



Swami Ramanand Teerth Marathwada University, Nanded
Second Year B. Pharmacy, IIIrd Semester

Subject : Physical Chemistry
Subject Code/Paper No : (BPH31)
Credits : 03(02T+1 Pr)

Scope

This Course is concerned with the study of Physical and chemical properties of materials which are pertinent in the design of drug delivery system. The understanding of physico-chemical properties of materials helps to minimize the manufacturing stresses and enable the smooth production. Last but not the least it aids a pharmacist to choose the right kind of material to predict the release and biologic action of drug product.

Objectives

On the successful completion of the following theory topics and laboratory work, Students shall be able.....

1. To explain the structure of matter and to distinguish between solids, liquids and gases states.
2. To compare the solution (electrolytic and non electrolytic) systems and explicate the influence of colligative properties of solutions on the liquid orals.
3. To choice and operate the equipments used in Pharmaceutics laboratory relevant to practicals.

Course content (Theory)

1. States of Matter: (06 Hrs)

Gaseous state: Definition, characteristics of gases, gas laws (Boyle's law, Charles law, combined gas law, Avogadro's law, Dalton's law). Liquefaction of gases- critical Phenomenon, critical constants and their determination, methods of liquefaction of gases (Faraday, Lindes, Claudes method).

Liquid State: definition, introduction to Intermolecular forces, Vapour pressure, surface tension, viscosity, refractive index, optical activity and their significance in Pharmaceuticals.

Solid State: definition, types of solid, crystal structure, X-Ray Crystallography, introduction to polymorphism and its importance in the pharmacy.

2. Solutions of Non-electrolytes (Colligative properties of solution) and Electrolysis: (4Hrs)

Study of: Ways of expressing concentrations, solubility of partially miscible liquid, colligative properties and their determination (Lowering of vapor pressure, elevation of boiling point, freezing point depression) osmosis and determination of osmotic pressure.

Electrolysis: Statements of Faradays (first and second) laws of electrolysis and mathematical equations.

3. Solubility and Distribution Phenomenon: (3 Hrs)

General principles, solvent-solute interactions, solubility of gases in liquids, solubility of liquids in liquids, solubility of solids in liquids, distribution of solutes between immiscible solvents.

Partition coefficient and Phase rule.

4. Surface and Interfacial phenomenon: (4 Hrs)

Surface and Interfacial tension, surface free energy. Measurement of Surface and Interfacial tension. Liquid interface, adsorption at liquid interfaces, adsorption at solid interface, applications of surface active agents, HLB classification, micelle formation, determination of critical micelle concentration and importance with respect to suspension and emulsion. Detergency and wetting agents. Electrical properties of interfaces: Electrical double layer, Nernst and zeta potential.

5. Thermodynamics: (04 Hrs)

Introduction to thermodynamics, related concepts and pharmaceutical applications. Thermodynamic processes (Isothermal, Adiabatic, Isochoric, reversible and irreversible), First and second law of thermodynamics, heat reactions. Hess's law, entropy and enthalpy.

6. Adsorption Phenomenon: (03 Hrs)

Study of: Adsorption versus Absorption, Types of adsorption, adsorption isotherm (Freundlich and Langmuir adsorption) and its applications.

Books Recommended:

Text Book

1. Alfred Martin, Physical Pharmacy, (ivth edition 1997), B.I Waverly Pvt Ltd, New Delhi

Reference Books

1. B.S. Bahl, G. D, Tuli, Arun Bahl, Essential of Physical Chemistry, 1999, S. Chand & Ltd, New Delhi.

2. A. T. Florence and D. Attwood Physico-Chemical Principles of Pharmacy(3rd edition)1998, Macmillan Press Ltd London.

3. Samuel Glasston, Text Book of Physical Chemistry, (2nd edition)1996, Macmillan India Ltd.

4. Text Book of Physical Pharmaceutics, by CVS Subrahmanyam IInd edition, Vallabh Prakashan, Delhi.

Course Content (Practical/Lab Work)

1. To determine weight per ml and specific gravity of benzene and Carbon tetrachloride using specific gravity bottle.
2. To study the effect of temperature on density of given liquid by using specific gravity bottle.
3. To determine surface tension by drop count/drop weight method.
4. To study the effect of addition of electrolytes on surface tension.
5. To determine Critical Solution temperature (CST) of Phenol and Water system.
6. To determine partition coefficient of Iodine between Carbon tetrachloride and distilled water.
7. To determine Refractive index of a given liquids using Abbe Refractometer.
8. To determine the percentage composition of unknown solution using Abbe Refractometer.
9. To determine specific rotation of optically active substance and its concentration in the sample solution.
10. To determine HLB value of given fatty acid ester.
11. To determine solubility of given solid in different solvents.
12. To determine the Critical Micelle Concentration (CMC) of given surfactant.
13. To determine the molecular weight of a substance by Rast Camphor method.

Books Recommended:

1. Practical Pharmaceutical Technology by – Engene
2. Physico-chemical experiments by- Robert Livingston, The Macmilan Company.
3. Laboratory Manual of Physical pharmacy by CVS Subrahmanyam , Vallabh Prakashan, Delhi.



Swami Ramanand Teerth Marathwada University, Nanded
Second Year B. Pharmacy, IIIrd Semester

Subject : **Pharmaceutical Microbiology**
Subject Code/Paper No : **BPH32**
Credits : **03 (02T+01Pr)**

The Course

The study of microbiology aims at study of microbes having impact on human health, transmission of diseases, benefits of microbes to human beings and environment, their role in genetic information and microbiological products.

Objective: To acquaint the students of Pharmaceutical Sciences with basic knowledge of various microbes, their habitat, morphology, reproduction and their clinical and industrial significance.

Course Content (Theory)

1. Introduction to Microbiology: (03 Hr)

Definition, history, classification of microbes, applications and scope of Pharmaceutical Microbiology.

2. Study of Bacteria: (10 Hr)

Size, Shape and arrangement, Structure, Cell wall, cytoplasm, capsules, sporulation and germination, bacterial classification based on nutritional requirement, Endo toxins and exotoxins, Reproduction (binary fission, genetic exchange, transformation, conjugation and transduction), types of culture media, growth curves, physical conditions required for bacterial growth, measurement of bacterial growth, biochemical tests.

Disease causing bacterias and their characteristics e.g. - Staphylococcus, streptococcus, Diplococcus, neisseria, clostridium, corynebacterium, pseudomonas, etc.

3. Study of Fungi: (04 Hr)

Introduction, classification, industrial importance of fungi, dermatophytes – trichophyton, microsporum, epidermophyton, deep and superficial mycoses, clinical/industrial significance of candida albicans, penicillium, aspergillus, saccharomyces.

4. Study of Protozoa: (02 Hr)

Introduction, occurrence, classification, clinical industrial importance, morphology, reproduction

5. Study of Viruses: (05 Hr)

Introduction, general properties, structure of viruses (helical symmetry and icosahedral symmetry), Bacteriophage and its epidemiological uses (lytic growth cycle and lysogeny). Human viruses and their cultivation in cell culture, chick embryo and animal inoculation, interferons, structure of HIV virus, tumor viruses ; prions.

Books recommended:

Text Books:

1. W.B.Hugo & A.D. Russell, Pharmaceutical Microbiology (6th edi.), Blackwell science ltd.,
2. L.E.Casida, Jr., Industrial Microbiology (9th edition), New Age International (p) Ltd., Publishers, New Delhi.
3. Dr. Chandrakant R. Kokare, Pharmaceutical Microbiology (6th edi.), Nirali Prakashan, Pune.

Reference Books:

1. Gerald Reed, Prescott and Dunn's Industrial Microbiology, (4th edition), CBS publishers and distributors, Delhi.
2. Seymour S.Block, Disinfection, sterilization and preservation, (4th edition) Lea and Febiger, Philadelphia, London.
3. Diane M.Collett & Michael E. Aulton, Pharmaceutical Practice, 1990, Churchill Livingstone, New York.
4. R.Ananthnarayan and C.K. Jayaram Panikar, text book a microbiology (6th edition), Orient Longman Limited, Hyderabad.
5. Frobisher, Hinsdill, crabtree, Good heart, Fundamentals of Microbiology (9th edition), Saunders' International student edition, Toppan Company Limited, Tokyo, Japan.
6. Michael J.Pelczar, Jr., E.C.S. chan, Noel R, Krieg, Microbiology (5th edition) 1993, Tata McGraw – Hill publishing company Ltd., New Delhi.
7. S.S. Purohit, Microbiology (Fundamentals and applications), (6th edition), 2000-2001, Agrobio (India), Jodhpur.
8. Jacquelyn G. Black, Microbiology (principles and explorations), Prentice Hall, New Jersey.
9. Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton, Industrial Microbiology, An introduction (2001) Blackwell Science.
10. Rojer Y. Stanier, John L. Ingraham, Mark L. Wheehis, Page R. Painter, General Microbiology (5th edition), Macmillan press ltd.

Course Content:(Practical)

- Experiment No. 1. Study of Microscope, its important parts and their functions.
- Experiment No. 2. a) To study the operations of different instruments in microbiology laboratory: Colony counter, Zone reader
b) To study the common apparatus used in microbiology laboratory: Culture tube, Petri dish, Inoculating loops and needles, Culture slide, Pipettes, Refrigerator, Incubator.
- Experiment No. 3. a) Preparation and fixation of microorganism for staining using given sample.
b) To study the given organism sample by simple stain method
- Experiment No. 4. To study the given organism sample by Gram's stain method
- Experiment No. 5. a) To study the given organism sample by acid- fast stain method.
b) To study the cell wall of microorganism in given sample by staining method.
- Experiment No. 6. a) To study the motility of given sample of microbe
b) To stain endospores of given sample of microbe
- Experiment No. 7. To study enzymatic activity of microorganisms
a) Demonstration of hydrolysis of starch
b) Demonstration of coagulase production
c) Demonstration of acid and gas production from carbohydrate.
- Experiment No. 08 a) To inoculate given sample of microorganism in agar slope.
b) To transfer the inoculums into culture media
- Experiment No. 09. a) Isolation of pure culture using pour plate method
b) To inoculate and cultivate microbes using streak plate technique.
- Experiment No. 10. To determine colony count of bacteria present in given pharmaceutical Sample.
- Experiment No. 11. To estimate bacterial count of aseptic areas.
- Experiment No. 12. To find out microbial population in soil sample.

Experiment No. 13. To study the lactose fermenting bacterial from milk sample using differential plating.

Books recommended:

1. James G. Cappuccino & Natile Sherman, Microbiology a laboratory manual (4th edition), Addison – weley langman, Inc.
2. C.H.Collins, Patricia M. Lyne, J.M. Grange, Microbiological methods,(7th edition) Butter worth Heinemann, Oxford.
3. L.Jack Bradshaw, Laboratory Microbiology 4th edition Saunders college publishing, Harecourt Brace Jovenovich college publishers.
4. R.S. Gaud, G.D. Gupta, Practical Microbiology, Nirali Prakashan, Pune.
5. Vinita kale, Kishor Bhusari, practical Microbiology, Principles and techniques, Himalaya Publishing House , Mumbai.
6. P.Gunasekaran, Laboratory manual in microbiology, New age International (p) publishers



Swami Ramanand Teerth Marathwada University, Nanded
Second Year B. Pharmacy, IIIrd Semester

Subject : **Organic Chemistry-III (Theory)**
Subject Code/Paper No : **BPH 33**
Credits : **4 (03Th+ 01Pr)**

Scope:

This syllabus has been designed to understand the basics of Heterocyclic compounds, selected rearrangements & Green chemistry.

Heterocyclic compounds

- Students are expected to learn synthesis and reactions involved in below mentioned heterocyclic compounds in view to apply the similar principle to structurally related heterocyclic compounds.
- Along with this basis of resonance structure, its stability and reactivity should be learned
- The study of synthesis and chemical reaction of Heterocyclic compounds will assist the learner for understanding of future/ prospective of drugs and pharmaceutical synthesis.

Molecular rearrangements:

- Students are expected to learn classification, mechanism and applications of different rearrangements mentioned below.
- The study of synthesis and chemical reaction of rearrangements will assist the learner for understanding of future/ prospective of drugs and pharmaceutical synthesis using rearrangements.

Green Chemistry- Microwave assisted synthesis- Students are expected

- Students will be evident to new concept of organic synthesis as compared to conventional laboratory synthesis.
- Various basic aspects while designing MW assisted synthesis should be learned and applied
- Comparison of Microwave assisted synthesis with conventional laboratory synthesis can be studied at all the levels of reactions including reaction time, reactants required, product obtained –quality and quantity, wastage of reactants, environmental safety etc

- ❖ Finally, learned concepts must be applied practically to evaluate/ assess the gained knowledge
 - ❖ Motivation for extracurricular readings of research journals for the understanding of current scenario of syllabus content is highly appreciated.
-
-

Course content (Theory)

1. **Cyclic hydrocarbons:** (03 hrs)
Structure, nomenclature, reactions and syntheses of compounds like Naphthalene and anthracene

2. **Heterocyclic chemistry:** (18 hrs)
 2. a) **structure & nomenclature of the following heterocyclic Compounds:**
Furan, thiophene, pyrrole, pyrazole, thiazole, imidazole, oxazole, isoxazole, hydantoin, purine, pyridine, piperidine, pyrimidine, pyrazine, piperazine, indole, benzofuran, benzthiazole, benzimidazole, benzoxazole, quinoline, isoquinoline, quinazoline, Coumarin, Phenothiazine, Acridine

 2. b) **Resonance, synthesis and reactions of following heterocyclic compounds:**
 2. b. 1) Furan:
 - Synthetic methods including synthesis using carbohydrates, oxazoles, Diels-Alder Adduct, Paal-Knorr synthesis.
 - Reactions with acids, bases, electrophillic aromatic substitution (EAS), carbenes, nitrenes, oxidizing and reducing agents, Diels-Alder reaction.
 2. b. 2) Imidazole:
 - Synthetic methods including synthesis from imidazolines, α -haloketones, Radiszewskii reaction.
 - Reactions with acids, electrophillic aromatic substitution (EAS), nucleophiles, oxidizing and reducing agents, imidazoles as catalysts in ester hydrolysis.
 2. b. 3) Pyridine
 - Preparation from acetylene, piperidine, beta-picolene, glucoconic aldehydes, THF alcohol
 - Reactions with- Basicity of pyridine, electrophillic and nucleophillic substitution (explain importance of nucleophillic substitution as compared to other heterocyclic compounds), oxidation, reduction reactions
 2. b. 3) Pyrimidine:
 - Preparation from malonic ester, ethyl cortonate, formamide, dechlorination of 2, 4-dichloropyrimidine, α , β -unsaturated ketones.
 - Reactions with acids, electrophillic substitution reactions, nucleophillic reagents (explain its importance as compared to other heterocyclic compounds), oxidizing & reducing reagents, thioclaisen rearrangement

2. b. 4) Quinoline:

- Synthetic methods including Skraup synthesis, Doebner-Miller synthesis, Friedlander synthesis, Pfitzinger synthesis, Pictet synthesis, Conrad-Limpach synthesis.
- Reactions with acids, electrophilic Aromatic Substitution (EAS), nucleophiles, oxidizing and reducing agents, reaction with S and Hg.

2. b. 5) Indole:

- Synthesis by Fischer indole synthesis, Mandelung synthesis, Reissert synthesis and Bischler synthesis.
- Reactions with acids, EAS, Metallic K, Mannich reaction, oxidizing and reducing agents.

3. Molecular rearrangements:

(11 hrs)

- Introduction and classification of molecular rearrangements
- Concept of Whitmore 1,2 shift
- Definition, Mechanism, and applications of rearrangements involving migration towards (basis of classification should be discussed)-
 - electron deficient C atom
Pinacol-pinacolone & Benzil-Benzilic acid rearrangement,
 - electron deficient N atom
Beckmann, Hoffmann & Curtius rearrangement
 - electron deficient O atom
Bayer-villinger oxidation & Dakin rearrangement
 - electron rich C atom
Stevens & Favourski rearrangement.
 - Aromatic ring
Fries rearrangement
 - Sigmatropic rearrangement
Cope rearrangement

4. Green chemistry

(04 hrs)

Principle, atom economy, introduction to different green techniques (SFE, Ultrasound, photochemical, solid support, fluoros & solvent free reactions, solvents & catalyst), microwave synthesis & its comparison with conventional synthesis with at least following four examples

4.a) Microwave assisted reactions in water:

Oxidation (of toluene, alcohols)

4.b) Microwave assisted reactions in organic solvents:

Diels Alder Reaction

4.c) Microwave assisted solid state reactions:

anhydrides from dicarboxylic acid

4.d) Ultrasound assisted reactions:

Esterification & Cannizaro reaction

Text book:

1. I.L.Finar, Organic Chemistry, Vol. I & II, Longman (Low priced)

Books recommended :

- 1) T. Eicher, S. Hauptmann, The Chemistry of Heterocycles(New York 1995).
- 2) Ernest L. Eliel, Stereochemistry of Carbon compounds (Tata McgrawHill)
- 3) G.R.Chatwal, Reaction Mechanism and Reagents in Organic Chemistry, Himalaya
- 4) Pine, Hendrickson, Cram and Hammond, Organic Chemistry (Mcgraw Hill)
- 5) Morrison and Boyd, Organic Chemistry (Prentice Hall)
- 6) Agronomov etal, Problems and exercises in Organic Chemistry (Mir publishing Co.)
- 7) Bansal R.K., Heterocyclic Chemistry (New Age International)
- 8) I. L. Finar, Organic Chemistry (ELBS)
- 9) March Jerry, Advance Organic Chemistry (Wiley Interscience)
- 10) Stuart Warren, Designing Organic Synthesis(John Wiley)
- 11) Clayden, Greaves, Warren and Wathers, Organic Chemistry(Oxford)
- 12) Carey, F. A. Organic Chemistry (7th ed.) McGraw-Hill 2008
- 13) P Y Bruice- Organic Chemitry, 2nd edition, Prentice Hall, NJ.
- 14) Sanghai R Green Chemistry- Narosa Pubication -India
- 15) DST guideline- Green Chemistry
- 16) M.K. Jain, S.C. Sharma, Modern organic chemistry- Vishal Publishing co- Delhi
- 17) V.K.Ahluwalia, Green Chemistry- A text book(Narosa Publishing House)-New Delhi

Course content (Practical)

Skill should be adapted by students while performing practicals:

Lab practicals have been majorly divided in separation and identification of binary mixture, synthesis by rearrangements, synthesis of organic compounds and microwave assisted synthesis

Separation and identification- Students are expected

- to understand and learn the basics /rationale of separation, chemical reactions involved in separation along with practice safety measures in laboratory.
- To learn the **principle** involved in various qualitative tests (every test performed while separation) and analyze the given unknown binary organic compounds having different functional groups.
- To understand principle involved in different techniques such as filtration, colored reaction and precipitation of organic compounds along with reaction & mechanism.

Synthesis by rearrangements- Students are expected

- To learn theoretically learned concepts of rearrangements should be applied in laboratory and verified accordingly for possible reactions
- Change takes place during the course of reactions/ rearrangements should be taken in to consideration.
- The study of synthesis and chemical reaction of rearrangements will assist the learner for understanding of future/ prospective of drugs and pharmaceutical synthesis using rearrangements

Microwave assisted synthesis- Students are expected

- Students will be evident to new concept of organic synthesis as compared to conventional laboratory synthesis
- Comparison of Microwave assisted synthesis with conventional laboratory synthesis can be studied at all the levels of reactions including reaction time, reactants required, product obtained –quality and quantity, wastage of reactants, environmental safety etc

Application(s) of practically learned skills must be carried out to evaluate the gained knowledge

1. Separation and qualitative analysis of binary mixtures

(05)

2. Organic Synthesis by rearrangements (02)

- i. Beckmann rearrangement
- ii. Benzil - benzilic acid rearrangement

3. Organic Synthesis of heterocyclic compounds (05)

- I. 2-phenyl indole
- II. 7-Hydroxy-4-methyl Coumarin
- III. Benzimidazole
- IV. Benzotriazole
- V. 1,2,3,4-Tetrahydro carbazole

4. Microwave assisted synthesis (02)

- i. Aspirin
- ii. Paracetamol
- iii. Saponification of Fat: Synthesis of Soap
- iv. Hydrolysis of benzyl chloride with water
- v. Oxidation of toluene with KMnO_4 / of primary alcohols
- vi. Esterification of benzoic acid

Books recommended :

1. DST guidelines for Green Chem
2. Vogel's Practical organic chemistry



Swami Ramanand Teerth Marathwada University, Nanded

Second Year B. Pharmacy, IIIrd Semester

Subject : Clinical Biochemistry
Subject Code/Paper No : BPH34
Credits : 03 (02T+01Pr.)

Course Content (Theory)

1. **Introduction to Clinical biochemistry - (01Hr)**
2. **Cellular nutrition and Energy metabolism: (12Hrs)**
 - a. System overview - Energy input and output, energy currency and storage forms,
 - b. Metabolic pathways for energy production and their clinical significance. –
 - c. Carbohydrate metabolism – Glycolysis, Kreb’s cycle, oxidative phosphorylation
 - d. Lipid metabolism – Mitochondrial β –oxidation, Peroxisomal β –oxidation, hepatic ketogenesis
 - e. Protein metabolism – Deamination, metabolism of carbon skeleton
 - f. Respiratory quotient, metabolic regulation & adaptation.
 - g. Mechanism of energy imbalance – Impaired energy input and processing, alteration in energy output and demand, Energy imbalance & disease.
3. **Clinical Biochemistry: A special emphasis on understanding of condition responsible for diseases, basic mechanism of biochemical changes and pathological testing of following diseases. (07Hrs)**
 - a. Analytical, therapeutic and diagnostic use of enzymes.
 - b. Diseases related to carbohydrate metabolism– Galactosemia, glycogen storage diseases.
 - c. Diseases related to protein metabolism – Disorders associated with urea cycle (N-Acetylglutamate synthase deficiency, Carbamoyl phosphate synthetase I deficiency, Argininemia)
 - d. Disorders associated with metabolism of various amino acids, Kwashiorkor and marasmus.
 - e. Disorders associated with lipid metabolism – Hyperlipidemia and obesity
 - f. Disorders associated with Nucleic acid metabolism - Gout, Xanthinuria
 - g. Disorders related to deficiency of Vitamins – Night blindness, Rickets, Scurvy
4. **Liver function tests, Renal function tests, Gastric function tests and pancreatic function tests (04 Hrs)**
5. **Uses of biochemical data in clinical medicine (01Hrs)**

Recommended Books:

1. Harsh Mohan: Textbook of Pathology, Jaypee Brothers, Medical Publishers, New Delhi.
2. Harisons Internal Medicine, Tata Mc-Graw Hill Publications, Singapore.
3. Davidson’s Principles and Practice of Medicine, Churchill Livingstone, New York
4. Kumar V., Abbas A. K., Fausto N., Robbins and Cotran Pathologic Basis of Disease, Elsevier
5. Herfindal Eric T., Gourley Dick R., Textbook of Therapeutics, Drug and Disease Management, Lippincott Williams & Wilkins
6. C. M. Jangme, R. D. Wadulkar, M. D. Burande, B. N. Poul; Principles of Pathophysiology, Nirali Prakashan, Pune, 2015.

7. Deodhare S. G., General Pathology & Pathology of Systems, Popular Prakashan, Mumbai
8. Stethen J. Mcthee, Lingappa Vishwanath R., Wiliam F. Gang, Jack D. Lange, Pathophysiology of Disease and Introduction to Clinical Medicine, Prentice Hall International, UK, London

Course Content (Practical/Lab Work)

1. Different methods for collection of blood
2. Estimation of Haematocrit
3. Estimation of packed cell volume
4. Physical and Chemical examination of urine (Protein, Albumin)
5. Chemical test of urine sugar, ketone bodies
6. Test for bile salt and bile pigment in urine.
7. To isolate casein from milk and its confirmation by chemical tests
8. Determination of glucose in serum
9. Estimation of serum triglycerides
10. Estimation of serum proteins
11. Estimation of SGOT and SGPT in serum
12. Estimation of creatinine in serum and urine
13. Estimation of urea in serum and urine
14. Estimation of serum acid and alkaline phosphatase
15. Estimation of bilirubin content in blood

Note: Slaughter Animal's blood or discarded blood from pathology lab or human blood from blood bank can be used for above mentioned experiments or simulated samples may also be used wherever possible.

Books recommended:

1. Lehninger's Principles of Biochemistry by Albert Lehninger, 4/Ed., Palgrave Macmillan.
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. Clinical Biochemistry by S. P. Dandekar 2/Ed



Swami Ramanand Teerth Marathwada University, Nanded
Second Year B. Pharmacy, IIIrd Semester

Subject : **Introduction to Pharmaceutical Analysis.**
Subject Code/Paper No : **(BPH35)**
Credits : **03(02T +1 Pr.)**

Objectives and scope:

- Syllabus has been designed to understand the basics of Pharmaceutical Analysis and apply this knowledge in terms of its role in both qualitative and quantitative chemical analysis.
- This knowledge will help to comprehend basics of Pharmacopoeial standards and specifications of raw material used along with quality of finished product in terms of proportion or contents of components.
- It is expected to understand and apply basic principles of data treatment and data handling.
- Students should get acquainted with the relevance & significance of analytical techniques (volumetric techniques).
- Understand the difference between precipitation and gravimetric analysis
- Brief knowledge of techniques such as oxygen flask combustion technique, Nitrogen determination by Kjeldahl method and Karl Fischer Titration

Course Content (Theory)

UNIT I: Introduction to Pharmaceutical Analysis - (11 Hrs)

1.1 Introduction (03 hrs)

Importance of pharmaceutical analysis, quality systems, quality control, In process quality control (IPQC), quality assurance, need for quality system, classification of analytical methods (classical and instrumental analytical methods), choice of analytical method, methods of qualitative and quantitative analysis, steps in quantitative analysis, interference in analysis.

1.2 Sampling: (02 hrs)

Basic of sampling, sampling procedure, sampling statistics, sampling and physical state, crushing and grinding, hazards in sampling.

1.3 Errors in chemical analysis: (02 hrs)

Concepts of errors, classification of errors (determinate, indeterminate, instrumental, operational and personal or human errors) minimization of errors, errors in measurement, absolute and relative errors, precision, accuracy, Limit of detection (LOD), Limit of quantitation / quantification (LOQ), significant figures.

1.4 Statistical treatment of analytical data: (02 hrs)

Average, mode, median, standard deviation (SD), coefficient of variation (CV), test for significance (t- test, F-test), rejection of result (Q- test), significant figures

1.5 Standardization of pharmaceuticals as per Official Monograph (02 hrs)

General meaning and concept should be covered

UNIT-II: Volumetric Techniques and Calculations: (05 hrs)

2.1 Expression of concentrations, percent (w/w, w/v, v/v, v/w), normality, molarity, molality, mole fraction, equivalent weight,

2.2 Volumetric methods:

2.2.1 Definition: Titrimetric analysis, standard solution, titrate, titrant, equivalence point/ end point, indicator, titration error

2.2.2 Requirements of volumetric methods, classification of volumetric methods,

2.2.3 Experimental techniques standardization: primary standard and secondary standard, end point detection, calibrations of glassware (pipette, burette, volumetric flask) and analytical balance,

2.2.4 Expression of analytical results and factor calculations

UNIT-III Gravimetric analysis (05 hrs)

3.1 Precipitate, properties of precipitates, precipitation, conditions of precipitation, purity of precipitate: co-precipitation, post precipitation, digestion, amount of precipitant

3.2 Precipitating agents: Organic and inorganic precipitant; choice of precipitants,

3.3 Principle, various steps in gravimetric analysis, Calculation of results, advantages and disadvantages

3.4 Assay of sodium sulphate and aluminum in Alum

3.5

UNIT-IV Organically bound metals and nonmetals (01 hr)

Theory of oxygen flask combustion technique, determination of organically bound Iodine

UNIT-V Nitrogen determination by Kjeldahl method. (01 hr)

Theory and application

UNIT –VI Karl Fischer Titration (01 hr)

Theory and application

Course Content (Practical)

Skill should be adapted by students while performing practicals

- Understand the correct use of laboratory equipments with calibration of various apparatus used in analytical chemistry laboratory together with safety measures to be followed.
- Understand the principle with quantitative estimation of analyte by gravimetric analysis.
- Understand and apply basic principles of data treatment and data handling.

Module 1 Introduction to Pharmaceutical analysis laboratory (02)

Exercise No.1-2. To Calibrate

- Analytical apparatus (burette, pipettes, volumetric flasks, micro pipettes).
- Balances

Module 2 Preparation and standardization of standard solution (04)

Exercise No.3-6 To prepare and standardize molar & normal strength solutions of acid, alkali, oxidizing & reducing agent, complexing and precipitating agent.

To prepare various concentration (ppm, $\mu\text{g/ml}$, % w/v, % v/v) solutions

Module 3 Standardization of pharmaceuticals (02)

Exercise No.7-8 Perform I P Monographs

Module 4 Gravimetric analysis (02)

Exercise No. 9-10 To perform the assay of given sample of Aluminium /

Barium Sulphate by Gravimetric

Module 5 Data handling and statistical studies (03)

Exercise No.11-13 Software (Excel, Graph pad, Dap, SOFA or suitable free available basic statistical calculation software's)

Open source statistical packages, free wares & Proprietary statistical packages

Software based practical's such as calculation of mean, mode, SD, % RSD, CV, R^2 , drawing of calibration curve.

- Examples such as hemoglobin level, red blood cells, white blood cells (Hb, rbc, wbc) counts determined by/ results of previous year batches
- Melting and boiling point of synthesized product or its yield of previous year batches

- Burette reading or such examples can be included
- concept of accuracy and precision should also be covered

Module 6 **Determination of halogen** (Demonstration) **(01)**

Exercise No. 14 Determination of organically bound halogens in given sample
by oxygen flask combustion method

Module 7 **Determination of Nitrogen** (Demonstration) **(01)**

Exercise No. 15 Determination of nitrogen in given sample by Kjeldahl method.

Module 8 **Karl Fisher's method** (Demonstration)

Exercise No. 16 To determine moisture content of given sample **(01)**

RECOMMENDED BOOKS:

1. Practical Pharmaceutical Chemistry, Part I and II by Beckett and Stenlake.(CBS)
2. Vogel's Text Book of Qualitative Chemical Analysis, 5th edition (Longman Pub.)
3. Indian Pharmacopoeia Vol-I and II (1996).
4. Alexeyev Quantitative analysis, CBS publications.
5. Gary Christain – Analytical Chemistry (John Wiley)
6. Pharmaceutical Analysis , Vol. –I , Dr. A V Kasture and Dr. S G Wadodkar
7. Pharmaceutical Analysis , Vol. –I , Ashutosh Kar, CBS Publishers
8. Eugene L. Grant Richard's Statistical Quality Control (Mc Grew Hill)
9. Skoog, West, Holler, Analytical Chemistry- An Introduction(Saunder pub.)
10. Parimoo P., Pharmaceuical Analysis (CBS)



Swami Ramanand Teerth Marathwada University, Nanded
Second Year B. Pharmacy, IIIrd Semester

Subject : Plant Genetics & Tissue Culture
Subject Code/Paper No : BPH36
Credits : 03 (02T+01Pr.)

Course Objective:

The objective of the course is to study with sufficient knowledge to impart advanced level training in the field of Pharmacognosy, Phytochemistry and Biotechnology so as to meet the industrial, research and academic standards.

Course Content (Theory)

UNIT-I

Plant Cell & Tissue culture:

Introduction, Historical development of plant tissue culture, types of culture, cell culture techniques, cellular totipotency, Laboratory Organisation (Nutritional requirements, growth & maintenance). Application of plant tissue culture in pharmacognosy and pharmacobiotechnology.

(07 hrs)

UNIT-II

Introduction to genetics:

Genetics As Applied to Medicinal Herbs, Mutation, Polyploidy, Chemical races, Artificial Mutations, Hybridization, genetic engineering of plants.

(05 hrs)

UNIT-III

Recombinant DNA Technology:

Introduction, transgenic plants, recombinant DNA techniques (Gene Splicing), DNA-Ligase, Cloning vector, Hybridization probes.

(04 hrs)

UNIT-IV

Drug Delivery in Gene Therapy:

Gene Transfer, objectives of gene therapy, diseases & gene therapy.

(04 hrs)

UNIT-V

Enzymes:

Introduction, classification, types of inhibition, isolation techniques, Immobilization of enzymes, Application of enzymes to plant biotechnology

(04hrs)

TEXT BOOK:

1. A text book of pharmaceutical biotechnology, C K Kokate, Sunil Jalalpure, and Pramod Harakadle, Elsevier publications 2012.

Book recommended :

1. Kumar H. D., Textbook of Biotechnology, 2nd Edition, 1991, Affiliated East West Press Pvt.Ltd., New Delhi.
2. Vyas, S. P., Dixit V. K., Pharmaceutical Biotechnology, 1st Edition, 1999, CBS Publishers and Distributors, Delhi.

3. Plant Tissue Culture and its Biotechnological Application by Tabata, M., Springer, Berlin.
4. Plant Biotechnology and Transgenic Plants (CRC Press) By Oksman-Caldente
5. Transgenic Plants By R Ranjan Agarobotanica.1999.
6. Pharmacognosy and Pharmacobiotechnology by Ashutosh Khar New Age International Publishers 2003
7. Herbal Drug Technology SS Agarwal and M Paridhavi Univdersities Press 2007
8. Introduction to Plant Tissue culture, Razdan, M.K., Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Course Content (Practical/Lab Work)

1. Introduction to laboratory equipments.
2. Media preparation and sterilization
3. Surface sterilization of different explants -shoot tip, nodal and leaf
4. Initiation of callus and regeneration
5. Micropropagation of –Brahmi and Vasaka
6. Isolation of enzyme- papain and bromelain
7. To study entrapment of plant cell in alginate gel.
8. Immobilization of enzyme by adsorption.
9. Immobilization of potato derived catalase.
10. To study immobilization of enzyme in calcium alginate beads.
11. Agrobacterium mediated transformation of plant tissue
12. Isolation of protoplast
13. Isolation of DNA from plant sources
14. Estimation of DNA .
15. Determination of mitotic index on onion shoot tip.

Books recommended:

1. Enzyme Technology (Springer) edited by Ashok Pandey, Colin Webb, Carlos Ricardo Soccol, Christian Larroch
2. A Practical Guide to Assay Development and High-Throughput Screening in Drug (CRC) By Taosheng Chen
3. Practical Biotechnology, R.S.Goud, G.D.Gupta, S.B.Ghokhale, Nirali Prakashan, Pune



Swami Ramanand Teerth Marathwada University, Nanded
Second Year B. Pharmacy, IIIrd Semester

Subject : Introduction to Unit Operations
Subject Code/Paper No : (BPH37)
Credits : 02(02T)

Objective:

Unit operations play an important role in the design and manufacture of dosage forms, operations like milling, granulation, drying, evaporation, mixing, pulverizing, blending etc. Are often employed in the process of making Drug Delivery systems like tablets, capsules, ointments, jellies, liquid orals and may other solid, semisolid, liquid dosage forms. The students of undergraduate programme in pharmacy do laboratory work by compounding various dosage forms on small scale without involving machines. The knowledge of how dosage forms are manufactured on large scale at accelerated rate involving various unit operations is therefore significant. The students shall be exposed to the technical operations employed by pharmaceutical manufacturers to produce Drug Delivery Systems on large scale achieving reproducibility, efficacy with every unit of dosage form manufactured.

Course content (Theory)

1. Industrial processing and basic principles (3 hrs.)

Definition of unit operations, unit processes. Steady and unsteady states, dimensionless equations dimensional formulas, dimensional analysis, and dimensionless groups. Unit operations and unit processes, scientific foundations- basic laws, ideal gas equation, Dalton's law, material balance, mole, molarity, mole fraction, energy balance, rate of reaction, steady state and non steady state. Dimensions, units, and inter-conversions.

2. Materials of construction: (3 hrs.)

Factors affecting the material selection for Pharmaceutical plants. Classification into metals and non –metals. Ferrous Metals: Cast iron, mild steels and Stainless steels, Non-Ferrous Metals: Copper and alloys, nickel alloys, Aluminum, Nonmetals: Glass, Plastics and their types.

3. Size reduction and separation (5hrs.)

Theory and objectives of size reduction, crack propagation and toughness, surface hardness, energy requirements of size reduction process, influence of size reduction on size distribution, size reduction methods and equipments, crushers, grinders, ultra fine grinders. Factors affecting size reduction, Mechanisms of size reduction with examples. Cutting machines used in pharmaceutical industries, Objective of size separation, efficiency, size separation methods. Theories of size separation, cyclone separator and bag filter. Sieving, agitation, brushing sedimentation, elutriation, equipments used, vibrating screens, centrifugal sifter.

4. Agitation and mixing (4hrs.)

Agitation and mixing definition, purpose of agitation, agitation equipments viz. impellers, propellers, paddles, turbines, flow pattern in agitated vessels helps in mixing, swirling and its prevention. Blending and mixing theory of mixing, types of mixtures, the mixing process, the scale of scrutiny, degree of mixing, mixing of powdered materials, mechanism of mixing, convective, shear and diffusive, influence of powder aggregates on mixing, segregation, types of

segregation, ordered mixing, practical importance segregation of ordered mixing, mixing of semisolids, planetary mixers, sigma blade mixers.

5. Filtration and centrifugation (4hrs.)

Definition, Mechanism and types of filtration, factors affecting rate of filtration. Methods to increase filtration rate, classification of filters. Filter and filtration techniques used in pharmaceutical manufacturing. Study of filter press, rotary drum filter and vacuum filters. Principle of centrifugation, advantages and disadvantages, study of perforated basket centrifuge, tubular bowl centrifuge.

6. Fluid flow (6hrs.)

Importance of fluid flow, nature of fluid. Fluid static measurement of pressure difference by manometers (classification only). Fluid flow- the Reynolds experiment and Reynolds number. Viscosity – definition, units, the Hagen Poiseuille equation, obeying and non obeying liquids, the Bernoulli's theorem, rate of fluid flow, Measurement of fluids – Methods of measuring like Orifice, venturi, pitot tube and rotometers,

Transportation of Fluids:

Pipe as a channel of fluid flow, Pipefitting, joints- coupling, unions, Flanges, valves and cocks commonly employed. Apparatus used for moving fluids with special reference to Pumps. The airlift theory in brief, reciprocating pumps, piston pumps and vacuum pumps

Transportation of Gases:

Devices used blowers and compressors, ejectors and fans.

Transportation of Solids - Conveying:

Conveying equipments e. g. belt, chain, screw and pneumatic conveyer for transport of solids.

Text books:

1. Pharmaceutical Engineering Principle and Practice: C. V. S. Subrahmanyam Vallabh Prakashan, Delhi.

Books recommended :

1. Unit operations and chemical engineering – WL: Mc Cabe, JC Smith, P. Harriott, Mc Graw hill international.
2. Pharmaceutics – The science of Dosage form Design – ME Aultonm, Churchill Livingstone ELBS low priced.
3. Introduction to chemical engineering – W L Badger & JT Bancrero, Tata MC Grew Hill.
4. Unit operations – G G Brown, CBS Publication.
5. Principles of Refrigeration (SI Version) – R T Dossat, Wiley Eastern.
6. Unit processes in Pharmacy |- David ganderton.
7. Material Selection for processing plants – Russel Gackenback, Reinhold publications.
8. Plant engineers hand book – Stainer, Mc Milon Publication.
9. Chemical engineers hand book – perry and Chilton, Mc Grew Hill.

10. Theory and Practice of Pharmacy – Leon Lackman and others., Lea and Febeger publications.
11. Chemistry of engineering material by Linger.
12. Principles of industrial instrumentation – D. Patranabis, Tata Mc Graw Hill.
13. Basic Refrigeration and air conditioning – PN Ananthnarayan, Tata Mc Graw Hill.
14. Refrigeration and air conditioning – CP Arora, Tata Mc Graw Hill.
15. Remington Pharmaceutical sciences – Hoover, Mac Publishing Co.
16. Pharmaceutical Engineering, K. Sambamurthy, New Age, International (P). Ltd., Publishers, New Delhi.
17. Introduction to Pharmaceutical Engineering, Dr. A R Paradkar, Nirali Prakashan, Pune.



Swami Ramanand Teerth Marathwada University, Nanded

Second Year B. Pharmacy, IIIrd Semester

Subject	: Causes of Disease and Prevention
Subject Code/Paper No	: BPH38
Credits	: 02 (02T)

Pathophysiology is an integrative science that draws concepts from many basic and clinical sciences, including Anatomy, Physiology, Pathology, Biochemistry, Genetics, Pharmacology, Cell and Molecular Biology and Biophysics. Pathophysiology focuses on the mechanism of diseases. These mechanisms are dynamic process that,

- i) Cause disease
- ii) Give rise to signs and symptoms
- iii) Signify the body's attempt to overcome disease.

Need of the course in curriculum:

Globally a pharmacist is a part of health care team and is therefore is a health practioners. Understanding mechanisms of disease enables him to design and implementation of "clinical interventions" which often prove effective in treatment of disease.

Objective:

The general theoretical framework of the subject Pathophysiology is based upon the theories and related concepts of "adaptation" and "homeostatis". An orientation to disease as disordered physiology can enable a student to understand causes of disease; how and why the symptoms and signs of various conditions appear; so that rational therapies can be devised.

Course Content (Theory)

- 1. Concepts and theories of Pathophysiology: (04Hrs)**
Introduction to Pathophysiology, concept of health, disease and clinical intervention (definition and models); components of the disease process and related interventions; classification of disease, General systems theory, stress theory, related concepts of adaptation and homeostasis
- 2. Intercellular communication: (02 Hrs)**
Mechanism of intercellular communication, mechanism of abnormal intercellular communication, clinical significance of intercellular communication
- 3. Electrophysiology (Action potential and conduction): (02 Hrs)**
Generation of membrane potential and action potential, mechanism of conduction, conduction in specific excitable tissues (Nervous, Skeletal, Cardiac Tissue and smooth muscle), mechanism altered conduction.
- 4. Cellular mechanism of muscle contraction: (02 Hrs)**
Microanatomy of muscle tissue, filament mechanism of contraction, Regulation of muscle contraction, mechanism of abnormal muscle contraction, clinical consequences of alteration in muscle contraction

5. **Inflammation:** (04 Hrs)
Basic mechanism involved in the process of inflammation and repair, Alteration in vascular permeability and blood flow, migration of WBC's, acute and chronic inflammation, brief outline of the process of repair and healing.
6. **Immunity and related disorder:** (04 Hrs)
Classification of immune response, components of immune system, regulation of immune response, phases of the immune response and mechanism of immunopathology, Hypersensitivity reactions, Pathophysiology of AIDS.
7. **Haematological disorders: Anemias, Leukaemia:** (02 Hrs)
8. **Cardio vascular system:** (04 Hrs)
Atherosclerosis, Hypertension, Congestive heart failure, Angina pectoris

Books recommended:

1. Margie Hansen; Pathophysiology: foundation of disease and clinical intervention; W.B. Saunders Company, London, 1998.
2. K.L.McCance, Sue E. Huether; Pathophysiology: The Biologic Basis for Disease in Adults and children's, 3rd edition, Mosby, Inc., 1998.
3. Stephen J. Mcphee, et.al. Pathophysiology of Disease: An introduction to clinical medicine; 2nd edition, Prentice-Hall International Inc., 1997.
4. C. M. Jangme, R. D. Wadulkar, M. D. Burande, B. N. Poul; Principles of Pathophysiology, Nirali Prakashan, Pune, 2015.
5. John B.Walter; Pathophysiology of Human Disease, Lea & Febiger, London, 1998.
6. William Boyd; A Text Book Pathophysiology, 8th edition, Lea & Febiger, Philadelphia, 1949.
7. J.R. Anderson; Text Book of Pathology, 25th edition, ELBS, Arnold, 1985.
8. Edward D. Frohlien; Pathophysiology: Altered Regulatory Mechanisms in Disease, 3rd edition, J.B. Lippincott Company, London, 1984.
9. Y.M. Bhende, S.G. Deodhar, General Pathology, (Part-1&2), Popular Prakashan, Mumbai.
10. Harsh Mohan; Text Book of Pathology, Jaypee Medical Book Publishers.
11. Parth; Pathophysiology, Lippincott, London.
12. Cortran, Kumar P. Robbins; Robbins Pathologic Basis of disease.
13. Cop Stead; Perspective in Pathophysiology, Saunders.
14. Prakash Ghadi, Pathophysiology, 1st edition, Career Publication, Nashik, 2000



Swami Ramanand Teerth Marathwada University, Nanded

Second Year B.Pharmacy IVth Semester

Subject : Physical Pharmaceutics
Subject Code / Paper No. : BPH41
Credits : 03 (02T+01Pr)

Scope of Subject

This Course is concerned with the study of Physico-chemical properties of materials which are pertinent in design of drug delivery system. The understanding of physical and chemical properties of materials helps to minimize the manufacturing stresses and enable the smooth production. Last but not the least it aids a pharmacist to choose the right kind of material to predict the release and biologic action of drug product.

Learning objectives:

On the successful completion of the following theory topics and laboratory work, student shall be able....

1. To Understanding the mechanism of dissolution and diffusion processes which are useful in the prediction of onset of action of the drug moiety in the body.
2. To explicate the rheological properties of the materials and their determination by the correct use of various equipments in Pharmaceutics laboratory relevant to practicals.
3. To predict the rate of reactions and implementation of stability testing procedures which are useful in evaluation of drug delivery systems.

Course content (Theory)

- 1. Rheology:** (5 Hrs)
Fundamentals of Rheology, type of flow, measurement of flow, Newtonian system, Non-Newtonian systems, thixotropy and anti thixotropy in formulation, Methods of viscosity measurements and apparatus for determination of viscosity, applications in pharmacy.
- 2. Micromeritics:** (4 Hrs)
Introduction and Pharmaceutical applications. Particle size and distribution, methods for determining particle size, particle shape and surface area, methods for determining surface area, derived properties of powders. Flow of Powders: Introduction, methods to determine, factors affecting powder flow, Pharmacopoeial specification of Angle of repose, Hausner's ratio, Carr's index.
- 3. Disperse systems:** (3Hrs)
Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy, DLVO Theory. Kinetic, Optical and Electrical properties of Colloids.
- 4. Chemical kinetics:** (04 Hrs)

Rate, order and molecularity of reaction, study of zero, first and second order reaction, determination of shelf life, half life, effect of temperature.

5. Diffusion and Dissolution: (4 Hrs)

Introduction and definition. Steady state diffusion, procedures and apparatus. Applications and mathematical equations. Diffusion principles in biologic systems, Dissolution: Introduction, definition and factors affecting dissolution, Steps in dissolution and apparatus. Drug release, applications.

6. Stability testing: (04 Hrs)

Study of: official definition of stability, physical and chemical degradation of pharmaceutical products and preventative measures, factors affecting degradation, stability testing and storage conditions. Arrhenius equation, energy of activation.

Books Recommended:

Text Books:

1. Martin's Physical pharmacy by Patrick J. Sinko, 5th edition, Lippincott Williams & Wilkins, New York, 2006.
2. Subrahmanyam CVS. Essentials of Physical Pharmacy. 1st ed. New Delhi: VallabhPrakashan; Reprint 2006

Books Recommended :

1. Pharmaceutics: The Science of Dosage Form Design, 2nd edition, Aulton, Michael E., Churchill Livingstone, London, 2002.
2. Remington: The Science and Practice of Pharmacy, Vol-I & II, 20th edition, Gennaro, Alfonso R. Lippincott Williams & Wilkins, New York, 2002.
3. Physicochemical Principles of Pharmacy, 3rd edition, Florence, A. T. Atwood, D. Macmillan Press Ltd., London 1998.
4. Pharmaceutical Dosage Forms and Drug Delivery Systems, Ansel Howard. C., Allen, Loyd V., Popovich, Nicholas G. Lippincott Williams & Wilkins, New York, 2002.
5. Cooper and Gunn's Tutorial Pharmacy, ed. Carter, S. J., 6th edition, CBS Publishers & Distributors, Delhi, 2000.
6. Bentley's textbook of Pharmaceutics by E. A. Rawlins
7. Madan and Tuli S. Essentials of Physical Pharmacy. Chand & Company, New Delhi.

Course content (Practical)

1. To determine partition coefficient of Iodine in carbon tetrachloride and distilled water.
2. Determination of particle size by optical microscopy.
3. Determination of particle size by sieving analysis.
4. To determine Bulk density and Tapped density of given powders.
5. Determination of Carr's index and Housner ratio of given powder material.
6. Determination of viscosity of given liquid samples by Ostwald viscometer.
7. To study the effect of effect of temperature and concentration on viscosity of sugar syrup.
8. Determination of angle of repose of given powder sample.
9. To study the effect of moisture and glidants on flow property of powders.
10. Determination of order of hydrolysis, rate constant of reaction and half life of Methyl acetate in the presence of acid.
11. To determine the physical stability of given dosage form.
12. To prepare and evaluate the physical stability of sulphur colloids and to study the influence of additives on its stability.
13. To study the diffusion and dissolution test apparatus.

Books Recommended:

1. Gaud RS and Gupta GD .Practical Pharmaceutics. 1st ed. New Delhi: CBS Publishers & Distributers; Reprint 2010.
2. Hadkar UB. A Textbook of Physical Pharmacy. 4th ed. Pune: NiraliPrakashan; 2007
3. Kapoor KL. Textbook of Physical Pharmacy. Vol. II, 3rd ed. McMillan India Ltd.
4. Laboratory Manual of Physical pharmacy by CVS Subrahmanyam , Vallabh Prakashan, Delhi.



Swami Ramanand Teerth Marathwada University, Nanded
Second Year B. Pharmacy, IVth Semester

Subject : Sterilization and Disinfection
Subject Code/Paper No : BPH42
Credits : 03 (02T+01Pr)

The Course;

The study of Sterilization and Disinfection includes various techniques involved in making the pharmaceutical preparations sterile or reducing the microbial count to a safe level. It also includes the principles and methods involved in making the pharmaceutical manufacturing in a hygienic and aseptic environment.

Objective:

To acquaint the students of Pharmaceutical Sciences with basic knowledge of principles and techniques of sterilization and disinfection, sources of microbial contamination, microbial control in aseptic area and various evaluation tests for disinfectants and preservatives.

Course content (Theory)

1. Criteria of Sterilization: Introduction to sterilization, bioburden, sensitivity of microorganisms, survivor curves, D-value, Z-value, F-value, Q₁₀ value, inactivation factor. **(02 Hrs)**
2. Methods of Sterilization: Principles, methods and applications of physical methods (Dry heat sterilization e.g. hot air oven; Moist heat sterilization e.g. Temp. below, above and at 100°C, autoclave; Radiation e.g. ionizing, nonionizing and cathode rays; and Filtration e.g. asbestos filter, sintered glass filter, filter candles and membrane filter), chemical sterilization (gaseous sterilization e.g. formaldehyde, ethylene oxide, β-propiolactone, by using disinfectants). **(05 Hrs)**
3. Sterilization Monitors: Physical, chemical and biological indicators **(01 Hr)**
4. Test for Sterility: Principle, culture media, quantity of test sample and culture medium, dilution fluids and method for membrane filtration test and direct inoculation test. **(02 Hrs)**
5. Design of Aseptic Area and Microbial Control: Introduction, sources of contamination, building design, construction and production facilities (floors, walls and ceilings, doors, windows, services, personnel, protective clothing, cleaning and disinfection), environmental control, (air supply, airflow pattern), testing of clean and aseptic rooms (

general methods, air sampling methods, surface sampling methods).
(04 Hr)

6. Disinfectants: (03Hrs)

Definition - antiseptics, preservatives and sanitizing agents. Chemical classification of disinfectants - acids and alkalis, Halogens and derivatives, iodine, phenols, black fluids, white fluids, Alcohols, Formaldehyde, Hydroxy acids and their esters, surface active agents, dyes, metals.

7. Evaluation of Disinfectants: Factors affecting activity of disinfecting agents, evaluation methods- tube dilution and agar plate method, filter paper method, ditch plate method, phenol coefficient methods (RW Coefficient, chick martin, AOAC, Kelsey - Sykes test)
(03 Hrs)

8. Microbial Spoilage: Introduction, sources of microbial spoilage, assessment of microbial spoilage, microbial limit tests (membrane filtration, total plate count, most probable number)
(02 Hrs)

9. Pharmaceutical preservatives: Introduction, chemical preservatives, factors affecting preservative efficacy, preservative efficacy test.
(02 Hrs)

Books Recommended

Text Book:

1. W.B.Hugo & A.D. Russell, Pharmaceutical Microbiology (6th edi.), Blackwell science ltd.,
2. L.E.Casida, Jr., Industrial Microbiology (9th edition), New Age International (p) Ltd., Publishers, New Delhi.
3. Dr. Chandrakant R. Kokare, Pharmaceutical Microbiology (6th edi.), Nirali Prakashan, Pune.

Reference Books:

1. Gerald Reed, Prescott and Dunn's Industrial Microbiology, (4th edition), CBS publishers and distributors, Delhi.
2. Seymour S.Block, Disinfection, sterilization and preservation, (4th edition) Lea and Febiger, Philadelphia, London.
3. Diane M.Collett & Michael E. Aulton, Pharmaceutical Practice, 1990, Churchill Livingstone, New York.
4. R.Ananthnarayan and C.K. Jayaram Panikar, text book a microbiology (6th edition), Orient Longman Limited, Hyderabad.
5. Frohisher, Hinsdill, crabtree, Good heart, Fundamentals of Microbiology (9th edition), Saunders' International student edition, Toppan Company Limited, Tokyo, Japan.
6. Michael J.Pelczar, Jr., E.C.S. chan, Noel R, Krieg, Microbiology (5th edition) 1993, Tata McGraw – Hill publishing company Ltd., New Delhi.
7. S.S. Purohit, Microbiology (Fundamentals and applications), (6th edition), 2000-2001, Agrobio (India), Jodhpur.

8. Jacquelyn G. Black, Microbiology (principles and explorations), Prentice Hall, New Jersey.
9. Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton, Industrial Microbiology, An introduction (2001) Blackwell Science.
10. Rojer Y. Stanier, John L. Ingraham, Mark L. Wheehis, Page R. Painter, General Microbiology (5th edition), Macmillan press ltd.

Course content (Practical)

- Experiment No. 1 To study the operations of different instruments used in pharmaceutical Sterilization processes: Autoclave, Hot air oven, laminar air flow.
- Experiment No. 2. a) To sterilize given sample of powder/glassware/vials using hot air Oven
b) To sterilize given sample of rubber gloves / surgical cotton / Ligature by autoclave.
c) To sterilize given sample of material (blood sera / thermolabile liquids) by filtration
- Experiment No. 3. a) To prepare and sterilize nutrient broth
b) To prepare and sterilize nutrient agar
- Experiment No. 4. Aseptic transfer of nutrient agar i) To prepare agar plate. ii) To prepare slant.
- Experiment No. 5. Aseptic transfer of liquid culture media i) To petri dish ii) To culture tube
- Experiment No. 6. To standardize given sample of disinfectant using phenol coefficient test.
- Experiment No. 7. Sterility test by filtration method
a) To perform sterility test for aqueous solution.
b) To perform sterility test for ointment and creams
- Experiment No. 8. Sterility test by direct inoculation
a) To perform sterility test for aqueous solution and suspensions
b) To perform sterility test for solids
- Experiment No. 9. To study the effect of chemical agents on bacterial growth
- Experiment No. 10. To study the effect of temperature on microbial growth
- Experiment No. 11. a) To study the effect of osmotic pressure on microbial growth
b) To study the effect of pH on microbial growth.
- Experiment No. 12. Microbial assay of antibiotic using turbidimetric method
- Experiment No. 13. To examine given sample of milk for microorganism using methylene blue test.

Books Recommended:

6. James G. Cappuccino & Natile Sherman, Microbiology a laboratory manual (4th edition), Addison – weley langman, Inc.
7. C.H.Collins, Patricia M. Lyne, J.M. Grange, Microbiological methods,(7th edition) Butter worth Heinemann, Oxford.
8. L.Jack Bradshaw, Laboratory Microbiology 4th edition Saunders college publishing, Harecourt Brace Jovenovich college publishers.
9. R.S. Gaud, G.D. Gupta, Practical Microbiology, Nirali Prakashan, Pune.
10. Vinita kale, Kishor Bhusari, practical Microbiology, Principles and techniques, Himalaya Publishing House , Mumbai.
11. P.Gunasekaran, Laboratory manual in microbiology, New age International (p) publishers.



Swami Ramanand Teerth Marathwada University, Nanded
Second Year B. Pharmacy, IVth Semester

Subject : Classical Analytical Techniques
Subject Code/Paper No : BPH43
Credits : 03 (02T+01Pr)

Objectives and scope:

- The objective of the course "Classical Analytical Techniques" is to study the various techniques employed in analysing pharmaceuticals.
- The course encompasses the methods of production of analytical data, which is related to quality of the product assured by employing instrumental techniques.
- Understanding of basics of titrations principles and methods involved in used in different titration methods such as aqueous, non-aqueous, precipitation, complexometric, redox titration methods is **highly expected.**

Course content (Theory)

Unit-I	Introduction of classical analytical methods	01 hr
Unit-II	Aqueous acid base titrations	06 hrs
2.3	Theory: Acid –base theory, law of mass action and its application, acid base equilibrium, ionic product of water, pH, pKa, Henderson-Hasselbach equation common ion effect	
2.4	Endpoint detection, neutralization indicators, theory of indicators, (no chemical structures to be included), mixed indicators, universal indicator, choice of indicators	
2.5	Theory of various neutralization titrations (include at least two examples of each), like	
	2.3.1 Titration of strong acid with strong base (Vice-versa)	
	2.3.2 Titration of weak acid with strong base (Vice-versa)	
	2.3.3 Titration of weak base with strong acid (Vice-versa)	
	2.3.4 Titration of weak acid with weak base (Vice-versa)	
2.6	Preparation and standardization of 1N NaOH and 1N HCl (as per I.P.)	
2.7	Back titration: Definition, principle, blank determination, assay of aspirin IP	

Unit-III Non Aqueous Titrations **02 hrs**

3.1 Introduction, non aqueous solvents and their classification with examples, Indicators (excluding structures), factors affecting non aqueous titrations

3.2 Preparation and standardization of 0.1N perchloric acid IP

Unit-IV Complexometric Titrations **05 hrs**

4.1 Theory, chelating agents & its synonyms, complex formation, factors affecting complex formation,

4.2 Detection of endpoint, theory of indicators, metallochrome indicators (eriochrome black t, mordant blue III, catechol violet, murexide, xylenol orange -no chemical structures to be included)

4.3 EDTA, types of EDTA titration and names of other complexing agents

4.4 Preparation and standardization of disodium EDTA IP

4.5 Masking and demasking agents: Theory and application in determination of mixture containing two and three metal ions.

Unit-V Oxidation Reduction Titrations **06 hrs**

5.1 Oxidation, reduction, oxidizing agents, reducing agents, redox potential, oxidation number, balancing oxidation-reduction reaction,

5.2 Principle, indicators: internal, self indicator, external (no chemical structures to be included)

5.3 Permanganate titration: theory, preparations and standardization of 0.02 M potassium permanganate IP

5.4 Cerimetry: theory, preparations and standardisation of 0.1M Cerium (IV) sulphate

5.5 Iodometric and Iodimetric titrations: Theory, Preparations and standardisation of 0.1N Iodine solution I.P., Preparations and standardisation of 0.1 N Sodium Thiosulphate

5.6 Titration with Potassium Iodate: Theory, Preparations and standardisation of 0.025 M Potassium iodate

Unit-VI Argentometric titrations: **03 hrs**

6.1 Theory of precipitation, solubility product, titration curve, Factors influencing solubility of precipitate

6.2 End point detection, Mohr's method, Volhard's method, Fajan's method

6.3 Preparation and standardisation of 0.1 N AgNO₃ and 0.1M Ammonium thiocyanate

Unit-VII Sodium nitrite Titrations **01 hr**

Theory, Preparations and standardization and of 0.1 N NaNO₂

Text book:

1. Practical Pharmaceutical Chemistry, Part I and II by Beckett and Stenlake.(CBS)
2. Vogel's Text Book of Qualitative Chemical Analysis, 5th edition (Longman Pub.)

Books recommended:

1. Gary Christain – Analytical Chemistry (John Wiley)
2. Pharmaceutical Analysis , Vol. –I , Dr. A V Kasture and Dr. S G Wadodkar
3. Pharmaceutical Analysis , Vol. –I , Ashutosh Kar, CBS Publishers
4. Eugene L. Grant Richard's Statistical Quality Control (Mc Graw Hill)
5. Skoog, West, Holler, Analytical Chemistry- An Introduction(Saunderson pub.)
6. Parimoo P., Pharmaceutical Analysis (CBS)
7. V. Alexeyev , Quantitative Analysis (CBS)
8. Indian Pharmacopoeia Vol-I and II (1996)

Exercise No. IV a. To prepare and standardize 0.05 M Potassium Iodate I.P.

Exercise No. IV b. To perform the assay of given sample of Potassium Iodide I.P.

Pr. No. 4. Argentometric titration 02

Exercise No. I a. To prepare and standardize 0.1 N Silver Nitrate I.P.

Exercise No. I b. To perform the assay of given sample of Sodium Chloride I.P.

Exercise No. II a. To prepare and standardize 0.1N Ammonium Thiocyanate I.P.

Exercise No. II b. To perform the assay of given sample of Potassium Chloride I.P

No. 5. Complexometric titration (ANY 02 OF Ib, Ic & Id) 02

Exercise No. I a. To prepare and standardize 0.05 M Disodium EDTA IP.

Exercise No. I b. To perform the assay of given sample of Calcium Gluconate IP

Exercise No. I c To determine hardness of water,

Exercise No. I d To perform the assay of given sample of magnesium sulphate

Pr. No. 9. Sodium nitrite titration 01

Exercise No. I a. To prepare and standardize 0.1 N Sodium Nitrite IP

Exercise No. I b To perform the assay of given sample of Sulphanilamide

IP/ Sulphadiazine IP

Book recommended :

- 1) Practical Pharmaceutical Chemistry, Part I and II by Beckett and Stenlake.(CBS)
- 2) Vogel's Text Book of Qualitative Chemical Analysis, 5th edition (Longman Pub.)
- 3) Indian Pharmacopoeia Vol-I and II (1996)
- 4) Alexeyev Quantitative analysis, CBS publications



Swami Ramanand Teerth Marathwada University, Nanded

Second Year B. Pharmacy, IVth Semester

Subject : Organic Chemistry-IV
Subject Code/Paper No : BPH 44
Credits : 3 (02T+01Pr)

Objective:

After learning/ understanding of basics of stereochemistry in previous year semester, it is anticipated to learn the advanced part of stereochemistry. This syllabus has been designed to understand the basics as well as advanced part of stereochemistry which will be highly useful for students for stability of pharmaceuticals, drug designing along with polymer chemistry. The stereochemistry mainly highlights the geometric isomerism, optical isomerism, configuration and conformational analysis. Polymer chemistry includes classification of polymers and methods of polymerization.

Course Content (Theory)

1. Stereochemistry part -I (18Hrs)

- While teaching emphasis must be given to include practical based approaches for learning stereochemistry (such as 3D models, ppt, videos, computer soft ware's, assignments to prepare stereo models etc).
- Problems based on drawing of different configurational isomers & stereochemical formulas must be covered and practised by students in terms of examination point of view.

1.a) Geometric isomerism- (05Hrs)

- Geometric isomerism - cause of geometric isomers
- Inter conversion of geometric isomers
- Geometrical isomerism of oximes
- Distinction between configuration of geometric isomers
- Cis-trans isomerism resulting from-
 - multiple double bonds
 - monocyclic compounds
 - fused and bridged ring system
- Out-in isomerism

1.b) Optical isomerism: (05 Hrs)

- Stereogenic centre (examples such as 4-ethyl-4-methyloctane, linalool, limonene, 1,2-epoxy propane, 2-cyclopenten-1-ol, 3-cyclopenten-1-ol should be covered)
- Elements of symmetry
 - Identity
 - Proper axis of symmetry
 - Plane of symmetry
 - Centre of symmetry
 - Alternating or improper axis of symmetry
- Symmetry in achiral structures
- Asymmetric molecules
- Chirality: Cause of optical isomerism
- Criterion of enantiomerism
- Chirality at atoms other than carbon
- Prediction of number of optical isomers
- Methods of resolution of racemic mixture
- Racemization

1.c) Configuration: (03 Hrs)

- Dotted line wedge formula and Fischer projection formula
- Guidelines for writing stereochemically equivalent structures on Fischer projections
- Cahn-Ingold-Prelog R-S notational system (for one and two chiral centre)

1.d) Conformational analysis: (05 Hrs)

- Andiron formula / Sawhorse projection formula
- Newman projection formula
- Conformational analysis of butane (including potential energy diagram)
- Molecular mechanics applied to alkanes and cycloalkanes-
 - strain energy
 - angle strain
 - Baeyer strain theory
- Conformations of cyclohexane
 - axial and equatorial bonds in cyclohexane
 - Conformational inversion (ring flipping) in cyclohexane

2. Stereochemistry part-II: (03 Hrs)

- Concept and definition of stereoselective and stereospecific reactions
- Stereochemistry of addition of halogens to alkenes - syn and anti addition
- Stereochemistry of E2 reaction - syn and anti elimination

3. Polymers: (03 hrs)

- Classification of polymers
- General methods of polymerization (chain & step reaction)
- Molecular mass of polymers
- Biopolymers and biodegradable polymers
- Methods of polymerization (free radical, cationic and anionic addition polymerizations)

- Copolymerization
- Definition & examples of -natural rubber; vulcanization of rubber& synthetic rubbers

Text book:

1. I.L.Finar, Organic Chemistry, Vol. I & II, Longman (Low priced)

Books recommended :

- 18) T. Eicher, S. Hauptmann, The Chemistry of Heterocycles(New York 1995).
- 19) Ernest L. Eliel, Stereochemistry of Carbon compounds (Tata McgrawHill)
- 20) G.R.Chatwal, Reaction Mechanism and Reagents in Organic Chemistry, Himalaya
- 21) Pine, Hendrickson, Cram and Hammond, Organic Chemistry (Mcgraw Hill)
- 22) Morrison and Boyd, Organic Chemistry (Prentice Hall)
- 23) Agronomov etal, Problems and exercises in Organic Chemistry (Mir publishing Co.)
- 24) Bansal R.K., Heterocyclic Chemistry (New Age International)
- 25) I. L. Finar, Organic Chemistry (ELBS)
- 26) March Jerry, Advance Organic Chemistry (Wiley Interscience)
- 27) Stuart Warren, Designing Organic Synthesis(John Wiley)
- 28) Clayden, Greaves, Warren and Wathers, Organic Chemistry(Oxford)
- 29) Carey, F. A. Organic Chemistry (7th ed.) McGraw-Hill 2008
- 30) P Y Bruce- Organic Chemitry, 2nd edition, Prentice Hall, NJ.
- 31) Sanghai R Green Chemistry- Narosa Pubication -India
- 32) DST guideline- Green Chemistry
- 33) M.K. Jain, S.C. Sharma, Modern organic chemistry- Vishal Publishing co- Delhi
- 34) V.K.Ahluwalia, Green Chemistry- A text book(Narosa Publishing House)-New Delhi
- 35) Morrison & Boyd-p. No. 1077; Paula Bruice 2nd edition- p. No. 1111; Clayden, OC, Oxford press-p. No.1451

Course content (Practical)

Skill should be adapted by students while performing practicals:

Lab practicals have been majorly divided in separation and identification of binary mixture, synthesis of organic compounds and demonstration of stereo models/ stereochemistry practicals.

Separation and identification- Students are expected

- To understand and learn the basics /rationale of separation, chemical reactions involved in separation along with practice safety measures in laboratory.
- To learn the principle involved in various qualitative tests (every test performed while separation) and analyze the given unknown binary organic compounds having different functional groups.
- To understand principle involved in different techniques such as filtration, colored reaction and precipitation of organic compounds along with reaction & mechanism.
- Significance of synthesis of derivatives

Synthesis of organic compounds- Students are expected

- Understand concept and purpose of synthesis along with recrystallization (principle, solvent selection, cause of precipitation), techniques of filtration and precipitation along with its reaction & mechanism.
- Change takes place during the course of reactions should be understood along with its principle and its applications
- The study of synthesis and chemical reaction will assist the learner for understanding of future/ prospective of drugs and pharmaceutical synthesis using rearrangements

Stereochemistry practicals

Understand relevance of stereochemistry & its significance in Pharmaceutical Sciences in terms of stability of pharmaceuticals, drug designing

Application(s) of practically learned skills must be carried out to evaluate the gained knowledge.

-
-
- | | |
|--------------------------------------------------------------------------------|------------|
| 1. Separation and qualitative analysis of binary mixtures (Solid-Solid) | (5) |
| 2. Synthesis of organic compounds | (8) |
| a) Anthranilic acid from Phthalimide | |
| b) Anthraquinone | |
| c) Benzanilide (Two steps) | |
| d) Benzoic acid | |
| e) Chloramine T | |
| f) Dichloramine T | |

- g) 2,4,6-tribromoaniline
- h) 2,4,6-tribromoacetanilide

3. Demonstration of Stereo models/ stereochemistry practicals (1)

- I. Syn and anti-elimination and addition reactions
- II. Workshop on Stereomodels of organic compounds, employing Stereomodel and Computer software.

Text book:

- 1. I.L.Finar, Organic Chemistry, Vol. I & II, Longman (Low priced)

Books recommended:

- 1. T. Eicher, S. Hauptmann, The Chemistry of Heterocycles(New York 1995).
- 2. Ernest L. Eliel, Stereochemistry of Carbon compounds (Tata McgrawHill)
- 3. G.R.Chatwal, Reaction Mechanism and Reagents in Organic Chemistry, Himalaya
- 4. Pine, Hendrickson, Cram and Hammond, Organic Chemistry (Mcgraw Hill)
- 5. Morrison and Boyd, Organic Chemistry (Prentice Hall)
- 6. Agronomov etal, Problems and exercises in Organic Chemistry (Mir publishing Co.)
- 7. Bansal R.K., Heterocyclic Chemistry (New Age International)
- 8. I. L. Finar, Organic Chemistry (ELBS)
- 9. March Jerry, Advance Organic Chemistry (Wiley Interscience)
- 10. Stuart Warren, Designing Organic Synthesis(John Wiley)
- 11. Clayden, Greaves, Warren and Wathers, Organic Chemistry(Oxford)
- 12. Carey, F. A. Organic Chemistry (7th ed.) McGraw-Hill 2008
- 13. P Y Bruice- Organic Chemitry, 2nd edition, Prentice Hall, NJ.
- 14. Sanghai R Green Chemistry- Narosa Pubication -India
- 15. DST guideline- Green Chemistry
- 16. M.K. Jain, S.C. Sharma, Modern organic chemistry- Vishal Publishing co- Delhi
- 17. V.K.Ahluwalia, Green Chemistry- A text book(Narosa Publishing House)-New Delhi



Swami Ramanand Teerth Marathwada University, Nanded
Second Year B. Pharmacy, IVth Semester

Subject : **Fundamentals of Pharmacology**
Subject Code/Paper No : **(BPH45)**
Credits : **03(02T+1Pr)**

Need of the Course in Curriculum:

The students of the degree program in pharmacy are trained in a manner –

- i) To design and fabricate drug for clinical use
- ii) To render professional services on drugs and related matters to other health practitioners
- iii) To render services as counsellor to patients.

All these aspects require knowledge and understanding of the subject Pharmacology. The courses as anatomy & physiology, pathophysiology, pharmacokinetics, drug interactions at various levels of the program are the inputs in understanding the subject matter.

Objective of the Course:

The course in Fundamentals of Pharmacology provided understanding of the basic principles that underline current therapy, Pharmacokinetics, Pharmacodynamics, Toxicology and Therapeutics.

Course Content (Theory)

- | | | |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 1. | Definition, Introduction and scope of Pharmacology with sources of drugs | 01 |
| 2. | Different Routes of drug Administration with their advantages and disadvantages. | 01 |
| 3. | Basic Concepts of Pharmacokinetics
Absorption, Distribution, Metabolism, Excretion | 05 |
| 4. | Pharmacodynamics
Mechanism of drug action, Drug Receptors interactions and molecular and biochemical basis of drug action, Theories of Receptors, Non-Receptor mechanism of drug action, Factors modifying drug dose and response, Dose response relationship, Affinity and intrinsic activity, Additive effect, synergism, potentiation, Drug Antagonism Phenomenon, Drug Tolerance and Drug Dependence, Therapeutic index | 05 |
| 5. | Pharmacology of ANS
i. Cholinergic system-
Parasympathomimetic (Cholinergic) drugs | 09 |

Parasympatholytic (anti Cholinergic) drugs		
ii. Adrenergic system		
Sympathomimetic (Adrenergic) drugs		
Sympatholytics (Anti-adrenergic) drugs		
iii. Drugs affecting the transmission in Autonomic Ganglion		
iv. Neutomuscular blocking agents and Antispasticity drugs		
v. Local anaesthetics		
6. Adverse Drug Reactions	01	
7. Drug Interactions, Types of drug interactions	01	
8. Development of New Drug		01

Text book:

1. F.S.K. Barar: Essential of Pharmacotherapeutics, 3rd edition, 2000, S.Chand & company Ltd., New Delhi.

Books recommended:

1. R.S. Satoskar & S.B. Bhandarkar: Pharmacology and pharmacotherapeutics, 6th edition 1999, Popular Prakashan, Mumbai.
2. H.P. Rang and M.M. Dale: Pharmacology, 4th edition, 1999, Churchill Livingstone, London.
3. A.G. Gilman, L.S. Goodman: The Pharmacological basis of therapeutics 9th edition, 1995, International Edition, McGraw-Hill, New York
4. M.H. Paranjpe, K.G. Bothara: Fundamentals of Pharmacology (Vol.I & II), 1990, Nirali Prakashan, Pune.
5. K.D. Tripathi: Essentials of Medical Pharmacology.
6. S.D. Seth : Text book of Pharmacology, 2nd edition, 1999, B.I. Churchill Livingstone (P) Ltd., New Delhi
7. B.G. Katzung: Basic and clinical Pharmacology : 8th edition, 2000, McGraw-Hill Medical Publishing Division
8. Leonard S. Jacob: Pharmacology, 3rd edition, 1992, Harval Publishing Company, Malvern.
9. C.R. Craig and R.E. Stitzel: Modern Pharmacology, 3rd edition, 1990, Little, Brown and Company, Boston.
10. A.Kucers and N.McK Bennett: The use of antibiotics, 3rd edition, 1982, W.H. Medical Book Ltd., London.
11. R.W. Foster B.Cox: Basic Pharmacology, 1980, Butterworths, London.

Course Content (Practical/Lab Work)

1. Introduction of Basic Equipments used in Experimental Pharmacology.
2. Preparation of various physiological salt solutions used in experimental pharmacology. (Composition and significance).
3. Study of Laboratory animals in experimental pharmacology.
4. Calculation of Dose of drug on the basis of Age, body weight & surface area.
5. To demonstrate oral and Parenteral route of drug administration in rat/mice (by using pharmacology software's or by using video clips)
6. To demonstrate blood withdrawal by puncture of retro orbital plexus and from tail vein of rats (by using pharmacology software's or by using video clips)
7. To study the effect of Mydriatic and Miotics on Rabbit eye. (by using pharmacology software's or by using video clips)
8. Study of different parameters of animals e.g. body weight, life span, B.P, temperature etc (by using pharmacology software's or by using video clips)
9. Plasma concentration – time curve, pharmacological parameters such as t_{max} , C_{max} , Therapeutics window, MEC, MSC etc. (Application of above parts, developing graphs and calculation which aimed at problem-solving skill of students)
10. Bioavailability and Bio equivalence
 - a) Determination of AUC and its significance.
 - b) Relative and absolute bioavailability.
 - c) Bio equivalence study and its significance.
11. To study the concepts related to calculation of LD_{50} , ED_{50} , Therapeutic Index along with its importance

Note: It is suggested to use alternative teaching methods such as Books, Models, Films, and Computer aided instructional packages like MSBTE, Mumbai's CAI Package for Experiments in Pharmacology; ExPharmPro; ExPharm; X-Cology; or any other such packages for above practicals wherever required.

Books recommended:

1. S.K. Kulkarni; Hand book of Experimental Pharmacology, 2nd edition, Vallabh Prakashan, 1997 (Reprint).
2. S.R. Kale, R.R. Kale; Practical Pharmacology, 1st edition, Nirali Prakashan, Pune, 1994.
3. Dr. Ravindra Rao ; Hand book of Practical Pharmacology, 2nd edition, Jaypee Brothers Medical publishers, New Delhi, 1985.



Swami Ramanand Teerth Marathwada University, Nanded
Second Year B. Pharmacy, IVth Semester

Subject : Pathophysiology of Diseases
Subject Code/Paper No : BPH46
Credits : 02 (02T)

The Course:

Pathophysiology is an integrative science that draws concepts from many basic and clinical sciences, including Anatomy, Physiology, Pathology, Biochemistry, Genetics, Pharmacology, Cell and Molecular Biology and Biophysics. Pathophysiology focuses on the mechanism of diseases. These mechanisms are dynamic process that,

- ii) Cause disease
- ii) Give rise to signs and symptoms
- iii) Signify the body's attempt to overcome disease.

Need of the course in curriculum:

Globally a pharmacist is a part of health care team and is therefore is a health practioners. Understanding mechanisms of disease enables him to design and implementation of "clinical interventions" which often prove effective in treatment of disease.

Objective:

An orientation to disease as disordered physiology can enable a student to understand the mechanisms underlying the disease and its clinical manifestations, so that rational therapies can be devised.

Course Content (Theory)

- | | |
|-------------------------------------------------------------------|-------------|
| 1. Gastro intentional system - | (03) |
| Peptic ulcer, inflammatory bowel diseases, Diarrhoea | |
| 2. Liver and Biliary system - | (02) |
| Viral hepatitis, cirrhosis | |
| 3. Respiratory system - | (03) |
| Chronic Obstructive Pulmonary Disease, Asthma, Tuberculosis | |
| 4. Neurologic system - | (04) |
| Schizophrenia, Depression, Epilepsy, Parkinsonism | |
| 5. Endocrine System - | (02) |
| Diabetes insipidus, Goitre, Diabetes mellitus | |
| 6. Urinary system - | (02) |
| Acute and chronic renal failure, UTI | |
| 7. Reproductive system- | (04) |
| Erectile dysfunction, Cryptorchidism, Amenorrhea, Vulvo-vaginitis | |
| 8. Musculo-Skeletal system - | (02) |
| Gout and Rheumatoid Arthritis | |

Books recommended:

1. Margie Hansen; Pathophysiology: foundation of disease and clinical intervention; W.B. Saunders Company, London, 1998.
2. K.L.McCance, Sue E. Huether; Pathophysiology: The Biologic Basis for Disease in Adults and children's, 3rd edition, Mosby, Inc., 1998.
3. Stephen J. Mcphee, et.al. Pathophysiology of Disease: An introduction to clinical medicine; 2nd edition, Prentice-Hall International Inc., 1997.
4. C. M. Jangme, R. D. Wadulkar, M. D. Burande, B. N. Poul; Principles of Pathophysiology, Nirali Prakashan, Pune, 2015.
5. John B.Walter; Pathophysiology of Human Disease, Lea & Febiger, London, 1998.
6. William Boyd; A Text Book Pathophysiology, 8th edi, Lea & Febiger, Philadelphia, 1949.
7. J.R. Anderson; Text Book of Pathology, 25th edition, ELBS, Arnold, 1985.
8. Edward D. Frohlien; Pathophysiology: Altered Regulatory Mechanisms in Disease, 3rd edition, J.B. Lippincott Company, London, 1984.
9. Y.M. Bhende,S.G. Deodhar, General Pathology,(Part-1&2),Popular Prakashan, Mumbai.
10. Harsh Mohan; Text Book of Pathology, Jyapee Medical Book Publishers.
11. Parth; Pathophysiology, Lippincott, London.
12. Cortran, Kumar P. Robbins; Robbins Pathologic Basis of disease.
13. Cop Stead; Perspective in Pathophysiology, Saunders.
14. Prakash Ghadi, Pathophysiology, 1st edition, Career Publication, Nashik, 2000



Swami Ramanand Teerth Marathwada University, Nanded

Second Year B. Pharmacy, IVth Semester

Subject : Unit Operation in Pharmaceutical Technology
Subject Code/Paper No : (BPH47)
Credits : 02(02T)

Objectives:

Unit Operations play an important role in the design and manufacture of dosage forms. Operations like milling, granulation, drying, evaporation, mixing, pulverizing, blending etc. are often employed in the process of making of Drug Delivery Systems like tablets, capsules, ointments, jellies, Liquid orals and many other solid, semisolid, liquid dosage forms. The students of undergraduate programme in Pharmacy do laboratory work by compounding various dosage forms on small scale without involving machines. The knowledge of how dosage forms are manufactured on large scale at accelerated rate involving various unit operations is therefore significant. The students shall be exposed to the technical operations employed by pharmaceutical manufacturers to produce Drug Delivery Systems on large scale achieving reproducibility, efficacy with every unit of dosage form manufactured

Course content (Theory)

1. Heat transfer & its application (4hrs.)

All operations involve energy, heat as a form of energy, Nature of heat flow, conduction, convection, radiation, Heat transfer by conduction, Fourier's law. Thermal conductivity, steady state conduction, heat flow through a cylinder, principle of heat flow in fluids, energy balance, Rate of heat transfer by forced convection in laminar flow, heat transfer from condensing vapours and to boiling liquids, emission of radiation. Heat exchange equipments.

2. Evaporation (3hrs.)

Objectives of evaporation, properties of evaporating liquids, concentration, foaming, temperature, sensitivity, scale, materials of construction, types of evaporators, fire heated, jacketed, horizontal and vertical, standard and basket types.

3. Distillation (4hrs.)

Introduction, theory of distillation (ideal solution Raoult's law, Dalton's Law, real solution). Volatility and relative volatility. Boiling point diagrams and equilibrium curve. Classification of distillation methods, simple distillation, fractional distillation, distillation under reduced pressure, vacuum, steam distillation, molecular distillation and application.

4. Drying (3hrs.)

Theory of drying, classification of dryer, principle of drying, temperature pattern, heat transfer, mass transfer, phase equations, equilibrium moisture and free moisture, bound and unbound water, rate of drying, constant rate period. Drying equipment, batch dryers, hot air oven, vacuum tray dryers. Tumbling dryers, drum dryers, rotator dryers, etc. Advantages and disadvantages

5. Crystallization (4hrs.)

Theory and principle of crystallization, Mier's theory and its limitation. Crystal property, crystal form, crystal habit, Nucleation, crystal growth, Basis of Super saturation, classification of crystallizes, Tank and agitated batch, Swenson Walker, Vacuum crystallizers, Krystal crystallizers, principles underlined (diagrams expected). Effect of operating variables, Magma density, rate of circulation, caking of crystals, prevention of caking.

6. Dehumidification & humidity control: (5hrs.)

Theory of humidification and dehumidification, study of air conditioning, refrigerants and refrigeration cycle, cooling towers. Dehumidifier, freeze dryers and air conditioners. Corrosion-definition and types of corrosion, factor influencing corrosion, theories of corrosion, methods of prevention of corrosion.

7. Industrial hazards and safety: (2 hrs.)

Hazards in industry, mechanical, chemical, electrical, fire and explosion, a) chemistry of fire, b) classification of fire, c) methods of extinguishing, d) Examples from industry (by fire and chemicals). Theory of accidents: a) social environments, b) unsafe actions, c) unsafe conditions. Prevention of accidents.

TEXT BOOKS:

1. Pharmaceutical Engineering Principle and Practice: C. V. S. Subrahmanyam Vallabh Prakashan, Delhi.

Books recommended:

1. Unit operations and chemical engineering – WL: Mc Cabe, JC Smith, P. Harriott, Mc Graw hill international.
2. Pharmaceutics – The science of Dosage form Design – ME Aultonm, Churchill Livingstone ELBS low priced.
3. Introduction to chemical engineering – W L Badger & JT Bancrero, Tata MC Grew Hill.
4. Unit operations – G G Brown, CBS Publication.
5. Principles of Refrigeration (SI Version) – R T Dossat, Wiley Eastern.
6. Unit processes in Pharmacy |- David ganderton.
7. Material Selection for processing plants – Russel Gackenback, Reinhold publications.
8. Plant engineers hand book – Stainer, Mc Milon Publication.
9. Chemical engineers hand book – perry and Chilton, Mc Grew Hill.
10. Theory & Practice of Pharmacy – Leon Lackman and others., Lea and Febeger publications.
11. Chemistry of engineering material by Linger.
12. Principles of industrial instrumentation – D. Patranabis, Tata Mc Graw Hill.
13. Basic Refrigeration and air conditioning – PN Ananthnarayan, Tata Mc Graw Hill.
14. Refrigeration and air conditioning – CP Arora, Tata Mc Graw Hill.
15. Remington Pharmaceutical sciences – Hoover, Mac Publishing Co.
16. Pharmaceutical Engineering, K. Sambamurthy, New Age International (P). Ltd. New Delhi.
17. Introduction to Pharmaceutical Engineering, Dr. A R Paradkar, Nirali Prakashan, Pune.



Swami Ramanand Teerth Marathwada University, Nanded
Second Year B. Pharmacy, IVth Semester

Subject : Calculus and Biostatistics
Subject Code/Paper No : (BPH48)
Credits : 02(02T)

Course Content (Theory)

A] Determinants and matrices: [4 hr]

Properties of determinants. Solution of simultaneous equations. by Crammer's rule, Types of matrices, Arithmetic operations of matrices, Rank of matrices, Cayley Hamilton theorem.

B] Differential calculus: [5 hr]

Calculation of n^{th} derivatives, some standard results Leibnitz's theorem from n^{th} derivatives, LaGrange's and Rolles mean value theorems (statements only), Taylors and Maclaurin series (without proof).

C] Integral calculus: [3 hr]

Integration by parts, Properties of definite integrals and reduction formulae.

D] Differential equations: [5 hr]

Formation of differential equation. Solution of First order and first degree differential equations (Variable-Separable, Homogenous, Linear). Linear differential equations of higher order with constant coefficients.

E] Biostatistics: [5 hr]

Arithmetic: Mean, Median and Mode. Measures of Dispersion, Range, Quartile deviation, Mean deviation, Standard deviation and Coefficient of variation.

F] Statistical interences: [3 hr]

Testing, Testing Procedure, "T" Test, Chi square Test (X^2) Confidence interval in biological assays.

Books recommended:

1. Differential Calculus; Shanty Narayan S. Chand and Co.
2. Integral Calculus, Shanty Narayan, S. Chand and Co.
3. Introductory course in differential equations: D A Murray.
4. Topic's in Mathematics, Calculus and Solid Geometry; Chug, Dahila and Gupta.
5. Introduction to Statistical Methods C B Gupta.

6. Introduction to Biostatistics; Mahajan.
7. Biostatistics and computer Sciences; Shah and Prabhakar



Swami Ramanad Teerth Marathwada University, Nanded
Second Year B.Pharmacy IVth Semester

Subject : **Computer Application**
Subject Code / Paper No. : **BPH49**
Credits : **1 (1Pr)**

Scope:

The primary purpose is that a student need not spend much time on learning but utilize it for working. The students are expected to learn fundamentals, windows, Internet & utilize it during training.

Objective:

The objective of course is to

- Interact with MS office & other operating systems.
- From pharmaceutical point of view, a student can create labels to be affixed on container, can generate various graphics.
- Generate special graphs useful in pharmaceuticals & pharmacology practical etc.
- Study human anatomical structure with the help of Ms PowerPoint.
- Create a presentation.
- Interact with people working at opposite pole of the world via Internet.

Course Content (Practical)

- 1. Introduction to Computers:** (2 practical)
Basic components of computer, Types of computers, Characteristics, hardware organization of computers, Memories: RAM, ROM and Secondary Devices.
- 2. Introduction to Operating System:** (2 Practical)
Definition, Types of operating systems- Windows XP, Windows Vista, Windows 8.1, Open source like Linux, etc.
- 3. Computer Languages & Computer Packages:** (4 Practical)
Types of Languages, understanding Programming, Exposure to Microsoft Office suite- MS Word, MS Excel, MS PowerPoint, its advantages and Use.
- 4. Introduction to Computer Network:** (1 Practical)
Definition, LAN, WAN, Internet, World Wide Web.
- 5. Computer Graphics:** (1 Practical)
Definition, Display Devices, Graphical Input & output devices, Multimedia- Definition and application.

6. Computer Application:

(2 Practical)

Basics of Computer use in various Pharmaceutical and clinical studies, use of computers for sketching and drawing of structures, understanding MIS for hospital management systems

7. Introduction to various Pharmaceutical software

(1 Practical)

Pharmtail, Statistics, ANOVA etc.

Books Recommended:

1. E. Bbalaguruswamy, Programing in BASIC, third edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
2. Ravikant Taxali, PC software made simple, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
3. Bichkar R.S. & Dr.Sontakle T.R , Basic programming for IBM PCs, Sadhusudha Publications, Second Edition, Nanded.
4. Guy Hart Davis, The ABCs of Microsoft Office 97, Professional Edition, BPB Publication, New Delhi.
5. Dr. Prabhakar Gupta & Vishal Gupta, Computer Fundamentals and Programming, Pragati Prakashan, Meerut.