

SEMESTER III

BP301T. PHARMACEUTICAL ORGANIC CHEMISTRY –II (Theory)

45 Hours

Course Content:

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained.

To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

Unit-I

10 Hours

Benzene and its derivatives

- A. Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule.
- B. Reactions of benzene - nitration, sulphonation, halogenation- reactivity, Friedel Crafts alkylation-reactivity, limitations, Friedel Crafts acylation.
- C. Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction.
- D. Structure and uses of DDT, Saccharin, BHC and Chloramine T.

Unit-II

10 Hours

Phenols* - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols.

Aromatic Amines* - Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts.

Aromatic Acids* - Acidity, effect of substituents on acidity and important reactions of benzoic acid.

Unit-III

10 Hours

Fats and Oils

Fatty acids – reactions.

Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.

Analytical constants– Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value– significance and principle involved in their determination.

Unit-IV

08 Hours

Polynuclear Hydrocarbons: Synthesis, reactions.

Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives.

Unit-V

07 Hours

Cycloalkanes*

Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only.

BP305P. PHARMACEUTICAL ORGANIC CHEMISTRY -II (Practical)

4 Hrs/week

1. Experiments involving laboratory techniques:
 - Recrystallization.
 - Steam distillation.
2. Determination of following oil values (including standardization of reagents):
 - Acid value.
 - Saponification value.
 - Iodine value.
3. **Preparation of compounds**
 - Benzanilide/Phenyl benzoate/Acetanilide from Aniline/Phenol/Aniline by acylation reaction.
 - 2,4,6-tribromo aniline/para bromo acetanilide from Aniline.
 - Acetanilide by halogenation (Bromination) reaction.
 - 5-nitrosalicylic acid/meta di-nitrobenzene from salicylic acid/ nitro benzene by nitration reaction.
 - Benzoic acid from benzyl chloride by oxidation reaction.
 - Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.
 - 1-Phenyl azo-2-naphthol from Aniline by diazotization and coupling reactions.
 - Benzil from benzoin by oxidation reaction.
 - Dibenzal acetone from benzaldehyde by Claisen-Schmidt reaction.
 - Cinnamic acid from benzaldehyde by Perkin reaction.
 - *p*-Iodo benzoic acid from *p*-amino benzoic acid.

Recommended Books (Latest Editions)

- Organic Chemistry by Morrison R.T., Boyd R.N. and Bhattacharjee, S.K. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), New Delhi.
- Organic Chemistry by Jonathan Clayden, Nick G. S. Warren. Oxford University Press, Oxford.
- Organic Chemistry by G. Marc Loudon, Oxford University Press, Oxford.
- Organic Chemistry by Francis A. Carey and Robert M. Giuliano, Tata McGraw Hill Publishing Company Ltd., New Delhi.
- Strategic Applications of Named Reactions in Organic Chemistry by Laszlo Kurti and Barbara Czako, Elsevier Academic Press.
- Organic Chemistry by I.L. Finar, Volume-I, Pearson Education Ltd, New Delhi.
- Elementary Practical Organic Chemistry by Vogel A.I., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), New Delhi.

- Practical Organic Chemistry by Mann F.G, and Saunders B.C., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), New Delhi.
- Introduction to Organic Laboratory Techniques by Pavia, Lampman and Kriz, Cengage Learning, Delhi.
- Reaction and Reaction Mechanism by Ahluwalia/Chatwal, Narosa Publishing House, New Delhi.
- A Guidebook to Mechanism in Organic Chemistry by Sykes P., Longman Group Ltd, London.
- Organic Chemistry by Jain M.K., Sohan Lal Nagin Chand & Co, New Delhi.
- Textbook of Organic Chemistry by P.L. Soni, Sultan Chand & sons, New Delhi.

BP302T. PHYSICAL PHARMACEUTICS-I(Theory)

45 Hours

Course Content:

Unit-I

10 Hours

Solubility of drugs: Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications.

Unit-II

10 Hours

States of Matter and properties of matter: State of matter, changes in the state of matter, latent heats, vapor pressure, sublimation critical point, eutectic mixtures, gases, aerosols– inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid- crystalline, amorphous & polymorphism.

Physicochemical properties of drug molecules: Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications.

Unit-III

10 Hours

Surface and interfacial phenomenon: Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB scale, solubilization, detergency, adsorption at solid interface.

Unit-IV

08Hours

Complexation and protein binding: Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.

Unit-V

07 Hours

pH, buffers and Isotonic solutions: Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.

BP306P. PHYSICAL PHARMACEUTICS – I (Practical)

4 Hrs/week

1. Determination the solubility of drug at room temperature.
2. Determination of pKa value by Half Neutralization/Henderson Hasselbalch equation.
3. Determination of Partition co- efficient of benzoic acid in benzene and water.
4. Determination of Partition co- efficient of Iodine in CCl₄ and water.
5. Determination of % composition of NaCl in a solution using phenol-water system by CST method.
6. Determination of surface tension of given liquids by drop count and drop weight method.
7. Determination of HLB number of a surfactant by saponification method.
8. Determination of Freundlich and Langmuir constants using activated char coal.
9. Determination of critical micellar concentration of surfactants.
10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method.
11. Determination of stability constant and donor acceptor ratio of Cupric Glycine complex by pH titration method.

Recommended Books: (Latest Editions)

- Physical Pharmacy by Alfred Martin, Lippincott Williams and Wilkins, USA.
- Tutorial Pharmacy by Cooper and Gunn, CBS, New Delhi.
- Pharmaceutical Calculations by Stocklosam J., Lea & Febiger, Philadelphia.
- Pharmaceutical Dosage forms: Disperse systems by Lieberman H.A, Lachman C, Volume 3, Marcel Dekker Inc.
- Physical Pharmaceutics by Ramasamy C. and Manavalan R., PharmaMed Press, Hyderabad.
- Laboratory Manual of Physical Pharmaceutics by C.V.S. Subramanyam. J., Thimma Settee.
- Experimental Pharmaceutics by Eugene, Parott, Burgess Pub. Co., UK.
- Physical Pharmaceutics by C.V.S. Subramanyam. CBS Publication
- Textbook of Physical Pharmacy by Gaurav Jain & Roop K. Khar, Reed Elsevier India Pvt. Ltd., New Delhi.
- Physical Pharmaceutics by Shotton E & Ridgeway K, Oxford University Press, London.
- Essentials of Physical Pharmacy by D.V. Derle, BSP Book Pvt. Ltd., Hyderabad.
- Pharmaceutics: The Design and Manufacture of Medicines by Aulton M.E, Churchill Livingstone.

BP303T. PHARMACEUTICAL MICROBIOLOGY (Theory)

45 Hours

Course content:

Unit-I

10 Hours

Introduction, history of microbiology, its branches, scope and its importance.

Introduction to Prokaryotes and Eukaryotes.

Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count).

Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.

Unit-II

10 Hours

Identification of bacteria using staining techniques (simple, Gram's & Acid-fast staining) and biochemical tests (IMViC).

Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization.

Evaluation of the efficiency of sterilization methods.

Equipments employed in large scale sterilization.

Sterility indicators.

Unit-III

10 Hours

Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses.

Classification and mode of action of disinfectants.

Factors influencing disinfection, antiseptics and their evaluation.

For bacteriostatic and bactericidal actions.

Evaluation of bactericidal & Bacteriostatic.

Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.

Unit-IV

08 Hours

Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification.

Principles and methods of different microbiological assay.

Methods for standardization of antibiotics, vitamins and amino acids.

Assessment of a new antibiotic.

Unit-V**07Hours**

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage.

Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.

Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures.

Application of cell cultures in pharmaceutical industry and research.

BP307P. PHARMACEUTICAL MICROBIOLOGY (Practical)

4 Hrs/week

1. Introduction and study of different equipment and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology.
2. Sterilization of glassware, preparation and sterilization of media.
3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.
4. Staining methods- Simple, Grams staining and acid-fast staining (Demonstration with practical).
5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.
6. Microbiological assay of antibiotics by cup plate method and other methods
7. Motility determination by Hanging drop method.
8. Sterility testing of pharmaceuticals.
9. Bacteriological analysis of water
10. Biochemical test.

Recommended Books (Latest edition)

- Pharmaceutical Microbiology by W.B. Hugo and A.D. Russel: Blackwell Scientific Publications, Oxford London.
- Industrial Microbiology by Prescott and Dunn., 4th edition, CBS Publishers & Distributors, Delhi.
- Microbiology by Pelczar and Chan Kreig, Tata McGraw Hill, New Delhi.
- Lippincott's Illustrated Reviews-Microbiology by Harvey, Champe and Fisher, Lippincott Williams and Wilkins, New Delhi.
- Principles and Practices of Contamination Control and Cleanrooms by C.K. Moorthy, Pharma Book Syndicate, Hyderabad.
- Pharmaceutical Microbiology by Malcolm Harris, Balliere Tindall and Cox., The Williams & Wilkins Co., NY.
- Fundamental Food Microbiology by Bibek Ray and Arun Bhunia, CRC Press, NY.
- Industrial Microbiology by Rose, Butterworths, USA.
- Fundamentals of Microbiology by Frobisher M., Hinsdill et al., 9th ed., Japan.
- Cooper and Gunn's Tutorial Pharmacy, CBS Publisher and Distribution.
- Microbial Technology by Pepler, Academic Press.
- I.P., B.P., U.S.P. - latest editions.
- Ananthnarayan and Paniker's Textbook of Microbiology, edited by C.K.J. Paniker, Orient-Longman, Hyderabad.
- Fundamentals of Microbiology by Edward, Benjamin Cummings, USA.

- Pharmaceutical Microbiology by N.K. Jain, Vallabh Prakashan, Delhi.
- Bergey's Manual of Systematic Bacteriology, Williams and Wilkins, Philadelphia.
- Disinfection and Sterilization- Theory and Practice, General and Industrial Chemistry Series by Sykes G., E & F.N. Spon Ltd., London.
- General Microbiology by Stanier R.Y., Ingraham, J.L., Wheelis M.L., Painter P.R., Macmillan Press Limited, London.
- Microbiology: An Introduction by Tortora, G.J., Funke, B.R. and Case, C.L., Pearson India Education Services Pvt. Ltd., Noida.
- Pharmaceutical Dosage Forms: Parenteral Medications by Sandeep Nema, John D. Ludwig, Informa Healthcare.

BP304T. PHARMACEUTICAL ENGINEERING (Theory)

45 Hours

Course content:

Unit-I

10 Hours

Flow of Fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturi meter, Pitot tube and Rotameter.

Size Reduction: Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.

Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

Unit-II

10 Hours

Heat Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.

Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator & Economy of multiple effect evaporator.

Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation.

Unit-III

10 Hours

Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.

Mixing: Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier.

Unit-IV**08 Hours**

Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seitz filter.

Centrifugation: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

Unit-V**07 Hours**

Materials of pharmaceutical plant construction, corrosion and its prevention: Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and their prevention. Ferrous and non-ferrous metals, inorganic and organic non-metals, basic of material handling systems.

BP308P. PHARMACEUTICAL ENGINEERING (Practical)

4 Hours/week

1. Determination of radiation constant of brass, iron, unpainted and painted glass.
2. Steam distillation – To calculate the efficiency of steam distillation.
3. To determine the overall heat transfer coefficient by heat exchanger.
4. Construction of drying curves (for calcium carbonate and starch).
5. Determination of moisture content and loss on drying.
6. Determination of humidity of air – From wet and dry bulb temperatures- use of Dew point method.
7. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
8. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots.
9. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond coefficients, power requirement and critical speed of Ball Mill.
10. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
11. Factors affecting rate of filtration and evaporation (Surface area, Concentration and Thickness/viscosity).
12. To study the effect of time on the rate of crystallization.
13. To calculate the uniformity Index for given sample by using Double Cone Blender.

Recommended Books: (Latest Editions):

- Introduction to Chemical Engineering by Walter L. Badger & Julius Banchemo, Tata McGraw Hills, New Delhi.
- Solid Phase Extraction, Principles, Techniques and Applications by Nigel J.K. Simpson- Latest edition.
- Pharmaceutical Engineering by K. Sambamurthy, New Age International (P) Ltd., New Delhi.
- Unit Operation of Chemical Engineering by McCabe Smith, McGraw Hills, New Delhi.
- Pharmaceutical Engineering Principles and Practices by C.V.S Subrahmanyam et al., Vallabh Prakashan, Delhi.
- Remington Practice of Pharmacy by Martin, Latest edition.
- Lachman/Lieberman's Theory and Practice of Industrial Pharmacy by Roop K. Khar, S.P. Vyas, F.J. Ahmad and G.K. Jain, CBS Publishers & Distributors Pvt. Ltd., New Delhi.

- Cooper and Gunn's Tutorial Pharmacy edited by S.J. Carter, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
- Unit Operations by G.G. Brown, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
- Perry's Chemical Engineers' Handbook by R.H. Perry and D.W. Green, McGraw-Hill, USA.
- Aulton's Pharmaceutics: The Design and Manufacture of Medicines; 3rd edition, Churchill Livingstone, UK.
- Bentley's Textbook of Pharmaceutics edited by E.A. Rawlins, Reed Elsevier India Pvt. Ltd., New Delhi.
- Pharmaceutical Process Engineering by Anthony J. Hickey and David Ganderton, Vol-112, Drugs and Pharmaceutical Sciences, Marcel Dekker, Inc., USA.

KVE301. UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

30 Hours

Course Content:

UNIT-I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education
Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT-II

Understanding Harmony in the Human Being - Harmony in Myself Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’, Understanding the needs of Self (‘I’) and ‘Body’ - Sukh and Suvidha, Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer), Understanding the characteristics and activities of ‘I’ and harmony in ‘I’, Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-III

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family.

UNIT-IV

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence
Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-Astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-V

Implications of the above Holistic Understanding of Harmony on Professional Ethics
Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

Recommended books:

- A Foundation Course in Human Values and Professional Ethics by R.R. Gaur, R Sangal, G P. Bagaria, 2009.
- Energy & Equity by Ivan Illich, 1974, the Trinity Press, Worcester, and Harper Collins, USA.
- Small Is Beautiful: A Study of Economics As If People Mattered by E.F. Schumacher, 1973, Blond & Briggs, Britain.
- How the Other Half Dies by Sussan George, 1976, Penguin Press. Reprinted 1986, 1991.
- Limits to Growth – Club of Rome’s report by Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Universe Books.
- Jeevan Vidya Ek Parichay by A. Nagraj, 1998, Divya Path Sansthan, Amarkantak.
- Science and Humanism by P.L. Dhar, RR Gaur, 1990, Commonwealth Publishers.
- Human Values by A.N. Tripathy, 2003, New Age International Publishers.
- How to Practice Natural Farming by Subhas Palekar, 2000, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
- Fundamentals of Ethics for Scientists & Engineers by E G Seebauer & Robert L. Berry, 2000, Oxford University Press.
- Engineering Ethics (including Human Values) by M Govindrajran, S Natrajan & V.S. Senthil Kumar, Eastern Economy Edition, Prentice Hall of India Ltd.
- Foundations of Ethics and Management by B.P. Banerjee, Excel Books.