharma Book Syndicate, Hyderabad. Books

BACK

I B. PHARM

SEMESTER I

1.1.6 REMEDIAL BIOLOGY

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	General organization of the Plant and Plant Cell and its inclusions. The Plant Tissues (Meristematic and Permanent)	3
2	Broad classification of the Plant Kingdom.	3
3	Morphology & histology of root, stem, bark, wood, leaf, flower, fruit and seed.	6
4	Plant taxonomy Study of different families, namely, Leguminous, Umbeliferous, Solanaceae, Liliaceae,zingiberaceae & Rubiaceae with special reference to medicinal plants.	8
5	Plant Physiology Transpiration, Photosynthesis, Respiration and Growth.	5
6	Study of Animal Cell, Animal Tissues, Difference between Plant & Animal Cell.	5
7	Study of representatives of Pisces, Reptiles, and Aves with special reference to the medicinal values. Basic concept of molecular biology. (DNA, RNA).	6

1.1.6 REMEDIAL BIOLOGY (PRACTICALS)

3 Hours/Week

1) Study of Microscope.
2) Study of Plant tissues (Meristematic & Permanent).
3) Morphological study of plant parts studies in theory.
4) Study of Histological preparation of roots, stem, flower, ……).
5) Study of Animal tissues through permanent slides.

Note : There shall be no University Examination for Remedial Biology Practical.

BOOKS RECOMMENDED:

1) Dutta A.C. "Botany for Degree students" Oxford.
2) Marshall & Williams "Text Book of Zoology" CBS Publishers & Distributors, Delhi.
3) Fahn "Plant Anatomy" Aditya Books Private Ltd., New Delhi.
4) Weiz, Paul B "Laboratory Manual in Science of Biology" Mc Graw-Hill Book Co.
5) Text Book of Biology by S.B. Gokhale.
6) A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.
7) A Text Book of Biology by B.V. Sreenivasa Naidu.
8) A Text book of Biology by Naidu and Murthy.
9) A manual for pharmaceutical biology practical by S.B. Gokhale and C.K. Kokate.

BACK

I B. PHARM

SEMESTER I

1.1.6 REMEDIAL MATHEMATICS

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**Algebra** Determinants, Matrices. **Trigonometry** Sides and angles of a triangle, solution of triangles. **Analytical Geometry** Points, Straight line, circle , parabola.	8
2	**Differential Calculus** Limit of a function, Differential calculus, Differentiation of a sum, Product, Quotient Composite, Parametric, exponential, trigonometric and Logarithmic function. Successive differentiation. Leibnitz's theorem, Partial differentiation, Euler's theorem on homogenous functions of two variables	8
3	**Integral Calculus** Definite integrals, integration by substitution and by parts, Properties of definite integrals.	6
4	**Laplace transform** Definition, Laplace transform of elementary functions, Properties of linearity and shifting.	6
5	**Differential equations** Definition, order, degree, variable separable, homogeneous, linear, heterogeneous, linear, differential equation with constant coefficient, simultaneous linear equation of second order.	8

BOOKS RECOMMENDED:

1) Differential calculus – by Shantinarayan.
2) Text book of Mathematics for second year pre-university – by Prof. B.M. Sreenivas.
3) Integral calculus – By Shanthinarayan.
4) Engineering mathematics – by B.S. Grewal.
5) Trigonometry – Part-I – By S.L. Loney.

BACK

I B. PHARM

SEMESTER II

1.2.1 PHARMACEUTICS - II

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPICS	NUMBER OF HOURS
1	Historical background & development of profession of pharmacy & pharmaceutical industry in India- Current Status	2
2	Introduction to pharmacopeias and formulary- Development of Indian Pharmacopoeia & other compendia including IP, BP, USP, NF, Ph. Eur, International Pharmacopoeia, BPC, PC, Extra Pharmacopoeia and NFI	2
3	Introduction to GMP - cGMP, Quality Assurance, Introduction to Quality Appraisal, Purity & Identity of Active Pharmaceutical Ingredients, Product quality	4
4	Review of dosage forms-sterile & non-sterile & studies on the following delivery systems: a. Non-sterile monophasic system-Preformulation, formulation development , vehicles & excipients, Manufacturing processes, equipments, packaging, quality control standards of solutions, syrups, elixirs, linctuses, ENT preparations, Ayurvedic & Homeopathic liquids. b. Disperse systems- General considerations- free energy, thermodynamics v/s kinetic stability- classification of disperse systems. I. Suspensions- Physicochemical principles, wetting, sedimentation flocculated & deflocculated systems-structured vehicle – particle size charges, caking in suspensions, importance of change in solubility because of change in particle size and polymorphic forms. Preformulation, formulation of pharmaceutical suspensions (oral & topical) - suspending agents -classification, types, examples, wetting agents, deflocculating & flocculating agents, instability in suspension, manufacturing, equipment employed, packaging, rheology of suspensions, Quality control Standards.	7 8

Sr. No	TOPICS	NUMBER OF HOURS
	II. Emulsions Physicochemical principles, Theories of emulsification, instability in emulsions, emulsion types, liquid crystalline phase concept, steric stabilization , HLB value, Preformulation, formulation, classification of emulsifiers with examples, manufacture of emulsions, equipments, homogenization, packaging and Quality control Standards.	8
5	Layout design of liquid section- facilities & design considerations.	2
6	Introduction to pharmaceutical packaging materials & packaging systems with special reference to liquid packaging.	3

BOOKS RECOMMENDED:

1. Pharmaceutical dosage and drug delivery systems –Ansel-Popovich & allen – (Williams and Wilkins)
2. American Pharmacy – Dittert (J.B. Lippincott)
3. Remington: The science and practice of Pharmacy- Alfonso R. Gennaro- (Mack Publishing co.)
4. Bentleys Text book of Pharmaceutics- Rawlins (ELBS)
5. Industrial Pharmacy: Lachman (Lea & Febiger)
6. Banker and Rhodes- Modern Pharmaceutics- (Dekker)
7. Hanlon- Handbook of Packaging and Engineering (McGraw Hill)
8. Swarbrick and Boylan- Encyclopedia of Pharmaceutical Technology (Dekker)
9. History of Pharmacy and Pharmacopoeia- Harikishan Singh
10. IP, BP, USP, NF, BNF, NFI, Martindale, Ph. Eur, and international Pharmacopoeia

1.2.1 PHARMACEUTICS - II (PRACTICALS)

3 Hours/Week

Note: Stress to be laid on formulation components, processing and packaging-Quality control (Raw material, IPQC, and finished

1. Monophasics

A. Solutions
a. Tincture of Iodine IP
b. Magnesium citrate solution NFXII
c. Cresol with soap solution
d. Surgical Chlorinated Soda solution BPC
e. Paracetamol Paediatric Solubilised drops

B. Syrups
a. Cough syrup
b. Haemetinic Syrup

C. Elixirs
a. Piperazine citrate Elixir BPC
b. Paracetamol Elixir Pediatric BPC

D. Linctuses
a. Simple linctus BPC and any other compendial preparation

E. Ear and nose preparations
a. Ear drops containing antibiotics (e.g. Gentamycin/chloramphenicol)
b. Nasal drops containing a decongestant

F. Ayurvedic and Homeopathic liquids
a. Asavas (Drakshasava or kumariasava)
b. Arishta (Asokarista)
c. Preparation and standardization of one mother tincture

2. Biphasics

A. Emulsions
a. Turpentine liniment IP
b. Liquid paraffin emulsion IP

B. Suspensions
a. Calamine lotion IP
b. Magnesium hydroxide mixture (Milk of magnesia) IP
c. Antacid suspension- Magnesium hydroxide and Aluminium hydroxide mixture.

BOOKS RECOMMENDED:

1. Pharmaceutical dosage and drug delivery systems –Ansel-Popovich & allen – (Williams and Wilkins)
2. American Pharmacy – Dittert (J.B. Lippincott)
3. Remington: The science and practice of Pharmacy- Alfonso R. Gennaro- (Mack Publishing co.)
4. Industrial Pharmacy: Lachman (Lea & Febiger)
5. Pharmacopoeias and Formularies- Harkishin Singh
6. IP, BP, USP, NF, BNF, NFI, Martindale, Ph. Eur, and international Pharmacopoeia
7. M.L. Shroff General Pharmacy series
8. Mittal , Pharmaceutical formulations.

BACK

I B. PHARM

SEMESTER II

1.2.2 COMMUNITY AND HOSPITAL PHARMACY

(THEORY)

TOTAL

HOURS: 36

Sr. No	TOPICS	NUMBER OF HOURS
1	Community pharmacy: definition, concept, scope	1
2	Patient compliance and counseling	3
3	Patient medication records	1
4	Drug information and pharmaceutical advice	4
5	Responding to symptoms	3
6	Hospital : definition, classification, function, organization	2
7	Hospital Pharmacy: definition, scope, personnel, duties and responsibility, location and layout, Bulk Compounding, Hospital Supplies	5
8	Pharmacy and therapeutic committee	2
9	Hospital formulary	1
10	Purchase and inventory control	2
11	Central sterile service dept	2
12	Dispensing to inpatients and outpatients, bed-side pharmacy, satellite pharmacy, dispensing of NDPS/controlled substances	2
13	Sterilization techniques & Disposal : surgical instruments, syringes, needles, catheters, rubber gloves, catheter s, containers- closures, Surgical Dressings, Gowns and Barrier clothing	3
14	Medicinal gases	2
15	Introduction to Surgical Instruments & Health accessories	2
16	Application of computers in community and hospital pharmacy	1

1.2.2 COMMUNITY AND HOSPITAL PHARMACY (PRACTICALS)

3 Hours/Week

1. Identification and sterilization of various types of materials used in hospital pharmacy like surgical instruments & devices, syringes and needles, rubber tubings, absorbent cotton and gauze
2. Use of computers in drug information centre, prescription filing, documentation of information on drug interactions
3. Compendial Evaluation of Absorbent cotton and Gauze
4. Preparation & Quality control of large volume parenterals like normal saline, dextrose injection
5. Introduction to standard books like NF, USP DI, Extra pharmacopoeia.

BOOKS RECOMMENDED:

1 Hospital Pharmacy -Hassan

2 Text book of Hospital Pharmacy -Blackwell Scientific
3 Text book of Hospital Pharmacy - Merchant & Quadry
4 Pharmacopoeias & Formularies

BACK

I B. PHARM

SEMESTER II

1.2.3 PHARMACEUTICAL ORGANIC CHEMISTRY- II

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**Aldehydes and Ketones** General methods of preparation including use of dimethyl sulphoxide in the preparation of aldehydes and ketones and reactions, Mechanism of nucleophilic addition and condensation reactions – acetal, imine, oxime, hydrazone, semicarbazone formation, Addition of Grignard reagent, hydrides ($LiAlH_4$ and $NaBH_4$). Meerwein-Ponndorf-Verley reduction and Oppenauer oxidation, Mechanisms of Aldol condensation, Cannizzaro reaction, Knoevenagel reaction, Perkin reaction, Haloform reaction and Mannich reaction	7
2	**Alpha(α)-beta(β) unsaturated carbonyl compounds** Michael addition, Robinson annulation reaction and addition of Grignard reagents.	4
3	**Carboxylic Acids and their Derivative** Acid halides, anhydrides, esters and amides. General methods of preparation and reactions.	5
4	**Esters** Mechanism of esterification and transesterification, ester hydrolysis, Beta (β) keto esters – mechanism of Claisen and Dieckmann reaction, Reformatsky reaction , Darzens glycidic ester condensation, use of acetoacetic ester and malonic ester in synthesis.	5
5	**Amines** Concept of Acids & Bases- Arrhenius Theory, Lowry –Bronsted Theory & Lewis Acid Base theory**.** General methods of preparation and reactions, Hinsberg method of separation of amines, Stork enamine reaction, reaction of amines with nitrous acid, formation of diazonium salts and use of diazonium salts in synthesis.	6
6	**Alcohols, Phenols and ethers** General methods of preparation and reactions, Lucas test for alcohols, Kolbe-Schmitt and Reimer Tiemann reaction.	6
7	**Sulphonic acids** General methods of preparation and reactions	3

BOOKS RECOMMENDED:

1. Robert Thornton Morrison, Robert Neilson Boyd and Saibal Kanti Bhattacharjee Organic Chemistry by publisher Dorling Kindersley (India) Pvt. Ltd. Licensees of Pearson Education in South Asia.

2. Finar : "Organic Chemistry," Vol.1 (The Fundamental Principles), ELBS Longman.

3. Finar : "Organic Chemistry," Vol.2 (Stereochemistry & The Chemistry of Natural Products), ELBS Longman- Pearson Education Asia Pvt.Ltd.

4. Peter Sykes, A guide book to Mechanisms in Organic Chemistry, Pearson Education.

5. Stanley Pine, Organic Chemistry, McGraw-Hill Companies.

6. Paula Yurkanis Bruice, Organic Chemistry, Pearson Education.

7. T.W. Graham Solomons and Craig B. Frhyle Organic Chemistry, Wiley-India.

8. Paula Yurkanis Bruice, K.J. Rajendra Prasad, Essential Organic Chemistry, Pearson Education.

9. Ernest Eliel, Stereochemistry of Organic Compound.

10. Francis A. Carey and Richard J. Sundberg, Advanced Organic Chemistry, Part A: Structure and Mechanisms.

11. Francis A. Carey and Richard J. Sundberg Advanced Organic Chemistry, Part B: Reactions & Synthesis.

12. Michael Smith, Michael B. Smith and Jerry March March's Advanced Organic Chemistry: Reactions, Mechanisms.

13. L. G. Wade and M. S. Singh, Organic Chemistry by Publisher Doerling Kindersley (India) Pvt. Ltd. Licensees of Pearson education in South Asia.

14. Pine, Hendrickson, Cram and Hammond, Organic Chemistry, McGraw-Hill Companies.

16. Allinger, Cava, De Jough, Johnson, Lebel, Stevens, Organic Chemistry, Worth.

17. Streitweiser and Heathcock, Organic Chemistry, Academic Press.

18. John McMurry, Fundamentals of Organic Chemistry, Mary Finch.

1.2.3 PHARMACEUTICAL ORGANIC CHEMISTRY- II (PRACTICALS)

3 Hours/Week

Preparative Organic Chemistry- To cover study of the following type of reactions.

Sl. No.	Reaction Type	Synthesis
1.	Acylation	**N and O acetylation** Recommended preparation of acetanilide, acetyl salicyclic acid, benzanilide and betanaphthylbenzoate.
2.	Electrophilic aromatic substitution in aromatic ring	**Bromination** Preparation of 2,4,6- tribromoaniline and p-bromoacetanilide. **Sulphonation** Preparation of sulfanilic acid and sodium p-toluene sulfonate. **Nitration** Preparation of m-dinitrobenzene, p-nitroacetanilide, 2,4-dinitrochlorobenzene and picric acid.
3.	Formation of Oximes from Aldehydes & Ketones	Preparation of cyclohexanone oxime from cyclohexanone and benzophenone oxime from benzophenone
4.	Diazotization and diazo coupling reaction	Preparation of phenyl azo-beta naphthol from aniline.
5.	Oxidation	Preparation of o-chlorobenzoic acid from o-chlorotoluene, benzoic acid from nitrobenzene.
5.	Reduction	Preparation acetanilide from nitrobenzene, anthrone from anthroquinone, m-nitroaniline from m-dinitrobenzene and benzophenone from benzhydrol.
6.	Substitution reaction	Preparation of Nerolin.

BOOKS RECOMMENDED:

1. Practical Organic Chemistry by F. G. Mann et al, Publishers Orient Longman.

2. An introductory course in Practical Organic Chemistry by F. D. Crenstone et al.

3. A textbook of Practical Chemistry for B.Sc. by V. Nadkerny Popular Prakashan

4. Introduction to Organic Laboratory Techniques contemporary approach. by D.L. Pavia Publisher Saunders Golden Sunburst.

5. Furniss B.S. & others – Vogel's Textbook of Practical Organic Chemistry Publisher ELBS

BACK

I B. PHARM

SEMESTER II

1.2.4 BIOCHEMISTRY – I

(THEORY)

TOTAL HOURS:36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**CARBOHYDRATES** Introduction Classification – homopolysaccharides and mucopolysaccharides, Chemistry & Pharmaceutical importance of carbohydrates Selected reactions of carbohydrates like reaction with strong acids, alkali and phenyl hydrazine, oxidation and reduction. Qualitative tests for detection of carbohydrates . Disorders related to carbohydrates – Galactosemia, hypoglycemia, Diabetes Mellitus, Hereditary Fructose intolerance Glucose tolerance test.	6
2	**PROTEINS** Classification of amino acids, significance. Selected reactions of amino acids like Ninhydrin reaction, Sanger's reaction, Edman's reaction, reaction with Dansyl chloride, Biuret reaction, Isoelectric point and its importance. Peptides of biological importance. Classification of protein simple, conjugated and derived. Structure of protein, and denaturation. Qualitative tests for detection Brief mention of techniques for separation of protein and amino acids. Application of Paper and Thin layer chromatography , Electrophoresis, Ion-exchange chromatography, Biological value of protein, Plasma proteins, normal values and significance.	6
3	**LIPIDS** Classification and chemistry of Lipids with significance Fat soluble vitamins A,D,E, K Selected reactions of fats like saponification, halogenation, hydrogenation and rancidity of fats. Analytical constants of fats and oils and their significance. Liposomes and micelles. Disorders related to lipids metabolism – Niemann Picks disease, Gaucher's disease, hyperlipidaemia, Tay-sachs disease, Atherosclerosis,Lipid profile.	4

Sr. No.	TOPICS	NUMBER OF HOURS
4	**ENZYMES** Nomenclature and IUB classification. Properties of enzymes, specificity Factors affecting enzyme activity –pH, temp, substrate, metal ions Mechanism of enzyme action Enzyme kinetics (Michaelis Menten & Lineweaver Burk plot) Inhibition of enzymes with examples Enzyme induction and repression Medical and Pharmaceutical importance of enzymes Diagnostic enzymes, Therapeutic enzymes. Regulation of enzyme activity Purification and measurement of Enzyme activity	6
5	**COENZYMES AND PROSTHETIC GROUPS** Water soluble vitamins and their coenzymes – Structure, Role of coenzyme in enzyme action (at least two examples each) and deficiency symptoms Coenzymes of oxido reductases (NAD^+, $NADP^+$, FMN, FAD). Coenzymes of vitamin B1, B6, B12, Ascorbic acid. Group transferring, coenzymes like Biotin, tetrahydrofolic acid, S-adenosyl methionine, ATP, Coenzyme A.	5
6	**NUCLEIC ACIDS** Bases, sugars, nucleosides, nucleotides, Nucleic acids DNA structure, DNA as carrier of genetic information and its role in protein biosynthesis. Properties of DNA, palindromic DNA. Chromatin, histones, nucleosomes, chromosomes Recombinant DNA. RNA structure, types and properties Nucleotide analogs of Pharmaceutical importance	5
7	**BIOLOGICAL OXIDATION** **C**oncept of free energy, redox potential, biological oxidation High energy compounds with examples, ATP structure and significance Electron transport chain (components and role) Inhibitors and uncouplers of Electron transport chain Oxidative Phosphorylation (Chemiosmotic theory) Shuttle mechanism, Substrate levels Phosphorylation.	4

BOOKS RECOMMENDED:

1. Murray R.K. Granner, D.K. Mayes, P.A. Rodwell, V.W Harpers Biochemistry 27th Ed. Prentice Hall International Inc.

2. Nelson D.L. and Michael M. Cox Lehninger Principles of Biochemistry 4th Edn 2005 W. H. Freeman and company, New York

3. Berg JM, Tymoczko JL & L. Stryer. Biochemistry 5th International Edition, W. H. Freeman and company NewYork.

4. Conn E.E, Stumpf , Bruening G and Doi R.H. Outlines of Biochemistry 5th Edn 2003 John Wiley and Sons, Singapore

5. Deb. A.C Fundamentals of Biochemistry, 8th Edn 2004 New central Book Agency (P) Ltd, India .

1.2.4 BIOCHEMISTRY – I (PRACTICALS)

3 Hours/ Week

1. Qualitative tests for carbohydrate confirmatory tests by Osazone formation. (Glucose, Fructose, Maltose, Lactose, sucrose, starch, Dextrin).

2. Quantitative estimation of sugar by Willstatter's method

3. Study of physical and chemical properties of fats/oils.

4. Determination of acid value of oil/Saponification Value Determination of iodine value of oil / Peroxide Value

5. Estimation of Ascorbic acid (vitamin C) from Lime juice/natural source by dye method.

6. Separation of amino acids by radial paper chromatography

7. Thin layer Chromatography of amino acids or carbohydrates

BOOKS RECOMMENDED:

1. Plummer, D.T. An introduction to Practical Biochemistry, 3rd Edn, Tata Mc Graw Hill New Delhi 1988.
2. Jayaraman T. Lab Manual in Biochemistry W.B. Saunders Co. , Philadelphia.
3. Varley H., Gowenlock AH and Maurice Bell Practical Clinical Biochemistry, Vol 1, William Heinemann Medical Books, Ltd, London.

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I B. PHARM

SEMESTER II

1.2.5 ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY- II (THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBERS OF HOURS
1	**Cardiovascular System** Anatomy of the heart and blood vessels, heart valves & Blood circulation ,cardiac muscle, conducting system of heart, cardiac cycle, ECG and its significance, significance of heart sounds. heart valve defects,. Blood vessels and hemodynamics, blood pressure and its regulation. Cardiac output and its regulation. Shock & homeostasis hypertension, MI, CCF	15
2	**Urinary System** Anatomy and functions of the kidney. Physiology of urine formation, composition of urine kidney function tests . Renin- angiotensin system and micturition.	8
3	**Fluid, Electrolyte and Acid base homeostasis** Fluid compartment, electrolytes in the fluid, regulation of water and electrolyte, acid –base balance. Dehydration, hypon/ hpernatremia, Hypo/ hyperkalemia, fluid replacement in body	4
4	**Respiratory System** Anatomy and Physiology of respiratory organs, Pulmonary ventilation regulation and factors affecting respiration , respiratory volumes, vital capacity and their clinical significance. Exchange & Transportation of gases. Control of respiration. Exercise and respiratory system, Disorders such as hypoxia, asthma, COPD	8
5	**Demonstration** 1) BP /ECG Measurement (Biopak) 2) Lung volume 3) Polyphysiograph	1

BOOKS RECOMMENDED:

1. Gerald J. Tortora & Sandra Reynolds Grabowaski Principle of Anatomy & Physiology . 10th Edition (2003) John Wiley & Sons Inc, Newyork, USA

2. Concise medical Physiology by Choudhary

3. Anne Waugh and Alleon Grant Ross & Wilson's Anatomy & Physiology in Health & 9t h Edition (2001) Churchill Livingstone, Edinbrigh, London, New York.

4. Arthur C. Guyton & John Half. Textbook of Medical Physiology 10t h Edition (2000) W.B. Saunders Company, Philadelph , Pensylvania, USA 3.B. R. Mackenna & R. Callander Illustrated Physiology 6t h Edition 1997, Churchill Livingstone, Newyork Edinburgh, London

5. Praful b. Godkar Textbook of Medical Laboratory Technology 2 nd Edition2006 Bhalani Publishing House, Mumbai

BACK

I B. PHARM

SEMESTER II

1.2.6 PHARMACOGNOSY – I

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	Definition, history, scope and development of Pharmacognosy.	2
2	Source of drugs, biological, marine, mineral and plant tissue culture as source of drugs. Organised and unorganized crude drugs. Systematic description of a crude drug.	2
3	Different methods of classification of crude drugs – alphabetical, morphological, taxonomical, chemical, pharmacological and chemotaxonomical classification of drugs.	2
4	Cultivation, Collection, processing and storage of crude drugs. Factors affecting cultivation of crude medicinal plants. **Exogenous**- Altitude, climate, temperature, rainfall, soil and soil fertility, pest & pest control, growth hormones. **Endogenous**-Mutation, Hybridisation, polyploidy and chemodenses). Detailed method of cultivation and processing of the following drugs: Senna, Cinchona, Isabgul, Opium & Ergot.	6
5	Study of morphological, microscopical and cell wall constituents of crude drugs: a. Cell wall constituents and cell inclusions (Ergastic substances – organic and inorganic substances). b. Study of simple plant tissues – parenchyma, collenchyma, sclerenchyma, complex tissues – xylem and phloem. Study of stomata and trichomes. c. General characters of woods, barks, leaves, flowers, seeds, fruits, roots and rhizhomes. d. Study of morphology and microscopy of different plant parts Leaf – Datura and Senna	15
	Bark – Cinnamon and cinchona Wood–Quassia Stem – Ephedra Root – Rauwolfia and Liquorice Rhizome – Ginger and Podophyllum Flower – Clove Fruit – Coriander and Fennel Seed – Isapgul and Nuxvomica	

Sr. No.	TOPICS	NUMBER OF HOURS
6	Adulteration: Definition, causes for adulteration, different methods of adulteration and general methods for detection of adulterants	2
7	Introduction to pesticides of natural origin – introduction study of the following with respect to their occurance, chemistry and uses (Pyrethrum, Neem, Tobacco)	3
8	Fibres: Study of fibres used in pharmacy such as cotton, silk, wool, nylon, glass wool, polyester and asbestos.	2
9	Pharmaceutical Aids: Study of pharmaceutical aids like Talc, Diatomite, Kaoline, Bentonite, and Natural Colours (to be discussed)	2

1.2.6 PHARMACOGNOSY – I (PRACTICALS)

3 Hours/Week

1. Study of microscope and different parts of microscope.
2. Study of trichomes and stomata.
3. Study of cell wall constituents and cell inclusions.
4. Morphological and microscopical study of the following drugs:
    - Leaf – Datura and Senna
    - Bark – Cinnamon and cinchona
    - Wood–Quassia
    - Stem – Ephedra
    - Root – Rauwolfia and Liquorice
    - Rhizome – Ginger and Podophyllum
    - Flower – Clove
    - Fruit – Coriander and Fennel
    - Seed – Isapgul and Nuxvomica
5. Morphology of other crude drugs studied in theory (Fibres, Pharmaceutical aids, Pesticides etc.)

BOOKS RECOMMENDED:

1. Trease G. E. and Evans, W. C., Pharmacognosy, 16th Ed, Bailliere Tindall, Eastbourne, U.K., 2010.
2. Kokate C. K., Purohit A. P. and Gokhale S. B., Pharmacognosy 41st Ed., Nirali Prakashan, 2008.
3. Tyler V. E., Brady R., Textbook of Pharmacognosy, 8th Ed, Lea and Febiger, Philadelphia, 1981.
4. Iyengar, M. A., and Nayak, S. G. K., Anatomy of Crude Drugs, 8th Ed., Manipal Power Press, Manipal., 2001.
5. Kokate, C. K., Practical Pharmacognosy, 3rd Ed., Vallabh Prakashan, Delhi., 1991.
6. Medicinal plants of India, Indian Council of Medical Research, New Delhi.
7. Wallis, T. E., Textbook of Pharmacognosy, 5th Ed., J. A., Churchill Limited, London, 1985.

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II B. PHARM

SEMESTER III

1. 3.1 PHARMACEUTICS III

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**DESIGN AND DEVELOPMENT OF PHARMACEUTICALS** General considerations, Preformulation and formulation of dosage forms, general principles, excipients, detailed aspects and controls- Introduction to Process and equipment validation. Procurement of Raw Materials - Manufacturers reliability, Manufacturer's Drug Information Profile.	6
2	**TABLETS** **i) Introduction** Types of tablets, their description, advantages and disadvantages of tablets in general. a. Granulation technology: Tablet Formulation components/excipients (binders, diluents, colorants, flavors, glidants, anti adherents, disintegrants, superdisintegrants etc.), review of solid-solid and solid-liquid mixing, drying of granules, mixing, granulation and drying equipments, advances in granulation technology and equipment, fluidization and fluidization equipment, pneumatic conveying, characterization of granules, in-process control. b. Tablet Compression: Tablet Machines (Single punch, single and double rotary machines, dry cota compression machines), compression cycle, defects in compressed tablets, in-process control, prevention of cross contamination. Problems & trouble shooting in tablets. Tablet tooling, types & applications.	1 8 5

Sr. No.	TOPICS	NUMBER OF HOURS
	c. Packaging of Tablets: Packaging materials (aluminium foil, paper, plastic-PVC film, jars, labels etc.), packaging machines (blister, strip packaging, bulk pack), Cross contamination, product mix-up, product identification and relevant cGMP, in process control. d. Quality Control standards: pharmacopoeial requirement, Disintegration test, Dissolution test, hardness, friability, weight variation, content uniformity etc. **ii) Coating of Tablets** Need for coating, types (sugar, film, compression coating), materials used, coating equipments (different types of coating pans, fluid bed coating etc.), coating process, defects in coating, evaluation of coated tablets, safety considerations. **iii) Manufacturing facilities and layout design of tablet dept.**	2 3 5 2
3	**POWDERS AND GRANULES** Advantages, pretreatment to ingredients, processing techniques, mixing and equipment used for the same, pouches and bottle packing and equipments used for the same, environmental controls during manufacturing and packing of powders, effervescent products.	4

BOOKS RECOMMENDED:

1. Ansel's Pharmaceutical Dosage forms and Drug Delivery system (Wolter Kluwer, Lippincott William Wilkins)

2. Remington's Pharmaceutical Sciences- Alfonso R. Gennaro (Mack Publishing Co)

3. Bentleys T.B. of Pharmaceutics- Rawlins(ELBS)

4. The Theory and Practice of Industrial Pharmacy by Lachman, Lieberman and Kanig (Lea and Febiger)

5. Modern Pharmaceutics- Dekker, Banker Rhodes

6. Groves- Parenteral Products (William Heinemann Medical Books Ltd.)

7. Hanlon- H.B.of packg. Engg.(Mc Graw Hill)

8. Swarbrick and Boyan- Encyclopedia of Pharmaceutical Technology (Marcel Dekker)

1. 3.1 PHARMACEUTICS - III
(PRACTICALS)

3Hours/Week

NOTE: Latest text books and pharmacopoeia should be referred.

1. Excipients : Evaluation of about three latest tablet excipients (atleast one multifunctional excipient)
2. Packaging: Evaluation of packaging materials.
3. Tablets
   i) Granulation, Compression including IPQC
   - Soluble aspirin tablets,
   - Riboflavin tablets,
   - Paracetamol tablets,
   - Chewable tablets
   - Antihistaminic tablets

   ii) Evaluation of marketed Paracetamol tablets
4. Tablet Coating: demonstration
5. Powders – Formulation & evaluation
   - Oral-rehydration solution formulation
   - Dry syrup formulation for reconstitution
   - Senna granules

Note: Incase of non-availability of raw materials/drugs for carrying out practical experiments covering similar principles can be carried out.

BOOKS RECOMMENDED:

1. Ansel, Introduction to Pharmaceutical Dosage Forms(Lea and Febiger)
2. Sinko P., Martin's Physical Pharmacy and Pharmaceutical Sciences, Lippincott/ Wolter Kluer.
3. Remington's Pharmaceutical Sciences (Mack)
4. Mittal, Pharmaceutical Formulations.
5. Lachman, Industrial Pharmacy (Lea & Febiger)
6. Banker, Modern Pharmaceutics, Marcel Dekker.
7. Official pharmacopoeia like I.P., B.P., U.S.P.

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II B. PHARM
SEMESTER III

1. 3.2 PHYSICAL PHARMACEUTICS - I
(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**STATES OF MATTER** SOLIDS: Crystallization, Factors affecting crystallization Crystal size, Methods of crystal analysis: X-Ray Diffraction, Bragg's Method and powder method Polymorphism: Definition, Different shape of polymorphs, Example and its application to pharmacy, Mention Detection techniques. LIQUIDS: Intermolecular Forces, Additive, Constitutive, Colligative Property GASES: Ideal Gas Equation, liquefaction of gases	6
2	**PHYSICAL PROPERTIES OF DRUG MOLECULES** Refractive Index, Snell's Law, Molar Refraction, Optical Rotation, Angle of Rotation, Optical Rotatory Dispersion, Dielectric Constant, Dipole Moment Dissociation Constant	5
3	**CHEMICAL KINETICS** Rate of reaction, Order of reaction, Molecularity of a reaction Mathematical treatment of zero, first and second order Half Life, Biological Half Life, Shelf Life Determination of order Effect of temperature Arrhenius equation and energy of activation Stability of pharmaceuticals Kinetic aspects of chemical degradation of drugs Understanding of statistical aspects of expiry period Degradation pathways Physical & chemical instability & evaluation methods Accelerated stability studies, Storage of Drugs	7

Sr. No.	TOPICS	NUMBER OF HOURS
4	**IONIC EQUILIBRIA & BUFFERS** Modern Theories of Acids, Bases and Salts Sorensen's pH scale Calculation of pH, pKa Dissociation & Dissociation Constant Ionization of Weak Acids & Bases Buffers in Pharmaceutical & Biological systems Buffer Equation Buffer Capacity Buffered Isotonic Solutions Concept of Tonicity in Pharmacy Methods of adjusting Tonicity & pH	6
5	**SOLUBILITY & DISTRIBUTION PHENOMENA** Solute solvent interactions Solubility of Gases in liquids, Solubility of liquid in liquids Solubility of solids in liquids, Factors affecting solubility Solubility of slightly soluble electrolytes Solubility of weak electrolytes Influence of pH, solvents, solubility parameter and combined effect of pH and Solvents Distribution Phenomenon: Nernst distribution law and its limitations, Effect of ionic dissociation and association, application in Pharmacy	7
6	**DIFFUSION & DISSOLUTION** Diffusion and Dissolution-steady state diffusion Diffusion Cells Study of permeability of polymer and biological membranes Laws of Diffusion, Methods & Procedures for study of Diffusion Transport of drug across GIT, Types of Drug Release -Lag time Dissolution – The diffusion Layer Model, Noye- Whitneys Equation Factors influencing Dissolution, Dissolution apparatus Drug in polymer matrices, effect of porosity and tortuosity.	7

1. 3.2 PHYSICAL PHARMACEUTICS - I (PRACTICALS)

3 Hours/ Week

1. Determination of half life and rate constant for First Order and Second Order Reactions.

2. Accelerated Stability Testing, Shelf Life determination.

3. Preparation of Buffer, measurement of pH and calculation of pKa using pH meter.

4. Determination of Buffer Capacity

5. Determination of HLB number of surfactants by Griffin's method

6. Determination of solubility of solids at different temperatures.

7. Critical Solution Temperature

8. Determination of partition coefficient of Iodine between Water & Carbon Tetrachloride.

9. Determination of partition coefficient of Benzoic Acid between Benzene & Water.

10. Determination of concentration of optically active substance using Polarimeter.

11. To determine the heat of neutralization of strong acid and strong base.

12. To determine the effect of surfactant (Tween 80) on solubility of salicylic acid.

BOOKS RECOMMENDED:

1. Textbook of Physical Chemistry, Glasstone Samuel, Mc Millan Publishers.
2. Advanced Pharmaceutical Solids, Carstensen J. T, Marcel Dekker
3. Chemical Stability of Pharmaceuticals, Connors K. A, Wiley J.
4. Physical Pharmacy, Martin Alfred, Waverley Publishers
5. Physical Chemistry with Applications to Biological System, Raymond Chang, Collier Mac Millan International Ed.
6. Martin's Physical Pharmacy and Pharmaceutical Sciences, Sinko.
7. Essentials of Physical Pharmacy, CVS Subramanyam, Vallabh Prakashan
8. Textbook of Physical Pharmaceutics, CVS Subramanyam, Vallabh Prakashan
9. Remington: The Science and Practice of Pharmacy (Mack Publishing Co.)
10. Lachman and Liebermann - Theory and practice of Industrial Pharmacy
11. Pharmaceutical Technology - Eugene Parrott
12. Bentleys Text book of Pharmaceutics - E A Rawling

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II B. PHARM

SEMESTER III

1. 3. 3 PHARMACEUTICAL MICROBIOLOGY (THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1.	History of Microbiology. Introduction to microbiology. Significance of microbiology in general and in the pharmaceutical industry.	3
2.	Structure, functioning and morphology of bacterial cells. Study of bacterial growth, factors affecting growth, growth curve and turbidimetry, generation time and growth rate, batch v/s continuous growth, chemostat and turbidostat. Organization of microbial cells –eukaryote v/s prokaryote, archaebacteria v/s eubacteria. Axenic culture and pure culture techniques, growth cultivation, types of media, preservation, anaerobic growth. Introduction to extremophiles and viable but non-cultural bacteria.	5
3.	Classification of micro-organisms. Basis of classification. Traditional and modern approaches used for bacterial identification including molecular methods. Classification of microbes based on source of nutrients and energy.	3
4.	Study of rickettsiae, chlamydiae, actinomycetes, slime molds, fungi, viruses, algae, protozoa, prions. Life-cycle of bacteriophage and basic concepts of virology.	4
5.	Introduction to microscopy: light, dark field, phase contrast, fluorescent, electron. Working of microscope. Methods of staining, Simple, differential, structural and vital. Types of stains used in microbiology. Use of stain-based methods to detect bacteria (propidium iodide). Study of Flow cytometry.	4
6.	Enumeration and detection of bacteria- traditional and modern methods. Use of diagnostic kits and molecular methods.	2
7.	Microbiology of air, water, soil, normal flora of human body, probiotic and pre-biotics. Study of aseptic techniques. Sterility and asepsis, standards required in pharma units, procedures followed.	2

Sr. No.	TOPICS	NUMBER OF HOURS
8.	Control of micro-organisms; sterilisation methods- dry and moist heat, radiation, filtration, gaseous chemosterilisers. Methods of validation-sterility tests, indicators. Pasteurization, TDT,TDP concept, survivor curve. Study of antiseptics and disinfectants, types, properties, factors affecting action, evaluation.	3
9.	Study of microbial genetics and variation. Structure and organization of bacterial genome .DNA transfer methods, Extra-chromosomal genetic elements- transposons and plasmids, mutations and mutagenic agents, mutagenic repair-dark and photodynamic. Flow of genetic information and gene manipulation. Applications of microbes in recombinant DNA technology.	3
10.	Microbiological bioassays. Mechanisms of anti-microbial drug-resistance	2
11.	Brief introduction to immunity Basic types of serological reactions-agglutination, precipitation, flocculation. Widal, VDRL, RIA and ELISA.	1
12.	Medical Microbiology- Germ Theory of disease, Concept of virulence. Study of infections caused by *Staphylococcus, Pseudomonas, Clostridium, Vibrio, Mycobacterium, Salmonella, Shigella, E.coli, Leishmania, Plasmodium and fungal infections.*	4

1. 3. 3 PHARMACEUTICAL MICROBIOLOGY

(PRACTICALS)

3 Hours/ Week

1. Working of basic laboratory instruments like hot air oven, autoclave, incubator, shaker, laminar flow, microscope, colorimeter, colony counter, antibiotic zone reader

2. Preparation and sterilization of culture media for bacterial isolation and cultivation.

3. Sub-culturing and isolation of bacteria in pure culture: streak, stab, aseptic transfers in solid and liquid media, cultivation of anaerobes, serial dilution, enrichment and selective media.

4. Isolation and cultivation of fungi.

5. Staining methods- Monochrome, gram, acid-fast, negative, cell wall and endospore

6. Identification of bacteria as per Bergeys manual. Use of Biochemical tests.

7. Validation of sterilization by spore strips and controls.

8. Bacterial growth curve by turbidimetry.

9. Viable count, MPN, dry and wet weight of bacteria.

10. Antibiotic sensitivity tests

11. Isolation by selective enrichment: isolation of alkalophiles, thermophiles and cholesterol degraders from soil.

BOOKS RECOMMENDED:

1. Pharmaceutical Microbiology by Ashutosh Kar. New Age International Publishers (2008).

2. Textbook of Medical Microbiology by Anant Narayan Ed. By Panicker, 7th Edition, Universities Press.

3. Microbiology, an introduction by Tortora, Funke and Casse, 9th edition, Pearson Publications.

4. Hugo and Russell Pharmaceutical Microbiology.

BACK

II B. PHARM

SEMESTER III

1. 3.4 PHARMACEUTICAL ORGANIC CHEMISTRY – III

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**Nomenclature, Synthesis and Chemical reactions of the following polynuclear hydrocarbons** Naphthalene, Anthracene and Phenanthrene. (Nomenclature will include polyfunctional substitution by various organic functional groups in these ring systems) Huckel rule for aromaticity, 2, 4 and 6 annulenes.	6
2	**Nomenclature, Synthesis and Chemical reactions of the following simple and fused heterocyclic compounds** Pyrrole, Furan, Thiophene, Imidazole, Oxazole, Thiazole, Pyridine, Pyrimidine, Indole, Quinoline and Isoquinoline. (Nomenclature will include polyfunctional substitution by various organic functional groups in these ring systems)	15
3	**Stereochemistry** i. Geometrical isomerism – Z & E nomenclature, determination of configuration by physical and chemical methods. ii. Optical isomerism – Compounds with one and two asymmetric carbon atoms, the conditions of chirality, Representation- dotted, line wedge, Fischer, Sawhorse and Newman projections. Notations / Nomenclature using D, L and R, S. Resolution of racemic mixture. Diastereomers – Erythro & Threo isomers. iii. Conformation – ethane, propane and n-butane – eclipsed, staggered and gauche conformations. Potential energy as a function of dihedral angle in ethane, propane and n-butane. Cyclohexane – boat, chair, twisted boat (skew boat). Important features of the preferred chair conformation. Relative stabilities of various conformations of monosubstituted and disubstituted cyclohexanes. Number of stereoisomers of disubstituted cyclohexanes. iv. Atropisomerism – Biphenyl and tetra ortho-substituted biphenyls.	10

Sr. No.	TOPICS	NUMBER OF HOURS
4	**Stereospecificity and Stereoselectivity in organic reactions** SN^1 & SN^2 reactions, syn & anti-elimination and addition reactions in acyclic compounds. Curtin Hammett principle	5

BOOKS RECOMMENDED:

1. Organic Chemistry- By Stanley Pine, 5th Edn. (McGraw-Hill).

2. Organic Chemistry- By Allinger, Cava, De Jough, Johnson, Lebel, Stevens, (Worth Publishers)

3. Organic Chemistry- By Robert Thornton Morrison, Robert Neilson Boyd and Saibal Kanti Bhattacharjee, 7th Edition, (Pearson)

4. Introduction to Organic Chemistry, Andrew Streitwieser, Clayton H. Heathcock and Edward M. Kosower. (Macmillan)

5. Stereochemistry of Carbon Compounds, Ernest. L. Eliel and Samuel H Wilen, (Wiley India)

6. Stereochemistry of Organic Compounds -Principles and Applications, D. Nasipuri (New Age International Publishers)

7. Advanced Organic Chemistry, By E.S. Gould (Wiley Eastern Edition)

8. Principles of Organic Synthesis, By-R.O.C. Norman (Nelson Thorns Publication)

9. A guide book to Mechanisms in Organic Chemistry, Peter Sykes (Pearson Education)

10. Heterocyclic Chemistry By- Joule J.A. and K. Mills. 5th Edition (Wiley)

11. Finar : "Organic Chemistry," Vol.1-The Fundamental Principles (ELBS Longman)

12. Finar : "Organic Chemistry," Vol. 2 -Stereochemistry & The Chemistry of Natural Products (ELBS Longman- Pearson Education Asia Pvt.Ltd.)

13. Heterocyclic Chemistry, By-Raj K. Bansal (New Age international Publishers)

14. Advanced Organic Chemistry, By- Bahl and Bahl, (S. Chand & Company Ltd., Ramnagar, New Delhi)

15. Synthetic Organic Chemistry, Gurdeep Chatwa l (Himalaya Publishing House)

1. 3.4 PHARMACEUTICAL ORGANIC CHEMISTRY – III (PRACTICALS)

3 Hours / Week

1. Qualitative Organic Analysis: Separation of Solid - Solid, Solid - Liquid or Liquid - Liquid binary organic mixture, identification and characterization of components thereof by physical, chemical tests followed by derivatization into known compounds.

2. Synthesis of the following heterocyclic compounds:
   i) Preparation of 3,5-dimethylpyrazole from Acetylacetone.
   ii) Preparation of 5,5-diphenylimidazoline-2,4-dione from Benzil.
   iii) Preparation of Benzotriazole from *o*-phenylenediamine.

3. Stereomodelling: conformations of ethane, propane, n-butane and cyclohexane. (Use of computer software generated 3D models)

BOOKS RECOMMENDED:

1. Practical Organic Chemistry by F. G. Mann and B.C. Saunders, (Orient Longman/ Pearson Education)

2. An Introductory course in Practical Organic Chemistry by F. D. Gunstone, D. M. Smith, John Traquair Sharp (Chapman and Hall)

3. A Textbook of Practical Chemistry for B.Sc.- By V. Nadkerny (Popular Prakashan)

4. Introduction to Organic Laboratory Techniques contemporary approach. by D.L. Pavia (Saunders Golden Sunburst)

5. Vogel's - Textbook of Practical Organic Chemistry – Edited by Furniss B.S et. al. (ELBS)

6. Experimental Organic Chemistry Vol. I & II by P.R. Singh, D.S. Gupta and K.S. Bajpai (Tata McGraw-Hill)

7. Advanced Practical Organic Chemistry by O.P. Agarwal.

BACK

II B. PHARM

SEMESTER III

1. 3.5 ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY - III (THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**ENDOCRINE SYSTEM** Anatomy physiology and related disorders of various endocrine glands. Formation, storage, action & regulation of their hormones. Hypothalmus – Location and release of factors, portal system. Anterior pituitary – Growth hormone, TSH, FSH, LH, ACTH, Prolactin, oxytocin menlanocyte stimulating hormones Formation, storage, action & regulation of thyroid, parathyroid, adrenal, pancreatic hormones. Hormones of thymus & pineal gland. Disorders due to hyper and hypo secretion of these hormones Diseases like diabetes, Hypothyrodism & thyrotoxicosis Stress response . Hormone replacement therapy.	14
2	**REPRODUCTIVE SYSTEM** Male reproductive system anatomy and physiology. Spermatogenesis, semen & normal sperm count. Male sex hormone its production and function. Female reproductive system anatomy and physiology and their hormones, & oogenesis. Female reproductive cycle & physiology of menstruation. Female sex hormones their production and functions, coitus and fertilization, Sex differentiation, contraception & OCs. Etiology & Pathophysiology of Cryptorchidism, vasectomy, hysterectomy, amenorrhea, infertility, premature ejaculation, disorder of prostate, STD, vulvitis, viginitis, polycytic, ovaries, tumors.	5 6

Sr. No.	TOPICS	NUMBER OF HOURS
3	**DIGESTIVE SYSTEM** Anatomy & Physiology of different parts of digestive system and their functions.(Mouth, tongue teeth, oesophagus, stomach, small intestine, large intestine). Formation and functions of digestive secretions. Movements of Gastro intestinal track like swallowing, peristalsis, defection etc. Digestion and absorption of carbohydrates, proteins and fats. Etiology, pathogenesis, signs and symptoms of : Peptic ulcers Zollinger Ellison's syndrome Inflammatory bowel disease Cholecystitis and cholelithiasis, Jaundice, Hepatitis, Pancreatitis Achalasia GERD, Diarrhea, constipation, appendicitis.	8
4	Pregnancy, early pregnancy tests, its maintenance. Embryonic period, Fetal period, teratogens, Maternal changes during pregnancy, parturition, Physiology of lactation. Breast cancer, Stem cell research, cloning.	3

BOOKS RECOMMENDED:

1. Gerald J. Tortora & Sandra Reynolds Grabowaski Principle of Anatomy & Physiology . 10th Edition (2003) John Wiley & Sons Inc, Newyork, USA

2. Concise medical Physiology by Sujit Chaudhari

3. Anne Waugh and Alleon Grant Ross & Wilson's Anatomy & Physiology in Health & 9t h Edition (2001) Churchill Livingstone, Edinbrigh, London, New York.

4. Arthur C. Guyton & John Half. Textbook of Medical Physiology 10t h Edition (2000) W.B. Saunders Company, Philadelph , Pensylvania, USA 3.B. R. Mackenna & R. Callander Illustrated Physiology 6t h Edition 1997, Churchill Livingstone, Newyork Edinburgh, London

5. Praful b. Godkar Textbook of Medical Laboratory Technology 2 nd Edition2006 Bhalani Publishing House, Mumbai

1. 3.5 ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY - III PRACTICALS

3 Hours/ Week

1. Preparations of hypertonic, hypotonic and calculations based on it as under:-
   a) Preparing --- % solution & Stock solutions
   b) Preparing and diluting specific molar, normal solution
   c) Diluting solution in terms of mEq/L, µg,ng, ppm etc.
   d) Measure and adjust pH of different solutions.
2. Histology of the tissues covered in theory
3. Dissection based on simulated experiments and Computer Aided Learning (Pertaining to systems covered in theory)

BACK

II B. PHARM

SEMESTER III

1. 3.6 PHARMACEUTICAL ANALYSIS – I (THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**Basic Concepts of Volumetric Analysis:** Significance of quantitative analysis in quality control, different techniques of analysis, types of errors, precision and accuracy, selection of sample. Fundamentals of volumetric analysis, methods of expressing concentration, calculation of equivalent weight and stoichiometry, primary and secondary standards. Theory of indicators (both external and internal), concept of end point.	6
2	**Aqueous Acid Base Titrations:** The Law of mass action, Hydrolysis of salts, Neutralization curves, types of acid-base titrations, choice of indicators, mixed indicators, universal indicators, direct titrations and modifications in titration of strong acid, weak acid, strong base and weak base. Applications: assay of Hydrochloric acid, Benzoic acid, Aspirin, Boric acid, Calcium Hydroxide, Lactic acid, Ammonium Chloride.	5
3	**Non-aqueous titrations:** Theory, solvents, indicators, types of non-aqueous titrations. Applications in assay of Sodium benzoate, Ephedrine hydrochloride, Ethosuximide.	3
4	**Oxidation-Reduction Titrations:** Concepts of oxidation and reduction, redox reactions, theory of redox titrations, Redox indicators, oxidation-reduction curves. Titrations involving potassium permanganate, potassium dichromate, ceric sulphate, iodine (iodimetry and iodometry), potassium iodate, potassium bromate, titanous chloride. Applications: Assay of Hydrogen Peroxide, Ferrous Sulphate, Ascorbic acid, Copper Sulphate, Potassium Iodide, Isoniazid, Indigo carmine.	8
5	**Complexometric titrations:** Theory, formation of complex and its stability, titration curves, types of EDTA titrations, metallochromic indicators, masking and demasking agents. Applications: Assay of Magnesium sulphate, Calcium phosphate, Calcium gluconate.	4

Sr. No.	TOPICS	NUMBER OF HOURS
6	**Precipitation Titrations:** Theory, precipitation reactions, factors affecting solubility of precipitate. Titrations- Mohr's method, Volhard's method, Fajan's method and Gay Lussac method. Applications: Assay of Sodium Chloride, Potassium Chloride	4
7	**Diazotisation Titrations:** Theory, diazotisation reactions, applications.	1
8	**Gravimetric Analysis:** Theory, solubility products, steps in gravimetric analysis, impurity in precipitate, organic precipitants, precipitation in homogeneous solution. Applications: Precipitation of Aluminum by Oxine method, Calcium as Oxalate, Magnesium as Pyrophosphate, Aluminum by homogenous precipitation method.	5

1.3.6 PHARMACEUTICAL ANALYSIS – I (PRACTICALS)

3 Hours/ Week

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

1. Calibration of volumetric apparatus.

2. Calibration of weighing Balances.

3.Preparation and standardization of Standard solutions of Hydrochloric acid,Sodium hydroxide, Potassium permanganate, Cerric ammonium sulphate, Iodine, Sodium thiosulphate, Potassium bromate, Silver nitrate, Ammonium thiocyanate, Perchloric acid, EDTA.

4. Acid-Base Titrations: Aspirin, Sodium carbonate, Ammonium chloride.

5. Non-aqueous titrations: Sodium benzoate / Ephedrine hydrochloride.

6. Oxidation Reduction Titrations: Ferrous sulphate, Ascorbic acid, Copper sulphate, Isoniazid.

7. Precipitation titrations: Sodium chloride, Potassium chloride.

8. Complexometric titrations: Calcium gluconate, Magnesium sulphate, Zinc oxide.

9. Gravimetric Analysis : Nickel by Oxine method, Aluminum by Oxine method, Zinc sulfate by Oxine method. (any two)

BOOKS RECOMMENDED:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Text book of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control , McGraw Hill.
3. Beckett A. H. and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II, The Anthlone Press of University of London.
4. Connors K. A, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry, John Wiley.
6. Garrat- The quantitative analysis of Drug, Toppan & Co.
7. Vogel's textbook of Quantitative Chemical Analysis by Mendham & others, Pearsons Education Limited.
8. A.V.Kasture, S. G. Wadhodkar, K. R. Mahadik, H. N. More, Pharmaceutical Analysis Vol. I & II, Nirali Publication.
9. D. Skoog, James Leary; Principles of Instrumental Analysis, HarCourt Brace College Publishers.
10. Chatten L.G, A Texbook of Pharmaceutical Chemistry, Vol I and II, Marcel Dekker, New York.
11. Y. Anjaneyulu, K. Chandrasekhar, Valli Manickam, A textbook of Analytical Chemistry, Pharma Book Syndicate.
12. Latest editions of IP, BP, USP

BACK

II B. PHARM
SEMESTER III
1.3.7 BIOSTATISTICS
(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPIC	NUMBER OF HOURS
1	**BIOSTATISTICS** Introduction and scope of biostatistics, use of statistics in Pharmaceutical Sciences,. Variables and Attributes, Collection and presentation of Statistical data, Procedures for Inferential Statistical tests, Frequency Distribution and Graphical Representation	3
2	**METHODS OF SAMPLING** Random Methods: Random, stratified, systematic, cluster; Non-random: Deliberate , convenience, quota sampling, Choice of sampling, sampling and non sampling errors	3
3	**DIAGRAMMATIC AND GRAPHIC REPRESENTATION** Introduction, Diagrammatic representation: line , Bar: Divided, percentage and multiple bar diagram, Pie ; Histogram, Frequency curve, ogive; Significance ,limitations.	4
4	**MEASURES OF CENTRAL TENDENCY** Introduction, Arithmetic mean, Median, mode, Geometric mean, Harmonic mean (in a series of individual observations, discrete and continuous) **Merits and demerits of** Geometric mean, Harmonic mean Range, Variance ,Standard deviation, Mean deviation and Coefficient of Variation. Skewness and Kurtosis	5
5	**PROBABILITY** Concept of probability, Classic Probability, conditional Probability ,Theorems of Probability, Probability Applications, Probability Distributions, Binomial, Poisson, Normal, Area under the curve, Standard normal curve.)	3
6	**CORRELATION** Correlation analysis, Types: Positive, simple, partial and multiple correlation , Linear and non-linear correlation Methods, Graphic method, Degree of correlation	4

Sr. No.	TOPIC	NUMBER OF HOURS
7	**REGRESSION ANALYSIS** Difference between Correlation and Regression, Regression lines, Regression equations, Significance test for regression coefficient, Uses of regression Analysis	3
8	**TEST OF SIGNIFICANCE** Introduction, Basic idea of Null hypothesis, Alternative hypothesis, Type-1 error Type-II error, level of significance, Degree of freedom,. Test of Single mean, single variance, Two sample means and Variances. T-test for paired samples, Analysis of variance in one way classification, Practical examples	5
9	**DESIGNING AND METHODOLOGY OF AN EXPERIMENT OR A STUDY** Steps, Plan of action , Presentation briefs, Demography and vital statistics, Statistical quality control charts :Types.	6

BOOKS RECOMMENDED:

1. Fundamentals of Biostatistics, Khan and Khanum
2. Pharmaceutical Statistics - By Sanford Bolton
3. Basic Statistics and Pharmaceutical Applications, James E.De Muth
4. Statistics Method - S.P.Guptha
5. Methods in Biostatistics – B.K.Mahajan

BACK

II B. PHARM

SEMESTER IV

1.4.1 PHARMACEUTICS - IV

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPICS	NUMBER OF HOURS
1	**CAPSULES** Introduction, Classification, advantages and disadvantages, Hard Capsules (gelatin and non gelatin base), shell manufacturing, factors influencing (type of gelatin, impurities, plasticizers, environmental controls), Fill material formulation, components/excipients, Hard Gelatin Capsule filling equipments (automatic, semiautomatic, manual), processing, in-process controls, defects in filled capsules, evaluation of finished capsules and official standards. Soft Gelatin Capsules – Shell components and control on shell properties, formulation components/excipients, filling equipment, processing environmental control, defects in manufactured capsules, evaluation and official standards	5 5
2	**MICROENCAPSULATION** Definition, need, advantage, applications, methods of microencapsulation, coacervation-phase separation, pan-coating, air suspension coating, solvent evaporation, multi-orifice, centrifugal, spray drying and spray congealing and other processes, advances in microencapsulation technology, advances in core preparation, pelletization and pelletization equipment, extrusion and spheronization, CF-Granulator, Rotoprocessors, manufacturing processes and equipment for coacervation, phase separation, Quality control standards and evaluation.	8
3	**SEMISOLID DOSAGE FORMS** Classification, dermatologicals and transdermal preparations, skin morphology, factors affecting absorption of drugs, penetration enhancers, <u>Ointments:</u> Ointment bases, selection, properties of drug and the base governing drug release from ointments, formulation factors, manufacturing processes and equipments(filling and sealing machine), leak testing, Packaging and evaluation, Quality control.	2 3

Sr. No	TOPICS	NUMBER OF HOURS
3	<u>Creams:</u> Definition, advantages and disadvantages, types, ingredients and components, manufacturing, environmental controls, in-process and finished product controls, stability of creams and stability evaluation. <u>Gels and Jellies:</u> Definition, natural and synthetic gelling materials, rheological properties of gels and jellies, types of gels, formulation factors and components, packaging, stability and stability evaluation, Quality control.	3 2
4	**BIOLOGICAL PHARMACEUTICALS** Study of a) Whole human Blood, Blood products before and during collection, transportation and storage and plasma substitutes. b) Glandular products with respect to the precautions, processing/extraction, purification, packaging, safety and efficacy, evaluation and standards. c) Sutures and ligatures: Classification into absorbable and non-absorbable sutures, Catgut-boilable and non-boilable, processing and manufacturing, hardening of catgut, sterilization and packaging, Storage requirements, official standards.	8

1.4.1 PHARMACEUTICS - IV (PRACTICALS)

3Hours/Week

Hard gelatin Capsules: Evaluation of empty hard gelatin capsules as per IP.

1. Filling of empty hard gelatin capsules using hand operated capsule filling machine –demonstration.

2. Evaluation of one official capsule formulation.

3. Preparation and evaluation of Microcapsules/ Pellets.

4. Preparation of topical semisolids
    a. Simple ointment IP
    b. Calamine cream aqueous BPC
    c. Proflavine cream
    d. Non-staining Iodine Ointment with methyl Salicylate BPC
    e. Medicated gel - Diclofenac diethyl ammonium gel
    f. Medicated Gel – using different category of polymers
    g. Comparative study of various polymers with respect to rheological behaviour and viscosity

BOOKS RECOMMENDED:

8. Ansel, Introduction to Pharmaceutical Dosage Forms(Lea and Febiger)

9. Sinko P., Martin's Physical Pharmacy and Pharmaceutical Sciences, Lippincott/ Wolter Kluer.

10. Remington's Pharmaceutical Sciences (Mack)

11. Mittal, Pharmaceutical Formulations.

12. Lachman, Industrial Pharmacy (Lea & Febiger)

13. Banker, Modern Pharmaceutics, Marcel Dekker.

Official pharmacopoeia like I.P., B.P., U.S.P.
14.

BACK

II B. PHARM

SEMESTER IV

1.4.2 PHYSICAL PHARMACEUTICS – II

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPICS	NUMBER OF HOURS
1	**INTERFACIAL PHENOMENA** Surface Tension Interfacial Tension Surface Free Energy Spreading Coefficient Measurement of Surface Tension & Interfacial Tension Contact Angle Wetting Surface Active Agents Critical Micelle Concentration HLB Adsorption at liquid interfaces Types of Adsorption isotherms	8
2	**RHEOLOGY** Newtonian Systems Law of Flow Concept of Viscosity Types of Viscosity Methods to determine Viscosity Non- Newtonian Systems Plastic, Pseudo plastic, Dilatant Thixotropy Thixotropy in Formulation Anti Thixotropy Rheopexy	8
3	**COLLOIDS** Types of Colloids Methods of Preparation of colloids Purification Properties Stabilization Donnan Membrane Phenomena	8

Sr. No	TOPICS	NUMBER OF HOURS
4	**COMPLEXATION** Importance in Pharmacy Classification Method of analysis of complexes Applications Drug Protein Binding Methods to determine drug protein binding	6
5	**MICROMERITICS** Importance in Pharmacy Particle Size Distribution Methods to determine Particle Size, Particle Shape, Surface Area Derived properties of powders	6

1.4.2 PHYSICAL PHARMACEUTICS - II (PRACTICALS)

3 Hours/Week

1 To determine the surface tension and parachore of given sample using stalagnometer.
2 To determine the specific surface area of charcoal using acetic acid by adsorption method.
3 To determine critical micellar concentration (CMC) of given ionic surfactant using stalagnometer.
4 To determine the effect of electrolyte on sedimentation of calamine suspension.
5 To determine the particle size distribution using optical microscopy.
6 To determine the particle size distribution using sieve analysis.
7 To study the effect of lubricant on flow property of given powder.
8 To determine the various densities and porosity of given powder system.
9 To determine the viscosity using different equipments of given sample of liquid.
10 To determine the molecular weight of PVP / PVA using Ostwald's viscometer.
11 To demonstrate viscosity measurement using Brookfield's viscometer.
12 To determine density/specific gravity of liquids.

BOOKS RECOMMENDED:

1. Textbook of Physical Chemistry, Glasstone Samuel, Mc Millan Publishers.
2. Advanced Pharmaceutical Solids, Carstensen J. T, Marcel Dekker
3. Chemical Stability of Pharmaceuticals, Connors K. A, Wiley J.
4. Physical Pharmacy, Martin Alfred, Waverley Publishers
5. Physical Chemistry with Applications to Biological System, Raymond Chang, Collier Mac Millan International Ed.
6. Martin's Physical Pharmacy and Pharmaceutical Sciences, Sinko.
7. Essentials of Physical Pharmacy, CVS Subramanyam, Vallabh Prakashan
8. Textbook of Physical Pharmaceutics, CVS Subramanyam, Vallabh Prakashan
9. Remington: The Science and Practice of Pharmacy (Mack Publishing Co.)
10. Lachman and Liebermann - Theory and practice of Industrial Pharmacy
11. Pharmaceutical Technology - Eugene Parrott
12. Bentleys Text book of Pharmaceutics - E A Rawling

BACK

II B. PHARM

SEMESTER IV

1. 4.3 PHARMACEUTICAL ORGANIC CHEMISTRY – IV

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**MOLECULAR REARRANGEMENT: MECHANISM AND STEREOCHEMISTRY** i. Rearrangement of electron-deficient systems General reactions, Wagner Meerwein , Pinacol-Pinacolone, Wolff, Beckmann, Hofmann, Curtius, Schmidt, Lossen, Baeyer Villiger oxidation & Dakin Oxidation. ii. Rearrangement of electron rich systems – Stevens, Sommelet, Wittig, Favorskii, Neber and Benzilic acid rearrangements. iii. Migration of double & triple bonds- Cope rearrangement iv. Migration/ Rearrangement in aromatic ring- Fries & Claisen rearrangements v. Migration of functional groups- Willgerodt reaction	14
2	**STEROIDS** Introduction, Occurrence, Ring systems, Classification, Configuration & conformation: 5-alpha and 5-beta cholestane (conventional formula and conformational representation)	4
3	**RADICAL REACTIONS** **S**table free radicals, radical ions, chain reaction course – chain initiation (generation of radicals) propagation and termination reactions. Radical coupling, substitution at saturated carbon, addition to alkenes, aromatic substitution, Sandmeyer reaction, Gomberg reaction & Hunsdiecker reaction.	6
4	**ORGANOMETALLIC COMPOUNDS** A brief study of synthetic uses of Organomagnesium (Grignard reagents) and Organozinc reagents.	4
5	**MOLECULAR ORBITALS** Method of Linear combination of atomic orbitals (LCAO) – Sigma & Pi bonding. Frontier orbitals – HOMO & LUMO. Molecular orbital approach to linear conjugated system. Molecular orbital description of 1,3-butadiene, allyl system (allyl radical, allyl cation & allyl anion). Symmetry properties of orbitals – m and C_2. Electrocyclic reactions of butadiene. Cycloaddition (4s+2s) & (2s+2s).	8

BOOKS RECOMMENDED:

1. Pine, Hendrickson, Cram and Hammond, Organic Chemistry, McGraw-Hill Companies.

2. Allinger, Cava, De Jough, Johnson, Lebel, Stevens, Organic Chemistry, Worth.

3. Robert Thornton Morrison, Robert Neilson Boyd and Saibal Kanti Bhattacharjee Organic Chemistry by publisher Dorling Kindersley (India) Pvt. Ltd. Licensees of Pearson Education in South Asia.

4. Streitweiser and Heathcock, Organic Chemistry, Academic Press.

5. Ernest. L. Eliel, Stereochemistry of Carbon Compounds, Tata McGraw Hill Publishing Co. Ltd. New Delhi.

6. D. Nasipuri, Stereochemistry of Organic Compounds – Principles and Applications, New Age International Publishers

7. E.S. Gould, Advanced Organic Chemistry, Wiley Eastern Edition.

8. R.O.C. Norman, Principles of Organic Synthesis, Nelson Thorns Publication.

9. Peter Sykes, A guide book to Mechanisms in Organic Chemistry, Pearson Education.

10. Finar : "Organic Chemistry," Vol.1 (The Fundamental Principles), ELBS Longman.

11. Finar : "Organic Chemistry," Vol.2 (Stereochemistry & The Chemistry of Natural Products), ELBS Longman- Pearson Education Asia Pvt.Ltd.

12. Bahl and Bahl, Advanced Organic Chemistry, S. Chand & Company Ltd. Ramnagar, New Delhi.

13. Gurdeep Chatwal, Synthetic Organic Chemistry, Himalaya Publishing House.

1. 4. 3 PHARMACEUTICAL ORGANIC CHEMISTRY – IV (PRACTICALS)

3 Hours / Week

1. Quantitative Organic Analysis: Quantitative determination of reactive organic functional groups like
   a) hydroxyl group
   b) amino group
   c) carbonyl group
   d) carboxylic acid group
   e) unsaturation
   f) phenol content
   g) equivalent weight of carboxylic acid and amine

2. Synthesis of the following organic compounds based on molecular rearrangements & Name reactions:
   i) Beckmann Rearrangement: Benzanilide from Benzophenone oxime
   ii) Fischer Synthesis: 2-phenylindole from phenylhydrazine

BOOKS RECOMMENDED:

1. Practical Organic Chemistry by F. G. Mann et al, Publishers Orient Longman.

2. An introductory course in Practical Organic Chemistry by F. D. Crenstone et al.

3. A textbook of Practical Chemistry for B.Sc. by V. Nadkerny Popular Prakashan

4. Introduction to Organic Laboratory Techniques contemporary approach. by D.L. Pavia Publisher Saunders Golden Sunburst.

5. Furniss B.S. & others – Vogel's Textbook of Practical Organic Chemistry Publisher ELBS

6. Indian Pharmacopoeia 2007, volume 1.

7. Clanke et al, A handbook of organic analysis, Publisher Arnold Herneman.

8. Williamson K.L., Macroscale and Microscale organic experiments, D.C. Health & Cambridge

BACK

II B. PHARM

SEMESTER IV

1.4.4 ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY - IV

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPICS	NUMBER OF HOURS
1	**NERVOUS SYTEM** **Nervous tissue :** Histology of nervous tissue, Electrical signals in neurons , Synapse, signal transmission at synapse, neurotransmitters, neural circuits.	3
2	**SPINAL CORD & SPINAL NERVES** Anatomy & physiology of spinal cord, Spinal nerves reflex arc & action.	2
3	**BRAIN** Organization, protection, & blood supply. Cerebrospinal fluid its formation & circulation and function. Blood brain barrier and its significance. Structure, organization &function of Cerebrum, cerebellum, Diencephalon (thalamus, hypothalamus, epithalamus etc.) Limbic system, RAS etc . Brain stem (Midbrain, pons and medulla oblongata). Various areas of cortex (Sensory / motor) Cranial nerves their origin, type and function. Brain injury.	11
4	**AUTONOMIC NERVOUS SYSTEM** Sympathetic and parasympathetic nervous system. Neurotransmitters and their receptors. Properties of neurons and of various neurotransmitters	4
5	**SENSORY, MOTOR & INTEGRATIVE SYSTEM** Sensation, somatic & motor and their pathways. Basal ganglion and its disorder Phantom limb, analgesia, amnesia,	7
6	**SPECIAL SENSES** Anatomy of Eye, ear, tongue & nose. Physiology of Olfaction, Gustation ,vision, hearing & equilibrium. Common disorders of these organs like blindness, deafness.	5
7	**ETIOLOGY, PATHOGENESIS, SIGNS & SYMPTOMS OF** Epilepsy, parkinsonism, alzheimer's disease, cerebral hypoxia, Bipolar disorders and Schizophrenia, stroke, anxiety and depression	**4**

BOOKS RECOMMENDED:

1. Gerald J. Tortora & Sandra Reynolds Grabowaski Principle of Anatomy & Physiology . 10th Edition (2003) John Wiley & Sons Inc, Newyork, USA

2. Concise medical Physiology by Sujit Chaudhari

3. Anne Waugh and Alleon Grant Ross & Wilson's Anatomy & Physiology in Health & 9t h Edition (2001) Churchill Livingstone, Edinbrigh, London, New York.

4. Arthur C. Guyton & John Half. Textbook of Medical Physiology 10t h Edition (2000) W.B. Saunders Company, Philadelph , Pensylvania, USA 3.B. R. Mackenna & R. Callander Illustrated Physiology 6t h Edition 1997, Churchill Livingstone, Newyork Edinburgh, London

5. Praful b. Godkar Textbook of Medical Laboratory Technology 2 nd Edition2006 Bhalani Publishing House, Mumbai

BACK

II B. PHARM

SEMESTER IV

1.4.5 PHARMACOLOGY – I

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**GENERAL PHARMACOLOGY** Pharmacology in 21st Century, Alternative therapeutic principles. Definitions of drug (Chemical name, generic name , proprietary or brand name), dose, dose conversion in animals and human, pharmacokinetic, Pharmacodynamics. Balancing risk, benefit and cost , stages of drug development, laws governing animal study (CPCSEA). Different components/items of label of marketed preparations.	3
2	**ROUTES OF DRUG ADMINISTRATION** Local & Systemic route. Example of each type (Oral, rectal, percutenous, IV, IM, SC, IT, inhalation etc.) Meaning of terms like CR, SR, depot preparation.	2
3	**PHARMACOKINETICS** **Absorption of drugs**. (Partitioning and pKa of some drugs, first pass effect with examples) **Drug distribution**: Movement of drug across biological membrane, BBB, binding of drugs to plasma proteins. Volume of distribution: Definition concept, apparent Vd. **Drug metabolism**(Biotransformation) : Kinetics of metabolism, Types of drug metabolism.(Phase I&II),Enzyme Induction &Inhibition Eg. of CYP 450 enzymes and their substrates. Examples of active metabolites, toxic metabolites. **Drug elimination**: Renal elimination of a drug and other routes of drug disposition, (Urine, Faeces, Milk, Sweat, expired air, saliva.) Factors affecting ADME of a drug. **Half life of drug. Bioavailability**: Definition , Concept and factors influencing bioavailability.	6

4	**PHARMACODYNAMICS** How Drug acts ; Mechanism & Sites for action of drug. Receptor- Classification & functioning of ligand gated, ion channels, GPCR, Nuclear receptor. Formation of second messengers. Interaction of drugs with receptors. . Agonist & Antagonist, Combined effect of drug (Synergism, additive.). Dose response relationship - graded and quantal response.	7
Sr. No.	**TOPICS**	**NUMBER OF HOURS**
5	**FACTORS AFFECTING DRUG ACTION** (Ethnicity, race, age, sex route of administration, diseases, placebo effect.) **Adverse drug effects :** Definition, Classification factors , mechanism and types of ADR. ADR reporting.	3
6	**DRUGS ACTING ON GIT** Pharmacology of : Antacids, anti-secretory and other anti-ulcer drugs. Laxatives and antidiarrheal drugs. Drugs used in IBD. Emetics, antiemetics and prokinetics. Digestants and carminatives. Appetite stimulants and suppressants. (Detailed pharmacology of any one prototype drug & examples of some market preparations and their dose should be discussed)	3
7	**DRUGS USED IN BLOOD DISORDER** Hematinics and drugs used in anemia. Coagulants, anticoagulants and antiplatelet agents, Thrombolytics and anti-fibrinolytics. (Detailed pharmacology of any one prototype drug & examples of some market preparations and their dose should be discussed)	2
8	**DRUGS USED IN ENDOCRINE DISORDERS** Diabetes, Thyroid, reproductive system(Antiestrogen, antiprogesterone, androgens, drugs affecting contraception, uterus, Abuse of anabolic steroids in sports erectile dysfunction, corticosteroids, Bone metabolism, pituitary gland. Obesity. (Detailed pharmacology of any one prototype drug & examples of some market preparations and their dose should be discussed)	10

1. 4.5 PHARMACOLOGY – I (PRACTICALS)

3Hours/ Week

4. Study of commonly used appliances in experimental Pharmacology

5. Preparations of physiological solutions

6. Study of common laboratory animals, feeding and weighing of animals

7. Terminology associated with animal behavior and observations based on it.

8. Study of different routes of administration of drugs in mice/rats

9. Calculation of dose and amount to be administered in animals from the stock solutions

10. Calculation of Human Equivalent dose (HED) from animal dose

11. Study of various anesthetic and the procedure to anaesthetized animals.

12. Identification of various dosage forms & their respective routes in humans. Advantages, disadvantages of each dosage forms.

13. Recommendation of OTC drug for GIT problems (Market preparations)

14. Identifying different components of labeled drugs.

15. Indicating the temperature & storage conditions (IP) and expiry of the various products.

16. Measure body temperature.

17. Measure & recording room temperature, relative humidity, temp of various chambers of refrigerator.

BOOKS RECOMMENDED:

1. Goodman and Gilman's The Pharmacological basis of therapeutics. Goodman Gilman, T.W. Rall, ALS. Nies, P. Taylor McGraw – Hill, New Delhi

2. Essentials of Medical Pharmacology, K. D. Tripathi Jaypee Brothers Medical Publishers(P) Ltd

3. Rang and Dale's Pharmacology, HP Rang, MM Dale, JM Ritter & RJ Flower
4. Basic and Clinical Pharmacology , Katzung

5. Drug Discovery and Evaluation : Pharmacology Assay – Vogel

6. Handbook of experimental Pharmacology – Dr. S.K Kulkarni

BACK

II B. PHARM

SEMESTER IV

1.4.6 COMPUTER APPLICATIONS

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**OPERATING SYSTEMS** Purpose of an Operating System, Types & functions, Multiprogramming , Multiprocessing, Time Sharing Operating System, On-Line and Real-Time systems	4
2	**FLOW CHART AND ALGORITHM DEVELOPMENT** Definition and properties of the algorithm, Flow chart symbols and their uses, Examples of efficient algorithm and flow-chart, conversion of Algorithm/flow chart to high-level language , Structured Systems analysis and development	6
3	**DATABASE MANAGEMENT SYSTEMS** Introduction to data base, DBMS. Database versus early file keeping system, need for DBMS, Database Languages, Database language, Introduction to Relational Database and SQL Relational databases design ,tables and fields ,Introduction to MS Access, main components of Access tables, Fields, Queries, reports, Forms table handling, working on Query and use of database.	5
4	**COMMUNICATIONS ANS CONNECTIVITY** Overview of Computer Networks, LAN, MAN, WAN, Internet , Intranet, Network topology, Network Architecture , Network Protocols Internetworking: Bridges, Repeaters and Routers, Voice messaging systems, Video conferencing systems, Shared resources, Online services, User connection, Modems, Types of modems, Types of connections, Communication channels, Telephone lines, Coaxial cable, Fiber optic cables, latest storage devices	7

Sr. No.	TOPICS	NUMBER OF HOURS
5	**DATA SECURITY** Leading Viruses, Antivirus Software, System security, Internet security, encryption, Types of Computer Crimes, E-Waste management.	4
6	**COMPUTER APPLICATIONS IN PHARMACEUTICAL SCIENCES** Use of ICT in Pharmaceutical Industry and clinical studies , Data mining, Concept of Software as a service(SaaS), Introduction to Neural Networks and Nanotechnology, Bioinformatics: Meaning, scope and areas of Bioinformatics.	10

1.4.6 COMPUTER APPLICATIONS (PRACTICALS)

(College exam)

3 Hours/Week

1. Relational Database Management System software-MS Access
   Creating database, Creating table, designing table – creating forms

   Creating main menu for the operations of forms

   Creating sub forms

   Data retrieval using DBMS queries

   Creating forms to operate files, Printing reports

   Creation of Pharmaceutical databases

2. Advanced MS.Excel –Graphs, Histogram, Bar, Line, Pie etc in Excel
   Autofilter, Sorting, Lookup table , Pivot table , Inbuilt functions

3. Use of data structures using high level language

4. Biostatistics Lab: Use of SPSS/MINITAB/MS EXCEL package

BOOKS RECOMMENDED:

1. Computer application in Pharmacy by Fassett, William & Christensen Dale.
2. Comdex Computer Course Kit - Vikas Guptha
3. Fundamental of Statistics - S.C.Guptha
4. Microsoft Office Access , Cary N.Prague, Michael R.Irwin
5. Basic Electronics and Computer Applications, Rajiv Khanna, New Age International Publishers
6. Computer Fundamentals, BPB Publications.
7. Hunt N and Shelley J. Computers and Common Sense , Prentice Hall of India.
8. G.N.Rao, Biostatistics & Computer Applications .Pharmamed Press , Hyderabad

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II B. PHARM
SEMESTER IV

1.4.7 PHARMACEUTICAL MARKETING & MANAGEMENT (THEORY)

TOTAL HOURS: 36

Sr. No	TOPIC	NUMBER OF HOURS
1	**Management Concepts** Functions of management , Plans, Span of management, Centralization and decentralization. Motivation- Carrot and stick theory, Maslows and Herzbergs theory, Leadership- Styles, Ingredients of leadership, Leadership based on authority, Likert's 4 system of management, Management Grid, TOWS Matrix, BCG Matrix.	8
2	**Communication** Communication Process, Types of communication, Barriers to effective communication, Methods to improve communication. Written communication- steps, styles.	4
3	**HRM** The HRM Process, HR Planning, Recruitment and Downsizing, Selection, Orientation, Training and Development, Performance Appraisal, Compensation and Benefits, Safety and Health	6
4	**Marketing** Market Segmentation- Customer based segmentation. Product based segmentation, Competitor based segmentation Product Management, Life cycle, Introductory, Growth, Maturity and Decline phase, Consumer Behavior High Involvement and Low involvement products, Roles in Consumer Decision Making, Influences on Buying Behavior Market Research Market research Process- Problem definition, Research Objectives, Research Design, Sources of data, Data Collection, Data Analysis, Report and Presentation Marketing Mix and Pricing Strategies	10

Sr. No	TOPIC	NUMBER OF HOURS
5	**Distribution** Middlemen, Channel Levels, Distribution Alternatives Factors affecting distribution decisions	3
6	**Inventory Management** Objectives, Cost, Factors affecting inventory, Techniques	3
7	**Materials Management** Activities of Materials Management, Importance and objectives	2

BOOKS RECOMMENDED:

1. Essentials of Management By Koontz
2. Marketing Management By Kotler
3. Organization Behavior by Ivancevich & Matteson
4. Production Operations Management By Aswattappa
5. Fundamentals of Management By Stephen Robbins

BACK

III B. PHARM

SEMESTER V

1.5.1 PHARMACEUTICS – V

(QUALITY ASSURANCE & REGULATORY AFFAIRS)

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPIC	NUMBER OF HOURS
1	Basic concept of Quality Control & Quality Assurance, Total Quality Management, Philosophy of GMP, GLP, ISO and introduction to ICH guidelines with focus on Q7 & Q9.	6
2	Quality Control Laboratory: Responsibilities, routine controls, instruments, protocols, standard test procedure, sampling plans etc. Quality control, documentation and audits of QC facilities	4
3	Validation- Introduction to qualification & validation, Equipment, Method, Personnel and Process validation, Validation of water system and air handling systems.	6
4	In-process quality control on various dosage forms. Standard Operating Procedures for operations like cleaning, filling, drying, compression, coating, sterilization etc.	6
5	Introduction to Intellectual Property Right.(reference WIPO, copyright)	3
6	Pharmaceutical product registration, Introduction to International Regulations, requirements, procedures and application of new drug approval process	5
7	Introduction to Regulatory requirements – European community, United States of America, Japan, India and other territories. New Developments in regulatory affairs across the world with regard to WHO and ICH guidelines.	4
8	Dossier preparation	2

BOOKS RECOMMENDED:

1. Quality Control by Dale H. Bester field, Prentice Hall International Inc., New Jersey, 5th ed., (1998).

2. Good Laboratory Practice by Sandy Weinberg, Mercel Dekker, New York, 2nd ed.Vol.69,(1995).

3. New Drug Approval Process by Richard A Guarino, Mercel Dekker, New York, 2nd ed., Vol. – 56 (1993).

4. Validation of Pharmaceutical Process by Carleton F.J. and Agalloco, Mercel Dekker, Inc. New York.

5. How to Practice GMP, by P. P. Sharma, 2nd ed., Vandana Publishing, New Delhi.

BACK

III B. PHARM

SEMESTER V

1.5.2 PHARMACEUTICAL ENGINEERING I

(THEORY)

TOTAL HOURS:36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**UNIT OPERATIONS** Introduction, basic laws.	2
2	**FLUID FLOW** Utillity of various flow gadgets in pharma industry-manometers, pressure gauges	1
3	**MATERIAL HANDLING SYSTEMS** a. Liquid handling - Different types of pumps. b. Gas handling-Various types of fans, blowers and compressors. c. Solid handling-Bins, Bunkers, Conveyers, Air transport	2
4	**FILTRATION AND CENTRIFUGATION** Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter, sintered glass filters, air filters. Factors affecting filtration, mathematical problems on filtration, optimum cleaning cycle in batch filters. Principles of centrifugation, industrial centrifugal filters, and centrifugal sedimenters.	4
5	**CRYSTALLISATION** Characteristics of crystals like-purity, size, shape, geometry, habit, forms size and factors affecting them, Solubility curves and calculation of yields. Material and heat balances around Swenson Walk Crystallizer. Supersaturation theory and its limitation Nucleation mechanisms, crystal growth. Study of various types of Crystallizer, tanks, agitated batch, Swenson Walke Single vacuum, circulating magma and crystal Crystallizer, Caking of crystals and its prevention.	4
6	**DEHUMIDIFICATION AND HUMITY CONTROL** Basic concepts and definition, wet bulb and adiabatic saturation temperatures, Psychrometric chart and measurement of humidity, application of humidity measurement in pharmacy, equipments for dehumidification operations.	6
7	**REFRIGERATION AND AIR CONDITIONING** Principal and applications of refrigeration and air conditioning.	5

Sr. No.	TOPICS	NUMBER OF HOURS
8	**MATERIAL OF CONSTRUCTION** General study of composition, corrosion, resistance, Properties and applications of the materials of construction with special reference to stainless steel and glass.	6
9	**INDUSTRIAL HAZARDS AND SAFETY PRECAUTIONS** Mechanical, Chemical, Electrical, fire and dust hazards. Effluent treatment plant. Industrial dermatitis, Accident records etc.	6

BOOKS RECOMMENDED:

1. Elementary Chemical Engineering - Max S. Peters, Published by McGraw Hill Book Company, New York, 1954
2. Perry's Chemical Engineer's Handbook - Robert H Perry, Green D.W., Maloney J.O, 1998, McGraw – Hill Inc., New York.
3. Tutorial Pharmacy by Cooper & Gunn, ed. S.J.Carter, CBS Publishers & Distributors, Delhi, 6th Edition, 2000.
4. Unit Operations of Chemical Engineering, 5th edition - McCabe, Smith & Harriott, McGraw – Hill Inc., New York.
5. Pharmaceutical Engineering – K.Sambamurthy, 2002 NAI (P) Ltd., Delhi.
6. Pharmaceutics : The Science of Dosage Form Design - M.E. Aulton.
7. The Theory & Practice of Industrial Pharmacy – Lachman L., Lieberman H.A. & Kanjig J.L., 3rd edition, 1990 Varghese Publishing House, Bombay.
8. Remington: The Science & Practice of Pharmacy. Vol.I & II 20th edition, 2000. Lippincott, Williams & Wilkins Philadelphia.
9. Paradkar A.R. Introduction to Pharmaceutical Engineering, 3rd Edition, 2001, Nirali Prakashan, Pune.
10. Subramanyam C.V.S., Thimma J, Suresh S.S. et. al., Pharmaceutical Engineering : Principles and Practice, 2002, Vallabh P

BACK

III B. PHARM

SEMESTER V

1.5.3 BIOCHEMISTRY – II

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**METABOLISM OF CARBOHYDRATES**. Glycolysis, fermentation and regulation Citric acid pathway (TCA) Glyoxylate pathway Gluconeogenesis Glycogenesis and Glycogenolysis. regulation and related disorders Hexose mono phosphate shunt Metabolism of galactose and fructose Disorders related to carbohydrate metabolism Regulation of blood glucose levels Two hours post prandial test Principle of Hb A1c	8
2	**LIPID METABOLISM** Introduction Beta oxidation of saturated fatty acids (even and odd chain) Energetics and Regulations. Beta oxidation of unsaturated fatty acids (oleic and linoleic acid),Alpha Oxidation of Phytanic acid , Omega oxidation of Lauric acid Formation and utilization of ketone bodies Cholesterol synthesis and conversion to bile acids, transport and excretion Biosynthesis of saturated and unsaturated fatty acids with regulation and conversion to triglycerides Lipoprotein metabolism Phospholipid and Sphingolipid metabolism	6
3	**PROTEIN METABOLISM** General reactions of amino acids – Transamination, Deamination and decarboxylation of amino acids Ammonia transport Urea transport & metabolic disorders Metabolism of Sulphur containing amino acid- Methionine Catabolism of Phenylalanine & tryptophan, tyrosine Biosynthesis of nutritionally nonessential amino acids Biosynthesis of biologically important molecules creatine, histamine, Epinephrine, Norepinephrine	5

Sr. No.	TOPICS	NUMBER OF HOURS
4	**PURINE PYRIMIDINE METABOLISM** Biosynthesis/Catabolism of purine nucleotides Pyrimidine biosynthesis / Regulation / catabolism Salvage pathways and related Disorders.	3
5	**DNA ORGANIZATION, REPLICATION AND REPAIR** Brief introduction of genetic organization of mammalian genome. Replication of DNA in prokaryotes & Eukaryotes DNA damage and repair mechanisms. Biosynthesis of RNA (transcription) and RNA processing Reverse transcription (RNA Directed DNA synthesis) RNA Dependent RNA synthesis Solid Phase DNA Synthesis (chemical synthesis of DNA), DNA Sequencing (Maxim-Gilbert method, Sanger Dideoxy method and automation of DNA Sequencing) Regulation of Gene Expression - Lac operon	7
6	**GENETIC CODE AND PROTEIN SYNTHESIS** Features of Genetic code Protein synthesis or translation Inhibitors Post translational modification Role of signal sequences in protein targeting Chaperone proteins	4
7	**CANCER, ONCOGENES AND GROWTH FACTORS** Causes of cancer Biochemical changes in cancer cells Oncogenes	3

BOOKS RECOMMENDED:

1. Harpers Biochemistry- Edited by Robert K. Murray, David Bender, Victor W. Rodwell, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil, 27th Ed. (McGraw-Hill Medical Inc.)

2. Principles of Biochemistry and e-book, Nelson D.L. and Michael M. Cox Lehninger 5th Edn 2008 (Palgrave Macmillan)

3. Biochemistry- Berg JM, Tymoczko JL & L. Stryer. 5th International Edition (W. H. Freeman and Company, NewYork)

4. Outlines of Biochemistry- Conn E.E, Stumpf , Bruening G and Doi R.H., 5th Edn 2003 (John Wiley and Sons, Singapore)

5. Fundamentals of Biochemistry, Deb. A.C, 8th Edn 2004 (New central Book Agency (P) Ltd, India)

6. Biochemistry a case oriented Approach,Montgomery R, Convey TW and Spector AA., 5th Edn, 1990 (C.V. Mosby Company -International Edition)

7. Textbook of Biochemistry with Clinical Correlations – Thomas M. Devlin , 6th Edn., (Wiley Liss)

8. Textbook of Medical Biochemistry, Chatterjee M., Rana Shinde, 6th Edn., (Jaypee Publishers, India)

1.5.3 BIOCHEMISTRY – II (PRACTICALS)

3 Hours/Week

1. Estimation of blood glucose by Nelson Somogyi method
2. Estimation of blood glucose by o-Toludine method
3. Estimation of Cholesterol by liebermann burchard reaction
4. Estimation of Serum creatinine by Jaffe Method
5. Estimation of Serum bilirubin by Van de Bergh Reaction
6. Estimation of alkaline phosphatase in serum
7. Estimation of protein by Folin Lowry method
8. Estimation of protein by Biuret method
9. Estimation of Ribose/RNA by Orcinol method
10. Determination of optimum pH of Beta amylase from sweet potato.
11. Determination of Km of B-amylase
12. Determination of optimum temperature of B-amylase.
13. Separation of Protein by SDS-PAGE (Demonstration)

BOOKS RECOMMENDED:

1. Text Book of Clinical Chemistry – Norbert W. Tietz (W.B. Saunders-Medical)

2. An introduction to Practical Biochemistry, Plummer, D.T., 3rd Edn, 1988 (Tata Mc Graw Hill, New Delhi)

3. Lab Manual in Biochemistry, Jayaraman T. (W.B. Saunders Co. , Philadelphia)

4. Practical Clinical Biochemistry, Varley H., Gowenlock AH and Maurice Bell, Vol. 1 (William Heinemann Medical Books, Ltd, London)

BACK

III B. PHARM

SEMESTER V

1.5.4 MEDICINAL CHEMISTRY – I

(THEORY)

TOTAL HOURS:36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**Introduction to Medicinal Chemistry** Overview and Importance from pharmacy perspective	1
2	**Physicochemical Properties and Drug Action-** The following physicochemical properties of drugs will be studied a) Partition coefficient b) Solubility c) Surface activity d) lionization	2
3	**Importance of the following in Drug Receptor interactions** a) Hydrogen bonding b) Hydrophobic interaction c) Ionic bonding d) Covalent Bonding e) Chelation	2
4	**Stereochemical properties & Drug Action**	2
5	**Fundamental Concepts of Drug Metabolism including biotransformations**	2
6	Development of the following classes of drugs including Chemical Classification, structure activity relationship (S.A.R), mechanism of action, outline of synthesis for drugs marked with [s] , metabolism for drugs marked with [m], chemical nomenclature, generic names, few common Brands/route of administration), Biotransformation/ metabolism and side effects, updates with the most recent drugs under each class (last 5 years) – **A. Anticoagulants** Forms of heparin, Low molecular weight heparins, Coumarin derivatives like Warfarin, Anisindione, Dicoumarol **B. Anti thrombotic agents** Aspirin, Dipyrimadole, Clopidogrel, Ticlopidine, Tirofiban, Streptokinase, Urokinase	2 2

Sr. No.	TOPICS	NUMBER OF HOURS
	C. Drugs acting on Cholinergic nervous system	3
	1. Cholinergic drugs and related agents a) Cholinergic agents: Biosynthesis and Stereochemistry of acetyl choline. Cholinergic agonists: Acetylcholine, Carbachol[s], Bethanechol, Methacholine, Pilocarpine. b) Indirectly acting cholinergic agonists: Physostigmine, Neostigmine, Pyridostigmine[s], Edrophonium, Ambenonium Chloride, Demecarium Bromide, Ecothiophate, Isoflurophate, Malathion, Pralidoxine[s]	5
	2. Cholinergic blocking agents: a. Solanaceous alkaloids and synthetic analogues - Atropine, Hyoscyamine, Scopolamine, Homatropine. b. Papaverine and related compounds: Ethaverine HCl and Dioxyline Phosphate. c. Synthetic cholinergic blocking agents: Cyclopentolate, Clinidium Bromide, Dicyclomine[s], Glycopyrrolate, Piperdolate, Poldine, Propantheline, Isopropamide, Tropicamide[s] ; Centrally acting muscle relaxants and antiparkinson drugs: Benztropine mesylate, Chlorphenoxamine, Biperiden, Procyclidine[s], Trihexyphenidyl. d. Ganglionic blocking agents: Trimethaphan camsylate, Mecamylamine e. Neuromuscular agents: Tubocurarine chloride, Mutocurine iodide, Decamethonium bromide, Pancuronium bromide	1
	D. Drugs acting on the Adrenergic Nervous System 1. Adrenergic Agents a) Adrenergic neurotransmitters: Function, structure, biosynthesis and metabolism. b) Sympathomimetic agents: Epinephrine, Isoprotenerol, Phenylephrine[s], Salbutamol[s,m], Terbutaline, Dopamine, Ephedrine[m], Pseudoephedrine, Metaraminal[s], Hydroxy-amphetamine, Methoxy phenamine, Isoxsuprine, Ritodrine, Cyclopentamine[s], Propylhexedrine, Naphazoline[s], Oxymetazoline, Tetrahydrozoline, Xylometazoline.	3

Sr. No.	TOPICS	NUMBER OF HOURS
	2. Adrenergic blocking agents Dibenamine, Phenoxybenzamine, Phentolamine[s], Tolazoline, Ergot alkaloids, Propranalol[s,m], Practolol, Metaprolol, Labetalol, Timolol[s], Atenolol, Dichloroisoproterenol, Pronethalol, Butoxamine, Prazosin	2
	E. Cardiovascular Drugs and Anti- Hypertensives including Anti-Arrhythmic Agents and Calcium channel blockers Lanatosides A, B and C, Stropanthin, Citoxin, Digoxin, Quinidine, Procainamide, Nifedipine[m,s], Amlodipine, Verapamil[s], Diltiazem[m]	3
	Antihypertensive Agents Adrenergic blocking agents, Clonidine, Methyldopa[m], Diazoxide, Hydralazine[m].	
	ACE inhibitors Enalapril, Captopril, Lisinopril	
	Vasodialators Amyl nitrite, Nitroglycerine, Isoxsuprine, Nylidrin, Sodium Nitroprusside	
	Angiotensin II antagonist Losartan[s], Valsartan, Telmisartan	
	Antilipidemics : **Fibrates** : Clofibrate[s], Fenofibrate, Bezafibrate, Gemfibrozil, **Statins** : Lovastatin, Fluvastatin, Pravastatin, Atorvastatin, Simvastatin, Rosuvastatin, Cholesterol absorption inhibitors : Ezetemibe, Niacin, Boxidine [s] Anion exchange resins – Cholestyramine, Colestipol	2

Sr. No.	TOPICS	NUMBER OF HOURS
	Diuretics Mannitol, Acetazolamide[s] , Methazolamide, Dichlorphenamide[s], Chlorthiazide[s], Benzthiazide, Xipamide, Chlorthalidone, Furesemide, Ethacrynic acid, Triamterene[s], Amiloride	2
	F. Local Anaesthetics Cocaine, Benzocaine[s], Tetracaine, Procaine[s,m], Lidocaine[m], Bupivacaine	2

BOOKS RECOMMENDED:

1. Foye's - Principles of Medicinal Chemistry, 5th Edition, Edited by – David A. Williams, William O. Foye, Thomas L. Lemke (Lippincott Williams and Wilkins)
2. Wilson and Gisvold's Textbook of Organic Medicinal & Pharmaceutical Chemistry, 12th Edition, by Charles Owens Wilson, John Marlowe Beale and John H. Block (Lippincott Williams and Wilkins)
3. Burger's Medicinal Chemistry and Drug Discovery, 6th Edition, (Vol 1- 6), Ed .by Donald J Abraham, Wiley Interscience Publication.
4. Essentials of Medicinal Chemistry – Andrejus Korolkovas, 2nd Edition, (John Wiley and Sons)
5. Organic Chemistry of Drug synthesis (Vol. 1 – 7) by Lednicer & Mitscher (Wiley Interscience)
6. Pharmaceutical Chemistry – Drug Synthesis by Herman J. Roth , Axel Kleemann and T. Beisswenger (Ellis Horwood)
7. Pharmaceutical Chemistry – by Herman J. Roth (Taylor and Francis Group)
8. Profiles in Drug synthesis by V.N. Ghogte (Vols 1 -2)
9. Remington's- The Science & Practice of Pharmacy, 21st Edition, Vol. 1 & 2, (Lippincott Williams and Wilkins)
10. Drug Metabolism: Current Concepts – By Corina Lonescu, Mino R. Caira (Springer).
11. Organic Chemistry of Drug Design and Drug Action – By Richard B Silverman, 2nd edition (Academic Press)
12. Medicinal Chemistry – By Ashutosh Kar, New Age International Pvt. Ltd., New-Delhi, 4th Edition.

1.5.4 MEDICINAL CHEMISTRY - I (PRACTICALS)

3Hours/Week

The following preparations/ synthetic methods shall be studied with adequate knowledge of mechanisms involved in various steps. Emphasis shall be given to Recrystallization of products.

1. Phenothiazine
2. Benzimidazole
3. 5,5-Diphenylhydantoin
4. 1,2,3,4-Tetracarbazole
5. Diphenyl quinoxaline
6. Benzotriazole.
7. Acetyl salicylic acid.
8. Benzylidene acetone/chalcone.
9. Tribromobenzene (from aniline)

BOOKS RECOMMENDED:

1) Vogel's - Text book of Practical Organic Chemistry- 5th Edition, Ed. by Brian S. Furniss, Anthony J. Hannaford, Peter W.G. Smith, Austin R. Tatchell (Longmann, Scientific and Technical)

2) Practical Organic Chemistry- Frederick George Mann and Bernard Charles Saunders (Longmann)

3) The Systematic Identification of Organic Compounds- R.L. Shriner, C.K.F. Hermann, T.C. Morrill, D.Y. Curtin, and R.C. Fuson (John Wiley & Sons)

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III B. PHARM

SEMESTER V

1.5.5 PHARMACOLOGY – II

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPICS	NUMBER OF HOURS
1	**CHEMICAL MEDIATORS** General principles of transmission, Electrical signals in neurons, ion channels, RMP, Role of various ions. Generation & Propagation of AP. Signal generation at Synapse, basic steps in neurotransmission, presynaptic and posy synaptic modulation. Neurotransmitters & Neural Circuits.	5
2	**CHEMICAL MEDIATOR AND ANS** Historical perspective, Basic anatomy & various transmitters, basic steps, co-transmission	1
3	**CHOLINERGIC TRANSMISSION** Cholinergic receptor &physiology, Drugs effecting Muscarinic receptor Role of EDRF, [Detailed mechanism of AchE (I)& their use. Drugs Acting on ANS ganglion. Drugs acting on NMJ Skeletal muscle relaxants. (Detailed pharmacology of any one prototype drug & examples of some market preparations and their dose should be discussed)	8
4	**ADRENERGIC TRANSMISSION** Classification of adrenergic receptors, types of catechol amines, formation & metabolism. Sympathomimetic drugs, therapeutic classification of adrenergic drugs. Anti-adrenergics drugs and their therapeutic use. Drugs glaucoma. (Detailed pharmacology of any one prototype drug & examples of some market preparations and their dose should be discussed)	6
5	**DRUGS ACTING ON CARDIOVASCULAR SYSTEM** Cardiac electrophysiology, rhythm, contractility and oxygen consumption, (role of ATP/ Adenosine, Rynodine receptor, Calcium ions). Antianginal agents and drugs used in ischemic heart diseases. Antihypertensive agents.(RAS, Ednothelin, Nitric oxide , Diuretics). Drugs in congestive heart failure & cardiac shock. Drugs used in artherosclerosis, & hyperlipidemia. Drugs used in arrhythmias. (Detailed pharmacology of any one prototype drug & examples of some market preparations and their dose should be discussed)	14

Sr. No	TOPICS	NUMBER OF HOURS
6	**LOCAL ANAESTHETIC** Chemical Aspects & Mechanism of action (Detailed pharmacology of any one prototype drug & examples of some market preparations and their dose should be discussed)	2

1.5.5 PHARMACOLOGY – II (PRACTICALS)

3 Hours/Week

1. Measurement / Monitoring of BP/ECG/Pulse/ BMI/waist hip ratio on human volunteers.
2. To record the dose response curve of Histamine using isolated guinea pig/ rat ileum preparation
3. Simulated experiment demonstrating effect of drug on CVS & ANS from currently available software.

BOOKS RECOMMENDED:

1. Goodman and Gilman's The Pharmacological basis of therapeutics. Goodman Gilman, T.W. Rall, ALS. Nies, P. Taylor McGraw – Hill, New Delhi
2. Essentials of Medical Pharmacology, K. D. Tripathi, Jaypee Brothers Medical Publishers(P) Ltd
3. Rang and Dale's Pharmacology, HP Rang, MM Dale, JM Ritter & RJ Flower
4. Basic and Clinical Pharmacology , Katzung
5. Drug Discovery and Evaluation : Pharmacology Assay – Vogel
6. Handbook of experimental Pharmacology – Dr. SK Kulkarni
7. Drug Screening by Dr. S. K Gupta - Vallabh Prakashan

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III B. PHARM
SEMESTER V
1.5.6 PHARMACOGNOSY –II
(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBEROF HOURS
1	**ROLE OF CRUDE DRUGS IN NATIONAL ECONOMY** • Role of medicinal and aromatic plants in national economy. • Importance and status of herbal medicines and cosmetics. • A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.	5
2	**TRADITIONAL SYSTEM OF MEDICINE** • Introduction to traditional system of medicine – Ayurvedic, Siddha, Unani and Homeopathy	4
3	**BRIEF INTRODUCTION OF DIFFERENT PHYTOCONSTITUENTS** • Introduction, occurrence and distribution of alkaloids, glycosides, volatile oils, resins, tannins, carbohydrates, Lipids (fixed oils, fats, waxes) and proteins.	9
4	**EXTRACTION METHODS** • Introduction to different methods of extraction – maceration, percolation, infusion, decoction, soxhlet extraction. • Introduction to newer techniques of extraction	8
5	**EVALUATION OF CRUDE DRUGS** • Definition and different methods of evaluation like: Organoleptic, Physical, Chemical, Biological and Microscopical.	10

1.5.6 PHARMACOGNOSY –II (PRACTICALS)

3Hours/Week

1. Quantitative microscopy:

    a. Leaf constant values: Stomatal number, Stomatal Index, Vein-islet number, Vein termination number and Palisade ratio.
    b. Determination of dimension of Calcium oxalate crystals, stone cells, starch grains and phloem fibres.
    c. Determination of number of starch grains and length of trichomes using lycopodium spore method.

2. Determination of moisture content, ash value, extractive value and swelling factor.

3. Separation of phytoconstituents by TLC.

4. Demonstration of Soxhlet extraction, percolation and maceration.

BOOKS RECOMMENDED:

1. Trease G. E. and Evans, W. C., Pharmacognosy, 16th Ed, Bailliere Tindall, Eastbourne, U.K., 2010.

2. Kokate C. K., Purohit A. P. and Gokhale S. B., Pharmacognosy 41st Ed., Nirali Prakashan, 2008.

3. Tyler V. E., Brady R., Textbook of Pharmacognosy, 8th Ed, Lea and Febiger, Philadelphia, 1981.

4. Iyengar, M. A., and Nayak, S. G. K., Anatomy of Crude Drugs, 8th Ed., Manipal Power Press, Manipal., 2001.

5. Kokate, C. K., Practical Pharmacognosy, 3rd Ed., Vallabh Prakashan, Delhi., 1991.

6. Medicinal plants of India, Indian Council of Medical Research, New Delhi.

7. Wallis, T. E., Textbook of Pharmacognosy, 5th Ed., J. A., Churchill Limited, London,1985.

BACK

III B. PHARM

SEMESTER V

1.5.7 PHARMACEUTICAL ANALYSIS – II

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPICS	NUMBER OF HOURS
1	**Electrochemical Method of Analysis:** Definition of all types of electrochemical methods of analysis.	1
	(A) Conductometry: Introduction, conductivity cell**,** principle, instrumentation. Applications including conductometric titrations, high frequency titrations.	3
	(B) Potentiometry: Introduction, electrochemical cell, different types of electrodes- Reference electrodes (Normal hydrogen electrode, Calomel electrode, Silver-Silver chloride electrode), Indicator electrodes (Hydrogen electrode, Glass electrode, Antimony-Antimony oxide electrode), measurement of electrode potential and pH. Applications including potentiometric titrations.	6
	(C) Coulometry: Coulomb's law, Coulometric titrations at fixed potential/current	2
	(D) Polarography: Introduction, instrumentation and Applications including Amperometric Titrations	3
2	**Thermal Methods of Analysis :** Introduction, theory, instrumentation, applications- Thermogravimetry (TG), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC).	7
3	**Miscellaneous Methods of Analysis:** Kjeldahl's method of nitrogen estimation, Oxygen flask combustion method.	2
4	**Determination of Moisture Content** (including Karl Fischer)	2
5	**Radiopharmaceuticals and their Quality Control:** Radiopharmaceuticals and radionuclide generators , Quality Control of Radiopharmaceuticals, Radiochemical methods in analysis (Radiometric Titrations, Isotope Dilution Analysis, Neutron Activation Analysis) .	6

Sr. No	TOPICS	NUMBER OF HOURS
6	**Radioimmunoassays and Related Techniques:** Introduction, principle, techniques and applications for RIA, IRMA and ELISA.	4

1.5.7 PHARMACEUTICAL ANALYSIS – II (PRACTICALS)

3 Hours/ Week

1. Determination of cell constant.
2. Conductometric titration:
    a) Strong Acid v/s Strong base.
    b) Weak acid v/s strong base.
    c) Strong acid v/s weak base.
    d) Mixture of strong acid and weak acid with a strong base.
3. Calibration of pH meter.
4. Potentiometric titration of Acid v/s Base (2 examples).
5. pKa determination of phosphoric acid / boric acid.
6. Water determination by Karl –Fischer method.
7. Determination of moisture content by Loss on Drying

BOOKS RECOMMENDED:

1. Gurdeep. R. Chatwal, Sham. K. Anand; Instrumental methods of chemical Analysis; Himalaya Publishing House.

2. Connors K A, A textbook of Pharmaceutical Analysis, wiley Interscience, New York.

3. Gary Christian- Analytical Chemistry , John Wiley .

4. Vogel's T.B of Quantitative Chemical Analysis by Mendham & others Pearsons Education Limited.

5. Beckett A H and Stenlake J B , Practical Pharmaceutical Chemistry Vol I and II , CBS Publishers and distributers.

6. A. Blazek- Thermal Analysis, Van Nostrand Reinhold Co., London.

7. D. Skoog, James Leary; Principles of Instrumental analysis, HarCourt Brace College Publishers.

8. Willard, Dean, Merrit and settle; Instrumental methods of Analysis, CBS Publishers and distributors.

9. Bassett J, Denny R.C, Jeffery G H, Mendham J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.

10. Gopal.Saha, Fundamentals of Nuclear Pharmacy, Springer-verlag, New York.

11. Latest Editions of IP, USP, BP, EP and International Pharmacopoeia.

BACK

III B. PHARM

SEMESTER VI

1.6.1 COSMETICOLOGY- I

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPIC	NUMBER OF HOURS
1	Definition of Cosmetics, Historical background and present status of cosmetic industry, products encompassed by cosmetic industry, soaps and cosmetics, classification of Cosmetics and Primary functions	3
2	Structure of Skin, Hair, Nails and skins appendages, mouth & oral care; and interactions with Cosmetics.	3
3	Microbial Contamination in Cosmetics, need for preservatives, water purification system, Good Manufacturing Practice	2
4	Perfumes, Colors and other raw materials used in Cosmetics - A brief review, specialty raw materials like lipids, polymers.	4
5	Safety in cosmetics: need for evaluation, toxicity testing, sensitivity, eye irritation, raw material selection, sources of raw material (mineral, natural, synthetic), regulatory requirements, animal testing, ethical committee, human volunteers	4
6	Study of following Cosmetics with respect to Raw materials, Formulations, Processing Equipments and Quality Control: general discussion a. Products for personal Hygiene- Pedicure, Manicure, Dental Care preparations including Tooth Pastes, Tooth Powders, Mouth Washes b. Facial Make-up Products- Skin Creams- Cold creams, Vanishing Creams, Emollient Creams, Foundation Make-up, Bleach Creams, Anti-acne Creams, Face Powders, Lipsticks, Rouge, Eye Make-up Products, Mascara, Face Packs- Cleansing Preparations- Moisturizers.	2 4 14

BOOKS RECOMMENDED:

1. Harry's Cosmeticology- Willkinson (Leonard Hill)
2. Cosmetics – Sagarin (Inter Science)
3. The Chemistry and Manufacture of Cosmetics- De Navaree vol. 1 to 4 (Von. Nostrand).
4. Thomsen – Modern Cosmetics-(Universal Publishing).
5. "Formulation and Function of Cosmetics" – Jellinek
6. "Cosmetic & Skin" – Walls and Lubowe.
7. " Cosmetics- Formulation, manufacturing and Quality Control"- P.P.Sharma
8. "Principle of Practice of Modern Cosmetics" Raphe Harry.
9. Drug and Cosmetics Act

1.6.1 COSMETICOLOGY-I (PRACTICALS)

3Hours/Week

Manufacture of cosmetic Products.
Raw material control- Formulation-Processing and Packaging- in process control and evaluation of finished Products.

Skin Cleansers
Cleansing Milk

Skin moisturizers
Moisturizing lotion
Cold Cream

Facial Cosmetics
Under make up Foundation
Vanishing cream
Lipstick
Rouge

Dental Products
Tooth Paste

Anti Acne Cream
Face pack

BOOKS RECOMMENDED:

1. Harry's Cosmeticology- Wilkinson(Leonard thill)
2. Sagarin Cosmetics (Inter sciences)
3. De Navavre Vol 1-4, The Chemistry and manufacture of cosmetics.

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III B. PHARM

SEMESTER VI

1.6.2 PHARMACEUTICAL ENGINEERING II (THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**HEAT TRANSFER** Source of heat, heat transfer, steam and electricity as heating media, determination of requirement of amount of steam/electrical energy, steam pressure, Boiler capacity.	4
2	**EVAPORATION** Basic concept of phase equilibria, factor affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators.	4
3	**DISTILLATION** Principle of Distillation, Phase Diagrams, Azeotropic and extractive distillation.	4
4	**DRYING** Moisture content and mechanism of drying, rate of drying and time of drying calculations; classification and types of dryers, dryers used in pharmaceutical industries. Special drying methods.	6
5	**SIZE REDUCTION AND SIZE SEPARATION** Reduction and Size Separation Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of a mills including ball mill, hammer mill, fluid energy mill etc.	6
6	**MIXING** Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing equipments	4
7	**AUTOMATED PROCESS CONTROL SYSTEMS** Process variables, temperature, pressure, flow, level and vacuum and their measurements. Elements of automatic process control and introduction to automatic process control systems. Elements of computer aided manufacturing (CAM).	5
8	**Reactors and fundamentals of reactors design for chemical reactions.**	3

BOOKS RECOMMENDED:

1. Elementary Chemical Engineering - Max S. Peters, Published by McGraw Hill Book Company, New York, 1954
2. Perry's Chemical Engineer's Handbook - Robert H Perry, Green D.W., Maloney J.O, 1998, McGraw – Hill Inc., New York.
3. Tutorial Pharmacy by Cooper & Gunn, ed. S.J.Carter, CBS Publishers & Distributors, Delhi, 6th Edition, 2000.
4. Unit Operations of Chemical Engineering, 5th edition - McCabe, Smith & Harriott, McGraw – Hill Inc., New York.
5. Pharmaceutical Engineering – K.Sambamurthy, 2002 NAI (P) Ltd., Delhi.
6. Pharmaceutics : The Science of Dosage Form Design - M.E. Aulton.
7. The Theory & Practice of Industrial Pharmacy – Lachman L., Lieberman H.A. & Kanjig J.L., 3rd edition, 1990 Varghese Publishing House, Bombay.
8. Remington: The Science & Practice of Pharmacy. Vol.I & II 20th edition, 2000. Lippincott, Williams & Wilkins Philadelphia.
9. Paradkar A.R. Introduction to Pharmaceutical Engineering, 3rd Edition, 2001, Nirali Prakashan, Pune.
10. Subramanyam C.V.S., Thimma J, Suresh S.S. et. al., Pharmaceutical Engineering : Principles and Practice, 2002, Vallabh Prakashan, Delhi.

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III B. PHARM

SEMESTER VI

1.6.3 BIOTECHNOLOGY

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**INTRODUCTION TO PHARMACEUTICAL BIOTECHNOLOGY** Milestones in biotechnology, drugs produced using biotechnology, techniques used for manufacture, various applications and challenges.	3
2	**IMMUNOLOGY AND IMMUNOLOGICAL PREPARATIONS** Understanding of how immune system works, cells and molecules involved in immune response, MHC, Signal transduction, immune dysfunction, role of immunomodulators. Manufacture, quality control, preservation and administration of human and veterinary vaccines, human immunosera. Manufacture of recombinant Hepatitis B surface antigen vaccine. Concept of hypersensitivity and preparation of diagnostic biologicals and allergenic extracts. Monoclonal antibodies –their production by Hybridoma technology and use in diagnostics, therapeutics (herceptin) and as immunomodulators.	8
3	**GENETIC RECOMBINATION** Natural and artificial methods of gene transfer in plant, animal and microbial cells. Methodology and applications of gene cloning in detail. TECHNIQUES like southern blot, PCR, rt-PCR, EST, RFLP. Manufacture of recombinant insulin, interferon, growth hormone. Cloning of plants and animals. Plant and Animal tissue culture.	8
4	**FERMENTATION TECHNOLOGY** Screening for new metabolites, strain development, primary and secondary metabolites, substrates for industrial processes, parts and functiontioning of stirred tank fermenters and designs of various other fermenters used in biotechnology, study of methods and concepts used in fermentations, pre-fermentation processes	8

	(optimisation, inoculum build-up, scale-up, sterilisation	
Sr. No.	**TOPICS**	**NUMBER OF HOURS**
	processes), Product recovery and down-stream processing. Fermentative production of antibiotics (streptomycin, tetracyclines, natural and semi-synthetic penicillins), Vitamins B2 and B12, dextrans, cyclosporins. Microbial Bio-transformations with special reference to steroids.	
5	**IMMOBILISATION OF CELLS AND ENZYMES – APPLICATIONS, TECHNIQUES** Manufacture of streptokinase and L-asparaginase. Enzyme bioreactors.	4
6	**INTRODUCTION TO PHARMACOGENOMICS AND BIO-INFORMATICS** Human Genome project, SNPs, Impact of pharmacogemonics and significance. MALDI-TOF technique to map SNPs , use of in-vivo, in-vitro methods and microarrays. Roche Amplichip.	3
7	**GENETIC DISEASES AND GENE THERAPY**	2

1.6.3 BIOTECHNOLOGY
(PRACTICALS)

3 Hours/Week

1. Sterility tests.
2. Tests for microbial contamination.
3. MIC of antimicrobials.
4. Microbiological bioassays of antibiotics.
5. Estimation of DNA by Diphenylamine method.
6. Evaluation of preservative efficacy.
7. Study and monitoring of sugar-alcohol fermentations.
8. Steroid biotransformation and detection by TLC.
9. Optimisation of growth parameters for a given culture.

BOOKS RECOMMENDED:

1. W.B Hugo and Russel, pharmaceutical microbiology 6th edition Blackwell scientific publications, London , 1998
2. Bergey's Manual of determinative microbiology 9th Ed, Williams and Wilkinsons, 1994.3. Collins C.H. microbiological methods. 6th Ed , butterworth ,London, 1989
3. Cooper and Gunn's –tutorial pharmacy , 9th Ed , CBS publisher and distribution ,1986
4. Frobishers Fundamentals of Microbiology, 9th edition Toppan company Ltd. Tokyo, Japan 6. Pelezar Reid microbiology , 5th Ed Tata MC Graw-hill Publishers company, 1993
5. Pharmacopoeia of India Govt of India 1966 and 1996 editions
6. Prescott, Harley and Klein's microbiology 2nd Ed W.C. Brown publishers 1993
7. Raitt, immunology, 4th Ed Harwood academic publishers , Mosbey London 1997
8. S.P. Vyas , and Dixit pharmaceuticals biotechnology , 1st Ed , CBS publishers and distributors New Delhi 1998
9. S.S Korl pharmaceutical biotechnology, fundamentals and applications , 1st Ed Vallabh Prakashan, New Delhi
10. Stanier Ingraham general microbiology 5th Ed Wheelies and Painter , 1987
11. Bentley's textbook of pharmaceutics by Rawlins 8th Ed , ELBS publications , 1984
12. Watson J.D. Recombinant DNA technology 2nd Ed scientific American books LTD 1992
13. Ananth Narayan AND Pannicker , textbook of microbiology , 6th Ed Orient Longman , Chennai 1995.

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III B. PHARM

SEMESTER VI

1.6.4 MEDICINAL CHEMISTRY – II

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
	Development of the following classes of drugs including Chemical Classification, structure activity relationship (S.A.R), mechanism of action, outline of synthesis for drugs marked with [s], metabolism for drugs marked with [m], chemical nomenclature, generic names, few common Brands/route of administration), Biotransformation/ metabolism and side effects, updates with the most recent drugs under each class (last 5 years) –	
1	**DRUGS ACTING ON THE CENTRAL NERVOUS SYSTEM** A. General anaesthetics 1. Inhalation anaesthetics Halothane[s], cyclopropane, Methoxyflurane[s], Enflurane, Isoflurane, Sevoflurane, Nitrous oxide. 2. Ultra short-acting barbiturates Methohexital sodium[s,] Thiopental Sodium, Thiamylal Sodium. Dissociative anaesthetics: Ketamine hydrochloride	4
	B. Sedative and Hypnotics and antianxiety agents 1. Barbiturates: (a) Barbital , Phenobarbital[s,m], Mephobarbital. (b) Amobarbital, Butabarbital, Pentobarbital, Secobarbital, Talbutal 2. Miscellaneous sedatives – Hypnotics (a) Amides and Imides: Glutethimide[s,] Methaqualone, Methyprylon, Zaleplon, Zolpidem (b) Alcohols and their carbamate derivatives: Ethchlorvynol, Meprobamate[s], Aldehydes and their derivatives: Chloral Hydrate, Paraldehyde, Triclofos Sodium	5

Sr. No.	TOPICS	NUMBER OF HOURS
	3. Benzodiazepines Chlordiazepoxide[s], Diazepam[s,m], Oxazepam, Potassium chlorazepfate, Prazepam, Lorazepam, Halazepam, Flurazepam, Alprazolam C. Skeletal muscle relaxants Chlorphenesin[s], Methocarbamol, Carisoprodol. D. Drugs used in spasticity (Centrally Muscle Relaxants): Baclofen, Dantrolene sodium, Buspirone. E. Anticonvulsants (Anti-epileptic drugs) 1. Barbiturates 2. Hydantoins: Phenytoin sodium[s,m], Ethotoin, Mephenytoin. 3. Oxazolidine diones: Trimethadione, Paramethadione. 4. Succinimides: Phensuximide[s], Methsuximide, Ethosuximide. 5. Benzodiazepines: Clonazepam, Diazepam, Chlorazepate. 6. Diabenzazepines: Carbamazepine[s,m], Oxacarbazepine 7. Miscellaneous: Primidone, Valproic acid[m]. F. Antipsychotic Agents and Anti-depressants Haloperidol, Chlorpromazine[m], Imipramine[m,s], Desipramine, Amitryptyline, Tranylcypromine, Thioridazine, Trifluperazine, Chlorprothixene, Pimoxide, Nolidone, Pargyline, Doxepin, Trazodone, Sertraline, Fluoxetine G. Drugs used in Parkinsonism Benztropine mesylate, Procyclidine, Orphenadrine hydrochloride, Ethopropazine, Levodopa, Carbidopa[s], Benezaride, Amantadine hydrochloride, Biperidone, Trihexyphenidyl Hydrochloride[s] H. Drugs for Alzheimer's Disease Tacrine[s], Velnacrine, Linopiridine, Donepezil[s], Icopezil, Phenserine, Tolserin, Beseperidine, Rivastigmine, Galantamine	1 1 4 3

Sr. No.	TOPICS	NUMBER OF HOURS
2	**ANALGESICS, ANTIPYRETICS AND ANTI-INFLAMMATORY AGENTS** A. Morphine and related compounds, Morphine modifications: Morphine[m] and its salts: Ethyl Morphine, Apo-Morphine, Meperidine[s], Alphaprodine, Anileridine, Diphenoxylate, Fentanyl, Methadone[s], Levorphanol, Propoxyphene, Butorphanol, Pentazocine, Nefopam B. Narcotic Antagonists Nalorphine, Levallorphan, Naloxone, Naltroxone, Cyclazocine. C. Anti-inflammatory Analgesics: 1. Salicylic acid Derivatives: Sodium Salicylate, Magnesium Salicylate, Choline Salicylate, Salicylamide, Aspirin, Salasalate, Diflunisal. 2. N-aryl anthranilic acid Derivatives: Mefenamic acid[s] 3. Aryl acetic acid Derivatives: Indomethacin[s,m], Sulindac, Tolmetin, Diclofenac sodium[s], Ibuprofen, Naproxen, Fenoprofen, Piroxicam , Ketoprofen[s], Ketorolac, 4. Aniline and p-aminophenol Derivatives: Acetanilide, Phenacetin[s], Paracetamol[s,m]. 5. Pyrazolone and Pyrazolidinedione derivatives: Antipyrin Aminopyrine, Dipyrone	2 2 5 1 6
3	**HYPOGLYCEMICS** Insulins and various types, Chlorpropamide[s], Tolbutamide, **SULPHONYLUREAS** Glyburide (Glibenclamide), Glipizide[s], Gliclazide, Glimepiride, **MEGLITINIDES** Nateglinide, Repaglinide, **BIGUANIDES** Metformin, Phenformin. **THIAZOLIDINEDIONES** Pioglitazone, **ALFA-GLUCOSIDASE INHIBITORS** Acarabose, Miglitol, Voglibose, **DIPEPTIDYL PEPTIDASE IV INHIBITORS** Sitagliptin, Saxagliptine, Vidagliptine.	2

BOOKS RECOMMENDED:

1. Foye's - Principles of Medicinal Chemistry, 5th Edition, Edited by – David A. Williams, William O. Foye, Thomas L. Lemke (Lippincott Williams and Wilkins)
2. Wilson and Gisvold's Textbook of Organic Medicinal & Pharmaceutical Chemistry, 12th Edition, by Charles Owens Wilson, John Marlowe Beale and John H. BlockJ.H. Block & J.M. Beale (Lippincott Williams and Wilkins)
3. Burger's Medicinal Chemistry and Drug Discovery, 6th Edition, (Vol 1- 6), Ed .by Donald J Abraham, Wiley Interscience Publication.
4. Essentials of Medicinal Chemistry – Andrejus Korolkovas, 2nd Edition, (John Wiley and Sons)
5. Organic Chemistry of drug synthesis (Vol 1 – 7) by Lednicer & Mitscher (Wiley Interscience)
6. Pharmaceutical Chemistry – Drug Synthesis by Herman J. Roth , Axel Kleemann and T. Beisswenger (Ellis Horwood)
7. Pharmaceutical Chemistry – by Herman J. Roth (Taylor and Francis Group)
8. Profiles in Drug synthesis by V.N. Ghogte (Vols 1 -2)
9. Remington's- The Science & Practice of Pharmacy, 21st Edition, Vol 1 & 2, (Lippincott Williams and Wilkins)

1.6.4 MEDICINAL CHEMISTRY – II (PRACTICALS)

3 Hours/Week

The following **(Any Eight)** preparations/ synthetic methods shall be studied with adequate knowledge of mechanisms involved in various steps. Emphasis shall be given to Recrystallization of products. Elementary study of spectral characterization of products to be discussed.

1. Synthesis of p-fluorotoluene from p-toluidine
2. Cinnamic acid synthesis (Perkin's Reaction)
3. Preparation of Anthranillic acid from Phthalic acid
4. Preparation of o-Chloro Benzoic acid from Anthranillic acid
5. Benzoin Condensation and Benzillic acid rearrangement
6. Preparation of p-Bromo aniline from acetanilide
7. 1-Phenyl-azo-2-naphthol from aniline
8. 1-Amino-2-Naphthol from 1-Phenyl-azo-2-naphthol by Reduction reaction.
9. Preparation of Phenacetin from p-hydroxyacetanilide
10. Preparation of 3-methyl-1-phenyl pyrazol-5-one (Antipyrine) from Ethylacetoacetate and phenyl hydrazine
11. Preparation of 2-amino-thiazole

BOOKS RECOMMENDED:

1. Vogel's - Text book of Practical Organic Chemistry- 5th Edition, Ed. by Brian S. Furniss, Anthony J. Hannaford, Peter W.G. Smith, Austin R. Tatchell (Longmann, Scientific and Technical)

2. Practical Organic Chemistry- Frederick George Mann and Bernard Charles Saunders (Longmann)

3. The Systematic Identification of Organic Compounds- R.L. Shriner, C.K.F. Hermann, T.C. Morrill, D.Y. Curtin, and R.C. Fuson (John Wiley & Sons)

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III B. PHARM
SEMESTER VI
1.6.5 PHARMACOLOGY –III
(THEORY)

TOTAL HOURS:36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**METHODS OF MEASUREMENT IN PHARMACOLOGY** DRC , Principles of Bioassay, Animal model diseases , Concept of Clinical trials and its phases.	**6**
2	**CHEMICAL TRANSMISSION IN CNS** Amino Acid transmission (Role of glutamate , GABA,Glycine) , Noradrenaline, Dopamine, 5-HT, Ach , purines, peptides, NO, Melatonin, histamine.	2
3	**DRUGS ACTING ON CNS** Pharmacology of General Anesthetics (Inhalation & IV). Sedatives, hypnotics, anxiolytics (Sleep disorders, anxiety nature & type, animal models of anxiety, Detail discussion on GABA receptor, agonist antagonist, inverse antagonist. Benzodaizepine, types &metabolites). Anti-epileptics. (Types of epilepsy, MOA antiepileptic drugs & AED). Nature of schizophrenia & antimaniacs, Dopamine & glutamate theory, antipsychotic drugs. Theories and nature of depression , antidepressant drugs. Neurodegenerative diseases ; Mechanism of neuronal death , excitotoxicity, apoptosis(Drug used in Parkinson, Alzheimer's disease.) Neural mechanism of pain, pain pathway, its modulation, endogenous opioids , vaniiloid receptors Analgesics, Opioid agonists and antagonists CNS stimulant , Drug Addiction and its nature. Abuse of Cocaine, nicotine, cannabis. Alcohol (Harmful effects and deaddiction/ use of disulfiram). Misuse of Phosphodiesterase inhibitor (sildenafil). Cannabinnoids receptor /endocannabinoid & hallucinogens. Migraine and its treatment. (Detailed pharmacology of any one prototype drug & examples of some market preparations and their dose should be discussed)	21

Sr. No.	TOPICS	NUMBER OF HOURS
4	**LOCAL HORMONE AND INFLAMMATION** (role of ecosanoids, PAF, Bradykinin, cytokines, nitric oxide etc in inflammation) antipyretics, NSAID and anti-gout drugs. Possible future developments (Detailed pharmacology of any one prototype drug & examples of some market preparations and their dose should be discussed)	3
5	**TOXICOLOGY** Concept of Hazard & Risk General principles in the management of poisoning. Incidence, signs, symptoms and treatment of poisoning due to :Opium alkaloids, barbiturates, benzodiazepines, organophosphorus compounds, antidepressants and paracetamol, methanol, heavy metals and heavy metal antagonists. Measurement of poisons in blood / Detecting substance of abuse.	4

1.6.5 PHARMACOLOGY –III (PRACTICALS)

3 Hours/Week

1. Bioassay of Histamine using isolated guinea pig/ rat ileum preparation.
2. Analgesic activity using Hot plate analgesio meter
3. Antianxiety activity using elevated plus maze
4. Locomotor activity using rota rod
5. Detection of substance of abuse & poisons using the readymade kits available in the market.

BOOKS RECOMMENDED:

1. Goodman and Gilman's The Pharmacological basis of therapeutics. Goodman Gilman, T.W. Rall, ALS. Nies, P. Taylor McGraw – Hill, New Delhi
2. Essentials of Medical Pharmacology, K. D. Tripathi, Jaypee Brothers Medical Publishers(P) Ltd
3. Rang and Dale's Pharmacology, HP Rang, MM Dale, JM Ritter & RJ Flower
4. Basic and Clinical Pharmacology , Katzung
5. Drug Discovery and Evaluation : Pharmacology Assay – Vogel
6. Handbook of experimental Pharmacology – Dr. SK Kulkarni

BACK

III B. PHARM
SEMESTER VI
1.6.6 PHARMACOGNOSY – III
(THEORY)

TOTAL HOURS: 36

Sr. No	TOPICS	NUMBER OF HOURS
1.	**HERBAL FORMULATION** Methods of preparation of formulations in ayurveda like Asava, Arishta, Churna and Bhasma Study of the following herbs used in cosmetics: Shampoo – soap nut Conditioners – Amla and Henna Hair Colourants – Amla and Henna Skin Care – Aloe vera, Turmeric, Sandal Wood	10
2.	**CARBOHYDRATES** Definition, classification, chemistry and tests for identification. Pharmacognostic study of Isapgul, Agar, Acacia, Honey, Tragacanth, Pectin, Guar gum, Starch and Cellulose.	8
3.	**LIPIDS (FATS, FIXEDOILS AND WAXES)** Definition, method of extraction, chemistry, tests and method of analysis. Pharmacognostic study of Castor oil, Shark liver oil, Chaulmoogra oil, spermaceti, bees wax, Lanolin, Kokum butter and Lard.	6
4.	**PROTEINS** Definition, classification, chemistry and tests. Pharmacognostic study of collagen and gelatin.	4
5.	**TANNINS** Definition, properties, classification, tests and uses of tannins. Pharmacognostic study of Pale Catechu, Black Catechu, Myrobalan, Arjuna, Amla and Galls	4
6.	**RESINS** Definition, classification and Physical, Chemical and biological nature. Pharmacognostic study of Cannabis, Colophony, Podophyllum, Asafoetida, Ginger, Capsicum, Benzoin, Balsam of Peru, Turmeric.	4

1.6.6 PHARMACOGNOSY – III (PRACTICALS)

3Hours/ Week

1. Chemical tests for identification of the following crude drugs:
   Tragacanth, Agar, Acacia, Lanolin, Honey, Gelatin, Pale catechu, Black Catachu, Colophony, Asafoetida and Benzoin

2. Preparation and Evaluation of Herbal formulations studied in theory.

3. Study of powdered drugs microscopically: Arjuna, Turmeric, Podophyllum, Ginger and Capsicum.

4. Morphological study of the following drugs:
   Agar, Acacia, Isapghul, Myrobalan, Arjuna, Pale Catechu, Black Catechu, Amla, Colophony, Asafoetida, Ginger, Capsicum and Turmeric.

BOOKS RECOMMENDED:

1. Trease G. E. and Evans, W. C., Pharmacognosy, 16th Ed, Bailliere Tindall, Eastbourne, U.K., 2010.

2. Kokate C. K., Purohit A. P. and Gokhale S. B., Pharmacognosy 41st Ed., Nirali Prakashan, 2008.

3. Tyler V. E., Brady R., Textbook of Pharmacognosy, 8th Ed, Lea and Febiger, Philadelphia, 1981.

4. Iyengar, M. A., and Nayak, S. G. K., Anatomy of Crude Drugs, 8th Ed., Manipal Power Press, Manipal., 2001.

5. Kokate, C. K., Practical Pharmacognosy, 3rd Ed., Vallabh Prakashan, Delhi., 1991.

6. Medicinal plants of India, Indian Council of Medical Research, New Delhi.

7. Wallis, T. E., Textbook of Pharmacognosy, 5th Ed., J. A., Churchill Limited, London, 1985.

BACK

III B. PHARM

SEMESTER VI

1.6.7 PHARMACEUTICAL JURISPRUDENCE

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPIC	NUMBER OF HOURS
1	**Pharmacy Act 1948** Introduction, objective, constitution, composition & functions of Central Council, Education Regulations, Approved courses of study and examination. Constitution & composition of State Pharmacy Council. Registration of Pharmacists & Commission of Enquiry.	4
2	**Drugs & Cosmetics Act 1940 and Drugs & Cosmetics Rules 1945** Introduction, Definitions of various important terms, composition of the Drugs Technical Advisory Board, The Central Drugs Laboratory, The Drugs Consultative Committee, Standards of Quality in relation to Drug & Cosmetic. Definition relating to misbranded drugs & cosmetics, Adulterated Drugs, and spurious Drugs & Cosmetics. Provisions relating to Prohibition of manufacture and sale of certain drugs and cosmetics, provisions relating to appointment of Inspector, Govt. Analyst, Licensing & Controlling Authority. Provisions relating to Powers of Inspector and procedure to be followed while exercising various powers including the sampling procedure & seizing of drugs. Provisions relating to import of Drugs. Definition of New Drug, Manufacture of New Drug for clinical trials or Marketing. - Provisions relating to manufacture for sale, sale and distributions Allopathic Drugs. - Labelling and packing of Allopathic Drugs. - Requirement for the collection, storage, processing and distribution of whole Human Blood, Human Blood components by Blood Banks.	15

Sr. No	TOPIC	NUMBER OF HOURS
	- Approval of Institutions for carrying out Tests on Drugs & Cosmetics. - General provisions relating to manufacture of Cosmetics for sale. - Labelling of Cosmetics. - General review of various schedules appended to Drugs & Cosmetics Rules. - Penalties for various offences under the Act.	
3	**Medicinal and toilet preparations (Excise Duties) Act 1955** Objectives, requirement of bonded and non-bonded manufactory, manufacturing of medicinal and toilet preparations in bonded and non-bonded manufactory, manufacture and warehousing of Alcoholic preparations, issue of spirit from spirit store, procedures, offences & penalties.	3
4	**Narcotic drugs & psychotropic substances Act 1985** Introduction, objectives, definitions of various terms, Authorities and Officers, Prohibition, control and Regulation& General aspects covering Offences & Penalties.	4
5	**Drugs (Price control) Order 1995** Objectives, definitions, salient features, calculation f retail price of formulation, various powers of Government under the order.	3
6	**Drugs & Magic Remedies (objectionable Advertisements) Act 1954** Objectives, Definitions , Prohibition of mis-leading advertisement and advertisement of certain drugs & magic remedies, exempted advertisement, offences and penalties	3
7	**A brief study with special reference to main provisions of the following acts:** a) Poisons Act. b) Insecticide Act. c) Prevention of cruelty to Animal Act 1960 d) Shops and Establishment Act. e) Standards of Weights and Measures Act	4

BOOKS RECOMMENDED:

1. Code of Pharmaceutical Ethics (Pharmacy Council of India)
   Mithal B. M. "A Text Book of Forensic Pharmacy" (National Book Centre, Calcutta)

2. Bharati – "Manual of Drug and Pharmacy Laws in India " (1977) (Paramount Law Pub)

3. Govt. of India Publications of above Acts and Rules

4. Books on commentaries such M. L. Mehirase, K. K. Singh and any other similar publications by other authors.

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IV B. PHARM

SEMESTER VII

1.7.1 PHARMACEUTICS – VI

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPIC	NUMBER OF HOURS
1	Oral sustained and controlled drug delivery: Definitions : Historical development, components of therapeutic system-classification-Details of matrix and diffusion control systems a) Biopharmaceutical aspects-steady state concept and calculation of maintenance dose, loading dose. b) Design and evaluation of SR & CR preparations	14
2	Formulation and evaluation of microemulsions, SMEDDS (Self Microemulsifying Drug Delivery System), multiple emulsions.	6
3	Brief Introduction to polymers - New additions and applications (Eudragits,Carbopols, PVA.	2
4	Introduction to novel drug delivery: mucosal, transdermal, parenteral implants & pumps, Bioadhesives, Targeted delivery, OROS (Osmotic Delivery, Push Pull Delivery), Externally modulated devices and delivery : iontophoresis, sonophoresis, etc. Nanomedicines. (No details to be taught)	4
5	Medicated Aerosols-Components , Manufacture and Evaluation.	6
6	Pilot plant scale up technique: Groups responsibilities-Facilities-Example of Scaling up.	4

1.7.1 PHARMACEUTICS – VI (PRACTICALS)

3Hours/Week

1. Preparation of Tablets using matrix excipients.
2. Preparation of Transdermal patches.
3. Demonstration of drug release studies from OROS.
4. Preparation of Microemulsion
5. Preparation of Multiemulsion
6. Demonstration of drug release from tablets using modified release polymers

BOOKS RECOMMENDED:

1. Ansel, Introduction to Pharmaceutical Dosage Forms(Lea and Febiger)
2. Sinko P., Martin's Physical Pharmacy and Pharmaceutical Sciences, Lippincott/ Wolter Kluer.
3. Remington's Pharmaceutical Sciences (Mack)
4. Mittal, Pharmaceutical Formulations.
5. Lachman, Industrial Pharmacy (Lea & Febiger)
6. Banker, Modern Pharmaceutics, Marcel Dekker.
7. Official pharmacopoeia like I.P., B.P., U.S.P.

BACK

IV B. PHARM

SEMESTER VII

1.7.2 BIOPHARMACEUTICS & PHARMACOKINETICS- I (THEORY)

TOTAL HOURS: 36

Sr. No	TOPIC	NUMBER OF HOURS
1	**INTRODUCTION** Biopharmaceutics definition and subject relevance, Definition of absorption, distribution, metabolism, excretion, elimination, disposition, first pass effect, enterohepatic cycling, bioavailability, pharmacokinetics and Pharmacodynamics	2
2	**ABSORPTION OF DRUGS** Factors affecting drug absorption and bioavailability, methods for studying drug uptake, drug absorption barriers	5
3	**MECHANISM OF DRUG TRANSPORT** Different mechanism of drug transport, passive transport and pH – partition theory, facilitated diffusion, Active Transport etc.; Blood and its binding constituents as carriers of drug in the body, Perfusion limitation and permeability limitation in drug transport.	6
4	**CONCEPTS OF COMPARTMENT MODELS** Pharmacokinetics of one compartment model drug, mathematical treatment to pharmacokinetics upon I.V. bolus dosing, I.V. Infusion and first order extravascular input, Multicomparment model behaviour (excluding the derivation or mathematical treatment), Central and Peripheral Compartments, distribution phase and pseudo distribution equilibrium phase. Definition of pharmacokinetic parameters including volumes of distribution, clearance, biological half life, renal clearance, non renal clearance absolute clearance, bioequivalence and miscellaneous parameters. Methods of estimation of pharmacokinetic parameters and parameters for bioavailability /bioequivalence, including methods for residuals, rate method and sigma minus method of estimation of renal clearance, area under the curve, area under moment curve, mean residual time.	14

Sr. No	TOPIC	NUMBER OF HOURS
5	**PLASMA CONCENTRATION AND THERAPEUTIC RESPONSE** An introduction to pharmacodynamics	2
6	**NON LINEAR PHARMACOKINETICS** Non Linearities in absorption and elimination. Examples of drug showing non-linear absorption or elimination, individualization of dosage regimens and non linear Pharmacokinetics.	3
7	**DOSAGE REGIMENS** Factors affecting dosage regimens, utility curve and therapeutic window, multiple dose pharmacokinetics, fluctuation, accumulation index, steady state concept, time to reach steady state, loading dose, maintenance dose, calculations for determination, problem solving, drugs requiring individualization of dosage regimes-a discussion	4

BOOKS RECOMMENDED:

1. Wagner, J.G. Biopharmaceutics and Relevant Pharmacokinetics, Drug Intelligence Pub. Hamilton

2. Swarbrick, J : Current concepts in Pharmaceutical Sciences: Biopharmaceutics: Lea & Febiger,Philadelphia

3. Wagner J.G. ,Fundamentals of Clinical Pharmacokinetics.Drug Intelligence Publications,Hamilton

4. Gibaldi, M : Biopharmaceutics and Clinical Pharmacokinetics. Lea & Febiger, Philadelphia

5. Rowland, M and Tozer,T.N.Clinical Pharmacokinetics :Concepts and applications. Lea & Febiger, Philadelphia

6. Notari R.E.,Bippharmaceutics,Marcel Dekker.

7. Leon Shargel and Andrew B.C. Yu, applied Biopharmaceutics and Pharmacokinetics(Appleton Century- Crofts)

8. Sarfaraz Niazi- Text book of Biopharmaceutics and Clinical Pharmacokinetics (Appleton Century Crofts, New York)

BACK

IV B. PHARM

SEMESTER VII

1.7.3 COSMETICOLOGY- II

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPIC	NUMBER OF HOURS
1	Study of following Cosmetics with respect to Raw materials, Formulations, Processing Equipments and Quality Control: general discussion a. Hair Care preparations- Shampoos, Hair dressings, Hair Tonics, Hair conditioners, Hair Rinses, Hair Colorants, Hair Waving and Strengthening Preparations. b. Protective Preparations- Hand and Body Creams and lotions (Barrier Preparations), Sunscreen (agents, classification), Suntan and Anti-Sunburn Products, Insect Repellents, antiperspirants c. Nail Products – types of nail products, film forming agents and solvent systems, pearlescent agents- natural & synthetic, nail polish, nail lacquer remover d. Miscellaneous Preparations- Depilatories, epilatories, Shaving Preparations and aids, Anti- Lice Preparations, perfuming preparations like body perfumes, handkerchief perfumes	4 6 2 8
2	Baby Cosmetics – selection of raw materials, safety considerations, common types	2
3	Herbal Cosmetics- preparation types, common herbal materials used in cosmetics, regulatory requirements if any.	2
4	Aerosols - Definition, Cosmetic Applications, Manufacture and filling, Equipments and Quality Control.	4
5	Schedule S of Drug and Cosmetics Act in relation to cosmetics Manufacture- Hygiene- Pollution control- Ecological Concern.	2
6	Packaging of cosmetics, stability of cosmetics – general considerations	2
7	Cosmeceuticals – definition, comparison with drug products, types of actives in cosmeceuticals, current trends, regulatory requirements	4

BOOKS RECOMMENDED:

1. Harry's Cosmeticology- Willkinson (Leonard Hill)
2. Cosmetics – Sagarin (Inter Science)
3. The Chemistry and Manufacture of Cosmetics- De Navaree vol. 1 to 4 (Von. Nostrand).
4. Thomsen – Modern Cosmetics, Universal Publishing.
5. "Formulation and Function of Cosmetics" – Jellinek
6. "Cosmetic & Skin" – Walls and Lubowe.
7. " Cosmetics- Formulation, manufacturing and Quality Control"- P.P.Sharma
8. "Principle of Practice of Modern Cosmetics" Raphe Harry.
9. Drug and Cosmetics Act

1.7.3 COSMETICOLOGY- I (PRACTICALS)

3Hours/Week

Manufacture of cosmetic Products.
Raw material control, Formulation, Processing and Packaging, in process control and evaluation of finished Products.

Sun care Products
Suntan Lotions
Sunscreen Cream

Hair Care Products
Medicated hair lotion (Anti- Dandruff)
Shampoo
Cream hair dressing

Nail Care Products
Nail Lacquer
Nail Polish
Nail lacquer remover

Shaving products
Lather Shaving cream
Brushless Shaving Cream
After Shave Lotion

Herbal Cosmetics

Fragrance products
Handkerchief Perfume

BOOKS RECOMMENDED:

4. Harry's Cosmeticology- Wilkinson(Leonard thill)
5. Sagarin Cosmetics (Inter sciences)
6. De Navavre Vol. 1-4, The Chemistry and manufacture of cosmetics.

BACK

IV B. PHARM

SEMESTER VII

1.7.4 MEDICINAL CHEMISTRY – III

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
	Development of the following classes of drugs including Chemical Classification, structure activity relationship (S.A.R), mechanism of action, outline of synthesis for drugs marked with [s], chemical nomenclature, generic names, few common Brands/route of administration) and side effects, updates with the most recent drugs under each class (last 5 years) –	
	Chemotherapy	1
	Sulfonamides Sulfamethoxazole[s], Sulfacetamide, sulfadoxine Trimethoprim[s], Sulfathiazole[s], Phthalylsulfathiazole, Sulfadimethoxine.	3
	Antibiotics Penicillin and semisynthetic Penicillins – Penicillin-G, Penicillin-V, Ampicillin, Amoxicillin, Cloxacillin, Dicloxacillin; Flucloxacillin, Piperacillin, Cephalosporins - Cephalexin, Cephadrine, Cefadroxil, Cefuroxime, Cefixime, Cefotaxime, Cefepime, Cefaclor, Cefazolin, Cefdinir, Cefetamet, Cefoperazone, Cefpirome, Cefpodoxime, Ceftazidine, Ceftizoxime, Cefditoren	13
	Aminoglycosides Streptomycin, Gentamycin , Kanamycin, Amikacin, Netilmicin, Tobramycin	
	Chloramphenicol	
	Tetracyclines Tetracycline, Oxytetracycline, Demeclocycline, Minocycline, Doxycycline	
	Macrolides Erythromycin, Azithromycin, Clarithromycin, Roxithromycin, Spiramycin	

Sr. No.	TOPICS	NUMBER OF HOURS
	New Beta-lactams Thienamycin, Aztreonam, Impenem, Meropenem Other antibiotics Clindamycin, Colistin Sulphate, Lincomycin, Linezolid, Nitrofurantoin, Vancomycin, **Beta-lactamase inhibitors** Clavulanic acid, Sulbactam, Tazobactam **Quinolone carboxylic acids** Norfloxacin, Ciprofloxacin, Pefloxacin, Sparfloxacin, Levofloxacin,Gemifloxacin, Lomefloxacin, Moxifloxacin, Nalidixic Acid, Ofloxacin, Prufloxacin, Balofloxacin **Antitubercular & Antileprotic Drugs** PAS[S], Isoniazid[S] , Pyrazinamide, Ethambutol[S], Streptomycin, Rifamycins, Dapsone[S], Clofazimine, Cycloserine, Important drug combinations.	3
	Antifungals Griseofulvin, Amphotericin, Nystatin, Flucytosine Clotrimazole[S], Ketoconazole, Fluconazole, Itraconazole, Tolnaftate[S], Terbinafine.	2
	Anthelmintics Piperazine, Pyrantel pamoate, Levamisole, Diethyl carbamazine, Ivermectin, Mebendazole[S], Albendazole, Niclosamide, Praziquantel[S]	3
	Antimalarials Life cycle of parasite, drugs acting on different stages – Quinine, Mefloquine, Chloroquine[S] , Primaquine[S] , Pyrimethamine , Proguanil, Cycloguanil[S], Atovaquone , Halofantrine, Artemisinin and its derivatives (Arteether, Artemether, Artesunate), Drug combinations.	4
	Antiamoebic General aspects of infection, Life cycle of parasite, Emetine, Dehydroemetine, diiodohydroxyquinolones, Metronidazole[S], Tinidazole, Ornidazole, Diloxanide [S], Chloroquin, Nitazoxanide, Satranidazole, Secnidazole	3

Sr. No.	TOPICS	NUMBER OF HOURS
	Antivirals Abacavir, Amantadine[s], Rimantadine, Idoxuridine[s], Vidarabine, Methisazone, Interferons, Acyclovir[s], Famciclovir, Zidovudine, Stavudine, Nevirapine, Indinavir, Oseltamivir, Zanamivir, Didanosine, Efavirenz, Ganciclovir, Lamivudine, Lopinavir, Ritonavir, Nelfinavir, Ribavirin,, Tenofovir, Saquinavir, Atazanavir, Adefovir, Emtricitabine	4

BOOKS RECOMMENDED:

1. Foundation of Molecular Pharmacology, The Chemical basis of Drug action- By John Bedford Stenlake, Vol. 2, The Athlone Press London.
2. Foye's - Principles of Medicinal Chemistry, 5th Edition, Edited by – David A. Williams, William O. Foye, Thomas L. Lemke (Lippincott Williams and Wilkins)
3. Wilson and Gisvold's Textbook of Organic Medicinal & Pharmaceutical Chemistry, 12th Edition, by Charles Owens Wilson, John Marlowe Beale and John H. BlockJ.H. Block & J.M. Beale (Lippincott Williams and Wilkins)
4. Burger's Medicinal Chemistry and Drug Discovery, 6th Edition, (Vol 1- 6), Ed by Donald J Abraham, Wiley Interscience Publication.
5. Essentials of Medicinal Chemistry – Andrejus Korolkovas, 2nd Edition, (John Wiley and Sons)
6. Organic Chemistry of Drug synthesis (Vol 1 – 7) by Lednicer & Mitscher (Wiley Interscience)
7. Pharmaceutical Chemistry – Drug Synthesis by Herman J. Roth , Axel Kleemann and T. Beisswenger (Ellis Horwood)
8. Pharmaceutical Chemistry – by Herman J. Roth (Taylor and Francis Group)
9. Profiles in Drug synthesis by V.N. Ghogte (Vols 1 -2)
10. Introduction to Medicinal Chemistry- By Patric G.L., (Abingdon Oxfordshire, UK)

1.7.4 MEDICINAL CHEMISTRY – III (PRACTICALS)

3Hours/Week

The following preparations/ synthetic methods shall be studied with adequate knowledge of mechanisms involved in various steps. Emphasis shall be given to Recrystallization of products. Elementary study of spectral characterization of products to be discussed.

Synthesis of :

1. Saccharin
2. Chloramine T
3. 3- Methyl pyrazol-5-one
4. 4-Methyl-7-hydroxy coumarin.
5. Eosin
6. Phenylurea and diphenylurea
7. 2-Phenyl indole from acetophenone
8. Sulphanilamide
9. INH

BOOKS RECOMMENDED:

1. Vogel's - Text book of Practical Organic Chemistry- 5th Edition, Ed. by Brian S. Furniss, Anthony J. Hannaford, Peter W.G. Smith, Austin R. Tatchell (Longmann, Scientific and Technical)

2. Practical Organic Chemistry- Frederick George Mann and Bernard Charles Saunders (Longmann)

3. The Systematic Identification of Organic Compounds- R.L. Shriner, C.K.F. Hermann, T.C. Morrill, D.Y. Curtin, and R.C. Fuson (John Wiley & Sons)

BACK

IV B. PHARM
SEMESTER VII
1.7.5 PHARMACOLOGY – IV
(THEORY)

TOTAL HOURS: 36

Sr. No	TOPICS	NUMBER OF HOURS
1	**DRUGS ACTING ON IMMUNE SYSTEM** Pharmacology of: Anti histaminics. Immunostimulants, immunosuppressants, immunomodulator and DMARDS. (Detailed pharmacology of any one prototype drug & examples of some market preparations and their dose should be discussed)	5
2	**RESPIRATORY SYSTEM** Drugs used in Asthma, COPD, Cough. (Detailed pharmacology of any one prototype drug & examples of some market preparations and their dose should be discussed)	4
3	**CHEMOTHERAPY** General Principles of Chemotherapy. Sulphonamides and co-trimoxazole. Quinolones. Penicillins & Cephalosporins antibiotics. Chloramphenicol and & tetracycline. Macrolides, and miscellaneous antibiotics. Chemotherapy of tuberculosis & leprosy. Anti –fungal agents, Antimalarials, Antiamoebic. Anthelmintic, Drugs used in UTI & STD. Chemotherapy of viral diseases. Chemotherapy of malignancy. (Detailed pharmacology of any one prototype drug in the category & examples of some market preparations with dose should be discussed)	27

BOOKS RECOMMENDED:

1. Goodman and Gilman's The Pharmacological basis of therapeutics.
   Goodman Gilman, T.W. Rall, ALS. Nies, P. Taylor McGraw – Hill,
   New Delhi
2. Essentials of Medical Pharmacology, K. D. Tripathi
   Jaypee Brothers Medical Publishers(P) Ltd
3. Rang and Dale's Pharmacology, HP Rang, MM Dale, JM Ritter & RJ Flower
4. Basic and Clinical Pharmacology , Katzung
5. Drug Discovery and Evaluation : Pharmacology Assay – Vogel
6. Handbook of experimental Pharmacology – Dr. SK Kulkarni

BACK

IV B. PHARM
SEMESTER VII
1.7.6 PHARMACOGNOSY - IV
(THEORY)

TOTAL HOURS: 36

Sr. No	TOPIC	NUMBER OF HOURS
1	**ISOLATION, PURIFICATION, ESTIMATION OF PHYTOCONSTITUENTS** General methods used for isolation and purification of phyto-constituents. Preliminary phytochemical screening of natural products. Detailed methods of isolation, identification and estimation of the following: Quinine, Ephedrine, Digitoxin, Ca-sennosides, Glycyrrhizin and Diosgenin	7
2	**BIOGENESIS OF PHYTOPHARMACEUTICALS** Techniques employed in the elucidation of biosynthetic pathways Brief study of basic metabolic pathways- Shikimic acid pathway Biosynthesis of – Hyoscyamine, Morphine, Reserpine, Cholesterol.	6
3	**MARINE DRUGS** Definition, classification and study of marine drugs belonging to the following class -Cardiovascular, cytotoxic, Antimicrobial, Antibiotic, Anti-inflammatory and Antispasmodic.	3
4	**VOLATILE OILS** Definition, properties, classification, chemical nature, methods of extraction and analysis of volatile oils Pharmacognostic study of Clove, Cinnamon, Fennel, Coriander, Eucalyptus, Musk, Cardamom, Nutmeg, Valerian, Lemon peel and Orange peel	6
5	**ALKALOIDS** Definition, occurrence and distribution, properties, classification, chemistry and tests. Pharmacognostic study of Lobelia, Datura, Belladonna, Cinchona, Ipecac, Opium, Ergot, Rauwolfia, Nux-vomica, Kurchi, Ephedra, Aconite and Vasaka.	8
6.	**GLYCOSIDES** Definition, occurrence, distribution, properties, classification and tests. Pharmacognostic study of Digitalis, Stropanthus, Squill, Aloe, Senna, Rhubarb, Cascara, Liquorice, Ginseng, Dioscorea, Wild Cherry Bark, Mustard, Kalmegh, Quassia, Cantharides and Picrorrhiza.	6

1.7.6 PHARMACOGNOSY – IV (PRACTICALS)

3 Hours/ Week

1. Isolation of phytopharmaceuticals: Quinine, Ca-Sennosides, Caffeine and Glycyrrhizinic acid

2. Estimation of : Quinine, Ephedrine, Ca-Sennosides, Caffeine and Curcumin

3. General and specific tests for the following class of drugs:
   Alkaloids – Atropine, Quinine, Caffeine, Reserpine
   Glycosides – Digitoxin, Glycyrrhizin, Sennosides, Barbaloin
   Flavanoids – Rutin

4. Powder study of the following crude drugs:
   Fennel, Coriander, Cinnamon, Eucalyptus, Ephedra, Vasaka, Rauwolfia, Nux vomica, Digitalis, Senna, Quassia, Kurchi and Datura

BOOKS RECOMMENDED:

1. Trease G. E. and Evans, W. C., Pharmacognosy, 16th Ed, Bailliere Tindall, Eastbourne, U.K., 2010.

2. Kokate C. K., Purohit A. P. and Gokhale S. B., Pharmacognosy 41st Ed., Nirali Prakashan, 2008.

3. Tyler V. E., Brady R., Textbook of Pharmacognosy, 8th Ed, Lea and Febiger, Philadelphia, 1981.

4. Iyengar, M. A., and Nayak, S. G. K., Anatomy of Crude Drugs, 8th Ed., Manipal Power Press, Manipal., 2001.

5. Kokate, C. K., Practical Pharmacognosy, 3rd Ed., Vallabh Prakashan, Delhi., 1991.

6. Medicinal plants of India, Indian Council of Medical Research, New Delhi.

7. Wallis, T. E., Textbook of Pharmacognosy, 5th Ed., J. A., Churchill Limited, London, 1985.

8. Jean Bruneton, Pharmacognosy and Phytochemistry of Medicinal Plants, Lavoisier Publishing.

BACK

IV B. PHARM

SEMESTER VII

1.7.7 PHARMACEUTICAL ANALYSIS – III

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPICS	NUMBER OF HOURS
1	**Basic concepts in spectroscopy** Introduction to electromagnetic radiation and its interaction with matter, atomic spectra, molecular spectra, photometers and spectrophotometers.	3
2	**UV-Visible absorption spectrophotometry** Introduction, electronic transitions , Beer-Lambert law, deviations, applications. Definitions: Chromophore, auxochrome, bathochromic shift, hypsochromic shift, hyperchromism and hypochromism. **Instrumentation:** Optical diagram of photometer and UV-Vis spectrophotometer - light source, collimating systems, monochromators, sample cells, and detectors. Calibration of instrument **Applications** of Beer Lambert law to single component analysis (use of calibration graph, use of a standard absorptivity value, single or double point standardization) and multi component analysis (simultaneous equation method), chemical derivatisation, optimum conditions for spectrophotometric measurements.	6
3	**IR spectroscopy:** Introduction, Theory, Vibration modes (normal mode, combination mode and overtone bands), types of molecular vibrations, Impact of hydrogen bonding. **Instrumentation**: Dispersive, Attenuated Total reflectance and FTIR instruments. Light sources, sample cells, monochromators, detectors, interferometer. Sample preparation and handling techniques. Calibration of instrument, Applications- Characterization of functional groups and electronic configuration through I.R spectrum.	6
4	**Fluorescence Spectroscopy**: Origin of fluorescence and phosphorescence, singlet and triplet states, factors affecting fluorescence intensity, quenching, relation of molecular structure to fluorescence. **Instrumentation** – Optical diagram of fluorimeter and spectrofluorimeter– light sources, primary and secondary filters, monochromators, sample compartment and detectors. Calibration of instrument. Applications of Fluorimetry.	4

Sr. No	TOPICS	NUMBER OF HOURS
5	**Atomic absorption spectrometry**: Introduction, principle, instrumentation, flameless techniques, interferences, and Calibration of instrument. Applications of Atomic Absorption Spectroscopy.	4
6	**Atomic emission spectrometry:** Introduction, principle, instrumentation, interferences. Calibration of instrument. Applications of Atomic Emission Spectroscopy.	3
7	**Mass Spectrometry:** Theoretical aspects (EI and CI only), basic instrumentation, elements of interpretation of spectra and applications (Quantitative and Qualitative)	5
8	**Nuclear Magnetic Resonance Spectroscopy:** Theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications (Quantitative and Qualitative)	5

1.7.7 PHARMACEUTICAL ANALYSIS – III (PRACTICALS)

3 Hours/Week

1. Determination of λ max of some drugs.
2. Estimation of Ibuprofen by UV spectrophotometry.
3. Assay of pure drugs official in IP by UV spectrophotometry (any 2).
4. Assay of dosage forms official in IP by UV spectrophotometry (any 4)
5. Estimation of Iron by visible spectroscopy.
6. Estimation of Quinine sulphate by fluorimetry.
7. To study the effect of quenching on fluorescence of Quinine sulphate.
8. Estimation of Riboflavin by fluorimetry.
9. Determination of Sodium or Potassium by flame photometer.
10. Study of IR spectra of simple compounds.

BOOKS RECOMMENDED:

1. Vogel's textbook of Quantitative Chemical Analysis by Mendham & others, Pearsons Education Limited.
2. Skoog, Holler, Nieman, Principles of instrumental Analysis , Thomson Books /Cole.
3. Kalsi P.S , Spectroscopy of Organic compound ,New Age international publisher.
4. Christian G.D, J Analytical Chemistry , John Wiley.
5. Connors Kenneth A, Text books of Pharmaceutical Analysis , Wiley India.
6. Kemp William, Palgrave N.Y, Organic spectroscopy .
7. Willard, Dean, Merrit and settle; Instrumental methods of Analysis, CBS Publishers and distributors.
8. Beckett A H and Stenlake J B , Practical Pharmaceutical Chemistry Vol I and II , CBS Publishers and distributers.
9. Leslie.G.Chatten, Pharmaceutical chemistry [Instrumental Techniques] , Marcel Dekker.
10. Silverstain, Spectrophotometric identification of organic compounds, Wiley India.
11. J.K.M Sanders &R. A Hunter, Modern NMR Spectroscopy, Oxford University press
12. G.W.Ewing; Instumental Methods of analysis, McGraw Hill.

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BACK

IV B. PHARM

SEMESTER VIII

1.8.1 PHARMACEUTICS –VII

(THEORY)

TOTAL HOURS:36

Sr. No.	TOPICS	NUMBER OF HOURS
1	**Sterile drug delivery systems & classification** (a) Parenteral, ophthalmic & others (b) Antibiotic and non-antibiotic products. **1) Parenteral Preparations** a) General requirements b) Types and their formulation with reference to powders for reconstitution, solutions, suspensions, emulsions and depot preparations, preparation of sterile water for injection. Pharmacopoeial evaluation of sterile water for injection. c) Containers and closures (glass, plastic and rubber) and their evaluation, form fill seal technology. Evaluation of containers and closures including a mention of compatibility testing (to be covered more extensively under stability) d) Design of facilities and environmental control: basic design concepts, Cleanliness classes, air handling (HVAC system), HEPA filters, laminar air flow and laminar air flow rooms, change room design, materials of construction, sterilization, testing of clean & Aseptic rooms, validation of environment and filters. e) Personnel factors: Selection, training, monitoring and motivation, concepts to be considered for education of (workers-personal hygiene, gowning and entry procedure, restrictions in work area and importance of the same. f) Processing of parental products by terminal sterilization, filtration sterilization followed by aseptic filling and by aseptic compounding. Validation of sterilization process and process validation. g) Quality control and Quality assurance.	1 17

Sr. No.	TOPICS	NUMBER OF HOURS
2	**Opthalmic products** Anatomy and physiology of the eye, general requirements/safety considerations, formulation, isotonicity adjustment, isotonicity calculations, manufacture, packaging and quality control. Introduction to inserts, occuserts.	8
3	**Chemical Kinetics, Drug Stability and Stability Prediction** Mechanism of drug in stability: hydrolysis, oxidation, isomerization, photochemical decomposition and polymerization. A Revision or review of mechanisms of physical instability in dosage forms. Interactions with containers and closures and the evaluation-compatibility testing, chemical decomposition in the solid state Stability testing of drugs and tentative expiration date, cGMP/ICH guidelines in stability testing and expiration dating, prediction of shelf life, Bracketing & Matrixing	10

BOOKS RECOMMENDED:

1. Pharmaceutical dosage forms – Ansel, Popovich & Allen (Text books) and Drug Delivery System – (Williams & Hikkings)

2. American Pharmacy – Dittert (J.B. Lipincott)

3. Remington's Pharmaceutical Sciences – Alfonso R. Gennaro (mack Publishing Co.)

4. Bentleys T.B. of Pharmaceutics – Rawlins (ELBS)

5. Frobisher – Fundamentals of Microbiology (Toppan)

6. Lachman, Industrial Pharmacy (Lea & Febiger)

7. Banker, Modern Pharmaceutics, Marcel Dekker

8. Groves – Parenteral Products –(William Heinemann Medical Books Ltd)

9. Hanson – H.B. of package Engg – (McGraw Hill)

10. Swarbrick & Boyan – Encyclopedia of Pharm. Technology – Dekker.

1.8.1 PHARMACEUTICS –VII (PRACTICALS)

3 Hours/Week

Note :1) Products may be assayed to evaluate accuracy in regular practicals. Assays are not to be given to students in university examinations.
2) Formulation of different dosage forms should give stress on material specification, preformulation, process controls and documentation.
3) Latest edition of books should be used.

1. Preparation and evaluation of sterile water for injection, I.P.

2. Treatment to be given to containers and closures for injections.

3. Formulations and evaluation of the following sterile dosage forms:

   i) SVPs
      a. Ascorbic acid Injection, I.P.
      b. Calcium Gluconate Injection, I.P.
      c. An Injection demonstrating co-solvent phenomenon.
      d. An Injection containing colloidal Calcium with vitamin D.
      e. Ethanolamine Oleate Injection.

   ii) LVPs
      a. Sodium chloride and Dextrose Infusion I.P.
      b. An Injection containing fat emulsion.

   iii) OPTHALMIC PREPARATION
      a. Sulphacetamide eye drops, B.P.C.
      b. Tetracycline eye ointment, I.P.
      c. Chloramphenicol eye ointment, I.P.

4. Accelerated stability testing of an injection.

In case of non-availability of drugs, suitable changes may be made in the preparations/experiments.

BOOKS RECOMMENDED:

1. Ansel, Introduction to Pharmaceutical Dosage forms.
2. Dittert, Sprouls American Pharmacy(J.B. Lippincott)
3. Martin, Remington's Pharmaceutical Sciences(Mack
4. Harkishan Singh, Pharmacopeias and formularies, Vallabh Prakashan Delhi
5. M.L. Shroff General Pharmacy Series.
6. Mital, Pharmaceutical Formulations.
7. Lachman, Industrial Pharmacy(Lea & Febiger)
8. I.P.,B.P., BPC, U.S.P.

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IV B. PHARM

SEMESTER VIII

1.8.2 BIOPHARMACEUTICS & PHARMACOKINETICS- II (THEORY)

TOTAL HOURS: 36

Sr. No	TOPIC	NUMBER OF HOURS
1	**INTRODUCTION TO BIOPHARMACEUTICS PART I** Specific aspects covering fate of drug in the body and biological processes associated with it.	2
2	**PROTEIN BINDING OF DRUGS** Factors affecting protein binding, significance, determination of protein binding, plasma and tissue binding of drugs.	4
3	**DISTRIBUTION** Rate of distribution, perfusion limitation, permeability limitation, extent of distribution, drugs with small intermediate and high volume of distributions and their relative plasma and tissue binding.	4
4	**BIOTRANSFORMATION OF DRUGS** Need for drug biotransformation, drug metabolizing organs and enzymes, chemical pathways, phase I and Phase II reactions**,** methods to study biotransformation, factors affecting biotransformation, bioactivation and tissue toxicity, Biopharmaceutics drug disposition classification system.	6
5	**ELIMINATION** Organ clearance concepts, Hepatic clearance, Hepatic extraction ratio, Blood flow limitation in hepatic clearance, first pass effect; Renal clearance and mechanisms of renal excretion, estimation of renal clearance, factors affecting renal elimination; Biliary Clearance, enterohepatic cycling and other miscellaneous modes of drug elimination.	6
6	**CLINICAL APPLICATIONS** Effect of enzyme induction, enzyme inhibition blood low and protein binding on hepatic clearance, dose adjustment in renal failure	2

Sr. No	TOPIC	NUMBER OF HOURS
7	**BIOAVAILABILITY AND BIOEQUIVALENCE** Absolute bioavailability, relative bioavailability, bioavailability study design, measurement of biovailability, pharmacokinetic and pharmacodynamic methods Dissolution rate and the methods of enhancing dissolution rate. Official and unofficial methods of estimation of dissolution/ in vitro release of drugs from the dosage form. In-vitro, in-vivo correlation and it significances. Physiology of gastro intestinal tract (review) and oral bioavailability. Physiochemical and physiological factors affecting bioavailability of drugs from parenteral routes- examples of procaine, penicillin G suspension and insulin- Zn suspension.	12

BOOKS RECOMMENDED:

1. Wagner, J.G. Biopharmaceutics and Relevant Pharmacokinetics, Drug Intelligence Pub. Hamilton

2. Swarbrick, J : Current concepts in Pharmaceutical Sciences: Biopharmaceutics: Lea & Febiger,Philadelphia

3. Wagner J.G. ,Fundamentals of Clinical Pharmacokinetics.Drug Intelligence Publications,Hamilton

4. Gibaldi, M : Biopharmaceutics and Clinical Pharmacokinetics. Lea & Febiger, Philadelphia

5. Rowland, M and Tozer,T.N.Clinical Pharmacokinetics :Concepts and applications. Lea & Febiger, Philadelphia

6. Notari R.E.,Bippharmaceutics,Marcel Dekker.

7. Leon Shrgel and Andrew B.C. Yu, applied Biopharmaceutics and Pharmacokinetics(Appleton Century- Crofts)

8. Sarfaraz Niazi- Text book of Biopharmaceutics and Clinical Pharmacokinetics (Appleton Century Crofts, New York)

1.8.2 BIOPHARMACEUTICS & PHARMACOKINETICS - II (PRACTICALS)

3 Hours/Week

1. Study of drug release by diffusion cell (using biological and synthetic membranes)

2. A study of drug binding to albumin using dialysis method.

3. Workshop on compilation of pharmacokinetic parameters given plasma and urine data following a single i.v. bolus dose for a one compartment model drug. Plotting the data on a semi log paper. Use of linear regression analysis.

4. Workshop on computation of bioavailability parameters given individual plasma data following oral dose of test product and a standard product. Computation of AUC, Cmax, Tmax with their associated standard deviation. Use of trapezoidal rule.

5. Workshop on computation of pharmacokinetic parameters of a drug from plasma data following a single i.v. bolus dose for a two compartment model drug. Use of linear regression analysis and the method of residuals.

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IV B. PHARM

SEMESTER VIII

1.8.3 MEDICINAL CHEMISTRY - IV

(THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
	Development of the following classes of drugs including Chemical Classification, structure activity relationship (S.A.R), mechanism of action, outline of synthesis for drugs marked with [s], metabolism for drugs marked with [m], chemical nomenclature, generic names, few common Brands/route of administration), Biotransformation/ metabolism and side effects, updates with the most recent drugs under each class (last 5 years) –	
1	**Antineoplastics**: Antimetabolites: 6-Mercaptopurine[s], Methotrexate, 5-Fluoro-uracil[s], Mechlorethamine, Chlorambucil[s], Procarbazine, Dacarbazine, Mithramycin, Bleomycin, Idarubicin, Vinblastin, Vincristine, Cisplatin[s], Taxol, Cyclophosphamide[s], Topotecan, Letrozole, Tamoxifen	5
2	**Antihistaminics, Antiemetics and Anti Ulcer Drugs:** **Histamines and Antihistaminic agents:** A. Histamine receptors, biosynthesis and metabolism B. Antihistaminic agents – H_1 antagonists: 1. Amino alkyl ethers Diphenhydramine[s,m], Dimenhydrinate, Doxylamine, Clemastine, Bromodiphenhydramine. 2. Ethylene diamines Pyrilamine[s], Mepyramine[s], Methapyrilene, Tripelennamine 3. Propylamine derivatives: Pheniramine[s],Chlorpheniramine, Dexchlorpheniramine, Brompheniramine, Triprolidine. 4. Phenothiazine derivatives Promethazine[s], Trimeprazine, Methdilazine. 5. Piperazine derivatives\ Cyclizine, Chlorcyclizine, Meclyzine[s] , Buclizine.	1 5

Sr. No.	TOPICS	NUMBER OF HOURS
	6. Miscellaneous compounds Cetirizine[s], Diphenyl pyraline, Dimethindene, Antazoline , Azatadine, Cyproheptadine[s] New Antihistamines with less sedation Astemizole, Cetrizine, Loratidine, Terfenadine.	
	C. H_2 receptor Antagonists: Cimetidine, Ranitidine[s], Famotidine	2
	D. Proton-pump inhibitors: Omeprazole[s,m], Pantoprazole, Rabeprazole, Lansoprazole	1
3	**<u>Steroids:</u>** a) Classification of steroids, configuration and conformation b) <u>Adrenocorticoids</u> Cortisol, Hydrocortisone acetate, Fludrocortisone acetate, Betamethasone, Flucinolone acetonide, Triamcinolone, Methylprednisolone, Dexamethasone, Prednisone, Prednisolone, c) <u>Androgens and Anabolic Steroids</u>: Testosterone, Fluoxymestrone d)<u>Estrogens</u>: Ethynyl estradiol, Estradiol, Mestranol, Estrone, Dienestrol, Diethylstilbestrol and Non-steroidal estrogens e)<u>Progestational agents</u>: Progesterone, Norethindrone, Norgestrel, Dimethisterone. f) Effect of following functional groups <u>into Steroid</u> 1) 9-Alpha-fluoro-11-Betahydroxy 2)17-Alpha-Ethynyl and 17 Beta Methyl 3)16-Alpha 17-Beta Acetonide g) <u>Miscellaneous steroids</u>: Fusidic acid, Spironolactone h) <u>Oral contraceptives</u>	7
4	**Diagnostic agents**: Diatrizoate, locetamic acid, Metrizamide, Iohexol, Iodipamide, Ioxaglate, Iodoxyl[s]. Dyes : Evans Blue[s], CongoRed, Rose Bengal, Fluorescein, Phenolsulfophthlein, Aminohippuric acid, Indigocarmine	2
5	**Antiseptics & Disinfectants** Alcohols (Ethyl alcohol and Isopropyl alcohol), Substituted Phenols, Methenamine mandalate, p-hydroxy-benzoic acid esters, Chloramine-T, Dichloramine-T, 8-hydroxy quinoline derivatives, Acridine derivatives, Mercurials (Mercurochrome, Thiomersal, Nitromersal) and	3

Sr. No.	TOPICS	NUMBER OF HOURS
	Nitrofurantoin derivatives, Triclosan, Halazone[s].	
6	**Antitussives** Noscapine, Dextromethorphan, Levopropoxyphene, Benzonatate, Caramiphen Edisylate, Chlorphendianol	2
7	**Vitamins** Water Soluble Vitamins and Fat Soluble Vitamins: Vitamin A, B1, B2, B6, B12, Folic Acid, Niacinamide, Vitamin C, Biotin, Vitamin K, Vitamin D, Vitamin E, Vitamin K	2
8	Introduction to Drug design and QSAR Drug/Drug interaction (Chemistry Aspects) Drug Evaluation (Long Term use, bioavailability)	6

BOOKS RECOMMENDED:

1. Foundation of Molecular Pharmacology, The Chemical basis of Drug action- By John Bedford Stenlake, Vol. 2, The Athlone Press London.
2. Foye's - Principles of Medicinal Chemistry, 5th Edition, Edited by – David A. Williams, William O. Foye, Thomas L. Lemke (Lippincott Williams and Wilkins)
3. Wilson and Gisvold's Textbook of Organic Medicinal & Pharmaceutical Chemistry, 12th Edition, by Charles Owens Wilson, John Marlowe Beale and John H. BlockJ.H. Block & J.M. Beale (Lippincott Williams and Wilkins)
4. Burger's Medicinal Chemistry and Drug Discovery, 6th Edition, (Vol 1- 6), Ed .by Donald J Abraham, Wiley Interscience Publication.
5. Essentials of Medicinal Chemistry – Andrejus Korolkovas, 2nd Edition, (John Wiley and Sons)
6. Organic Chemistry of drug synthesis (Vol 1 – 7) by Lednicer & Mitscher (Wiley Interscience)
7. Pharmaceutical Chemistry – Drug Synthesis by Herman J. Roth , Axel Kleemann and T. Beisswenger (Ellis Horwood)
8. Medicinal Chemistry, D. Sriram and P. Yogeswari, Pearson Education (2007)
9. Pharmaceutical Chemistry – by Herman J. Roth (Taylor and Francis Group)
10. Profiles in Drug synthesis by V.N. Ghogte (Vols 1 -2)

1.8.3 MEDICINAL CHEMISTRY – IV (PRACTICALS)

3Hours/Week

The following preparations/ synthetic methods (minimum eight) shall be studied with adequate knowledge of mechanisms involved in various steps. Emphasis shall be given to Recrystallization of products. Elementary study of spectral characterization of products to be discussed.

Synthesis of :

1. Phenytoin
2. Paracetamol from Nitrobenzene
3. Reimer-Tiemann reaction on Naphthol
4. Reaction involved of the following operation:
   a) Oxidation:Preparation of nicotinic acid
   b) Esterification:
   c) Cyclization eg. Benzimidazole
5. 2-Hydroxy-4-methylquinoline from Acetoacetanilide.
6. Flavone
7. Benzocaine
8. Uramil

BOOKS RECOMMENDED:

1. Vogel's - Text book of Practical Organic Chemistry- 5th Edition, Ed. by Brian S. Furniss, Anthony J. Hannaford, Peter W.G. Smith, Austin R. Tatchell (Longmann, Scientific and Technical)
2. Practical Organic Chemistry- Frederick George Mann and Bernard Charles Saunders (Longmann)
3. The Systematic Identification of Organic Compounds- R.L. Shriner, C.K.F. Hermann, T.C. Morrill, D.Y. Curtin, and R.C. Fuson (John Wiley & Sons)

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IV B. PHARM
SEMESTER VIII
1.8.4 PHARMACOGNOSY – V
(THEORY)

TOTAL HOURS: 36

Sr. No	TOPIC	NUMBER OF HOURS
1.	**Standardization** • Importance of standardization of raw materials, extracts, and formulations with suitable examples. • WHO guidelines for the assessment of crude drugs and extracts • Applications of HPLC and HPTLC for the evaluation of drugs and extracts • Standardization of the following drugs: Gokhru, Ashwagandha, Kalmegh, Brahmi, Vasaka, Curcuma and Glycyrrhiza. • Determination of alcohol content in Asavas and Arishtas. • Nutraceuticals: Spirulina, Garlic, Ginko biloba, Momordica, Arnica and Fenugreek.	10
2.	**Plant Biotechnology and Applications** • Polyploidy, mutation, hybridization and chemodemes and their application in improving the quality of medicinal plants. • Tissue culture: (i) Types, techniques and application (ii) Callus and suspension culture (iii) Production of secondary metabolites (iv) Applications of plant biotechnology	8
3.	**Enzyme Biotechnology** • Botanical Source, method of preparations, Properties, chemical nature and uses of - Papain, Bromelain, Streptokinase, Urokinase, Hyaluronidase and Trypsin	7
4.	**Study of traditional drugs** • Common and vernacular names, source, chemical constituents and uses of Kantakari, Malkangani, Tylophora, Apamarga, Gokhru, Shankhapushpi, Gaduchi, Shilajit, Punarnava, Brahmi.	9
5.	**Patenting of Natural Products**	2

1.8.4 PHARMACOGNOSY - V
(PRACTICAL)

3 Hours/ Week

1. Morphological and powder study of some of the drugs studied in theory.
2. Determination of alcohol content in asava and arishta.
3. Marker based standardization of crude drugs by HPTLC.
4. TLC of some of the drugs studied in theory.
5. Simple experiments on immobilization of cells and enzymes.

BOOKS RECOMMENDED:

1. Trease G. E. and Evans, W. C., Pharmacognosy, 16th Ed, Bailliere Tindall, Eastbourne, U.K., 2010.
2. Kokate C. K., Purohit A. P. and Gokhale S. B., Pharmacognosy 41st Ed., Nirali Prakashan, 2008.
3. Tyler V. E., Brady R., Textbook of Pharmacognosy, 8th Ed, Lea and Febiger, Philadelphia, 1981.
4. Iyengar, M. A., and Nayak, S. G. K., Anatomy of Crude Drugs, 8th Ed., Manipal Power Press, Manipal., 2001.
5. Kokate, C. K., Practical Pharmacognosy, 3rd Ed., Vallabh Prakashan, Delhi., 1991.
6. Medicinal plants of India, Indian Council of Medical Research, New Delhi.
7. Wallis, T. E., Textbook of Pharmacognosy, 5th Ed., J. A., Churchill Limited, London, 1985.
8. WHO guidelines for standardization of herbal drugs, WHO.
9. Harborne, J. B., Phytochemical methods, Chapman and Hall, International Ed., London.
10. Pulok, K. Mukharjee, Quality control of Herbal Drugs, Buisness horizons, New Delhi.

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IV B. PHARM
SEMESTER VIII

1.8.5 CLINICAL PHARMACOLOGY (THEORY)

TOTAL HOURS: 36

Sr. No.	TOPICS	NUMBER OF HOURS
1	Clinical Pharmacy daily activities Definition, objectives and procedures of Ward round participation Treatment chart review Drug information ADR monitoring and reporting Therapeutic drug monitoring. Home Medication Review Drug product selection	5
2	Patient data analysis Interpretation of patient data in the evaluation of disease state and its importance, interpretation of laboratory test results of liver function tests, renal function tests, pulmonary function tests, haemogram, cardiac enzymes. Health Screening Services Definition, scope, and uses of health screening services, procedures involved in screening blood pressure, capillary blood glucose, body mass index ,	6
3	Drug Interactions (Drug-Drug, Drug-Food, Drug-Lab investigations) – types, interpretation and detection, prevention, Practice on market prescriptions, Use of drug interaction software's.	4
4	Drugs and Poison Information Introduction to drug and poison information resources, systematic approach in answering DI queries, Critical evaluation of drug information and literature, Establishing a Drug Information Centre, Poisons information centre, Drug Information Bulletin	4
5	Pharmacovigilance Scope, definition and aims of Pharmacovigilance system in India, Epidemiology. Adverse drug reactions - Classification, mechanism, predisposing factors, causality assessment, monitoring and detecting adverse drug reactions, and reporting adverse drug reactions with examples, role of Pharmacist.	4

Sr. No.	TOPICS	NUMBER OF HOURS
6	Drug use in special population Pregnancy, geriatrics, paediatrics and breast-feeding, vulnerable population	3
7	Health Screening Services Definition, scope, and uses of health screening services, procedures involved in screening blood pressure, capillary blood glucose, body mass index	2
8	OTC medications – definition, need, and role of Pharmacist. OTC medications in India, counseling for OTC products. Self medication and role of pharmacist in promoting safe self-medication.	2
9	Responding to symptoms/minor ailments Relevant pathophysiology, common non-pharmacological and OTC drug therapy, and referral to doctor – in :Pain, GI disturbances (Nausea, Vomiting, Dyspepsia, diarrhea, constipation), Worm infestations, Pyrexia, Ophthalmic symptoms, URT infections, skin disorders, oral and dental disorders.	6

1.8.5 CLINICAL PHARMACOLOGY (PRACTICALS)

3 Hours/Week

1) Explaining the use of prescribed product and preparation of Bill
2) Measure BP/BGL/BMI in human volunteers
3) Giving suitable instructions to the patients on use of the medicines
4) Calculate maintenance dose for selected drugs using given data
5) Reporting ADR to CDSCO
6) Case study
7) Critical Analysis of prescriptions
8) Providing drug information services
9) Calculation of dose (Paracetamol and other drugs)

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IV B. PHARM

SEMESTER VIII

1.8.6 PHARMACEUTICAL ANALYSIS IV

(THEORY)

TOTAL HOURS: 36

Sr. No	TOPIC	NUMBER OF HOURS
1	**Chromatography:** Introduction and general principles- classification of chromatographic methods (based on separation procedure and on development procedure), chromatogram and theoretical considerations (distribution coefficient, partition coefficient, retention characteristics, capacity factor, selectivity factor, column efficiency- HETP and band broadening- Van Deemter equation), optimization of column performance, system suitability tests, qualitative and quantitative analysis.	5
2	**Paper Chromatography:** Introduction, sample preparation, types of papers, solvents, chromatographic chambers, sample application, development techniques, qualitative analysis- location of spots and R_f values, quantitative analysis, applications of Paper Chromatography.	3
3	**Thin Layer Chromatography & High Performance Thin Layer Chromatography:** Introduction, principle, adsorbents, preparation of plates, precoated plates, sample application, solvents, development techniques, qualitative and quantitative analysis, applications of TLC and HPTLC, Preparative TLC.	6
4	**Column Chromatography:** Introduction, columns, packing of column, sample application, column elution. Modes of chromatography (adsorption, partition, ion-pair, ion-exchange, gel permeation affinity), Applications of Column Chromatography.	3
5	**High Performance Liquid Chromatography (HPLC):** Introduction, modes of chromatography, instrumentation- solvent reservoir, solvent treatment system, pumps (reciprocating, displacement, pneumatic), sample injection systems ,columns, column packings, stationary phases, fittings (for normal and reverse phase, analytical and guard columns, thermostats),mobile phases and detectors (UV-single wavelength, variable wavelength, photodiode array, fluorescence, refractive index, electrochemical, radiochemical detectors), sample derivatization, Applications of HPLC- qualitative and quantitative analysis. UPLC.	6

Sr. No	TOPIC	NUMBER OF HOURS
6	**Gas Chromatography (GSC and GLC)** Introduction, principle, instrumentation - carrier gas supply and controls, columns (packed and capillary) and oven, sample injection system, stationary phases in GLC and GSC, detectors (thermal conductivity, electron capture, flame ionisation), sampling techniques (head space analysis, pyrolysis, adsorption of volatiles, derivatisation), Applications of GC-qualitative and quantitative analysis.	5
7	**Electrophoresis:** Introduction, principle, types and applications of electrophoresis.	2
8	**X-Ray Methods:** Introduction, identification of crystalline compound, X-ray powder diffraction, Bragg reflections, diffraction methods, application of X-ray methods- crystallographic study.	3
9	**Validation of analytical methods:** A brief introduction as per ICH guidelines.	3

1.8.6 PHARMACEUTICAL ANALYSIS – IV (PRACTICALS)

3 Hours/Week

1. Monograph Analysis of active pharmaceutical ingredients (any 2).

2. Separation and identification of mixtures using Paper Chromatography (any 2).

3. Separation and identification of mixtures using TLC (any 2).

4. Separation and identification of components in marketed pharmaceutical formulations by TLC (any 4).

5. Column chromatographic separation of two component mixture (Demonstration).

6. Assay of a drug using HPLC (Demonstration of any 2 drugs).

7. Assay of a drug using GC (Demonstration).

BOOKS RECOMMENDED:

1. A. Braithwaite & F.J. Smith, Chromatographic Methods, Chapman and Hall, London/ New York.
2. D.A. Skoog & J. Leary- Principles of Instrumental Analysis, Saunders College Publishing, USA.
3. Browning- Chromatography, McGraw Hill, London.
4. H.H. Willard, L.L. Merrit & John Dean- Instrumental Methods of Analysis, CBS publishers and Distributors, India.
5. Beckett & Stenlake, Practical Pharmaceutical Chemistry, CBS publishers and Distributors, India.
6. James W. Munson- Pharmaceutical Analysis, Modern Methods, Marcel Dekker Inc., USA.
7. G.W. Ewing, Instrumental Methods of Analysis, McGraw Hill.
8. K.A. Connors- A Textbook of Pharmaceutical Analysis, Wiley India.
9. Advances in Chromatography, Marcel Dekker, Series of books.
10. G. Christian- Analytical Chemistry, John Wiley.
11. I.R.Berry& R.A.Nash, Pharmaceutical Process Validation, Marcel Dekker Inc,New York.
12. Gurdeep. R. Chatwal, Sham. K. Anand; Instrumental methods of chemical Analysis; Himalaya Publishing House.
13. Latest editions of IP, BP, USP

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