

SYLLABI OF BACHELOR OF PHARMACEUTICAL SCIENCES

SECOND YEAR B. PHARMACY

2.1 (T) PHYSICAL PHARMACY

(Theory: 90 Hrs.; 3 Hrs./Week)

Top ic No	SECTION-I	Hrs.
1	Intermolecular Forces and gaseous state of matter: Binding forces between molecular gaseous state, Deviation from gas theory, Compressibility factor, Vander Waal equation for real gases, correction for pressure and volume, Law of Corresponding state,(only equation) critical constant and their determination, Liquefaction of gases: Linde's process, Claude's process, application of liquefaction to Aerosols i.e. principle of aerosols, 2 phase and 3 phase Systems.	07
2	Phase Rule: Gibbs phase rule, one component (Water), two components, and three components system.	05
3	Solid State: Crystallization, factors affecting crystallization, crystal size, Methods of crystal analysis: X-Ray Diffraction, Bragg's Method and powder method; Polymorphism: Definition, Different shape of polymorphs, Example and its application to pharmacy, Mention Detection techniques. Glass transition temperature and thermodynamic principles involved. Note: Problems only using Bragg's Equation to calculate 'd' and 'n'	06
4	Colloids: Introduction and types, optical, kinetic and electrical properties of colloids, Protective colloids, stabilization of colloidal system, DLVO theory, Schulz Hardy rule, Hoffemeister series, Application in pharmacy. Importance of thermodynamic principles in solubilization.	08
5	Solution of Non-electrolytes and Electrolytes: Properties and types of solutions, ideal and real solutions, various concentration terms, Raoult's law and it's deviations, boiling point and boiling point diagram, Colligative properties: elevation of boiling point, depression of freezing point, and osmotic pressure, problems involving molecular weight determinations, Solution of electrolytes: equivalent and specific conductance, conductometric titration, Arrhenius theory, Debye Huckel Theory, Colligative properties of electrolytes.	10
6	Solubility and Distribution Phenomenon: Solute solvent interactions, Solubility of Gases in liquids, liquid in liquids and solids in liquids, factors affecting solubility, solubility of slightly soluble electrolytes, solubility of weak electrolytes, influence of pH, solvents, solubility parameter and combined effect of pH and Solvents, Distribution phenomenon: Nerst distribution law and its limitations, Effect of ionic dissociation and association, application in Pharmacy. Solubility parameter and BCS classification. Solubility and thermodynamic principles (No derivation required)	10
SECTION-II		
7	Surface and Interfacial Phenomenon:	10

	Surface and interfacial tension, Surface free energy, measurement of surface and interfacial tension, spreading coefficient, adsorption at liquid- interfaces, surfactants (Types, HLB scale and its applications including wetting, foaming anti-foaming, and micellar solubilization), soluble monolayer and Gibbs equation, insoluble monolayer and film balance, adsorption at solid interfaces, adsorption isotherms, (Langmuir and Freundlich), Measurement of surface free area, Electrical Properties of interfaces: Nerst and Zeta Potential., Electrical double layer.	
8	Rheology: Fundamentals of rheology, Types of flow, quantitative measurement of flow, Methods of viscosity measurements, mechanical model to illustrate flow on viscoelasticity, thixotropy, measurement of thixotropy in formulation, rheology of disperse system, pharmaceutical application of rheology.	07
9	Chemical Kinetics and Stability: Reaction theories, rate, order and molecularity, mathematical treatment of zero, first and second order, complex reaction: reversible, parallel and side reactions, steady state and rate determining step, determination of order, Effect of temperature, Arrhenius equation and energy of activation, meaning of stability of pharmaceuticals, kinetic aspects of chemical degradation of drugs, understanding of statistical aspect of expiry period, degradation pathways, physical & chemical instability & evaluation methods, Accelerated stability studies	10
10	Micromeritics: Introduction and pharmaceutical importance, particle size and distribution, particle shape, particle volume, particle number, surface area, methods for determining particle size, particle volume measurement, specific surface, method for determining surface area, derived properties of powder: porosity, packing arrangement, densities, bulkiness, flow properties of powder, angle of repose, factors affecting flow of powder.	09
11	Diffusion and dissolution: Steady state diffusion: Fick's laws of diffusion, steady state, concept and importance of dissolution, USP dissolution test. Dissolution model like Hixson Crowell, Higuchi model, Korsmeyer-Peppas etc. Drug release modeling through polymer matrix & laminates.	08

Recommended Books

1. Martins Physical Pharmacy and Pharmaceutical Sciences, 5/Ed., Patric J. Sinka, Lippincott Williams and Wilkins
2. Essentials of Physical Chemistry by B. S. Bahl, G. D. Tuli, Golden Jubilee Ed., S. Chand and Company
3. Essentials of Physical Chemistry and Pharmacy, H. J. Arnikar, S. S. Kadam, K. N. Gujar, Orient Longman Pvt. Ltd, India
4. Pharmacy Review by Leon Shargel, Wiley Medical Publication, New York
5. Textbook of Physical Pharmacy, Vol. II, 3/Ed., K. L. Kapoor, McMillan India Ltd
6. Principles of Physical Chemistry Physical Chemistry, 4/Ed., Samuel H. Marlton, Carl F. Frultoon, Oxford and IBH publishing Co. Pvt. Ltd., New Delhi
7. Physical Pharmacy by Dr. U.B. Hadkar, Nirali Prakashan, 8/Ed, Mumbai

8. Textbook of Physical Pharmaceutics by C.V. S. Subrahmanyam, 2/Ed, Vallabh Prakashan, New Delhi
9. Theory and Practice of Industrial Pharmacy by H A Liebermann, Leon Lachman and J B Schwartz
10. Physical Pharmacy, by Martin, Swarbrick and Cammarata Indian Edition, Varghese Publishing House, Mumbai
11. Remington's The Science and Practice of Pharmacy, 21/Ed. Vol I & II, Lippincott Williams and Wilkins
12. USP/NF The Official Compendia of Standards, 2004 Asian Ed, United State Pharmacopoeial Convention
13. Text Book of Physical Chemistry, by Samuel Glasstone, McMillan India.
14. Walter John Moore's Physical Chemistry by London Longman.

2.1 (P) PHYSICAL PHARMACY **(Practical: 90 Hrs.; 3Hrs./Week)**

I. Chemical Kinetics:

1. First order Kinetics
 - a. Determination of degree of hydrolysis of given ester
 - b. Determination of relative strength of two acids
 - c. Determination of degree of hydrolysis of Urea hydrochloride
 - d. Determination of order of reaction by equal fraction method
2. Second order Kinetics
 - a. To find Degree of hydrolysis of second order reaction when $a=b$
 - b. To Verify Ostwald's dilution law for Second order reaction
3. Determination of energy of activation of acid hydrolysis of methyl acetate

II. Surface Tension:

- a. Determination of surface tension of given liquid
- b. Determination of critical micelle concentration of a surfactant by stalagmometer.

III. Determination of HLB of Glyceryl Monostearate

IV. Determination of Specific Surface area of charcoal by adsorption method.

V. Viscosity:

- a. Determination of viscosity of given liquid
- b. Determination of composition of binary mixture by viscosity method.

VI. Phase Rule

- a. Determination of Critical solution temperature of Phenol water system
- b. Determination of plate point of three-component system

VII. Distribution co-efficient:

- a. Determination of partition coefficient of iodine between carbon tetrachloride and water
- b. Determination of partition coefficient of benzoic acid between water and benzene **VIII.**

Determination of particle size distribution of any material by

- a. Sieve analysis
- b. Microscopy

IX. Polarimetry:

- a. Determination of specific rotation of optically active substance and also its concentration in sample
- b. Kinetic of inversion of cane sugar

X. Conductivity:

- a. Determination of normality of given acid by conductometric titration
- b. Verification of Ostwald's dilution law by conductometry.

XI. Determination of **molecular weight** of a substance by Rast's Camphor or Ebullioscopic method.

Recommended Books:

1. Handbook of Practical Physical Pharmacy and Physical Pharmaceutics by U. B. Hadkar, Nirali Prakashan, 4/Ed., 2007, Pune
2. Practical Physical Pharmacy by H.N. More and A. A. Hajare, Career Publication. 1/Ed, 2007, Nashik
3. Practical Physical Pharmacy by Gaud and Gupta, Nirali Prakashan
4. Essentials of Physical Pharmacy, by Madan and Tuli, S. Chand & Company, New Delhi
5. Martin's Physical Pharmacy and Pharmaceutical Sciences, 5/Ed. by Patric J. Sinka, Lippincott Williams and Wilkins, 2007
6. Essentials of Physical Chemistry and Pharmacy. H. J. Arnika, S. S. Kadam, K. N. Gujar, Orient Longman Pvt. Ltd, India,
7. Practical Physical Pharmacy, Gurtoo and Kapoor.

2.2 (T) PHARMACEUTICAL MICROBIOLOGY & IMMUNOLOGY
(Theory: 90Hrs.; 3 Hrs. /Week)

Top ic No	SECTION-I	Hrs.
1	Introduction to Microbiology: Scope and applications to pharmaceuticals, Whittaker's five kingdom concept, classification of microbes into bacteria, rickettsia, actinomycetes, fungi, protozoa, algae and viruses. Historical developments- contributions of Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch and Paul Ehrlich.	05
2	Microscopy: Principle and applications of compound, Dark- field, phase contrast and fluorescence microscope. Different parts of compound microscope, resolving power, magnification power, numerical aperture and working distance. Electron microscopy-SEM and TEM	04
3	Biology of microorganisms: a) Bacteria: Size, shape, structure, cell wall, capsules, spores, flagella and other parts of bacteria. Reproduction, growth, growth requirements, growth curve, culture media, measurements of bacterial growth, counting methods, colony characteristics, methods for isolations. Identification and preservation of microbial cultures. Characteristics of <i>Staphylococcus</i> , <i>Pseudomonas</i> , <i>Salmonella</i> and <i>Escherichia</i> . b) Yeasts and moulds: Introduction, characteristics and applications of <i>Saccharomyces cerevisiae</i> , <i>Candida albicans</i> , <i>Penicillium</i> and <i>Aspergillus</i> . Dermatophytes. c) Rickettsia: Introduction and study of disease causing Rickettsia. d) Actinomycetes: Isolation, identification and importance in antibiotic production. e) Viruses: Introduction, general properties, structure, bacteriophage- lytic	15 04 01 03 06

	growth cycle and lysogeny. Human viruses - cultivation and multiplication. Introduction to tumor and Human Immunodeficiency virus.	
4	Microbial Spoilage and Preservation of pharmaceutical products: Types of microbial spoilage, Factors affecting the microbial spoilage of pharmaceutical products, Sources and types of microbial contamination, Microbial standards for non-sterile pharmaceuticals, Assessment of microbial contamination and spoilage, Microbial limit tests, Preservative efficacy test: challenge test	06
SECTION-II		
5	Sterilization: Different methods - dry heat, moist heat, gaseous, radiation and filtration. Sterilization monitors, D-value, Z-value., Sterility testing of pharmaceutical products as per I.P	07
6	Disinfections: Chemical classification of different disinfectants, dynamics and factors affecting on disinfectant action and selection of disinfectants, methods used for evaluation of disinfectant, Phenol coefficient test.	05
7	Aseptic Techniques: Designing of aseptic area, sources of contamination in aseptic area, and methods of prevention, laminar air flow.	04
8	Microbial assays: Importance, assay of antibiotics (Penicillin and Streptomycin) and Vitamin B ₁₂ . MIC	03
9	Immunology: a) Fundamentals of Immunology: Microbial flora, host-microbe interactions, microbial virulence, exotoxins, endotoxins. Defense mechanisms of host – specific and nonspecific. Types of Immunity. Immune response, antigens, antibodies, monoclonal antibodies- production and applications. b) Antigen - Antibody reactions: Introduction, precipitation, agglutination, compliment fixation, neutralization reactions, immunofluorescence and ELISA and other tests. c) Hypersensitivity reactions: Introduction, Immediate and delayed hypersensitivity, type I, II, III, IV hypersensitivity d) Preparation of vaccines and sera: Introduction, manufacturing and quality control. Preparation of vaccines (BCG, TAB, DPT, Polio, MMR and Rabies), toxoids (Tetanus and Diphtheria) and sera (antibacterial, antiviral, antitoxin and antivenum). Preparation of allergic extracts and diagnostics.	11 04 04 08

Recommended Books

1. Anathnarayan R. and Panikar C. K. J., (2000). Textbook of Microbiology, 6/Ed., Orient Longman.

2. Aulton M. E., *Pharmaceutics-The Science of Dosage Form Design*, Churchill Livingstone, 1998
3. Baird, R.M., et al. (eds.), *Handbook of Microbiological Quality Control – Pharmaceutical and Medical Devices*. Taylor and Francis Inc., London, 2000.
4. Carter S. J., *Copper and Gunn's Tutorial Pharmacy*, CBS Publishers and Distributors, Delhi, 1996.
5. Collee J. G. et al, *Mackie and McCartney Practical Medical Microbiology*, Fourteenth Edition, Churchill Livingstone Publications, New York, 1996.
6. Hugo W. B. and Russell A. D. *Pharmaceutical Microbiology*, 6/Ed., Blackwell Science, 1998.
7. Kokare C. R., *Pharmaceutical Microbiology-Principles and Applications*, 6/Ed., Nirali Prakashan, Pune, India, 2008.
8. *Indian Pharmacopoeia*, Govt. of India, Ministry of Health and Family Welfare. 1996 & 2007.
9. Pelczar M. J. et al., *Microbiology*, 5/Ed., McGraw Hill, New York, 1986.
10. Rawlins E. A., (eds.), *Bentley's Textbook of Pharmaceutics*, 8/Ed., Bailliere Tindall, London, 1992.
11. Akers M. J., *Parenteral Quality Control*, 2/Ed., Marcel Dekker Inc., New York 1994
12. Brooks. G.F, Butel. J. S., Morse. S. A, Jawetz, Metrics, & Adel bergs *Medical Microbiology*, 21/Ed., Appleton & Lange Publication, United State of America, 1989
13. Maloy. S. R., Cronan. J. E., *Microbial Genetics*, 2/Ed., Narosa Publishing House, New Delhi, 2006.
14. Ingraham.J. L , Ingraham C. A. , *Introduction to Microbiology*, 2/Ed., Thomson. Brooks Cole, U.S., 2000
15. Wiley M. Sherwood L. M., Woolverton C. J. Prescott, Harley & Klein's *Microbiology*, 7/Ed., McGraw Hill International Edition, 2008.
16. Frobisher M, HinsDill. R. D, Crabtree K.T., Good Heart. C. R, *Fundamentals of Microbiology*, 9/Ed., Saunders Company, Japan, 1974.
17. Casida. L.E., *Industrial Microbiology*, 2/Ed., New Age International

2.2 (P) PHARMACEUTICAL MICROBIOLOGY & IMMUNOLOGY **(Practical: 90 Hrs.; 3 Hrs./Week)**

1. To study the principle and working of laboratory equipments.
2. Preparation and sterilization of nutrient broth, nutrient agar, slants, stabs and plates.
3. To study different techniques of Inoculation of cultures.
4. Isolation of pure culture by streak plate technique.
5. Isolation of pure culture by pour plate technique.
6. Study of *Aspergillus*, *Penicillium* and *Candida* species with respect to morphology (wet mount technique).
7. Observation of motility of bacteria by hanging drop technique.
8. Identification of isolated bacteria by simple, negative, Gram, acid fast and spore Staining

9. Determination of microbial count of air by any suitable method.
10. Determination of thermal death temperature and time
11. Phenol coefficient of disinfectant.
12. Sterility testing of different pharmaceutical products.
 - a. Injections
 - b. Ophthalmic preparations
13. Antibiotic assays- Penicillin and Streptomycin.
14. MIC (minimum Inhibitory concentration)
15. Study of microbial limits of following as per I.P.
 - a. Aluminum hydroxide gel.
 - b. Starch.
16. Isolation of microbes from soil for production of antibiotics and enzymes.
17. Microbial study of water by TPC, MPN and IMViC.

Recommended Books

1. Baird, R.M., et al. (eds.), (2000). Handbook of Microbiological Quality Control – Pharmaceutical and Medical Devices. Taylor and Francis Inc., London.
2. Cappuccino, J. G. and Sherman N., (1992). Microbiology- A Laboratory Manual, Third Edition, The Benjamin / Cumming Publishing Company.
3. Kokare C. R. (2007). Pharmaceutical Microbiology-Experiments and techniques, Second Edition, Career Publications, Nashik, India
4. Carter S. J., (1996). Copper and Gunn's Tutorial Pharmacy, CBS Publishers and Distributors, Delhi.
5. Collee J. G. et al., (1996). Mackey and McCartney Practical Medical Microbiology, Fourteenth Edition, Churchill Livingstone Publications, New York.
6. Hugo W. B. and Russell A. D., (1998). Pharmaceutical Microbiology, Sixth Edition, Blackwell Science.
7. Indian Pharmacopoeia, (1996 & 2007). Govt. of India, Ministry of Health and Family Welfare.
8. Rawlins E. A., (eds.), (1992). Bentley's textbook of Pharmaceutics, Eighth Edition, Bailliere Tindall, London.
9. Akers M. J., (1994). Parenteral Quality Control, Second Edition, Marcel Dekker Inc., New York.
10. Collins C. H. et al (1998). Microbiological Methods, Seventh Edition, Butter worth-Heinemann Ltd.

2.3 (T) PHARMACEUTICAL BIOCHEMISTRY (Theory) 90Hrs. (3 Hrs. /week)

Top ic No	SECTION-I	Hrs.
1	Introduction to Biochemistry: Scope of the subject in Pharmaceutical Sciences, Biochemical reactions, Highlights of Prokaryotic and eucaryotic cell metabolism.	03
2	Biochemical Morphology: Prokaryotes, cell structure sub cellular	04

	components: Nucleus and Plasma membrane, Endoplasmic reticulum, lysosomes, peroxisomes, golgi apparatus, mitochondria.	
3	Biomembranes: Structure and composition, model proposed, function and properties of membrane, transport hypothesis: Active and Passive, facilitated transport, Na ⁺ , K ⁺ , H ⁺ pumps. Glucose transport, excitable membrane.	05
4	Biomolecules: - Proteins: Introduction, functional classification. Amino acids: Classification, Physicochemical properties, optical activity, reaction with ninhydrin, formaldehyde, R-group amino acids. Essential, non-essential amino acids, deficiency. Structure: Peptide bond, end group analysis. α Helix, β sheet structure. Tertiary, Quaternary structure, Globular Protein, Fibrous protein, and medicinally important amino acids. Carbohydrates: Complex carbohydrates, Structure of chitin, starch glycogen. Lipids: Definition, Classification, Functions, Types of fatty acids and its biological role.	08
5	Enzymes: Introduction, Classification, (according to the reaction catalysis and sources) Structure of enzymes, co-factor, active sites Km, Vmax, Double reciprocal plot, effect of active substrates, pH ionic strength, conc., temperature on rate of enzymes reactions. Enzyme inhibition (Competitive, Non-competitive, irreversible). Concept of antimetabolites. Manufacturing of medicinal compounds by enzymatic reactions. Penicillin acylase for the production of 6-APA acid. Therapeutic uses of enzymes.	08
6	Metabolism: Bioenergetics: Concept of free energy, standard free energy, high energy, biological compounds, ATP Phosphorylation, Carbohydrate metabolism. Anaerobic pathways of glucose metabolism, two phases of glycolysis. Alcohol fermentation, energy balance, gluconeogenesis, homeostasis of blood, Pentose Phosphate pathways: Significance and role in RBC. Citric acid cycle: Aerobic pathway of glucose metabolism, TCA cycle. Lipid metabolism: Oxidation of fatty acids, formation of ketone bodies, biosynthesis of fatty acids and cholesterol, HDLP, LDLP, Clinical significance. Protein metabolism: Importance of protein in diet. Digestion of proteins, oxidative degradation of amino acids, Transamination, urea formation, Catabolism of various keto acids formed during oxidative amination of amino acids. (Structures are not required.). Biosynthesis of one aromatic amino acid and aliphatic amino acid, metabolism of purine, pyrimidine, porphyrins.	12
SECTION-II		
7	Nucleic acids: Chemical composition, as genetic material nucleosides, structure, biochemical function, replication, flow of genetic information, transcription, translation, genetic code, gene, genome gene expression, genetic disorder DNA recombination.	07
8	Nutrition: Concept of balanced diet, principle nutrients, nutritional diseases, role of crude fiber, Energy metabolism: BMR.	03
9	Vitamins: Structure and biochemical function of fat-soluble and water-soluble vitamins.	06
10	Acid-base balance and mineral metabolism: Concept of body fluids, regulation of electrolyte, acid-base balance. Mineral metabolism of calcium, iron and iodine.	06
11	Clinical Biochemistry	
11.1	Laboratory management, record keeping, collection and preservation of	03

	sample. Handling of hazardous samples, chemicals. Common instruments of clinical laboratory.	
11.2	Different terms to express clinical values, protein, enzyme, hormones, minerals, pH etc. Limits of different clinically important substances.	07
11.3	Liver function Test.	02
11.4	Kidney Function Test.	02
11.5	Genetic disorders of carbohydrate, fat protein and nucleic acid metabolism.	04
11.6	Advance diagnostic techniques PCR, Radio immuno assay, ELISA, DNA finger print, Immunofluorescence, biosensors such as glucometer etc..	05
11.7	Marker enzymes and their diagnostic applications like lactate dehydrogenase, acetylcholinestrace, phosphatase, amylase etc.	05

2.3 (P) PHARMACEUTICAL BIOCHEMISTRY

(Practical: 90 Hrs.; 3 Hrs/Week)

1. Isolation of DNA and Characterization by Electrophoresis.
2. Protein isolation techniques & identification methods
 - Isolation of milk casein
 - Separation of protein by electrophoresis and gel chromatography
 - Biuret test, UV method and Lowry's method for protein identification.
3. Estimation of Total Proteins, albumin, Cholesterol, Triglycerides, LDL, HDL, Bilirubin, SGOT, SGPT, S. Alkaline Phosphates. S. Acid Phosphatase, Electrolytes such as Na, K, Cl, Uric acid, Vitamins, Sugars, Urea and Creatinine (16 exercises)
4. Isolation of starch from potato, isolation of egg albumin.
5. Abnormal constituents from urine: Proteins, sugars, Ketone bodies, bile salts and bile pigments.
6. Gastric Juice Analysis: Bound and free.

Recommended Books for Theory & Practicals

1. Lehninger's Principles of Biochemistry by Albert Lehninger, 4/Ed., Palgrave Macmillon.
2. Biochemistry by Lubert Stryer, W.H., Freeman & Company, New York.
3. Harper's Illustrated Biochemistry by R.K. Murray & D.K. Granner, 27/Ed, McGraw Hill.
4. An Introduction to Practical Biochemistry by David Plummer, 3/Ed, Tata McGraw-Hill Edition.
5. Varley's Practical Clinical Biochemistry by Harold Varley, 6/Ed., CBS Publishers, New Delhi.
6. Molecular Biology by J.D. Watson, The Benjamin/Cummings Company Inc.
7. Pocket Comparison to Robbins & Cortran Pathologic Basis Disease by Robbins, Cortran, Kumar, 7/Ed, Elsevier.
8. Clinical Biochemistry by Herold Varley, CBS Publishers, New Delhi.
9. Text Book of Biochemistry with Clinical Correlations by Thomas & Devlin, A Wiley Medical Publication.

10. Clinical Chemistry Interpretation and Techniques by Alex Kaplan Lavernel L. & Szebo Kent E. Opheim Published Lea and Febiger.
11. Laboratory Medical Technology by Prafulla Godkar.
12. Text Book of Pathology by Harsh Mohan, 5/Ed., Jaypee Brothers Medical Publishers (P) Ltd.
13. Clinical Biochemistry by S. P. Dandekar 2/Ed
14. Pathophysiology of Disease by Mephee & Lingappa, 2/Ed., Appleton & Lane.
15. Pharmaceutical Biochemistry by Sharma P.K & Dandiya P.C, Vallabh Prakashan.
16. Human Biochemistry by Jamam, Orten.
17. Methods in Enzymology, Academic Press.

2.4 (T) PHARMACEUTICAL ORGANIC CHEMISTRY–II
(Theory: 90 Hrs; 3 hrs./Week)

Topic No	SECTION-I	Hrs
1	Stereochemistry: Geometrical isomerism, E & Z nomenclature, optical isomerism, chirality, Diastereomerism, R & S nomenclatures, Fischer representation, Resolution of Racemic modification. Conformational isomerism, Newman and Sawhorse representation, conformational isomerism in ethane and n-butane, conformations of cyclohexane, monoalkyl and dialkyl cyclohexanes, conformation in decalin. Conformation and chemical reactivity and the use of these in configuration as illustrated by reactions in ring A of steroids, additions, eliminations, epoxide opening, reduction of Ketones, relative rate of esterification and oxidation of epimeric alcohol. Atropisomerism in ortho substituted Biphenyls and allenes, Stereo selective and stereo specific reactions.	20
2	Chemistry of carbohydrates: Introduction, Classification and reactions of C ₅ and C ₆ sugars and cyclic structures/glycosides. Mutarotation, Establishment of structures of monosaccharides, disaccharides and starch by chemical methods.	15
3	Chemistry of amino acids: Methods of peptide synthesis- solution and solid phase peptide synthesis (up to pentapeptide), Structure of natural amino acids, isoelectric point. Methods of preparation of amino acids. Peptide bonds, structures of some biologically and medicinally important simple peptides.	05
4	Introduction to Combinatorial Chemistry: History, Multiple Parallel Synthesis, Chemistry and equipments, Mixture synthesis Strategies including solid supported synthesis, Deconvolution methods.	05
SECTION-II		
5	Organic synthesis by retro synthesis: Introduction to common terms. Disconnections involving one and two functional groups, Rules of disconnection, The retro-synthesis of following drugs be covered: Ibuprofen, Propranolol, Losartan, Ciprofloxacin and Sulfamethoxazole.	10
6	Molecular Rearrangement reactions: Rearrangement of electron deficient systems, migration to oxygen, nitrogen, and carbon, Mechanism and stereochemistry of Bayer-Villiger and Dakin oxidations, Wagner, Merewin rearrangements, Wolf and related rearrangements, Pinacol-Pinacolone rearrangement, Beckman, Curtius, Lossen, Hoffman and Schmidts rearrangements. Rearrangements of electron rich system inclusive of Stevens' Witting. Sommet, Favoroski, Neber and Benzilic acid rearrangement. Willgerodt reaction, Cope rearrangement. Rearrangement to aromatic	20

	nucleus including mechanism of Fries, Claisen and N-Halormide rearrangement..	
7	Chemistry of heterocyclic compounds: Structures and numbering and corresponding drugs of the following Heterocyclic compounds: furan, thiophene, pyrroie, pyrazole, thiazole, imidazole, oxazole, isoxa/ole, hydantoin, pyridine, pyridazine, pyrimidine, indole, benzyl furan, benzylthiazole, benzimidazole, benzoxazole, quinoline, isoquinoline, quinazoline, cinnoline, purine, xanthine, pteridine, Coumarin; Synthesis and Reaction of following compounds: furan, thiophene, pyrrole, indole imidazole, thiazole, pyridine, quinoline and isoquinoline	15

2.4 (P) PHARMACEUTICAL ORGANIC CHEMISTRY –II

(Practical: 90 Hrs./3Hrs/Week)

1. Qualitative analysis of binary mixtures

1.1 Solid-Solid mixtures (minimum 10)

1.2 High vacuum (fractional) distillation of liquid-liquid mixtures (minimum 2)

2.1 **Quantitative determination of reactive groups**, nitro, hydroxyl, primary and secondary amines, esters, amides and carbonyl.

2.2 Analysis of Fats and Oils

2.3 Acid value

2.4 Saponification value

2.5 Iodine value

2.6 Peroxide value

3. Chromatographic techniques

3.1 Column chromatographic separation of o & p- nitro aniline

3.2 Preparative thin layer chromatographic separation of regio isomers.

Recommended Books for Theory and Practicals

1. Stereochemistry of Carbon Compounds by E. L. Eliel, 32 reprint 2005, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
2. Stereochemistry of Organic Compound Principles and Applications by Nasipuri, Revised Edition, New Age International Publishers.
3. Advanced Organic Chemistry by E.S. Gould, 4/Ed. Wiley Eastern Edition.
4. Principles of Organic Synthesis by Norman, 3/Ed., Nelson Thorns Publication.
5. Organic Chemistry by Morrison & Boyd, 7/Ed, Pearson Education.
6. Heterocyclic Chemistry by Joule and Mill, 4/Ed., Blackwell Publishing Oxford.
7. Organic Chemistry by Fieser & Fieser, Vol. I-X, 1/Ed. Asia Publishing House.
8. Modern Hetrocyclic Chemistry By Leao Payrettee.
9. Organic Synthesis- The disconnection approach by Stuart Warren, John Wiley & Sons
10. Vogel's Textbook of Practical Organic Chemistry by A. I. Vogel, 5/Ed., Pearson Education.
11. Handbook of Organic Analysis (Qualitative and Quantitative) by H. T. Clarke, 1/Ed.,

Arnold-Heinemann.

12. Textbook of Practical Heterocyclic Chemistry by Fitten and Smalley.
13. Synthesis of Drugs-Synthone approach Vol. 1, by Radhakrishnan Ayer, J. R. Rao, M. S. Degani, S. A. Ghone, K. Mohanraj, 2/Ed, 2008, Sevak Publication Pvt. Ltd.
14. Quantitative organic Analysis by Siggas & Honna, 4/Ed., A Wiley Interscience Publication. John Wiley & Sons.
15. Organic Synthesis, Vol. I to X, John Wiley & Sons Ins. New York.

2.5 (T) PHARMACUTICAL ANALYSIS-I

(Theory: 60 Hrs; 2 Hrs./Week)

Topic No	SECTION-I	Hrs.
1	Aqueous acid base titration: - Acid base equilibria, Definition of acid and base, Acid-base dissociation constants for strong acid and base, weak acids and bases. Theory of buffer solutions, buffer index, preparation of standard solutions, acid base titration, titration curves theory of acid base indicators, Chemical Classification of indicators Non- aqueous titrations: Theoretical considerations, limitations, solvents and their Properties, titration of weak acids and bases, indicators in non-aqueous titrations, Pharmaceutical application according to official books as per I. P. and B. P.	12
2	Oxidation reduction titration: Theory of redox titration, redox reactions, redox curves, redox indicators, permanganate, iodine, cerriometric titrations, ceric ammonium, Nitrate and Sulfate, Potassium Bromate, Potassium Ioided titrations, Sodium Nitrate titrations Assay of Sulphanilamide. Titanous chloride titrations. Pharmaceutical applications as per official books.	10
3.	Polarimetry: Theory of optical activity, Polarization of light, measurement & production of polarized light, specific & molecular rotation; Linear, Circular and elliptically polarized light, Optical Rotatory Dispersion (ORD), Circular Dihroism (CD), Cotton Effect (CE), applications of ORD & CD, Instrumentation, Polarimeter & applications	4
4.	Conductometry: Introduction, measurement of conductivity, conductivity apparatus, conductometric titrations, applications of conductometric titrations & high frequency titrations	4
SECTION-II		
5.	pH and Potentiometry: Definition of pH, methods of pH determination, pH meter & its standardization, measurement of potential, potentiometric titrations and apparatus, applications of pH & Potentiometry	6
6	Theory of Complexometric titrations: Concept of complexation and chelation. Coordination Number, stability of complexes, factors affecting stability constants, Selectivity of complexometric titrations, types of EDTA titrations, Metallochromic Indicators. Mixture analysis, Pharmaceutical applications as per official books.	6
7	Precipitation titrations: Precipitation reactions, preparation of titration curve, Indicators used in precipitation titrations, (Mohr's, Volhards Kfajans, Gaylussacs methods), Pharmaceutical applications as per official books.	5
8	Gravimetric analysis: Theory, precipitation gravimetry, solubility product,	5

	Different types of precipitates, co-precipitation, post-precipitation, organic and in-organic precipitants. Pharmaceutical applications of gravimetric analysis.	
9	Organically bound metals and non-metals: Theory of oxygen flask combustion Technique, determination of organically bound iodine, mercury, (Non-staining iodine ointment, mersalyl. Nitrogen determination by Kjeldahl's method. Saccharin BP procedure.	4
10	Statistical techniques: definition of terms, mean, mode median, SD, percent CV. Statistical tests of significance, t test, F test, and Q-test, Classification of errors and means to minimize errors. Applications of all above tests to chemical data.	4

2.5 (P) PHARMACUTICAL ANALYSIS-I

(Practical: 90 Hrs.; Hrs/Week)

A. Instructions and Demonstration

1. Remarks and General Directions. Laboratory requirements: Laboratory Note-Book, match box, weighing bottle, calibrated fractional weight box, glass marking pencil, watch glass, butter paper, spatula, etc.
2. Introduction to lab equipments and basic lab operations: Use and care of glass wares and plastic wares, volumetric glass wares and nonvolumetric glassware, techniques of measuring, careful measuring of meniscus, use of rubber bulb for pipetting, use and care of Bunsen burner. Techniques for filtration, use of fluted filter paper, Lab reagents, proper storage and labeling, labeling of inflammable, corrosive, poisonous, photosensitive, volatile, and hygroscopic substances, Shelf life of lab reagents, safety measures, eye shower, and bath shower.
3. Laboratory techniques: Cleaning and drying of apparatus, including volumetric Apparatus, use of balance, precision of balance, sampling.
4. Discussion: Concepts of analytical reagents (AR, GR, LR etc.) purity and strength requirements, calculations, errors, rejection of results, significance

B. Experimental

1. Methods of Calibration: Pipettes, Burettes, Volumetric flasks, specific gravity bottles, set of weights
2. Preparation and standardization of secondary standard solutions
3. Assay of drugs by Acid-Base titration as per Official books
4. Assay of drugs by non-aqueous titration as per Official books
5. Assay of drugs by Complexometric titration as per Official books
6. Assay of drugs by precipitation titrations as per Official books
7. Assay of drugs by Redox titration as per Official books – Ceric ammonium sulphate/Nitrate titration
8. Assay of sulpha drugs by diazotization
9. Iodometric and iodimetric titration
10. One I.P. monograph for one raw material

11. Titanous chloride titration: preparation and standardization of titanous chloride solution, assay of indigo carmine.
12. Gravimetric determinations.

Recommended Books for Theory and Practicals

1. Vogel's Text Book of Quantitative Chemical Analysis, 6/Ed., Pearson Education.
2. Quantitative analysis by V. Alexyev, Student Edition, CBS Publisher & Distributors.
3. Fundamentals of Analytical Chemistry by Skoog, West, Holler, Harvest, 8/Ed., Thomson Brookscole.
4. Pharmaceutical Analysis by Higuchi, Reprint 2004, CBS Publisher & Distributors.
5. The quantitative analysis of drugs by Garrat DC, 3/Ed., CBS Publisher & Distributors.
6. Quantitative Analysis by Day R A & Underwood A L. 5/Ed., Prentice Hall of India Pvt. Ltd. New Delhi.
7. Analytical Chemistry by Christian G D, 6/Ed., John Wiley & Sons.
8. A Textbook of Pharmaceutical Analysis by Connors KA, 4/ed., John Wiley & Sons.
9. Practical Pharmaceutical Chemistry Part-I by Beckett A H & Stanlake J B, 4/Ed., CBS Publisher & Distributors.
10. Handbook of Instrumental Techniques for Analytical Chemistry by Frank Settle, First Indian Reprint 2004, Pearson Education
11. Pharmaceutical Analysis Vol. II & K. R. Mahadik, S.G. Wadodkar, H. N, I. More, Nirali Prakashan.

2.6 (T) PHARMACOGNOSY-I

(Theory: 90 Hrs; 3 hrs/Week)

Topic No	SECTION-I	Hrs.
01	General Pharmacognosy. a. History, definition and scope of pharmacognosy. b. Introduction to botanical system of classification. Banthum and Hooker, Royale, Miller, Linneus c. System of classification of crude drugs with examples.	08
02	Morphological and microscopical examination of crude drugs. a. Description, morphology and microscopy of followings, Leaves, Barks, woods, Inflorescences and Flowers, Fruits, Seeds, Subterranean organs. b. Cell differentiation and ergastic cell contents – the cell wall, parenchymatous tissue, Epidermis, Epidermal trichomes, stomata, endodermis, Cork tissue, chollenchyma, schleroids, fibers, xylem, phloem, secretary tissues, and ergastic cell contents	10
03	Principles related to commercial production of natural products a. Method of cultivation b. Environmental condition for production of crude drugs c. Plant growth regulators. d. Pest and pest control.	07

	<p>e. Collection of crude drugs</p> <p>f. Processing and drying of crude drug, various method of drying herbs materials and demerits.</p> <p>g. Storage condition and preservation</p> <p>h. Packaging and labeling.</p>	
04	<p>Adulteration: Adulteration, substitution, deterioration, method of adulteration, primary and secondary factor of adulteration.</p>	03
05	<p>Quality control of crude drugs:</p> <p>5.1 Necessity of Quality control of crude drugs</p> <p>5.2 Evaluation of organoleptic, Microscopic features of crude drug including quantitative microscopy, i.e.</p> <p>a. leaf constants</p> <p>b. length and width of fibers</p> <p>c. lycopodium spore method</p> <p>5.2 Physical evaluation parameters</p> <p>5.3.1 Determination of Moisture content</p> <ul style="list-style-type: none"> • Loss on drying • Karl Fischer method (Moisture content) • I.R. Balance • Toluene Distillation. <p>5.3.2 Extractive values</p> <p>5.3.3. Ash values</p> <p>5.3.4 Solubility, optical rotation, refractive index</p> <p>5.3.5 Foreign organic matter</p> <p>5.3.6 Crude fiber determination</p> <p>5.4 Chemical evaluation: Preliminary phytochemical investigation of crude drug</p>	12
SECTION-II		
01	<p>Introduction to primary and secondary metabolites Definitions, properties and classification</p>	03
02	<p>Extraction: Introduction, basic principles, conventional methods of extraction i.e. maceration, percolation, infusion, decoction, continuous hot extraction, types of extract</p>	04
03	<p>Carbohydrates:</p> <p>a. Classification and general chemistry of carbohydrates.</p> <p>b. Starches, and modified starches including manufacturing and characterization of Maize, Wheat, Rice, Potato, Arrow root, Tamarind Kernel powder, Tapioca starch.</p> <p>c. Inulin: Methods of preparation and uses.</p> <p>d. Cellulose: Wood cellulose and different derivatives of cellulose (Methyl cellulose, Ethyl cellulose, Carboxymethyl cellulose, sodium carboxymethyl cellulose, cellulose nitrate, cellulose acetate, cellulose acetate phthalate, hydroxypropyl, methyl cellulose).</p>	18

	e. Gums: Acacia, Tragacanth, sterculia gum, Ghati gum, Xanthum gum, Guar gum, locust-bean gum. f. Alginates and alginic acid g. Agar h. Carrageneenan i. Mucilage (Psyllium and Isapgol) j. Pectin	
04	Natural Sweeteners: Honey, Stevia, Abrus, Amacha (<i>Hydrangia macrophylla</i>)	03
05	Natural fibers: Cotton, Silk, Wool, Jute	02
06	Herbal dietary supplements: Arnica, Chamoline, cucumber, Fenugreek, Garlic, Onion, Spinach, Beet, Carrot, Ginseng, Tomato, Spirulina, Fewerfew, Astragalus, Melissa	05

Recommended Books

1. Trease and Evans: Pharmacognosy, 15/Ed., Saunders Company, London.
2. Tyler, Brady and Robbers: Pharmacognosy: CBS Publisher and Distributors, New Delhi
3. Wallis T. E.: Textbook of Pharmacognosy: CBS Publisher and Distributors, Delhi
4. Kokate, Purohit, Gokhale: Pharmacognosy: Nirali Prakashan, Pune.
5. Rangari: Pharmacognosy: Career Publications
6. Chemistry of Organic Natural Products by O. P. Agrawal, Goel Publication house
7. The Indian Pharmacopoeia, 1996 & 2007.
8. The British Pharmacopoeia.
9. M. A. Iyengar: Study of Crude Drug.
10. Martindale: The Extra Pharmacopoeia.
11. E. Ramstad: Modern Pharmacognosy: Mc Graw Hill Book Company, INC.
12. Kalia A. N: Industrial Pharmacognosy.
13. Mohammad Ali, Pharmacognosy.

2.7. (T) PHARMACOLOGY-I (Theory: 90 Hrs; 3 hrs/Week)

Topic No	SECTION-I (GENERAL PHARMACOLOGY)	Hrs.
01	Definitions, scope and general principles of pharmacology Nature and sources of drugs, drug nomenclature, Essential drug (medicine) concept	01
02	Detail discussion, merits and demerits of various routes of drug administration	02
03	Pharmacokinetics: Biological membranes- structure, types, properties and functions of biological membranes Physicochemical factors and processes in transfer of drugs across the biological membranes Drug absorption, Bio-availability, factors affecting drug absorption and bio-availability • Distribution, Metabolism (Biotransformation) and Excretion (Elimination) of drugs and factors affecting all these processes	13

	<ul style="list-style-type: none"> • Basic concept of Clinical Pharmacokinetics especially with reference to clearance, volume of distribution, half-life, bioequivalence and extent of bioavailability • Basic concepts and general discussion on nonlinear pharmacokinetics and therapeutic drug monitoring (TDM) 	
04	Pharmacodynamics: <ul style="list-style-type: none"> • Site and Mechanisms of drug action, structure activity relationship (SAR) • Drug Receptors- Basic discussion about receptors, classification and families of receptors, drug effects and regulation of receptors • Quantitation of drug receptor interactions and their effects, dose response relationships and therapeutic index 	07
05	Principles of Therapeutics: <ul style="list-style-type: none"> • Individualization of drug therapy: concept of drug summation, drug synergism, drug antagonism and its types • Adverse Drugs Reactions (ADR) and Drug Toxicity (Teratogenicity, carcinogenicity, mutagenicity), Iatrogenic Diseases • Drug Regulation and Development 	04
06	Gene Therapy: <ul style="list-style-type: none"> • Basic discussion on Gene transfer technologies, obstacles to gene therapy, viral vectors, non-viral DNA delivery strategies • Therapeutic Paradigms: Gene therapy for Inherited Disorders, Genetic Repair Strategies, Gene Inactivation Strategies, Ectopic Synthesis Therapeutic Proteins • Disease Targets for Gene Therapy 	06
07	Clinical Pharmacology: <ul style="list-style-type: none"> • Drug Treatment in Pediatric, Geriatric patients • Drug Treatment during Pregnancy and Lactation 	02
08	Pharmacology of drugs acting on blood and blood forming organs <ul style="list-style-type: none"> • Haemopoietics • Coagulants and Anticoagulants • Thrombolytics and Antiplatelet agents • Drugs used in Hyperlipidemias 	06
09	Pharmacology of Autacoids and their antagonists	03
	SECTION-II (PATHOPHYSIOLOGY)	
01	Cardiovascular System: <ul style="list-style-type: none"> • Pathophysiology of Hypertension, Ischemic Heart Disease (Angina and Infarction) • Pathophysiology of Congestive Cardiac Failure, Cardiac arrhythmias, Shock 	06
02	Respiratory System <ul style="list-style-type: none"> • Pathophysiology of Bronchial Asthma and Pneumonia. • Pathophysiology of Tuberculosis • Pathophysiology of Chronic Obstructive Airway Disease 	05

03	Digestive System: <ul style="list-style-type: none"> • Pathophysiology of Peptic Ulcer • Pathophysiology of Amoebic and Bacillary Dysentery • Pathophysiology of Hepatitis and Typhoid Fever 	05
04	Central Nervous System: <ul style="list-style-type: none"> • Pathophysiology of Epilepsy, Parkinsons and Alzheimers Disease • Pathophysiology of Psychosis • Pathophysiology of Schizophrenia and Depression 	07
05	Urinary System: <ul style="list-style-type: none"> • Pathophysiology of Urinary Tract Infections • Pathophysiology of Acute and Chronic Renal Failure 	05
06	Reproductive System: <ul style="list-style-type: none"> • Pathophysiology of Sexually Transmitted Diseases • Pathophysiology of AIDS 	05
07	Endocrine System: <ul style="list-style-type: none"> • Pathophysiology of Diabetes Mellitus 	02
08	Miscellaneous: <ul style="list-style-type: none"> • Pathophysiology of Malaria • Pathophysiology of Leprosy 	02
09	Pathophysiology of Malignancy	04
10	Pathophysiology of Allergy and Hypersensitivity	02
11	Pathophysiology of Pain and Inflammation	02

Recommended Books

1. Goodman and Gillman: Pharmacological Basis of Therapeutics, *McGraw-Hill, Medical Publishing Division, New York.*
2. Rang H.P. and Dale M.M.: Pharmacology, *Churchill Livingstone, Edinbergh.*
3. Katzung B.G.: Basic and Clinical Pharmacology, *Lange Medical Publications, California.*
4. Bowman W.C. and Rand M.J.: Textbook of Pharmacology, *Blackwell Scientific Publications, Oxford.*
5. Pradhan S.N., Maickel R.P. and Dutta S.N.: Pharmacology in Medicine-Principles and Practice, *S.P. Press International Inc., Maryland.*
6. Craig C.R. and Stitzel R.E.: Modern Pharmacology, *Little Brown and Co., Boston.*
7. Melman K.I. and Morelli H.F.: Clinical Pharmacology: Basic Principles in Therapeutics, *Macmillan Press, New York.*
8. Laurence D.R. and Bennett P.N.: Clinical Pharmacology, *Churchill Livingstone, Edinburgh.*
9. Bevan J.A. and Thompson J.H.: Essentials of Pharmacology, *Harper and Row Publishers, Philadelphia.*
10. Drill V.A.: Pharmacology in Medicine, *McGraw Hill Co., New York.*
11. Grollman A.: Pharmacology & Therapeutics, *Lea & Fabiger, Philadelphia.*
12. Avery G.S.: Drug Treatment, *Adiss Press, Sydney.*
13. Das M.M. and Dutta S.K.: Ghosh's Modern Concepts on Pharmacology & Therapeutics, *Hilton & Co., Calcutta.*
14. Barar F.S.K.: Essentials of Pharmacotherapeutics, *S. Chand & Co., New Delhi.*

15. Krantz and Carr: Pharmacology Principles of Medical Practice, *Williams & Wilkins Co, Baltimore.*
16. Satoskar R.S. and Bhandarkar S.D.: Pharmacology & Pharmacotherapeutics, *Popular Prakashan, Bombay.*
17. Pharmacopoeia of India (1985), *Controller of publication, Delhi.*
18. Tripathi K.D.: Essentials of Medical Pharmacology, *Jaypee Brothers, Medical Publishers, New Delhi.*
19. Harsh Mohan: Textbook of Pathology, *Jaypee Brothers, Medical Publishers, New Delhi.*
20. Harisons Internal Medicine, *Tata Mc-Graw Hill Publications, Singapore.*
21. Davidsons: Textbook of Medicine. *Tata Mc-Graw Hill Publications, Singapore.*
22. Robins: Textbook of Pathology.
23. Bodhankar SL, Vyavahare NS.: Pathophysiology. *Nirali Publications, Pune.*
24. Balaraman R., Gulati OD., Patil PL., Goyal RK (Editor): History of Pharmacology. *B. S. Shah Publications, Ahmedabad.*

2.8 (T) ENVIRONMENTAL SCIENCES

(40 Hrs.)

Unit 1: The Multi-disciplinary Nature of Environmental Studies

Definition, scope and importance. Need for public awareness.

Unit 2: Ecology and Ecosystems

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

Unit 3: Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity.
- Value of biodiversity: consumptive use, productive use, social, ethical, and aesthetic and option values.
- Biodiversity at global, National and local levels.
- India as a mega – diversity nation.
- Hot Spots of biodiversity.
- Threats to biodiversity: habitat, poaching of wildlife, man wildlife conflicts.

- Endangered and endemic species of India.
- **Unit 4: Natural Resources.**
- Natural resources and their conservation.
 - a. **Air resources:** Features, composition, structure, air quality management.
 - b. **Forest resources:** Use and over/exploitation, deforestation, case studies, timber extraction, mining, dams and their effect on forests and tribal people.
 - c. **Water resources:** Use and over –utilization of surface and ground water, flood, drought, conflicts over water, dams –benefits and problems; water quality management: management of water resources. E.g. rivers, lakes, ground water, etc: fluorosis and arsenic problems.
 - d. **Mineral resource:** draw on and exploitation, environmental effects of extracting and using mineral resources, case studies.
 - e. **Food resources:** World food problems, changes caused by agricultural and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
 - f. **Energy resources:** Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources, Case studies.
 - g. **Land resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources and prevention of pollution. Equitable use of resources for sustainable lifestyles. Disaster management: Floods, earthquakes, cyclone and landslides.

Unit 5: Environmental Pollution.

- Definition
- Air pollution: Definition, causes, effects and control measures: Air Quality Management, Air Pollution Case Studies.
- Water pollution: Definition, causes, effects and control measures: case studies: Water Quality Management: Definition, causes, effects and control measures.
- Marine Pollution
- Thermal pollution.
- Soil pollution: Definition, causes and control measures: case studies
- Noise pollution.
- Nuclear hazards: Waste Management:
- Waste minimization through cleaner technologies; reuse and recycling of wastes.
- Solid waste management Causes, effects and control measures of urban and industrial wastes: hazardous waste: bio medical waste.
- Role of an individual in prevention of pollution..
- Pollution case studies.
- Disaster management: floods, earthquake, cyclone and landslides

Unit 6: Social Issues and the Environment

- From Unsustainable to Sustainable development.

- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management.
- Resettlement and rehabilitation of people: its problems and concerns, Case studies.
- Environmental ethics: environmental value relationships: environmental ethics and species preservation.
- Climate change, global warming, acid, ozone layer depletion, nuclear accidents and holocaust Case studies.
- Wasteland reclamation.
- Consumerism and waste products..
- Legislation to protect the environment.
- Environmental Protection Act..
- Air (Prevention and Control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.
- Environmental Impact Assessment (EIA): Environmental Management Systems (EMS): Environmental Management Systems (EIS).
- P. I.L: Public Hearing and Role of NGOs.
- ISO 9000 and 14000.
- Issues involved in enforcement of environment of environmental legislation.
- Public awareness.
- Environmental Economics-environment and standard of living.

Unit 7: Human Population and the Environment

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

Unit 8: Field Work (any two of the following)

- Visit to local area to document environmental assets-river/ forest/ Grasslands/ Hill/ Mountain
- Visit to a local pollution site-Urban/ Rural/ Industrial/Agricultures/etc.
- Study of common plants, insects, birds.
- Study of simple ecosystems- pond, river, hill slopes, etc.

Unit 9: Environmental issues related to the specific discipline for Pharmacy Course.

- Maintenance of healthy environment in Pharmaceutical industry

- Disposal of wastes,
- Hospital waste, Pharmaceutical industrial waste.
- Air sampling and air handling in Pharma. Industries.
