# ***Annexure – I***

Scheme of Examination for eight semesters of B. Pharm. Course
Name and number of heads of passing, number of papers, duration of examinations, maximum marks, and minimum marks for passing, periodic tests duration, maximum marks.

**First Year B. Pharm. (Semester-I)**

| **THEORY** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Entry | Subject | No. Of Papers | Semester Exam. | | | Periodic Test | | Total Max. | Min. marks for Passing |
| | | | Duration Hours | Maxi. Marks | Min. for Passing | Duration (Hours) | Max. Marks | | |
| 1 | Anat., Physio. & Patho.- I | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 2 | General Chemistry- I | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 3 | Organic Chemistry- I | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 4 | Physical Pharmacy- I | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 5 | Pharmaceutics- I | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 6 | Pharm. Engineering- I | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| **PRACTICALS** | | | | | | | | | |
| 7 | Organic Chemistry- I Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 8 | Physical Pharmacy- I Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 9 | Anat., Physi. & Path.- I Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| * 1 hour tutorial either before or after the practical: However exam will be for 04 hours. | | | | | | | | | |
| Total Marks for the Semester | | | 450 | | | | | | |
| Minimum marks for passing the semester | | | 225 | | | | | | |

**First Year B. Pharm. (Semester-II)**

| **THEORY** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Entry | Subject | No. Of Papers | Semester Exam. | | | Periodic Test | | Total Max. | Min. marks for Passing |
| | | | Duration Hours | Maxi. Marks | Min. for Passing | Duration (Hours) | Max. Marks | | |
| 1 | Organic Chemistry- II | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 2 | Pharmaceutical Analysis- I | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 3 | Physical Pharmacy- II | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 4 | Pharmaceutics- II | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 5 | Microbiology | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 6 | Anat., Physio. & Patho.- II | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| **PRACTICALS** | | | | | | | | | |
| 7 | Pharmaceutical Analysis- I Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 8 | Pharmaceutics- I Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 9 | Physical Pharmacy- II Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 10 | Microbiology Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| Total Marks for the Semester | | | 500 | | | | | | |
| Minimum marks for passing the semester | | | 250 | | | | | | |

**Second Year B. Pharm. (Semester-III)**

| **THEORY** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Entry | Subject | No. Of Papers | Semester Exam. | | | Periodic Test | | Total Max. | Min. marks for Passing |
| | | | Duration Hours | Maxi. Marks | Min. for Passing | Duration (Hours) | Max. Marks | | |
| 1 | Organic Chemistry- III | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 2 | Pharmaceutical Analysis- II | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 3 | Biochemistry- I | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 4 | Pharmaceutics- III | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 5 | Pharmaceutical Engineering- II | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 6 | Mathematics- I | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 7 | Anat., Physio. & Patho.- III | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| **PRACTICALS** | | | | | | | | | |
| 8 | Pharmaceutical Analysis- II Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 9 | Pharmaceutics- II Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 10 | Computer Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| Total Marks for the Semester | | | | 500 | | | | | |
| Minimum marks for passing the semester | | | | 250 | | | | | |

**Second Year B. Pharm. (Semester-IV)**

| **THEORY** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Entry | Subject | No. Of Papers | Semester Exam. | | | Periodic Test | | Total Max. | Min. marks for Passing |
| | | | Duration Hours | Maxi. Marks | Min. for Passing | Duration (Hours) | Max. Marks | | |
| 1 | Pharmacology- I | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 2 | Organic Chemistry- IV | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 3 | Biochemistry- II | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 4 | Dispensing Pharmacy | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 5 | Mathematics- II | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 6 | Psychology & Sociology | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 7 | Anat., Physio. & Patho.- IV | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| **PRACTICALS** | | | | | | | | | |
| 8 | Organic Chemistry- II Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 9 | Dispensing Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 10 | Biochemistry- I Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| Total Marks for the Semester | | | | 500 | | | | | |
| Minimum marks for passing the semester | | | | 250 | | | | | |

**Third Year B. Pharm. (Semester-V)**

| **THEORY** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Entry | Subject | No. Of Papers | Semester Exam. | | | Periodic Test | | Total Max. | Min. marks for Passing |
| | | | Duration Hours | Maxi. Marks | Min. for Passing | Duration (Hours) | Max. Marks | | |
| 1 | Pharm. Med. Chem.- I | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 2 | Biochemistry- III | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 3 | Pharmacognosy- I | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 4 | Pharmaceutics- IV | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 5 | Hosp. Pharm. & DSM | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 6 | Pharm. Biotechnology | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 7 | Pharmacology- II | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| **PRACTICALS** | | | | | | | | | |
| 8 | Pharm. Chem.- I Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 9 | Pharmaceutics- III Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 10 | Biochemistry- II Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 11 | Pharm. Biotech. Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| Total Marks for the Semester | | | | 550 | | | | | |
| Minimum marks for passing the semester | | | | 275 | | | | | |

**Third Year B. Pharm. (Semester-VI)**

| **THEORY** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Entry | Subject | No. Of Papers | Semester Exam. | | | Periodic Test | | Total Max. | Min. marks for Passing |
| | | | Duration Hours | Maxi. Marks | Min. for Passing | Duration (Hours) | Max. Marks | | |
| 1 | Pharm. Med. Chem.-II | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 2 | Pharm. Analysis- III | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 3 | Pharmacognosy- II | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 4 | Pharmaceutics- V | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 5 | Cosmeticology | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 6 | Pharmaceutical Management | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 7 | Pharmacology- III | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| **PRACTICALS** | | | | | | | | | |
| 8 | Pharmacology- I Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 9 | Pharmacognosy- I Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 10 | Cosmeticology Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| Total Marks for the Semester | | | | 500 | | | | | |
| Minimum marks for passing the semester | | | | 250 | | | | | |

**Final/Fourth Year B. Pharm. (Semester-VII)**

| **THEORY** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Entry | Subject | No. Of Papers | Semester Exam. | | | Periodic Test | | Total Max. | Min. marks for Passing |
| | | | Duration Hours | Maxi. Marks | Min. for Passing | Duration (Hours) | Max. Marks | | |
| 1 | Pharmacology- IV | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 2 | Pharm. Med. Chem.- III | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 3 | Pharm. Analysis- IV | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 4 | Pharmacognosy- III | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 5 | Pharmaceutics- VI | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 6 | Biopharm.& Pharmacokinetics | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| **PRACTICALS** | | | | | | | | | |
| 7 | Pharmacology- II Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 8 | Pharm. Chem.- II Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 9 | Pharmacognosy- II Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 10 | Pharmaceutics- IV Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| Total Marks for the Semester | | | | 500 | | | | | |
| Minimum marks for passing the semester | | | | 250 | | | | | |

**Final/Fourth Year B. Pharm. (Semester-VIII)**

| **THEORY** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Entry | Subject | No. Of Papers | Semester Exam. | | | Periodic Test | | Total Max. | Min. marks for Passing |
| | | | Duration Hours | Maxi. Marks | Min. for Passing | Duration (Hours) | Max. Marks | | |
| 1 | Clinical Pharm.& Drug Interaction | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 2 | Pharm. Med. Chem.-IV | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 3 | Pharm. Analysis-V | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 4 | Pharmacognosy-IV | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 5 | Pharmaceutics-VII | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 6 | Novel Drug Delivery Systems | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| 7 | Forensic Pharm. & Juris. | 1 | 2 | 40 | 16 | 1 | 10 | 50 | 20 |
| **PRACTICALS** | | | | | | | | | |
| 8 | Pharmaceutics- V Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 9 | Pharamacognosy- III Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| 10 | Pharm. Analysis- III Lab. | 1 | 4 | 40 | 16 | 4 | 10 | 50 | 20 |
| Total Marks for the Semester | | | | 500 | | | | | |
| Minimum marks for passing the semester | | | | 250 | | | | | |

## SYLLABUS COPY FOR FIRST YEAR B. PHARM

### SEMESTER – I

**GENERAL CHEMISTRY** **3 hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Kinetics and Reaction Mechanism. Kinetic and thermodynamic product control, principle of microscopic reversibility, isotope effect on kinetic effect of reaction medium on the rate of the reaction | 5 |
| 2. | Transition state theory. General theory of the transaction state, the reaction coordinate, rate determining transition state, Curtin principle. | 4 |
| 3. | Acid-Base Catalysis. General mechanisms of acid and base catalyzed reactions, rates of acid and base catalyzed reactions, Bronsted catalysis correlation of reaction rates with acidity functions. | 5 |
| 4. | Charge-Transfer complexes and reactions. Definition of Complex, Charge- transfer transition, donors and acceptors, ground state charge transfer contribution. | 5 |
| 5 | Co-ordination Chemistry, Nomenclature, Theories of bonding in co-ordinate complexes, Stability of complexes and chelation. | 5 |
| 6. | Brief introduction to the inorganic medicinal compounds: antacid(Magnesium trisilicate and aluminium hydroxide ), antimicrobial (hydrogen peroxide and povidone-iodine), astringent(Zinc oxide) and Pharmaceutical aid(tale and barium sulphate) | 6 |

**Reference Books:**


1. Isrie V. Anslyn and Dennis A. Dougherty, Modern Physical Organic Chemistry, John Wiley, 2006
2. Neil Isaacs, Physical Organic Chemistry, 2nd Edition, Pearson Education 1995
3. Louis P. Hanunett, Physical Organic Chemistry, Megraw Hill Education, 2nd Rev Edition, 1970
4. Edward M. Kosower, An Introduction to Physical Organic Chemistry, John Wiley and Sons, Inc, 1968
5. J.D Lee, A New Concise Inorganic Chemistry, 3rd edition Van Nostrand Reinhold Company Ltd.
6. John H. and Edward B., Inorganic Medicinal and Pharmaceutical Chemistry Varghese Publishing House, 1986.

**ORGANIC CHEMISTRY –I** **3hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Structure and Properties of Organic Compounds : Types of bonds in organic compounds, hybridization of orbital's, formation of the same and bonds formed, bond length, bond angles, bond energles, bond polarization | 4 |
| 2. | Inductive effects, concepts of H-bonding hyperconjugation resonance, Van der Waal's interaction, inclusion phenomena, Acidity and basicity of molecules | 4 |
| 3. | Concept of Electrophiles and Nucleophiles<br>Calculations for determining empirical and molecular formulae | 3 |
| 4. | Mechanism and elementary stereochemistry discussion of SN1, SN2 and Sn1 mechanisms, En, E2 and E Discussion of substitution vs. elimination | 7 |
| 5. | Discussion of the following classes of compounds in brief, with regard to IUPAC nomenclature, sources, methods of preparation, Physical properties and general reactions of hydrocarbons (alkanes, alkenes, alkynes) | 5 |
| 6. | Addition reaction of alkenes: Markonikov, Anti-Markonikov rules, Hydroboration, Oxymercuration-Demercuration, Ozonolysis, addition of KMnO4 and Addition reactions across conjugated. | 6 |
| 7. | Aliphatic halogen compounds | 2 |

**Reference Books:**


1. Robert T. Morrison and Robert N. Boyd, Organic Chemistry, 6th Edition, Pearson Education Pvt. Ltd., 2005
2. Peter Sykes, A Guide book to Mechanisms in organic Chemistry, 6th Edition, Pearson Education, 2007
3. H. Finar, Organic Chemistry, 5th Edition, Pearson Education, 2006
4. Stanley Pine, Organic Chemistry, 5th Edition, McGraw- Hill Companies, 2007
5. Francis Carrey, Organic Chemistry, 4th Edition, McGraw- Hill Companies,2000


**ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY - I** **3hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Brief Introduction to human body and organization of human body | 1 |
| 2. | Structural and functional characteristics of following tissues<br>• Epithelial<br>• Connective<br>• Nervous<br>• Muscle | 2 |
| 3. | Detailed structure of cell membrane and trans-membrane movement of substances | 2 |

| | | |
|---|---|---|
| 4. | Components and functions of lymphatic system:<br>• Lymphatic organs and tissues<br>• Organization of Lymph vessels<br>• Formation and flow of lymph | 2 |
| 5. | Definition and etiology of following diseases in detail<br>• AIDS<br>• Autoimmune disease (Rheumatoid arthritis /Grave's disease / Myasthenia Gravis / Rheumatic fever)<br>• Hypersensitivity (Allergy) | 3 |
| 6. | Haematology<br>• Composition of blood<br>• Functions of blood elements<br>• Erythropoiesis<br>• Synthesis of Haemoglobin<br>• Leucopoisis<br>• Coagulation of blood<br>• Blood groups | 8 |
| 7. | Definition & etiology of following diseases , in detail<br>• Anaemias Types of anaemias<br>• Polyeythemia<br>• Leucopenia<br>• Leukocytosis<br>• Thrombocytopenia<br>• Leukemia | 4 |
| 8. | Structure and Properties of following muscles<br>• Cardiac muscles<br>• Smooth muscles<br>• Skeletal muscles<br>• Neuromuscular transmission and contraction of skeletal muscle<br>• Energy metabolism in the muscle<br>• Types of muscle contractions<br>• Muscle tone | 7 |
| 9. | Definition and etiology of following diseases, in detail<br>• Spasticity<br>• Tetany | 1 |

**Reference Books:**


1. Anne Waugh and Alleon Grant Ross & Wilson's Anatomy & Physiology in Health & 9th Edition (2001) Churchill Livingstone, Edinbrigh, London, Newyork.
2. Gerald J. Tortora & Sandra Reynolds Grabowaski Principle of Anatomy & Physiology 10th Edition (2003) John Wiley & Sons Inc, Newyork, USA
3. Arthur C. Guyton & John Half. Textbook of Medical Physiology 10th Edition (2000) W.B. Saunders Company, Philadelph , Pensylvania, USA
4. B. R. Mackenna & R. Callander Illustrated Physiology 6th Edition 1997, Churchill Livingstone, Newyork Edinburgh, London
5. Praful b. Godkar Textbook of Medical Laboratory Technology 2nd Edition 2006 Bhalani Publishing House, Mumbai
6. V. G. Ranade, P. N. Joshi & Shalini Pradhan A Text book of Practical Physiology 3rd Edition 1982 P.V.G. Prakashan, Pune 30

**PHYSICAL PHARMACY - I** **(3hrs/ week)**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Gases:<br>• Ideal and Real Gases<br>• Vanderwaals phenomenon<br>• Critical phenomenon, critical constants and their determination<br>• Liquefaction of gases – Linde's process and Claude's process<br>• Application of Liquefaction in aerosols- introduction to the concept | 6 |
| 2. | Physical Properties of Drug Molecules<br>• Additive, constructive and colligative properties with examples<br>• Dipole moment, significance to pharmacy, concept of polarisability and molar<br>• Polarisation<br>• Retractive index and molar refraction and application of moral retraction to determine structures.<br>• Viscosity: Definition, Concepts and applications -> Textbook of Pharmacy Subramanyam<br>• Optical rotation and specific rotation and its application | 6 |
| 3. | Solutions of Non-electrolytes:<br>• Units for expressing concentration<br>• Ideal and real solutions<br>• Raoults law, deviation from Raoults law<br>• Methods to measure vapour pressure lowering and its application (problems)<br>• Distillation of binary mixtures and azeotropic distillation<br>• Concept of steam distillation<br>• Elevation of boiling point and determination of molecular weight (problems)<br>• Depression of freezing point and determination of molecular weight (Problems)<br>• Osmotic pressure: Concept, Methods to determine, molecular weight determination from osmotic pressure | 9 |
| 4. | **Thermodynamics**<br>• Definition, Application and Limitations<br>• Systems –Homogenous, Heterogenous<br>• Types of systems Open, Closed, Adrabatic, Isothermal<br>• Types of Properties- Intensive and Extensive Property<br>• Equilibrium and Non-Equilibrium states<br>• Types of Processes- Isothermal Adrabatic, Isobanic, Isochoric, Cyclic Process<br>• Reversible and Irreversible process<br>• First Law of thermodynamics<br>• Enthalpy, heat Capacity, cP- cV-R (Derivation)<br>• Work of expansion against variable pressure<br>**Thermo-chemistry**<br>• Heat of reaction, Heat of Formation, Heat of combustion, Heat of Solution – Differential and Integral heat of solution.<br>• Bond Energy – Calculation of Heat of reaction from bond energy | 9 |

| | | |
|---|---|---|
| | data<br>• Kirehoffs equation, Hess's law of constant heat summation<br>• Second law of thermodynamics<br>• Carrot theorem<br>• Efficiency of heat engine<br>• Entropy<br>• Third law of thermodynamics<br>**Free Energy and its applications**<br>• Pressure and Temperature coefficients of free energy<br>• Maximum net work, Criteria for equilibrium<br>• Chemical potential (only definition)<br>• Gibbs Helmholtz equation<br>• Clausius Clapereyon equation No derivation<br>• Vant Holf equation No derivation | |
| 5. | Properties of Solutions of Electrolytes<br>• Electrolysis<br>• Faradays laws of electrolysis<br>• Electrolytic conductance, Specific conductance, Equivalent conductance, Molecular conductance<br>• Transport Number<br>• Measurement of conductance<br>• Variation of equivalent conductance with<br>• Arrhenius theory of electrolytic dissociation-colligative properties, activity coefficient expressing collagative properties.<br>• Theory of strong electrolytes<br>• Degree of dissociation<br>• Kohlrauschs law of independent migration of<br>• Application of conductivity measurements conductometric titrations and solubility of a sparingly soluble salt<br>• Equivalent conductance of a weak electrolyte at infinite dilution<br>• Degree of dissociation of a weak electrolyte | 9 |

**Reference Books:**


1. P. J. Sinko, "Martin's Physical Pharmacy and Pharmaceutical Science" 5th Edition, Lippincotts Willians and Wilkin, Indian Education Distributed by B. I. Publications Pvt. Ltd, 2006.
2. A. Findlay, "Practical Physical Pharmacy' revised and edited by J. A. Ktchener, 8th Edition. Lonmans, Green and Company Ltd 1967.
3. B. S. Bahl, A. Bahl, G. D. Tuli, "Essentials of Physical Chemistry" revised edition, S. Chand and company Ltd, New Delhi, 2006.
4. U. B. Hadkar "A Textbook of Physical Pharmacy", 6th Edition Nirali Prakashan, Pune 2006.
5. U. B. Hadkar, T. N. Vasudevan, K. S. Laddha "Practical Physical Pharmacy" Yucca Publishing House, Dombivali, 1994.


**PHARMACEUTICS-I** **3hrs/week**

| S. No. | Topic | Hours |
|---|---|---|

| | | |
|---|---|---|
| 1. | Historical background to the profession of Pharmacy in India in brief.<br>Brief overview of status of Pharmaceutical industry in India | 2 |
| 2. | Introduction to Pharmacopoeias.<br>Development of Indian Pharmacopoeia and other Compendia including B.P.,U.S.P., N.F., Ph Eur., International pharmacopoeia and B.P.C. | 3 |
| 3. | Definition of Drug<br>Concept of dosage form and formulation – Scope of Pharmaceutics<br>Routes of administration and physiological considerations<br>Classification of dosage forms and their applications. | 3 |
| 4. | Drug administration: Introduction to bioavailability and biopharmaceutics.<br>Concepts of drug efficiency and dose response.<br>Introduction to Absorption, Distribution and fate of drug. | 4 |
| 5. | Pharmaceutical Calculations: Reduction and enlargement of formula, Formula by weight (w/v, w/w, v /v); in parts. | 3 |
| 6. | Introduction to Good Manufacturing Practices and Quality Assurance | 2 |
| 7. | Introduction to galenicals. A method of preparation of extracts includes maceration, percolation, decoction, infusion and digestion. | 3 |
| 8. | Introduction to alternate systems of medicine: Ayurveda, Homeopathy, Unnani and Siddha. | 1 |
| 9. | Delivery systems: Non – sterile monophasic liquids.<br>Unit operation of : Filtration and clarification ( Theory and equipment for filtration of solid from liquids ) and mixing | 8 |
| 10. | Rheology : Definition and concepts, types of flow, thixotropy and measurement of flow properties | 3 |
| | **Total** | 33 |

**Reference Books:**


1. L. V. Allen Jr., N. G. Popovich and H. C. Ansel "Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems ",8th Edition Lippincotts Williams and Wilkin, Indian Education Distributed by B. I. Publications Pvt. Ltd, 2005
2. P. J. Sinko, "Martin's Physical Pharmacy and Pharmaceutical Science" 5th Edition, Lippincotts Williams and Wilkin, Indian Edn, Distributed by B. I. Publications Pvt. Ltd,2006
3. M. E. Aulton "Pharmaceutics- The Science of Dosage Form Design" Churchill Livingstone, London, 2002.
4. "Remington- The Science and Practice of Pharmacy ", Vol. I and II, 21st Edn. Lippincotts Williams and Wilkin, Indian Edn. Distributed by B. I. Publications Pvt. Ltd.,2005
5. M. L Shroff "Principles of Pharmacy Part I and II"8th Edn. Five star Enterprises, Calcutta.
6. E. A. Rowling "Bentleys Textbook of Pharmaceutics" 8th Edn. Bailliere Tindall, London, Indian Edn. Published by All India Traveler Book Seller Delhi, 1992.

7. P. C. Dandiya, R. K. Khat and N. K. Gurbani "The Pharmacist Year Book 1993 1st Edn. CBS Publishers and Distributors, Delhi 1993.
8. G. Sonnedecker "Kremers and Urdang's History of Pharmacy" 4th Edn Lippincotts Company, USA, 1976.
9. R. A. Lyman and G. Urdang "American Pharmacy" 5th Edn.
10. James Swarbick "Current concepts in Pharmaceutical Sciences: Dosage form design and bioavailability" Lea and Febiger, Philadelphia, 1973.
11. Harkishan Singh "Pharmacopoeias and Formularies" Vol. I Vallabh Prakashan, Delhi 1994.
12. S. J. Carter "Cooper and Gunn's Tutorial Pharmacy" 6th Edn. CBS Publishers and Distributors, Delhi, 1986.
13. M. J. Stocklosa, H. C. Ansel,"Pharmaceutical Calculations" 8th Edition, Indian Edition by K.M. Varghese Company, Mumbai 1986.

**PHARMACEUTICAL ENGINEERING I** **3hrs/ week**

**Note:** Only principles and equipments to be covered
No mathematical derivations and numerical problems

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Fluid Flow:<br>• Mention fluid properties such as Viscosity, compressibility and surface tension of fluids<br>• Hydrostatics influencing fluid flow<br>• Fluid dynamics – Bernoulli's theorem, flow of fluids in pipes, laminar and turbulent flow. | 4 |
| 2. | Heat Transfer:<br>• Modes of heat transfer – conduction, convention and radiation.<br>• Fourier's law for slabs and pipes (only equation and factors affecting)<br>• Concepts of thermal conductivity and steady state heat transfer.<br>• Compound resistance in series.<br>• Heat transfer by convection – Natural convection and forced convection, dimensional analysis. Heat transfer between fluid and solid boundary.<br>• Heat transfer by radiation – Kirchhoff's law and Stefan Boltzmann law. (only equation and factors affecting)<br>• Overall heat transfer coefficient<br>• Heat exchangers- tubular and plate | 6 |
| 3. | Mass transfer:<br>• Mass transfer in turbulent and laminar flow<br>• Concept of interfacial mass transfer. | 2 |
| 4. | Pumping:<br>• Positive displacement pumps- reciprocating pumps, rotary pumps<br>• Centrifugal pumps<br>• Special pumps | 4 |
| 5. | Measurements:<br>• Measurement of flow – Classification of flow meters, venture | 4 |

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| | meter, orifice meter, pitot tube, rotameter and current flow meters<br>• Pressure measurement – Classification of manometers, simple manometer, U tube manometer and modifications, Bourdon gauge | |
| 6. | Conveying of Solids:<br>• Belt conveyor, Bucket conveyor, screw conveyor and Pneumatic conveyor. | 1 |
| 7. | Water Purification:<br>• Pretreatment and purification by deionization, reverse osmosis and distillation. | 2 |
| 8. | Refrigeration and Air Conditioning:<br>• Water vapour- air mixture<br>• Hygrometry<br>• Humidification and dehumidification equipments – spray ponds, natural draft cooling towers and mechanical draft cooling towers.<br>• Refrigeration- equipment and concept of refrigeration load, concepts of brine systems and absorption systems | 4 |
| 9. | Centrifugation :<br>• Principle , objective and requirements of centrifugation<br>• Equipments- Hydro extractors. | 1 |
| 10. | Corrosion:<br>• Mechanism and types of corrosion.<br>• Factors influencing rate of corrosion.<br>• Methods of combating corrosion. | 3 |
| 11. | Material of Construction:<br>• Classification into metals & nonmetals<br>• Ferrous and its alloys – cast iron, mild steel and stainless steel<br>• Copper and its alloys<br>• Nickel and its alloys<br>• Aluminum and its alloys<br>• Glass<br>• Plastics – Classification into thermoplastics and thermosetting plastics Properties and applications of polyvinyl chloride, polyethylene, polypropylene, polystyrene, polyster, ABS, phenolic and epoxy plastics, fluorocarbon plastics, chlorinated plastics and poly carbonate plastics. | 4 |
| | **Total** | **35** |

**Reference Books:**


1. K. Sambamurthy “Pharmaceutical Engineering” New Age International Pvt. Ltd. New Delhi, 2001.
2. A. R. Paradkar “Introduction to Pharmaceutical Engineering”7th Edn. Nirali Prakashan, Pune 2005.
3. W. L. Badger and J. T. Banchero “Introduction to Chemical Engineering” Mc. Graw Hill Book Company.
4. R. H. Perry and D. W. Green “Perry’s Chemical Engineer’s Handbook “7th Edn. Chemical Hand Book. Mc Graw Hill Book Company, 1997.

**ORGANIC CHEMISTRY LABORATORY- I** **4hrs/ week**

Organic Sporting: Qualitative analyses of organic compounds – aspects to be covered are solubility characterization and preliminary tests, elements detection, functional group characterization, derivative preparation

**Reference Books:**

1. Textbook of practical organic chemistry by Vogel, 4th edition, publishers Longman group Ltd.
2. Practical Organic Chemistry by F.G. Mann and B.C. Saunders, 4th edition published by Orient-Longman.
3. Handbook by Kulkarni and Pathak, Published by Dastane Ramchandra and Company

**PHYSICAL PHARMACY LAB – I** **4hrs/ week**

1. Determination of refractive index, molar refraction. Using water as a reference standard to determine refractive index of two organic solvent and their mixtures and to determine composition of unknown. To determine RI of a solid (KCl) from two concentrations of solid solutions.
2. **Viscosity:** To determine the composition of the unknown binary mixture.
3. **Polarimetry:** Different Concentrations of sugar, determination of unknown concentration and specific rotation.
4. Determination of molecular weight by Rast camphor method. Demonstration of Landsberger method.
5. Determination of heat of solution.
6. Partition coefficient – Iodine

**Reference Books:**

1. U. B. Hadkar, T. N. Vasudevan, K. S. Laddha “Practical Physical Pharmacy” Yucca Publishing House, Dombivali, 1994.

**ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY – Lab (4hrs/ 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

3. Microscopic study of permanent slides Tissues:
   - Columnar, Cuboidal, Squmaous, Ciliated Epithelium

- Cardiac/Skeletal/ Smooth muscle
- Ovary,Testis, Liver, Pancreas, Thyroid, Tongue, Stomach, Intestine, Kidney, Lung, Spinal Cord, Cerebrum, Artery, Vein

4. Measurement of blood pressure

5. Tutorial Discussion on some common investigational procedures used in diagnosis of disease with the help of charts slides Name and Importance of following tests:

    1. Electroencephalogram (EEG) in diagnosis of Epilepsy
    2. Electrocardiogram (ECG) in diagnosis of cardiac arrhythmia
    3. Liver Function Tests
        - Serum Bilirubin
        - Serum glutamate oxaloacetate transaminase (SGOT)
        - Serum glutamate pyruvate transaminase (SGPT)
        - Urine Bilirubin
        - Urine Urobilinogen
    4. Kidney Function Tests
        - Serum Creatinine
        - Serum Urea, Uric Acid
        - Blood Urea Nitrogen(BUN)
    5. Blood Glucose
    6. Serum Cholesterol/ Triglycerides
    7. Serum Alkaline phosphatase (ALT)
    8. Serum Acid phosphatase (APT)
    9. Serum Lipase
    10. Serum Amylase
    11. Serum Calcium
    12. Serum lactate dehydrogense (LDH)
    13. Thyroid Function Tests- T3, T4
    14. Diagnostic tests for infectious diseases like
        - Malaria
        - Tuberculosis
        - Dengue
        - Leptospirosis

**Reference Books:**


1. Anne Waugh And Allison Grant Ross & Wilson's Anatomy & Physiology in Health & Illness 9th Edition (2001) Churchill Livingstone, Edinbruigh, London, Newyork.
2. Gerald J. Tortora & Sandra Reynolds Grabowaski Principals of Anatomy & Physiology 10th Edition (2003) John Wiley & Sons Inc, Newyork, USA
3. Arthur C. Guyton & John E. Hall Textbook of Medical Physiology 10th Edition (2000) W. B. Saunders Company, Philadelphia, Pensylvania, USA.
4. B. R. Mackenna & R. Callander Illustrated Physiology 6th Edition, Churchill Livingstone, Newyork Edinburgh, London.
5. Praful B. Godkar Textbook of Medical Laboratory Technology 2nd Ed. 2006 Bhalani Publishing House, Mumbai
6. V. G. Ranade, P. N. Joshi & Shalini Pradhan, A Textbook of practicalphysiology,3rd Edition 1982 P.V.G. Prakashan, Pune- 030.

## SEMESTER – II

**ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY –II** **3hrs/ week**

| S. No | Topic | Hours |
|---|---|---|
| 1. | Anatomy and physiology of Respiratory System<br>- Exchange of gases<br>- External and Internal respiration<br>- Mechanism and regulation of respiration<br>- Lung volumes and lung capacities | 4 |
| 2. | Definition and etiology of following diseases, in detail<br>- Asthma<br>- Pneumonia<br>- Bronchitis<br>- Emphysema<br>- Respiratory Acidosis and Alkosis | 3 |
| 3. | Reproductive System<br>- Anatomical and Physiological considerations of male and female reproductive system<br>- Menstrual cycle | 4 |
| 4. | Definition and etiology of following diseases, in detail<br>- Infertility<br>- Sexually transmitted diseases (STD)<br>- Dismenorrhea | 2 |
| 5. | Endocrine System<br>Location hormones and functions of following endocrine glands:<br>- Pituitary<br>- Thyroid & Parathyroid<br>- Adrenal<br>- Pancreas<br>- Tests & Ovaries<br>- Control of hormone secretion | 12 |
| 6. | Etiology of hypo and hyper secretion of above endocrine glands and related diseases | 5 |

**Reference Books**


1. Anne Waugh And Allison Grant Ross & Wilson's Anatomy & Physiology in Health & Illness 9th Edition (2001) Churchill Livingstone, Edinbrigh, London , Newyork
2. Gerald J. Tortora & Sandra Reynolds Grabowaski Principals of Anatomy & Physiology 10th Edition (2003) John Wiley & Sons Inc, Newyork, USA
3. Arthur C. Guyton & John E. Hall Textbook of Medical Physiology 10th Edition (2000) W. B. Saunders Company, Philadelphia, Pensylvania, USA
4. B. R. Mackenna & R. Callander Illustrated Physiology 6th Edition 1997, Churchill Livingstone, Newyork Edinburgh, London
5. Praful B. Godkar Textbook of Medical Laboratory Technology 2nd Edition 2006 Bhalani Publishing House, Mumbai
6. V. G. Ranade, P. N. Joshi & Shalini Pradhan A Textbook of practical physiology, 3rd Edition 1982 P. V. G. Prakashan, Pune 30

**ORGANIC CHEMISTRY – II** **3hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| | Discussion of the following classes of compounds in brief, with regard to IUPAC nomenclature, sources, methods of preparation, Physical properties and general reactions, with mechanisms | |
| 1. | Alcohols and ethers | 4 |
| 2. | Carbonyl compounds (aldehydes and ketones) | 5 |
| 3. | Carboxylic acids, esters, anhydrides, amides | 5 |
| 4. | Amines and other nitrogen containing compounds. | 6 |
| 5. | Aromatic compounds: Concepts of aromaticity and aromatic character, Huckel rule, structure and resonance in benzene; Nomenclature of aromatics: Electrophilic and nucleophilic sunstitution reactions in aromatic compounds. | 10 |
| 6. | Preparation and reactivity of polycyclic aromatics – naphthalene's anthracene and phenanthrene | 6 |

**Reference Books**


1. Morrison and Boyd, Organic Chemistry, 6th Edition, Pearson Education Pvt. Ltd, 2006.
2. Peter Sykes, A Guidebook to Mechanisms in organic Chemistry, 6th Edition, Pearson Education, 2007.
3. I. L. Finar, Organic Chemistry, 5th Edition, Pearson Education, 2006 Stanley Pine, Organic Chemistry, 5th Edition, Mc Graw – Hill Companies, 2007.
4. Francis Carrey, Organic Chemistry, 4th Edition, Mc Graw – Hill Companies, 2000.


**PHARMACEUTICAL ANALYSIS – I** **3 hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Introduction to the study of monographs of five official compounds – sodium chloride, calcium carbonate. Talc, boric acid and ferrous sulphate. | 4 |
| 2. | I.P. Limits tests for insoluble matter, soluble matter, nonvolatile matter, volatile matter, residue on ignition and ash value. | 3 |
| 3. | Various limit tests prescribed in I.P. e.g. chloride, sulphate, arsenic, lead, iron, nitrate, alkali and alkaline earth metals. | 3 |
| 4. | The theoretical basis and techniques of quantitative analysis, Solute, solvent, solution, solubility product range, concentration, definition of normality, molarit, molality, milliequivalence, strong acids and bases, weak acids and bases, buffers, primary and secondary standards, calculation based on stochiometry problems, theory of indicators (both external and internal indicators), concept of end point. | 5 |
| 5. | Classification of theoretical considerations and applications to volumetric analysis. | 3 |
| 6. | Acid base titrations in aqueous medium titrations, complexometric titrations, redox titrations, argentimetric titrations and non-aqueous titrations with suitable example. | 15 |

| | | |
|---|---|---|
| 7. | Estimation studies of important gases – Oxygen, Nitrogen and Carbon dioxide. | 3 |

**Reference Books**


1. A. H. Bekett and J. B. Stanlake, Practical Pharmaceutical Chemistry, 4th edition, CBS Publishers and Distributors, 1997.
2. G. H. Jeffery and J. Bassett, Vogels' Textbook of Quantitative Chemical Analysis, 5th Edition, Longman Scientific and Technical, 1989.
3. Indian Pharmacopoeia, British Pharmacopoeia, USP, Martindale.


**PHYSICAL PHARMACY – II** **3 hrs / Week**

| S. No. | TOPICS | Hours |
|---|---|---|
| 1. | Ionic equilibria and buffers:<br>▪ Sorensens pH scale, calculation of pH, effect of pH on<br>▪ Ionization of weak acids and bases, calculation of<br>▪ Fraction unionized, buffers in pharmaceutical and biological systems, concept of tonicity, isotonic buffer<br>▪ Solutions, application of buffers and concept of tonicity in pharmacy.<br>Problems | 4 |
| 2. | Solubility:<br>▪ Solubility of gases in liquids, henrys law and applications<br>▪ Miscible liquids and partially miscible liquids<br>▪ Solubility of solids in liquids, ideal solubility, solubility parameters and prediction of solubility in regular solutions<br>▪ Partition phenomena and partitioning of weak electrolytes and its applications | 6 |
| 3. | Chemical Kinetics:<br>▪ Molecularity, order of a reaction and specific rate constant<br>▪ Zero order, first order and second order reaction. (Problems)<br>▪ Methods to determine order of a reaction<br>▪ Energy of activation, Arrhenius equation and application<br>▪ Collision theory and transition state theory<br>▪ Accelerated stability studies – concepts and applications<br><br>Problems | 8 |
| 4. | Catalysis:<br>▪ Definition, types and specificity | 2 |
| 5. | Interfacial phenomena:<br>▪ Surface tension, Interfacial tension<br>▪ Surface free energy<br>▪ Pressure difference across curved interfaces<br>▪ Measurement of surface and interfacial tension-Capillary rise method<br>▪ Drop weight method<br>▪ Du Nuoy tensiometer method<br>▪ Spreading of liquids<br>▪ Spreading coefficient<br>▪ Adsorption at liquid interfaces | 8 |

| | | |
|---|---|---|
| | ▪ Surface active agents<br>▪ Hydrophilic – Lipophilic balance<br>▪ Types of monolayers at liquid interfaces<br>▪ Soluble monolayers<br>▪ Gibbs adsorption equation (No derivation)<br>▪ Insoluble monolayers and film balance<br>▪ Adsorption at solid interfaces<br>▪ Adsorption isotherms<br>▪ Freundlich adsorption isotherm<br>▪ Wetting angle and Contact angle<br>Problems | |
| 6. | Electromotive force:<br>▪ Electrochemical cell<br>▪ Types of electrodes<br>▪ Nernst equation and cell emf<br>▪ pH meter and Measurement of pH<br>▪ Ion sensitive electrodes<br>▪ Oxidation reduction indicators<br>▪ Concentration cells<br>Problems | 3 |
| 7. | Colloids:<br>▪ Classification<br>▪ Preparation, colloid properties such as optical<br>Kinetic and electrical<br>▪ Gold number<br>▪ Protective colloid<br>▪ Schultz Hardy rule. | 5 |

**Reference Books**


1. P. J. Sinko, "Martin's Physical Pharmacy and Pharmaceutical Sciences" 5th edition, Lippincotts Williams and Wilkin, Indian Edn. Distributed by B. I. Publications Pvt. Ltd., 2006.
2. A. Findlay, "Practical Physical Pharmacy" revised and edited by J. A. Kitchener, 8th Edn. Longmans, Green and company Ltd. 1967.
3. B. S. Bahl, A. Bahl, G. D. Tuli, "Essentials of Physical Chemistry " revised edition, S. Chand and company Ltd., New Delhi, 2006.
4. U. B. Hadkar "A Textbook of Physical Pharmacy", 6th Edn. Nirali Prakashan, Pune 2006.
5. U. B. Hadkar, T. N. Vasudevan, K. S. Laddha "Practical Physical Pharmacy" Yucca Publishing House, Dombivali, 1994.


**PHARMACEUTICS – II**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Introduction to per formulation studies with respect to monophasics:<br>▪ Organoleptic properties<br>▪ Purity<br>▪ Solubility and techniques of solubilzation<br>▪ Partition coefficient and dissociation constant, Salt formation<br>▪ Polymorphism and crystal habit<br>▪ Stability and Interaction with excipients. | 9 |
| 2. | Complexion: | 2 |

| | | |
|---|---|---|
| | ▪ Types of complexes and their analysis. | |
| 3. | Formulation, large scale manufacturing, packaging and Quality Control of non-sterile monophasic liquids:<br>▪ Solutions<br>▪ Aromatic waters<br>▪ Syrups<br>▪ Elixirs<br>▪ Linctuses<br>▪ Drops<br>▪ Glycerites<br>▪ Paints<br>▪ Lotions<br>▪ Liniments<br>▪ Sprays. | 9 |
| 4. | Powder Technology:<br>▪ Fundamental and derived properties of powders and their measurement<br>▪ Size reduction.<br>▪ Size separation. | 7 |
| 5. | Formulation, large scale manufacturing, Packaging and Quality control of Powders:<br>▪ Dusting powders<br>▪ Oral rehydration powders<br>▪ Dry syrup formulations. | 4 |
| 6. | Diffusion:<br>▪ Fick's laws and steady state diffusion, measurement of diffusion.<br>Dissolution:<br>▪ Dissolution rate, Noyes – Whitney equation, Hixon-Crowell Law | 4 |

**REFERENCE BOOKS:**


1. L. V. Allen Jr., N. G. Popovich and H. C. Ansel "Ansel's Pharmaceutical Dosage Forms and Drug Delivery S. D. systems", 8th Edn. Lippincotts Williams and Wilkin. Indian Edn Distributed by B.I. Publications Pvt. Ltd., 2005.
2. P. J. Sinko," Martin's Physical Pharmacy and Pharmaceutical Sciences" 5th edition, Lippincotts Williams and Wilkin, Indian Edn. Distributed by B. I. Publications Pvt. Ltd., 2006
3. M. E. Aulton "Pharmaceutics- The Science of Dosage form Design" Churchill Livingston, London, 2002.
4. "Remington- The Science and Practice of Pharmacy", Vol. I and II, 21st Edn. Lippincotts Williams and Wilkin, Indian Edn. Distributed by B. I. Publications Pvt. Ltd., 2005
5. E. A. Rowling "Bentleys Textbook of Pharmaceutics" 8th Edn. Bailliere Tindall London, Indian Edn. Published by all India Traveler Book seller Delhi, 1992.
6. R. A Lyman and G. Urdang "American Pharmacy" 5th Edn.
7. James Swarbick "Current concepts in Pharmaceutical Sciences: Dosage form design and bioavailability" Lea and Febiger, Philadelphia, 1973.
8. S. J Carter "Cooper and Gunn's Tutorial Pharmacy" 6th Edn. CBS Publishers and Distributors, Delhi, 1986.
9. Industrial Pharmacy

**MICROBIOLOGY** **3 hrs/ Week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Brief history of microbiology: Microbiology, scope and application in pharmaceutical sciences | 1 |
| 2. | Microscopy: Simple microscope, Compound microscope.<br>Resolving power, magnification, angular aperture, and numerical aperture, oil immersion microscopy to be covered in practical, phase contrast and dark field.<br>Fluorescent and electron microscopy. | 3 |
| 3. | Staining (All staining with respect to bacteria):<br>Monochromatic staining<br>Gram staining<br>Acid fast staining<br>Capsule, flagella spore, cell wall staining<br>Negative staining<br>Motility | 2 |
| 4. | Classification of micro-organism as different types | 1 |
| 5. | Classification of bacteria:<br>Morphology, cell characteristic, habitat nutrition Cultivation of bacteria:<br>Culture media: Cultivation, storage media, enrichment media differential media, microbiological assay media<br>Cultivation of aerobes and an aerobes<br>Pure culture techniques – isolation<br>Preservation of cultures<br>Reproduction and Growth phases, measurement of growth, factors affecting growth, continuous cultivation, enumeration of bacteria<br>Identification of bacteria<br>Overview of bacterial diseases in brief<br>Mycobacterium sp., Salmonella sp., Shigella sp., Staphylococcus Sp., Klebsiella sp., E.coli., Pseudomonas, Clostridium- self study | 2<br>2<br>2<br>2<br>2<br>2<br>2 |
| 6. | Viruses:<br>Morphological characteristic, enumeration, cultivation and reproduction HIV and oneogenic Viruses. | 3 |
| 7. | Riekketsiae- Diseases | 1 |
| 8. | Fungi:<br>Morphological characteristics and classification, reproduction,<br>mycosis in brief (Pathogenic fungi like Aspergillus, Dermatophytes. Candida albicans)- | 2 |
| 9. | Algae:<br>Morphological characteristics, reproduction, economic significance of algae | 1 |
| 10. | Protozoa:<br>Morphological characteristics and classification, reproduction, Pathogenic protozoa like Amoeba, Paramecium, Trichomonas, Plasmodium | 2 |
| 11. | Control of micro-organisms:<br>Different techniques of sterilization and their application. Introduction to aseptic techniques(no equipments to be covered)<br>Disinfectants and principles of disinfection. | 6 |

**Reference Books:**


1. M. J. Pelezar Jr., E. C. S. Chan and N. R. Krieg "Microbiology Concepts and Applications" McGraw Hill, Inc., USA, 1993.
2. M. Frobisher, R. D. Hinsdill, K. T. Crabtree and C. R. Goodheart "Fundamentals of Microbiology", 9th Edn. Saunders College Publishing, Philadelphia 1968.
3. W. B. Hugo and A. D. Russel "Pharmaceutical Microbiology" 6th Edn, Blackwell Science Ltd. UK, 2003.
4. R. Ananthanarayan and Ck. J. Paniker "Test Book of Microbiology", 7th Edn. Orient Longman Pvt. Ltd, Hyderabad, 2005


**PHARMACEUTICAL ANALYSIS LABORATORY – I** **4hrs/ week**

1. Preparation and standardization of 0.1 N HCl, 0.1 N NaOH, 0.1N Na2S2O3, 0.1 N KMnO4, 0.1 N Iodin.
2. Assay of Zinc oxide, Magnesium sulphate, Ferrous sulphate, Potassium iodide, Copper sulphate.
3. Titrimetric Analysis : Determination of total alkalinity and sodium carbonate of sodium hydroxide determination of percentage of aspirin, Determination of ascorbic acid
4. Argentimetric titration NaCl powder and KCl.
5. I.P. limit tests for: chloride, sulphate, arsenic, heavy metal, iron.

**Reference Books:**


1. A. H. Bekett and J. B. Stanlake, Practical Pharmaceutical Chemistry, 4th edition, CBS Publishers and Distributors, 1997.
2. G. H. Jeffery and J. Bassett, Vogels' Textbook of Quantitative: Chemical Analysis, 5th Edition. Longman Scientific and Technical 1989.
3. Indian Pharmacopocia, British Pharmacopocia, USP, Martindale


**PHARMACEUTICS LAB – I** **4hrs/week**

**List of experiments**
Aromatic waters
Chloroform water I.P 66
Concentrated Dill water I.P 66 Concentrated Anise water B.P.C 73
Dill water
Gripe water

**Syrups**
Syrup I.P 66
Artificial syrup
Cough syrup – Codeine phosphate syrup B.P.C

**Linctus**
Simple linctus B.P.C
Elixirs
Piperzine citrate elixir B.P.C

**Ear drops**
Chloramphenicol ear drops B.P.C

**Nasal drops**
Ephedrine sulphate nasa drops B.P.C

**Glycerites**
Glycerin of starch I.P 55
Glycerin of boric acid I.P 55
Glycerin of tannic acid I.P 66

**Solutions**
Aqueous Iodine solution I.P 66
Weak Iodine solution I.P 66
Paracetamol Solubilised Paediatric drops
Cresol with soap solution I.P
Magnesium citrate oral solution N.F XIV
Chlorinated soda solution, surgical B.P.C
Iodine Paint compound B.P.C 68

**Powders**
Oral rehydration salt (ORS)
Evaluation of liquids for specific gravity and viscosity and powders for bulk density, flow rate and angel of repose

**PHYSICAL PHARMACY LAB – II** **4hrs/week**

**KINETICS**

1. Relative strength. Hydrochloric acid/ sulphuric acid
2. Second order reaction (saponification)
3. Determination of order by equal fraction method (first order reaction )
4. Ostwalds isolation method to determine order

**NONKINETICS**

1. Parnton coefficient - Benzoic acid
2. Surface tension: 1. Determination of surface tension of water, toluene, n-hexane, parachor and critical solution temp determination. 2. Determination of CMC
3. Phenol water : Critical solution temp and composition
4. Determination of molecular weight of a polymer from solution viscosity
5. Adsorption : Surface area determination
6. HLB of A surfactant
7. Potentiometer : Titration and determination of bufler capacity

**Reference Books:**

1. U. B Hadkar, T. N. Vasudevan, K. S. Laddha “Practical Physical Pharmacy” Yucca Publishing House, Dombivali, 1994.

**MICROBIOLOGY LABORATORY** **4hrs/ week**

1. Study of microscope and common laboratory equipments
2. Gram staining
3. Monochrome staining

4. Negative staining
5. Cell wall staining
6. Scope staining
7. Capsule staining
8. Motility by hanging drop technique
9. Preparation and sterilization of nutrient broth, agar slants, plates, anoculation techniques.
10. Isolation of pure culture by pour plate and streak plate methods. Colony characterization and growth patterns in broth of cocci and bacilli
11. Total count by Breeds smear method
12. Growth by optical density, total plate count
13. Study of yeast, Aspergillus and Penicillum with respect to morphology
14. Observation on prepared slides of malarial parasite in blood smear, intestinal amoeba in stools.

## SYLLABUS COPY FOR SECOND YEAR B. PHARM

## SEMESTER III

### ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY – III 3Hrs/ week

| S. No. | Topics | Hours |
|---|---|---|
| 1. | **Nervous System**<br>Anatomy and physiology of :<br>- Central Nervous System (CNS)<br>- Peripheral Nervous System (PNS)<br>- Autonomic Nervous System (ANS)<br>- Properties of Neurons, Neurotransmitter and neurotransmission<br>- Cranial and spinal nerves<br>- Sensory and Motor pathways | 9 |
| 2. | **Definition and Etiology of following diseases in detail**<br>- Epilepsy<br>- Parkinsonism<br>- Alzheimer's Disease<br>- Cerebral Hypoxia<br>- Stroke (Cerebrovascular disease)<br>- Anxiety & Depression<br>- Mania and Schizophrenia | 7 |
| 3. | **Structure and Function of following sensory organs**<br>- Eye<br>- Ear<br>- Tongue<br>- Nose<br>- Skin | 6 |
| 4. | **Digestive System**<br>- Parts of digestive system. Their structure and functions<br>- Digestion and absorption of carbohydrates, proteins and fats<br>- Phases of gastric secretion | 8 |
| 5. | **Definition and Etiology of following diseases in detail**<br>- Peptic ulceration<br>- Zollinger – Ellison's Syndrome<br>- Inflammatory Bowel Disease (Ulcerative colitis, Crohn's disease )<br>- Cholecystitis & Cholelithiasis<br>- Jaundice<br>- Hepatitis<br>- Pancreatitis<br>- Achalasia<br>- Reflux esophagitis | 6 |

**Reference Books:**


1. Ross & Wilson Anatomy & Physiology in health & Illness. 10th Edition. Anne Waugh, Allison Grant, Churchill Livingstone Elsevier, 2006
2. Tortora & Grabowaski Principles of Anatomy & Physiology. 11th Edition, J Wiley & Sons. 2007
3. Guyton & Hall Textbook of Medical Physiology, 10th Edition. Harcourt Singapore. 2001
4. B. R. Mackenna & R. Callander Illustrated Physiology. 6th Edition. NY Churchill Livingstone. 1997
5. Kplan, Jack, Opheim, Toivola Lyon, Clinical Chemistry: Interpretation & Techniques, 4th Edition, Williams & Williams, London 1995.
6. Praful B. Godkar, Darshan P. Godkar Textbook of Medical Laboratory Technology, 2nd Edition Bhalani Mumbai. 2006
7. P.C. Dandiya & P. K. Sharma Bio-Chemistry & Clinical Pathology (Theory & Practical).
8. Russel J. Greene & Norman D. Harris Pathology & Therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice, 2nd Edition, Pharmpress NY. 2000
9. Ranade & Joshi Manual of Practical Physiology, Pune Vidyarthi Gruha Prakashan.
10. Eric Herfindal, Dick Gourley. Text Book of Therapeutics: Drug and Diseases Management, 7th Edition, Lippincott Williams & Wilkins, A Wolters Kluvers Company.
11. Cotran, Kumar and Colins, Robins-Pathologic Basis of diseases, 6th Edition, WB Sauders Company.
12. The Merck Manual of Medical Information, Home Edition. Merck Research Laboratories, Division of Merek & Co Inc. White House Station. N. J. 1997.


## ORGANIC CHEMISTRY – III 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | **Stereochemistry**<br>Optical isomerism; representation of molecules by Fisher, Newman and Sawhorse projection formulae R, S and D, L notations, diastereomers and resolution of racemic mixtures. Geometrical isomerism E and Z nomenclature.<br>Conformers of ethane, n-butane and cyclohexanes (mono and disubstituted cyclohexanes to be discussed). aspects of stability and optical activity. | 16 |
| 2. | **Name reactions**<br>Aldol condensation, Nitroaldol Claisen Condensation Michael addition, Dieckmann's cyclisation, Stobbe, Reformatsky, Knoevenagel, Perkin, Cannizaro, Beckmann, Lossen, Curtius, Bayer-Villeger, Favorskii, Hoffman, Wolff, Schmidt, Wittig, Benzilic acid rearrangement, Sommolet, Stevens, Pinacol. Problems based on the transformations to be solved | 20 |

**Reference Books:**


1. Stereochemistry of Carbon Compounds. E. L. Eliel. Tata McGraw-Hill Publishing Co. Ltd. 1986.
2. Stereochemistry, Conformation and Mechanisms. P. S Kalsi. 4th Ed., New Age International Publishers 2001.
3. Strategic Applications of Named reactions in Organic Synthesis. L. Kurti and B. Czako, Elsevier Science & Technology Books. March 2005.
4. Organic Chemistry, S. H. Pine. 5th Ed., Tata McGraw Hill Publishing Co. Ltd., 2007.
5. Principles of Organic Synthesis. R. O. Norman. 2nd Ed., Chapman and Hall. 1978.
6. Organic Chemistry, John McMurry, 5th Ed. Brooks/ Cole, Thomson Learning, 1999.
7. Organic Chemistry, Francis Carey, 5th Ed., McGraw Hill.


## PHARMACEUTICAL ANALYSIS II 3hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | **Types of errors**<br>Concepts of errors: Mean, median, standard deviation, relative standard deviation, Absolute and relative errors, precision, accuracy, significant figures. Determinate and indeterminate errors and the ways to minimize them. Variables in analytical chemistry and scope of pharmaceutical analysis. | 3 |
| 2. | **Solvent extraction**<br>Principle, factors affecting liquid-liquid extraction (Solvent method of extraction stripping and pH effect, salting out effect. etc). Soxhlet extractions, Multiple extractions, applications (alkaloids, sodium benzoate, pilocarpine nitrate, any one nasal drops) | 6 |
| 3. | **Refractometry**<br>Snell's Law, Definitions of specific and molar refraction, factors affecting measurement of refractive index (pressure, wavelength, temperature), Principle (Grazing angle of incidence, Critical angle of refraction). different types of refractometers (Abbes, pulfrich, Dipping type) with construction and working of Abbes refractometer in detail. Applications. | 4 |
| 4. | **Polarimetry**<br>Introduction to electromagnetic properties of lightwaves. monochromatic radiation, production of linearly polarized light, definitions – circular birefringence, left and right circularly polarized light, optical rotatory dispersion, molecular ellipticity, circular dichroism, Instrumentation: Light source, polarizer, sample cell, analyser, Anisotropic crystals, Nicol's prism, Determination of optical activity (Half shade effect), Applications. | 6 |
| 5. | **Principales of Gravimetric Analysis**<br>Theory: Mass as measurement signal and precipitation equilibria, Unit | 6 |

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| | operations in gravimetric analysis, Organic and Inorganic precipitants factors affecting gravimetric analysis, Calculations-Gravimetric factor Applications: Assay of Nickel by dimethylglyoxime and assay of aluminum by oxine reagent of $Ba^{+2}$ $BaSO_4$ | |
| 6. | **Miscellaneous-**<br>**Oxygen flask combustion method-** (I.P. apparatus, analysis of organically bound halogens, sulphur and phosphorus, assay of di-iodohydroxy quinoline)<br>**Aquametry-** Different types of water present in a sample, analysis of water by Karl Fischer titrations – preparation of KFR reagent as per I.P. standardization of KPR as per I.P. Stability of KFR, application for Ampicillin trihydrate)<br>**Kjeldahl's method-** (Apparatus, methods of digestion of sample application-anyone from I.P.). | 3<br>4<br>3 |

**Reference Books:**


1. Vogel textbook of Practical Organic Chemistry- 4th edition, 1984, Elbs & Longmans, London.
2. Beckett & Stenlake-Practical Pharmaceutical Chemistry, 4th edition, 1988. CBS Publishers & Distributors, India.
3. Gary Christian-Analytical Chemistry, 4th edition, 1986, John Wiley & Sons. New York.
4. Takeau Higuchi and Finar Brochmann Hanssen-Pharmaceutical Analysis, 1st edition, 1997, CBS Publishers & Distributors.
5. MEITES H.B. of Analytical Chemistry, 1st edition, 1963, Mc Graw Hill Book Company, New York
6. Grant, Eugene, L. Leavenworth, Richard S. Statistical Quality Control, 4th edition, 1972, Mc Graw Hill Kogakasha Limit, Tokyo.
7. I.P., U.S., P., B.P., European Pharmacopoeia.


## BIOCHEMISTRY I — 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | **Carbohydrates**<br>Definition, biological roles, aldoses and ketoses, trioses to hexoses, D-L notation, Fischer and Haworth projection formulae (glucose as example), Monosaccharides ranging from trioses to hexoses (Fisher projection, names and abbreviations of common sugars), Reactions of carbohydrates – optical properties, oxidation, reduction, hemiacetal/ hemiketal formation, acetate/ ketal formation, glycosides, acid catalyzed rearrangement, base catalyzed rearrangement, hydrazone formation, mutarotation, anomeric carbon. Disaccharides and polysaccharides – introduction to structures of simple compounds and their biological role (sucrose, maltose, lactose, cellulose, starch, amylose). Unusual sugars like glucose amine, muramic acid etc. | 10 |

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| 2. | **Proteins**<br>Definition, biological roles, amino acids – types, structures, names, three letter abbreviations, one letter codes, unusual amino acids. Reactions of amino acids, acid base behavior, isoelectric pH, optical activity, N-acylation, ninhydrin reaction, reaction with flurodinitro benzene. Dansyl chloride reaction. Edman reaction, Schiff base formation, esterification, side chain reactions, Peptides and proteins, peptide bond and its special properties, introduction to primary, secondary, tertiary and quaternary protein structure and their features in brief. | 10 |
| 3. | **Nucleic acids**<br>Definition of DNA and RNA, nitrogenous bases, nucleosides, nucleotides, structure of DNA, shorthand notation of DNA polymers, melting and annealing of DNA, brief introduction to semiconservative replication and information flow via mRNA to proteins. Types of RNA-mRNA, tRNA and rRNA – their structure and their biological role. | 6 |
| 4. | **Lipids**<br>Definition, biological roles, fatty acids – saturated, unsaturated, shorthand notation, common fatty acids, Properties of fatty acids – physical properties, formation of esters, triacylglycerols, fats vs oils, acid value, iodine value, ester value, rancidity, hydrolysis of fats, hydrogenation of oils, compound lipids – phospholipids, sphingolipids, glycolipids, Structure and biological roles of some common compound lipids. Introduction to terpenoids – fat soluble vitamins and cholesterol. | 6 |
| 5. | **Vitamins**<br>Detailed description of the mechanisms involved in the biochemical roles of vitamins A, D, E, K, B1, B2, Niacinamide, B6, biotin, folic acid, ascorbic acid, lipoic acid, inositol and pantothenic acid, Biological role of B12 (without structure). | 4 |

**Reference Books:**


1. Lehninger, Principles of Biochemistry, 4th Ed., Eds. Nelson D. L. and Cox M.M. Replika Press Pvt. Ltd., India, 2007.
2. Biochemistry, Stryer L., 3rd Ed., W.H. Freeman & Co. 1988.
3. Harper's Biochemistry, 25th Ed., Eds. Murray R.K., Granner D.K., Mayes P.A. and Rodwell V.W. Appleton and Lange, USA, 2000.
4. Outlines of Biochemistry, 5th Ed., Eds. Conn. E. Stumpf P.K., Bruening G and Doi Roy H., John Wiley & Sons, USA, 1987.
5. Textbook of Biochemistry with Clinical Correlations, 5th Ed., Ed. Devilin T.M., Wiley Liss, USA, 2002.


## PHARMACEUTICS – III 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|

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|---|---|---|
| 1. | Biphasic Dispersed Systems: Physicochemical principles thermodynamic, instability of dispersed systems<br>• Suspensions – definition, advantage & disadvantage, desirable features, Theoretical (Preformulation) aspects wetting phenomena, particle – particle reactions, DLVO theory, flocculated and deflocculated systems, Schulze Hardy Rule, Sedimentation in suspensions, Crystal Factors, Rheology. Preparation of suspension – Precipitation methods and Dispersion method, Formulation Additives, Large Scale manufacture with equipments Q.C. tests including stress testing, layout, Example formulations – official preparations.<br>• Emulsions – Definition, advantage and Disadvantage, Theoretical aspects – interfacial tension, need for emulsion. Theories of emulsification. Droplet stabilization, Mechanism of emulsifier's, selection of emulsifiers – HLB, Davis method, PIT method, cloud point determination, classification of emulsifiers with examples, other additives. Rheology aspects, Manufacturing – large scale with equipments, Packaging, stability of emulsion, Q.C. tests & stress tests, layout Examples – Official preparations. | 12<br><br>8 |
| 2. | **Semisolids**<br>• Introduction<br>• Introduction to anatomy of Skin.<br>• Function of Skin<br>• Percutaneous absorption and Penetration.<br>• Factors influencing.<br>• Methods used to evaluate percutaneous absorption.<br>• Permeation enhancers.<br>• Ointments, Ointment Bases, Pastes, Gels, Poultice.<br>• Selection of bases – Large scale manufacturing and processing with equipments.<br>• Q.C. testing, Examples of Preparation. | 10 |
| 3. | **Suppositories**<br>• Definition, advantage & disadvantage, desirable features<br>• Anatomy of Rectum in brief & rectal absorption<br>• Suppository bases – Features desired, Classification and selection, Special Bases.<br>• Manufacturing and Packaging, Q,C, tests<br>• Example – formulations | 6 |

**Reference Books:**


1. Lachman Leon, Lieberman Herbert A. Kanig Joseph L., "The Theory and Practice of Industrial Pharmacy", 3rd Edition 1987, Varghese Publishing House, Mumbai.
2. Lieberman Herbert A., Rieger, "Pharmaceutical Dosage Forms – Dispersed Systems". Volume 1/ 2/ 3, 2nd Edition, 2005, Marcel Dekker Inc. New York.

3. Remington, The Science and practice of Pharmacy, 21st ed., Volume I & II B. L. Publications Pvt. Ltd., 2005.
4. Martin A. Physical Pharmacy, 4th Ed., Lea & Febiger, Philadelphia, London, 2006.
5. M.E. Aulton, Ed. Pharmaceutics – The Science of Dosage Form Design, Churchill Livingstone Medical Division of Longman Group, U.K. Ltd., 2002.

## PHARMACEUTICAL ENGINEERING - II

- Only principles and equipments to be covered.
- No mathematical derivations and numerical problems

| S. No. | Topic | Hours |
|---|---|---|
| 1. | **Fluidization**<br>• Theory of fluidization | 2 |
| 2. | **Extraction:** Solid-Liquid & Liquid-Liquid Extraction<br>• Mechanism and method of extraction process and factors affecting extraction process.<br>• Equipments employed in solid-liquid extraction-Soxhlet extractor, Open tank, Agitated tank, Vortical or Turbo extractor, extraction battery and Robert diffusion battery, Rotocel extractor, Bollman extractor, Bonotto extractor, Screw extractor and Hilderbrandt extractor.<br>• Equipments employed for Liquid-Liquid extraction-Mixer settler, Spray columns, Packed Columns, Agitated columns, Podbielniak extractor. | 6 |
| 3. | **Distillation:**<br>• Vapor-Liquid equilibrium<br>• Distillation methods<br>Equilibrium distillation<br>Simple Distillation<br>Fractional distillation – Theory of batch fractionation, Columns (only construction and working)-Plate columns-bubble cap, sieve plate column, Packed columns, Concept of plate efficiency and HETP (no detailed theories and derivations)<br>Distillation under reduced pressure – Theory of molecular distillation and equipments Falling film and centrifugal molecular distillation still, applications<br>Azeotropic and Extractive distillation- Theory of azeotropic and extractive distillation, applications such as dehydration of alcohol.<br>Steam distillation- Theory of steam distillation and applications of steam distillation such as methods of separation of Volatile constituents and preparation of aromatic water, purification of high boiling liquids. | 6 |
| 4. | **Crystallization:**<br>• Crystal forms and crystal habits<br>• Theory of crystallization-Supersaturation-Mier's Theory of | 5 |

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|---|---|---|
| | supersaturation, Nucleation, Crystal growth<br>• Crystallizers- Classification, Tank crystallizers, Agitated tank crystallizers, Swenson Walker crystallizer, Vacuum crystallizer and its modifications such as circulating magma and DTB crystallizer, Krystal or Oslo crystallizer.<br>• Caking of crystals. | |
| 5. | **Evaporation:**<br>• Heat transfer process in boiling liquids in evaporators<br>• Evaporators-Pan evaporators, Horizontal tube evaporator, short tube vertical evaporator, Falling film evaporator Forced circulation evaporator. Wiped film evaporator, Evaporator accessories-condensers, vacuum pumps, expansion and bucket traps, Entertainment separators, Vapor recompression. Scale information. | 6 |
| 6. | **Drying:**<br>• Mechanism and theory of drying<br>• Dryer-tray dryer, vacuum tray dryer, tunnel dryer, Rotary drum dryer, Spray dryer, Freeze dryer, Fluidised bed dryer | 4 |
| 7. | **Pollution from Pharmaceutical Industry:**<br>Air pollution and preservation -<br>• Wet scrubber, dust collector.<br>Water pollution-<br>• Bulk drug manufacture- dirty water, acids and alkalis, dissolved salts, organic chemicals.<br>• Formulation manufacturing- sterile product, liquid dosage forms, solid dosage form, fermentation products, radiological products.<br>• Waste treatment processes- segregation, neutralization and pretreatment, dissolved salt removal, preaeration, biological treatment. | |
| 8. | **Industrial hazards and safety:**<br>• Fire Hazards and extinguishers<br>• Chemical hazards and extinguishers<br>• Mechanical and electrical hazards<br>• Accidents- unsafe action and unsafe condition<br>• Prevention of accidents | 4 |

**Reference Books:**


1. K. Sambhamurthy, Pharmaceutical Engineering, New age international (p) limited publishers, 1998.
2. Dr. A. R. Paradkar, Introduction to Pharmaceutical Engineering, 10th edition, Nirali Prakashan, 2007.
3. James Swarbrick & James C. Boylon, Encyclopedia of Pharmaceutical Technology, Marcel Dekker, INC, New York, 1994.
4. Walter L. Badger & Julius T. Bancherro, Introduction to Chemical Engineering, Mc. Graw Hill Inc., 1955.

5. M. E. Aulton, Ed. Pharmaceutics – The Science of Dosage from Design, Churchill Livingstone Medical Division of Lognman Group, UK, Ltd., 2002.
6. S. J. Carter, Cooper and Gunn's Tutorial Pharmacy, 6th edition, CBS Publishers & Distributors, New Delhi, 2005.
7. Robert H. Perry, Don W. Green, Perry's Chemical Engineers Handbook, 7th edition, Don W. Green, James O. Maloney, Mac Graw Hill, 1997.

## MATHEMATICS – I 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | **Differential Calculus:** Successive Derivative's Lebnitz's rule forth derivative, Lagrange's and Rolle's mean value theorems (Statements only), Taylors and Maclaurin's series (without proof) with application curvature. | 5 |
| 2. | **Partial Differentiation:** Functions of two or three variables, change of variables, application to errors, maxima and minima. | 3 |
| 3. | **Integral Calculus:** Integration by parts, properties of definite integrals and reduction formulae; Determination of length of the curve area and volume. | 8 |
| 4. | **Differential equations:** Formation of differential equations solution of first order and first degree equations, linear differential equation of higher order with constant coefficients, simple application to chemical reactions and biopharmaceutics. | 8 |
| 5. | **Determinants and Matrices:** Properties of determinants and applications, solution of simultaneous equations with three variables by Crammers method: Type of matrices, inverse of matrices, rank of a matrices, eigen values and eigen vectors, Caley Hamilton theorem. ` | 7 |
| 6. | **Numerical Methods:** Finite difference operator's (delta and E), interpolation of equal intervals-Newton's method and Lagrange method: Numerical integration-Trapezoidal rule, Simpson's 1/3rd and 3/8th rules. | 5 |

**Reference Books:**

1. Mathematics for pharmacy students (Volume I): Gujar, K. N. Bhavale Ashok 1st Edition, Career publication.
2. Differential Calculus: Nareyan, S. 1st Edition, S. chand Publication.
3. Applied Mathematics – I, Baphana R. M., 3rd Edition, Techmax Publication.
4. Textbook of Applied Mathematics Volume I & II, Wartikar P. N. 7th Edition Pune Vidyarthi Griha Prakashan.
5. Integral Calculus, Shanti Narayan, 1st Editions, S. Chand Publication.
6. A Textbook of matrices, Shantinarayan, 10th Edition, S. Chand Publication.

## PHARMACEUTICAL ANALYSIS LABORATORY – II 3 hrs/ week

1. **Preparation and standardization** of 0.05 M EDTA and 0.1 N perchloric acid.

2. **Redox titrations-** assay of sodium nitrite (KMnO4 method). Assay of sodium nitrite, assay of methyl paraben/ propyl paraben, determination of sulphur in sulphur ointment, assay of Lugol's solution, assay of hydrogen peroxide, assay of isoniazid.
3. **Complexometric titrations**- Assay of aluminium hydroxide gel, determination of percentage of calcium and magnesium in a mixture, assay of calcium gluconate powder and injection, assay of zinc. Sulphate powder.
4. **Gravimetric analysis-** $Al^{+3}$ as Al-oxinate, $Ba^{+2}$ as $BaSO_4$, $Ni^{+2}$ as Ni-dimethyl glyoxime.

### Demonstration experiments:

1. **Non-aqueous titrations-** assay of pyridoxine hydrochloride, assay of Norfloxacin/ Metronodazole, assay of chlorpromazine hydrochloride.

**PHARMACEUTICS LABORATORY – II** **3 hrs/ week**

1. **SUSPENSIONS:** (a.) Paediatric Kaolin Mixture B.P. 1980, (b.) Paediatric Chalk Mixture B.P. 1988, (c.) Calamine Lotion I.P.' 66, (d.) Kaolin Poultice I.P.' 66, (e.) Microscopic evaluation, rheology and sedimentation rate studies for any one of the above suspension.
2. **EMULSION:** (a.) Liquid Paraffin Emulsion I.P.' 66, (b.) White Liniment B.P.C., (c.) Turpentine Liniment I.P.' 1966, (d.) Benzyl Benzoate Application I.P.' 66, (e.) Microscopy of any of the above emulsion
3. **OINTMENTS:** (a.) Simple Ointment I.P.' 66, (b.) Sulphur Ointment I.P.' 66 (Microscopic evaluation), (c.) Emulsifying Ointment I.P.' 66, (d.) Benzoic Acid Ointment, Compound B.P.C' 68, (e.) Iodine Ointment, Non-staining B.P.C.' 68, (f.) Iodine Ointment, Non-staining with Methyl Salicylate B.P.C. 1968.
4. **CREAMS:** (a.) Cetrimide Cream B.P. 1993.
5. **GELS:** (a.) Diclofenac Sodium Gel
6. **PASTES:** (a.) Titanium Dioxide Paste.

**COMPUTER LABORATOY** **4 hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | **Computer Devices**<br>a. Input and Output devices<br>b. Secondary storage units<br>c. Memory ROM and RAM Virtual memory<br>d. ALU, the Control Unit, and CPU<br>e. Classification of Computers – Microcomputers, personal computers, laptop computers, minicomputers, mainframes and supercomputers. | 2 |
| 2. | **Operating Systems (OS)**<br>a. Purpose of the OS<br>b. Management functions of OS<br>c. Services provided by OS<br>d. Types of OS<br>e. User interfaces – command line and GUI | 2 |

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| | f. Features of the MS-DOS, Windows and UNIX OSes<br>g. k. Features of the MS-DOS, Windows and UNIX OSes | | |
| 3. | **Types of Computer Language**<br>a. Need for interpreter<br>b. Computer Program<br>c. Interpreter<br>d. Compiler<br>e. Classification of Computer Languages – Conventional advantages and limitations<br>f. Very brief introduction to C++ Language. | | 3 |
| 4. | **Introduction to Computer Networks**<br>a. What is a Computer Network<br>b. Networking Basis<br>c. Common types of Networks – LAN, WAN and their variations<br>d. Network topologies – bus, ring, star, mesh<br>e. Network Protocols<br>f. Network components – Computers, communications medium, modem, repeater, hubs, switches, bridges, gateways, routers, and network interface cards. | | 4 |
| 5. | **Algorithms and Flowcharts**<br>a. Algorithm<br>b. Characteristics of algorithm<br>c. Writing algorithms<br>d. Flowcharts and symbols, drawing a flowchart<br>Divide and conquer strategy | | 2 |
| 6. | **Introduction to Data structure**<br>a. Types of data structures<br>b. Arrays<br>c. Structure or records<br>d. Stack<br>e. Queue<br>f. Linked Lists<br>g. Tree | | 2 |
| 7. | **Introduction to DBMS and SQL**<br>a. Features of DBMS<br>b. Introduction to Relational Database Management Systems (DBMS)<br>c. Introduction to Ingres DBMS | | 2 |
| 8. | **General applications of Computers in Pharmaceutical Sciences.** | | 2 |
| 9. | **CONCEPTS OF NETWORKING** Introduction to Networking, Types of Networking (LAN, MAN, WAN, VWAN), Topologies, Requirements for using Networking, Networking Terminologies (Client, Server, Node, Terminals etc.) | | 4 hrs |
| 10. | **WINDOWS** | | |
| 11. | Session - 1 | Introduction to Operating System, Features of Operating systems, types of operating systems, Difference between | 1 |

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| | | Dos and Windows<br>Starting and Shutdown of PC, Screen Components, Notepad (File Menu)<br>Notepad Complete with all menus | |
| 12. | Session - 2 | WordPad File and Edit Menu<br>WordPad complete with all menus | 1 |
| 13. | Session - 3 | Paint – all tools, Paint – all menus – paint complete | 1 |
| 14. | Session - 4 | Character Map, Control Panel (Date & Time, Keyboard, Mouse, Display)<br>Creation of files and folders, moving files, copying files, Recycle bin, Run, My Documents, My Computer, Finding Files and Folders, doubts clearing. | 1 |
| 15. | **MS-OFFICE** | | |
| 16. | **(A); WORD PROCESSING** | | |
| 17. | Session - 1 | Introduction to package, language, MS-office and introduction to word; File and Edit Menu; View menu options. | 1 |
| 18. | Session - 2 | Insert menu options; Format font (full), paragraph and change case Format bullets and numbering, columns, bullets and numbering, borders and shading, tabs. | 1 |
| 19. | Session - 3 | Table menu full, Tools – spelling and grammar, thesaurus, mail merge with single field, multiple field and queries options. | 1 |
| 20. | Session - 4 | Macro, autocorrect, letter wizard<br>Envelop and labels, window menu options | 1 |
| 21. | Session - 5 | Drawing toolbar options, Drawing toolbar draw option. | 1 |
| (B); EXCEL | | | |
| Session - 1 | | Introduction to screen, components (database, spreadsheet and chart), use of excel, auto fill, fill handle features, calculator with '=' sign, sum and average function | 1 |
| Session - 2 | | Edit menu, View menu, Inset menu | 1 |
| Session - 3 | | Format menu, spelling and grammar, protection, autocorrect, goal seek, macro, options (view and custom lists); Data – sort, forms, subtotals, filters, pivot table. | 1 |
| Session - 4 | | Window menu complete, numeric and date and time functions; Numeric functions: ABS, FACT, COUNT, COUNTBLANK, POWER, MOD, PRODUCT, MIN, MAX, QUOTIENT; Date and time functions: NOW, TODAY, TIME | 1 |
| Session - 5 | | Text functions: LOWER, UPPER, PROPER, MID, REPLACE, LEN, TRIM, CONCATENATE, LEFT, RIGHT; Logical function: AND, OR, NOT, EXACT. | 1 |
| (C); POWERPOINT | | | |
| | | Introduction to PowerPoint, creating presentation with auto content wizard | 1 |

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| | Creating presentation with design template, custom animation, slide transition, sounds and songs insertion<br>Creating different types of blank presentations<br>Points to be noted while creating PowerPoint presentations<br>1. No spelling Mistakes<br>2. Proper Clipart in each slide<br>3. Proper Slide Transition Effects<br>4. Proper Text Animation Effects<br>Proper Timings | |
| **INETERNET SYLLABUS** | | |
| Session - 1 | Theory of Internet, basic requirements to run internet, web site, domain name, sub domain, chatting, email, surfing, Surfing and creating e-mail ID | 1 |
| Session - 2 | Inbox, compose, sending and receiving greeting cards, text files, images downloading, search engines (google, yahoo, Lycos, khoj etc.)<br>Chatting, yahoo messenger and other things. | 1 |

**Reference Books:**


1. Basic Electronics and Computer Applications, Rajiv Khanna, New Age International Publishers, 2007.
2. Introduction to Biostatistics 7 Computer Science, Y.I. Shah, A. R. Paradekar, M. G. Dhayagude, Nirali Prakashan, 3rd Ed., 2004.
3. Fundamentals of Computers, V. Rajaraman, Prentice Hall of India Pvt. Ltd., 1986.
4. Schaum's Outline Series. Theory & Problems of "Introduction to Computer Science", by Francis Scheid, McGraw Hill Book Co., 1983.

## SEMSETER IV

**PHARMACOLOGY – I** **3 hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | General principles of pharmacology<br>• Introduction to Pharmacology<br>• Routes of drug administration with special reference to their advantages and disadvantages<br>• Drug absorption, distribution, metabolism and excretion.<br>• Factors modifying the actions of drugs.<br>• Drug Toxicity in human<br>- Toxic effects of drugs on different systems, organs & tissues. | 13 |
| 2. | Mechanism of drug action:<br>a) Brief introduction of physiological receptors<br>- structural and functional families<br>- cytoplasmic second messengers<br>b) drug-receptor interaction<br>- dose-response relationship<br>- drug antagonism | 8 |
| 3. | Drugs used in the disorders of gastro-intestinal tract<br>• Emetics, antiemetics & prokinetic drugs<br>• Purgatives & antidiarrheals, antispasmodics<br>• Drugs used in the treatment of hyperacidity & peptic ulceration<br>• Inflammatory bowel diseases | 8 |
| 4. | Drugs used in haematological disorders<br>- Antiplatelet agents<br>- Anticoagulants<br>- Thrombolytic agents<br>- Antianaemic drugs | 7 |

**Reference Books:**


1. Goodman & Gilman's Pharmacological Basis of Therapeutics Joel G. Hardman, Lee E. Limbird , Alfred Goodman Gillman 11th Edition, The McGraw – Hill Companies Inc., 2001.
2. Satoskar, R. S. Bhandarkar S. D. & Rege N. N. Pharmacology & Therapeutics 20th Edition Popular Prakashan, 2007.
3. Rang & Dale Pharmacology – 5th Edition, Churchill Livingstone 2003.
4. Lippincott's Illustrated Reviews: Pharmacology – Lippincott – Raven 3rd Edition Howland & Nycets Publishers N Y, 2006.
5. Lewis Pharmacology – By Crossland – 5th Edition, Churchill Livingstone.
6. Laurence, D. R. & Bennet Clinical Pharmacology – 9th Edition, Elsevier, N Y, 2006.
7. Kulkarni, S. K. Handbook of Experimental Pharmacology – 3rd Edition Vallabh Prakashan New Delhi, 2005.

8. B. G. Katzung – Basic and Clinical Pharmacology 9th Edition Appleton and Lange publication, 2004.
9. Gosh M. N. – Fundamentals of Experimental Pharmacology, 3rd Edition, Hilton & Company, Calcutta, 2005.

## ORGANIC CHEMISTRY – IV 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Introduction to free radical chemistry, stability and structure, generation of free radicals (thermal decomposition, photochemical methods, oxidation-reduction, electrolysis), propagation of free radicals, termination of free radicals, Discussion of Birch reduction, Kolbe electrolysis, Hunsdiecker reaction, Sandmeyer reaction. | 6 |
| 2. | Peptide Chemistry, Chemistry of the peptide bond, methods of forming peptide bond including solid phase peptide synthesis, amino acid protecting agents. | 6 |
| 3. | Organometallic chemistry: Introduction organomagnesium, organolithium and some mixed organoboranes. | 8 |
| 4. | Polymer Chemistry: Introduction to Polymers, polymer characteristics, properties, methods to determine properties. | 5 |
| 5. | Heterocyclic aromatics- synthesis and reactions of five and six numbered rings with one and two heteroatoms like pyrrole, oxazole, thiophene, furans, imidaxele, pyrazole, thickzole, isoreazole, pyridine, pyrimidine, quinoline and isoquinoline, pyrazine and indole. | 12 |

**Reference Books:**

1. Organic Chemistry, S. H. Pine, 5th Ed., Tata McGraw Hill Publishing Co. Ltd., 2007.
2. Principles of Organic Synthesis, R. O. Norman, 2nd Ed., Chapman and Hall, 1978.
3. Organic Chemistry, John McMurry, 5th Ed., Brooks/Cole, Thomson Learning, 1999.
4. Organic Chemistry, Francis Carey, 5th Ed. McGraw Hill
5. Organic Chemistry, Vols. 1 and 2, I. L. Finar, 5th Ed., Pearson Education, 2005.
6. Heterocyclic Chemistry, J. A. Joule and K. Mills, 4th Ed., Blackwell Publishing, 2005.

## BIOCHEMISTRY II 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Biochemical Energetics: Concept of free energy, standard free energy vs transformed free energy vs free energy for a reaction. Relationship of standard free energy to reaction equilibrium constant, concepts of enthalpy and entropy, introduction to first and second law of thermodynamics. Standard free energy changes of some important biological reactions. Concept of oxidation – reduction reactions, standard electrode potential, transformed standard electrode potential, standard | 6 |

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| | electrode potentials of some biological important redox couples. | |
| 2. | Concept of high energy phosphate bond and ATP as a carrier of energy. Concept of oxidation states of carbon in different compounds. Introduction to the terms metabolism, anabolism and catabolism. | 3 |
| 3. | Digestion of food and absorption of monosaccharides, amino acids and fatty acids into circulation. Fate of absorbed nutrients and relationship with regard to immediate use, storage, re-release and interconversion. Role of different organs in these process especially liver, kidney, muscle, adipose, tissue, brain and rbcs. | 3 |
| 4. | Carbohydrate metabolism: Discussion of glycolysis, reversal of glycolysis, glycogen synthesis and breakdown, pentose phosphate pathway, TCA cycle, glyoxalate shunt, gluconeogenesis, NADH/ $NAD^+$ shuttles, with respect to the location, intermediates, enzymes, energy yield and regulation. Examples of drugs related to carbohydrate metabolism modulation. | 13 |
| 5. | Lipid metabolism: Discussion of the oxidation and biosynthesis of saturated and unsaturated fats with respect to location, intermediates, enzymes, energy yields or requirements, and regulation, formation of ketone bodies, acetate mevalonate pathway, biosynthesis of cholesterol. Examples of drugs that are related to lipid metabolism modulation. | 4 |
| 6. | Electron transport chain: Components of the ETC oxidative phosphorylation vs substrate level phosphorylation, comparison of this with photosynthesis and photophosphorylation, absorption of light by chlorophyll and energy conservation. Discussion of proton motive force and generation of ATP by use proton gradients. Examples of some toxins that interfere with ETC. | 3 |
| 7. | Nucleic acid metabolism: Discussion of biosynthesis of purines and pyridines with respect to location, intermediate, enzymes, cofactors, and regulation, Salvage pathways for nucleic acids. Example of drugs interfering with these pathways. | 4 |

**Reference Books:**


1. Lehninger, Principles of Biochemistry, 4th Ed., Nelson D. L. and Cox M. M. Replika Press Pvt. Ltd., India, 2007.
2. Biochemistry, Stryer L, 3rd Ed., W. H. Freeman & Co., 1988.
3. Harper's Biochemistry, 25th Ed., Eds. Murray R. K. Granner D. K., Mayes P. A. and Rodwell V. W. Appleton and Lange, USA, 2000.
4. Outlines of Biochemistry, 5th Ed., Eds. Conn E. Stumpf p. K. Bruening G and Doi Roy H., John Wiley & Sons, USA, 1987.
5. Textbook of Biochemistry with Clinical Correlations, 5th Ed., Ed. Devlin T. M. Wiley Liss, USA, 2002.


## DISPENSING CHEMISTRY 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|

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|---|---|---|
| 1. | Definition of Compounding and Dispensing | 1 |
| 2. | Prescription and its parts: Different types of prescriptions, prescription pricing, recording of prescription | 4 |
| 3. | Calculations: various calculations involved in compounding and dispensing such as - weights and measures % calculations, dilutions and concentrations, isotonic solutions, HLB value calculation, posology, imperial system of weights and measures. | 8 |
| 4. | Basic principles in compounding and dispensing: Types of dosage forms, formulation of dispensed products, storage and stability of products, containers and closures for products. Labeling of dispensed products Preparation of stock solutions; Latin terms and abbreviations. | 4 |
| 5. | Compounding and Dispensing aspects of<br>solutions (for oral use, external use, for body cavities),<br>suspensions,<br>emulsions and creams,<br>ointments, pastes, gels,<br>suppositories, pessaries,<br>powders, granules, lozenges, pastilles, pills, tablets, capsule, tablet, triturate, etc.<br>Incompatibilities<br>Prepackaging, Dispensing of properties | 2<br><br>2<br>2<br>2<br>2<br>3<br>2<br><br>1 |

**Reference Books:**


1. Cooper and Gunns Dispensing for Pharmaceutical students Twelfth edition Edited by S.J. Carter Indian edition CBS Publishers, Delhi 1987.
2. Pharmaceutical Practice Edited by D. M. Collett and M.E. Aulton, Churchill Livingstone ELBS edition, 1991.
3. Pharmaceutical Practice Edited by A.J. Winfield and R.M.F. Richards, Second edition Churchill Livingstone, 1998.
4. Pharmaceutical Practice Edited by A.J. Winfield and R.M.E. Richards, Third Edition, Churchill Livingstone, 2004.
5. Husa's Pharmaceutical Dispensing, Edited by Eric Martin, Sixth edition, Mack Publishing Company, 1966.
6. Pharmaceutical Calculations – by H. C. Ansel and M. J. Stoklosa, Lippincott Williams and Wilkins, 2006.
7. Pharmaceutical Calculations – by Bradley, Gustafson and Stoklosa, Third Edition, Lea and Febiger, 1957.


## MATHEMATICS – II (FUNDAMENTALS OF STATISTICS) 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | **Measures of central tendency:** Arithmetic's mean, median and mode | 08 |
| 2. | **Measure of dispersion:** Range, quartile deviation mean deviation | 18 |

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|---|---|---|
| | and standard deviation, Coefficients of variation, moments, skewness, and kurtesis, moments generating, Probability expectations and variance, binomial, Poisson and Normal distributions, Fitting of curve by the method of least square. { $Y=a+bX$:$Y = a+bX+cX^2$ , $Y= aX^h$ , $Y= ab^X$, $Y =ac^{bX}$ } | |
| 3. | Sampling distribution for mean and Proportion: Test of hypothesis for specified values of means and proportion for large samples, Testing equality of two means and proportions, Students 't' test for single sample and paired observation. F-Test and analysis of variance, testing of attributes, Chi-square distribution. | 10 |

**Reference Books:**


1. Fundamentals of statistics: Gupta, S. C. 6th Edition Himalaya publication.
2. Mathematics for pharmacy students (Vol-I), Gujor K. N. Bhavale Ashok Edition, career publication.
3. Measurement, statistics of computation C. Cormich D., 1st Edition, John Wiley & Sons.
4. Biostatistics in pharmaceutical Industry, Buncher, R. C. 1st Edition, Matcel Decker Inc.
5. Vogel's Textbook of Quantitative Chemical Analysis, Mendham, J. R. C. Denney, 6th Edition, Pearson Education Pvt. Ltd.


## PSYCHOLOGY AND SOCIOLOGY 3 hrs/ week

Note: All relevant topics can be dealt with special reference to the Pharmaceutical Industry

### Psychology

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Nature, Definition of Psychology-Introduction subfields of Psychology, Industrial Psychology,<br><br>Organizational Behavior – Nature Scope Goals. | 2 |
| 2. | Personnel Selection<br><br>Occupational Information-uses<br>Personnel Specifications<br>Job analysis<br>Selection techniques: Application Blanks-Biodata<br><br>Interviews<br><br>Psychological tests<br>(Intelligence tests, Aptitude tests, Personality tests) | 2 |
| 3. | Work Motivation:<br><br>Theories (Maslow's Herbergs, Vrooms, Equity Theory), Ways to | 4 |

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| | motivate people in organizations Financial and nonfinancial Incentive, Job satisfaction. | |
| 4. | Leadership-Trail – theory of leader, leadership skills, leadership styles Fielder's contingency model. | 4 |
| 5. | Team and Team building | 2 |
| 6. | Accident-causes<br><br>Accident prevention-safety measures | 2<br><br>2 |
| 7. | Organizational change-Resistance,<br>Overcoming resistance, Continuous and episodic change | 2 |

## SOCIOLOGY

| S. No. | Topic | Hours |
|---|---|---|
| 1. | **Concept of:** The relevance of sociology to industry, Social adjustment of workers | 3 |
| 2. | **Communication-** its levels and types. | 3 |
| 3. | **Science, technology, industry and society:** Impact, Role, Problems (with special reference to Pharmaceutical Industry) | 3 |
| 4. | **Sociology of Medicine in India:** an approach. The best of both the world-bringing traditional medicine up-to-date. Who chooses modern medicine and why? Man, medicine and environment. Allopathic medicine in India. Class composition of medical students. Its relevance to Pharmacy – Pharmaceutical Marketing. | 6 |
| 5. | **Industrial Democracy:** Workers participation in management. | 3 |

**Reference Books:**


1. Sociology by Anthony Giddnes
2. Industrial Relation by P. B. Mammudity
3. Sociology by Harrambus
4. Sociology Change by Kappu Swami
5. Man, Medicine and Environment-Rene Du Bos (1969)
6. Organizational Behavior-Human Behavior at work –By New Strom and Keith Davis
7. Organizational Behavior –By Suja Nair, Himalaya Publishing Company
8. Industrial Psychology and Sociology –By Milind Wagh, Career Publication
9. Industrial Psychology and Sociology –By B. V. Pathak, Nirali Prakashan


## ANATOMY, PHYSIOLOGY AND PATHPHYSIOLOGY – IV 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Cardiovascular System<br>- Functional anatomy of heart<br>- conducting system of heart<br>- cardiac cycle, Electrocardiogram (ECG) | 12 |

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| | - Functional anatomy of blood vessels<br>- Blood pressure and factors regulating blood pressure<br>- Baroreceptors, chemoreceptors vasomotor center<br>- Humoral and Neuronal Control of Blood Pressure and circulation.<br>- Enterohepatic circulation | |
| 2. | Definition and Etiology of following diseases in detail<br>- Hypertension<br>- Congestive Cardiac Failure<br>- Cardiac Arrhythmia<br>- Angina Pectoris<br>- Ischemic Heart Disease<br>- Arteriosclerosis/ Atherosclerosis<br>- Varicose veins, Hemorrhoids | 10 |
| 3. | Urinary system:<br>- Anatomy and Physiology of Urinary System<br>- Formation of urine<br>- Water balance, electrolyte balance & acid-base balance | 6 |
| 4. | Formation of body fluids and fluid compartments. | 4 |
| 5. | Definition and Etiology of following diseases in detail<br>- Renal failure<br>- Glomerulonephritis<br>- Renal calculi/ Kidney stones<br>- Urinary Tract Infections (UTI) | 4 |

**Reference Books:**


1. Ross & Wilson Anatomy & Physiology in Health & Illness, 10th Edition, Anne Waugh, Alison Grant, Churchill Livingstone Elsevier, 2006.
2. Tortora & Grabowaski Principles of Anatomy & Physiology, 11th Edition, J. Wiley & Sons, 2007.
3. Guyton & Hall Textbook of medical Physiology, 6th Edition, Harcourt Singapore, 2001.
4. B. R. Mackenna & R. Callander Illustrated Physiology, 6th Edition, N. Y. Churchill Livingstone, 1997.
5. Kaplan, Jack, Opheim, Toivola, Lyon Clinical Chemistry: Interpretation & Techniques, 4th Edition, Williams & Williams London 1995.
6. Praful B. Godkar, Darshan P. Godkar Textbook of Medicinal Laboratory Technology, 2nd Edition, Bhalani Mumbai- 2006.
7. Russel J. Greene & Norman D. Harris Pathology & Therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice, 2nd Edition Pharmapress, N Y, 2000.
8. Ranade & Joshi Manual of Practical Physiology, Pune Vidyarthi Gruha Prakashan.
9. Eric Herfindal, Dick Gourley, Textbook of Therapeutics: Drug and Diseases Management, 7th Edition, Lippincott Williams & Wilkins. A. Wolters Kluvers Company.
10. Cotran, Kumar and Collins, Robins – Pathologic Basis of diseases, 6th Edition, W. B. Saunders Company.
11. The Merck Manual of medical Information, Home Edition, Merck Research Laboratories, Division of Merck & Co. Inc. White House Station, N. J., 1997.

**ORGANIC CHEMISTRY LABORATORY II** **4 hrs/ week**

Techniques in Organic Chemistry: Quantitative separation of binary organic mixture by physical and chemical methods mixture of different types including compounds with more than one functional group to be given, complete characterization if individual components including physical constants followed by preparation of suitable derivative. Purification techniques solvent selection for recrystallisation, recrystallization techniques, simple distillation, fractional distillation, steam distillation.

## DISPENSING PHARMACY LABORATORY 4 hrs/ week

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| 1. Solutions | 1. Zinc Chloride & Zinc sulphate mouth wash BPC<br>2. $KMnO_4$ solution<br>3. Sodium Bicarbonate Ear Drops BP<br>4. Pediatric Ferrous Sulphate Solution BP 1988 |
| 2. Suspensions | 5. Calamine Lotion IP<br>6. Menthol & Eucalyptus Inhalation |
| 3. Emulsion | 7. Arachis Oil Emulsion<br>8. Calciferol Emulsion<br>9. Oily Calamine Lotion BP 1980/ Benzoyl Benzoate Application BP 1988/ White liniment |
| 4. Ointment | 10. Sulphur ointment BPC/ Calamine & Coal Tar Ointment/ Whitfield's Ointment |
| 5. Paste | 11. Zinc & Coal Tar Paste/ Titanium Dioxide paste |
| 6. Gels | 12. Lubricating Jelly |
| 7. Cream | 13. Medicated Cream |
| 8. Powders | 14. Hyoscine HBr Powder<br>15. Seidlitz Powder<br>16. Mg Trisilicate Oral Powder BP 1988/ Dusting Powder |
| 9. Granules | 17. Effervescent Granuales<br>18. Isapghul Granuales |
| 10. Tablet triturates | 19. Boric Acid/ Riboflavin |
| 11. Capsules | 20. Chlordiazepoxide Capsules |
| 12. Pills | 21. Compound Rhubarb Pills BPC 1960/ Potassium Permanganate Pills |
| 13. Pastilles | 22. Medicated Pastilles |
| 14. Lozenges | 23. Brompton Cough, Lozenge/ Bismuth Carbonate Lozenges |
| 15. Suppositories | 24. Compound Bismuth Subgallate Suppositories BP 1980 |
| 16. Incompatibility | 25. Eutectic mixture |
| 17. Prepackaging | |

**BIOCHEMISTRY LABORATORY – I** **4 hrs/ week**

Quantitative test for carbohydrates confirmatory tests by osazone formation

Quantitative estimation of glucose by Willstates and Lane and Eynon method, estimation of sucrose: Simple colour reactions of proteins and amino acids, precipitation reactions of proteins

Determination of acid value, iodine value and sap value of lipids

Enzymes: Ptyline activity of saliva

## SYLLABUS COPY FOR THIRD YEAR B. PHARM

## SEMSETER V

### PHARMACEUTICAL MEDICINAL CHEMISTRY – I 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Physiochemical properties and drug action | 4 |
| 2. | Metabolism<br>Discussion of the following classes of drugs including, classification, chemical nomenclature, structure including stereochemistry, generic names, chemistry, physiochemical properties, SAR, metabolism, molecular mechanism of action, introduction to rational development if any, of the class of drugs. | 6 |
| 3. | Chemotherapeutic agents –<br>a. Antitubercular agents – PAS*, ethonamide, isonamide, pyrazinamide, ethambutol*, antitubercular antibiotics (streptomycin, rifampin, viomycin and cycloserine – the first three only highlights of structure to be discussed).<br>Combination therapy.<br>b. Antileprotic drugs – dapsone* and clofazimine | 6 |
| 4. | Antimalarials – Natural products like cinchona alkaloids (with stereochemistry and drug action) and artemisinin and its derivatives like artether and artemether and artesunate. Synthetic antimalarials such as 8-aminoquiacridines eg. Primaquine, Quinoline methanols eg mefloquine: misc, like halofantrine and lumefantrine: DHFR inhibitors like pyrimethamine* and cycloguanil and sulfonamides like sulfodoxine, sulfadiazine*, and sulfalene. Combination therapy. | 5 |
| 5. | Antifungal agents – Natural products like griseofulvin, amphotericin B and nystatin (later two only general aspects of structure related to activity) and the antifungal azoles like clotrinazole, ketoconazole, fluconazole and itraconazole. | 4 |
| 6. | Antibacterial agents<br>a. Antibiotics – penicillins (natural and semisynthetic penicillins like Penicillin G, PenicillinV, ampicillin*, amoxicilline*, oxacillin, nafcillin, methacillin and ampicillin prodrugs like bacampicillin and pivampicillin), cephalosporins (cephalexin, cephalothin, cefaxitin, cefuroxime, cefotaxime, cefepine and cefpirome) tetracycline, chlortetracycline, oxytetracycline, doxycycline and miocycline and its prodrug – rolitetracycline); macrolides (erythromycin, rocithromycin, azithromycin – only highlights of structure to be discussed); aminopglycosides (gentamicins and neomycins – only highlights of structure to be discussed); Chloramphenicol.<br>b. Sulfonamides – Short, intermediate and long acting sulfonamides, sulfonamides for ophthalmic infections, for burn | 10 |

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| | therapy and for intestinal infections, ulcerative colitis and for reduction of bowel flora.<br>c. Fluroquinolones like norfloxacin, ciprofloxacin*, sparfloxacin, gatifloxacin<br>d. Oxazolidinediones | 2<br><br><br><br><br>1 |
| | * indicates synthesis to be discussed | |

**Reference Books:**


1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 11th Ed., Eds. John H Block and John M Beale, Lippincott Williams & Wilkins, 2004.
2. Foye's Principles of Medicinal Chemistry, Eds., T. L. Lemke and D. A. Williams, Williams & Wilkins, Baltimore, 2002.
3. Medicinal Chemistry, Ashutosh Kar, 4th Edition, New Age International Publishers, 2007.
4. The Art of drug Synthesis, Eds. Douglas S Johnson and Jie Jack Li, Wiley Interscience, 2007.
5. Pharmaceutical Chemistry, Vol. EDrug Synthesis Eds. H. J. Roth, A. Kleeman and T. Beissewenger, Ellis Horwood Ltd., 1988/
6. The Organic Chemistry of Drug Synthesis, Daniel Lednicer, Vols. 1 to 7, Wiley.


**BIOCHEMISTRY III** **3 hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | DNA replicator: Details of DNA replication, difference between prokaryotes and eukaryotes, telomeres and telomerases DNA polymorphisms and single nucleotide polymorphism. Examples with DNA or interfering with DNA replication.<br>Solid phase DNA synthesis, DNA sequence (Maxim-Gilbert method, Sanger dideoxy method and automation of DNA sequencing) | 8<br><br><br><br>5 |
| 2. | Protein Biosynthesis: Details of DNA transcription and RNA Protein, difference between prokaryote and eukaryotes, concepts of introns and exons and intron splicing, concept of posttranslational modifications (examples of glycosylated proteins, conjugated proteins, insulin). Examples of protein synthesis inhibitors used as drugs.<br>Solid phase peptide synthesis, Edman reaction based protein sequencing and its automation. | 7 |
| 3. | Enzyme kinetics: Classification of enzymes. Effects of enzyme concentration, substrate concentration, temperature, pH on enzyme reactions. General mechanisms of enzyme catalysis acid base catalysis, oxidation-reductions, proximity effects, transition state theory, etc. Michaclis – Menten equation and meanings of Km and Vmax and identification of inhibition patterns via LWB and Eadic | 8 |

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| | Hofstee plots. Examples of drugs that enzyme inhibitors. | |
| 4. | Metabolic regulation: Brief description of the following: Enzyme compartmentalization, kinetic factors, modification of enzymes for regulation, cascade systems, repression and induction of enzymes and their regulation via modulation of transcription and translation. | 8 |

**Reference Books:**


1. Lehninger, Principles of Biochemistry, 4th Ed., Eds. Nelson D. L and Cox M. M. Replika Press Pvt. Ltd., India, 2007.
2. Biochemistry, Stryer L., 3rd Ed., W. H. Freeman & Co., 1988.
3. Harper's Biochemistry, 25th Ed., Murray R. K., Granner D. K., Mayes P. A. and Rodwell V. W., Appleton and Lange, USA, 2000.
4. Outlines of Biochemistry, 5th Ed., Eds. Conn E. Stumpf P. K., Bruening G and Doi Roy H. John Wiley & Sons, USA, 1987.
5. Textbook of Biochemistry with Clinical Correlations, 5th Ed., Ed. Devlin T. M., Wiley Liss, USA, 2002.


## PHARMACOGNOSY I — 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Origin, scope and history of Pharmacognosy | 2 |
| 2. | Literature and information about official and related text available about herbals and drugs of natural origin concept of authentication of crude drugs | 2 |
| 3. | Role of Pharmacognosy in allopathy and traditional systems of medicine, namely, ayurveda, unani, siddha, Chinese etc. and nutraceuticals, cosmetic etc. | 3 |
| 4. | Introduction to medicinal botany with respect to barks, wood, root, fruit, seed, flower, leaves etc. Methods of classification and their significance in the study of drugs of natural origin (alphabetical, biological, chemical, taxonomical, chemataxonomical, and pharmacological) and sources of drugs of nature origin (Plant, animal, mineral and marine with one example of each class). | 6 |
| 5. | Pharmacognosy of crude drugs<br>Cultivation, collection, preparation, drying, storage, and quality control of drugs of natural origin. Commerce and trade of drugs of natural origin. | 6 |
| 6. | Methods of extraction (percolation, maceration, soxchlet etc.) of different classes of phytochemicals from crude drugs. Introduction to newer techniques of extraction. | 4 |
| 7. | Primary and secondary metabolites and their biosynthetic pathways. Study of terpenoids, fixed oils, shikimic acid pathway, acetate hypothesis and polyketides with one example of each class. | 6 |
| 8. | Plant cell structure with respect to cell organelles and cell contents | 4 |

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| | such as starch grains, calcium oxalate crystals, idoblasts etc. | |
| 9. | Introduction to plant tissue culture and its technique and applications plant growth regulators and hormones. | 3 |

**Reference Books:**


1. Trease D. & Evans W. C.: Text Book of Pharmacognosy: W. B. Saunders.
2. Tyler V. E. Brady L. R. & Robbers J. E.: Pharmacognosy; Lea Feibger, USA.
3. Wallis T. E.; Text Book of Pharmacognosy; CBS Publishers, Delhi.
4. Kokate C. K., Purohit A. P. & Gokhale S. B.: Pharmacognosy; Nirali Publications, Pune.
5. Harbone J. B.: Phytochemical Methods: A guide to modern techniques Analysis: Chapman & Hall, London.
6. Bruncton J.: Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited.
7. Vasudevan T. N. & Laddha K.S.: A Textbook of Pharmacognosy, Vrinda Publication House, Jalgaon.
8. The Indian Pharmacopeia: The Controller of Publication; Delhi.
9. Brain K.R. & Turner T. D.: The Practical Evaluation of Phytopharmaceuticals: Wright, Scientica, Bristol.
10. Iyenger M.A. & Nayak S. G.: Anatomy of Crude Drugs: Manipal Power Press Manipal.
11. Iyenger M. A. : Pharmacognosy of Powdered Drugs; Manipal Power Press, Manipal.
12. Kokate C.K.: Practical Pharmacognosy; Vallabh Prakashan.
13. Wagner, Bladt & Zgainski; plant Drug Analysis; Springer Verlag.
14. Khandelwal K. R.: Practical Pharmacognosy Techniques and Experiments; Nirali Prakashan, Pune.
15. Vasudevan T. N. Laddha K. S.: Practical Pharmacognosy; New Vrinda Publishing House, Jalgaon.


## PHARMACEUTICS IV — 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Tablets<br>• Definition Advantages and Limitations Preformulation aspects<br>• Tablet formulation and design additives excipients with examples<br>• Large scale manufacturing with equipments-for drying, mixing, Direct compression, Granulation, Dry Granulation (Slugging And Roller Compaction)<br>• Compression – (Single station tablet press and Rotary press), Physics of tablet compression (brief), Processing problems, in tabletting, Layout of tablet section.<br>• Tablet types: Effervescent, Buccal, lozenges, chewable, sublingual, Dispersible, soluble, Orodispesible Q. C. of Tablets. | 2<br>3<br>7<br>5<br>4 |
| 2. | Capsules | 6 |

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| | • Hard capsules – Raw materials, gelatin manufacturing (brief), manufacturing of hard capsule shells, size, sealing, storage, Mention of gelatin substitute – vegetarian capsules, Hard capsule fill formulation aspects, Large scale manufacturing filling of hard capsule shells, filling equipments with examples (stress or principle of equipments), Packaging – strip & Blister packaging equipments. Q. C. tests, Layout of capsule section.<br>• Soft Gelatin Capsules- Raw material Gelatin- desirable properties, Soft Capsule- properties, nature of shell & contents, Large scale manufacturing- Rotary Die Process Packaging Q.C. tests. | |
| 3. | Acrosols-<br>• Definition, advantages & disadvantages, desirable features.<br>• Components – Prepellants-types, selection, two phase & three phase systems. Containers – Tin Plate, Aluminum, Glass, Plastics, Valve, & Actuator Standard valve (detail) & specialized valves (in brief), Product concentrate Different formulation systems- solution, Dispersions, Foams Powders. | 5 |

**Reference Books:**


1. Aulton Michael E., "Pharmaceutics The Science of Dosage Form Design", 2nd Edition, 2002, Churchill Livingstone Publishers.
2. Lieberman Herbert A., Lachman Leon, Schwartz/ Joseph B., "Pharmaceutical Dosage Forms - Tablets", Volume 1/2/3, 3rd Edition, 2005, Marcel Dekker Inc., New York.
3. Lachman Leon, Lieberman Herbert A, Kanig Joseph L., "The Theory and Practice of Industrial Pharmacy", 3rd Edition 1987, Varghese Publishing House, Mumbai.
4. E. A. Rawlins, Ed., Bentley's Textbook of Pharmaceutics, 8th Edn, Ballierwe Tindall, 1995.
5. Ridgways K., Hard capsules- Development & Technology, Pharmaceutical Press London, 1987.


## HOSPITAL PHARMACY AND DRUG STORE MANAGEMENT 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Hospital pharmacy – history and development, Duties and responsibilities of hospital pharmacist. | 1 |
| 2. | Hospitals, classification, organization, Administration and functions. | 1 |
| 3. | Pharmacy and therapeutics committee: Objective, composition and function | 2 |
| 4. | Hospital formulary: Advantage, disadvantage, preparation, contents a few examples. | 2 |
| 5. | Purchasing procedure, storage and inventory control | 2 |
| 6. | Dispensing of controlled substances: Hospital control procedures | 1 |
| 7. | Prepackaging, manufacturing and bulk compounding of large volume | 2 |

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| | parenterals, total parenteral nutrition and intravenous additives. | |
| 8. | Central sterile service: Advantages, plan, location, Sterilization and disposal of surgical materials. Sterilization of rubber gloves, syringes, needles, catheters, surgical instruments, powders and other materials. | 2 |
| 9. | Medical gases: Therapeutic use of gases; colour coding of cylinders, care of cylinders and accessories. | 1 |
| 10. | Health accessories: Wheel chairs, canes, crutches, bedpans, vaporizers, syringes, needles, clinical thermometers, first aid suppliers. | 1 |
| 11. | Clinical applications of radiopharmaceuticals: Introduction to particulate radiation, half life, therapeutic and diagnostic radiopharmaceuticals, and facilities required protection of operators. | 2 |
| 12. | Use of computers in hospitals | 1 |
| 13. | Introduction to Pharmacy Practice<br>• Pharmacy Trade or Profession<br>• Reorientation from Product to Patient Focus | 1 |
| 14. | Code of Ethics for a Pharmacist | 1 |
| 15. | Community Pharmacy :Scope in India and Abroad | 2 |
| 16. | Channel's of distribution<br>• Wholesalers & Retailers and Their role. Classification, Functions and Services. | 2 |
| 17. | Forms of business Organization (in brief)<br>Hindu Undivided family, Sole proprietorship, Partnership, Company and Co-operative Society. | 2 |
| 18. | Entrepreneurship: Trails of Entrepreneur and Development as an Entrepreneur | 1 |
| 19. | Location analysis | 1 |
| 20. | Layout Design (Exterior and Interior) | 1 |
| 21. | Purchasing and inventory Control<br>(Methods, restricted to retail only viz., Want Book, Systematic Want Book, Open to Buy Budgeting, ABC, VED and EOQ Analysis. Use of computers for inventory control) | 2 |
| 22. | Sales Promotion | 1 |
| 23. | Risk Management & Insurance Policies for Shopkeeper | 1 |
| 24. | Frauds in Retail Practice: How to prevent them | 1 |

**Reference Books:**


1. "Principles and methods of pharmacy management" Smith, Lea and Febiger.
2. "Drug store and management" Nolen and maynard, Mcgraw Hill, 1941.
3. "A Textbook of pharmacy management" Tomiski (Kugan page).
4. "Drug Store and Business Management" A. P. Battase, Unique Publication. Battase Unique Publication, 1999.
5. Hospital pharmacy: William E. Hassan, 5th Edition, Lea & Febiger, Philadelphia.

6. A textbook of Hospital: S. H. Merchant and Dr. J. S. Quadry, 4th Edition, B. S. Shah Prakakshan, Ahmadabad, 2001.
7. Hospital Pharmacy: Dr. H. P. Tipnis and Dr. Amrita Bajaj, First Edition, Career Publication, Maharashtra, 2007.
8. Gennaro Alfonso R., "Remington: The Science and Practice of Pharmacy", 20th Edition, 2000, Published Lippincott Williams & Wilkins.

**PHARMACEUTICAL BIOTECHNOLOGY** **3 hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Introduction to Biotechnology, Historical Perspectives, Definitions, Scope, Relevance to Pharma Industry | 1 |
| 2. | Microbiological Limit tests-Need, Standards for raw materials of natural origin (pharmacopoeial with some examples) | 1 |
| 3. | Microbiological assays- Basic principles, some examples. | 2 |
| 4. | Immunology-<br>• Host-microbe interactions, Introduction to terms-infection, infestation, pathogen, resistance, susceptibility etc.<br>• Factors affecting pathogenicity and infection, organization of immune system-organs & cells involved.<br>• Innate defence mechanism – first line of body defence, physiological phenomena-inflammatory response, fever, cellular, mediators; soluble (humoral) mediators, phagocytosis.<br>• Specific Defence Mechanism – Characteristics, Antigen, Cell-mediated immunity, Humoral immunity-antibody structure and types, Pathways of immune response, Clonal selection theory<br>• Hypersensitivity & Allergy<br>• Immunodeficiency states- Primary & acquired, Autoimmunity.<br>• Introduction to diagnostic markers.<br>• Serology-precipitin tests, agglutinin, complement fixation. Tests, immunoflueroscence, RIA, ELISA<br>• Immunological products-Vaccines & Sera- Definitions and Classification, Outline of general method of preparation of bacterial & viral vaccines, Typical Examples of each type, Q. C. aspects, Recent trends in vaccines. | 12 |
| 5. | Fermentation Technology-<br>Example of products of fermentation (microbial, animal and plant), types of fermenters, design of fermenter, factors affecting fermentation and down stream process, Production of penicillin, dextram, amylase, Introduction to single cell protein, biological oxygen demand. | 4 |
| 6. | Introduction to rDNA technology-<br>Details of restrictions endonuclease, SI nuclease, Ligase, Alkaline phosphatase, Vectors (Plasmid, cosmid, YAC), Gene expression | 6 |

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| | (Bacterial expression system, Yeast expression system, animal expression system, Plant expression system)<br>Application of rDNA technology for production of Pharmaceutical products e.g. Insulin, human growth hormone, interferon | |
| 7. | Techniques used in molecular biology-<br>Introduction to polymerase chain reaction, DNA sequencing, cDNA library, genomic library, blotting techniques, electrophoresis. | 4 |
| 8. | Introduction to gene therapy, transgenic animal and transgenic plants, Site directed mutagenesis. | 2 |
| 9. | Definition of enzyme and cell immobilization, methods for enzyme immobilization (adsorption, covalent binding, entrapment, matrices with example), example of immobilization, introduction to biosensor with immobilized enzyme e.g. glucose oxidase, penecillinase. | 3 |
| 10. | Introduction to Hybridoma technology – Production and application of monoclonal antibody, animal cell culture with diagnostic applications | 1 |

**Reference Books:**


1. A textbook of biotechnology by R. C. Dubey.
2. Biotechnology by B. D. Singh.
3. Pharmaceutical Biotechnology by S. P. Vyas and dixit
4. Pharmaceutical Biotechnology by S. S. Kori.
5. Biotechnology by H. D. Kumar.
6. A textbook of microbiology by Ananthnarayan.
7. Pharmaceutical Microbiology by W. B. Hugo and A. D. Russell.
8. Lehninger principle of Biochemistry by David, Nelson.
9. Pelezar, Chan & Krieg, Microbiology-Concepts and Applications, International Edn., McGraw Hill, Inc., 1993.
10. Weir Stewart: Immunology, 8th Edn., Churchill Livingstone, 1997.


## PHARMACOLOGY II 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Introduction to Chemotherapy<br>Basic principles of chemotherapy<br>Mechanism of action of chemotherapy agents<br>Mechanism of resistance to chemotherapeutic agents | 6 |
| 2. | Antibacterial drugs<br>Sulfonamides and Trimethoprim<br>Quinolones & Fluoroquinolones<br>Penicillins, cephalosporins & cefamycins & other β lactum antibiotics<br>Tetracyclines<br>Chloramphenicol<br>Aminoglycosides<br>Erythromycin | 8 |

| | | |
|---|---|---|
| | Macrolides | |
| 3. | Chemotherapy of following diseases<br>Amoebiasis<br>Malaria<br>Helminthiasis<br>e. Tuberculosis & leprosy<br>f. Fungal infection<br>g. Viral disease<br>h. Cancer | 12 |
| 4. | Drugs used in endocrine disorders<br>- Antidiabetic agents<br>- Antithyroid agents<br>- Oxytocies<br>- Oral contraceptives<br>- Bone Metabolism & Drugs used in Osteoporosis<br>(Bone Structure & Composition, Bone Remodeling, disorders of Bone and Drugs used in Treatments) | 10 |

**Reference Books:**


1. Goodman & Gilman's Pharmacological Basis of Therapeutics- Joel G. Hardman, Lee E. Limbird, Alfred Goodman GillMan 11th Edition, The McGraw – Hill Companies Inc., 2001.
2. Satoskar, R. S. Bhandarkar S. D. & Rege N. N. Pharmacology & Therapeutics – 20th Edition, Popular Prakashan, 2007.
3. Rang & Dale Pharmacology, 5th Edition, Churchill Livingstone, 2003.
4. Lippincott's Illustrated Reviews: Pharmacology – Lippincott – Raven 3rd Edition Howland & Nycets Publishers N Y, 2006.
5. Lewis Pharmacology – By Crossland – 5th Edition, Churchill Livingstone
6. Laurence, D. R. & Bennet Clinical Pharmacology- 9th Edition, Elsevier, N. Y., 2006.
7. Kulkarni, S. K. Handbook of Experimental Pharmacology – 3rd Edition Vallabh Prakashan New Delhi, 2005.
8. B. G. Katzung – Basic and Clinical Pharmacology, 9th Edition Appleton and Lange publication, 2004.
9. Gosh M. N. – Fundamentals of Experimental Pharmacology, 3rd Edition, Hilton & Company, Calcutta, 2005.


## PHARMACEUTICAL CHEMISTRY LABORATORY – I 4 hrs/ week

Introduction/ transformation of functional groups in molecules

1. Acetylation (synthesis of aspirin & acetanilide **or** benzanilide)
2. Bromination (synthesis of p-bromoacetanilide **or** p-nitrobromobenzene)
3. Nitration (synthesis of p-nitroacetanilide **or** m-dinitrobromobenzene)
4. Oxidation (synthesis of benzoic by oxidation of toluene **or** benzyl alcohol with alkaline potassium permanganate)
5. Bromination (synthesis of sodium toluene-p-sulfonate or p-Nylenesulfonate acid)

6. Reduction (Ketones, synthesis of benzhydrol by reduction of benzophenone with zinc and sodium hydroxide) **or** synthesis of m-nitroaniline by partial reduction of m-dinitrobenzene with sodium polysulfide.
7. Esterification (synthesis of n-butylacetate from n-butanol and acetic acid) Demonstration of reaction monitoring by TLC.

## PHARMACUTICS LABORATOY III 4 hrs/ week

1.A) Evaluation of excipients-bulking agent, directly compressible diluents, conventional Bulk density, flow properties, compressibility and discussion of observations
B) Evaluation of excipients – disintegrating agents
Swelling index determination and discussion of observations.
C) Evaluation of excipients of tablet-Lubricants glidents
2. Granulation for Soluble aspirin tablets IP and evaluation
3. Granulation compression and evaluation Riboflavin in tablet IP 96
4. Granulation, compression and evaluation of Chewable antacid tablets.
5. Granulation and Compression of Ascorbic acid tablets IP 96
6. Granulation, compression and evaluation of Paracetamol tablets IP 96
7. Dissolution test for paracetamol tablets IP.
8. Evaluation of Capsule shells, filling of ampicillin trihydrate capsules and their evaluation.

## BIOCHEMISTRY LABORATORY II 4 hrs/ week

Colorimetric estimation of blood sugar, blood cholesterol
Estimation of protein by Biuret method and Folin Ciocalteau method
Estimation of RNA
Estimation of Vitamin E and Vitamin C
Extraction of enzymes, Partial purification by alcohol, acetone precipitation, ammonium sulphate precipitation, Study of factors affecting rate of an enzymatic reactions: Effect of activators, inhibitors, or rate of enzymatic reaction, Determination of $K_m$ of any one enzyme, Assay of alkaline phosphatase, α-amylase, protease, polyphenol, oxidase, lipase Chromatographic separation of amino acids.

## PHARMACEUTICAL BIOTECHNOLOGY LABORATORY 4 hrs/ week

Air Microbiology by solid and liquid impingement methods

Coliform Count of water by MPN technique

Test for Sterility as per IP

Microbial Limit test on Excipients as per I.P. – Hard Gelatin Capsule Shells, Tragacanth, Starch, Lactose

Studies on selective media: McConkey Agar, Cetrimide Agar, Vogel Johnson and Medium for *S typhi*

Antibiotic Sensitivity test by disc method

Widals test tube agglutination method

Biochemical Tests (Catalase, Oxidase, Urease, Nitratase, Protease, Amylase and IMVIC)

Antimicrobial assay of antibiotic, introduction to zone of inhibition and calculation

Immobilization of enzymes and cells by calcium alginate, gelatin and agar

Isolation of DNA

Selection and isolation of bacteria by replica plating

Determination of thermal of bacteria b replica plating

Effect of Ultra-Violet exposure on growth of E coli

Demonstration of electrophoresis either by PAGE or Agarosegel electrophoresis

## SEMSETER VI

**PHARMACEUTICAL MEDICINAL CHEMISTRY – II** **3 hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Steroids – Configuration 5 α and 5 β cholestane, conventional formula and conformational representation. Reactions in ring A & B of steroids – conformation and chemical reactivity, addition, elimination, epoxide opening, relative rates of esterification and oxidation of epimeric alcohols and reduction of ketones, rearrangement reactions, Medicinal chemistry of steroids: Sex hormones (androgens like testosterone and its esters: estrogens like estradiol, ethinyl estradiol and mestranol: progestines like medroxy progesterone acetate, megesterol acetate, norethindrone and norgestrel), anabolic steroids like danazol, stanozolol and androizoxazole: non steroidal estrogens like diethylstilbestrol and cholotrianisene, antiestrogens like tamoxifen and clomiphene, corticoids and steroidal antoflammatory like cortisone, hydrocortisone, prednisolone, dexamethasone, betamethasone and triameinolone. | 9 |
| 2. | Antihistamines $H_1$, $H_2$ receptors. Emphasis to be on the second generation H1 antagonists such as fexofenidine, astemazole, loratidine cetrizine and acrivastine, H2 receptor antagonist like cimetidine*, ranitidine, famotidine, nizatidine, proton pump inhibitors like omeprazole and lansoprazole. | 4 |
| 3. | Diureties<br>a. Site 1 - Carbonic anhydrate inhibitors acetazolamide*, methazolamide.<br>b. Site 2 - High ceiling or loop diuretics is sulfamoyl anthranilic acids like furosemide*, azosemide and bumetanide in phenoxyacetic acids ethacrynic acid*<br>c. Site 3 - Thiazide and Thiazide like diuretics<br>d. Site 4 - Potassium sparing diuretics such as spironoloactone triamterene and amiloride | 5 |
| 4. | Local Anesthetics<br>a. Amino esters – procaine, tetracaine, benzocaine<br>b. Amino amides – lidocaine*, mepivacaine, bupivacaine<br>c. Amino ethers – pramoxine<br>d. Alcohols – Benzyl alcohol, eugenol | 3 |
| 5. | Hypoglycemics (Insulin not to be discussed)<br>1. Biguanides e.g. metformin b. Sulfonylurea's 1st Generation like tolbutamide *, cholorpropamide, tolazamide and acetohexamide: 2nd Generation like glyburide, glypizide, 3rd Generation like glimepride and repaglimide.<br>2. Thiazolidinediones such as troglitazone, ciglitazone, rosiglitazone and pioglitazone<br>3. β – Glycosidase inhibitors like acarbose, voglibose and miglitol. | 4 |

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| 6. | Antiviral agents including HIV – ara-A, indoxuridine*, amantadine*, acyclovir, ganciclovir and ribavirin, HIV agents –both non-nucleosides like nevirapine & delaviridine and nucleosides like AZT and protease inhibitors like indinavir, saqvunavir, ritonavir (only highlights of structure). Combination therapy | 4 |
| 7. | Antineoplastics<br>a. alkylating agents like mechlorethamine, chlorambucil*, cyclophosphamide*, mitomycin C, busulfan, carmustine, lomustine, dacarbazine and procarbazine.<br>b. Antimetabolites like azaserine, methotrexate*, 5-fluorouracil, ara-C, 6-MP and 6-TG<br>c. Antibiotics like dactinomycin, doxorubicin, bleomycin, and other natural products like vincristine, vinblastine, paclitaxel (only highlights of structure to be discussed)<br>d. Miscellaneous compounds like cis-platin and some newer derivatives<br>e. Combination therapy | 7 |
| | * indicates synthesis to be discussed | |

**Reference Books:**


1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 11th Ed., Eds. John H Block and John M Beale, Lippincott Williams & Wilkins, 2004.
2. Foye's Principals of Medicinal Chemistry, Eds., T. L. Lemke and D. A. Williams, Williams & Wilkins, Baltimore, 2002.
3. Medicinal Chemistry, Ashutosh Kar, 4th Edition, New Age International Publishers, 2007.
4. The art of Drug Synthesis, Eds. Douglas S Johnson and Jie Jack Li, Wiley Interscience, 2007.
5. Pharmaceutical Chemistry, Vol. 1: Drug Synthesis, Eds. H. J. Roth, A. Kleeman and T. Beissewenger, Ellis Horwood Ltd., 1988.
6. The Organic Chemistry of Drug Synthesis, Daniel Lednicer, Vols 1 to 7, John Wiley.


## PHARMACEUTICAL ANALYSIS III — 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | **Basic concepts in spectroscopy-** Introduction: Electromagnetic radiation and interaction with matter, electronic spectra, wavelength, wavenumber, frequency, absorbance, transmittance, photometers, spectrophotometers. | 2 |
| 2. | **UV-Vis absorption spectroscopy-** electronic transitions and UV spectra, chromophores, Auxochromes, bathochromic and hypsochromic shifts, hyperchromism and hypochromism, Beer-Lamberts law (Definition, derivation of mathematical expression, limitations), Applications of Beer's law to single component analysis | 15 |

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| | and multicomponent analysis (calibration graph, standard absorptivity value, single standardisation, double standardisation, simultaneous equation method, difference spectroscopy, derivative spectroscopy), effect of solvents, Instrumentation- Light sources, Filters, monochromators, cells, detectors, single beam and double beam spectrophotometers, with block and ray diagrams. | |
| 3. | **Fluorescence spectroscopy-** origin of fluorescence and phosphorescence spectra, singlet and triple states, factors affecting fluorescence intensity, Quantitative fluorescence intensity, applications, Instrumentation-light sources, primary and secondary filters, monochromators, detectors. | 3 |
| 4. | **Infrared spectroscopy-** I.R. regions, requirements for I.R. absorption, vibrational and rotational transitions, dipole changes, types of molecular vibrations, potential energy diagrams (harmonic oscillator and anharmonic oscillator), Vibrational frequency, factors influencing vibrational frequencies, vibrational modes (normal mode, combination bands and overtone bands), Instrumentation: light source, frequency selector, sample preparation, detectors, double beam I.R. spectrophotometer (schematic diagram), Qualitative applications (identification of functional groups, identity by fingerprinting). | 6 |
| 5. | **Electrochemical methods-** Theory, Introduction, Instrumentation and Applications of:<br>• Coulometry<br>• Polarography & Pulse polarography<br>• Amperometry<br>• Electrogravimetry | 10 |

**Reference Books:**


1. Skoog-Principals of Instrumental Analysis, 4th edition, Saunders College Publishing, 1992, USA.
2. Willard H.H.L. L. Merrit & John A. Dean-Instrumental Method of Analysis, 6th edition, 1986, CBS Publishers & Distributors, New Delhi.
3. Ewing Galen W-Instrumental Method of Chemical Analysis, 3rd edition, 1969, Mc Graw Hill Book Company, New York.
4. Beckett & Stenlake-Practical Pharmaceutical Chemistry, 4th edition, 1988, CBS Publishers & Distributors, India.
5. Vogel textbook of Practical Organic Chemistry 4th edition, 1984, Flbs & Longmans, London.
6. James W. Munson-Pharmaceutical Analysis: Modern methods, Marcel Dekker Inc., 1981, USA

**PHARMACONOSY II** **3 hrs/ week**

**Drugs mentioned in bold are for detailed study**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Evaluation and Significance of quality control of drugs of natural origin (DONO)<br>Study of organoleptic, microscopic, physical, chemical and biological methods of evaluation, Physicochemical parameters such as moisture content, ash value, acid insoluble ash, heavy metals content and pesticides residue, microbial bioburden etc. for crude drugs with respect to pharmacopeias. Introduction to W.H.O. guidelines and monographs of drugs of natural origin. | 7 |
| 2. | Detailed morphology and microscopy of organized drugs and evaluation parameters for unorganized drugs mentioned in bold. | 5 |
| 3. | Quantitative microscopy, Lycopodium spore method, Leaf constants, camera lucida, diagrams of microscopic objects to the scale with camera lucida. | 3 |
| 4. | Detailed study of carbohydrates with respect to chemistry, sources preparation and uses. All cellulose derivatives, starches, honey, inulin, alginic acid, gums **(tragacanth, acacia, sterculia, Nanthan, guar)**. Mucilages **(agar,isapghol, linseed) malt and malt extract**, dextram, **pectins,** chitin, hyaluronic acid, Study of sources, constituents and uses of carbohydrate containing herbs i.e. fig, bael, (Cassis latin fistula, tamarkind kernel powder (TKP). | 4 |
| 5. | Introduction to organic acids, fruits (citrus, tamarind, garcinia, amla). | 2 |
| 6. | Introduction to Pesticides of natural origin – Introduction study of following with respect to their occurrence, chemistry and applications, **Pyrethrum**, nicotin, **neem**, Red squill. | 2 |
| 7. | Study of chemistry, classification, extraction, properties, sources and uses of Tannins.<br>Detailed pharmacognostic study and application of **galls, catechu** (pale and black), **Kino**, arjuna, ashoka, harda, behra | 2 |
| 8. | Study of Lipids (Waxes, fats, fixed oils) their chemistry and classification. Study of following with respect to sources, extraction & composition of lipids and uses: Arachis, castor, sesame, **linseed**, jajoba, olive, almond, mustard, wheatgerm, cottonseed, coconut, safflower, sunflower, croton, neem, rice bran, hydnocarpus, cod halibut and sharkliver oil, Study of kokum butter, coca butter, woolfat, spermaceti wax, beeswax, carnuba wax, lecithin. | 5 |
| 9. | Hydrocarbons<br>Introduction to composition, properties & sources of alkanes, isoalkanes and anti isoalkanes, alkenes, ethylene, polyacetylenes (stearolic acid, falcarinone, dehydro matricaria esters, thiophenes from tagetes). | 2 |

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| 10. | Study of sources, structure and properties of sulphides from Allium species (A. cepa & A sativum) | 2 |
| 11. | Study of structure, occurrence and uses of essential amino acids, Study of peptides, proteins, protein hydrolysates, Sources, preparation and uses of gelatin. | 2 |

**Reference Books:**


1. Trease D. & Evans W.C.: Textbook of Pharmacognosy; W.B. Saunders.
2. Tyler V.E., Brady L.R. & Robbers J.E.: Pharmacognosy; Lea Feibger, USA.
3. Wallis T.E.: Textbook of Pharmacognosy: CBS Publishers, Delhi.
4. Kokate C.K. Purohit A.P. & Gokhale S.B.: Pharmacognosy: Nirali Publications, Pune.
5. Harbone J.B.: Photochemical Methods: A guide to modern techniques of Plant Analysis: Chapman & Hall, London.
6. Bruneton J.: Pharmacognosy, Phytochemistry, Medicinal Plants, Intercept Limited.
7. Vasudevan T.N. & Laddha K.S.: A Textbook of Pharmacognosy, Vrinda Publication House, Jalgaon.
8. The Indian Pharmacopoeia: The Controller of Publication; Delhi.
9. Brain K.R. & Turner T.D.: The Practical Evaluation of Phytopharmaceuticals; Wright, Scientica, Bristol.
10. Iyenger M.A. & Nayak S.G.: Anatomy of Crude Drugs: Manipal Power Press, Manipal.
11. Iyenger M.A.: Pharmacognosy of Powdered Drugs: Manipal Power Press, Manipal.
12. Kokate C.K.: Practical Pharmacognosy: Vallabh Prakashan.
13. Wagner, Bladt & Zgainski: Plant Drug Analysis: Springer Verlag.
14. Khandelwal K.R.: Practical Pharmacognosy Technique and Experiments: Nirali Prakashan, Pune.
15. Vasudevan T.N. Laddha K.S.: Practical Pharmacognosy: New Vrinda Publishing House. Jalgaon.


## PHARMACEUTICS V — 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Tablet coating<br>• Need for tablet coating<br>• Sugar coating – Raw materials, steps in detail, coating defects/problems<br>• Film coating – Raw materials, Aqueous film coating, defects/problems<br>• Enteric coating<br>• Coating Equipments – Conventional & modified pans, coating columns (fluidized bed coating), Spray equipment & other accessories.<br>• Q.C. of coated tablets. | 12 |
| 2. | Microencapsulation<br>• Definition, need/ reasons, concepts of core & coat<br>• Methods with equipments - Wuster process, coacervation- | 7 |

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| | phase separation, spray drying and related processes, interfacial polymerization, multiorifice centrifugal process, pan coating, solvent evaporation. | |
| 3. | Biological products<br>• Sutures & Ligatures - definition, classification, catgut manufacturing & processing - details, other absorbable sutures (brief), Non absorbable types - silk, linen, polyamides, polyesters, polyolefins, metallic wires, Q.C. testing of sutures & ligatures.<br>• Blood products - Need, problems/ hazards, Blood banking procedures. Whole human blood, Red cell cone, cone of platelets.<br>Plasmapheresis, plasma, serum, Fractionation of plasma, Study of some fractions – clotting factors like Fibrinogen, AHF, Factor IX complex, Prothrombin, Albumin preparations, γ globulin preparations. Q.C. aspects of blood products.<br>• Plasma substitutes (Plasma volume expanders) – need, properties desired, examples-hydrolyzed gelatin based products, HETA starch, Dextran (in detail)<br><br>Glandular products<br>• Insulin – extraction from pancreas, purification, insulin injections (official)<br>• Thyroid – Processing & product (official)<br>• ACTH preparations<br>• Oxytocin and vasopressin | 4<br><br><br><br><br><br>6<br><br><br><br><br><br><br><br><br>3<br><br>4 |

**Reference Books:**


1. Lachman Leon, Lieberman Herbert A. kanig Joseph L., “The Theory and Practice of Industrial Pharmacy”, 3rd Edition 1987, Varghese Publishing House, Mumbai.
2. Deasy Patrick B., “Microencapsulation and Related Drug Processes”, Volume 20, 1984, Marcel Dekker Inc., New York.
3. Cole G “Pharmaceutical Coating Technology”, Taylor & Francis Ltd. Bristol, PA, 1995.
4. Isaac Ghebre-Sellassie, “Pharmaceutical Pelletization Technology”, Volume 37, 1989, Marcel Dekker Inc., New York.
5. E. A. Rawlins, Ed., Bentley’s Textbook of Pharmaceutics, 8th Edn., Ballierwe Tindall, 1995.
6. S. J. Carter Ed., Tutorial Pharmacy, Cooper & Gunn, 6th Edn., CBS Publishers & distribution, India, 1986.
7. Remington, The science and practice of pharmacy, 21st ed., Vol I & II, B. L., Publications Pvt. Ltd., 2005.

**COSMETICOLOGY** **3 hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Definition of cosmetics<br>Historical background<br>Classification of cosmetics and functions | 1 |
| 2. | Structure of skin, hair, nails and skin appendages and interaction with cosmetics. | 2 |
| 3. | Toxicology of cosmetics-irritation and sensitization reaction to cosmetics, tests to predict such reactions<br>Microbiological aspects of cosmetics | 2 |
| 4. | A brief review on perfumes, colors and other raw materials used in cosmetics. | 2 |
| 5. | Study of following cosmetics with respect to raw materials, formulation, processing and quality control:<br>• Personnel hygiene products- pedicure and manicure preparations, dental care preparations including tooth paste, tooth powder, mouth washes and denture cleaners, antiperspirants and deodorants.<br>• Facial makeup products- skin creams and lotions including cleansing cream, cold cream, vanishing cream, foundation makeup, bleach cream, face powder, roage, lipstick, eye makeup, face packs, and moisturizers.<br>• Protective preparations-hand and body creams and lotions, barrier preparations and emollient preparations, sunscreen and antisunburn preparations, insect repellants.<br>• Hair care preparations- shampoo, women's and men's hair dressing, hair tonics and hair conditioners, hair rinses, hair colorants, hair waving and straightening preparations.<br>• Miscellaneous preparations- Introduction to depilatories shaving preparations, nail products, bath oils, baby cosmetics, antilice preparations, herbal cosmetics.<br>• Schedule S of drug and cosmetics Act in relation to cosmetic manufacture, hygiene, pollution control-ecological concern. | 4<br>9<br>4<br>5<br>6<br>1 |

**Reference Books:**

1. Harry's Cosmetology, 7th Ed., edited by J.B. Wilkinson & R.J. Moore, Longman Singapore, Publishers Pvt. Ltd.

2. Cosmetics- Science and Technology, Vol 1,2 & 3 M.S. Balsam & Edward Sagarin Ed., 2nd edition, Wiley Interscience publications, 1972.
3. Cosmetics-Formulations, Manufacturing & Quality Control by P.P. Sharma – 3rd edition, Vandana Publications Pvt. Ltd., 2005.

## PHARMACEUTICAL MANAGEMENT 3 hrs/ week

1. Basic principals and types of viable Business and enterprise. Health care industry - positioning the pharmacist fit in the industry Major players, major brands, Core, auxiliary and allied products and marketing, Major Components of Pharma business

   (Lectures 3)

2. Financial management, Source of funds, basics of balance sheet and profit an loss account.
   Product: DPCO, Costs of inputs in a product, Direct/ indirect, Activity based costing, Taxes, cost benefit analysis of a product, SWOT analysis of a product in competitive market, National budget.

   (Lectures 3)

3. Product Cost, value of a product, Market economics, COST OUTPUT relationship, PROFIT Management, Pricing analysis, Pricing policy Performance management Materials and Inventory management Vendor development, Stock audits.

   (Lecturers 3)

4. Quality management: FDA regulations and approvals, WHO requirements, General awareness of Global requirements of MHRA/ MCA/ TGA/ USFDA/ ISO up gradation. Six sigma concept, Product and process environment Management.

   (Lecturer 3)

5. Market research process. Market forecasting process. Analysis of Volume and growth of Peripheral markets: Nutraceuticals.
   Cosmeceuticals implants.

   (Lecturer 3)

6. Marketing and sales: uniqueness of medical products marketing. Role of retail chemist, distributors, stockist, wholesaler, C & F agents, what is a market, a market share, competitive marketing.
   Change in offing-malls, chain of corporate retails outlets, Brands and Generic market.

   (Lecturer 6)

7. Export market management: market search, preparations and Development, Regulated and unregulated market requirements Continents and Countries for Global market, Hospitals, Govt./ Corporate purchasers, ESIS schemes , NGOs.

   (Lecturer 3)

8. Role of product development and clinical research, Major Diseases and major molecules, Clinical research, patent registration, IPR, PRODUCT and PROMOTIONAL POLICIES.

   (Lecture 4)

9. Other regulatory requirements Factory Act., Pollution Act., Fire-safety and hazard management Hazaop study, (MSDS) safety data sheets.

(Lecturer 3)

10. Leadership, Motivation, Delegation, communication, Conflict management, Shop floor management.

(Lecture 3)

11. Management concepts that help to create value Ps: product, place, price, people, packing, pace, Organization- ZS concept.

(Lecturer 2)

**Reference Books:**


1) Marketing Management 12th edition by Kotler, Loshy & Jha.
2) Marketing Management 2nd edition by Dr. Rajan Saxena.
3) Introduction to Marketing Management by Adrian Palmer.
4) Financial Management by Prasanna Chandra.
5) Financial Management by I. M. Pandey.
6) Human Resource management by Ashwathapa.
7) Personnel & Human Resource Management by Subba Rao.
8) Production & Operations Management by K. Ashwathapa.
9) Production & Operations Management by S. N. Chary.
10) Production & Operations Management by S. A. Chunawala.
11) Business Logistics/ Supply Chain Management by Ronald Ballon.
12) Introduction to Supply Chain Management by Robert Hanfiels.


## PHARMACOLOGY III — 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Autonomic nervous system<br>- Brief introduction to Anatomy and Physiology of ANS<br>- Adrenergic agents (Sympathomimetic agents)<br>- adrenergic blocking agents<br>- Cholinergic drugs (Cholinomimetic agents e.g. Anticholinesterases)<br>- Antochoilinergic drugs<br>a) Muscarrinic drugs<br>b) Nicotinic blockers<br>- Drugs acting at neuromuscular junction (skeletal muscle relaxants)<br>- Drugs acting on autonomic ganglia (stimulants and blockers) | 18 |
| 2. | Cardiovascular system<br>Drugs used in the treatment of:<br>Hypertension<br>Congestive cardiac failure<br>Angina pectoris<br>Cardiac arrhythmias | 14 |

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|---|---|---|
| | Drugs used in the treatment of hyperlipoproteinaemia | |
| 3. | Diuretic drugs | 6 |

**Reference Books:**


1. Goodman & Gilman's Pharmalogical Basis of Therapeutics – Joel G. Hardman. Lee E. Limbird, Alfred Goodman Gill Man 11th Edition, The McGraw - Hill Companies Inc, 2001.
2. Satoskar, R. S. Bhandarkar S D & Rege N. N. Pharmacology & Therapeutics - 20th Edition, Popular Prakashan, 2007.
3. Rang & Dale Pharmacology 5th Edition, Churchill Livingston 2003.
4. Lippincott's Illustrated Review Pharmacology - Lippincott - Raven 3rd Edition Howland & Nyeets Publishers N Y, 2006.
5. Lewis Pharmacology - By Crossland - 5th Edition, Churchill Livingstone.
6. Laurence D. R. & Bennet Clinical Pharmacology - 9th Edition, Elsevier, N Y, 2006.
7. Kulkarni, S. K. Handbook of Experimental Pharmacology 3rd Edition Vallabh and Prakashan, New Delhi, 2005.
8. B. G. Katzung Basic and Clinical Pharmacology - 9th Edition, Appleton and Lange publication, 2004.
9. Gosh M. N. Fundamentals of Experimental Pharmacology, 3rd Edition, Hilton & Company, Calcutta, 2005.


## PHARMACOLOGY LABORATORY I — 4 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Experiments<br>a) Dose Response Curve (DRC) of any agonist (eg. Ach/ Histamine) using a suitable isolated tissue preparation.<br>b) L V infusion a simulated model using rubber tube mounted on a wooden board (the students are taught to calculate the dose and concentration to be used, actual dilution for preparation of infusion, setting of L V, infusion including cannulation, setting of drop rate, for infusion over a given period of time) * Indian Journal of Pharmacology, Vol 39 (I), Feb. 2007: 57-59.<br>(Free Full text available at www.jip-online.com) | |
| 2. | Demonstration<br>a) effects of drug on isolated frog heart (CD's/ actual)<br>- Adrenaline, Acetylcholine<br>- Atropine Propranolol<br>- Effect of excess of calcium and potassium on isolated heart<br>- Effect of lack of Ca, K on isolated heart<br>- Effect of digitalis on hypodynamic heart<br>b) Stimulated experiment (CD's) Expharm<br>- effect of drug on eye<br>- effect of drug on GI motility<br>c) Demonstration with the help of CD's or Kymograph recordings | |

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|---|---|---|
| | - Effect Neostigmine on DRC of Ach<br>- Effect of Panecuronium on DRC of Ach<br>**(Give the reading to the students and ask them to plot the graphs and draw the conclusion from the results, eg. Identify type of antagonism existing between two drug by studying the nature of the graph, competitive and non competitive**<br>**Find out the potency of the drugs by studying the DRC by studying IC 50 values)**<br>Calculation of $P^A2$ value for atropine using Ach as agonist. | |
| 3. | Tutorials<br>Laboratory Animal Handling<br>Care and Ethics in Animal experimentation. | |

**Reference Books:**


1. Kulkarni, S. K. Handbook of Experimental Pharmacology, 3rd Edition Vallbh Prakashan, New Delhi, 2005.
2. Gosh M. N. Fundamentals of Experimental Pharmacology, 3rd Edition, Hilton & Company, Calcutta, 2005.
3. S. B. Kasture. A Handbook of Experiments in Pre-Clinical Pharmacology, 1st Edition, Career Publications, 2006.
4. W. L. M. Perry, Pharmacological Experiments on Isolated Preparations, 2nd Edition, E & S Livingstone, Edinburgh & London, 1970.


**Websites:**

Indian journal of Pharmaceutical education and research, Vol. 41 (1), Jan-Mar, 2007; 52-61 (www.ipper.org )

## PHARMACOGNOSY LABORATORY I — 4 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Quantitative estimation by lycopodium spore method<br>a) Determination on number of particles (starch grains/ stone cells/ lignified fibers) in given sample of crude drugs.<br>b) Determination of %purity of ginger powder.<br>c) Histochemical identification of starches (maize, rice, wheat, potato) | 3 |
| 2. | Identification and Measurement of dimensions of different types of starch grains and calcium oxalate crystals, trichomes and stomata. | 1 |
| 3. | Leaf constants – Stomatal index, stomatal number, palisade ratio, vein islet number, veinlet termination number. | 3 |
| 4. | Determination of alcohol soluble and water soluble extractives, total ash value and acid insoluble ash and water soluble ash value for any one crude drug as per I.P. | 3 |
| 5. | Identification of unorganized drugs by chemical tests (agar, acacia, tragacanth, gelatin, sterculia, pale catechu, black catechu and Kino) | 1 |

| | | |
|---|---|---|
| 6. | Detection of adulterants fixed oils | 1 |
| 7. | Visit to medicinal plant garden | 2 |
| | **Total** | **14** |

## COSMETICOLOGY LABORATORY 4 hrs/ week

Formulation – Processing, Packaging and Evaluation of cosmetic preparations.

1. Skin cleansers
   - Cleansing milk
   - Clear cleansing gel
2. Skin moisturizers
   - Cold cream
   - Hand and body lotion
   - Moisturizing lotion
3. Suncare products
   - Medicated dusting powder
   - Sunscreen cream
4. Facial cosmetics
   - Vanishing cream
   - Foundation lotion
   - Eye shadow
   - Lipstick
5. Hair care products
   - Clear liquid shampoo
   - Antidandruff shampoo
   - Men's hair dressing preparation
6. Nail care products
   - Nail Lacquer
   - Nail Lacquer remover
7. Shaving preparations
   - Lather shaving cream
   - Brushless shaving cream
   - Aftershave lotion
8. Dental care products
   - Tooth paste
   - Medicated toothpaste
   - Mouthwash
9. Herbal cosmetics
   - Powder face scrub
   - Antiwrinkle cream
   - Antiacne cream

## SYLLABUS COPY FOR FINAL YEAR B. PHARM
## SEMSETER VII

**PHARMACEUTICAL MEDICINAL CHEMISTRY – III** **3 hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| | Discussion of the following classes of drugs including classification, chemical nomenclature, structure including stereochemistry, generic names, chemistry, physicochemical properties, SAR, metabolism, molecular mechanism of action and synthesis, introduction to rational development if any of the class of drugs. | |
| 1. | **Cholinergic Drugs:**<br>(i) cholinergic agonists (methocholine, carbochol*, bethanechol, pilocarpine)<br>(ii) Ach esterase inhibitors (physostigmine, neostigmine*,tacrine*, ambenonium chloride, isofluorphate, pralidoxime)<br>(iii) Cholinergic antagonists (atropine, scopolamine, homatropine hydrobromide, ipratropium bromide); synthetic cholinergic antagonists (cyclopentolate*, dicyclomine*, ben/otropine mesylate, procyclidine hydrochloride, isopropamide iodide, tropicamide)<br>(iv) Ganglion blocking agents (trimethaphan, camsylate, mecamylamine)<br>(v) Neuromuscular blocking agents (tubocurarine, gallamine, triethiodide, succinyl choline chloride) | 9 |
| 2. | **Adrenergic Drugs:**<br>(i) α-adrenergic agonists (phenylephrine, naphazoline, xylometazoline, oxymetazoline, methyldopa, clonidine*, guanabenz, guanfacine )<br>(ii) β-adrenergic agonists (isoproternol, terbutaline*, albuterol, salmeterol, isoxsuprine, ritodrine)<br>(iii) α-adrenergic antagonists (tolazine, phentolamine, phenoxybenzamine, prazosin, doxazosin)<br>(iv) β-adrenergic antagonists (propranolol*, atenolol, metoprolol, acebutalol, alprenolol, timolol, labetalol*)<br>other adrenergic agents (amphetamine, pseudophedrine, ephedrine, guanethidine*, propylhexedrine, reserpine). | 9 |
| 3. | **CVS Drugs:**<br>(i) antianginal agents (amyl nitrite, isosorbide dinitrate, pentaerythritol tetranitrate, verapamil, bepridil, diltiazem, nifendipine*, amlodipine, nimodipine, dipyridamole)<br>(ii) antiarrhythmic agents (quinidine, procainamide*, disopyramide, lidocaine, tocainide, mexilitine, encainide, amiodarone, pro[afenone, verapamil, diltiazen, propranolol, sotalol*).<br>(iii) Antihypertensive agents (a) review of adrenergic agents (b) review of Ca channel blockers (c) ACE inhibitors (captopril*, enalapril, benzepril, ramipril) (d) angiotensin II receptor antagonists (losartan, valsartan*, candersartan)<br>(iv) Vasodilators and K-channel agonists (diazoxide, minoxidil)<br>(v) Antihyperlipidemic agents (clofibrate*, gemfibrozil, niacin, lovastatin, | 4<br>4<br>6<br>1 |

| | | |
|---|---|---|
| | atorvastatin) | 3 |
| | * Indicates synthesis to be discussed | |

**Reference Books:**


1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 11th Ed. Eds. John H. Block and John M. Beale, Lippincott Williams & Wilkins, 2004
2. Foye's Principals of Medicinal Chemistry, Eds. T. L. Lemke and D. A. Williams. Williams & Wilkins, Baltimore, 2002.
3. Medicinal Chemistry, Ashutosh Kar, 4th Edition, New Age International Publishers, 2007.
4. The Art of Drug Synthesis, Eds. Douglas S. Johnson and Jie Jack Li, Wiley Interscience, 2007.
5. Pharmaceutical Chemistry, Vol. EDrug Synthesis Eds. H. J. Roth, A. Kleeman and T. Beissewenger, Ellis Horwood Ltd. 1988.
6. The Organic Chemistry of Drug Synthesis, Daniel Lednicer, Vols 1 to 7, Wiley.


## PHARMACEUTICAL ANALYSIS IV 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | **Chromatography**<br>Principal's, terminology-stationery phase, mobile phase, classification of chromatography methods, migration rate of species (partition coefficient, retention time, adjusted retention time), Rate of solute migration (capacity factor, selectivity factor), Column efficiency and band broadening (shape of peak-Gausssian, plate height, number of theoretical plates, van Deemeter equation), Optimisation of column performance (Column resolution, capacity factor, selective factor, tailing factor, peak width), Qualitative analysis, Quantitative analysis (Peak height, peak areas, calibration and internal standard, external standard, area normalization). | 3 |
| 2. | **Gas chromatography (GSC &GLC)**<br>Introduction, Principal, Instrumentation-carrier, columns, injection system, detectors (advantage, disadvantage, applications of Thermal conductivity, electron capture, thermionic, flame ionization, nitrogen phosphorus, photoionisation), head space analysis, applications. | 5 |
| 3. | **HPLC**<br>Introduction, Principal, Instrumentation-mobile phase reservoir, pumps (reciprocating, displacement, pneumatic, isocratic elution, gradient elution), solvent treatment system, Injection systems (Rheodyne injector in detail, direct sample introduction, sampling loops), columns and fittings (for reverse and normal phase, analytical and guard columns. Thermostats, column packing), detectors advantages, disadvantages, (UV-single wavelength, variable wavelength, phtotodiode array), fluorescence, refractive index, electrochemical. | |
| 4. | **Ion exchange chromatography**<br>Principal, ion exchange resins, mobile phases, applications. | 2 |

| | | |
|---|---|---|
| 5. | **Ion pair chromatography**<br>Principal, applications | 1 |
| 6. | **Size exclusion chromatography**<br>Principal for gel permeation and gel filtration method, support media, mobile phases, applications | 1 |
| 7. | **Paper chromatography**<br>Introduction, choice of filter papers, solvents, chromatographic chambers, development techniques (descending, ascending, radial multiple chromatography, two-dimensional chromatography), qualitative analysis-location of spots, Quantitative analysis (direct and elution method), factors affecting retention factor, applications. | 3 |
| 8. | **Thin layer chromatography**<br>Introduction, Principal, different absorbents different methods for preparation of plates, solvents, development techniques cascending, descending, horizontal, multiple development two dimensional development, preparative TLC, Qualitative evaluation visualization of spots, Quantitative evaluation (Area, weight, densitometry elution factors affecting RF, applications) | 3 |
| 9. | **High performance thin layer chromatography**<br>Introduction, Principal, preparation of plates, development techniques Qualitative evaluation, Quantitative evaluation Instrumentation (adsorbents, solvents, sample application, scanning and documentation), applications. | |
| 10. | **Validation** of analytical methods as per U.S.P. | 1 |
| 11. | **Statistics & Statistical Quality control**<br>Normal distribution, t-test, F-test, linear regression correlation coefficient, confidence limits. | 3 |
| 12. | **Sampling procedures**<br>Objectives, different kinds of samples, sampling plan, sampling schemes, sampling equipments, methods of statistical analysts as applied to sampling and interpretation of results. | 3 |
| 13. | **Thermal methods of analysis**<br>Theory, introduction, instrumentation, factors affecting analysis, pharmaceutical applications of: **Thermogravimetry (TG), Differential thermal analysis (DTA), Differential Scanning Calorimetry (DSC).** | 5 |

**Reference Books:**


1. Skoogh-Principals of Instrumental Analysis, 4th edition, Saunders College Publishing, 1992, USA.
2. Browning Chromatography, 1969, Mc Graw Hill, London.
3. Willard H. H., L. L. Merrit & John A. Dean-Instrumental Method of Analysis 6th edition, 1986, CBS Publishers & Distributors, New Delhi.
4. Beckett & Stenlake-Practical Pharmaceutical Chemistry, 4th edition, 1988, CBS Publishers & Distributors, India.
5. I.P., U.S.P., B.P. European Pharmacopeia.

6. James W. Munson-Pharmaceutical Analysis, Modern methods, Marcel Dekker Inc. 1981, USA.

## PHARMACOGNOSY III 3 hrs/week

**Drug mentioned in bold are or detailed study**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Alkaloids: Chemistry, Classification and occurrence of alkaloid in general. Detailed study of the following plants containing alkaloids **Ephedra,** Colchicum, cocoa, & **tea,** coffee, lobelia, tobacco, belladonna, **datura** stramonium, hyoscyamus, **cinchona**, **opium**, ashwagandha, **ipecac**, **rauwolfia**, vinca, **nux vomica**, **vasaka**, aconite, **kurchi**, pilocarpus, cola, coca, pepper, curare, alkaloids, ergot.<br><br>Biosynthesis of lysergic acid, opium alkaloids, tropane, alkaloids, colchicines, emethine, quinine. | 12 |
| 2. | Occurrence structure and applications of following Glycosides<br>a) **Anthroquinone**- Rubia, cochineal, **aloes**, hyperieum, cascara, andira, **senna**, **rhubiarb**.<br>b) **Isothiocyanate**- Brassica<br>c) **Cyanogenetic**- Almonds, wild cherry<br>d) **Napthoquinone**- Plumbago, alkanna, **henna**, walnut<br>Biosynthesis of aloe emodin, amygdaline, juglone. | 6<br><br>2 |
| 3. | Brief introduction to Plant allergens<br>Definition, classification (inhalant, injectant, infestants etc.) with example. Plants causing hay fever & dermatitis, mould causing allergy. | 2 |
| 4. | Sources, preparation and uses of following enzymes:<br>Papain, bromelain, malt extract, serratiopeptidase, urokinase, streptokinase, pepsin.<br>Study of lectins and snake venom, Preparation of polyvalent antivenins | 3 |
| 5. | Study of following herbs as health food (Neutraceuticals):<br>Alfaalfa, arnica, apricot, pits, bran, chamomic, chicory, cucumber, fenugreek, onion, garlic, gentian, hydrocotyle, hibiscus, hops, honey, marigold, amla. Ginseng, ashwagandha, ginko biloba, spirulina, gymnema, momordica, tinospora. | 3 |
| 6. | Occurrence, composition, preparation and uses of following drugs of mineral origin:<br>Diatomic, chalk, bentonite, talc.<br>Study of sulphur containing naturally occurring compounds (sulphide, thiophenes). | 2 |

**Reference Books:**


1. Trease D. & Evans W.C; Textbook of Pharmacognosy; W. B. Saunders.
2. Tyler V. E. Brady L. R. & Robbers J. E.; Pharmcognosy; Lea Feibger, USA.

3. Wallis I. E. Textbook of Pharmacognosy; CBS Publishers, Delhi.
4. Kokate C. K. Purohit A. P. & Gokhale S. B. Pharmacognosy: Nirali Publications, Pune.
5. Harbone J. B. Phytochemical Methods: A guide to modern techniques of Plant Analysis Chapmann & Hall, London.
6. Bruncton J. Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited.
7. Vasudevan I. N. & Buddha K. S. A textbook of Pharmacognosy, Vrinda Publication House, Jalgaon.
8. The Indian Pharmacopeia. The Controller of Publication Delhi.
9. Brain K. R. & Furner L. D. The Practical Evaluation of Phytopharmaceuticals Wright Sceintica, Bristol.
10. Lyenger M. A. & Nayak S. G. Anatomy of Crude Drugs: Manipal Power Press, Manipal.
11. Lyenger M. A. Pharmacognosy of Powdered Drugs: Manipal Power Press, Manipal.
12. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan.
13. Wagner, Bladi & zagainskit: Plant Drug Analysis: Springer Verlag.
14. Khandelwal K. R.: Practical Pharmacognosy Techniques and Experiments: Nirali Prakashan, Pune.
15. Vasudevan L. N. Laddha K. S.: Practical Pharmacognosy: New Vrinda Publishing House, Jalgaon.

**PHARMACEUTICS VI** **3 hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Introduction to sterile dosage forms<br>Parental products<br>• Various routes of parental administration, pyogens, vehicle,- WFI preparation, purity, storage and distribution, vehicles other than WFI, additives in parental products, types of formulations, freeze drying , containers- glass and plastics- types and evaluation, concept of FFS, rubber closures and testing, personnel, facilities- layout, environmental control cleanliness classes, air handling (HVAC systems), HEPA filters, laminar flow, production procedures, QA & QC- sterility test, pyrogen/ endotoxin test, particulate evaluation, leaker test. | 12 |
| 2. | Ophthalmic products<br>• Anatomy and physiology of eye – lachrymal system, tears, precorneal tear film, cornea, ocular bioavailability, types of ophthalmic products- solutions, suspension, ophthalmic ointments and gels, preservatives and efficacy test, additives, QA and QC sterility test, clarity, particle size for suspension, tests on ointments and collapsible tubes, packaging.<br>• Contact lens solutions: types of lenses-cleaning solution, disinfection solution, lubricants, multipurpose solutions and packages. | 8 |
| 3. | Oral sustained and controlled release systems<br>• Advantages of SR systems, biopharmaceutical consideration and | 8 |

| | | |
|---|---|---|
| | dose calculation of drug, properties of drug with reference to the design of oral SR systems, matrix and reservoir type of systems, dissolution controlled systems, diffusion controlled systems, ion exchange controlled systems. | |
| 4. | Stability studies<br>• Kinetic principles, Arrhenius equation and derivation of shelf life based on Arrhenius equation, limitations and advantages equation, degradation pathways- hydrolysis, oxidation , photolytic degradation, methods to enhance stability studies, introduction to ICH guidelines. | 8 |

**Reference Books:**


1. Pharmaceutical dosage forms: Parental medications, Vol. I, II, III, ed. by Kenneth A. Avis, Leon Lachman and H. A. Liberman, Marcel Dekker Inc., 1986.
2. Pharmaceutics The Science of dosage form design ed. by M. E. Aulton, 2nd ed., Churchill Livingstone, 2002.
3. Modern Pharmaceutics, 4th ed. Revised and Expanded ed. by Gilbert S. Banker and Christopher T. Rhodes, Marcel Dekker INC., 2002.
4. The theory and practice of industrial pharmacy, ed. by Leon Lachman, H. A. Liberman, J. I. Kanig, 3rd ed., Verghese Publishing house, 1987.
5. Remington, The science and practice of Pharmacy, 21st ed., Vol. I and II, B. L. Publications Pvt. Ltd., 2005.
6. Ophthalmic drug delivery, ed. by Ashim K. Mitra, 1993, Marcel Dekker INC.
7. Turco and Kings, Sterile Dosage forms, 3rd Edn., Lea & Febiger, Philadelphia, 1985.
8. Michael J. Akers, Quality Control of Parenterals, Marcel Dekker
9. "Controlled drug delivery – Fundamentals and Applications", Robinson Joseph R., Lee Vincent H., Vol. 29, Marcel Dekker Inc.


## BIOPHARMACEUTICS AND PHARMACOKINETICS 3 hrs/ week

| Topic | Hours |
|---|---|
| Introduction to the subject of biopharmaceutics and Pharmacokinetics. Emphasis on the importance in drug discovery, development and clinical pharmacy. | 1 |
| Definitions, different mechanisms of drug transport, physiology of cell membrane and passage of drugs across cell membrane. | 2 |
| Modified pH partition theory and its limitations. Zero v/s first order transport. | 2 |
| Rate limiting steps in drug absorption, Theories of dissolution, Physicochemical factors affecting the bioavailability of drugs. | 2 |
| Physiology of GH and oral bioavailability Formulation, dosage form related factors and physiological factors affecting oral bioavailability | 2 |
| Different routes of drug administration as alternative to oral route Factors affecting bioavailability of drugs from parental routes e.g. insulin zinc suspension | 2 |
| Dissolution rate and methods of enhancing dissolution rate. Official and unofficial methods of dissolution. Application to different dosage forms | 2 |

| | |
|---|---|
| In vitro in view correction and its significance | 1 |
| Distribution Definition relationship of drug transport to distribution process, perfusion limitation permeability limitation. Plasma protein and tissue protein binding, introduction to the concept of volume of distribution and factors affecting distribution. | 3 |
| Elimination, Definition, introduction to elimination via metabolism and excretion Hepatic clearance drugs, first pass effect and dependence of hepatic extraction ratio. Introduction to renal clearance and factors affecting renal clearance. | 3 |
| Pharmacokinetics: Introduction to compartmental and physiological models. Introduction to the compartmental open model and its assumptions. | 1 |
| Mathematical treatment of Pharmacokinetics upon IV bolus dosing and extravascular dosing. Importance of volume of distribution. Clearance, elimination rate constant, half life, absorption rate constant, bioavailability. Introduction of the concept of area under the curve, the trapezoidal rule and the method residuals Introduction to the rate method and sigma minus method for urine analysis for IV. | 9 |
| Introduction to method for estimating bioavailability and bioequivalence. | 2 |
| Discussion of linear and nonlinear kinetics and description of factors resulting in non linear kinetics. | 2 |
| Application of PK principles through simple problems. | 2 |

**Reference Books:**


1. Brahmankar, D. M. Jaiswal, Sunil B., "Biopharmaceutics and Pharmacokinetics: a treatise", 1st Edition, 1995, Vallabh Prakashan, Delhi.
2. Banakar, Umesh, "Pharmaceutical Dissolution Testing", Volume 49, Marcel Dekker Inc., New York, 1992.
3. Malcom Rowland, Thomas Tozer, "Clinical Pharmacokinetics: Concept and Application", 3rd Edition, 1996. A Lea-Febiger book, B. L. Baverly Books Pvt. Ltd. USA.
4. Robert E. Notari, "Biopharmaceutics and Pharmacokinetics An Introduction", 1971, 4th Edition, Marcel Dekker Inc., New York.
5. Leon Shargel, Susanna Wu-Pong, Andrew B. C. Yu. "Applied Biopharmaceutics & Pharmacokinetics" 5th Edition, 2005, Singapore.
6. Milo Gibaldi, "Biopharmaceutics Clinical Pharmacokinetics" 4th Edition, 1991, USA.


## PHARMACOLOGY IV — 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Drugs acting on central nervous system<br>• Aliphatic alcohols<br>• General anaesthetics<br>• Local anaesthetics<br>• Sedative-hypnotics & anxiolytic agents<br>• Antidepressants<br>• Antipsychotics | 18 |

| | | |
|---|---|---|
| | • Drugs used in Neurodegenerative disorders<br>- Antiparkinsons<br>- Drugs used in Alzheimer's disease<br>• Analgesics, antipyretic and anti-inflammatory drugs<br>• CNS stimulants & Psychotomimetic drugs<br>(Convulsions and respiratory stimulants, Psychomotor stimulants and Psychotomimetic drugs) | |
| 2. | Autocoids<br>- Histamine, Antithistaminics<br>- 5 HT and Antagonists<br>- Kinins, Ecosonides, Cytokines, PAF | 6 |
| 3. | Pharmacotherapy of Bronchial asthma | 2 |
| 4. | Immunology – Regulation of Immune system physiological and pathological states, Signaling Pathways for activation and inhibition, Immunology of diseases like HIV and Cancer and their modulation & Immunomodulators. | 6 |
| 5. | Principals of toxicology<br>- Heavy metal poisoning and its treatment<br>- Pesticide poisoning and its treatment<br>- Opium alkaloid poisoning and its treatment | 4 |

**Reference Books:**


1. Goodman & Gilman's Pharmacological Basis of Therapeutics – Joel G. Hardman, Lee E, Limbird, Alfred Goodman Gillman 11th Edition, The McGraw Hill Companies Inc., 2001.
2. Satoskar, R. S. Bhandarkar S. D. & Rege N. N. Pharmacology & Therapeutics 20th Edition, Popular Prakashan, 2007.
3. Rang & Dale Pharmacology – 5th Edition, Churchill Livingstone, 2003.
4. Lippincott's Illustrated Reviews: Pharmacology – Lippincott Raven 3rd Edition Howland & Nycets Publishers N Y, 2006.
5. Lewis Pharmacology – By Crossland – 5th Edition, Churchill Livingstone.
6. Laurence D. R. & Bennet Clinical Pharmacology – 9th Edition, Elsevier, N Y, 2006.
7. Kulkarni, S. K. Handbook of Experimental Pharmacology, 3rd Edition, Vallabh Prakashan, New Delhi, 2005.
8. B. G. Katzung - Basic and Clinical Pharmacology 9th Edition Appleton and Lange publication, 2004.
9. Gosh M. N. – Fundamentals of Experimental Pharmacology, 3rd Edition, Hilton & Company, Calcutta, 2005.


## PHARMACOLOGY LABORATORY II — 4 hrs/ week

| S. No. | Topic |
|---|---|
| 1. | Experiments<br>Bioassay of<br>- Acetylchoine |

| | |
|---|---|
| | - Histamine |
| 2. | Demonstration<br>- bioassay of oxytocin<br>- bioassay of pancuronium (With Graph or Actual) |
| 3. | Demonstration/ Simulated CD's<br>- To study the CNS depressant activity of chlorpromazine on locomotor activity of mice using actophotometer<br>- To study the effect of diazepam on the muscle grip strength of mice using rota-rod apparatus.<br>- Analgesic effect of asprin using analgesiometer<br>- To study phenothiazine induced catatonia in rats and to study anticatatonic (antiparkinsons) effect of scopolamine<br>- To study the anticonvulsant property of diazepam on pentylene tetrazole induced convulsions in mice **or** anticonvulsant effect of phenytoin against maximal electroshock induced convulsion in mice |
| 4. | Toxicity studies (CPCSEA, OCED guideline)<br>- brief introduction to acute, subacute and chronic toxicity studies. |

**Reference Books:**


1. Kulkarni, S. K. Handbook of Experimental Pharmacology – 3rd Edition Vallabh Prakashan New Delhi, 2005.
2. Gosh M. N. Fundamentals of Experimental Pharmacology, 3rd Edition, Hilton & Company, Calcutta, 2005.
3. S. B. Kasture. A Handbook of Experiments in Pre-Clinical Pharmacology- 1st Edition, Career Publications, 2006.
4. W. L. M. Perry, Pharmacological Experiments On Isolated Preparations, 2bnd Edition, E & S Livingstone, Edinburgh & London, 1970.
5. Websites: Indian Journal of Pharmaceutical education and research, Vol. 41 (1) Jan-Mar, 2007; 52-61. (www.ipper.org )


**PHARMCEUTICAL CHEMISTRY LABORATORY – II** **4 hrs/ week**

1. Synthesis of heterocyclics: a) Benzimidazole from 0-phenylenediamine, b) 4-methyl carbostyril from Acetoacetanilide.
2. Perkin reaction: Cinnamic acid from benzaldehyde
3. Claisen/ Aldol Condensation acid from benzaldehyde.
4. Benzilic acid rearrangement: Benzilic acid from benzyl.
5. Holfmann rearrangement: Anthranilic acid from Phthalimide.
6. Reduction reaction: PABA from p nitrobenzoic acid.
7. Esterification: Benzocaine from PABA.
8. Condensation: Phenytoin.
9. Multistep reaction: Sulfanilamide from acetanilide.

## PHARMACOGNOSY LABORATORY II 4 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Morphology, microscope and chemical test for identification of cinchona, vasaka, ephedra, kurchi, datura, nux, vomica, senna, rauwolfia, ipeca. | 8 |
| 2. | TLC analysis:<br>1) Alkaloids of nux vomica cinchona<br>2) Glycosides of senna/ aloe | 2 |
| 3. | Morphological identification of drugs covered in theory (alkaloids and glycosides) any 20 samples | 2 |
| | **Total** | **12** |

## PHARMACEUTICS LABORATORY IV

1. Preparation and monographic testing WFI (IP)
2. Processing & testing of glass containers & rubber closures (as per IP)
3. Preparation and documentation of following:

A) Injections (official)

- Sodium chloride and Dextrose injection
- Calcium gluconate injection
- Ascorbic acid injection
- One injection with oily vehicle
- One suspension injection

B) Ophthalmic preparations

- Sulphacetamide eye drops
- One Antibiotic eye ointment
- Contact lens solution

4. Calculation of Pharmacokinetic parameters (plasma samples provided)

## SYLLABUS COPY FOR FINAL YEAR B. PHARM.
## SEMESTER VIII

**Pharmaceutical Medicinal Chemistry – IV** **3 hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| | Discussion of the following classes of drugs including, classification, chemical nomenclature, structure including stereochemistry, generic names, chemistry, physicochemical properties, SAR. Metabolism, molecular mechanism of action, and synthesis, introduction to rational development if any of the class of drugs: | |
| 1. | **CNS Drugs**<br>1. Sedatives and hypnothics (mephobarbital, Phenobarbital pentobarbital, secobarbital, diazepam, nitrazepam*. Oxazepam. Alprazolam. Midazolam, cholorodiazepoxide, choral hydrate, gluthethimde*, zolpidem, zopiclone)<br>2. Anticonsulvants (Phenobarbital, chlordizepoxide, diazepam, clonazepam*, phenytoin, trimethadione, paramethadione, ethosuximide*, phenosuximide, primidone, sodium valproate, carbamazepine*, progabide, lamotrigine, vigbatrin<br>3. Antipyschotics (chlorpromazine*, triflupromazine, thioridazine, fluphenazine, chlorprothixene, loxapine, clozapine, haloperidol*, droperiodol, risperidone*, pimozide, molindone<br>4. Antianxiety agents (meprobamate, tybamate, hydroxyzine, buspirone)<br>5. Antidepressants (imipramine, chlorimipramine, amitryptyline, nortriptyline, doxepine*, fluoxetine*, paroxetine, trazodone, iproniazid, pargline, isocarboxazide, tranylcypromine)<br>6. Antiparkinsons (carbidopa*, levodopa, selegiline, amantadine, bromocriptine, benzotropine*, procyclidine, trihexyphenidyl, orphenadrine)<br>7. Analgesics (opioids) (morphine, codeine, levophanol, dextromethorphan, phenazocine, pentazocine, meperidine*, α- and β-prodine, pheniridine, anileridine, fentanyl, methadone*, phenadoxone, racemoramide, dextropropoxyphene*, nalorphine, naloxone, naltrexone) | 5<br>5<br>5<br>1<br>5<br>2<br>7 |
| 2. | NSAID's (aspirin, paracetamol, phenylbutazone*, oxyphenbutazone, indomethacine, sulindac, mefenamic acid, ibuprofen, naproxen*, ketoprofen, nabumetone, diclofenac*, nimesulide, celecoxib, rofecoxib, piroxicam*, colchicines, sulfinpyrazone, allopurinol). | 6 |
| | * indicates synthesis to be discussed | |

**Reference Books:**


1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 11th Ed., Eds., John H Block and John M Beale, Lippincott Williams & Wilkins, 2004.
2. Foye's Principles of Medicinal Chemistry, Eds., T. L. Lemke and D. A. Williams, Williams & Wilkins, Baltimore, 2002.
3. Medicinal Chemistry, Ashutosh Kar, 4th Edition, New Age International Publishers, 2007.
4. The Art of Drug Synthesis, Eds., Douglas S Johnson and Jie Jack Li, Wiley Interscience, 2007.
5. Pharmaceutical Chemistry, Vol. 1: Drug Synthesis, Eds., H. J. Roth, A. Kleeman, and T. Beissewenger, Ellis Horwood Ltd., 1988.
6. The Organic Chemistry of Drug Synthesis, Daniel Lednicer, Vols. 1 to 7, Wiley.


## PHARMACEUTICAL ANALYSIS V — 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | **Atomic absorption and Emission spectroscopy**<br>Principle, difference between atomic absorption spectroscopy and flame emission spectroscopy, Instrumentation- Radiation sources, Flame atomization (types of flames, flame structure, flame atomizers), single and double beam spectrophotometers, advantages and disadvantages, Pharmaceutical applications. | 3 |
| 2. | Nuclear Magnetic Resonance Spectroscopy<br>Introduction, Phenomenon (Spinning nucleus, effect of an external magnetic field, precessional motion, precessional frequency, energy transitions), theory, Chemical shift and its measurement (factors influencing chemical shift-shielding, deshielding, Vander Waals deshielding, anisotropic effect. e.g. alkanes, alkenes, carbonyl, aromatic and cyclohexane), solvents used in NMR (Choice of solvents, solvent shifts-concentration, temperature, hydrogen bonding effects), Spin-spin coupling constants and splitting (splitting of NMR signals, theory, coupling, constants, multiplicities, of signal, chemical and magnetic equivalence), spin-spin decoupling, Instrumentation (Magnets, magnetic field sweep, radiofrequency oscillator, receiver, recorder and integrators, applications. | 6 |
| 3. | **Mass spectrometry**<br>Introduction, Basic principles, Instrumentation (single focusing and double focusing mass spectrometer, quadrupole mass spectrometer GC-MS, HPLC-MS), Electron impact, chemical ionisation, Field ionisation mass spectrometry, fast atom bombardment spectrometry), base peak, Molecular ion, metastable ions, Fragmentation processes, Applications. | 6 |
| 4. | **Radiochemistry and Radiopharmaceuticals-**<br>Fundamentals of radioactivity (radionuclide, Isotope, radioactive, decay, | 5 |

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| | half-life of radionuclide, specific activity, Bccquerel, Curie), Properties of radiation, Radiation protection, measurement of radioactivity (Geiger-Muller counter, liquid scintillating counting, gamma scintillation detector), Radiopharmaceuticals (Properties of radionuclide, pharmaceutical properties, chemical properties), 99m Tc generator, Quality control of radiopharmaceuticals (Physical, chemical and sterility control, radionuclide purity and radiochemical purity), Isotope dilution analysis. | |
| 5. | **Near IR spectroscopy-**<br>Introduction, Principles, Advantages, Qualitative measurements- NIR overtone bands of organic functional groups, Quantitative absorption-Absorbance measurements, diffuse reflectance measurements, Instrumentation- Radiation source, Wavelength selection, Detectors, Sample interface, Sample preparation, pharmaceutical applications of NIR. | 3 |
| 6. | **X-Ray methods-** Introduction, Instrumentation, identification of crystalline compound, X-ray powder diffraction, Bragg reflections, diffraction methods, Pharmaceutical analytical applications. | 3 |
| 7. | **Structural elucidation problems based on UV, IR, NMR, Mass spectroscopy (simple problems with molecular formula given).** | 8 |
| 8. | **Hyphenated Techniques-GC-MS, LC-MS (Interfaces and Applications only).** | 2 |

**Reference Books:**


1. Skoogh-Principles of Instrumental Analysis, 4th edition, Saunders College Publishing, 1992, USA.
2. Browning- Chromatography, 1969, McGraw Hill, London.
3. Willard H. H., L. L. Merritt & John Dean-Instrumental Method of Analysis, 6th edition, 1986, CBS Publishers & Distributors, India.
4. Beckett & Stenlake-Practical Pharmaceutical Chemistry, 4th edition, 1988, CBS Publishers & Distributors, India.
5. I.P., U. S. P., B. P., European Pharmacopoeia.
6. William Kemp-Organic Spectroscopy, 3rd edition, Reprinted 2005, Palgrave Publishers Ltd., New York.
7. Clive Whiston-Analytical Chemistry by open learning, 1987, John Wiley & Sons New York, Toronto.


## PHARMACOGNOSY IV — 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | **Glycosides**<br>Saponin glycosides (**liquorice**, quillaia, **asparagus**, ginseng, dioscorea, agave, fenugreek, bacopa, hydrocotyle, alpine, smilax *Acacia concinna, sapiandus*) | 6 |

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|---|---|---|
| | Cardiac (**digitalis**, strophanthus, squill, nerium, thevetia)<br>Biosynthesis of steroidal glycoside molecule. | |
| 2. | Volatile oils: with respect to sources, composition & preparation of volatile oils and uses.<br>Umbelliferous fruits (anise, caraway, **dill,** ajowan, **fennel**, **coriander**), **clove, cardamom, cinnamon,** *Saussurea lappa*, **eucalyptus,** sandalwood, star anise, patchouli oil, lemongrase, winter green, palmrosa, rose, abolmescus, rasana, nutmeg, lemon peel oil, orange peel oil, spearmint oil and peppermint oil, jatamansi, valerian, artmesia, vetiver. | 9 |
| 3. | Resins **turpentine,** cannabis hops, (**Colophony**, niyrrh, shellac, benzoin, **balsams (tolu, peru), turmeric, guggulu, ginger,** colocynth, guaiacum, **asafetida,** capsicum. | 4 |
| 4. | Flavonoids<br>Quercetin, Rutin, hesperidin & Flavonoids from orange peel powder. | 2 |
| 5. | Phenylpropanoids & Lignans<br>Podophyllum, psoralea, Ammi majus, phyllanthus | 2 |
| 6. | Polyketides – male fern, podophyllum | 1 |
| 7. | Terpenoids & iridoids (Structure, occurrence and uses)<br>Quassia, piccrorhiza, tinospora, Artemisia, taxus, carrot, gentian, chirata, andrographs | 4 |
| 8. | Biosynthesis of terpenoids (mono, sesqui, di and triterpenoids) (skeleton only) | 2 |
| 9. | Phytotoxins<br>*Abrus precatorius, aconite, belighia sapida*, curare, datura, lily of the valley, ergot, poison hemlock, poison ivy, yew, mushrooms, psoralea. | 2 |
| 10. | Introduction to marine Drugs<br>Cytotoxins with any two examples. | 2 |
| 11. | Special aspects of preparation of Ayurvedic formulations and herbal formulations.<br>Preparation and Evaluation of plant extracts and formulations with respect to phytoconstituents. | 2 |

**Reference Books:**


1. Trease D. & Evans W. C.: Textbook of Pharmacognosy; W. B., Saunders.
2. Tyler V. E. Brady L. R. & Robbers J. E.: Pharmacognosy; Lea Feibger, USA.
3. Wallis T. E.: Textbook of Pharmacognosy; CBS Publishers, Delhi.
4. Kokate C. K. Purohit A. P. & Gokhale S. B.: Pharmacognosy; Nirali Publications, Pune.
5. Harbone J. B.: Phytochemical Methods: A guide to modern techniques of Plant Analysis: Chapman & Hall, London.
6. Bruneton J.: Pharmacognosy, Phytochemistry, Medicinal Plants; Intercept Limited.
7. Vasudevan T. N. & Laddha K. S.: A Textbook of Pharmacognosy, Vrinda Publication House, Jalgaon

8. The Indian Pharmacopoeia: The Controller of Publication; Delhi.
9. Brain K. R. & Turner T. D.: The Practical Evaluation of Phytopharmaceuticals: Wright, Scientica, Bristol.
10. Iyenger M. A. & Nayak S. G.: Anatomy of Crude Drugs: Manipal Power Press, Manipal.
11. Iyenger M. A.: Pharmacognosy of Powdered drugs: Manipal Power Press, Manipal.
12. Kokate C. K.: Practical Pharmacognosy: Vallabh Prakashan.
13. Wagner, Bladi & Zgainski: Plant Drug Analysis; Springer Verlag.
14. Khandelwal K. R.: Practical Pharmacognosy Techniques and Experiments; Nirali Prakashan, Pune.
15. Vasudevan T. N., Laddha K. S.; Practical Pharmacognosy; New Vrinda Publishing House, Jalgaon.

## PHARMACEUTICS VII — 3 hrs/ week

Note: References to latest amendments of schedule M and Schedule U of Drugs and Cosmetics Act 1940 to be made wherever it is appropriate.

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Quality assurance (discuss specimen documents)<br>Raw material control, actives and inactive, in process control, sanitization, environmental and microbiological control, packaging and labeling control, finished product control, standard operating procedures, cGMP. Q. C. standards of identity, purity, quality and potency, Q. C. Charts, sampling & sampling plans. | 8 |
| 2. | Documentation – need/ importance, batch manufacturing records, SOPs, Maintenance & Retrieval of Documents. | 3 |
| 3. | Pilot plant scale up techniques – group's responsibilities, facilities, example of scaling up of manufacturing of tablets, liquids and semisolids. | 5 |
| 4. | Validation – Definition, Types, Qualification<br>Process Validation – steps & documentation (Brief), Examples – Raw Materials, mixing and granulation, mixer, granulator, Validation of sterilization process and equipment – microbial death kinetic terms, F Value applications, steps for validating steam sterilization method | 5 |
| 5. | Production management<br>Pharma industry – current scenario<br>Site selection and development – factors to be considered in designing a facility, layout of manufacturing facilities, environmental aspects, materials of construction, equipment selection, handling of components and containers, vendor audit, warehousing, maintenance and service aspects, Personnel – qualifications, selection, responsibilities & training. Materials management, sales forecasting, inventory control, production planning, elements of cost & cost controls. | 8 |
| 6. | Factory Layout- considerations/ steps, Examples of Typical layout schemes for Tablets, capsule, liquids, sterile formulations manufacturing areas. | 4 |

**Reference Books:**


1. The theory and practice of industrial pharmacy, ed., by Leon Lachman, H. A. Liberman, J. L. Kanig, 3rd ed., Verghese Publishing house, 1987.
2. The science and practice of Pharmacy, 21st ed., Remington, Vol. I and II, B. L. Publications Pvt. Ltd., 2005.
3. Cole, Graham, "Pharmaceutical Production Facilities: Design and Application", 1990.
4. Pharmaceutical Process Validation, 2nd Edition, Nash Robert A. Berry Ira R. Volume 57, 1992, Marcel Dekker Inc., New York.
5. Pharmaceutical dosage forms; parenteral medications, Vol. I, II, III, ed., by Kenneth A. Avis, Leon Lachman and H. A. Liberman, Marcel Dekker INC., 1986.


## NOVEL DRUG DELIVERY SYSTEMS 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Oral Controlled Drug Delivery Systems-<br>a) Multiparticulate drug delivery systems (Pellets)- need and significance of pelletization, techniques- pan coating, extrusion and spheronization, equipments, evaluation<br>b) Osmotic Systems- Basic principles, classification, oral osmotic pumps, applications & evaluation<br>c) Gastroretentive drug delivery systems (GRDDS)-<br>Regional variability in intestinal absorption and concept of absorption window, Design of GRDDS technologies- low density (Floating systems), Swelling and expanding systems, Mucoadhesive systems, high density systems, Evaluation of GRDDS. | 2<br><br><br><br>1<br><br>2 |
| 2. | Mucoadhesive drug delivery systems-<br>Mucoadhesion and theories, factors influencing mucoadhesion, *in vitro-in vivo* methods to study mucoadhesion, bioadhesive polymers and systems. | 4 |
| 3. | Ocular drug delivery systems<br>Limitations of conventional systems, ophthalmic insects-nonerodible and erodible inserts, pilocarpine ocular insert, Lacrisert, SCDI, Minidisc, NODS, polymers, particulates, enhancers, intraocular solutions, ocular iontophoresis, evaluation. | 6 |
| 4. | Transdermal drug delivery systems (TDDS)<br>Skin and skin permeation, modes of percutaneous penetration, components of TDDS, different types of TDDS and release control mechanisms, production, evaluation of PSA and TDDS – *in vitro, in vivo.* | 6 |
| 5. | Introduction to targeting, Passive and active targeting | 1 |
| | a) Targeting to lymphatic systems<br>Anatomy of lymphatic system, lymphatics in intestine, factors enhancing intestinal drug uptake, approaches, prodrug and delivery systems examples, parental drug administration for lymphatic transport | 2 |

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|---|---|---|
| | b) Liposomes<br>Structural components and classification, methods of preparation, size reduction, characterization, stability, applications.<br>c) Drug targeting to brain<br>The blood brain barrier, transport through blood brain barrier, factors affecting drug permeation through BBB, strategies for brain drug delivery<br>d) Nanoparticles<br>Preparation techniques, characterization, biodistribution, evaluation and applications.<br>e) Colonic targeting- Physiology of colon, difficulties in colonic targeting, approaches- prodrug, pH sensitive polymers, polysaccharides, time release systems, osmotic systems, azo polymers, evaluation. | 2<br><br>1<br><br>2<br><br>3 |

**Reference Books:**


1. Advances in controlled and novel drug delivery, ed. by N. K. Jain, CBS publishers and distributors, 2001.
2. Modern Pharmaceutics, 4th ed. Revised and Expanded ed. by Gilbert S. Banker and Christopher T. Rhodes, Marcel Dekker INC., 2002.
3. Targetted and controlled drug delivery, Novel carrier systems, S. P. Vyas and R. K. Khar, CBS publishers and distributors, 2002.
4. Controlled and Novel drug delivery, ed. by N. K. Jain, CBS publishers and distributors, 1997.
5. Controlled drug delivery, concepts and advances, S. P. Vitas and R. K. Khar, Vallabh Publishers, 2002.
6. The theory and practice of industrial pharmacy, ed. by Leon Lachman, H. A. Liberman, J. L. Kanig, 3rd ed., Verghese Publishing house, 1987.
7. The science and practice of pharmacy, 21st ed., Remington, Vol. I and II, B.L. Publications Pvt. Ltd., 2005.
8. Bioadhesive Drug Delivery Systems- Fundamentals, Novel Approaches, and Development, Mathiowitz Edith, Chickening III, Donald E., Lehr Claus-Michael, Volume 98, Marcel Dekker INC, New York, 1995.
9. Nanoarticulate Drug Delivery Systems, Thassu Deepak, Dellers Michael, Pathak Yashwant, Volume 166, Marcel Dekker Inc., New York, 2007.
10. "Microencapsulation Methods and Industrial Applications", Benita Simon, 2nd Edition, Marcel Dekker Inc., New York, 2006.
11. Controlled and Novel Drug Delivery, Jain N. K. 1st Edition, CBS Publishers and Distributors, New Delhi, 2004.
12. "Targeted and Controlled Drug Delivery- Novel Carrier Systems", Vyas S. P. Khar R. K., 1st Edition, CBS Publishers and Distributors, New Delhi, 2002.
13. Ophthalmic Drug Delivery Systems, Mitra, Ashim K., Volume 58, Marcel Dekker Inc., New York, 1993.
14. "Encyclopedia of Pharmaceutical Technology, Swabrick, Boylan, Volumes 1,6,8,9,10,12,13,14,15,16,17,18,19,20." Marcel Dekker Inc., New York.
15. Oral Mucosal Drug Delivery, Rathbone Michael J., Volume 74, 1996, Marcel Dekker Inc., New York, 1996.

**FORENSIC PHARMACY AND JURISPRUDENCE** **3 hrs/ week**

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Historical perspective including details of Chopra Committee and Hathi Committee | 1 |
| 2. | An objective study of the following Acts mearporating the latest amendments Pharmacy Act 1948<br>• Definition<br>• PCI and State Councils, Composition and Function<br>• Preparation of Registers and qualifications for entry into registers<br>• Educational Regulation and Approval of Courses and Institutions<br>• Offences and Penalties | 5 |
| 3. | Drugs and Cosmetic Act 1945<br>• Definitions<br>• Advisor bodies DLAB and DCC Composition and function<br>• Drug Control Laboratories and Government Analysts<br>• Drug inspectors, Licensing Authorities, Controlling Authorities and Customs Collectors<br>• Provisions Governing Import, Manufacture and Sale of Drugs.<br>• Labeling and Packaging of Drugs<br>• Provisions applicable to manufacture and Sale of Ayurvedic Drugs<br>• Provisions Governing Import, Manufacture and Sale of Homeopathic Drugs.<br>• Various offences and corresponding Penalties<br>• Broad content of various Schedules of the Drugs and Cosmetic Act and Rules. | 14 |
| 4. | Drugs and Magic Remedies (Objectionable Advertisements) Act 1954.<br>• Definitions, Prohibited Advertisement, Savings. | 2 |
| 5. | Narcotic Drugs and Psychotropic Substances Act<br>• Definitions<br>• Narcotics Commissioner and other officers<br>• Illicit Traffic and measures to prevent illicit traffic of opium.<br>• Offences and corresponding penalties. | 2 |
| 6. | Drug Price Control Order 1995 and new Drug Policy | 2 |
| 7. | Medicinal ad Toilet Preparations (Excise Duties) Act.<br>• Definitions, restricted and unrestricted preparations<br>• Manufacturing in bond and outside bond | 2 |
| 8. | Prevention of Food Adulteration Act 1954<br>• Definitions<br>• Central board of food standards, central food laboratory, compositions and functions<br>• Public analysis and food inspectors | 2 |
| 9. | Indian Patents Act 1975 | 2 |

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|---|---|---|
| 10. | Bombay Shops and Establishments Act<br>• Definitions and Provisions | 1 |
| 11. | Factories Act 1954<br>• Definitions and Provisions | 1 |
| 12. | Indian Penal Code and Code of Criminal Procedures<br>• Provisions pertaining to different Courts, jurisdiction and power<br>• Provisions governing entry, search, arrest, bailable and non-bailable offences, Cognizable and non-cognizable offences | 1 |
| 13. | Insecticides Act<br>• Definitions<br>• Procedure for licensing and registration of Insecticides<br>• Savings | 1 |

**Reference Books:**


1. "Forensic Pharmacy", Kuchekar and Kadtare and Itkar, Nirali Prakashan, 5th edition, 2005.
2. "Textbook of Forensic Pharmacy" N. K. Jain, Vallabhprakashan, 4th edition, 1999.
3. D & C Acts, 1940 and Rules, 1945, S. W. Deshpande and Nilesh Gandhi, Sumit Publishers 2006, Mumbai.
4. Govt. of India Publication of above Acts and Rules.


## CLINICAL PHARMACY AND DRUG INTERACTION 3 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Concept of clinical pharmacy, community pharmacy and hospital pharmacy (definition, scope and objectives) | 6 |
| 2. | Concept of therapeutic drug monitoring and patient compliance | 6 |
| 3. | Role of Pharmacist as a patient councilor | 3 |
| 4. | Rational use of drugs<br>- Drug- drug interactions – possible mechanisms and examples<br>- Drug interaction with food, alcohol, tobacco<br>- Adverse drug reactions – Types and examples<br>- Detection and Prevention of ADR<br>- Drugs used in geriatrics, pediatrics and pregnancy<br>- Irrational drug combination<br>- Dose adjustment in renal and hepatic dysfunction | 16 |
| 5. | General Introduction to drug discovery and development Pre-Clinical Stages<br>Clinical development – phases of clinical trials<br>Commercial Aspects | 5 |

**Reference Books:**


1. Clinical Pharmacy Dr. Tipnis, Dr. Bajaj, 1st Edition, Career Publications, 2003.

2. Clinical Pharmacology- P. N. Benett, M. J. brown, 9th Edition, Churchill Livingstone, 2006.
3. Text Book of Clinical Pharmacy Practice- G. Parthisarathi, Karin Nyfort Hansen, Milap C. Nahata, Orientlongman, 2004.
4. Clinical Pharmacy and Therapeutics- Roger Walker, Clive Edwards, 3rd Edition, Churchill Livingstone, 2003.

## PHARMACEUTICS LABORATORY V — 4 hrs/ week

1. S. R. oral tablets- use of hydrophobic and hydrophilic matrix materials (monolithic and reservoir) - preparation and *in vitro* release evaluation.
2. Dissolution testing – Marketed formulations of conventional tablets – soluble drug & poorly soluble drug (selection of medium)
3. Ophthalmic DDS- Mucoadhesive gel and evaluation.
4. Accelerated stability testing of any suitable drug/ formulation
5. Demonstration of sugar and film coating of tablets.
6. Microencapsulation by coacervation phase separation technique of a liquid (volatile oil) & a solid (Charcoal/ Paracetamol), evaluation of the products.
7. SR suppositories- PEG base and Hydrogel base- evaluation of *in vitro* release.

## PHARMACOGNOSY LABORATORY III — 4 hrs/ week

| S. No. | Topic | Hours |
|---|---|---|
| 1. | Macroscopy- microscopy of liquorice, clove, fennel, dill, cardamom, cinnamon, coriander, quassia, kalmegh, picrorrhiza, asparagus. | 8 |
| 2. | Extraction and detection of phytoconstituents of following classes (Any two examples of each class)<br>Flavonoids, glycosides (liquorice), volatile oils (clove, fennel, anise, dill) | 2 |
| 3. | Qualitative analysis of unorganized drugs as covered drugs as covered in theory (asafetida, myrrh, benzoin, guggul, and aloes). | 2 |
| 4. | Microscopic evaluation of Ayurvedic churna formulation & analysis of total tannins from Triphala churna. | 1 |
| 5. | Morphological identification of drugs covered in theory (volatile oils and glycosides) any 20 samples | 1 |
| | **Total** | **14** |

**PHARMACEUTICAL ANALYSIS LABORATORY III** **4 hrs/ week**

1. Determination of pka 1 and pka 2 of phosphoric acid.
2. Determination of HCl and phosphoric acid in a given mixture potentiometrically.
3. Assay of paracetamol tablets, propanolol tablets, albendazole tablets, Rifampicin capsules as per I. P.
4. Assay of quinine sulphate by fluorimetry.
5. Study of quenching effects of iodide ions on fluorescence of quinine sulphate.
6. Assay of phenylephrine hydrochloride ophthalmic solution by difference spectroscopy.
7. Assay of caffeine and sodium benzoate injection by simultaneous equation method and absorbance ration method.
8. Assay of trimethoprim in cotrimoxazole tablets as per I. P.
9. Assay of nifedipine and atenolol tablets by UV.
10. Determination of streptomycin base colorimetrically from Injection.
11. Identification of sample by TLC.

**Demonstration experiments:**

1. Assay of sample by HPLC/ HPTLC/ GC.
2. Qualitative analysis by I. R.
3. Determination of K+ from KCl by flame photometry.
4. Selection of mobile phase for TLC.
5. Identification of amino acids by paper chromatography.