

SCHEME OF EXAMINATION

B. Pharmacy - First Year

S. No.	Code BPH:	Subject (Theory Course)	Hrs/week	External Assessment	Internal Assessment	Total
1.	101	Pharmaceutical Chemistry – I (Inorganic Chemistry)	2	80	20	100
2.	102	Pharmaceutical Chemistry – II (Organic Chemistry-I)	3	80	20	100
3.	103	Pharmaceutics – I (General, Dispensing & Hospital Pharmacy)	3	80	20	100
4.	104	Pharmacognosy-I	3	80	20	100
5.	105	Pharmacology-I (Anatomy, Physiology & Health Education)	3	80	20	100
6.	106	Pharmacognosy-II (Pharmaceutical Biology)	2	80	20	100

S. No.	Code BPH:	Subject (Practical Course)	Hrs/week	External Assessment	Internal Assessment	Total
1.	107	Pharmaceutical Chemistry – I (Inorganic Chemistry)	3	80	20	100
2.	108	Pharmaceutical Chemistry – II (Organic Chemistry-I)	3	80	20	100
3.	109	Pharmaceutics – I (General, Dispensing & Hospital Pharmacy))	3	80	20	100
4.	110	Pharmacognosy-I	3	80	20	100
5.	111	Pharmacology-I (Anatomy, Physiology & Health Education)	3	80	20	100
6.	112	Pharmacognosy-II (Pharmaceutical Biology)	3	80	20	100

Theory: 16 hrs/week
 Practical: 18 hrs/week
 Total: 34 hrs/week



SCHEME OF EXAMINATION

B. Pharmacy – Second Year

S. No.	Code BPH:	Subject (Theory Course)	Hrs/week	External Assessment	Internal Assessment	Total
1.	201	Pharmaceutical Chemistry III (Physical Chemistry)	2	80	20	100
2.	202	Pharmaceutical Chemistry – IV (Pharmaceutical Analysis-I)	3	80	20	100
3.	203	Pharmaceutical Chemistry-V (Pharmaceutical Biochemistry)	2	80	20	100
4.	204	Pharmaceutical Chemistry – VI (Organic Chemistry-II)	3	80	20	100
5.	205	Pharmaceutics – II (Pharmaceutical Microbiology)	2	80	20	100
6.	206	Pharmaceutics – III (Pharmaceutical Engineering-I)	3	80	20	100
7.	207	Pharmaceutics-IV (Pharmaceutical Mathematics)	2	80	20	100
8.	208	Pharmaceutics-V (Computers in Pharmacy)	2	80	20	100
9.	209	Environmental Science	2	Internal Grading*		

***Note: There shall be internal evaluation for this subject and grading system shall be followed as detailed below:**

A >75%, B >65%, C >55%, D ≥ 50%, E < 50%, E Grade would be considered failure.

S. No.	Code BPH:	Subject (Practical Course)	Hrs/week	External Assessment	Internal Assessment	Total
1.	210	Pharmaceutical Chemistry III (Physical Chemistry)	3	80	20	100
2.	211	Pharmaceutical Chemistry – IV (Pharmaceutical Analysis-I)	3	80	20	100
3.	212	Pharmaceutical Chemistry-V (Pharmaceutical Biochemistry)	3	80	20	100
4.	213	Pharmaceutics – II (Pharmaceutical Microbiology)	3	80	20	100
5.	214	Pharmaceutics-V (Computers in Pharmacy)	3	80	20	100
6.	215	Pharmaceutics – VI (Pharmaceutical Engineering Drawing)	3	80	20	100

Theory: 21 hrs/week
 Practical: 18 hrs/week
 Total: 39 hrs/week



SCHEME OF EXAMINATION

B. Pharmacy - Third Year

S. No.	Code BPH:	Subject (Theory Course)	Hrs/week	External Assessment	Internal Assessment	Total
1.	301	Pharmaceutical Chemistry.-VII (Medicinal chemistry-I)	3	80	20	100
2.	302	Pharmaceutics VII (Physical Pharmacy)	2	80	20	100
3.	303	Pharmaceutics-VIII (Pharmaceutical Jurisprudence)	2	80	20	100
4.	304	Pharmaceutics-IX (Dosage Form Design & Cosmeticology)	2	80	20	100
5.	305	Pharmaceutics – X (Pharmaceutical Engineering-II)	2	80	20	100
6.	306	Pharmacology- II	3	80	20	100
7.	307	Pharmacology- III (Pharmaceutical Animal Biotechnology)	2	80	20	100
8.	308	Pharmacognosy-III	3	80	20	100

S. No.	Code BPH:	Subject (Practical Course)	Hrs/week	External Assessment	Internal Assessment	Total
1.	309	Pharmaceutical Chemistry.-VII (Medicinal chemistry-I)	3	80	20	100
2.	310	Pharmaceutics VII (Physical Pharmacy)	3	80	20	100
3.	311	Pharmaceutics-IX (Dosage Form Design & Cosmeticology)	3	80	20	100
4.	312	Pharmaceutics – X (Pharmaceutical Engineering-II)	3	80	20	100
5.	313	Pharmacology- II	3	80	20	100
6.	314	Pharmacognosy III	3	80	20	100

Theory: 19 hrs/week
 Practical: 18 hrs/week
 Total: 37 hrs/week



SCHEME OF EXAMINATION**B. Pharmacy – Fourth Year**

S. No.	Code BPH	Subject (Theory Course)	Hrs/week	External Assessment	Internal Assessment	Total
1.	401	Pharmaceutical Chemistry-VIII (Medicinal Chemistry-II)	3	80	20	100
2.	402	Pharmaceutical Chemistry IX (Pharmaceutical Analysis-II)	3	80	20	100
3.	403	Pharmaceutics –XI (Pharmaceutical Technology)	3	80	20	100
4.	404	Pharmaceutics-XII (Pharmaceutical Management)	2	80	20	100
5.	405	Pharmaceutics-XIII (Pharmaceutical Packaging Technology)	2	80	20	100
6.	406	Pharmacology- IV	3	80	20	100
7.	407	Pharmaceutics-XIV (Biopharmaceutics and Pharmacokinetics)	2	80	20	100
8.	408	Pharmacognosy-IV (Pharmaceutical Plant Biotechnology)	2	80	20	100

S. No.	Code BPH	Subject (Practical Course)	Hrs/week	External Assessment	Internal Assessment	Total
1.	409	Pharmaceutical Chemistry-VIII (Medicinal Chemistry-II)	3	80	20	100
2.	410	Pharmaceutical Chemistry-IX (Pharmaceutical Analysis-II)	3	80	20	100
3.	411	Pharmaceutics-XI (Pharmaceutical Technology)	3	80	20	100
4.	412	Pharmacology- IV	3	80	20	100
5.	413	Pharmaceutics-XIV (Biopharmaceutics & Pharmacokinetics)	3	80	20	100
6.	414	Pharmacognosy-IV (Pharmaceutical Plant Biotechnology)	3	80	20	100

Theory: 20 hrs/week
 Practical: 18 hrs/week
 Total: 38 hrs/week



BPH-101: PHARMACEUTICAL CHEMISTRY – I
(INORGANIC CHEMISTRY)

THEORY

Max. Marks: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART - A

- I. Review of electronic structure of atom, periodic classification and group properties of elements (3)
- II. Sources of impurities in Pharmacopoeial substances, disadvantages of impurities in pharmaceutical substances, Limit tests (principle, procedure and other details) for Chlorides, Sulphates, Iron, Lead, Heavy Metals and Arsenic (6)
- III. An outline of methods of preparation (of substances bearing asterisk), properties, tests for identity and purity of the following classes of inorganic pharmaceuticals included in Pharmacopoeia:-
 1. **Acids and Bases** : Water (Water, Purified Water, Water for Injection, Bacteriostatic water for Injection, Sterile Water for Injection) (3)
 2. **Gastrointestinal Agents:** Acidifying agents (Dil. HCl, Ammonium Chloride), Antacids (Aluminium Hydroxide Gel*, Aluminium Phosphate, Calcium Carbonate, Magnesium Carbonate*, Magnesium Trisilicate*, Combination Antacid Preparations) Protectives and Adsorbents (Kaolin), Cathartics (Magnesium Sulphate*), Emetics (Copper Sulphate*, Antimony Potassium Tartrate*) (5)
 3. **Topical Agents:** Anti-infective agents (Iodine*, Povidone-Iodine, Hydrogen Peroxide*, Potassium Permanganate*, Chlorinated Lime*, Boric Acid, Silver Nitrate*) Protectives (Calamine, Zinc Oxide, Talc, Titanium dioxide) Astringents (Alum*, Zinc Sulphate*) (4)
 4. **Dental Products:** Dental Plaque and its prophylaxis, Mouth Washes, Dentifrices, Anticaries Agents (Sodium Fluoride*, Stannous Fluoride*) (2)
 5. **Gases and Vapours:** Inhalants, Oxygen Therapy, Anesthetics and Respiratory Stimulants (Nitrous Oxide, Ammonium Carbonate) (2)

PART-B

6. **Major Intra- and Extra- cellular Electrolytes:** Fluid compartments of the body, Major Physiological Ions, Electrolytes used for replacement therapy (Sodium Replacement: Sodium Chloride), (Potassium Replacement: Potassium Chloride), (Calcium Replacement: Calcium Chloride, Calcium Gluconate, Calcium Lactate) and Parenteral Magnesium Administration: Magnesium Sulphate) (5)
7. **Maintenance of Physiological Acid-base Balance** Electrolytes used in Acid-Base Therapy (Sodium Acetate*, Potassium Acetate, Sodium Bicarbonate*, Potassium Bicarbonate, Sodium Citrate*, Potassium Citrate, Sodium Lactate*) Electrolyte Combination Therapy and Oral Rehydration Therapy (Ringer's Injection, Lactated Ringer's Injection, Oral Electrolyte Solutions) (4)
8. **Essential and Trace Elements:** Physiological role of Iodine, Iron, Copper, Zinc, Sulphur, Selenium, Chromium, Manganese and Molybdenum. Details of minimum two compounds of pharmaceutical interest of Iodine, Iron, Calcium and Zinc (4)
9. **Miscellaneous Agents:**

Expectorants : Ammonium Chloride, Potassium Iodide, **Sedatives** : Potassium Bromide*, Lithium Carbonate **Sclerosing Agents** : Morrhuate Sodium Injection, Sodium tetradecyl Sulphate Injection **Poisons and Antidotes:** Antidotes and their classification, Cyanide Poisoning and Heavy Metal Poisoning and their treatment (Sodium nitrite*, Sodium thiosulphate*, Dimercaprol, Penicillamine and EDTA salts)



Pharmaceutical Aids: **Antioxidants:** Sodium metabisulphite*, Hypophosphorous acid. **Preservatives:** Sodium benzoate, Nitrogen, Sulphur dioxide. **Filter-aids:** Purified talc, Kieselguhr, Charcoal **Adsorbants:** Activated Charcoal, Kaolin **Diluents:** Calcium Sulphate, Colloidal silicon dioxide **Suspending Agents:** Bentonite, Sodium lauryl sulphate **Colorants:** Red Ferric Oxide, Carbon black. (7)

10. **Inorganic radio-pharmaceuticals:** Radioactivity phenomenon, Radioactive rays and their properties, Isotopes, Half-Life period, Units of radioactivity, handling and storage of radionuclides, Medical (Therapeutic and Diagnostic) Applications of radionuclides, Radiopaque contrast media (Barium Sulphate), Measurement of radioactivity. (5)

Books Recommended (Latest Edition):

1. J.H.Block, E. Roche, T.O.Soine and C.O.Wilson, "Inorganic Medicinal and Pharmaceutical Chemistry", Lea & Febiger, Philadelphia.
2. L.M.Artherden, Bently and Drivers, "Textbook of Pharmaceutical Chemistry", S& Ed., Oxford University Press, Delhi.
3. Pharmacopoeia of India, Govt. of India, Ministry of Health.
4. A.H.Beckett and J.B.Stenlake, "Practical Pharmaceutical Chemistry", Part I, 3rd edition.
5. Pharmaceutica Inorganic I Chemistry, GR Chatwal, CBS Publishers.
6. Pharmaceutical Chemistry, N.C. Chaudhary, Vallabh Parkashan
7. H. Singh and V.K. Kapoor Pharmaceutical Inorganic Chemistry, Vallabh Prakashan, Delhi (Latest Edition).
8. vogel's textbook of quantitative chemical analysis .Longman Scientific & Co-published in the United States with John Wiley & Sons, Inc., New York



**BPH-102: PHARMACEUTICAL CHEMISTRY-II
(ORGANIC CHEMISTRY-I)
THEORY**

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two questions from each part.

PART A

1. Basic principles and concepts of organic chemistry

Atomic and molecular orbitals, covalent bond, electronegativity, bond fission, Inductive and field effects, hybridization, multiple bonds, bond lengths, bond angles and bond energies. Intermolecular forces, polarity of bonds, polarity of molecules, dipole moment, structure and physical properties including melting point, boiling point, solubility, acidity and basicity. Hyperconjugation, concept of tautomerism and types. Classes of reactions and classes of reagents including electrophiles, nucleophiles and radicals.

Transient reaction intermediates – carbocations, carbanions, carbenes, nitrene and nitrenium ions.

Quantitative elemental analysis, structure elucidation, empirical formula and molecular formula. (20)

2. Basic stereochemistry of organic compounds

Isomerism and its types, stereoisomers, enantiomers, diastereoisomers, meso-structures, configuration, chiral centre, optical activity, racemic modification & its resolution, reactions involving stereoisomers, stereoselective and stereospecific reactions.

Geometric isomers, conformational isomers, configurational isomers, conformational analysis of ethane and n-butane, conformations of cyclohexanes, axial and equatorial bonds, Newman projections, Fischer and Wedge formula.

Relative and absolute configuration, sequence rules, D & L, R & S and E & Z system of nomenclature. (18)

PART B

3. Structure, Nomenclature, preparation and reactions with special reference to mechanism of the following classes of compounds

Alkane, alkene, alkyne, cycloalkanes, dienes, alkyl halides, alcohols, amines, aldehydes and ketones. (20)

4. Carbohydrates (Monosaccharides, Disaccharides and Polysaccharides)

Monosaccharides : Introduction, definition and classification, stereoisomers of (+)-glucose, oxidation, osazone formation, lengthening of C-C chain of aldoses (Kiliani-Fischer synthesis), shortening of aldoses (Ruff degradation), conversion of an aldose into its epimer, configuration of (+)-glucose, configuration of aldoses, D and L system of configuration, tartaric acid, families of aldoses and their absolute configuration, cyclic structure of D-(+)-glucose and formation of glucosides, configuration at C-1 (anomers), methylation reactions, determination of ring size, conformation.

Disaccharides and polysaccharides: (+)-maltose, (+)-lactose, (+)- sucrose, starch, (+)-cellulose, structure of amylose, end group analysis, structure of amylopectin, structure and reactions of cellulose. (12)

5. Fats, lipids, and waxes

Introduction, nomenclature & classification, physical and chemical properties, analysis and phospholipids. (5)

Books Recommended (Latest Edition):

1. R.T. Morrison and R.N. Boyd. Organic Chemistry, Allyn and Bacon, Inc., Boston, USA.
2. Organic Chemistry: Vols.I-III, S.M. Mukherji, S.P. Singh, R.P. Kapoor and R. Dass, New Age International (P) Ltd. , Publishers, Ansari road, Second edition, New Delhi-110002.
3. I. L. Finar, Organic Chemistry, Vol. I and II, The English Language Book Society.
4. P.Sykes, A Guidebook to Mechanisms in Organic Chemistry, Orient Longman, New Delhi.
5. J. March, Advanced Organic Chemistry, Reaction, Mechanisms and Structure, Wiley Eastern : New Delhi.
6. S. Pine, Organic Chemistry, McGraw Hill, 1987.

**BPH-103: PHARMACEUTICS-I
(GENERAL, DISPENSING & HOSPITAL PHARMACY)**

Max. Marks: 80

Total Hours 75 (3 hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part

PART-A

1. **Introduction** Definition, History and scope of pharmacy, Introduction to pharmacopoeia, Sources of information required for pharmacists, General dispensing procedures. (4)
2. **Pharmaceutical Calculations** Metric and imperial system of weights and measures, percentage calculations, enlarging and reducing recipies, isotonic solutions, alcohol dilutions, allegation methods, proof spirits, displacement value. (8)
3. **Posology** Definition, Factors affecting dose selection, Calculation of children and infant doses. (3)
4. **Prescription** Definition, Various parts of prescription and their functions, handling of prescription, Sources of error and care required in dispensing prescriptions, special labelling instructions for different pharmaceutical dosage forms, Pharmaceutical latin terms used in prescriptions and their translation into English. (8)
5. **Incompatibilities in prescriptions**-Definition, Types of incompatibility- physical, Chemical and therapeutic, Study of examples of prescription containing incompatibility, their correction and dispensing methods. (6)
6. **Extraction:** Various methods of extraction of crude drugs namely infusion, decoction, percolation (various types including processes for concentrated preparations, continuous hot percolation), maceration (various types including processes for organized and unorganized drugs and for concentrated preparations- double and tripple maceration processes) and factors affecting choice of extraction process , (8)

PART-B

7. **Introduction :** Definition and scope, functions, Classification of hospitals based on various criteria, organization, management and health delivery system in India (3)
8. **Hospital Pharmacy** Definition, Functions and objectives of Hospital Pharmaceutical services, Location, Layout, Flow chart of material and men, Personnel and facilities requirements including equipments based on individual and basic needs, Requirements and abilities required for Hospital Pharmacists. (4)
9. **Drug distribution system in Hospitals:** Out-patient services, In-patient services: types of services, detailed discussion of unit dose system, Floor ward stock system, Satellite pharmacy services, Central sterile services, Bed Side Pharmacy, Pharmacy Therapeutic Committee (PTC), Hospital Formulary System and their organization, Drug Information Service and Drug Information Bulletin (7)
10. **Solid dosage forms** Powders- Definition, Advantages, Disadvantages, Preparation of different type of powders- bulk powders for internal and external use, Simple and compound powders, cachets, tablet triturates, Dispensing of powders involving special problems, Lozenges (5)
11. **Monophasic liquid dosage forms** Definition, brief description and formulation of mixtures, syrups, elixirs, aromatic waters, tinctures, linctuses, liniments, lotions, collodions, gargles, mouth-washes, throat paints, douches, enemas, ear drops, eye drops, nasal drops and inhalations (8)
12. **Biphasic liquid dosage forms** Suspensions and emulsions: Definition, advantages, disadvantages, classification, formulation, methods of preparation, stability and evaluation. (5)
13. **Semisolid dosage forms** Ointments, pastes, jellies, poultices, suppositories and pessaries: Definition, advantages, classification, types of ointment and suppository bases, factors governing selection of ideal ointment and suppository base, methods of preparation and evaluation (6)



Books Recommended

1. Dispensing Pharmacy by R.M Mehta by Vallabh Prakashan, New Delhi
2. Remington, The Science and Practice of Pharmacy, Mack Publishing Co., U.S.A. Latest Edition.
3. Cooper JW, Gunn G. Tutorial Pharmacy. Pitman Books Ltd., London, Latest Edition.
4. Carter SJ. Dispensing for Pharmaceutical Students. Pitman Books Ltd., London. Latest Edition.
5. Lachman L, Leibennan HA, Kanig JL. The Theory and Practice of Industrial Pharmacy. Lea and Febiger, Philadelphia, U.S.A. Latest Edition.
6. Banker GS, Rhodes CT. Modern Pharmaceutics. Marcel Dekker, New York, Latest Edition.
7. Raymond C, Row JP, Sheskey E.M. Handbook of Pharmaceutical Excipients, Pharmaceutical Press, London. Latest Edition.
8. Martin E.W. Husa's Pharmaceutical Dispensing, Mack Publishing Co., Pennsylvania, U.S.A. Latest Edition.
9. Rowlins EA, Bentley's Textbook of Pharmaceutics. Bailliere Tindall and Cox, London, Latest Edition.
10. Pratibha Nand and Khar R.K. "Pharmaceutical Dispensing", ISBN: 8123903947, ISBN-13: 9788123903947, 978-8123903947, Tata Publishers, New Delhi, 1999.
11. Sprowls JB, Prescription Pharmacy. JB Lippincott Company, Philadelphia. Latest Edition.
12. Laurence, DR and Bennet, P.N., Clinical Pharmacology, Churchill Livingstone
13. Hospital Pharmacy by W.E Hassan published by Lea & Febiger, Philadelphia
14. A text book of Hospital Pharmacy by Allwood and Fell CBS Publishers & Distributors.
15. Ansel HS and Popovich NG, Pharmaceutical Dosage Forms and Drug Delivery Systems, Baltimore, Md: Lippincott Williams & Wilkins. Latest Edition



**BPH-104: PHARMACOGNOSY-I
THEORY**

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. **Introduction:** Definition, history, scope and development of Pharmacognosy. (3)
2. **Sources of drugs:** Biological, marine, geographical and plant tissue cultures. (4)
Classification of drugs: Alphabetical, morphological, taxonomical pharmacological, chemical and others with their merits and demerits. (4)
3. **Cultivation, collection, processing and storage of crude drugs:** factors influencing cultivation of medicinal plants. Types of soils and fertilizers of common use. Pest management and natural pest control agents. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants. (8)
4. **Quality control of crude drugs:** Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation. (6)
5. **Study of fibers :** Cotton, silk, wool, polyester and asbestos. (4)
6. **Study of tannins and tannin containing drugs:** gambir, black catechu, gall, and myrobalan. (4)
7. **Introduction to ayurvedic preparations:** Arishtas, Asavas, Bhasmas, Churans, Gutikas, Lehas and Tailas. (5)

PART-B

8. **Study of Carbohydrates and derived products:** Agar, Guar gum, Gum Acacia, Honey, Isabgol, Pectin, Starch and Tragacanth. (7)
9. **Study of Lipids:** Bees wax, castor oil, Cocoa butter, Cod-liver oil, Linseed oil, Rice bran oil, Shark liver oil. (7)
10. **Study of the drugs containing resins and resin combinations:** Colophony, Podophyllum, Cannabis, Myrrh, Asafoetida, Balsam, Turmeric, Ginger. (6)
11. **Volatile oils:** General methods of obtaining volatile oils from plants. Study of volatile oils of mentha, coriander, cinnamon, cassia, lemon peel, lemon grass, orange peel, citronella, caraway, cumin, clove fennel, nutmeg, eucalyptus, cardamom, and sandalwood. (8)
12. **Study of pharmaceutical aids:** talc, diatomite, kaolin, bentonite, gelatin, and natural colorants. (5)
13. Natural allergens and photosensitizing agents. (4)

Books Recommended (Latest edition):

1. V. E. Tylor, L. R. Brady & J. E. Robbers, Pharmacognosy (9th Edition), K.M. Varghese Company, Bombay, India, 1988.
2. W. C. Evans, Trease and Evans Pharmacognosy (15th Ed.), W. B. Saunders Limited, 2002.
3. Trevor Robinson, The Organic Constituent of Higher Plants, Burge Publishing Co., 1967.
4. G. E. Trease, A Textbook of Pharmacognosy (7th Edition), Bailliere Tindall, London, 1957.
5. B. P. Jackson & D. W. Snowdon, Powdered Vegetable Drugs, Stanley Thomes Ltd., London, 1974.



BPH-105: PHARMACOLOGY-I
(ANATOMY, PHYSIOLOGY, AND HEALTH EDUCATION)

THEORY

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. **Scope of Anatomy, Physiology and basic terminology.** (2)
2. **Structure and functions of cell:** Ion channels, signal transduction, second messengers, electrophysiology of muscles, cell stimulation and neuronal functions. (4)
3. **Tissues:** Epithelial, Connective, Muscular and Nervous tissues, their types and characteristics. (5)
4. **Bones and Joints:** Structure and function of skeleton, types of joints and their disorder (5)
5. **Blood and Lymph:** Composition and functions of blood including their disorders. Blood grouping and its significance, mechanism of coagulation, bleeding and clotting disorders. Formation of lymph and its composition. Reticulo-endothelial system and its function. Platelet counts (5)
6. **Cardiovascular system:** Anatomy and physiology of heart, blood circulation, cardiac cycle, heart rate, blood pressure, ECG and heart sounds. (5)
7. **Digestive system:** Gross anatomy of the G.I.T. and its physiology with special reference to liver, pancreas and stomach. Digestion, absorption, movements of intestine and disorders of digestive system. (4)
8. **Respiratory system:** Anatomy of respiratory tract, Mechanism of respiration, Lung volumes, Transport of oxygen and carbon dioxide. Disorders like Cyanosis, Mountain sickness and Caisson's disease. (4)
9. **Urinary System:** Structure and functions of Kidney and Urinary Tract. Physiology of urine formation and acid base balance. (4)

PART-B

10. **Reproductive system:** Structure and function of Male and Female reproductive systems, Sex hormones, physiology of menstruation, coitus and fertilization. Spermatogenesis and Oogenesis, Pregnancy and parturition. (5)
11. **Basic anatomy and physiology** of Pituitary, Thyroid, Parathyroid, Adrenal and Pancreatic hormones and disorders of these glands. (6)
12. **Central Nervous System:** Structure and function of brain and spinal cord. Functions of cerebrum, cerebellum. Vital centers of medulla oblongata, cerebral ventricles, cranial nerves and their functions. (8)
13. **Autonomic Nervous System:** Anatomy, Physiology and Divisions of ANS. Motor and sensory pathways. (3)
14. **Sense organs:** Physiology of vision, audition, olfaction, taste and skin. (3)
15. **Health education:** Concepts of health and disease. Disease causing agents and prevention of disease. (2)
16. **Nutrition:** Balanced diet, Deficiency disorders of various nutrients, their prevention and treatment. (2)
17. **Communicable diseases:** The causative agents, modes of transmission and prevention of chicken pox, measles, diphtheria, tuberculosis, malaria, poliomyelitis, filariasis, rabies, tetanus, STD and AIDS. (5)
18. **First Aid:** Emergency treatment of shock, snakebite, burns, poisoning, fractures and resuscitation methods. (3)



Books Recommended (Latest edition):

1. A.C. Guyton & J.E. Hall, Text Book of Medical Physiology, 12th Edition, published by Elsevier Saunders, 2010.
2. A. Keele, E. Neil and N. Jools, Samson Wright's applied physiology, Thirteenth Edition, published by Oxford University Press, 1983.
3. W. F. Ganong, Review of Medical Physiology, 22nd Edition, published by McGraw Hill Professional, 2005.
4. J. Vander, J. H. Sherman and D. S. Luciano, Human Physiology 8th Edition, published by McGraw Hill, 2001.
5. Gray's Anatomy, edited by P.L. Williams & R. Warwick, 38th Edition, published by Churchill Livingstone, 1998.
6. Cunningham's Textbook of Anatomy, edited by G. J. Romanes, Eleventh Edition, published by Oxford University Press, 1964.
7. E. Braunwald, K.J. Isslbucher, J.B. Martin, A.S. Fauei, J.E. Wilson Harrison, D.L. Kasper, Principles of Internal Medicine, 17th Ed., McGraw Hill International Book Company, 2007.
8. Text book of Anatomy and Physiology for Health professionals by Indu Khurana, latest Edition, CBS Publishers, 2009.



BPH-106: PHARMACOGNOSY-II
(Pharmaceutical Biology)
THEORY

Max. Marks: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART- A

1. **Methods of classification of Plants:** Artificial, Natural and Phyllogenetic. (2)
2. **Plant cell:** Study of plant cell, its organelles, functions and cell inclusions. (3)
3. **Morphology:** Morphology of the Root, Stem, Leaf, Flower, Fruit and Seed. Modifications of Root, Stem and leaf. (6)
4. **Study of tissues:** Meristematic and Permanent tissues. (2)
5. **Anatomy:** Anatomy of Root, Stem and leaf. (3)
6. **Plant taxonomy:** Characters of Families- Ranunculaceae, Leguminosae, Liliaceae, Solanaceae, Apocynaceae, Rutaceae, Umbelliferae, Rubiaceae, Graminae, Labiate, Cruciferae, Papavaraceae. (9)

PART -B

7. **Cell Division:** Mitosis and meiosis. (3)
8. **Knowledge of Physiological processes:** Transpiration and Respiration, Growth and growth regulators. (3)
9. **Classification of Animals:** General characters of invertebrates and vertebrates up to class with important examples. (6)
10. **Study of Parasites:** Structure and life history of parasites as illustrated by entamoeba, trypanosoma, plasmodium, taenia and ascaris. (6)
11. **Study of life history of insects:** Housefly, Silkworm and Mosquito. (3)
12. **Knowledge of heredity and variation:** Mendel's laws and their importance in heredity. (4)

Books Recommended (Latest edition):

1. C. Datta, Botany Birla Publications Pvt. Ltd., Shahdara, Delhi. Dhama & Dhama. Invertebrates.
2. K. N. Bhatia, Botany Birla Publications Pvt. Ltd., Shahdara, Delhi. Dhama & Dhama. Invertebrates.
3. Holt, Rinehart and Winston: Modern Biology, Publisher: HHolt, Rinehart and Winston ISBN-10: 0030565413; ISBN-13: 978-0030565410
4. S. Sardana, O. P. Sharma, A text book of Pharmaceutical Biology; Birla Publications Pvt. Ltd., Shahdara, Delhi. Dhama & Dhama. Invertebrates.
5. Trevor Robinson, The Organic Constituent of Higher Plants; Burge Publishing Co.,
6. M. Hickey and C. King, 100 Families of Flowering Plants; Cambridge University Press,



**BPH-107: PHARMACEUTICAL CHEMISTRY-I
(INORGANIC CHEMISTRY)**

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3 hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. The background and systematic qualitative analysis of inorganic mixtures containing upto four radicals. (Minimum five Inorganic Mixtures must be analyzed)
2. Limits tests for impurities in Pharmaceutical Compounds (Limit tests for chlorides, sulphates, iron, lead, heavy metals and arsenic)
3. Identification tests of selected Inorganic Pharmaceutical Substances (Minimum FIVE samples)
4. Evaluation of antioxidant activity.
5. Preparation of inorganic substances(atleast five)
6. Preparation of dental products (atleast three)



**BPH-108: PHARMACEUTICAL ORGANIC CHEMISTRY-II
(ORGANIC CHEMISTRY-I)
PRACTICAL**

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note-Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Introduction to various laboratory techniques including:
 - Calibration of burette, pipette and thermometer
 - Determination of melting point
 - Determination of boiling point
 - Determination of mixed melting point
 - Distillation
 - Crystallization & Re-crystallization
 - Sublimation
2. Identification of organic compounds and their derivatization.
3. Identification tests of carbohydrates and fats.
4. Introduction to the use of stereomodels to study:
5. *R* and *S* configuration of enantiomers.
6. *E* and *Z* configuration of geometric isomers.



**BPH-109: PHARMACEUTICS-I
(GENERAL, DISPENSING & HOSPITAL PHARMACY)**

PRACTICAL

Max. Marks: 80

Total Hours 75 (3 hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Solid dosage forms including simple powders, compound powders, dusting powders, bulk and divided powders for oral use.
2. Monophasic dosage forms including simple mixtures, mixtures containing diffusible and indiffusible solids, liniments, lotions, enemas syrups, elixirs, aromatic waters, tinctures, mouthwashes, gargles, throat paints, ear drops.
3. Biphasic dosage forms including suspensions and emulsions for internal use.
4. Semisolid dosage forms including ointments, pastes, poultices and suppositories.
5. Ophthalmic products including eye drops.
6. Prescriptions related to pharmaceutical incompatibilities.
7. Hospital Pharmacy practicals-File Records, Indoor/Outdoor patient Services



BPH-110: PHARMACOGNOSY-I

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Microscopic measurements of cells and cell contents: starch grains, calcium oxalate crystals and phloem fibres.
2. Determination of leaf constants such as stomatal index, stomatal number, vein-islet number, vein termination number and palisade ratio.
3. Identification of crude drugs mentioned in theory.
4. Study of Microscopic and chemical characteristic of fibres.



**BPH-111: PHARMACOLOGY-I
(ANATOMY, PHYSIOLOGY, AND HEALTH EDUCATION)**

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Study of Microscope
2. Study of different systems with the help of models.
3. Microscopic study of different tissues.
4. Blood experiments: Enumeration of RBC and WBC, Haemoglobin estimation, ESR, blood group determination, bleeding and clotting time, heart rate and blood pressure recording. Advance techniques and elementary knowledge of Platelet count practicals
5. Identification of bones and points of identification.
6. Health education – charts for various communicable diseases.
7. Determination of vital capacity.



BPH-112: PHARMACOGNOSY-II
(Pharmaceutical Biology)
PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Microscope, Types, and Applications.
2. Morphology of Root, Stem, Leaf and their modifications.
3. Study of Vegetative Reproductive characters along with flower and its floral diagram of families- Ranunculaceae, Leguminosae, Liliaceae, Solanaceae, Apocynaceae, Rutaceae, Umbelliferae, Rubiaceae, Graminae, Labiate, Cruciferae, Papavaraceae.
4. Microscopic examination of Meristematic and Permanent tissues and the Root, Stem and Leaf of monocot and dicot plants form permanent slides.
5. Life cycle of Silk worm and Mosquito with the help of biological specimens.



**BPH-201: PHARMACEUTICAL CHEMISTRY – III
(PHYSICAL CHEMISTRY)**

THEORY

Max. Marks: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set FOUR questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART - A

1. States of Matter:

Gaseous: Brief introduction to the behavior of gases, ideal and real gases, equations of state, Deviation from ideal behavior, critical phenomena, critical constant and its determination, coefficient of thermal expansion and compressibility, Lewis Fugacity Rule.

Liquids: Intensive and extensive properties, Additive and constitutive properties, molar volume, molar refraction, surface tension, parachor, optical activity and their importance in structure elucidation.

Solids: Amorphous and crystalline solids, geometry and symmetry of crystals, point defects, Miller indices, types of crystals, physical properties of crystals, Crystal diffraction, Bragg's equation, application in mol. wt. determination, liquid crystalline state, smectic and nematic liquid crystals. Swarm theory of liquid crystals. (9)

2. Solutions:

Non- Electrolyte Solutions: Concentration scales, ideal and real solutions, colligative properties, Mol. wt. determination, Donnan- Membrane Equilibrium and drug absorption, Solution of gases in liquids, solutes distributing in immiscible solvents, partition- coefficient and its importance.

Electrolyte Solutions: Arrhenius theory of electrolytic dissociation, Debye-Huckel theory and its use in protein purification, Ionic equilibrium in blood, applications. (6)

3. Thermodynamics:

Energy and First Law of Thermodynamics: Preliminaries and definitions, reversibility, energy and enthalpy changes, heat capacities and their relationship for ideal gas, isothermal and adiabatic processes involving ideal gases. Applications, Thermo- chemical equations. Heats of reaction, effect of temperature, state etc. Kirchhoff's equation and numericals for exercises.

Second and Third Law of Thermodynamics: Carnot Cycle, irreversible process, molecular interpretation of entropy, entropy calculations for ideal gas systems, absolute entropy, entropy changes for phase changes and chemical reactions, Clausius- Clapeyron Equation.

Free Energy and Equilibrium: Helmholtz and Gibb's free energy, concept of spontaneity, chemical equilibrium, expressions for equilibrium constant, effect of volume, temperature and pressure. (10)

PART-B

4. Phase Equilibrium: Phase component, degrees of freedom, deduction of phase rule, equilibrium between phases and cooling curves. Phase diagrams for one component system, for two component systems involving eutectics. Three-component systems, triangular plots and partially miscible three liquid systems (formation of one, two and three miscible pairs). (10)

5. Kinetics and Adsorption:

Reaction Rates: Rate and rate constant, order and molecularity, zero, first, second and third order reactions, half- life time, determination of rate and order, consecutive, parallel and opposing reactions, ionic and free-radical reactions. Theories and reaction Kinetics, (Collision, Lindman and Transition state Theory), Chemical Equilibrium, Equilibrium constant.

Catalysis: Characteristics of catalyzed reactions, homogeneous and heterogeneous catalysis, acid base catalysis, enzyme catalysis, theory of catalysis.

Adsorption: Physisorption and Chemisorptions, adsorption isotherms, Freundlich and Langmuir adsorption isotherms, Gibbs adsorption isotherm, BET equation and its use in surface area determination. (15)

Books Recommended (Latest editions):

1. Physical Chemistry with Biological Applications, K. J. Laidler, Benjamin/Cumming publishing company 1978.
2. Physical Chemistry and its Biological Applications, W. S. Brey, Academic Press, 1978.
3. J. R. Barrante, Physical Chemistry of the Life Sciences, Printell (Latest Edition).
4. Principles of Physical Chemistry, R. Puri, L. R. Sharma and M. S. Pathania, Jalander Vishal publications (Latest Edition).



**BPH-202: PHARMACEUTICAL CHEMISTRY – IV
(PHARMACEUTICAL ANALYSIS – I)**

THEORY

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. **Introduction:** Importance of quality control, computation of analytical results, significant figure, concept of error, precision, accuracy, standard deviation, normal distribution curve, calibration of analytical equipments, fundamental of volumetric analysis, methods of expressing concentrations, primary and secondary standards. (3)
2. **Neutralization titrations:** Acid-base concept, Acid and base dissociation constant, Role of the solvent, Relative strength of acids and bases, Distribution of acid base species with pH, Buffer solution (Effect of dilution, added acids & bases upon buffer), Henderson Hasselbalch equation, neutralization curves, Acid base indicators, Mixed indicators, Acid base titrations (strong acid vs. strong base, weak acids-weak bases and mixtures of strong & weak acids), Polyprotic systems, phosphoric acid system, polyamine and amino acid systems. Titration of sodium carbonate. (7)
3. **Non-aqueous titrations:** Theoretical basis, types of solvents, indicators, scope, limitations, preparation and standardization of titrant solutions. Titrations of weak acids and weak bases. Standardization of perchloric acid, lithium and sodium methoxide, tetrabutyl ammonium hydroxide. Pharmaceutical applications. (4)
4. **Precipitation titrations:** Principles of precipitation titrations, solubility product, effect of acids, temperature and solvent on the solubility of precipitate. Argentometric titration (Mohr's method, Volhard's method and Fajan's method), mercurimetric titration and titration involving ammonium or potassium thiocyanate and barium sulphate, adsorption indicators. (5)
5. **Complexometric titrations:** Concept of complexation and chelation, Werner's theory, coordination number and electronic structure of complex ions, stability constants, titration curves, masking and demasking agents, types of complexometric titration, metal ion indicators, factors influencing the stability of complexes, EDTA-metal ion complexes, Determination of hardness of water. (6)
6. **Oxidation-Reduction titrations:** Concepts of oxidation-reduction, standard oxidation potential, Nernst equation, theory of redox titrations, redox indicators, titrations involving ceric ammonium sulphate, potassium permanganate, titanous chloride, sodium-2,6-dichlorophenol-indophenol, Iodimetry and Iodometry (preparation, standardization and titration). (6)
7. **Gravimetric analysis:** Colloidal state, Supersaturation, Co-precipitation, Post-precipitation, Digestion, Washing of the precipitate, Filtration, Filter papers and crucibles, Ignition, thermogravimetric curves with Specific examples like barium as barium sulphate, aluminium as aluminium oxide, Calcium as calcium oxalate and Magnesium as Magnesium pyrophosphate, Organic precipitants. (5)

PART-B

8. **Miscellaneous methods:** 1. Diazotisation 2. Kjeldhal method of nitrogen estimation 3. Oxygen Flask combustion 4. Karl fischer titration 5. Analysis of oils, fats and waxes. (7)
9. **Chromatography with Pharmaceutical applications of each category:**
Column chromatography: Adsorption and Partition theory, preparation, procedure and methods of detection. (3)
Thin layer chromatography: Theoretical consideration, preparation, procedure and detection of compounds. (3)
Paper chromatography: Theory of partition, different techniques employed and different

grade of papers used and detection. (3)

Gas Chromatography: Introduction, fundamentals of column operation and detection. (4)

Ion Exchangers: Types of exchangers, mechanism of ion exchange and column operation. (3)

Size-Exclusion Chromatography (3)

10. **Potentiometric titrations:** Introduction, Electrochemical cells, half-cells, electrodes, measurement of potential and applications in pharmaceutical analysis. (4)
11. **Conductometric titrations:** Basic concepts, different types of conductometric titrations, apparatus used and applications in Pharmaceutical Analysis. (3)
12. **Polarography:** Basic concept, theoretical considerations, Basic instrumentation, apparatus, principles, general polarography analysis and applications in pharmaceutical analysis. (3)
13. **Amperometry:** Amperometric titrations with one polarized electrode, general procedure, titration curves and applications. (3)

Books Recommended (Latest edition)

1. Practical Pharmaceutical Chemistry, Vol. I and II by A.H. Beckett and J.B. Stenlake, The Athlone Press of the University of London (Latest Edition).
2. Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis by J. Bassett, R.C. Denney, G.H. Jeffery & J. Medhan, John Wiley & Son r. Inc., New York.
3. Instrumental Mehtods of Analysis by H. H. Willard, L.L. Merritt: Jr., and J.A. Dean, Van Nostrand Reinhold, New York.
4. Pharmaceutical Chemistry, Vols. I and II by L. G. Chatten, Marcel Dekker, New York.
5. A Textbook of Pharmaceutical Analysis by K.A. Connors, Wiley-Interscience, New York.
6. Jenkin's Quantitative Pharmaceutical Chemistry by A.M. Knevel and F.E. Digangi, McGraw-Hill Book Co., New York.
7. Indian Pharmacopoeia 1996 and 2007, Govt. of India, Ministry of Health, Delhi.



**BPH-203: PHARMACEUTICAL CHEMISTRY – V
(PHARMACEUTICAL BIOCHEMISTRY)**

THEORY

Max. Marks: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. **Introduction to biochemistry:** Cell and its biochemical organization, Transport process across the cell membranes, Bioenergetics, Production of ATP, cyclic AMP and their biological significance. (5)
2. **Biological oxidation:** Coenzyme system involved in biological oxidation, Electron transport chain (its mechanism in energy capture, regulation, inhibition and Uncouplers of ETC), Oxidative phosphorylation: its energetics and mechanism. (5)
3. **Enzymes:** Definition, Nomenclature, IUB classification, Factors affecting enzyme activity, Enzyme action, Enzyme inhibition, Isoenzymes and their therapeutic and diagnostic applications, Coenzymes and their biochemical role, Diseases due to deficiency of coenzymes. (5)
4. **Carbohydrate metabolism:** Glycolysis, Citric acid cycle (TCA cycle), HMP shunt, Glycogenolysis, Gluconeogenesis, Glycogenesis, Metabolic disorders of carbohydrate metabolism (diabetes mellitus and glycogen storage diseases), Glucose & Galactose tolerance test and their significance, Hormonal regulation of carbohydrate metabolism. (10)

PART-B

5. **Lipid metabolism:** Oxidation of saturated fatty acids (β -oxidation), Ketogenesis and ketolysis, Biosynthesis of fatty acids and lipids, Biosynthesis and metabolism of cholesterol, Hormonal regulation of lipid metabolism, Defective metabolism of lipids (Atherosclerosis, fatty liver, hypercholesterolemia). (7)
6. **Protein and amino acid metabolism:** Protein turn over, nitrogen balance, Catabolism of amino acids (Transamination, deamination & decarboxylation), Fate of ammonia, Urea cycle and its metabolic disorders, Production of bile pigments, Hyperbilirubinemia, Porphyria, Jaundice, Metabolic disorders of amino acids. (7)
7. **Nucleic acid metabolism:** Biosynthesis and metabolism of purine and pyrimidine nucleotides, Protein synthesis (Components and inhibition of protein synthesis). (6)
8. **Introduction to clinical chemistry:**
 - I. Urine analysis: Introduction & clinical significance, Macroscopic & physical examination, Quantitative & semi quantitative tests.
 - II. Tests for NPN constituents: Introduction & clinical significance, Creatinine/Urea clearance, Analysis of creatinine, urea and uric acid in blood & urine.
 - III. Bile pigments metabolism.
 - IV. Hepatic function tests: Clinical significance of serum bilirubin, urine bilirubin and urine urobilinogen.
 - V. Lipid profile tests: Introduction to Lipoproteins (composition and functions), Clinical significance of test for serum lipids, total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides. (5)



Books Recommended (Latest edition):

1. *Lehninger Principles of Biochemistry* by D.L. Nelson, M.M. Cox, 6th Ed., W.H. Freeman and Company, New York: 2013.
2. *"Text Book of Biochemistry"* Harbans.Lal, CBS Publishers & Distributors. New Delhi.
3. *Biochemistry* by U. Satyanarayana, U. Chakrapani, 4th Ed., Elsevier Health Sciences, New Delhi: 2014.
4. *Textbook of Medical Biochemistry* by M.N. Chatterje, R. Shinde, 8th Ed., Jaypee Brothers Medical Publishers (P) Ltd., New Delhi: 2013.
5. *Harper's Illustrated Biochemistry* by R.K. Murray, D.K. Granner, P.A. Mayes, V.W. Rodwell, 26th Ed., Lange Medical Books/McGraw-Hill, New Delhi: 2003.
6. *Outlines of Biochemistry* by E.E. Conn, P.K. Stumpf, G. Bruening, R.H. Doi, 5th Ed., John Wiley & Sons, New York: 2007.
7. *Lippincott's Illustrated Reviews: Biochemistry* by R.A. Harvey, D.R. Ferrier, S.Karandish, 5th Ed., Lippincott Williams & Wilkins, New York: 2010.



**BPH-204: PHARMACEUTICAL CHEMISTRY-VI
(ORGANIC CHEMISTRY-II)
THEORY**

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART A

1. **Chemistry of heterocyclic compounds:** Nomenclature of heterocyclic compounds, five and six membered heterocycles, aromatic characteristics of heterocyclic compounds. Structure, synthesis and reactions of pyrrole, furan and thiophene, pyridine and piperidine.

Condensed five and six membered heterocyclics. Synthesis and reactions of indole, quinoline and isoquinoline (Fischer- Indole Synthesis, Skraup Synthesis and Bischler Nepieralski Synthesis).

Heterocyclic ring systems containing up to two hetero atoms. Chemistry of pyrazole, imidazole, oxazole, thiazole, pyridazines, pyrazine, purines and pyrimidines, preparation and reactions of adenine, guanine, cytosine, uracil, thymine. (21)

2. **Polynuclear hydrocarbons:** Synthesis and chemical reactions of naphthalene, phenanthrene and anthracene. (6)
3. **Name reactions with complete mechanism:** Michael, Mannich, Reformatsky, Wittig and Perkin reactions, Knoevengal, Benzoin condensations and benzilic acid rearrangements, Pinacol rearrangement, Clemmensen reduction & Knorr pyrazole synthesis. (10)

PART B

4. Structure, nomenclature, preparation and reactions of benzene, phenols, carboxylic acids, functional derivatives of carboxylic acid. (15)
5. Electro cyclic reactions, Sigmatropic reactions, Neighbouring group effects. Catalysis by transition metal complexes. (6)
6. Active methylene compounds: Ethyl acetoacetate and diethyl malonate synthesis and applications in organic synthesis. (4)
7. Amino acids, peptides and proteins: Classification, source, essential and non- essential amino acids. Physical properties, zwitterion structure, isoelectric point, chemical reactions, preparation and configuration of amino acids. Peptides and polypeptides. Geometry of peptide linkage. Structure determination of peptides. Terminal residue analysis. Partial Hydrolysis. Synthesis of peptides.

Classification and general characteristics of proteins: primary, secondary, tertiary and quaternary structure of proteins. Conjugated proteins. (13)

Books Recommended (Latest edition)

1. R.T. Morrison and R.N. Boyd. Organic Chemistry, Allyn and Bacon, Inc., Boston, USA.
2. Organic Chemistry: Vols.I-III, S.M. Mukherji, S.P. Singh, R.P. Kapoor and R. Dass, New Age International (P) Ltd. , Publishers, Ansari road, Second edition, New Delhi-110002.
3. I. L. Finar, Organic Chemistry, Vol. I and II, The English Language Book Society.
4. P.Sykes, A Guidebook to Mechanisms in Organic Chemistry, Orient Longman, New Delhi.
5. J. March, Advanced Organic Chemistry, Reaction, Mechanisms and Structure, Wiley Eastern : New Delhi.
6. S. Pine, Organic Chemistry, McGraw Hill, 1987.

**BPH 205:- PHARMACEUTICS – II
(PHARMACEUTICAL MICROBIOLOGY)**

THEORY

Max. Marks: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. **Introduction** to the science of microbiology. Contribution of various scientists to the microbiology : A.V. Leeuwenhoek, Louis Pasteur, Edward Jenner , Robert Koch, Alexander Fleming , Joseph Lister. (3)
2. **Classification of Microbes & their taxonomy**, Nutritional requirements, growth and cultivation of bacteria, fungus and virus. Study of different important media required for the growth of aerobic and anaerobic bacteria & fungi, differential media, enriched media and selective media, maintenance of lab cultures. (9)
3. **Different methods used in isolation and identification** of bacteria with emphasis to different staining techniques and biochemical reactions. Counting of bacteria -Total and Viable counting techniques. (5)
4. Detailed study of different methods of sterilization including their merits and demerits. Sterility testing of different pharmaceutical preparations. D value, Z value, F value, Biological, chemical & physical Indicators. (8)

PART-B

5. **Disinfectants-** Study of disinfectants, antiseptics, fungicidal and virucidal agents, factors affecting their activation .Mechanism of action of various agents. Evaluation of bactericidal, bacteriostatic, virucidal activities, Dynamics of antimicrobial action of disinfectants, Factors affecting the rate of antimicrobial action. (4)
6. **Microbial culture sensitivity testing:** Interpretation of results, Principles and methods of different microbiological assays, microbiological assay of Penicillin, Streptomycin and vitamin B₂ and B₁₂. (specific example of each category) (6)
7. **Fermentation and its design**, control of different parameters in fermentation process Preparation and isolation of fermentation products with special reference to penicillins, streptomycins, tetracyclines, alcohol, citric acid and vitamin B₁₂ (cyanocobalamin). Use of mutagenic agents, Isolation of mutants, factors influencing rate of mutation. (6)
8. **Immunology:** General introduction, infection, factors influencing infection, kinds of immunity, vaccines (i.e. Tetanus vaccine, Diphtheria vaccine, BCG vaccine), virus immunity, official viral vaccines (small pox vaccine, rabies vaccine, yellow fever vaccine, influenza vaccine, poliomyelitis vaccine, measles vaccine, typhus vaccine), toxoids (FT, TAF, APT, PTAP), diagnostic preparation, sera, antitoxins (i.e. Diphtheria antitoxins, Botulinum, Gas gangrene, Staphylococcus and Tetanus antitoxins) Brief control of immunological products-identification tests, toxicity tests, sterility tests, potency tests and storage of immunological products. Standardization of vaccines and sera. (9)

Books Recommended (Latest edition):

1. J. Woodward (Editor), Immobilized Cells and Enzymes, A Practical Approach, IRL Press.
2. L.M. Prescott, J.P. Harley and D.A. Klein, Microbiology, Wm. C. Brown Publishers, England.
3. S. J. Carter, Cooper and Gunn's Tutorial Pharmacy. Sixth Edition, Pitman Publishing Co, London.
4. M. Furbisher, Fundamentals of Microbiology, 8th Edition, W. B. Saunders Company, Philadelphia, USA.
5. W. B. Hugo and A. D. Russell, Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford.
6. Prescott & Donn, Industrial Microbiology, CBS. Publishers, Delhi.
7. K. K. Kieslich (Editor). Biotechnology, Vol 6a, Verlag chemie, Basel, Switzerland.



**BPH-206: PHARMACEUTICS – III
(PHARMACEUTICAL ENGINEERING-I)
THEORY**

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note: Examiner has to set four questions from each part and the candidates are required to attempt five questions with atleast two from each part.

PART - A

1. **Flow of fluids:** Introduction, mechanism of fluid flow, Reynolds number and its significance, Bernoulli's theorem, manometers and friction losses in pipes, measurement of flow rate using hydrodynamic methods (orifice meter, venturi meter, rotameter, pitot tube and weirs), displacement meters and dilution methods. (10)
2. **Transportation of Fluids:** Valves-Plug cocks, gate valves, globe valves, unidirectional valves, butterfly valve, diaphragm valve and automatic reducing valves, water hammer.
Pumps- Airlift pumps, egg pumps, centrifugal pumps, self-priming pumps, reciprocating pumps (piston pumps and plunger pumps), screw pump, diaphragm pump, gear pumps etc., factors affecting selection of pumps. (10)
3. **Heat Transfer:** Modes of heat transfer, various laws of heat transfer, overall heat transfer coefficient, mean temperatures for spheres, cylinders and heat exchangers, single pass heater, double pass heater, multi-pass heater, liquid-liquid heat interchanger/ exchanger and finned tubes heat exchangers. (8)
4. **Evaporation:** Principle, Factors affecting evaporation, natural circulation evaporators (evaporating pan, evaporating still, horizontal tube evaporator, standard vertical tube evaporator, basket evaporator, forced circulation evaporators, film evaporators, Conservation of energy through multiple effect evaporation and vapor compression. Material and energy balance of evaporators. (10)

PART - B

5. **Drying:** Theory, definitions, behavior of solids during drying, static bed dryers, moving bed dryer, fluidized bed dryers (batch and continuous) and pneumatic bed dryers. Freeze drying. (11)
6. **Centrifugation:** theory, industrial centrifuges-Filter type (Basket, semi and continuous), sedimentation type (Tubular, disc and continuous centrifuges). Applications in Pharmacy. (5)
7. **Filtration:** Theory, filtration at constant pressure and constant volume, filter aids, filter media, industrial filters i.e. sand filter, filter presses – Chamber type and plate & frame(washing and non-washing), rotary drum filter, leaf filters, edge filter. Membrane filtrations: filters, filter testing. Cross-flow filtration: Ultra filtration, reverse osmosis. (8)
8. **Humidification, dehumidification and air conditioning:** Definitions, Principles of Humidification, dehumidification and air conditioning, psychrometry, various methods for humidity measurement, large scale equipment for humidification and dehumidification, cooling towers. (5)
9. **Refrigeration:** Principle and equipments employed for vapor compression (mechanical), steam jet and absorption types of refrigeration cycles, applications in Pharmacy. (4)
10. **Transportation of materials:** Gases: Ejectors, compressors, fans and blowers. Solids: Intermittent and continuous methods in vertical, horizontal, spiral and inclined planes. (4)

Books Recommended (Latest edition):

1. Badger, Introduction to Chemical Engineering, McGraw Hill Co., International Student edition (Latest edition).
2. L.A. Lachman, H.A. Liberman and J.L. Kanig, The Theory and Practice of Industrial Pharmacy, 3rd edition, Lea and Febiger, Philadelphia, U.S.A.
3. McCabe, Smith & Harriot, Unit Operations of Chemical Engineering, 5th Edition or latest, McGraw Hill International, NY.
4. Coulson and Richardson's Chemical Engineering (Vol. 1&2) Butterworth-Heinemann.



**BPH-207: PHARMACEUTICS-IV
(PHARMACEUTICAL MATHEMATICS)**

THEORY

Max. Marks: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set FOUR questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART A

1. Algebra: Solution of linear equation, quadratic equation. Determinants, solutions of simultaneous equations by Cramer's rule. Definition of various matrices, arithmetic operations on matrices, transpose, adjoint reciprocal and inverse of a matrix, solution of simultaneous equations using matrix methods. Partial fractions and resolution of linear and quadratic (non-repeated) partial functions. (13)
2. Trigonometry: addition, subtraction and transformation formulae. T- ratio, solution of simple trigonometric identities. (6)
3. Probability and events, probability theorems, various distributions, normal distribution curve, standard normal curve (Z statistic), confidence limits, deviations from normality, Kurtosis and skewness. (3)
4. Statistical inference, type I and II errors, power test, t-test (paired and unpaired). (3)

PART B

5. Calculus: Differential: Limits and functions, differential coefficient, differentiation of standard functions, including function of a function (chain rule), differentiation of implicit functions, logarithmic differentiation, parametric differentiation, elements of successive differentiation. (8)
6. Integral: Integration as inverse of differentiation, indefinite integrals of standard forms, integration by parts, by partial fractions and by substitution, formal evaluation of definite integrals. (8)
7. Collection of primary and secondary data, sampling methods, merits and limitations of various random and non-random sampling methods, data organization including frequency distributions and tabulation, diagrammatic representation of data, simple, multiple, subdivided and floating bar diagrams, pie diagrams. 2-D and 3-D pictographic representation, graphs of frequency distributions. (5)
8. Measures of central tendency, mean, median, mode, GM, HM and weighted arithmetic mean from discrete and continuous frequency distributions, quartiles, measures of dispersion, range, quartile deviation, mean deviation, standard deviation, standard error of means, coefficient of variation. (4)

Books Recommended :

1. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi (Latest Edition).
2. Schaum, Differential Equations, McGraw-Hill, Singapore. (Latest Edition).
3. Frank Mathematics for B.Pharmacy by G.D Dhall, S.N. Chhibber, Hari om Trivedi and Subodh Chandra (Latest Edition) .
4. S. Bolton, C. Bon, Pharmaceutical statistics: practical and clinical application Marcel Dekker New York (Latest Edition) .



**BPH- 208: PHARMACEUTICS-V
(COMPUTERS IN PHARMACY)**

THEORY

Max. Marks: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. **History & Hardware:** Introduction to Computer, Computer classifications (According to generation, size and use). Introduction to hardware, CPU, Mother board, various ports and slots available with motherboard. Input devices, Output devices, Storage Devices and Memory. (5)
2. **Networking:** Introduction to networking, Classification of networking like LAN, WAN, MAN. OSI Reference modal, ARPANET, Hardware of networking – Modem, Hub, Cables. Power devices like UPS. (3)
3. **Number systems:** Decimal, Binary, Octal, Hexadecimal and their Applications. (3)
4. **Software:** Introduction to software, use of Machine language, Assembly language and Higher-level languages. (3)
5. **Application of computers in pharmacy:** Introduction to various uses of computer in pharmaceutical research and development, industries, authorities, education and in hospitals in maintenance of records, inventory control, medication monitoring, drug information and drug storage and retrieval in retail pharmacy establishments. (5)
6. **Operating systems:** Introduction to Operating system, classification, use of operating system like DOS, WINDOWS (98 & XP) & LINUX. (6)

PART-B

7. **Computer Package:** MS Word, MS PowerPoint, MS Excel, HTML with tags. (10)
8. **Maintenance:** Recovery, Security, Firewall, Backup & CD Writing. (2)
9. **Internet:** History, Introduction to Internet Browsers, URL. Introduction to email and how to check and compose an email? Important websites related to pharmaceutical information – like sites for information regarding drugs, medical literature, plants, adverse effects, clinical data, patent sites, FDA, WHO, etc. (3)
10. **Programming Language (Programming with C):** Introduction to programming; Problem analysis, algorithm, flow chart, coding, execution, debugging and testing, program documentation. Introduction to C: Programming rules. Key words, identifiers, constants, variables, defining variables, data type, declaring variables, initializing variables, conversion types, operators etc. Operators and expression, input and output statement in C.

Decision statements: **If, if.... Else, Nested if else..... Go to, Switch () Case, break**, and default statement, loop control statement: **While, Do,While, for, nested for**. Arrays: One dimensional, two dimensional. Preprocessor directives: **# include, # define**. (10)

Books Recommended (Latest edition)

1. Hunt & Shelly, Computer and common sense, Prentice-Hall India, 4th Edition 1988
2. Pradeep Nair, Payal Lotia, DOS 6 & 6.22: An Introduction with computer fundamentals, BPB Publications. 1st Edition 2002.
3. Peter Dyson, Windows 98 Instant Reference, BPB Publications, 2nd Edition 1999.
4. Sharon Crawford & Neil J. Salkin, ABCs of Windows 98, BPB Publications, 2nd Edition 1998.
5. John R. Hubbard, Programming in C++, TMH, New Delhi, 2nd Edition 2000.
6. P.K.Sinha, Fundamentals of Computer, BPB, 6th Edition 2004

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**BPH-209: ENVIRONMENTAL SCIENCE
THEORY**

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

Note: There shall be internal evaluation for this subject and grading system shall be followed as detailed below:

A >75%, B >65%, C >55%, D ≥ 50%, E < 50%, E Grade would be considered failure.

PART-A

1. **Environmental studies:** Definition, Scope and importance. Multidisciplinary nature of environmental studies. (2)
2. **Natural resources:**
 - **Forest:** Benefits of forests. Use and over exploitation, Deforestation and timber extraction. Dams - their effects on forests and tribal people.
 - **Water resources:** Global water resources distribution. Use and over-utilization of surface and ground water, Floods, Drought, Conflicts over water, Dams-benefits and problems.
 - **Mineral resources:** Usage and exploitation, Environmental effects of extracting and using mineral resources.
 - **Food:** World food problems, Changes caused by agriculture and overgrazing, Effects of modern agriculture, Fertilizer-pesticide problems, Water logging and salinity. Organic farming - Definition and advantages.
 - **Energy sources-** Conventional and non conventional / Renewable and non renewable.
 - **Fossil fuels:** Coal, Petroleum and natural gas -Availability, Dependency and environmental problems. Effect of global price of fossil fuel on nations.
 - **Alternatives to fossil fuels:** Hydro electric power, Bio energy, Nuclear, Wind, Solar, geothermal. Energy of future for transportation-Ethanol, Biodiesel and fuel cells.
 - **Land resources:** Land as a resource, Land degradation, Man induced landslides, Soil erosion and desertification.
 - Role of an individual in conservation of natural resources and equitable use of resources for sustainable life style. (8)
3. **Ecosystem** – Structure and functional components of ecosystem. Producers, Consumers and decomposers. Food chain and food web. Energy flow and material cycling in ecosystem. Balanced eco system. (3)
4. **Biodiversity and its conservation:** Definition: Species and ecosystem diversity. Threats to biodiversity: Habitat loss, Poaching of wild life, Man wild life conflicts. Hot spots of biodiversity. Endangered and endemic species of India. Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. (5)
5. **Environmental pollution:** Definition, Causes, Effects and control measures of: Water pollution (water quality standards and parameters, Assessment of water quality, Transformation process in water bodies, Oxygen transfer by water bodies, Turbulent mixing, Water quality in lakes and preservers, Ground water quality), Air pollution, Soil pollution and noise pollution), Air pollution, Soil pollution and noise pollution. (5)

PART-B

6. **Current environmental issues:** Population Growth, Human health and urbanization. Global warming (greenhouse effect), Climate change, Acid rain, Ozone layer depletion, Industrial and nuclear accidents, Nosocomial diseases (Hospital acquired infections). (7)₃₁



7. **Environmental protection:** Salient features of Environmental Protection Act, Air & Water Acts, Wildlife and Forest Acts. Functions of Central and State Pollution Control Boards. Role of NGO'S. Environmental education. Role of information technology in environment and human health. (7)
8. **Waste management:**
- **Water Treatment:** Water quality standards, Water sources and their quality, Water treatment processes, Pre-treatment of water, Conventional process, Advanced water treatment process.
 - **Waste Water Treatment:** Water flow rate and characteristics, Design of waste water network, Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion and its application.
 - **Solid Waste Management:** Sources classification and composition of MSW; properties and separation, storage and transportation, MSW Management, Waste minimization, Reuse and recycling, Biological treatment, Thermal treatment, Landfill, Integrated waste management. Hazardous Waste Management, Hazardous waste and their generation, Medical hazardous waste. Household waste, Transportation and treatment of hazardous waste: incinerators, Inorganic waste treatment, Treatment systems for hazardous waste, handling of treatment plant residue. (8)
9. **Field work:**
- Visit to a local area to document environmental assets – river/forest/ grassland/hill/mountain etc.
 - Visit to a local polluted site – urban/rural/industrial/agriculture
 - Study of common plants, insects and birds.
 - Study of simple ecosystems- pond, river and hill slopes. (5)

Books Recommended (Latest editions)

1. K.L. Davis & S.J. Masen, Principles of Environmental Engineering and Sciences, McGraw Hill International Edition, 2004.
2. William P Cunningham & Mary Ann, Principles of Environmental Science inquiring & applications, Cunningham & Cunningham (TMH, New Delhi).
3. Y.Anjaneyalu, Introduction to Environmental Science, B.S.Publication, Hyderabad.
4. G.Kiely, Environmental Engineering Irwin/McGraw Hill International Edition 1997.



**BPH-210: PHARMACEUTICAL CHEMISTRY – III
(PHYSICAL CHEMISTRY)**

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. To determine the molecular mass of naphthalene by Rast's method.
2. To determine the specific reaction rate of the acid catalysed hydrolysis of ethyl acetate.
3. To determine the specific reaction rate of the hydrolysis of ethyl acetate by sodium hydroxide.
4. To determine the partition coefficient of Iodine between CCl_4 and water.
5. To study the molecular state of benzoic acid in benzene by partition method.
6. To study the phase-diagram of a two component system having eutectic temperature (diphenylamine-naphthalene).
7. To draw the mutual solubility curve of phenol water system.
8. To measure the surface tension of solutions of any alcohol in water at different concentrations.
9. To study the adsorption of acetic acid on activated charcoal.
10. To determine the heat of neutralization of HCl and NaOH.
11. To determine the heat of combustion of naphthalene at constant pressure and temperature.
12. Structural determination using Atomic parachors.



**BPH- 211- PHARMACEUTICAL CHEMISTRY – IV
(PHARMACEUTICAL ANALYSIS – I)
PRACTICAL**

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Calibration of analytical weights and calibration of volumetric apparatus.
2. Preparation and standardization of volumetric solutions and assay of official compounds involving Acidimetry, Alkalimetry, Permanganometry, Ceriometry, Iodimetry, Iodometry, Gravimetry and Complexometry.
3. Chromatographic analysis of some pharmaceutical products.
4. Analysis of pharmaceuticals using potentiometer, conductometer, amperometer, polarograph.



**BPH-212: PHARMACEUTICAL CHEMISTRY – VII
(PHARMACEUTICAL BIOCHEMISTRY)**

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Preparation of standard buffer (nitrate, phosphate, carbonate and measurement of pH).
2. Separation of lipids by TLC.
3. Quantitative estimation of amino acids.
4. Quantitative estimation of proteins.
5. Identification of C-terminal amino acids of proteins.
6. Estimation of blood glucose, blood cholesterol, SGPT and SGOT activity.
7. Enzymatic hydrolysis of glycogen by α - and β -amylase.
8. Acid hydrolysis and action of salivary amylase on starch.
9. Estimation of chloride, glucose, ammonia and creatinine in urine.
10. Identification of carbohydrates, proteins and fats.
11. Identification of normal and abnormal constituents of urine.
12. Extraction of DNA/RNA from Biological samples



**BPH 213-: PHARMACEUTICS – II
(PHARMACEUTICAL MICROBIOLOGY)**

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Preparation and sterilization of aerobic and anaerobic media.
2. Aerobic and anaerobic cultivation of bacteria.
3. Gram's staining, acid fast staining and hanging drop preparation.
4. Separation of mixed cultures and maintenance of pure cultures.
5. Microbial viable count in Pharmaceutical Formulations.
6. Particle count in water for injection.
7. Thermal death time studies.
8. Morphological characteristics of moulds and Yeasts.
9. Turbidimetric assay of at least one drug using microbial culture.
10. Bio-Chemical reactions:
 - Starch Hydrolysis
 - Gelatin liquification and
 - Haemolysis of blood
11. Phenol coefficient test for disinfectant.
12. Production of at least one product by fermentation.
13. Microbiological assay of tetracycline and cyanocobalamin.
14. Test for limit of alkalinity of glass.
15. Test for sterility. (Rabbit method and LAL method)
16. Test for Pyrogens.
17. Preparation & Evaluation of injections of water, dextrose, normal saline and oily phenol.



BPH-214: PHARMACEUTICS-V
(Computers in Pharmacy)
PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Demonstration of hardware.
2. Operating system: DOS, WINDOWS.
3. All Operations like Creating, deleting files and folders.
4. Burning of DVD/CD & Windows CD.
5. Formatting and checking Bootable CD & Flash Drive.
6. Programming in C :
 - Program to find Addition, Subtraction, Division & Multiplication of Two numbers Using third variable.
 - Program to find Simple Interest.
 - Program to Calculate Sum of 5 Subjects and find percentage.
 - Program to find greatest in 3 Numbers.
 - Program to find that entered year is leap year or not.
 - Program to use Switch statement .Display Monday to Sunday.
 - Program to display first 10 natural no. & their sum.
7. Create a project Report of any topic relates to Pharmacy Using MS WORD.
8. Create a project & presentations in POWERPOINT.
9. Create and save a work sheet using MS EXCEL. Input data in cells, copy and move the data, make calculations, plot a graph from X and Y sets of data.
10. Internet (Search Engine, email, groups).



**BPH-215: PHARMACEUTICS- VI
(PHARMACEUTICAL ENGINEERING DRAWING)**

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

1. Introduction: Significance of Engineering Drawing in pharmaceutical industry, drawing instruments and their uses, lines, lettering and dimensioning.
2. Scales: Construction of plain scale, vernier scale, diagonal scale, comparative scale and isometric scale.
3. Isometric projections: Theory, isometric views and projections, construction of isometric projections/views of two dimensional figures (i.e. circle, triangle, square, rectangle, quadrilateral, pentagon, hexagon), three dimensional solids (i.e. cylinder, prism, pyramids, cones, punches, dies and simple machine parts).
4. Orthographic projections: Theory, types, construction of drawing in both first angle and third angle. Various methods of sectioning i. e. full section, half section, removed section, revolved section, partial section and offset section.
5. Conversion of orthographic projections into isometric projections/views.
6. Drawing of machine parts and simple pharmaceutical equipment.
7. Methods of depicting layouts of various sections of a pharmaceutical unit.

Books Recommended (Latest editions):

1. N. D. Bhatt Elementary Engineering Drawing, Charotar publishing house Pvt. Ltd
2. N. D. Bhatt, Machine Drawing, Charotar publishing house Pvt. Ltd
3. R.K Nema, K.S Rathore and C.S Bhan, Pharmaceutical Engineering Drawing, CBS Publisher and distributors
4. Frechand Viorck, A Manual of Engineering drawing for students and Draftsmen, McGraw-Hill book company publishers.



**BPH 301- PHARMACEUTICAL CHEMISTRY – VII
(MEDICINAL CHEMISTRY-I)
THEORY**

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

Note 2: During evaluation, answers without structures will carry only 10% weightage.

PART-A

1. Basic Principles of Medicinal Chemistry:

Physicochemical properties (solubility, Partition coefficient, Acid-Base properties, Chemical Bonding, Chelation, Surface activity), Stereochemical features (optical isomerism, geometric isomerism and Bioisosterism) of drug molecules and biological action, Drug-receptor interactions; Principles of drug design – QSAR, CADD and their applications. (6)

2. The following topics shall be treated covering introduction, classification (along with structural formulae and IUPAC names of only those drugs mentioned under each topic), mode of action, uses, structure activity relationships (S.A.R.s) and stereo aspects (where able applicable). Synthesis of substances bearing asterisk under each topic will be covered:

1. Drugs acting on autonomic nervous system:

- **Cholinergics and Anticholinergics:** Acetylcholine, Carbachol, Pilocarpine, Hyoscyamine Sulphate, Homatropine, Tropicamide, Cyclopentolate, Neostigmine*, Atropine Sulphate*.
- **Adrenergic drugs and Adrenergic blocking agents:** Nor-Adrenaline, Orcipronalene, Isoprenaline, Terbutaline, Ephedrine, Atenolol, Adrenaline*, Sulbutamol*, Phenylephrine*, Naphazoline*, Prazosin*
- **Neuromuscular blocking agents:** Gallamine*, Succinylcholine.
- **Antispasmodic:** Dicyclomine hydrochloride*. (12)

2. Drugs acting on central nervous system:

- **General anaesthetics:** Inhalational anaesthetics (Halothane, Nitrous Oxide, Cyclopropane), Intravenous anaesthetics, Thiopentone Sodium*, Methohexitone*, Sodium, Ketamine*
- **Local anaesthetics:** Ester-type local anaesthetics, Amethocaine, Proxymetacaine), Amide-type local anaesthetics (Prilocaine, Bupivacaine, Mepivacaine, Cinchocaine. (Benzocaine, Procaine, Ligocaine)
- **Hypnotics and Sedatives:** Barbiturates-Quinalbarbitone, Non-Barbiturates Diazepam, Triazolam, Phenobarbitone*, Pentobarbitone*, Flurazepam*
- **Anticonvulsants:** Phenobarbitone, Methylphenobarbitone, Troxidone, Ethosuximide, Chlonezepam, Vigabatrin, Primidone, Phenytoin*, Sodium Valproate*
- **CNS Stimulants:** Caffeine, Fenfluramine, Amphetamine*, Dexamphetamine*.
- **Psychotherapeutic agents: Antipsychotic agents-** Triflupromazine, Thioridazine, **Antidepressant agents** Imipramine, Desipramine, trimipramine, Nortriptyline, Protriptyline, Phenelzine Sulphate, Tranylcypromine Sulphate **Anxiolytics** Meprobamate, Diazepam, Chlordiazepoxide, Alprazolam, Haloperidol*, Chlorpromazine*, Amitriptyline*, Clobazam*.
- **Antiparkinsonian agents:** Carbidopa, Benserazide, Selegiline, Amantadine, Bromocriptine, benzhexol, levodopa*, Apomorphine*.
- **Opioid analgesics:** Morphine and related compounds, Diphenoxylate, Methadone, Dipipanone, Dextropropoxyphene, Pethidine*, Pentazocine*.
- **Opioid antagonists:** Nalorphine, Naloxone

- **Antitussives:** Pholcodine, Dextromethorphan, Isoaminile, Benzonatate. (20)

PART-B

3. **Steroids and related drugs:** General study on steroidal nomenclature and stereochemistry, Clinical importance of steroidal drugs, Biosynthesis of Cholesterol and other steroids, Estrogens -Estradiol, Ethinylestradiol, Mestranol, Progestogens & synthetic progestogens, Progesterone, Lynestrenol, Medroxyprogesterone Acetate, Megestrol Acetate, Androgens and related substances Methyltestosterone, Anabolic steroids-Ethylestrenol, Oxymetholone, Adrenocortical steroids and related substances-Cortisone, Hydrocortisone, Aldosterone, Desoxycortone, Prednisone, Dexamethasone, Betamethasone. Diethylstilbestrol*, Dienoestrol*, Testosterone*, Norethisterone*, Nandrolone*, Prednisolone*. (10)
4. **Diuretics:** Acetazolamide, Dichlorphenamide, Chlorothiazide, Polythiazide, Ethacrynic acid, Triamterene, Amiloride, Mannitol, Urea. Frusemide*, Hydrochlorothiazide*, Spironolactone*. (5)
5. **Autocoids: Antihistamines:** Diphenhydramine, Chlorcyclizine, Cetrizine, Astemizole, Terfenadine, Fexofenadine, Ranitidine, Famotidine, Nizatidine, Sodium Cromoglycate. Mepyramine*, Promethazine*, Chlorpheniramine*, Cimetidine*. **Eicosanoids:** Occurrence, Medicinal applications. (7)
6. **Analgesics, Antipyretics and Antiinflammatory (Non-steroidal) agents:** Aspirin, Mefanamic acid, Ibuprofen, Naproxen Nabumetone, Phenylbutazone, Oxyphenbutazone, Sulphinpyrazone, Paracetamol, Anti-Gout Drugs (Colchicine, Probenecid. Diclofenac sodium*, Indomethacin*, Piroxicam*, Allopurinol*. (7)
7. **Drugs affecting uterine motility:** Oxytocin, Ergotalkaloids and Prostaglandins. (4)
8. **Vitamins:** Fat soluble vitamins (A,D,E and K), water soluble vitamins (B-complex group, Folic acid and vitamin C), (4)

Books Recommended (Latest edition)

1. Wilson & Grisvold,, Text Book of Organic Medicinal & Pharmaceutical Chemistry, Lippincott Williams & Wilkins.
2. William Foye, Principles of Medicinal Chemistry, Lippincott Williams & Wilkins.
3. M.E. Wolff, Ed., Burger's Medicinal Chemistry, John Wiley and Sons, New York (Latest Edition).
4. S.N.Pandeya, A Text Book of Medicinal Chemistry, SG Publisher, Varanasi.
5. Text Book of Pharmaceutical Chemistry, Bentley & Driver, Oxford University Press, New Delhi.
6. H. Singh and V.K. Kapoor Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Delhi (Latest Edition).
7. Wermuth , The Practice of Medicinal Chemistry,, Academic Press. New York



**BPH-302: PHARMACEUTICS –VII
(PHYSICAL PHARMACY)**

THEORY

Max. Marks: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part. A candidate has to attempt at least two questions from each part.

PART-A

1. **Micromeritics and Powder Rheology:** Definition and applications of micromeritics in pharmacy, Fundamental properties of particles i.e. particle size and size distribution, particle number, particle shape and particle surface area, Hatch Choate equation, particle size determination methods i.e. optical microscopy, sieving and sedimentation method, particle volume measurement by coulter counter, specific surface, surface area determination methods i.e. air permeability and gas adsorption method, derived properties of powders i.e. packing geometry, porosity, densities, density determination methods for true, bulk and tapped density, bulkiness, flow properties, characterization of powder flow by compressibility index, Hausner ratio, angle of repose and its measurement methods, improvement of flow properties. (7)
2. **Pharmaceutical Rheology:** Newtonian systems, Newton's law of flow, kinematic viscosity, effect of temperature, Non Newtonian systems i.e. plasticity, pseudo plasticity, dilatancy, thixotropy, measurement of thixotropy and its applications in formulation, bulges and spurs, negative thixotropy, measurement of viscosity using capillary, falling sphere and rotational viscometers, viscoelasticity and viscoelastic models, pharmaceutical applications of rheology. (7)
3. **Complexation and protein binding:** Definition and applications of complexation in pharmacy, classification of complexes, methods of analysis, significance of protein binding, kinetics of protein binding and methods for determining protein binding. (6)
4. **Buffers and isotonic solutions:** Buffer equation for weak acid, weak base and its salt, buffer capacity, buffer preparation, pharmaceutical and biological buffers, buffered isotonic solutions and methods of adjusting tonicity. (5)

PART-B

5. **Surface and Interfacial Phenomena:** Classification of interfaces, surface and interfacial tension, surface free energy, methods for measurement of surface tension and interfacial tension, classification and applications of surfactants, adsorption at liquid interfaces, HLB concept and calculation of HLB value, wetting and contact angle, spreading coefficient, Critical micelle concentration and factors affecting CMC, surface films, adsorption phenomena, different types of adsorption isotherms and applications of adsorption, detergency, electric properties of interface. (7)
6. **Colloidal dispersions:** Definition, classification of colloids, optical, electrical and kinetic properties of colloids, stability of colloidal systems using DLVO theory, protective colloidal action, purification of colloidal dispersions, applications of colloids in pharmacy. (6)
7. **Pharmaceutical Suspensions and Emulsions:** Definition, types and utility of suspensions, interfacial properties of suspended particles, theory of sedimentation, sedimentation parameters i.e. sedimentation volume and degree of flocculation, wetting of particles, formulation components, controlled flocculation, flocculation in structured vehicles, rheological considerations, physical stability of suspensions. Emulsions: Definitions, types and utility of emulsions, mechanism of emulsifying agents, formulation components, physical stability of emulsions, micro-emulsions. (6)
8. **Kinetics and drug stability:** Definitions, determination of reaction rate constant, half life and shelf life for zero, first and second order reaction, determination of order of reaction, physical degradation of pharmaceutical products, chemical decomposition of drugs and its stabilization, influence of temperature, light, solvent and catalytic species on drug decomposition, accelerated stability studies, storage conditions. (6)



Books Recommended (Latest editions)

1. Martin's Physical Pharmacy and Pharmaceutical Sciences by Patrick J. Sinko and Yashveer Singh, (Eds.), Lippincott Williams and Wilkins, USA.
2. Theory and Practice of Physical Pharmacy by Gaurav K. Jain, Farhan J. Ahmad and Roop K. Khar, Reed Elsevier India Pvt. Ltd.
3. Advances in Pharmaceutical Sciences, Vol. 1 to 4 by H. S. Beans, A. H. Beckett and J. E. Careless.
4. Remington's Pharmaceutical Sciences, Mack Publishing Co, Eastern Pennsylvania, USA.
5. Textbook of Physical Pharmaceutics by CVS Subrahmanyam, Vallabh Prakashan, Delhi.



**BPH 303- PHARMACEUTICS – VIII
(PHARMACEUTICAL JURISPRUDENCE)**

THEORY

Max. Marks: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part. A candidate has to attempt at least two questions from each part.

PART-A

1. **Introduction:** Pharmaceutical legislation- a brief review. (3)
2. **A brief study of the following with special reference to the main provisions (with latest amendments):**
 - The Pharmacy Act
 - Code of Pharmaceutical Ethics
 - The Medicinal and Toilet preparations (Excise duties) Act & Rules.
 - The Narcotic Drugs and Psychotropic Substances Act and Rules.
 - Drugs (Prices Control) order 2013.
 - The Poisons Act.
 - The Insecticides Act.
 - The Patent Act and Rules 2013.
 - Factories Act.
 - The Prevention of Cruelty to Animals Act.
 - Right To Information Act. (22)

PART-B

3. The Drugs and Cosmetics Act and Rules (with latest amendments)
4. The Shop and Establishment Act.
5. The Drug and Magic Remedies (Objectionable Advertisements) Act. (25)

Books Recommended (Latest editions)

1. Mehta R.M., Forensic Pharmacy, Vallabh Prakashan, New Delhi.
2. Drugs and Cosmetics Act, 1940 and all amendments, Govt of India.
3. B. M. Mithal, Text Book of Forensic Pharmacy, National Book Centre, Dr. Sundari Mohan Avenue, Calcutta 700014.
4. Relevant Acts & Rules published by the Government of India.



**BPH-304: PHARMACEUTICS-IX
(DOSAGE FORM DESIGN AND COSMETICOLOGY)**

THEORY

Max. Marks: 80

Total Hours: 50(2hrs/week)

Note: Examiner has to set four questions from each part. A candidate has to attempt at least two questions from each part.

PART-A

1. **Preformulation studies:** Study of physicochemical properties of drug like physical form, particle size, shape, density, solubility, dissolution and organoleptic properties and their effect on formulation, stability and bioavailability.
Study of chemical properties of drug like hydrolysis, oxidation, reduction, racemization, polymerization and their influence on formulation and stability of products. (8)
2. **Biological Products :** Introduction and preparation of Whole human blood, concentrated human RBC, dried human plasma, dried human serum, human plasma protein fraction, human fibrinogen, human thrombin, ideal plasma substitute properties and products i.e. PVP, dextran, absorbable gelatin, oxidized cellulose, calcium gluconate. (5)
3. **Design, development and process validation methods** for pharmaceutical operations involved in the production of pharmaceutical products with special reference to liquid dosage forms. (5)
4. ICH Guidelines for stability testing protocol for various pharmaceutical products, GMP, Quality assurance and Quality audit (7)

PART-B

5. **Skin:** Structure and functions of skin, formulation, preparation and evaluation of cleansing creams, cold creams, cleansing lotions, foundation creams, moisturizing creams, sun protecting/ sunscreen preparations (6)
6. **Hairs :** Structure and functions, formulation, preparation and evaluation of shampoos, hair creams, hair colorants, depilatories, shaving cream and after shave lotion. (7)
7. **Nail:** Structure and functions, formulation, preparation and evaluation of nail lacquer. (4)
8. **Formulation, preparation and evaluation** of other cosmetics like, anti-perspirants and deodorants, tooth powders and tooth paste, lipsticks. (5)
9. **Herbal cosmetics** (3)

Books Recommended (Latest editions)

1. Lachman Leon, Leiberman H.A., Kanig J.L., Theory and practice of Industrial Pharmacy Fea & Febiger, Philadelphia, USA. 1976.
2. J. B. Wilkinson & R. J. Moore, Harry's Cosmeticology, Chemical publishing House, New York.
3. ICH Guidelines.
4. Aulton M.E. Aulton's Pharmaceutics: The Design and Manufacture of Medicines, Churchill Livingstone, London.
5. Remington's Pharmaceutical Sciences. Mack publication. Company, pennsylvania, USA .
6. IP/BP/USP.
7. Poucher's perfumes, Cosmetics and Soaps, Vol. 3 (Cosmetics), 9th edition.



Pt. B. D. SHARMA UNIVERSITY OF HEALTH SCIENCES, ROHTAK

8. Balsam M.S. and Sagarin E., Cosmetics: Science and Technology, Vol. 1-3, 2nd edition, 1974, Wiley Interscience, New York.
9. Banker G.S. and Rhodes CT, Modern Pharmaceutics, Vol .4, 2nd Ed. Marcel dekker Inc., New York, U.S.A.
10. Ansel H.S. and Popovich N.G., Pharmaceutical Dosage Forms and Drug Delivery Systems, Lippincott Williams & Wilkins, U.S.A.
11. Ali Javed , Khar R.K., Dosage form Design. Birla Publishers. New Delhi.
12. Sharma P.P. Cosmetics- Formulation, manufacturing & quality control. Vandana Publication . New Delhi.
13. Nema R.K., Rathore S.K. Textbook of Cosmetics , CBS Publishers , New Delhi.



**BPH-305: PHARMACEUTICS –X
(PHARMACEUTICAL ENGINEERING-II)**

THEORY

Max. Marks: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part and the candidates are required to attempt five questions with atleast two from each part.

PART-A

1. **Distillation:** Raoult's law, volatility, boiling point diagrams, azeotropic mixtures, equilibrium diagrams, types of distillation, rectification, rectifying columns, column packings, material and energy balance of a rectifying column, reflux ratio, determination of number of theory plates, H.E.T.P. and steam distillation. Applications of steam distillation in pharmacy. (8)
2. **Extraction:** Factors affecting, equipment for extraction of solids i.e. fixed bed diffusion battery, continuous diffusion battery, basket extractor, Rotocel extractor and Dorr agitator. Equipment for liquid-liquid extraction i.e. extraction towers and Podbielniak extractor. Super-critical fluid (SCF) extraction. (6)
3. **Mixing:** Theory, uniformity index, factors influencing selection of suitable mixer, study of equipment employed for solid-solid, liquid-liquid and solid-liquid mixing. Emulsification equipment. (8)
4. **Industrial hazards and safety precautions:** Mechanical, Chemical, Electrical, Fire and Dust hazards, safety requirements, accident records etc. (3)

PART-B

5. **Size reduction:** Mechanism, Laws and factors influencing, energy requirements, applications in pharmacy, study of grinding equipment i.e. fluid energy mill, hammer mill, ball mill and its variants, centrifugal mill, attrition mill, edge runner mill, squirrel cage disintegrator, Buhrstone mill. (7)
6. **Size separation:** Screening, screen effectiveness, screening equipment i.e. stationary (Hammer, Rotex, Trommels-simple, multiple and concentric) and vibrating types. Air suspension methods i.e. air separator and cyclone separators, sedimentation and hydraulic separation i.e. elutriation and double-cone classifier. (5)
7. **Crystallization:** Crystal forms and habits, Mier's supersaturation theory, Nucleation, Crystal growth theories, Crystallizers based on supersaturation, by cooling (i.e. tank crystallizers, agitated batch crystallizers and Swenson-Walker), adiabatic cooling (i.e. vacuum crystallizers) and evaporation (i.e. Krystal crystallizers). Material and energy balance of crystallizer. (7)
8. **Corrosion and its prevention:** Types and causes of corrosion, factors affecting corrosion rate and study of various methods for combating corrosion. (3)
9. **Materials for pharmaceutical plant construction:** factors affecting the selection of a material for pharmaceutical plant, ferrous metals (i.e. cast iron, steel and stainless steels), non-ferrous metals (i.e. Copper and its alloys, aluminum, tin, silver, nickel and alloys), non-metals i.e. glass, slate, asbestos, rubber, plastics and timber. (3)

Books Recommended (Latest editions)

1. Badger, Introduction to Chemical Engineering, McGraw Hill Co., International Student edition (Latest edition).
2. Coulson and Richardson's Chemical Engineering (Vol. 1&2) Butterworth-Heinemann.
3. Perry's Chemical Engineers' Handbook, 8th edition or latest McGraw Hills.
4. McCabe, Smith & Harriot, Unit Operations of Chemical Engineering, 5th Edition or latest, McGraw Hill International.



BPH-306: PHARMACOLOGY –II

THEORY

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. General pharmacology:

- Introduction to pharmacology, sources of drugs, dosage forms and routes of administration, mechanism of action, combined effect of drugs, factors modifying drug action, tolerance and dependence, pharmacogenetics.
- Absorption, distribution, metabolism and excretion of drugs, principles of basic and clinical pharmacokinetics, adverse drug reactions and treatment of poisoning, ADME drug reactions, bioassay of drugs and biological standardization, discovery and development of new drugs. (15)

2. Pharmacology of autonomic nervous system:

- Neurohumoral transmission (autonomic and somatic)
- Parasympathomimetics, Parasympatholytics, Sympathomimetics, Sympatholytics, Ganglion blocking and Stimulating agents
- Neuromuscular blocking agents.
- Local anaesthetic agents. (10)

3. Autocoids:

- Histamine, 5-HT and their antagonists
- Prostaglandins, thromboxane and Leukotrienes
- Pentagastrin, cholecystokinins, angiotensin, bradykinin and substance P. (6)

4. Drugs acting on the respiratory system:

- Anti-asthmatic drugs including bronchodilators
- Anti-tussive and Expectorants (6)

PART-B

5. Pharmacology of Central Nervous System:

- Neurohumoral transmission in the C.N.S.
- General anaesthetics
- Alcohols and Disulfiram
- Sedative and hypnotics
- Anti-anxiety agents and centrally acting muscle relaxants
- Psychopharmacological agents (Anti-psychotic, antidepressants, antimaniacs and hallucinogens)
- Anti-epileptic drugs
- Anti-parkinsonian drugs
- Analgesics, antipyretics and anti-inflammatory agents
- Narcotic analgesics and antagonists.
- CNS stimulants
- Anti-alzheimers drugs (24)

6. Drugs acting on the urinary system:

- Fluid and electrolytic balance
- Diuretics (4)



7. Drugs acting on the Gastrointestinal Tract:

- Antacids, antisecretory and anti-ulcer drugs.
- Laxative and antidiarrhoeal drugs.
- Appetite stimulants and suppressants.
- Emetics and anti-emetics.
- Miscellaneous: carminatives, demulcents, astringents, digestants, enzymes and mucolytics. (6)

8. Steroids:

- ACTH and corticosteroids.
- Androgens and anabolic steroids.
- Estrogen and Progesteron
- Drugs acting on the uterus. (4)

Books Recommended (Latest edition)

1. K.D.Tripathy, Essentials of Medical Pharmacology, JAYPEE Publication.
2. Satoshkar & Bhandarkar, Pharmacology & Pharmacotherapeutics, Popular Publication.
3. Prasun Kumar Das, S.K.Bhattacharya, Pharmacology, Elsevier Publication.
4. Goodman & Gilman, The Pharmacological Basis of Therapeutics, Mc Graw Hill.
5. S.D. Sethi, Text book of Pharmacology, Elsevier Publication.
6. Rang, Dale and Ritter, Pharmacology, Churchill Living Stone.
7. B.G.Katzung, Basic & Clinical Pharmacology, Lange.
8. Mary J, Mycer, Richard A, Pharmacology, Lippincott William & Willans



BPH-307: PHARMACOLOGY –III

(PHARMACEUTICAL ANIMAL BIOTECHNOLOGY)
THEORY

Max. Marks: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. **Introduction to Animal Biotechnology:** Definitions, history, branches and scope of animal biotechnology. Therapeutic and pharmaceutical applications of animal biotechnology. (5)
2. **Concept of aseptic techniques in animal tissue culture (ATC):** Design and layout of ATC laboratory, Equipment for ATC laboratory. Laboratory safety and Biohazards, balanced salt solutions and tissue culture media. Detection of contamination, preservation, storage and shipment of cells. Growth of cells in the serum free hormone(s) supplemented medium, Role of CO₂ in culture medium. (10)
3. Dispersion and disruption of tissue, monolayer and suspension culture techniques, measurement of growth and viability of cells in culture, maintenance of cultured cell line, primary and established cell line cultures, cell separation. (5)
4. **Enzymes:** Introduction, mechanism of action, isolation, purification of enzymes, Immobilized enzymes, methods of immobilization, applications of immobilized enzymes. Study of enzymes: Streptokinase and amylase. (5)

PART-B

5. **Stem cells and Gene Therapy:** History and introduction to gene therapy, types, methods and applications of gene therapy. History and introduction to stem cells, types of stem cells, human stem cell culture techniques (embryonic and germ cells), applications of stem cells, and ethical issues related to stem cells. (7)
6. **Genetic Engineering of Animal Cells:** Introduction to gene cloning and gene transfer techniques and host system, Transgenic animals and their applications, characterization of transfected cells; *in vitro* fertilization, embryo transfer and ethical issues of animal cloning. (7)
7. **Knock out technology:** Methods, limitations and applications. (4)
8. **Drug Delivery systems by Biotechnology:** Production of drugs from biotechnology:- a brief account of erythropoietins, interferons, insulin, monoclonal antibodies and follicle stimulating growth hormone, Cancer immunotherapy vaccines. (7)

Books Recommended (Latest editions)

1. Spier, R. R. and Griffiths, J. B. (1990). Animal Cell Biotechnology, Academic Press, London.
2. Gareth, E. J. (1996). Human Cell Culture Protocols, Humana Press.
3. Julio, E., Celis (1998). Cell Biology-A Laboratory Hand Book, Vol. I-IV, 2nd Ed., Academic Press, New York.
4. Butler, M. (2004). Animal Cell Technology, 2nd Ed., BIOS Scientific Publishers, U.K.
5. Freshney, R. T. (2006). Culture of Animal Cells, 5th Ed., John Wiley and Sons, New York.
6. Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman (Eds.), Concepts in Biotechnology, University Press.
7. Hood L.E., Weissman I., Wood W.B. and Wilson J.H. Immunology, Benjamin Cummings.
8. Biotol Series – Butterworth and Heineman, Oxford, 1992.
9. Essential Immunology, Roitt, I.M., Blackwell Scientific, Oxford, UK.
10. Immunology, Kubly, J., Freeman, W.H., Oxford.
11. Culture of Animal Cells- I. Freshney (Willy).

BPH-308: PHARMACOGNOSY –III

THEORY

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART – A

1. Biosynthetic studies: General technique of biosynthetic studies. Shikimic Acid and Acetate–mevalonate pathways and the various Secondary Metabolites obtained from these pathways. (3)
2. An introduction to active constituents of drugs: Their isolation, classification and properties, Phytochemical screening for alkaloids, saponins, sterols, cardenolides, bufadenolides, flavonoids and leucoanthocyanidins, tannins and polyphenols, anthraquinones, cyanogenetic glycosides, amino acids in plant extracts. (8)
3. Study of the biological sources, cultivation, collection, commercial varieties, chemical constituents, substituents, adulterants used, diagnostic microscopic and macroscopic features and specific chemical tests of following group of drugs containing glycosides.
Saponins: liquorice, ginseng, dioscorea,
Cardio-active sterols: digitalis, squill, strophanthus
Anthraquinones cathartics: aloe, senna, rhubarb
Others: Psoralea, ammi, gentian, saffron. (13)
4. Studies of traditional drugs, common vernacular names, botanical sources, morphology, chemical nature of chief constituents, pharmacology, categories and common uses and marketed formulations of following indigenous drugs: Amla, Kantkari, Satavari, Tylophora, Bhilava, Kalajira, Bach, Rasna, Punarnava, Chitrak, Apamarg, Gokhru, Shankpushpi, Gaduchi, Brahmi, Adusa, Arjuna, Ashoka, Methi, Lehsun, Palash, Guggal, Gymnema, Shilajit, Nagarmotha and Neem (10)
5. Biological sources, preparation, identification test and uses of the following enzymes: Diastase, papain, pepsin, trypsin and pancreatin. (4)

PART – B

6. Systematic study of source, cultivation, collection, processing, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following alkaloid containing drugs
 - Pyridine-piperidine: Tobacco, areca.
 - Tropane: Belladonna, datura and withania.
 - Quinoline and isoquinoline : Cinchona, ipecac, opium.
 - Indole: Ergot, rauwolfia, catharanthus.
 - Imidazoles: Pilocarpus.
 - Steroidal: Kurchi.
 - Alkaloidal amines: Ephedra.
 - Glyco-alkaloids: Solanum.
 - Purines: Coffee and tea. (13)
7. Terpenoids : Introduction, occurrence, general properties, classification, methods of extraction, Chemistry of medicinally important monoterpenes (Citral, Linalool, α -Terpineol, Menthol, α -Pinene and Camphor), Sesquiterpenoids (Farnesol, Zinziberene), Diterpenoids (Phytol), basic biosynthetic scheme for formation and pharmaceutical importance of Monoterpenoids, Sesquiterpenoids, Diterpenoids. (12)
8. Carotenoids: General Characters, classification, biosynthesis and pharmaceutical importance of α -carotene, β -carotenes, vitamin A. (4)
9. Flavonoids: Classification, isolation, basic biosynthetic scheme for formation of

anthocyanins, flavones, Isoflavone, flavanones, flavonol and flavane. (5)

10. Iridoids: General characteristics, biosynthesis, relation with alkaloids and medicinal importance (3)

Books Recommended (Latest editions)

1. W. C. Evans, Trease and Evans Pharmacognosy (15th Ed.), W. B. Saunders Limited, 2002.
2. Trevor Robinson, The Organic Constituent of Higher Plants, Burge Publishing Co., 1967.
3. G. E. Trease, A Textbook of Pharmacognosy (7th Edition), Bailliere Tindall, London, 1957.
4. Wallis, T.E., "Analytical Microscopy", J & A Churchil Limited, London.
5. Chemistry of Organic Natural Products (Vol.-1 & 2) by O.P. Agarwal.
6. Organic Chemistry of Natural Products (Vol.-1 & 2) by Gurdeep Chatwal. Books Recommended (Latest edition):
7. C. K. Kokatae, A. P. Purohit, S. B. Gokhale, Pharmacognosy; Nirali Prakashan; Pune.
8. Saharan, Moond, Chouhan & Gupta, Principles of Pharmacognosy; Agrobios (India)
9. Mohammed Ali, Pharmacognosy (vol.1 and 2); CBS Publishers & Distributors Pvt. Ltd.
10. James E. Robbers, Marilyn K. Speedie, Varro E. Tyler; Pharmacognosy and pharmaco-biotechnology, Williams & Wilkins. Baltimore..
11. Bruneton, J. Pharmacognosy, phytochemistry, medicinal plants. Lavoisier Publishing, Paris; France. ISBN 2-7430-0028-7
12. Vinod D Rangari, Pharmacognosy and phytochemistry (Part 1 and 2) Career Publications, Nashik; Pune.



**BPH 309-: PHARMACEUTICAL CHEMISTRY – VII
(MEDICINAL CHEMISTRY-I)**

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Synthesis of single step preparations of selected official drugs and their intermediates (atleast ten).
2. Monographs of selected official drugs including identification tests and tests for purity.
3. Preparations of TLC of synthesized drugs.
4. Stereo modeling of Drugs



**BPH-310: PHARMACEUTICS –VII
(PHYSICAL PHARMACY)**

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Determination of particle size and particle size distribution using optical microscopy.
2. Determination of particle size and particle size distribution using sedimentation method.
3. Determination of particle size and particle size distribution using sieving technique.
4. Determination of derived properties of powders like true density, bulk density, porosity, compressibility index, Hausner ratio,
5. Determination of angle of repose of powders.
6. Comparison of flow properties of powders and granules by angle of repose method.
7. Study effect of glidants on flow properties of powders.
8. Determination of surface and interfacial tension of liquids.
9. Determination of spreading coefficient of liquids.
10. Determination of HLB values of surfactants.
11. Determination of critical micellar concentration (CMC) of surfactants
12. Study of rheological properties of various types of systems using different viscometers.
13. Study effect of temperature and concentration of polymeric substance on viscosity.
14. Studies of different types of colloid and their properties.
15. Preparation of various types of suspensions and determination of their sedimentation parameters.
16. Preparation and stability studies of emulsions.
17. Studies on different types of complexes and determination of their stability constants.
18. Determinations of half-life rate constant and order of reaction.
19. To study the influence of various factors on the rate of reaction.
20. Accelerated stability testing, shelf life determination and expiration dating of pharmaceuticals.
21. Preparation of pharmaceutical buffers and determination of buffer capacity.
22. Experiments involving tonicity adjustments



**BPH-311: PHARMACEUTICS-IX
(DOSAGE FORMS DESIGN AND COSMETICOLOGY)**

PRACTICAL

Max. Marks: 80

Total Hours 75 (3 hrs/week

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Preparation and Evaluation of (a) cold cream (b) vanishing cream (c) Cleansing lotion and creams (d) moisturizing creams (e) hair creams and hair conditioners (f) shampoos (g) hair colorant (h) depilatory (i) shaving creams (j) tooth powder (k) tooth pastes (l) after shave lotions and other cosmetics as studied in theory.
2. Preformulation studies including drug-excipient, compatibility studies, effect of stabilizers, preservatives etc. in dosage form design.
3. Stability evaluation of various dosage forms.
4. Dissolution testing and data evaluation for oral solid dosage forms.
5. GMP guidelines for manufacturing of various products like Tablet, Capsule, Suspension, Emulsion & Parenterals.



**BPH-312: PHARMACEUTICS-X
(PHARMACEUTICAL ENGINEERING)**

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Number of experiments based upon theory portions of Pharmaceutical Engineering I & II. These experiments must include the following.

1. To perform Reynold's experiment.
2. Determination of fanning factor.
3. Comparison of the sensitivity of various manometers.
4. Determination of flow rate using venturimeter.
5. Determination of flow rate using orifice meter.
6. Determination of flow rate using pitot tube.
7. Determination of flow rate using rotameter.
8. Determination of overall heat transfer coefficient.
9. Effect of number, size of balls on the grinding rate in a ball mill.
10. Efficiency of a centrifugal pump.
11. Determination of specific cake resistance and filter medium resistance.
12. Effect of thickness of cake on filtration rate in a filter press.
13. Effect of colours on radiation of heat.
14. Comparison of heat exchangers efficiencies in parallel and counter-flow patterns.
15. Overall efficiency of steam distillation.
16. Determination of sieve effectiveness.
17. Use of psychrometric chart for determination of relative humidity, absolute humidity, dew point, humid heat and saturated volume based upon data of dry bulb and wet bulb temperature.
18. Use of psychrometric chart for determination of relative humidity, absolute humidity, wet bulb temperature, humid heat and saturated volume based upon data of dry bulb and dew point.
19. Classification by elutriation.
20. Determination of equilibrium moisture constant.



BPH-313: PHARMACOLOGY –II

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Introduction to Experimental Pharmacology.
2. Preparation of different solutions for experiments.
3. Common Laboratory animals and their maintenance.
4. Study of commonly used instruments in experimental pharmacology.
5. Experiments on intact preparations using Computer Simulations-
 - Study of different routes of administration of drugs in mice / rats. To study the effect of hepatic microsomal enzyme inhibitors and induction on the
 - Pentobarbitone/hexobarbitone/thiopental sodium sleeping time in mice.
6. Experiments on Central Nervous System using Computer Simulations;
 - Recording of spontaneous motor activity, stereotypy, analgesia, anticonvulsant activity and muscle relaxant activity of drugs using simple experiments.
 - Effects of autonomic drugs on rabbit's eye.



BPH-314: PHARMACOGNOSY –III

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Microscopic examination of diagnostic tissues in powdered crude drugs.
2. Pharmacognostic identification of various crude drugs.
3. Processing, extraction, isolation and characterization of natural products.



BPH-401: PHARMACEUTICAL CHEMISTRY
(MEDICINAL CHEMISTRY-II)
THEORY

MAX. MARKS: 80

TOTAL HOURS: 75 (3Hrs/week)

Note 1: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two questions from each part.

Note 2: During evaluation, answer without structures will carry only 10% weightage.

PART-A

1. **Drug metabolism:**

Introduction, General pathways of drug metabolism: Phase I (Functionalization) and Phase II (Conjugation) reactions. (10)

2. **Prodrug approach:**

Basic concepts, classification of prodrugs, reversal of prodrugs (chemical and enzymatic); detailed pharmaceutical and pharmacokinetic applications of prodrug approach (with suitable examples giving structural formulae of prodrugs and drugs), limitations of prodrug design. (6)

3. The following topics shall be treated covering introduction, classification (alongwith structural formulae and IUPAC names of only those drugs mentioned under each topic), mode of action, uses, structure activity relationships (S.A.R.s) and stereo aspects (where able applicable). Synthesis of substances bearing asterisk under each topic will be covered:

I. **Sulphonamides:** Development, Nomenclature, Antimicrobial spectrum, physico-chemical properties and biological activity, toxicity and side effects, reduction of crystal uria, synergism with DHFRIs. Sulphanilamide, Sulphadiazine*, Sulphamethoxazole*, Sulphadimethoxine*, Sulphacetamide Sodium*, Sulphamethizole, Sulphadoxine, Sulfaguanidine*, Succinylsulphathiazole, Sulphacetamide, Trimethoprim*, Mefenide. (5)

II. **Antibiotics:** Cycloserine*, Chloramphenicol*, benzyl-penicillin, procaine penicillin, phenoxymethylpenicillin, Phenethicillin, Methicillin, Cloxacillin, Ampicillin*, Amoxicillin, Carbenicillin, Cefalotin, Cefoexitin, Cefotaxime, Cefepime, Imipenem, Clavulanic acid, Sulbactam, Streptomycin, Chlortetracycline, Doxycycline, Fusidic acid, lincomycin and Spectinomycin. (8)

III. **Antifungal Agents:** Griseofulvin, Miconazole, Econazole, Clotrimazole, Fluconazole, 5-Fluorocytosine. (2)

IV. **Urinary Antiseptics:** Nalidixic acid*, Nitrofurantoin*, Quinolones. (2)

V. **Antimycobacterial Agents:** Isoniazid*, Pyrazinamide*, Ethambutol*, P.A.S.*, Ethionamide*, Thiacetazone*, Dapsone*, Clofazimine, Thalidomide. (4)

PART-B

VI. **Hormones: Thyroid hormones and Anti-thyroid agents:**

Thyroxine*, Liothyronine, Propylthiouracil*, Carbimazole*, Phenylthiourea.

Insulin and oral hypoglycaemic agents:

Insulin and Insulin preparations, Tolbutamide*, Tolazamide, Glibenclamide, Glipizide, Gliclazide, Metformin*, Repaglinide and Miglitol. (5)

VII. **Diagnostic agents:** Diatrizoic acid, Iothalamic acid, Iopanoic acid*, Iohexol, Iopamidol, Diodone*, Fluorescein sodium, Indigo Carmine and Metyrapone. (2)

VIII. **Antimalarials:** Life cycle of *Plasmodium* and types of chemotherapy. Quinine, Mefloquine, Chloroquine*, Primaquine*, Quinacrine, Amodiaquine*, Pyrimethamine*, proguanil, Mepacrine* and Atovaquone. (3)

IX. **Antiprotozoal agents:** Emetine hydrochloride, Quiniodochlor, Diloxanide Furoate*, Melarsen Sodium, Pentamidine Isethionate, Nitrofurazone, Eflornithine, Sodium Stibogluconate, Metronidazole*, Acetarsol* and Furazolidone*. (6)

- X. **Anthelmintic drugs:** Diethylcarbamazine citrate*, Thiabendazole*
Mebendazole*, Albendazole, Levamisole, Niclosamide*, Piperazine citrate*,
Niridazole, Hexylresorcinol* and Praziquantel. (6)
- XI. **Antineoplastic agents:** Introduction, Characteristics of cancer cells, Naming
of some neoplastic diseases, causes of cancer, Mustine Hydrochloride,
Chlorambucil*, Melphalan*, Cyclophosphamide, Thiotepa, Busulphan,
Lomustine*, Dacarbazine*, Mitobronitol, Methotrexate*, Fluorouracil*,
Cytarabine, Mercaptopurine, Thioguanine, Pentostatin, Doxorubicin, Mitomycin
C, Tamoxifen*, Cisplatin*. (5)
- XII. **Antiviral agents:** Introduction to DNA, RNA and Retro-Viruses, viral
replication. Idoxuridine, Aciclovir*, Penciclovir, Foscarnet Sodium, Ribavirin*,
Amantadine, Zidovudine*, Nevirapine, Bromopiramine. (3)
- XIII. **Drugs acting on cardiovascular system:**
Digitoxin, Digoxin, Ouabain, Milrinone, Glycerol Trinitrate, Isosorbide
Dinitrate*, Nifedipine*, Diltiazem, Quinidine, Procainamide* Methyldopa*,
Clonidine*, Propranolol*, captopril*, Flecainide, Amiodarone, Bretylium
Tosilate, Verapamil*, Lidocaine*, Propranolol*, Atenolol, Methyldopa*,
Clonidine*, Guanethidine*, Hydralazine*, Minoxidil, Diazoxide, Mexiletine,
Captopril*, Losartan, Phenoxybenzamine, Phentolamine*, Prazocin,
Isosuprine Hydrochloride, Clofibrate*, Mevastatin, and Cholestyramine. (8)

Books Recommended:

1. M.E. Wolff, Ed., Burger's Medicinal Chemistry, John Wiley and Sons, New York (Latest edition).
2. J. N. Delgado and W. A. Remers, Eds., Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. Lippincott Co., Philadelphia (Latest edition).
3. W. C. Foye, Principles of Medicinal Chemistry, Lea and Febiger, Philadelphia (Latest edition).
4. J. E. F. Reynolds, Martindale, The Extra Pharmacopoeia, The Pharmaceutical Press, London (Latest Edition). Bachelor of Pharmacy (Semester System) 57
5. H. Singh and V.K. Kapoor Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Delhi (Latest edition).



BPH-402: PHARMACEUTICAL CHEMISTRY – IX
(PHARMACEUTICAL ANALYSIS – II)

THEORY

MAX. MARKS: 80

Total Hours: 75 (3hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. **Electrophoresis:** Principle, instrumentation and applications. (6)
2. **Turbidimetry and Nephelometry:** Theory of light scattering, Nephelometry, Turbidimetry for practical analysis of dispersions, basic instrumentation used for analysis and applications in Pharmacy. (5)
3. **Theoretical aspects, basic instrumentation, applications of the following analytical techniques should be discussed.**
 - UV and Visible Spectroscopy.
 - Fluorimetry.
 - Flame Photometry.
 - Emission Spectroscopy.
 - Atomic Absorption Spectroscopy.
 - X-ray diffraction. (26)

PART-B

4. **Theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications of the following analytical techniques should be discussed.**
 - Infrared Spectrophotometry.
 - Nuclear Magnetic Resonance Spectroscopy including C¹³-NMR.
 - Mass Spectrometry
 - HPLC and HPTLC. (25)
5. **Quality Assurance**

GMP, NDA, TQM, Quality Review, quality documentation and International Conference of Harmonization (ICH) on quality, ISO Guidelines on quality .

Validation, quality audit, quality of equipment, validation of equipment and validation of analytical procedures. (13)

Books Recommended (Latest edition)

1. Spectroscopic identification of organic compounds by Silverstein, Basseler, Morrill, John Wiley and Sons, New York.
2. Introduction to Spectroscopy by Donald L. Pavia, G.M. Lampman, G.S. Kriz, Thomson Learning Inc., USA.
3. Practical Pharmaceutical Chemistry, Vol. I & II by A.H. Beckett and J.B. Stenlake, The Athlone Press of the University of London (Latest Edition).
4. Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis by J. Bassett, R.C. Denney, G.H. Jeffery & J. Medhan, John Wiley & Son r. Inc., New York.
5. Instrumental Mehtods of Analysis by H. H. Willard, L.L. Merritt Jr., and J.A. Dean, Van Nostrand Reinhold, New York.
6. Pharmaceutical Chemistry, Vols. I and II by L. G. Chatten, Marcel Dekker, New York.



**BPH-403: PHARMACEUTICS-XI
(PHARMACEUTICAL TECHNOLOGY)**

THEORY

MAX. MARKS: 80

Total Hours: 75 (3hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. Tablets:

Introduction: Objectives for design of pharmaceutical tablet dosage form, advantages and disadvantages of tablets, different types and classes of tablets, formulation of tablets using common tablet excipients, processing problems in developing formulation of tablets.

Tablet granulation: Basic characteristics and granulation properties, study of granulation equipments i.e. slugging, chilsonator, extruder, Day-Nauta granulator, double cone granulator, fluid bed granulator.

Tabletting machinery: Different types of tablet compression machinery for production of single layer, multilayer and compression-coated tablets. Compression machine tooling.

Physics of tablet making: Strain gauge, measurement of applied and transmitted pressure, distribution of forces during compression, effect of applied pressure on relative volume and factors affecting strength of tablet.

Tablet coating: Tablet coating principles, coated tablet properties, coating processes for sugar and film coating, materials used in film coating, film defects and specialized coating, coating processes i.e. air suspension coating and pan coating (using conventional, rear vented and perforated pans). (18)

2. Quality control of tablets: Official and unofficial tests for evaluation of tablets i.e. general appearance, organoleptic properties, hardness, friability, drug content, weight variation, disintegration and dissolution tests as per USP and IP. (10)

3. Parenterals: Types of parenteral products, routes of administration, formulation, containers, pyrogens, production facilities, production procedures for small and large volume parenterals, lyophilization, large scale production of injectable grade water, aseptic techniques and evaluation of parenteral products. (10)

PART-B

4. Capsules:

Hard gelatin capsules: Advantages and disadvantages of hard gelatin capsules, size of capsules, manufacture of hard gelatin capsule shell, formulation of hard gelatin capsules, finishing of capsules. Machinery for filling of hard gelatin capsules using auger, vibratory and piston pump principle. Quality control of hard gelatin capsules. (8)

Soft gelatin capsules: Advantages, applications and disadvantages of soft gelatin capsules, size and shape of soft gelatin capsules, formulation of soft gelatin capsule shell and contents, importance of base adsorption and minim/gram factors in soft gelatin capsules. Machinery for production of soft gelatin capsules using plate process, rotary die process, accogel process and bubble method. Quality control of soft gelatin capsules. (8)

5. Microencapsulation: Definition and applications. Study of various processes employed for microencapsulation i.e. coacervation phase separation, multiorifice centrifuge, electrostatic deposition, vacuum deposition, spray drying, spray congealing, polymerization, complex emulsion, air suspension technique, pan coating. Evaluation of microcapsules. (11)

6. Aerosols: Definitions, advantages of aerosols, components of aerosol package, various propellants (including code), containers, valves, actuators, formulation of different pharmaceutical aerosol systems, manufacture of pharmaceutical aerosols (pressure process and cold filling), selection of components and quality control of pharmaceutical aerosol products. (10)

Books Recommended (Latest editions)

1. Khar R.K., Vyas S.P. Lachman/ Leiberman , The Theory and Practice of Industrial Pharmacy (English), CBS Publishers & Distributors , New Delhi.
2. Roop k khar, SP Vyas, Farhan J Ahmed , "The theory and practice of Industrial pharmacy, Fourth edition Number of Pages: 1203 , ISBN: 978-81-239-2289-8 CBS Publishers, Delhi.2013
3. L. Lachman et. al, Theory and Practice of Industrial Pharmacy, Varghese publishing House, Hind Rajasthan Building, Dodar, Bombay.
4. Robinson J. R. & Vincent Pel-Lee. Controlled drug delivery, Marcel Dekker, New York, 1987.
5. Rubinstein M. H. , Pharmaceutical Technology, (Tabletting Technology), Volume-1, Ellis Horwood Limited, John Wiley & Sons.
6. Jain S.K., Soni V. Bentley's Text Book of Pharmaceutics, Elsevier Health Sciences.
7. Troy D.B., Beringer P. , Remington: The Science and Practice of Pharmacy , Lippincott Williams & Wilkins, Mack publishing Company, Pennsylvania, USA.
8. Swarbrick James, Boylan J.C. , Encyclopedia of Pharmaceutical Technology, Marcel Dekker , New York.



**BPH-404: PHARMACEUTICS-XII
(PHARMACEUTICAL MANAGEMENT)
THEORY**

MAX. MARKS: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. **General Management:** Concept, functions and principles, objectives and techniques of management, management by exception, management by crisis, management by departmentation. Span of management, Delegation: Significance, authority and power, centralization and decentralization, staff conflicts. Motivation: Need for recognizing motivating factors, hierarchy of human needs, theories X and Y: Communication: purpose, importance, process, barriers and breakdown in communication, making communication effective. (10)
2. **Personnel Management:** Definition, importance and objectives, qualities and functions of personnel manager: Human resource planning: Need, job analysis, job description and job specification. Recruitment and selection process: Sources of manpower, recruitment policies, selection procedures. Promotion, demotion, transfer and separation. Employee training: Need, importance, principles of training, training methods. Performance appraisal: Meaning, objectives, approaches and methods. Factors affecting personality development. Facing interview for a position in Pharma-company. (10)
3. **Introduction to Financial management:** Sources of finance, book keeping, loans and repayment, making balance sheet. **Introduction (only):** Goals of finance function; Concepts of value and return, Management of working capital, Management of cash, receivables, inventory and current liabilities; Management of corporate distress and restructuring strategy; Leasing, hire purchase and venture capital. (5)

PART-B

4. **Principles of Material Management:** Scope, problems, Inventory control : Methods of Inventory Control- ABC, VED, SDE, FMS and EOQ analyses, Lead time, safety stock, minimum and maximum stock levels, cost of item, vendor development, vendor audit and ordering procedures. Procurement of raw material and packaging material as per warehouse system, in-warding of material and goods, statutory records vis-à-vis schedule M requirements, issue of materials to production department and documentation systems thereof. Central Excise Act: Chapters related to drugs and chemicals, records thereof, value added tax, record keeping and total documentation of central excise, filing of central excise papers, classification and price list, tariff for AHC products, general exemption rule, Dispatch of goods from Pharmaceutical manufacturing unit (Biological and other than biological products), scrap and surplus, disposal of expired products. (12)
5. **Marketing and Production Management:** Function and problems, functions of marketing executives. Product life cycle, product line policies and strategies. Concept and components of marketing information system. Ethical and unethical marketing of Pharmaceutical products. Pricing of Pharmaceutical formulations. DPCO considerations. Production planning & control, production process analysis, plant location and layout. (8)
6. **Introduction (only):** Nuffield Foundation, DCGI, IPC, ISI, Pollution Control Boards, Classes of Drugs & Solvents, Current knowledge of Pharma-manufacturing sector in India. (5)



Books Recommended (Latest editions)

1. Principles and methods of Pharmacy management, Hargraves & Ferguson, Philadelphia, 1986.
2. Pharmaceutical industrial management by R.M Mehta by Vallabh Prakashan, New Delhi.
3. Personnel Management by Edwin B. Flippo, McGraw Hill 1987
4. Pharmaceutical industrial management by R.M Mehta by Vallabh Prakashan, New Delhi..
5. Materials Management: An integrated approach by P. Gopalkrishnan & M. Sundaresan, Prentice Hall, India .
6. Marketing Management analysis, planning and control, Philip Kotler. Prentice Hall, India
7. Central excise tariff, Govt. of India publication.
8. Relevant Acts & Rules published by the Government of India.
9. "Textbook of Pharmaceutical Management", Baboota and R. K. Khar, Birla Publications (2004).
10. Principles and practices of management Koontz H, O'Donnell, McGraw Hill 1972.
11. Relevant Reports (National & International)



**BPH-405: PHARMACEUTICS-XIII
(PHARMACEUTICAL PACKAGING TECHNOLOGY)**

THEORY

MAX. MARKS: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART- A

1. **Introduction:** Definition and objectives of packaging, hazards encountered by the package, selection of suitable package or closure, types of closures/ liners, child resistant packaging, tamper proof packaging and cushioning design. (5)
2. **Packaging materials:** Detailed study with regard to materials employed for packaging of pharmaceuticals with main emphasis on glass, plastics, metals, rubber, paper board and corrugated board. Ideal properties, formulation and evaluation of rubber closures. Evaluation of various packaging materials. (8)
3. **Films for Flexible Packages:** Ideal characteristics, formulation and different types of films for flexible package, production of oriented films, production of laminates, light resistant films, evaluation of films. (4)
4. **Strip Packaging:** Advantages of strip packaging, strip packaging materials, strip packaging machinery, strip package design and evaluation of strip package. (4)
5. **Blister Packaging:** Advantages of Blister packaging, blister packaging materials, blister packaging machinery, blister package design and evaluation of blister package. (4)

PART- B

6. **Pouch Packaging:** Advantages of pouch packaging, types of pouches, pouch packaging machinery, pouch package design and evaluation of pouch package. (5)
7. **Liquid Filling Machinery:** Factors influencing selection of liquid filling machinery. Balanced and unbalanced constant level filling, volumetric filling, gravimetric filling, level sensing filling, time fill, peristaltic and overflow liquid filling machinery. (5)
8. **Dry products Filling machinery:** Factors influencing selection of solid filling machinery. Augers, vibrating feeders, gravity flow systems, belt feeders, screw feeders, cascade filling systems, vacuum filling systems and weighing systems. (5)
9. **Sterile Product Packaging:** Various types of containers used for sterile products like ampoules, vials, bottles/ flexible packages for I.V. fluid, etc. Sterile product filling and sealing machinery i.e. ampoule/ vial filling and sealing machinery. Evaluation of sterile product packages. (5)
10. **Labeling:** Objectives, legal requirements, packaging inserts/outserts, bar code, bar code symbologies, types of labels, adhesives and labeling machinery. (5)

Books Recommended (Latest editions)

1. Khar R.K., Vyas S.P. Lachman/ Leiberman , The Theory and Practice of Industrial Pharmacy (English), CBS Publishers & Distributors , New Delhi.
2. Brody A.L., Marsh K.S., Wiley Encyclopedia of Packaging Technology., Wiley Interscience Publications, John Wiley and Sons, Inc New York.
3. Dean D. A., Evans E.R., Hall I. H., Pharmaceutical Packaging Technology, Taylor and Francis group, London and New York.
4. Swarbrick James, Boylan J.C. , Encyclopedia of Pharmaceutical Technology, Marcel Dekker , New York
5. Pharmacy Law and Practice. Jonathan Merrills and Jonathan Fisher. Blackwell Sci.
6. What is packaging design? Giles Calvier. Rotovision SA.
7. International Pharmaceutical Product Registration: Aspects of Quality, Safety and Efficacy. Cartwright, A. C., Matthews, Brian. Taylor & Francis Routledge.

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BPH-406: PHARMACOLOGY –IV

THEORY

MAX. MARKS: 80

Total Hours: 75 (3hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. Pharmacology of Cardiovascular system:

- Digitalis and cardiac glycosides
- Anti-hypertensive drugs
- Anti-anginal and vasodilator drugs
- Anti-arrhythmic drugs.
- Anti-hyperlipidemic drugs
- Drugs used in therapy of shock (15)

2. Drugs acting on the Haematopoietic system:

- Haematinics
- Anticoagulants, vitamin K and haemostatic agents
- Fibrinolytic and Anti-platelet drugs
- Blood and plasma volume expanders (10)

3. Pharmacotherapy:

- Drug use during infancy and in the elderly (Paediatrics & geriatrics).
- Drug use during pregnancy.
- Drug induced disease.
- The basics of drug interactions. (8)

4. Therapeutic drug monitoring. (2)

5. Concept of essential drugs and rationale drug use. (2)

PART-B

6. Chemotherapy:

- General principles of chemotherapy.
- Sulphonamides and co-trimoxazole.
- Antibiotics, penicillins, cephalosporins, betalactamas, tetracyclines, aminoglycosides, chloramphenical, erythromycin, quinolones and miscellaneous antibiotics.
- Chemotherapy of tuberculosis, leprosy, fungal diseases, antimalarial, viral diseases, anthelmintic, antiamebic, urinary tract infections and sexually transmitted diseases.
- Chemotherapy of malignancy and Immunosuppressive agents. (25)

7. Pharmacology of Endocrine system:

- Hypothalamic and pituitary hormones
- Thyroid hormones and antithyroid drugs, parathormone, calcitonin and vitamin D.
- Insulin, oral hypoglycemic agents and glucagon. (8)

8. Principles of Toxicology:

- Definition of poison, general principles of treatment of poisoning with particular reference to barbiturates opioids, organophosphorus and atropine poisoning.
- Heavy metals and heavy metal antagonists. (5)



Books Recommended (Latest edition)

1. K.D.Tripathy, Essentials of Medical Pharmacology, JAYPEE Publication.
2. Satoshkar & Bhandarkar, Pharmacology & Parmacotherapeutics, Popular Publication.
3. Prasun Kumar Das, S.K.Bhattacharya ,Pharmacology, Elsevier Publication.
4. Goodman & Gilman,The Pharmacological Basis of Therapeutics, Mc Graw Hill.
5. S.D. Sethi , Text book of Pharmacology, Elsevier Publication.
6. Rang, Dale and Ritter, Pharmacology, Churchill Living Stone.
7. B.G.Katzung, Basic & Clinical Pharmacology, Lange .
8. Mary J, Mycer, Richard A, Pharmacology, Lippincott William & Willans



**BPH-407: PHARMACEUTICS-XIV
(BIOPHARMACEUTICS AND PHARMACOKINETICS)**

THEORY

MAX. MARKS: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. Introduction to Biopharmaceutics and Pharmacokinetics and their role in formulation development and clinical setting. (3)
2. **Biopharmaceutics:**
Passage of drug across biological barrier (passive diffusion, active transport, facilitated diffusion and pinocytosis etc.). Factors influencing absorption-physiochemical, physiological and pharmaceutical. Drug distribution in the body, drug-plasma protein binding-kinetics and significances. (7)
3. **Pharmacokinetics:** Significance of plasma drug concentration measurement, Pharmacokinetics of drug absorption- absorption rate constant using Wagner-Nelson and Loo-Riegelman method, Volume of distribution and distribution coefficient. Compartmental kinetics- definition and scope, one compartment (i.v. bolus, i.v. infusion and oral) and two compartment models. Determination of pharmacokinetics parameters from plasma and urine data after drug administration by i.v. bolus, i.v. infusion and oral route. Curve fitting (method of residuals), regression procedures. (15)

PART-B

4. **Clearance:** Clearance concept, mechanism of renal clearance, clearance ratio, determination of renal clearance and significances. Hepatic elimination of drugs, first pass effect, extraction ratio, hepatic clearance, biliary excretion, enterohepatic circulation. (4)
5. **Non-linear Pharmacokinetics:** Non-linear pharmacokinetics with special reference to one compartment model after I.V. drug administration, Michaelis Menten equation, its special cases, reasons and determination of non-linearity. (4)
6. **Pharmacokinetics of pharmacologic responses:** Introduction, general models for reversible pharmacological responses. (4)
7. **Clinical pharmacokinetics:**
 - Definition and scope.
 - Multiple dosing, steady state concentration, accumulation index etc.
 - Dosage adjustment in patients with renal and hepatic failure.
 - Introduction to Pharmacokinetics drug interactions and its significance in combination therapy. (4)
8. **Bioavailability and bioequivalence:**
 - Types of bioavailability and bioequivalence. Measures of bioavailability-plasma and urinary excretion parameters.
 - Design of single dose bio-equivalence study and relevant statistics, in-vitro bioequivalence and IVIVC- *Invitro, Invivo, Correlation Insitu, Insilco*
 - Overview of regulatory requirements for conduction of bio-equivalence study. (4)
9. Design, development, production and evaluation of controlled release preparations. (5)



Books Recommended (Latest editions)

1. W. A. Ritschel Handbook of Basic Pharmacokinetics, Drug Intelligence Publications, Hamilton.
2. J. G. Wagner, Fundamentals of Clinical Pharmacokinetics. Drug Intelligence publications, Hamilton.
3. Remington's Pharmaceutical Sciences, Chapter Bioavailability and Bioavailability Testing, Mack publishing Co, Easton, Pennsylvania, USA.
4. Rowland, Malcolm and Tozer, Thomas Ng, Clinical Pharmacokinetics, Lea Febiger, Philadelphia.
5. Biopharmaceutics & Pharmacokinetics,- A Treatise, D.M. Brahmankar & S.B.Jaiswal, Vallabh Prakashan, Delhi.
6. Pharmacokinetics, Gibaldi & D.Perrier, Marcel Dekker, New York.
7. Biopharmaceutics & Clinical Pharmacokinetics – An Introduction, R.E.Notari, Marcel Dekker, New York, 4th Ed. – 2008.
8. Javed Ali, Roop K. Khar and Alka Ahuja, "Text book of Biopharmaceutics and Pharmacokinetics, Birla Publications, 2001.



**BPH-408: PHARMACOGNOSY-IV
(PHARMACEUTICAL PLANT BIOTECHNOLOGY)**

THEORY

Max. Marks: 80

Total Hours: 50 (2hrs/week)

Note: Examiner has to set four questions from each part and the candidate is required to attempt five questions with at least two from each part.

PART-A

1. **Introduction:** Pharmaceutical biotechnology, concepts and basic techniques in tissue culture, types of tissue culture, and their application in pharmaceutical sciences. (5)
2. **Micropropagation:** Organogenesis and somatic embryogenesis, clonal propagation of elite germplasm of pharmaceutical importance. Technical problems in micropropagation such as vitrification, explant exudation etc and their treatments, conservation of elite germplasm and establishment of gene banks (6)
3. Concept of cellular differentiation, totipotency, *in vitro* haploid production using anther and pollen cultures. Significance and applications (4)
4. Production and application of synthetic seeds. (4)
5. The use of non-classical techniques in the production of secondary metabolites by plant tissue culture, approaches towards scale up and elicitation of secondary metabolites *in vitro*. (6)

PART-B

6. Production of flavoring compounds through tissue culture. (3)
7. Antimicrobial agents from plant cell culture. (4)
8. Production of anti tumor compounds by plant cell culture. (4)
9. Production of edible vaccines by successful expression of foreign antigens in genetically engineered plants, prospects and applications. (4)
10. Types of bioreactors. Application of bioreactors in large scale production of useful pharmaceutical biotechnological products. (5)
11. Application of biotechnology in pharmacy. Intellectual property rights and patents in pharmacy. (5)

Books Recommended (Latest editions)

1. Balasubramanian D, Bryce CFA, Dharmalingam K, Green J and Jayaraman kunthala (Eds.), Concepts in Biotechnology, University Press India 1996 (Reprinted 2002)
2. Introduction to plant Tissue culture by M. K. Razdan. 2nd Edition 2010, Oxford & IBH Publishing Co.
3. Plant cell tissue and organ culture fundamental methods by O. L. Gambarg and G. C. Phillips, 1996, Narosa Publishing House.
4. Secondary metabolism in plant cell cultures by Phillip Marris, Alan H. Scragg, Angle Staff and Michael W. Fowler 1986, Cambridge University Press.
5. Biotechnological applications of plant cultures by Peter D. Shargoel and That T. Ngo, 1994. CRC Press Inc.
6. Satees, M.K, Biotechnology-5, 2003 New Age Int.(P) Ltd. Publishers. New Delhi.
7. Singh B.D 2006, Plant Biotechnology, Kalyani Publishers.

**BPH 409: PHARMACEUTICAL CHEMISTRY -VIII
(MEDICINAL CHEMISTRY II)**

PRACTICAL

MAX. MARKS: 80

Total Hours: 75 (3 hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Synthesis of selected drugs involving upto three steps (atleast fifteen).
2. Establishment of Pharmacopeial standards of the drugs synthesized.
3. TLC characterization of Synthesized selected drugs and intermediates containing two or three steps.



**BPH-410: PHARMACEUTICAL CHEMISTRY – IX
(PHARMACEUTICAL ANALYSIS-II)**

PRACTICAL

MAX. MARKS: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Exercises involving of Nephelo-turbidimeter, fluorimetry, flame photometry analytical techniques.
2. IR of samples with different functional groups
3. Workshop to interpret the structure of simple organic compounds using UV, IR, NMR and MS.



**BPH-411: PHARMACEUTICS-XI
(PHARMACEUTICAL TECHNOLOGY)**

PRACTICAL

MAX. MARKS: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Microencapsulation by coacervation phase separation brought about by change of temperature.
2. Microencapsulation by coacervation phase separation brought about by addition of non-solvent.
3. Microencapsulation by complex emulsion method
4. Formulation, preparation and evaluation of chewable tablets.
5. Preparation and evaluation of aspirin tablets.
6. Preparation and evaluation of paracetamol tablets.
7. Preparation and evaluation of effervescent tablets.
8. Preparation and evaluation of mouth dissolving tablets.
9. Preparation of film coated tablets.
10. Evaluation of coatings.
11. Granulation by slugging.
12. Determination of size and capacity of empty capsule shells
13. Determination of BA and M/G factor.
14. Formulation and evaluation of hard gelatin capsules.
15. Quality control of soft and hard gelatin marketed capsule products.
16. Preparation and evaluation of small volume parenterals.
17. Test for pyrogens.
18. Preparation and evaluation of large volume parenterals.
19. Formulation, preparation and evaluation of aerosols.
20. Evaluation of glass ampoules and rubber closures.



BPH-412: PHARMACOLOGY –IV

PRACTICAL

MAX. MARKS: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Experiments on isolated preparations:
2. To calculate the PA2 value of atropine using acetylcholine as an agonist on rat ileum preparation.
3. To calculate the PA3 value of mepyramine or chlorpheniramine using histamine as agonist on guinea pig ileum.
4. To find out the strength of the given sample on agonist (e.g. Acetylcholine, Histamine, 5-HT, Oxytocin etc.) using a suitable isolated muscle preparation by-
 - Matching Assay -Two Point Assay -Three Point Assay
5. Pharmacology of the Gastrointestinal Tract: To study the anti-secretory and anti-ulcer activity using pylorus ligated rats.
6. Clinical Pharmacology: To demonstrate the effects of certain clinically useful drugs on human volunteers like:-
 - Anti-histamines
 - Anti-anxiety and sedative drugs
 - Analgesics.
 - Beta blockers.



**BPH-413: PHARMACEUTICS-XIV
(BIOPHARMACEUTICS AND PHARMACOKINETICS)**

PRACTICAL

MAX. MARKS: 80

Total Hours: 100 (4hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. General methods for determination of various pharmacokinetic parameters like AUC, AUMC, MDT, MRT, MAT etc.
2. Studies on volume of distribution, drug & protein binding kinetics.
3. Applicability of dissolution and diffusion models like Noyes- Whitney equation and Fick's equation.
4. Determination of effect of pH on dissolution rate constant.
5. Determination of urinary excretion of sulfonamides / any other drug.
6. Determination of partition coefficient of hydrophilic and hydrophobic drugs in water/ octanol system.
7. In-vitro (intra-brand and inter-brand) evaluation of traditional dosage forms (capsules and tablets).
8. Study of release rate of drug through various ointment bases using agar plates/ dialysis membrane.
9. Studies related to one compartment modeling.
10. Finding pharmacokinetic parameters from given data sets of plasma and urinary excretion data for one compartment model.
11. Bioequivalence studies using data sets.



**BPH-414: PHARMACOGNOSY –IV
(PHARMACEUTICAL PLANT BIOTECHNOLOGY)**

PRACTICAL

Max. Marks: 80

Total Hours: 75 (3hrs/week)

Note- Number of experiments based upon aforementioned theory. These experiments should include the following.

1. Sub-culturing the established cultures.
 2. Working and Principles of autoclave and laminar flow cabinet used in PTC laboratory.
 3. Role of various sealing agents on microenvironment.
 4. Preparation of cotton plugs based on HEPA principle.
 5. Explant selection, preparation and sterilization.
 6. Effect of time and concentration of sterilizing agent on Explant sterilization.
 7. Initiation and maintenance of callus cultures.
 8. Effect of various parameters on callus culture and determination of its growth rate
 9. Initiation and maintenance of plant cell suspension cultures.
 10. Establishment of explant cultures and proliferation.
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