

## Department of Pharmaceutical Sciences

### TEACHING LOAD and SCHEME OF EXAMINATIONS FOR THEORY AND PRACTICAL PAPERS FOR B.PHARMACY COURSE w.e.f. 2014-15

#### B. Pharm. I st Semester

S. No.	Name of the subject	Theory (hrs)	Marks 80(Main)+ 20 (Int.Asst.)	Practicals (hrs)	Marks 80(Main)+ 20 (Int.Asst.)
BPH-1.1	Pharmaceutics I (General Pharmacy)	4	100	6	100
BPH-1.2	Pharmaceutical Chemistry I (Inorganic Chem.)	4	100	6	100
BPH-1.3	Pharmacology I (Anatomy & Physiology)	6	100	6	100
BPH-1.4	Remedial Biology *	4*	100*	4*	100 *
	Total =	18	300	22	300

Total = 40 hrs / week in I st Semester;

\* Only for PCM candidates; qualifying paper only; marks not to be counted for merit.

Total marks in I st Semester = 600

#### B. Pharm. II nd Semester

S. No.	Name of the subject	Theory (hrs)	Marks 80(Main)+ 20 (Int.Asst.)	Practicals (hrs)	Marks 80(Main)+ 20 (Int.Asst.)
BPH-2.1	Pharmaceutics II (Dispensing Pharmacy and Hospital Pharmacy)	4	100	6	100
BPH-2.2	Pharmaceutical Chemistry II (Organic chemistry)	5	100	6	100
BPH-2.3	Pharmacognosy I	4	100	6	100
BPH-2.4	Pharmaceutical Chemistry III (Physical Chemistry)	3	100	6	100
	Total =	16	400	24	400

Total = 40 hrs / week in II nd Semester; Total marks in II nd Semester = 800

#### B. Pharm. III rd Semester

S. No.	Name of the subject	Theory (hrs)	Marks 80(Main)+ 20 (Int.Asst.)	Practicals (hrs)	Marks 80(Main)+ 20 (Int.Asst.)
BPH-3.1	Pharmaceutics III (Pharmaceutical Engineering I)	6	100	6 (Engg. Drwg.)	100
BPH-3.2	Pharmaceutical Chemistry IV ( Pharm. Biochemistry)	4	100	6	100
BPH-3.3	Pharmacognosy II	4	100	6	100
BPH-3.4	Pharmaceutical Chemistry V (Heterocyclic and bioorganic chemistry)	4	100	--	--
BPH-3.5	Environmental Studies	4	100*	--	--
	Total =	22	400	18	300

Total = 40 hrs / week in III rd Semester; \* Qualifying paper only; marks not to be counted for merit. Total marks in III rd Semester = 700

### **B. Pharm. IV th Semester**

S. No.	Name of the subject	Theory (hrs)	Marks 80(Main)+ 20 (Int.Asst.)	Practicals (hrs)	Marks 80(Main)+ 20 (Int.Asst.)
BPH-4.1	Pharmaceutical Chemistry VI (Anal. Chem I)	6	100	6	100
BPH-4.2	Pharmaceutics IV (Pharmaceutical Microbiology)	6	100	6	100
BPH-4.3	Computer Sciences	4	100	6	100
BPH-4.4	Pharmaceutical Mathematics and Statistics	6	100	--	100
	Total =	22	400	18	400

Total = 40 hrs / week in IV th Semester; Total marks in IVth Semester = 800

### **B. Pharm. V th Semester**

S. No.	Name of the subject	Theory (hrs)	Marks 80(Main)+ 20 (Int. Asst.)	Practicals (hrs)	Marks 80 (Main)+ 20 (Int. Asst.)
BPH-5.1	Pharmaceutics V (Physical Pharmacy)	4	100	6	100
BPH-5.2	Pharmaceutical Chemistry VII (Medicinal Chemistry I)	6	100	6	100
BPH-5.3	Pharmaceutics VI (Pharmaceutical Engineering II)	4	100	6	100
BPH-5.4	Pharmacology II (Pathophysiology)	4	100	--	--
BPH-5.5	Pharmaceutics VII (Pharmaceutical Management)	4	100	--	--
	Total =	22	500	18	300

Total = 40 hrs / week in V th Semester; Total marks in Vth Semester = 800

### **B. Pharm. VI th Semester**

S. No.	Name of the subject	Theory (hrs)	Marks 80(Main)+ 20 (Int.Asst.)	Practicals (hrs)	Marks 80(Main)+ 20 (Int.Asst.)
BPH-6.1	Pharmaceutics VIII (Dosage Form Design)	6	100	6	100
BPH-6.2	Pharmacology III	6	100	6	100
BPH-6.3	Pharmacognosy III	4	100	6	100
BPH-6.4	Pharmaceutics IX (Forensic Pharmacy)	6	100	--	--
	Total =	22	400	18	300

Total = 40 hrs / week in VI th Semester; Total marks in VIth Semester = 700

**B. Pharm. VII th Semester**

S. No.	Name of the subject	Theory (hrs)	Marks 80(Main)+ 20 (Int.Asst.)	Practicals (hrs)	Marks 80(Main)+ 20 (Int.Asst.)
BPH-7.1	Pharmaceutics X (Pharmaceutical Technology)	6	100	6	100
BPH-7.2	Pharmaceutical Chemistry VIII ( Anal. Chem. II )	6	100	6	100
BPH-7.3	Pharmacognosy IV	5	100	6	100
BPH-7.4	Pharmacology IV (Pharmaceutical Biotechnology)	5	100	--	--
	Total =	22	400	18	300

Total = 40 hrs / week in VII th Semester; Total marks in VIIth Semester = 700

**B. Pharm. VIII th Semester**

S. No.	Name of the subject	Theory (hrs)	Marks 80(Main)+ 20 (Int.Asst.)	Practicals (hrs)	Marks 80(Main)+ 20 (Int.Asst.)
BPH-8.1	Pharmaceutical Chemistry IX (Medicinal chemistry II)	6	100	6	100
BPH-8.2	Pharmacology V	6	100	6	100
BPH-8.3	Pharmaceutics XII ( Biopharmaceutics )	6	100	6	100
BPH-8.4	Pharmaceutics XIII (Pharmaceutical Packaging)	4	100	--	--
	Total =	22	400	18	300

Total = 40 hrs / week in VIII th Semester; Total marks in VIIIth Semester = 700

S. No.	Semester	Total Marks
1	I st Semester	600
2	II nd Semester	800
3	III rd Semester	700
4	IV th Semester	700
5	V th Semester	800
6	VI th Semester	700
7	VII th Semester	700
8	VIII th Semester	700
	Grand Total =	5700

**Note:**

1. There shall be 80 marks for Main Theory / Practical Examinations and 20 marks for Internal Assessment, in all theory / practical papers. For Internal Assessment, the “Rules for award of Internal Assessment for UG courses”, as applicable from time to time, shall be implemented.
2. The distribution of marks for Main Theory Examination (80 marks) shall be as follows:

Each Question shall be of 16 marks ; Total Marks = 80		
Question One	Covering the entire syllabus	Short answer type questions
Question Two	Covering the Unit One	Any one question, out of two questions, need to be answered
Question Three		
Question Four	Covering the Unit Two	Any one question, out of two questions, need to be answered
Question Five		
Question Six	Covering the Unit Three	Any one question, out of two questions, need to be answered
Question Seven		
Question Eight	Covering the Unit Four	Any one question, out of two questions, need to be answered
Question Nine		

**Department of Pharmaceutical Sciences**  
**Revised syllabus w.e.f. 2014-15 academic session**

**B.PHARM. 1<sup>ST</sup> SEMESTER**

BPH – 1.1      PHARMACEUTICS I      (General Pharmacy)

**THEORY**

**Lectures = 4 hrs / week**

**Unit-I**

1. **Extraction:** Various methods of extraction of crude drugs namely percolation (various types including processes for concentrated preparations, constant hot percolation), maceration (various types including processes for organized and unorganized drugs, for concentrated preparations, double and triple maceration processes), Decoction. Formulation, preparation and uses of various Formulation, preparation and uses of pharmaceutical extracts

**Unit-II**

2. **Liquid Preparations:** Formulation, preparation and uses of various liquid products namely syrups, aromatic waters, spirits, solutions, mucilages, elixirs, glycerins, mouthwashes, gargles, nasal drops, ear drops.
3. **Semisolid dosage forms (ointments and suppositories):** ointment, ointment bases, and factors governing selection of ideal base, preparation of ointments. Suppositories-suppositories bases, selection of ideal base, preparation of suppositories

**Unit-III**

4. **Glandular Products:** Introduction, extraction methods and preparation of thyroid, liver, pancreas and pituitary gland.
5. **Surgical dressings:** like fibres, fabrics, bandages, surgical ligatures and sutures i.e. catgut and other absorbable and non-absorbable products. Quality control of surgical dressings

**Unit-IV**

6. **Immunology:** General introduction, infection, factors influencing infection, kinds of immunity, vaccines (i.e. Tetanus vaccine, Diphtheria vaccine, BCG vaccine, small pox vaccine), virus immunity, toxoids, toxins, diagnostic preparation, sera, antitoxins (i.e. Diphtheria antitoxins, Botulinium antitoxins), brief control of immunological products-identification tests, toxicity tests, sterility tests, potency tests and storage of immunological products.
7. **Blood and related products:** Whole human blood, concentrated human RBC, dried human plasma, dried human serum, human plasma protein fraction, human fibrinogen, human thrombin, plasma substitute, ideal plasma substitute properties, products i.e. PVP, Dextran, absorbable gelatin, sponge, oxidized cellulose, calcium gluconate.

**PRACTICALS:**

**( 6 hrs / week )**

Number of practicals based on aforementioned theory portion and including preparation of the following:  
Peppermint water, cinnamon water, camphor water, chloroform water, concentrated peppermint water, concentrated cinnamon water, simple syrup, syrup of ginger, syrup of orange, syrup of tolu, compound syrup of ferrous sulphate, spirit of peppermint, spirit of chloroform, spirit of ether, strong solution of ammonium acetate, surgical solution of chlorinated soda, solution of cresol with soap, solution of ferric chloride, strong solution of iodine, solution of hydrogen peroxide, tannic acid glycerin, boric acid glycerin, mouth washes, nasal drops, ear drops, elixirs, mucilage of acacia, mucilage of tragacanth, tincture of orange, capsicum tincture, strong tincture of ginger, tincture of lemon, tincture of tolu, tincture of nuxvomica, liquid extract of liquorice, liquid extract of ipecacuanha, liquid extract of belladonna, liquid extract of senna, concentrated infusion of clove, concentrated infusion of quassia, concentrated infusion of senna, liver extract.

**List of Books Recommended**

**Text Books**

1. Cooper and Gunn's, " *Tutorial Pharmacy*", CBS Publishers, Delhi.
2. " *Remington's Pharmaceutical Sciences*", Mack Publishing Co., P.A..
3. B M Mithal, " *A Textbook of Pharmaceutical Formulations*", Vallabh Prakashan, Delhi.

**Reference Books.**

4. " *Pharmacopoeia of India*", Published by the Controller of Publications, Delhi
5. " *British Pharmacopoeia*", Her Majesty Stationary Office, University Press, Cambridge.
6. " *The United States Pharmacopoeia*", The United States Pharmacopoeial Convention, Mack Pub Co., Easton, PA.
7. " *British National Formulary*", Published Jointly by British Medical Association and Royal Pharmaceutical Society of Great Britain.

**THEORY**

Lectures: 4 hrs./week.

**Unit I**

An outline of the methods of preparation, uses, sources of impurities, tests for purity and identity, including the limit test for iron, lead, heavy metals, chloride, sulphate and special tests if any, of the following classes of inorganic pharmaceuticals included in Indian Pharmacopoeia monograph details.

Acids and bases: Buffers, water.; Gastrointestinal agents: acidifying agents, antacids, protectives and adsorbents, cathartics.; Major extra and intra cellular electrolytes: physiological anions, electrolytes used for replacement therapy, acid base balance and combination therapy.

**Unit II**

Essential and trace elements: transition elements and their compounds of pharmaceutical importance: iron and haematinics, mineral supplements. Cationic and anionic compounds of inorganic drug useful for systemic effects. Topical agents: protectives, astringents and anti-infectives.

**Unit III**

Gases and vapours: oxygen, anesthetics and respiratory stimulants. Dental products: dentifrices, anti-caries agent. Complexing and chelating agents used in therapy- theoretical consideration and official products (calcium disodium edetate, disodium edetate, dimercaprol and penicillamine). Miscellaneous agents: sclerosing agents, expectorants, emetics, sedatives etc. Pharmaceutical aids used in pharmaceutical industry: antioxidants, preservatives, filter aids, adsorbents, diluents, excipients, suspending agents, colorants etc.

**Unit IV**

Inorganic radiopharmaceuticals: nuclear radiopharmaceuticals, reactions, nomenclature, methods of obtaining their standards and units of activity, measurement of activity, clinical applications and dosage, hazards and precautions. Inorganic toxicology: sources of toxic inorganics, individual metal toxicities –aluminium, arsenic, barium, lead, lithium, manganese, mercury. toxic anions-cyanide; antidotes- sodium nitrite, sodium thiosulphate, activated charcoal and light kaolin.

**PRACTICALS**

(6 hrs / week)

A number of practicals based on aforementioned theory including the followings:

1. Limit tests for impurities in pharmacopoeial compounds.
2. Quantitative analysis-assay of the following compounds: Boric acid, Solution of ammonia, sodium bicarbonate, sodium chloride, calcium hydroxide.
3. The background and systemic qualitative analysis of inorganic mixtures up to 4 radicals. Six mixtures to be analyzed, preferably by semi-micro methods.
4. To carry out identification tests for calamine, boric acid, hydrogen peroxide.

**List of Books Recommended****Text Books**

1. "Vogel's Textbook of Quantitative Inorganic Analysis", ELBS/ Longman, London.
2. J. H. Block, E. Roche, T. O. Soine and C. O. Wilson, "Inorganic Medicinal and Pharmaceutical Chemistry", Lea and Febiger, Philadelphia PA.

**Reference Books**

3. "Pharmacopoeia of India", Govt. of India, Ministry of Health
4. L. A. Diseher, "Modern Inorganic Pharmaceutical Chemistry".

**THEORY**

Lectures: 6 hrs./week.

**Unit-I****1. Introduction**

- a. Scope of anatomy, physiology and basic terminology used in these subjects.
- b. Introduction to human body & organization of human body.
- c. Functional & structural characteristics of cell, cell components and their function.
- d. Detailed structure of cell membrane & physiology of transport process.
- e. Structural & functional characteristics of elementary tissues of human body: epithelial, connective, muscular and nervous tissue, and their sub-types.

**2. Osseous system:** Structure, composition & functions of skeleton. Classification of joints, types of movements at joints, disorders of joints.

**3. Skeletal muscles:** Their gross anatomy & physiology of muscle contraction, physiological properties of skeletal muscles and their disorders.

**4. Haemopoetic system:** Composition & function of blood and its elements, their disorders, blood groups, and their significance, mechanism of coagulation, disorders of platelets and coagulation.

5. **Lymph and lymphatic system:** Composition, formulation and circulation of lymph, disorders of lymph and lymphatic system, basic physiology and functions of spleen.
6. **Respiratory system:** Anatomy of respiratory organs, functions of respiration mechanism and regulation of respiration, respiratory volumes and vital capacity.

#### Unit II

7. **Cardiovascular system:** Basic anatomy of heart, physiology of heart, blood vessels and circulation. Basic understanding of cardiac cycle, heart sounds and electrocardiogram. Blood pressure and its regulation, Brief outline of cardiovascular disorders like hypertension, hypotension, arteriosclerosis, angina, myocardial infarction, congestive heart failure and cardiac arrhythmias.
8. **Digestive system:** Gross anatomy of the gastrointestinal tract, function of its different parts including those of liver, pancreas and gallbladder, various gastrointestinal secretions and their role in the absorption and digestion of food.
9. **Autonomic nervous system:** Physiology and functions of the autonomic nervous system. Mechanism of neurohumoral transmission in the autonomic nervous system.
10. **Central nervous system:** Functions of different parts of brain and spinal chord. Neurohumoral transmission in the central nervous system, reflex action, electroencephalogram, specialized functions of the brain, cranial nerves and their functions.

#### Unit III

11. **Endocrine system:** basic anatomy and physiology of pituitary, thyroid, parathyroid, adrenals, pancreas, testes and ovary, their hormones and functions.
12. **Urinary system:** various parts, structures and functions of the kidney and urinary tract. Physiology of the urine formation and acid base balance. Disease of urinary system.
13. **Reproductive system:** Male and female reproductive systems and their hormones, physiology of menstruation, coitus and fertilization. Sex differentiation, spermatogenesis and oogenesis. Pregnancy its maintenance and parturition.
14. **Sense organs:** Basic anatomy and physiology of the eye (vision), ear (hearing), taste buds, smell and skin (superficial receptors).

#### Unit IV

15. **Health Education:**
  - A. Classification of food requirements, balance diet, nutritional deficiency disorders, their treatment and prevention, specification of drinking water.
  - B. Demography and family planning: Demography cycle, family planning, and various contraceptive methods. Medical termination of pregnancy.
  - C. Brief out line of communicable diseases, their causative agents, modes of transmission and prevention (chicken pox, influenza, diphtheria, cough, tuberculosis, poliomyelitis, hepatitis, cholera, typhoid, food poisoning, helminthiasis, malaria, filariasis, rabies, trachoma, tetanus, leprosy, syphilis, gonorrhoea and AIDS).
  - D. First aid: emergency treatment of shock, snakebites, burns, poisoning, fractures and resuscitation methods.

### PRACTICALS

(6 hrs / week )

1. Study of human skeleton.
2. Study of different systems with the help of charts and models.
3. Microscopic study of different tissues.
4. Estimation of hemoglobin in blood. Determination of bleeding time, clotting time, R.B. C. count, T. L. C., D. L. C., and E. S. R.
5. Recording of body temperature, pulse rate and blood pressure, basic understanding of electrocardiogram-PQRST waves and their significance.
6. Simple experiments involved in the analysis of normal and abnormal urine: collection of specimen, appearance, and determination of pH, sugar, proteins, urea and creatinine.
7. Physiological experiments on nerve-muscle preparations.
8. Determinations of vital capacity, experiments on spirometry.

#### *List of Books Recommended*

##### **Text Books**

1. C C Chatterjee, "*Human Physiology*", Medical Allied Agency, Calcutta.
2. Tortora, G J, "*Principles of Anatomy and Physiology*", Harper & row Publishers, NY.
3. N S Parmar, "*Health Education and Community Pharmacy*", CBS Publishers and Distributors, New Delhi.

##### **Reference Books**

4. Guyton, "*Textbook of Medical Physiology*", W B Sannders Company
5. "*Samson Wright's Applied Physiology*", Oxford University Press.
6. "*Best and Taylor's Physiological Basis of Medical Practice*", William and Wilkins, Baltimore.
7. B D Chaurasia, "*Human Anatomy*", CBS Publishers and Distributors, New Delhi.

**BPH-1.4          REMEDIAL BIOLOGY**

**THEORY**

**Lectures: 4 hrs./week.**

**Unit-I**

1. Cell: Definition of cell, different types of cell, structure, importance of different non-living inclusions. Different process of division of cell like amitosis, mitosis, meiosis and their significance.
2. Histology of Plants: Tissue system, Different types of plant tissues (meristematic and mature/complex) and their functions. Histology of root, stem, bark, wood, leaf, flower and seed.

**Unit-II**

3. Classification of plant: Different methods of classification plants like artificial and natural with their merit and demerit. Distinguished features of spore bearing and seed bearing plant with example.
4. Morphology of plant: general structure, types and function of the root, stem, leaf, flower, wood, fruit and seed. Different modification of root, stem and leaf.

**Unit-III**

5. Classification of animals: Definition of taxonomy, and general outline of the classification of animal kingdom.
6. Vertebrates: Fundamental characters of the vertebrates with special emphasis on the class like amphibians, reptiles, aves and mammals.

**Unit-IV**

7. Invertebrates: general characters of invertebrates. Structure and life history of following invertebrates: amoeba, trypanosoma, plasmodium, taenia, ascaris, earthworm, houseflies, mosquito, cockroach.

**PRACTICALS**

**(4 hrs. / week )**

1. Morphology of plant parts and their modifications as indicated in theory.
2. Care, use and type of microscope.
3. Study of different phases of division of cell by permanent slides
4. Preparation, microscopic examination of dicot and monocot stem, root and leaf.
5. Study of structure and distinguished features of vertebrates and invertebrates as mentioned in theory with the help of specimen.

**List of Books Recommended**

**Text Books**

1. Fahn, A., "*Plant Anatomy*", Pergamon Press, Oxford
2. B. M. Johri, "*Reproductive Biology of Plants*", Narosa publishing House, Mumbai..
3. S. C. Rastogi, "*Concepts in Molecular Biology*", Willey eastern Ltd., Mumbai.
4. Claude a. villee, "*Introduction to Animal Biology*", W. D. Saunders co., Philadelphia.

# B.PHARM. 2<sup>nd</sup> SEMESTER

BPH-2.1 PHARMACEUTICS II (Dispensing and Hospital Pharmacy)

## THEORY

Lectures: 4 hrs./week.

### UNIT-I

1. Definitions and General Dispensing Procedures.
2. Sources of information required for Pharmacists and History of Pharmacopoeias (I.P., B.P., and U.S.P.).
3. Sources of error and care required in dispensing prescriptions.
4. Pharmaceutical Latin-Latin terms used in prescriptions and their English equivalents.
5. Types of Dispensed products.
6. Containers, closures and labelling for dispensed products.
7. Colours, flavours, sweeteners and other additives used in prescriptions.

### UNIT -II

8. Principles involved and procedures adopted in dispensing of typical preparations like mixtures, emulsion, creams, ointments, powders, pastes, jellies, suppositories, ophthalmics, pastilles, lozenges, pills, lotions, liniments, inhalations, paints, sprays etc.
9. Incompatibilities-physical and chemical, occurrence and methods adopted in corrections.

### UNIT -III

10. Pharmaceutical Calculations- percentage solutions, enlarging and reducing recipes, calculation of doses, alligation, alcohol dilutions, proof spirit, isotonic solutions, milli-equivalents, displacement value etc.

### UNIT -IV

11. Hospital and its organisation:
  - a) Pharmacy, organisation and personnel
  - b) Hospital formulary
  - c) Purchasing and inventory control
  - d) Drug distribution
  - e) Dispensing to inpatients
  - f) Dispensing to outpatients
  - g) Drug charges
  - h) Pre-packaging
  - i) Central sterile supply
  - j) Drug information centre
  - k) Maintenance of records
  - l) Safe use of medicines

## PRACTICALS:

( 6 hrs / week )

Number of practicals based on aforementioned theory portion but including dispensing of preparations like emulsions, suspensions, solutions, creams, ointments, inhalations, liniments, paints, syrups, mixtures, pastes etc.

## List of Books Recommended

### Text Books

1. Cooper and Gunn's, "*Dispensing for Pharmaceutical Students*", CBS Publishers, Delhi.
2. R M Mehta, "*Dispensing Pharmacy*", Vallabh Prakashan, New Delhi.
3. B M Mithal, "*A Text book of Pharmaceutical Formulations*", Vallabh Prakashan, Delhi

### Reference Books

4. "*Dispensing of Medication*", Mack Publishing Co. Easton PA
5. William E Hassan, "*Hospital Pharmacy*", Lea & Febiger, Philadelphia
6. M J Stoklosa, "*Pharmaceutical Calculation*", Lea & Febiger, Philadelphia
7. Joel L Zatz, "*Pharmaceutical Calculations*", John Wiley and Sons, NY.
8. M C Attwood and J T Fell, "*Text Book of Hospital Pharmacy*", Blackwell Scientific Publications, Oxford

**BPH – 2.2 PHARMACEUTICAL CHEMISTRY II (Organic Chemistry)**  
**THEORY** **Lectures: 5 Hrs/week**

**Unit I**

Structure and Properties: Atomic structure; atomic orbitals, molecular orbital theory, wave equations, molecular orbital, bonding and anti-bonding orbitals, electronic configuration of some molecules, covalent bonds, hybrid orbitals, intermolecular forces, bond dissociation energy, polarity of bonds, polarity of molecules, structural and physical properties, intermolecular forces, acids and bases, isomerism.

**Unit II**

Stereochemistry: introduction, optical activity, stereoisomerism, specifications of configuration, reactions involving stereoisomers. Stereoselective and Stereospecific reactions.

Factors affecting electron availability:

- a. Inductive effects,
- b. Resonance effects,
- c. Hyper conjugation,
- d. Steric effects,
- e. Application of these factors on the strength of acids and bases Bond length,
- f. Tautomerism.

**Unit III**

Structure, Nomenclature, preparation and reactions of alkanes, alkenes, alkynes, cycloalkanes, dienes, benzene, polynuclear aromatic compounds, arenes, alkyl halides, alcohols, ether epoxides, amines, phenols, aldehydes and ketones, carboxylic acids, functional derivatives of carboxylic acid, carbanions, aldol condensation, claisen condensation, malonic esters and acetoacetic ester synthesis.

**Unit IV**

Nucleophilic aromatic substitutions:  $\alpha,\beta$ -unsaturated carbonyl compounds. Electrocyclic reactions, sigmatropic reactions, neighbouring group effects. Catalysis by transition metal complexes.

**PRACTICALS**

**(6 hrs / week )**

1. Synthesis of selected organic compounds.
2. Introduction to the use of stereomodels.
3. Identification of organic compounds and their derivatisations.
4. Synthesis of Aspirin, Phenyl benzoate, Iodoform, Nitrobenzene, Trichloroacetic acid, Phthamide, Osazone, Paraformaldehyde

**List of Books Recommended**

**Text Books**

1. T. R. Morrison and R. Boyd, "*Organic Chemistry*", Prentice Hall of India Pvt. Ltd., New Delhi.
2. I. L. Finar, "*Organic Chemistry*", Vol.I and II, ELBS/ Longman
3. A. I. Vogel, "*A Textbook of Practical Organic Chemistry*", The English Language Book Society and Longman group Ltd., London.

**Reference Books**

4. P. Sykes, "*A Guide Book to mechanism in Organic Chemistry*", Orient Longman, New Delhi.
5. J. D. Roberts and M. C. Caserio, "*Basic Principle of Organic Chemistry*", Inc., New York.
6. F. C. Mann, and B. C. Saunders, "*Practical Organic Chemistry*", The English Language Book Society and Longman group Ltd., London.
7. E. L. Eliel, "*Stereochemistry of Carbon Compounds*", Macgraw Hill Book Company, Inc., New York
8. "*Vogel's Textbook of Practical Organic Chemistry*", ELBS/ Longman, London

**BPH – 2.3 PHARMACOGNOSY I**

**THEORY** **Lectures: 4 Hrs/week**

**Unit-I**

1. Definition, history, development and scope of Pharmacognosy.
2. Sources of drugs: biological, marine, geographical and plant tissue cultures as sources of drugs.
3. Classification of drugs alphabetical, morphological, taxonomical, pharmacological, chemical and chemotaxonomical with their merits and demerits.
4. Adulteration of crude drugs, detection by morphological and microscopical methods by covering by determination of leaf constants, lycopodium spore method. Micrometers and measurement of microscopic characters. **Techniques in microscopy**; Details of mountants, clearing agents, chemomicroscopic reagents.

### Unit-II

5. Study of the following families with special reference to medicinally important plants- (at least three examples)-  
Apocynaceae, Solanaceae, Rutaceae, Umbelliferae, Leguminosae, Rubiaceae, Liliaceae, Labiate.  
`Cultivation, collection, processing and storage of crude drugs: factors influencing cultivation of medicinal plants, 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.
6. Study of pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatin, and natural colorants.

### Unit-III

7. An introduction to active constituents (Carbohydrates, lipids, phenolics, alkaloids, volatile oils and resins) of drugs: their isolation, classification and properties.
8. Systematic Pharmacognostical study of the following: (A.) Carbohydrates and derived products: Agar, Guar gum, Gum acacia, Honey, Isabgol, Pectin, Starch and Tragacanth. (B.) Lipids: Bees wax, Castor oil, Cod liver oil, Linseed oil, Shark liver oil and Wool fat.

### Unit-IV

9. Study of drugs containing resins and resin combinations: Podophyllum, Capsicum, Myrrh, Asafoetida, Balsam of tolu, Benzoin, Turmeric and Ginger.
10. Volatile oil: General methods of obtaining volatile oils from plants, study of volatile oils of Mentha, Coriander, Cinnamon, Lemon peel, Orange peel, Lemon grass, Caraway, Cumin, Dill, Spearmint, Clove, Fennel, Nutmeg, Eucalyptus, Cardamom, Valerian, Palmarosa, Gaultheria, Sandal wood.

### PRACTICALS

(6 hrs / week)

Practical exercises based on aforementioned theory including the following:

1. Morphological characteristics of plant families mentioned in theory.
2. Microscopic measurements of cells and cell contents and determination of leaf constants.
3. Morphological and microscopical study of crude drugs mentioned in theory.
4. Chemical examination for the identification of crude drugs mentioned in theory.

### List of Recommended Books

1. Kokate C. K., Purohit A. P. and Kokhale S.B., "*Text Book of Pharmacognosy*", Nirali Publication, Pune.
2. Treese, G. E. and Evans, W. C., "*Text Book of Pharmacognosy*", Bailliere Tindall, Eastbourne, U. K.
3. Wallis, T. E., "*Analytical Microscopy*", J. and A Churchill limited, London.
4. Handa, S. S., and Kapoor, V. K., "*Text Book of Pharmacognosy*", C.B.S. Publisher.
5. Mohammad Ali, "*Text Book of Pharmacognosy*"
6. Shah and Quadry, "*Pharmacognosy*".
7. Fahn, A., "*Plant Anatomy*", Pergamon Press, Oxford.
8. Clarke, E. C. G., "*Isolation and Identification of Drugs*", the Pharmaceutical Press, London.
9. Jean Brunton, "*Text Book of Pharmacognosy, Phytochemistry and Medicinal Plants*", Intercept Limited, Andover, England, U.K.

### BPH – 2.4

### PHARMACEUTICAL CHEMISTRY III ( Physical Chemistry )

### THEORY

Lectures: 3 Hrs/week

#### Unit I

Behaviour of gases: kinetic theory of gases, deviation from ideal behaviours and explanation. The liquid state: Physical properties (Parachor, refractive index, optical rotation, dipole moments and chemical constituents). Solutions: Ideal and real solutions, solutions of gases in liquids, colligative properties, partitions coefficient, conductance and its measurement, Debye huckel theory. Thermodynamics; first, second and third laws, zero law, absolute temperature scale, thermochemical equations, phase equilibrium and phase rule.

#### Unit II

Adsorption: Frudlich and Gibbs adsorption isotherms, Langmuir theory of adsorption. Photochemistry: Consequences of light absorption, Jablenski diagram, Lambert-Beer law, Quantum efficiency. Chemical Kinetics: Zero, first and second order reactions, complex reaction, theories of chemical kinetics, characteristics of homogeneous and heterogeneous catalysis, acid base and enzyme catalysis. Quantum mechanics: Postulates of quantum mechanics, operators in quantum mechanics, and the Schrodinger wave equation.

#### Unit III

Solution of electrolytes: Arrhenius theory of electrolytic dissociation, modern theory of strong electrolytes, and other coefficients for expressing colligative properties. Ionic equilibria; Ostwalds dilution law, Lawry Bronsted and Lewis theory of acids and bases, ionization constants of weak acids and bases, ionic product of water.

#### Unit IV

Electrochemistry: The electric cell, electrode potential, half cells, types of half cells, sign convention, Nernst equation, the salt bridge, activity series, standard potential, standard hydrogen electrode, measuring the relative voltage of half cells, calculations of standard potential, reference electrodes, indicator electrodes.

- A. Potentiometry: theoretical considerations, ion-selective electrodes, measurement of potential, location of end point equipment, analytical application, direct measurement of a metal concentration, differential curve, determination of  $K_{sp}$ , pH measurement dead-stop titrations; pH meter, pH definition, relation to pH to potential, equipment and applications.
- B. Conductance and high frequency titrations and their applications.
- C. Coulometric titrations, its principles and applications, controlled potential coulometry, cell design, instrumentation, advantages and limitations, and electrode selection.
- D. Polarography and its applications: theory of mass transport processes, current processes, current potential relationship, polarization, choice of electrodes, effect of oxygen, instrumentation, calculation of concentration, laboratory design and safety.
- E. Amperometric titrations and its applications.

## **PRACTICALS**

**( 6 hrs / week )**

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.

## ***List of Books Recommended***

### **Text Books.**

1. Bahl and Tuli, "*Physical Chemistry*", S. Chand & Co., New Delhi.

### **Reference Books**

2. W. S. Brey, "*Physical Chemistry and its Biological Applications*", Academic Press.
3. K. J. Laidler, "*Physical Chemistry with Biological Applications*", Benzman.
4. V. R. Williams and H. S. Williams, "*Basic Physical Chemistry for Life Sciences*", W. H. Freeman.
5. S. R. Pali and S. K.D.E. Prabartak, "*Practical Physical Chemistry*", Haltone Ltd. Calcutta.
6. J. A. Kitckener, "*Findly's Physical Chemistry*", (Ed.), Green and Company, London.
7. Jenkin's "*Quantitative Pharmaceutical Chemistry*", Mcgraw Hill Book Company, New York

# B.PHARM. 3<sup>rd</sup> SEMESTER

BPH – 3.1

PHARMACEUTICS III

(Pharmaceutical Engineering I)

Lectures: 6hrs/week

## THEORY

### UNIT – I

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 direct weighing or measuring, hydrodynamic methods, displacement meters and dilution methods. Regulation of flow using plug cocks, globe valves, gate valves, unidirectional valves, automatic regulating valve, butterfly valve and diaphragm valve, and water hammer.
2. **Refrigeration:** Principle and equipment employed for vapor compression refrigeration, lithium bromide absorption refrigeration and steam jet refrigeration..Applications of refrigeration in Pharmacy

### UNIT – II

3. **Heat Transfer:** Modes of heat transfer, Fourier's law, overall heat transfer coefficient, Stefan-Boltzman's law, single pass heater, multipass heater, liquid-liquid heat interchanger and finned tubes.
4. **Drying:** Theory, behaviour of solids during drying, static bed dryers, moving bed dryers, fluidised bed dryer and pneumatic bed dryers.

### UNIT – III

5. **Size reduction:** Mechanism, factors influencing, energy requirements, applications in pharmacy, grinders i.e. fluid energy mill, hammer mill, ball mill and its variants, centrifugal mill, attrition mill, edge runner mill, colloid mill, squirrel cage disintegrator, Buhrstone mill.
6. **Centrifugation:** theory, industrial centrifugal filters and industrial centrifugal sedimenters
7. **Filtration:** Theory, filter aids, filter media, industrial filters i.e. sand filter, washing and non-washing type filter presses, rotary drum filter, leaf filters, edge filter.

### UNIT – IV

8. **Evaporation:** Factors affecting evaporation, natural circulation evaporators e.g. evaporating pan, evaporating still, horizontal and vertical tube evaporators, forced circulation evaporators, film evaporators, multiple effect evaporation, material and energy balance of evaporators.
9. **Humidification, dehumidification and air conditioning:** Principles of Humidification, dehumidification and air conditioning, psychrometry, humidity measurement, large-scale equipment for humidification and dehumidification, cooling towers.

### List of Books Recommended

#### Text Book

1. Cooper and Gunns' *"Tutorial Pharmacy"*, CBS Publishers, Delhi
2. *"Bentley's Textbook of Pharmaceutics"*, ELBS Bacilliere Tindall.
3. W L Badger and J T Banchemo, *"Introduction to Chemical Engineering"*, McGraw Hill International Book Co., London

#### Reference Books

4. *"Remington' Pharmaceutical Sciences"*, Mack Publishing Co., P.A.
5. Leon Lachman, H A Liberman and J L Kanig, *"The Theory and Practice of Industrial Pharmacy"*, Lea & Febiger, Philadelphia
6. W L McCabe and J C Smith, *"Unit operations of Chemical Engineering"*, McGraw Hill International Book Co., London
7. R H Perry and C H Chilton, *"Chemical Engineers Handbook"*, McGraw Hill and Co.

## PRACTICALS

(Pharmaceutical Engineering Drawing)

(6 hrs / week )

1. Introduction: Significance of Engineering Drawing in Pharmaceutical Industry, drawing instruments and their uses, lines, lettering and dimensioning.
2. Scales: Construction of plain scales, 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 and three-dimensional objects.
4. Orthographic projections: Theory, types, and construction of drawing in both first angle and third angle. Various methods of sectioning i.e. full section, half section, removed 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.

### List of Books Recommended

#### Text Books"

1. N. D. Bhatt, *"Machine Drawing"*
2. N. D. Bhatt, *"Engineering Drawing "*

### Reference Books

3. French and Vierck, "A Manual of Engineering Drawing for Students and Draftsman"
4. Giesecke, Mitchell and Spencer, "Technical Drawing"

## BPH – 3.2 PHARMACEUTICAL CHEMISTRY IV (Pharmaceutical Biochemistry)

### THEORY

Lectures: 4 Hrs/week

#### Unit I

Energy, rich compounds, production of ATP, and its biological significance. Electron transport and biological oxidation.

Metabolism of lipids: Oxidation of fatty acids oxidation of unsaturated fatty acids, biosynthesis of fatty acids. Synthesis and degradation of triglycerides, hormonal influence of the mobilization of fat in adipose tissue, ketosis phospholipids, sphingolipids.

#### Unit II

Enzymes: classification of enzymes, general mechanism of enzyme function, factors affecting the velocity of enzyme catalysed reaction, activators and inactivators of enzymatic reaction. Clinical application of enzyme estimation. Isoenzyme, immobilization of enzymes.

#### Unit III

Metabolism of carbohydrates: an aerobic metabolism of glucose, aerobic metabolism of glucose (Kreb's cycle) pentose phosphate pathway, metabolism of galactos, glycogenesis, glycogenolysis, gluconeogenesis, regulation of blood glucose concentration.

Metabolism of proteins; nitrogen fixation, nitrogen balance, ammonia assimilation, nitrification and nitrate assimilation, amino acid degradation and urea cycle. Metabolism of phenyl-alanine and tryptophan.

#### Unit IV

Metabolism of purines and pyrimidines: biosynthesis of RNA and DNA. Role of cyclic nucleotide in enzyme activation. Gene protein relationship, control of protein synthesis. Mutation, physical and chemical mutagenesis repair mechanism, recombinant DNA technology, genetic code inborn error of metabolism. Biochemical role of trace elements

### PRACTICALS

( 6 hrs / week )

- 1) Preparation of standard buffer (nitrate, phosphate, carbonate and measurement of pH).
- 2) Quantitative estimation of proteins.
- 3) Estimation of blood glucose, blood cholesterol, SGPT and SGOT activity.
- 4) Acid hydrolysis and action of salivary amylase on starch.
- 5) Estimation of chloride, glucose, ammonia and creatinine in urine.
- 6) Identification of carbohydrates, proteins and fats.
- 7) Identification of abnormal constituents of urine.

### List of Books Recommended

#### Text Books

1. D. T. Plumer, "An Introduction to Practical Biochemistry", Tata Mcgraw Hill, New Delhi.
2. J. Jayaraman, "Laboratory Manual in Biochemistry", Wiley Eastern Ltd., Delhi.
3. E. E. Conn and P. K. Stumpf, "Outlines of Biochemistry", Jone Wiley and Sons, New York.

#### Reference Books

4. "Harper's Review of Biochemistry", Lange Medical Publications
5. A. L. Lehninger, "Principles of Biochemistry", CBS Publishers.
6. L. Stryer, "Biochemistry", W. H. Freeman and Company, San Francisco.
7. B. Harrow and A. Mazur, "Textbook of Biochemistry", W. B. Saunders Company, Philadelphia

## BPH – 3.3 PHARMACOGNOSY-II

### THEORY

Total Lectures: 4 Hrs/week

#### Section-A

1. Phytochemical screening: (a) Preparation of extracts. (b) Chemical and chromatographic methods of screening for alkaloids, glycosides, resins, tannins, saponins and flavonoids in plant extracts.
2. Study of the biological sources, cultivation, collection, commercial verities, chemical constituents, substituents, adulterants, diagnostic microscopic and macroscopic features and specific chemical tests of following group of Glycosides containing drugs:
  - a. Saponins: liquorice, ginseng, dioscorea and senega.
  - b. Cardio-active sterols: digitalis, squill, strophanthus and thevetia.
  - c. Anthraquinones : aloe, senna, rhubarb and cascara.

### Section-B

3. Study of Tannins and tannin containing drugs like gambir, black catechu, gall and myrobalan.
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, Shatavari, Apamarg, Gokhru, Shankhpushpi, Gaduchi, Brahmi, Arjuna, Methi, Lehsun, Guggal, Gymnema and Neem.
5. Holistic concepts of Drugs administration in traditional systems of medicine:  
Introduction to ayurvedic preparations like arishtas, asavas, gutikas, tailas, churnas, lehas and bhasmas.

### Section-C

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:
  - (a) Pyridine-piperidine: tobacco, areca and lobelia.
  - (b) Tropane: belladonna, hyoscyamine, datura and withania.
  - (c) Quinoline and isoquinoline : Cinchona, ipecac, opium.
  - (d) Indole: ergot, rauwolfia, catharanthus and physostigma.
  - (e) Imidazoles: pilocarpus.
  - (f) Steroidal: vertrum, kurchi.
  - (g) Alkaloidal amines: ephedra and colchicum.
  - (h) Glycoalkaloids: solanum.
  - (i) Purines: Coffee, tea and cola.

### Section-D

7. Introduction and study of plant bitters and sweeteners.
8. Plant based pesticides and insecticides.
9. Study of fibers used in pharmacy such as cotton, silk, wool, nylon, glass-wool, polyester and asbestos.

### PRACTICALS

1. Phytochemical screening of secondary plant metabolites listed as above in theory portion.
2. Morphological, microscopical and chemical evaluation of crude drugs as mentioned
3. above.
4. Standardisation/study of some traditional drug formulations/ayurvedic marketed preparations.

### List of Recommended Books

1. Kokate C. K., Purohit A. P. and Kokhale S.B., "Text Book of Pharmacognosy", Nirali Publication, Pune.
2. Trease, G. E. and Evans, W. C., "Text Book of Pharmacognosy", Bailliere Tindall, Eastbourne, U. K.
3. Tyler, V. C., Brady, L. R. and Robers, J.E., "Text Book of Pharmacognosy", 8<sup>th</sup> Ed. Lea and Febiger, Philadelphia.
4. Tyler, V. E. Jr. and Schwarting, A.E. "Experimental Pharmacognosy", Burgess Pub. Co., Minneapolis, Minnesota.
5. Wallis, T. E., "Text Book of Pharmacognosy", J. and A Churchill limited, London.
6. Clarke, E. C. G., "Isolation and Identification of Drugs", the Pharmaceutical Press, London.
7. Fahn, A., "Plant Anatomy", Pergamon Press, Oxford
8. Jean Brunton, "Text Book of Pharmacognosy", Phytochemistry and Medicinal Plants, Intercept Limited, Andover, England, U.K.

## BPH – 3.4 PHARMACEUTICAL CHEMISTRY V (Heterocyclic and Bio-Organic Chemistry)

### THEORY

Lectures: 4 Hrs/week

#### Unit I

Heterocyclic compounds: Study of fundamentals of heterocyclic compounds, nomenclature, method of synthesis and important chemical reactions of the following: Five membered Heterocycles: Furan, Thiophene, Pyrrole, Thiazole, oxazole, imidazole, Pyrazole. Six membered Heterocycles: Pyridine, pyridazine, Pyrimidine, Pyrazine, Pyrones. Benz-fused Heterocycles: Quinoline, Isoquinoline, Indole.

#### Unit II

Carbohydrates: An account of the Classification, chemistry, linkage and biological activity of Glucose, Sucrose, Structure elucidation of glucose, sucrose.  
Study of chemistry of fixed oils, fats and waxes.  
Classification, Chemistry and biological activity of vitamins.  
Polymers- Classification, Synthesis, reactions, crystallinity, polymer degradation mechanism, copolymerization and their applications in Pharmacy

### Unit III

Proteins and Amino Acids: Isolation and general methods of synthesis of amino acids and physico-chemical properties. General classification of proteins and end group analysis. Structural features of DNA and RNA.

### Unit IV

Terpenes: Classification, Isoprene rule, Chemistry of various constituents of volatile oils: Limonene, Pinene, Cineole, Camphor, Menthol, Menthone, Thymol, Citral and Eugenol. Structure elucidation of Pinene, Limonene, Camphor, Citral. Glycosides: Chemistry of salicin, cardiac glycosides, anthraquinone glycosides, saponins. and cardiac glycosides.

Fullerenes- Introduction, chemical reactions and applications

#### List of Books Recommended

##### Text Books

1. I. L. Finar, "*Organic Chemistry*", Vol. I and II, ELBS/ Longman.
2. A. I. Vogel, "*A Textbook of Practical Organic Chemistry*", The English Language Book Society and Longman group Ltd., London.

##### Reference Books

3. R. N. Acheson, "*An Introduction to Chemistry of Heterocyclic Compounds*", Interscience Publications, New Delhi.
4. P. Sykes, "*A Guide Book to Mechanism in Organic Chemistry*", Orient Longman, New Delhi.
5. J. D. Roberts and M. C. Caserio, "*Basic Principle of Organic Chemistry*", Inc., New York.
6. F. C. Mann, and B. C. Saunders, "*Practical organic Chemistry*", The English Language Book Society and Longman group Ltd., London
7. Billmeyer Fred. W., *Text Book of Polymer Science*, 3rd edition, Wiley Interscience Publication, John Wiley and Sons.
8. Dawande S.D., *Introduction to Polymers Sciences and Technology*, 1st edition, Denett and Co., Nagpur.
9. Gowariker V.R., Vishwanathan N.V., Sreedhar Jayadev, *Polymer Science*, New Age International, New Delhi.

**BPH – 3.5**

**ENVIRONMENTAL STUDIES**

**THEORY**

**Lectures: 4 Hrs/week**

#### **Unit-I**

1. The Multidisciplinary Nature of Environmental Studies  
Definition, scope and importance  
Need for public awareness
2. Natural Resources  
Renewable and non- renewable resources:  
Natural resources and associated problems
  - (a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
  - (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.
  - (c) Mineral resources: Use and over-exploitation, environmental effects of extracting and using mineral resources, case studies.
  - (d) Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
  - (e) Energy resources: Growing energy needs, renewable and non- renewable energy sources, use of alternate energy sources, case studies.
  - (f) Land resources: Land as a resource, land degradation man induced land slides, soil erosion and desertification.
    - Role of an individual in conservation of natural resources.
    - Equitable use of resources for sustainable life styles.

#### **Unit-II**

3. Ecosystems
  - Concept of an ecosystem.
  - Structure and function of an ecosystem.
  - Producers, consumers and decomposers.
  - Energy flow in the ecosystem
  - Ecological succession
  - Food chains, food webs and ecological pyramids.
  - Introduction, types, characteristic features, structure and function of the following ecosystem:
    - (a) Forest ecosystem
    - (b) Grassland ecosystem
    - (c) Desert ecosystem

(d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)

#### 4. Biodiversity and its Conservation

- Introduction-Definition: genetic, species and ecosystem diversity.
- Biogeographical classification of India.
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- Biodiversity at global, national and local levels.
- India as a mega-diversity nation.
- Hot-spots of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity: *In-situ* and *Ex-situ* conservation of biodiversity.

### Unit-III

#### 5. Environmental Pollution

##### Definition

- Causes, effects and measures of
  - (a) Air pollution
  - (b) Water pollution
  - (c) Soil pollution
  - (d) Marine pollution
  - (e) Noise pollution
  - (f) Thermal pollution
  - (g) Nuclear hazards
- Solid waste management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: floods, earthquakes, cyclone and landslides.

#### 6. Human Population and Environment

- Population growth, variation among nations.
- Population explosion-Family Welfare Programme.
- Environment and human health.
- Human rights.
- Value education.
- HIV/AIDS.
- Women and Child Welfare.
- Pole of Information Technology in Environment and human health.
- Case studies.

### Unit-IV

#### 7. Social Issues and the Environment

- From Unsustainable to Sustainable development.
- Urban problems related to energy.
- Water conservation, rain water harvesting, water shed management.
- Resettlement and rehabilitation of people: its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and Control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.
- Issues involved in enforcement of environmental legislation.
- Public awareness.

#### Field Work

- Visit to a local area to document environmental assets-river, forest grassland/hill/mountain.
- Visit to a local polluted site-Urban/ Rural/ Industrial/ Agricultural.
- Study of common plants, insects and birds.
- Study of simple ecosystems-pond, river, hill slopes etc.

**B.PHARM. 4<sup>TH</sup> SEMESTER**  
**BPH-4.1 PHARMACEUTICAL CHEMISTRY VI**  
**(Analytical Chemistry I)**

**THEORY**

**Lectures: 6 hrs / week**

**Unit I**

Introduction: Significance of quantitative analysis in quality control, different techniques of analysis, preliminaries and definitions, significant figures, rules for retaining significant digits, types of errors, mean deviation and standard deviation, statistical treatment of small data sheets, selection of sample, precision and accuracy, fundamentals of volumetric analysis, method of expressing concentration, primary and secondary standards. Acid Base Titrations: acid base concepts, role of solvent, relative strength of acids and bases, ionisation law, law of mass action, common ion effect, ionic product of water, neutralization curves, acid-base indicators, theory of indicators, choice of indicators, mixed indicators, application in assay of  $H_3PO_4$ , NaOH,  $CaCO_3$  etc.

**Unit II**

Oxidation Reduction Titrations: concepts of oxidation and reduction, redox reactions, strength and equivalent weights of oxidising and reducing agents. Theory of redox titrations, cell representations, measurement of electrode potential. Oxidation-reductions, potassium iodate titrations, potassium bromate titrations, titanous chloride titrations, iodophenol titration, pharmaceutical applications. Precipitation Titrations: precipitation reactions, solubility products, effects of acids, temperature and solvent upon the solubility of a precipitate. Argentometric titrations, ammonium potassium thiocyanate titrations, mercuric nitrate titrations, methods: Mohr's method, Volhards method, Fajans method and pharmaceutical applications.

**Unit III**

Gravimetric Analysis; preparation of Gooch crucible for filtration and use of sintered glass crucible, determination of water of hydration. Non-aqueous Titrations; theoretical titrations, scope and limitations, acid base equilibria in non-aqueous media, titrations of weak bases, titrations of weak acids, indicators, pharmaceutical products, should be selected for illustration. Complexometric Titrations: concept of complexation and chelation, Warner's co-ordination number and electronic structure of complex ions, stability constants, titration curves, masking and demasking agents, types of complexometric titrations, metal ion indicators, factors influencing the stability of complexes, applications.

**Unit IV**

Miscellaneous method of analysis; Diazotisation titration, Kjeldahl nitrogen determination, Karl fishcher titration, determination of alcohol in liquid galenicals, oxygen flask combustion, gasometry. Extraction procedure, separation of drug from excipients, liquid-liquid extraction, separation of mixtures by extraction, distribution law, successive extraction, the Craig method of multiple extraction, continuous counter-current extraction, effect of temperature.

**PRACTICALS:**

**( 6 hrs / week )**

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. Any other practical based in afore mentioned theory

**List of Books Recommended**

**Text Books**

1. "Vogel's Textbook of Quantitative Inorganic Analysis", ELBS/ Longman, London.
2. A. H. Beckett and J. B. Stenlake, "Practical Pharmaceutical Chemistry, Vol. I and II", The Athlon Press of the University of London.

**Reference Books**

3. I. M. Kolthoff and V. A. Stenger, "Volumetric Analysis, Vol. II Titration Methods", Interscience Publishers, Inc., New York.
4. K. A. Connors, "A Textbook of Pharmaceutical Analysis", Wiley Interscience, New York.
5. "Jenkin's Quantitative Pharmaceutical Chemistry", McGraw Hill Book Company, New York.
6. Lunn G., "HPLC- Method for Pharmaceutical Analysis"
7. Lunn G. "Handbook of Derivatisation Reaction for HPLC"

## BPH-4.2 PHARMACEUTICS IV (Pharmaceutical Microbiology)

### THEORY

Lectures: 6 hrs / week

#### Unit I

1. Introduction to the science of microbiology-ancient theories concerning the origin of life, contribution of great scientists to this science, with particular reference to the contributions of the following scientists: A.V. Leeuwenhoek, Louis Pasteur, Edward Jenner, Robert Koch, Alexander Fleming, Joseph Lister.
2. Microscopy: Microscopes, their magnification, resolution, illumination and filters, working of different types of microscopes, micrometry.

#### Unit II

3. Classification of microbes and their taxonomy.
4. Nutrition, cultivation isolation and identification of bacteria, fungi and viruses.
5. Bacterial enzymes – classification, nomenclature, production by fermentation, extraction methods, immobilization techniques and applications of bacterial enzymes in general and detailed account of following bacterial enzymes: alpha amylase (diastase) and proteases.

#### Unit III

6. Disinfection, factors affecting disinfection, dynamics of disinfection, disinfectants and antiseptics and their evaluation.
7. Sterilization, different methods, applications and evaluation of sterilization methods.
8. Aseptic technique.

#### Unit IV

9. Microbial standardisation of antibiotics ( ampicillin, streptomycin ), Vitamins ( Vitamin B-12, Niacin ) and calcium pantothenate.
10. Fermentation: Types of media used; factors affecting, control of various parameters during fermentation. A detailed account of the industrial fermentation process for manufacture of penicillin, streptomycin, glutamic acid; Lysine, citric acid, Vit.B<sub>12</sub>. [6]

### **PRACTICALS:**

( 6 hrs / week )

Number of experiments based upon afore mentioned theory and including experiments devised to prepare various types of culture media, subculturing of common aerobic and anaerobic bacteria, fungus and yeast, various staining methods, various methods of isolation and identification of microbes, sterilizing techniques and evaluation of sterilizing techniques, evaluation of aseptics and disinfectants, testing and sterility of pharmaceutical products as per I.P. requirements, evaluation of potency of antibiotics and vitamins etc.

### **List of Books Recommended**

#### **Text Books**

1. L. E. Casida, "Industrial Microbiology", New Age International (P) Ltd. New
2. Pelczar, Chan and Krieg, "Microbiology".

#### **Reference Books**

3. R Y Stanier, Ingrham, "General Microbiology", Wheelis and Painter.
4. Hugo and Russel, "Pharmaceutical Microbiology", Blackwell Scientific Publications, Oxford.
5. G Sykes, "Disinfection and Sterilization".
6. Davis, Dulbetco, Eisen "Microbiology".
7. Benzamin Lewin, Gene V, "Microbiology".
8. Prescott and Dunn, "Industrial Microbiology", Mcgraw Hill Book Company Inc.
9. Pepler, "Microbiology Technology", Vol.I & II.

## BPH-4.3 COMPUTER SCIENCES

### THEORY

Lectures: 4 hrs / week

#### Unit I

1. Introduction: Importance of computers, history of computers (generations), types of computers, classification of computers, components of a computer, applications of computers including Pharmaceutical applications, hardware description, Languages like assembly, machine, and common high-level languages, computer viruses.
2. Introduction to Internet: Concepts of Internet, WWW, Gopher, e-mail and applications of Internet. [5]

#### Unit-2

1. Programming in BASIC: Introduction to BASIC, flowcharting, BASIC statements, constants and variables, expressions in BASIC, print control, jumping and looping, subscripted variables, functioning and subroutines, histogram and graphs, programme design, file management in BASIC and computer graphics.

### Unit -3

1. Introduction to operating system with a special emphasis on Windows.
2. MS-Word- Introduction to Word processing, Introduction to MS word, Editing, formatting,, previewing and printing a document, advanced features of MS word (Find and replace, grammar and spelling, auto correct, word count, mail merge, table and charts).

### Unit-4

1. MS- excel- Worksheet basics, creating, formatting, previewing and printing a worksheet, graphs and charts, working with formulas and cell referencing, database creation, sorting, database functions (Mathematical and trigonometrical, statistical and logical functions).
2. MS-PowerPoint- Features and various versions, creating presentations, working with different views and menus of PowerPoint, editing and formatting a text, working with slides, printing a presentation, inserting objects, slide sorter and animation effects.

### PRACTICALS:

( 6 hrs / week )

Number of experiments based on aforementioned theory.

## **BPH-4.4 PHARMACEUTICAL MATHEMATICS AND STATISTICS**

### THEORY

**Lectures: 6 hrs / week**

#### Unit-I

**Matrices and Determinants:** definition of matrix, types of matrices, arithmetic operations on matrices, determinants and its expansion, important properties of determinants, solutions of simultaneous equations by Cramer's rule.

**Differentiation:** Concepts of functions, limits and differentiation; differentiation of standard functions (without using first principle), including function of a function (chain rule), differentiation of implicit functions, logarithmic differentiation, parametric differentiation, elements of successive differentiation.

#### Unit-II

**Integration:** integration as inverse of differentiation, indefinite integrals of standard functions, integration- by parts and substitution methods, formal evaluation of definite integrals.

**Differential equations:** definition, formation and solution of ordinary differential equations of first order and first degree (variable separable technique only).

**Laplace transforms:** definition, properties of linearity and shifting, transforms of elementary function (without proof) and inverse Laplace transforms not involving Euler's theorem.

#### Unit-III

**Measures of central tendency and dispersion:** requisites of an ideal measure, arithmetic mean, median, mode, range, mean deviation, standard deviation, coefficients of variation.

**Linear correlation:** bi-variate data, scatter diagrams, correlation, types of correlation, Karl Pearson's and Spearman's methods, coefficients of correlation and its important properties (without proof).

**Linear regression:** regression, method of least squares, lines of regression, regression coefficients and their important properties (without proof).

#### Unit-IV

**Probability:** events, classical and statistical definitions of probabilities, addition and multiplication laws of probability, conditional probability, Baye's theorem (statement only) and its applications.

**Standard probability distribution:** definitions, important properties (without proof) and applications of binomial, Poisson and normal distribution/ normal curves. Central limit theorem (statement only).

**Statistical inference:** concepts of parameter, statistic, sampling distribution, standard error, hypothesis, type-I and type-II errors; testing of hypothesis, t- test (paired and unpaired), Z-test (for means only).

Note:- Emphasis on Pharmaceutical applications, wherever possible, of the above-mentioned concepts and results (without proof).

### **Recommended Text Books:**

1. Goon, A.M, Gupta, M.K and Dasgupta, B, Basic Statistics, World Press.
2. Gupta, S.P, Statistical Methods, Sultan Chand & Sons, New Delhi.
3. Dinodoia, J and Chugh, K, Elements of Pharmaceutical Mathematics (Vol.I and Vol.II), Jeevons Publications, New Delhi.
4. Dhall, G.D, Chhibbar, S.N, Trivedi, H.O, and Chandra, S, Frank Mathematics for B.Pharm, Frank Bros. & Co. Ltd., New Delhi.

# B.PHARM. 5<sup>TH</sup> SEMESTER

BPH – 5.1

PHARMACEUTICS V

(Physical Pharmacy)

## THEORY

Lectures: 4 hrs / week

### UNIT-I

1. Matter- State and selected properties: State of matter, change in the state of matter, latent heats and vapour pressure, sublimation-critical point, eutectic mixtures, relative humidity, liquid complexes, liquid crystals, glassy state, solid-crystalline and amorphous polymorphism.
2. Micromeretic and Powder Rheology: Particle size and distribution, average particle size, number and weight distribution, particle number, method of determining particle volume, optical microscopy, sieving, sedimentation, measurement, particle shape, specific surface, methods of determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties.

### UNIT- II

1. Surface and Interfacial Phenomenon: Liquid interface, surface and interfacial tensions, surface free energy measurement of surface and interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interfaces, solid gas and solid-liquid interfaces, complex films, electric properties of interface.
2. Viscosity and Rheology: Newtonian systems, laws of flow, kinematic viscosity, effect of temperature, non Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling ball, rotational viscometers.

### UNIT- III

1. Dispersion system  
Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloid in pharmacy. Suspensions and Emulsions: Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations, emulsions; types, theories and physical stability.
2. Complexation: Classification of complexes, method of preparation and analysis, application.

### UNIT- IV

1. Kinetics and drug stability: general considerations & concepts, half life determination, influence of temperature, light, solvent, catalytic species and other factors, accelerated stability study, expiration dating.
2. Buffers: Buffer equation and buffer capacity in general, buffer in pharmaceutical systems- preparation- stability, buffered isotonic solutions, measurement of tonicity calculations, methods of adjusting isotonicity.

## PRACTICALS:

6hrs/week

Number of experiments based upon aforementioned theory and including the following:

1. Determination of latent heat, vapour pressure and critical point.
2. Studies on polymorphs, their identification and properties.
3. Determination of particle size, particle size distribution and surface areas using various methods of particle size analysis.
4. Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc.
5. Determination of surface/interfacial tension, HLB values and critical micellar concentration of surfactants.
6. Study of rheological properties of various types of systems using different viscometers.
7. Studies of different types of colloid and their properties.
8. Preparation of various types of suspensions and determination of their sedimentation parameters.
9. Preparation and stability studies of emulsions.
10. Studies on different types of complexes and determination of their stability constants.
11. Determinations of half-life rate constant and order of reaction.
12. To study the influence of various factors on the rate of reaction.
13. Accelerated stability testing, shelf life determination and expiration dating of pharmaceuticals.
14. Preparation of pharmaceutical buffers and determination of buffer capacity.

### List of Books Recommended

#### Text Books

1. Cooper and Gunns' "Tutorial Pharmacy", CBS Publishers, Delhi
2. A N Martin, "Physical Pharmacy", K M Varghese & Co., Mumbai
3. "Remington' Pharmaceutical Sciences", Mack Publishing Co., P.A.

#### REFERENCE BOOKS

4. E Shotton and K Ridgway, "Physical Pharmaceutics" Oxford University Press, London
5. Leon Lachman, H A Liberman and J L Kanig, "The Theory and Practice of Industrial Pharmacy", Lea & Febiger, Philadelphia
6. H C Ansel, "Introduction to Pharmaceutical Dosage Forms", K M Varghese & Co., Mumbai.
7. J T Carstensen, "Drug Stability", Marcel Dekker Inc., NY

THEORYUNIT-I

Basic Principles of Medicinal Chemistry: Physio-chemical aspects of Drug action- Stereochemical aspects of drug action (Optical, geometric and bioisomerism of drug molecules with biological action), conformational isomerism, solubility and partition coefficient, chemical bonding. Drug-receptor interactions- receptor concept, receptor- effector theories, types of receptor and their action including transduction mechanism and G proteins.

UNIT-II

Mode of action, uses, Structure activity relationship including physicochemical properties of the following classes of drugs. Drugs acting at Synaptic and neuro-effector junction sites: Cholinergics and anticholinergics, antispasmodics, antiulcer drugs, ganglionic stimulants, Neuromuscular blocking agents, sympathomimetic agents including biosynthesis of adrenergic neurotransmitter, adrenergic drugs and adrenoceptor blockers. Autocoids: Antihistamines, Ecosanoids, Anti-inflammatory agents (nonsteroidal), analgesic and antipyretics.

UNIT-III

Diuretics and Antidiuretics. Cardiovascular agents: Antihypertensives, Cardiotonics, Antiarrhythmics, antianginals, anticoagulants and antiplatelets, thrombolytics, antithrombolytics, hypolipoproteinemic drugs. Vitamins- Classification, chemistry of thiamine, pyridoxine, folic acid, ascorbic acid and vitamin A. Insulin and oral hypoglycemic agents. Thyroid and Antithyroid drugs. Oxytocics including oxytocin, ergot alkaloids and prostaglandins.

UNIT-IV

Synthetic procedures of following selected drugs – Neostigmine bromide, Cyclopentolate HCl, Propranolol, Benzhexol, Diphenhydramine, Chlorpheniramine, Promethazine, Cyclizine, Sodium chromoglycolate, Aspirin, Ibuprofen, Indometacin, Phenazone, Phenylbutazone, Oxyphenbutazone, Allopurinol, Probenecid, Furosemide, Acetazolamide, Chlorthalidate, Hydrochlorthiazide, Spironolactone, Triamterene, Nifedipine, Procainamide, Verapamil, Propranolol, Methyldopa, Clonidine, Guanethidine, Hydrallazine, Phentolamine, Clofibrate, Warfarin, Phenindione, Pyridoxine, Folic acid, Tolbutamide, Methylthiouracil, methimazole.

PRACTICALS

(6 hrs / week )

Synthesis of following compounds

1. Hippuric acid
2. 1-phenyl-azo-Z-naphthol
3. Picric acid
4. Sodium benzenesulphonate
5. Mannich reaction
6. Succinic anhydride
7. Methyl benzoate
8. Benzimidazole
9. oxalic acid
10. Hexamethylene tetramine
11. Acetene oxide

**List of Books Recommended****Text Books**

1. Wilson and Gisvold's "Textbook of Organic Medicinal and Pharmaceutical Chemistry", J. Lippincot Co., Philadelphia.
2. W. O. Foye, "Principles of Medicinal Chemistry", Lea and Febiger, Philadelphia.

**Reference Books**

3. C. Hansch, "Comprehensive Medicinal Chemistry", Pergman Press Oxford.
4. Y. C. Martin, "Quantitative Drug Design", Marcel Dekker, Inc. New York.
5. Exploring QSAR  
Vol. I- "Fundamentals and Applications in Chemistry and Biology" by C. Hansch and A. Leo.  
Vol.II- "Hydrophobic, Electronic and Steric Constants" by C. Hansch, A. Leo and D. Hockman, ACS Books Catalog.
6. M. E. Wolff, Ed. "Burger's Medicinal Chemistry", John Wiley & Sons, New York.
7. T. Nogardy, "Medicinal Chemistry – A Biochemical Approach", Oxford University Press, New York, Oxford.
8. Popst and Perrum, "Computer Aided Drug Design", Academic Press, New York

**THEORY**

**Lectures: 4 hrs / week**

**UNIT-1**

1. Distillation: Raoult's law, volatility, boiling point diagrams, azeotropic mixtures, equilibrium diagrams, types of distillation, rectification, rectifying columns, downcomers, material and energy balance of a rectifying column, reflux ratio, determination of number of theory plates, H.E.T.P. and steam distillation.
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.

**UNIT- II**

3. Mixing: Definition, objectives, mechanism, uniformity index, factors influencing selection of suitable mixer. Study of equipment employed for solid-solid, liquid-liquid and solid-liquid mixing. Emulsification equipment.
4. Size separation: Screening equipment i.e. trommels, rotex and hummer; air suspension methods i.e. air separator and cyclone separators; hydraulic separation i.e. elutriation and double cone emulsifier.

**UNIT- III**

5. Crystallization: crystal forms, habit, Mier's supersaturation theory, 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
6. Transportation of materials:  
Liquids: Pumps i.e. airlift, ejector, piston plunger, egg, diaphragm, gear, screw, centrifugal and self-priming.  
Gases: Ejectors, compressors, fans and blowers.  
Solids: Intermittent and continuous methods in vertical, horizontal and inclined plane.

**UNIT-IV**

7. 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), nonferrous metals (i.e. Copper and its alloys, aluminium, tin sliver, nickel and alloys), nonmetals i.e. glass, slate, asbestos, rubber, plastics and timber.
8. Industrial hazards and safety precautions: Mechanical-chemical-electrical-fire-dust hazards, safety requirements, accident records etc.
9. Corrosion and its prevention: Types of corrosion causes of corrosion and method for combating corrosion.

**PRACTICALS**

**6hrs/week**

Numbers of practical based on theory portions of Pharmaceutical Engineering-I and Pharmaceutical Engineering-II and including 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 orificemeter
6. Determination of overall heat transfer coefficient.
7. Effect of number of balls on the grinding rate in a ball mill.
8. Efficiency of a centrifugal pump.
9. Effect of thickness of cake on filtration rate in a filter press.
10. Effect of colour on radiation of heat.
11. Overall efficiency of steam distillation.
12. Use of psychrometric chart.
13. Flow rate using pitot tubes.
14. Determination of equilibrium moisture constant.

**List of Books Recommended**

**Text Books**

1. Cooper and Gunns' " *Tutorial Pharmacy*", CBS Publishers, Delhi
2. Leon Lachman, H A Liberman and J L Kanig, " *The Theory and Practice of Industrial Pharmacy*", Lea & Febiger, Philadelphia
3. " *Bentley Textbook of Pharmaceutics*", ELBS Bacilliere Tindall.
4. W L Badger and j t Banchemo, " *Introduction to Chemical Engineering*", McGraw Hill International Book Co., London

**Reference Books**

5. W L McCabe and J C Smith, " *Unit operations of Chemical Engineering*", McGraw Hill International Book Co., London
6. R H Perry and C H Chilton, " *Chemical Engineers Handbook*", McGraw Hill and Co.

**BPH – 5.4 PHARMACOLOGY II (Pathophysiology)**

**THEORY**

**Lectures: 4 hrs / week**

**Unit-I**

1. Pathophysiology of hypo- & hyper-secretion of endocrine glands & their disorders e.g. Diabetes mellitus.
2. Pathophysiology of anaemia, hypersensitivity, allergic conditions.
3. Pathophysiology of Asthma, Pneumonia, Bronchitis, Emphysema.
4. Pathophysiology of joints disorders – Arthritis, gout, myasthenia gravis, spasticity, tetany, fatigue.
5. Pathophysiology of cataract, glaucoma etc.

**Unit II**

6. Pathophysiology of psychosis, epilepsy, depression, Parkinson's & Alzheimer's diseases.
7. Basic mechanisms involved in the process of inflammation and repair Alterations in vascular permeability and blood flow, migration of WBC's, mediators of inflammation. Brief outline of the process of repair.
8. Pathophysiology of disorders related to digestive system: Peptic Ulcer, Ulcerative colitis, Crohns disease, Zollinger- Ellison syndrome, Amoebiasis, typhoid, Hepatitis, Cirrhosis of liver, pancreatitis.

**Unit III**

9. Pathophysiology of hypertension, angina, CHF, myocardial infarction, cardiac arrhythmias, ischemic heart disease, arteriosclerosis.
10. Pathophysiology of renal feature, glomerulonephritis, urinary tract infection.
11. Pathophysiology of tuberculosis, leprosy, malaria, influenza, chicken pox, tetanus, helminthiasis, filariasis.

**Unit IV**

12. Pathophysiology of sexually transmitted diseases, spermatogenesis, oogenesis.
13. Pathophysiology of syphilis, gonorrhoea and AIDS.
14. Pathogenesis & morphology of cell injury. Atrophy, hypertrophy, aplasia, metaplasia, & dysplasia, intracellular accumulation & pathophysiology of Neoplasm.

**BPH – 5.5 PHARMACEUTICS VII (Pharmaceutical Management)**

**THEORY**

**Lectures: 4 hrs / week**

**UNIT-1**

1. Concept of Management.  
Administrative Management (Planning, Organising, Staffing, Directing and controlling). [5]
2. Principles of Management (Co-ordination, Communication, Motivation, Decision-making, Leadership, Innovation, Creativity, Delegation of Authority/Responsibility, Record Keeping). [5]

**UNIT- II**

3. Pharmaceutical Marketing  
Functions Buying, selling, transportation, storage, finance, feedback, information, channels of distribution, wholesale, retail, departmental store, multiple shop and mail order business. [5]
4. Procedure of buying of drugs and pharmaceuticals by Government agencies. [5]

**UNIT-III**

5. Salesmanship: [5]  
Principles of sales promotion, advertising, ethics of sales, literature detailing.
6. Material management: [5]  
A brief exposure of the basic principles of material management, purchase, store and inventory management.

**UNIT- IV**

7. Production Management: [5]  
A brief exposure of the different aspects of production management, Production planning and control, Plant location, Plant layout and material handling, inspection and maintenance of plant facilities.
8. Personnel Management: [5]  
Objectives of personnel management, functions of personnel manager, recruitment, selection procedure, training and its methodology, job evaluation, performance evaluation, promotions, transfers and termination.

**List of Books Recommended**

**Text Books**

1. G W Plossl and O W Wight, "Production and Inventory Control, Principles and Techniques", Prentice Hall of India Pvt. Ltd., New Delhi.
2. Banerjee, "Principle and Practice of Management", Oxford and I B H Publishing Company. New Delhi..
3. Rustam S Pavel, "Salesmanship and Publicity", Progressive Corporation Pvt. Ltd. Mumabai.

**Reference Books**

4. S P Ganguly, "Principles and Practice of Management", Chatterjee Publishing Concern, Calcutta
5. K S menon, "Purchasing and Inventory Control", Wheeler Publishing, Allahabad.
6. C B Gupta, "Principles and Practice of Management", National publishing House, New Delhi

# B.PHARM. 6<sup>TH</sup> SEMESTER

BPH – 6.1 PHARMACEUTICS VIII (Dosage Form Design)

## THEORY

Lectures: 6 hrs / week

### Unit - I

1. Routes of Drug Administration
2. Types of Dosage Forms and Delivery Systems
3. New Drug Approval Process
4. Preformulation studies:
  - a) Study of following **physical properties** of drugs and their effect on formulation, stability and bioavailability:  
*Physical form, Particle size, shape and surface area, Density, Wetting, Dielectric constant, Solubility, Dissolution, and Organoleptic properties.*
  - b) Study of the following **chemical properties** of drugs and their influence on formulation and stability of products like:  
- *Hydrolysis, oxidation, reduction, racemization, polymerization.*
  - c) Pharmacological factors (Biological factors)

### Unit - II

5. Theory, Industrial Production, SOPs, Packaging, Labeling and Quality Control (official and other methods) of
  - Syrups
  - Suspensions
  - Emulsions
  - Ointments
  - Stabilization and Stability Testing Protocols for the above mentioned pharmaceutical products. Schedule 'P' and ICH Guidelines on Stability.
6. **Prodrugs** : Types and approaches to make prodrugs. Role of prodrugs in solving problems related to formulation development, stability and bioavailability.
7. **GMP**: Concept of Good Manufacturing Practices, Study of Schedule 'M' of D&C Act and cGMP guidelines of USFDA for *Solid Dosage Forms* and *Parenterals*.

### Unit - III

8. Nomenclature of Cosmetic Ingredients
9. Legal Aspects of Cosmetics and Functional Cosmetics (D&C, USFDA, EU, Health Canada, TGA, WHO, CHIC regulations)
10. Water in Cosmetics
11. Naturals in Cosmetics (Botanical, Animal, Milk and Minerals)
12. Colors in Cosmetics
13. Perfumes and Fragrances in Cosmetics
14. Preservatives in Cosmetics and Microbiological control of Cosmetics.  
**Formulation, preparation and quality control of the following colored cosmetics:**  
-- Lipsticks and Lip salves, Nail lacquers and Eye Cosmetics

### Unit – IV

15. Structure and functions of Hair, Teeth and Skin. Types of skin glands and skin secretions and physiology of sweating  
**Formulation, preparation and quality control of the following cosmetics:**
  - Tooth powders and Tooth paste
  - Antiperspirants and Deodorants
  - Creams -- Cold cream and Cleansing cream, Vanishing cream, Sunscreen cream, Foundation cream, Moisturizing cream
  - Hair cosmetics – Shampoos, Hair creams and fixers, Hair Colorants and Dyes,
  - Depilatories, Shaving creams and After Shave Lotion.
  - Astringents and Skin Tonics

## PRACTICALS

( lectures = 06 hrs per week)

- Preformulation studies including drug-excipient compatibility studies, effect of stabilizers, preservatives etc. in dosage form design.
- Experiments to illustrate comparative study of **Suspending Agents, Emulsifying agents, Preservatives and Antioxidants.**
- Formulation, preparation, packing, labeling and evaluation of the following class of dosage forms using laboratory scale equipments- Syrups (including dry syrups), **Suspensions, Emulsions and Topical Preparations.**

- Synthesis and characterization of some **Prodrugs**
- Stability evaluation of various dosage forms and determination of their shelf life.
- Preparation and evaluation of (a) Cold cream (b) Vanishing cream (c) Sunscreen cream (d) Hair creams (e) Shampoos (f) Shaving cream (g) Tooth powder (h) Tooth paste (i) Mouth wash (j) Lipsticks ,etc. as per BIS or other methods
- Any other experiments illustrative of the portion covered in the theory portion of the syllabus.

#### **Books Recommended**

1. H C Ansel, " *Introduction to Pharmaceutical Dosage Forms and Drug Delivery Systems*", K M Varghese & Co., Mumbai.
2. Remingtons Practice of Pharmacy
3. SOP by Shah
4. Modern Pharmaceutics-Banker and Rhodes
5. Encyclopedia of Pharmaceutical Technology – Swarbrick
6. Indian Pharmacopoeia
7. Leon Lachman, H A Liberman and J L Kanig, " *The Theory and Practice of Industrial Pharmacy*", Lea & Febiger, Philadelphia.
8. K A Connors, G L Amidon and V J Stella, " *Chemical stability of Pharmaceuticals*".
9. A Owunwonle, " *Hand Book of Radiopharmaceuticals*", Narosa Publishing House, New Delhi.
10. H S Bean, A H Beckett and J E Carless, " *Advance in Pharmaceutical Sciences*", Academic Press, London.
11. Sanju Nanda, Arun Nanda and Roop K. Khar, " *Cosmetic Technology*", Birla Publications Pvt. Ltd, Delhi.
12. S G Thompson, " *Modern Cosmetics*", Universal Publishing Corporation, Mumbai.
13. Harry's Cosmeticology

### **BPH – 6.2**

### **PHARMACOLOGY III**

**Lectures: 6 hrs / week**

#### **THEORY**

#### **Unit-I**

#### **1. General pharmacology:**

- a. 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.
- b. 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.

#### **2. Pharmacology of autonomic nervous system:**

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

#### **Unit-II**

#### **3. Pharmacology of Central Nervous System:**

- a. Neurohumoral transmission in the C.N.S.
- b. General anaesthetics
- c. Alcohols and Disulfiram
- d. Sedative and hypnotics
- e. Anti-anxiety agents and centrally acting muscle relaxants
- f. Psychopharmacological agents (Anti-psychotic, antidepressants, antimaniacs and hallucinogens)
- g. Anti-epileptic drugs
- h. Anti-parkinsonian drugs
- i. Analgesics, antipyretics and anti-inflammatory agents
- j. Narcotic analgesics and antagonists.
- k. CNS stimulants
- l. Drug Addiction & drug abuse.

#### **Unit-III**

#### **4. Pharmacology of Endocrine system:**

- a. Hypothalamic and pituitary hormones
- b. Thyroid hormones and antithyroid drugs,
- c. parathormone calcitonin and vitamin D.
- d. Insulin, oral hypoglycemic agents and glucagon.
- e. ACTH and corticosteroids.
- f. Androgens and anabolic steroids.
- g. Drugs acting on the uterus.

#### **5. Autocoids:**

- a. Histamine, 5-HT and their antagonists
- b. Prostaglandins, thromboxane and Leukotrienes

- c. Pentagastrin, cholecystokinins, angiotensin, bradykinin and substance P.

#### Unit-IV

#### **6. Important disorders of organ system and their management:**

- a. CNS disorders: epilepsy, Parkinson's disease, Alzheimer's disease, depression, schizophrenia, migraine.  
b. Endocrine disorders: Diabetes Mellitus and thyroid disorders.  
c. Joint and connective tissue disorders: rheumatic disease, gout and hyperurricemia.

#### **PRACTICALS**

( 6 hrs / week )

1. Introduction to experimental pharmacology
2. Preparation of different solutions for experiment
3. Drug doses preparation in experimental pharmacology.
4. Common laboratory animals and anesthetics used in animal studies.
5. Demonstration of Standard techniques in pharmacology
6. Blood sampling Drug administration procedures,
7. Procedures for rendering animals unconscious, chemical euthanasia.
8. Simulation of Graded bioassay on rat ileum
9. Simulation of recording of mydriasis and miosis on rabbit eye
10. Simulation of recording of gastric motility on frog oesophagus
11. Simulation of recording of heart rate and force of contraction
12. Simulation of recording of blood pressure of dog
13. Audio visual teaching of drug evaluation on different animals:
  - 13.1. Rabbit
  - 13.2. Mice
  - 13.3. Rats

Demonstration of effect of various drugs on following pathologies using suitable animal models:

14. Inflammation
15. Epilepsy
16. Analgesia
17. Stereotypy
18. Anxiety
19. Depression
20. Stress

#### **List of Books Recommended**

##### **Text Books**

1. H. P. Rang and M M Dale, "*Pharmacology*", Churchill Livingstone.
2. Berar, F S K "Textbook of Experimental Pharmacology", Interprint, New Delhi.

##### **Reference Books**

3. Goodman and Gilman's, "*The Pharmacological Basis of Therapeutics*", Pregman Press.
4. Paul L, "*Principles of Pharmacology*", Chapman and Hall.
5. Katzung, B G, "*Basic and Clinical Pharmacology*", Prentice Hall International.
6. Ghosh, M N, "*Fundamentals of Experimental Pharmacology*", Scientific Book Agency, Calcutta.

**BPH – 6.3**

**PHARMACOGNOSY III (Phytochemistry)**

#### **THEORY**

**Lectures: 4 hrs / week**

##### **Unit - I**

1. General technique of biosynthetic studies and basic metabolic pathways like shikimic acid pathway, acetate malonate pathway and acetate mevalonate (isoprenoid) pathway. An introduction to biogenesis of secondary metabolites of pharmaceutical importance.
2. Study of chemical and spectral approaches to simple molecules belongs to class alkaloids, glycosides, terpenoids and flavonoids.
3. Glycosides- medicinal importance and structure elucidation of glycosides like sinigrin and amygdalin.

##### **Unit - II**

4. Terpenoids- structure elucidation and medicinal importance of phytoconstituent like phytol, abietic acid, zingiberene, carvone, farnesol and caryophyllene, geraniol.
5. Irridoid- Importance, isolation and biosynthesis of medicinal important irridoid like aucubin, catalpol.

##### **Unit - III**

6. Carotenoids: Introduction, isolation and structure elucidation of beta-carotene, lycopene, vitamin A, xanthophylls of medicinal importance like lutein and zeaxanthin.
7. Steroids: structure elucidation and medicinal importance of the steroidal compounds like squalene, vitamin D and cholesterol.

##### **Unit - IV**

8. Alkaloids: Structure elucidation of medicinal important alkaloids from the following class-
  - Phenylethylamine- Ephedrine
  - Pyridine- Piperine
  - Pyrrolidine-Pyridine- Atropine and related alkaloids
  - Quinoline- Quinine
  - Isoquinoline- Papaverine
  - Phenanthrene- Morphine
  - Indole- Ergot
  - Purine- caffeine
9. Flavonoids: structure elucidation and medicinal importance of flavonoids like pelargonidin, cyanidin and quercetin.

### **PRACTICALS**

1. Different methods of extraction, isolation and identification of phytoconstituents pharmaceutical importance.
2. To check the authenticity of crude drugs by UV radiation.
3. To determine the volatile oil content and extractive value of the crude drugs.
4. To perform the TLC profile of different phytoconstituents.
5. To estimate the carvone content in caraway oil.
6. To estimate the glycyrrhizic acid in liquorice root.
7. To determine the aldehyde content in lemon oil.
8. To isolate the volatile oil from the clove buds.
9. To determine the eugenol content of the volatile oil.
10. To isolate the casein from the milk and report % yield.
11. To isolate the ricinoleic acid from the castor oil.
12. To isolate the caffeine and to identify it.
13. To isolate the nicotine from tobacco leaves and to identify it.
14. To isolate the piperine from the black pepper and to identify it.
15. To isolate the hesperidin from the orange peel and to identify it.

### **List of Books Recommended**

#### *Text Books*

1. Trease, G. E. and Evans, W. C., "*Text Book of Pharmacognosy*", Bailliere Tindall, Eastbourne, U. K.
2. Tyler, V. C., Brady, L. R. and Robers, J.E., "*Text Book of Pharmacognosy*", 8<sup>th</sup> Ed. Lea and Febiger, Philadelphia..
3. Clarke, E. C. G., "*Isolation and Identification of Drugs*", The Pharmaceutical Press, London.
4. De Mayo, P., "*The Chemistry of Natural Products*", Interscience, New York.
5. Harborne J. B., "*Phytochemical Methods*", Chapman and Hall, International Edition, London..
6. Pridham, J. B. and Swain, T., "*Biosynthetic Pathways in Higher Plants*", Academic Press, New York.
7. Rosenthaler, L., "*The Chemical Investigations of Plants*", G. Bell and Sons limited., London
8. Paul m Dewick, "Medicinal Natural Products", John Wiley & Sons, NY

#### **Reference Books**

9. Manitto, P., "*The Biosynthesis of Natural products*", Ellis Horwood, Chichester
10. Peach, K., and Tracey, M. V. "*Modern methods of Plants analysis*", Narosa Publishing House, New Delhi

### **BPH – 6.4**

### **PHARMACEUTICS IX (Forensic Pharmacy)**

**Lectures = 6 hrs / week**

#### **THEORY**

#### **Unit- I**

1. A brief review of evolution of Pharmaceutical legislation in India.
2. Pharmacy Act, 1948.
3. Drugs and Cosmetics Act, 1940 and rules there under.

#### **Unit - II**

4. AICTE Act, 1987.
5. Medicinal and Toilet Preparations (Excise Duties Act), 1955.
6. Shops and Establishments Act of the state.
7. Introduction to Consumer Protection Act, 1986.

#### **Unit - III**

8. Narcotic Drugs and Psychotropic Substances Act, 1985 and rules.
9. Drugs and Magic Remedies (Objectionable Advertisements) Act, 1954.
10. DPCO, 2013.

#### **Unit - IV**

11. Pharmaceutical Ethics
12. Patents Act, 1970 and rules.
13. Introduction to Wild Life Protection Act, 1972.
14. Prevention of Cruelty to Animal Act, 1960.

**Note: The teaching of all the above acts should cover the latest amendments.**

# B.PHARM. 7<sup>TH</sup> SEMESTER

BPH – 7.1 PHARMACEUTICS X (Pharmaceutical Technology)

## THEORY

Lectures: 6 hrs / week

### Unit - I

1. **Tablets:** Types of tablets, formulation of tablets, various granulation techniques including slugging, chilsonator, extractor, Day-Nauta granulator, double cone granulator, spray granulator. Tableting machinery for production of single layer, multilayer and compression coated tablets.  
*Tablet coating:* sugar coating, film coating and compression coating, coating processes i.e. air suspension coating and pan coating (using conventional, rear vented and perforated pans).  
*Quality Control of Tablets.*

### Unit - II

2. **Capsules:** Types, material, machinery, manufacture, sizes and other pharmacopoeial requirements of capsule shells Formulation, large-scale production and quality control of *Hard* and *Soft* capsules. Applications, advantages and disadvantages of capsule dosage form.
3. **Microencapsulation:** Terminology, advantages 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 and pan coating.
4. **Aerosols:** Definitions, advantages and applications, liquified-gas system, compressed gas system, propellants, containers, valves, cold-filling process, pressure filling process and quality control of aerosols.

### Unit - III

5. **Parenterals:** Types of parenteral products and formulation considerations. *Types and Quality of Water* used in Parenterals and requirement of Clean room.  
*Production facilities*, methods of production, containers and packaging of Small Volume and Large Volume Parenterals and their *quality control*.  
Large scale production of Injectable Grade Water  
*Quality control of parenterals.*
6. **Controlled and Novel Drug Delivery:** Classification, design, development, production and evaluation of Oral and Controlled Drug Delivery Systems.

### Unit - IV

7. **Process Validation:** Process validation methods for operations involved in the production of Tablets.
8. **Scale up Techniques :** Basic Concepts, Scale up of Tablets.
9. **Radiopharmaceuticals:** Fundamentals of Radio-pharmacy, therapeutic applications of isotopes, diagnostic applications of isotopes, use of radioisotopes in basic research, product development, product production, process control and quality control.

## PRACTICALS

(06 hrs per week)

Number of experiments based on aforementioned theory

### **Books Recommended**

1. "Remington's Pharmaceutical Sciences", Mack Publishing Co., P.A.
2. Leon Lachman, H A Liberman and J L Kanig, "The Theory and Practice of Industrial Pharmacy, Lea & Febiger, Philadelphia
3. "Bentley's Textbook of Pharmaceutics", ELBS Bacilliere Tindall
4. "Modern Pharmaceutics", ed G S Banker and Rhodes, Marcel Dekker Inc., NY
5. S Turco and R E King, "Sterile Dosage Forms", Lea & Febiger, Philadelphia
6. H A Liberman, L Lachman and J B Schwartz, "Pharmaceutical Dosage Forms: Tablets", Vol. 1, Marcel Dekker Inc, NY
7. Encyclopedia of Pharmaceutical Technology by Swarbrick
8. Commercial's Hand book of Drug Laws
9. Pharmacopoeia of India.

BPH – 7.2 PHARMACEUTICAL CHEMISTRY VIII (Analytical Chemistry II)

## THEORY

Lectures: 6 hrs / week

### Unit - I

Quality Assurance: Philosophy of GLP, ISO-9000, TQM, quality Review and Quality documentation. Regulatory aspects: Legislation & regulatory control, regulatory drug analysis, interpretation of analytical data. Validation /Quality audit; Quality of equipment, Validation of equipment, Validation of analytical procedures.

**Turbidimetry and Nephelometry:** Theory of light scattering, Nephelometry, Turbidimetry for Practical Analysis of dispersions, study of the working principles of instrument used for analysis and applications in Pharmacy.

### Unit - II

The theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications of the following analytical techniques should be thoroughly studied

- Ultraviolet and Visible Spectrophotometry.
- Fluorimetry.
- Infrared spectrophotometry.

### Unit - III

The theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications of the following analytical techniques should be thoroughly studied

- Flame photometry.
- Atomic absorption spectroscopy
- Nuclear magnetic resonance spectroscopy including  $^{13}\text{C}$  NMR.
- Mass spectroscopy.

### Unit - IV

Fundamentals of Chromatography. Introduction and theory of underlying different types of chromatography techniques like- Column chromatography, thin layer chromatography, paper and circular chromatography, adsorbents and solvents used in these techniques. Gas chromatography: introduction, principles of gas chromatography, basic GLC apparatus, sample introduction, column, column efficiency, solid support, liquid phases, branches of gas chromatography, detectors, temperature effect, application of GLC in pharmaceutical analysis. HPLC: introduction and nomenclature, instrumentation, liquid solid chromatography, liquid liquid chromatography, exclusion chromatography, HPLC columns, solvent selection in HPLC, data handling in HPLC, applications of HPLC, HPTLC-instrumentation and applications..

### PRACTICALS

(6 hrs / week )

- Exercises involving UV-visible spectroscopy, fluorimetry, flame photometry, Nephelo-turbidimeter.
- IR of samples with different functional groups
- Workshop to interpret the structure of simple organic compounds using UV, IR, NMR and MS.
- Experiments based on chromatographic techniques

### List of Books Recommended

#### Text Books

- William Kemp, "Organic Spectroscopy", Macmillan Press Ltd.
- Willard, Merritt, Dean, Settle, "Instrumental Method of Analysis", CBS Publishers, New Delhi.
- K. A. Connors, "A Textbook of Pharmaceutical Analysis", Wiley Interscience, New York.

#### Reference Books

- Silverstein et al., "Spectrometric Identification of Organic Compounds".
- Skoog, "Fundamental of Analytical Chemistry".
- John R. Dyer, "Applications of Absorption Spectroscopy of Organic Compounds".

### **BPH – 7.3**

### **PHARMACOGNOSY IV**

### THEORY

Lectures: 5 hrs / week

#### Unit - I

- Role of medicinal and aromatic plants trade in national economy of a country and introduction of world-wide trade regulations of herbal products.
- Current trade status and potential of some commercially important plants like diosgenin (dioscorea), taxol (taxus sps), digitalis, vinca, papain, cinchona, ginseng and laxative plants.

#### Unit - II

- Govt and private institutions and industries working in the study, research and analysis of medicinal and aromatic plants in India.
- Traditional and recent methods of extraction of bioactive compounds alongwith their merits and demerits.

#### Unit - III

- Marine pharmacognosy: Novel medicinal agents from marine sources.
- Introduction of standardization and quality control of herbal drugs and formulations. Process of preparation of standardized extracts.

#### Unit - IV

- Historical development of plant tissue culture, types of cultures, nutritional requirements, growth and their maintenance. Application of plant tissue culture in pharmacognosy.
- Natural allergens and photosensitizing agents.

### PRACTICALS

( 6 hrs per week )

Number of experiments based on aforementioned theory and including the following:

- Isolation and analysis of some selected phytoconstituents studied in theory.
- Extraction of volatile oils and their chromatographic profiles.
- Some experiments on basic techniques of plant tissue culture.

### List of Recommended Books

1. Brain, K.R. and Turner, T.D., *"The Practical Evaluation of Phytopharmaceuticals"*, Wright Scientechica, Bristol.
2. *"Export Potential of Selected Medicinal Plants"*, Prepared by Basic Chemicals, Pharmaceuticals and Cosmetic export Promotion Council, Bombay, and other reports.
3. "Herbal Drug Industry", Eastern Publishers.
4. Pridham, J.B. and Swain, T., *"Biosynthetic Pathways in Higher Plants"*, Academic Press, New York
5. Wealth of India. Council of Scientific & Industrial Research, India.
6. *"Supplement to Cultivation and Utilization of Medicinal Plants"*, RRL, Jammu.
7. Chopra, R.N., Nayar S.L. and Chopra, I.C., *"Glossary of Indian Medicinal Plants"*, C S I R, New Delhi.
8. *"Cultivation and Utilization of Aromatic Plants"*, RRL Jammu.

### BPH – 7.4 PHARMACOLOGY IV

#### THEORY

Lectures: 5 hrs / week

#### Unit-I

1. **Introduction to Biotechnology:**
  - a. Definition, history, different branches and scope of biotechnology.
  - b. Therapeutical and pharmaceutical applications of biotechnology.
2. **Enzymes:**
  - a. Production of enzymes
  - b. Methods of immobilization of enzymes: Adsorption, entrapment, microencapsulation and covalent coupling
  - c. Analytical applications of immobilized enzymes
  - d. Enzymes used in DNA recombinant technology
  - e. Study of enzymes such as hyaluronidase, streptokinase, streptodornase, amylases and protease etc.

#### Unit-II

3. **Immunology and Immunological preparations:**

Cellular and humoral immunity, immunological tolerance, antigen-antibody reactions and their applications.
4. **Genetic engineering:**
  - a. Concept and techniques of genetic engineering (gene transfer via transduction, transformation, conjugation, protoplast fusion and gene cloning).
  - b. DNA replication, its repair and recombination.
  - c. Applications of genetic engineering for production of pharmaceuticals

#### Unit III

5. **Tissue Culture and Cell Culture Technology:**
  - a. Introduction to cell culture and culture media
  - b. Culture procedures and primary cultures
  - c. Evolution of mammalian cell lines
  - d. Cloning of cell lines
  - e. Animal tissue culture and organ culture
  - f. Embryo culture and egg culture
  - g. Culturing of human embryonic stem cells
  - h. *In vitro* fertilization in humans
6. **Biotechnology in the field of pharmacy:**
  - a. Study and production of drugs obtained from biotechnology: Erythropoietins, interferons, vaccines, anticoagulants / thrombolytic agents, monoclonal antibodies, hormones etc.
  - b. Design of drug delivery system for biotechnological products

#### Unit IV

7. **Oncogenes and Tumor Suppressor Genes:**
  - a. Viral and cellular oncogenes.
  - b. Tumor suppressor genes from humans.
  - c. Structure, function and mechanism of action of pRB and p53 tumor suppressor proteins.

### List of Books Recommended

#### *Text Books*

1. *"Biotechnology and its Applications in Pharmacy"*, CBS Publishers.
2. S P Vyas and V Dixit, *"Pharmaceutical Biotechnology"*, CBS Publishers.

#### *Reference Books*

1. B R Glick and J J Pasternak, *"Molecular Biology; The Principle and Applications of Recombinant DNA"*, ASM Press.
2. *"Harper's Review of Biochemistry"*, Lange Medical Publications.
3. Prescott and Dunn, *"Industrial Microbiology"*, Mcgraw Hill Book Company Inc.

# B.PHARM. 8<sup>TH</sup> SEMESTER

BPH – 8.1

PHARMACEUTICAL CHEMISTRY IX  
(Medicinal Chemistry II)

## THEORY

Lectures: 6 hrs / week

### Unit I

Drug metabolism. Functionization reactions (Phase I)- Oxidation, reduction and hydrolytic reactions. Conjugation reactions: Glucuronic acid conjugation, sulphate conjugation, conjugation with amino acids, glutathione conjugation, acetylation, methylation. Chemistry and principles of prodrug design. QSAR by Hansch analysis

### Unit II

Mode of action, uses, structure activity relationship including physico-chemical properties of the following classes of drugs: Drugs acting on Central nervous System: General anesthetics, Local anesthetics, Hypnotics and sedatives, opioid analgesics, antitussives, anticonvulsants, antiparkinsonian drugs, CNS stimulants, psychopharmacological agents (neuroleptics, antidepressants, anxiolytics). Steroids and related drugs: Steroidal nomenclature and stereochemistry; androgens and anabolic agents; oestrogens and parogestational agents; adrenocorticoids.

### Unit III

Chemotherapeutic agents: Antibacterials including antimetabolites. Antibiotics (b-lactams, tetracyclines, aminoglycosides, polyenes, cycloserine, chloramphenicol). Antiviral agents including anti-HIV agents, Antineoplastics, Antifungals, Antimycobacterials, Antihelmentics. Antiprotozoals. Antiseptics and disinfectants. Urinary antiseptics.

### Unit IV

Synthetic procedure for following drugs: Procaine, Lignocaine, Cinchocaine, Thiopentone, Phenobarbitone, Hexobarbitone, Diazepam, Mehtaqualone, Phenytoin, Troxidone, Pethidine, N-methylmorphine, Chlorpromazine, Trifluoperazine, Amitryptiline, Nikethamide, Cholesterol, Dihydroepiandrosterone, Oestradiol, Diethylstilbosterol, Progesterone, Cortisone acetate, Diethyl carbamazine, Thiabendazole, Sulphadiazine, Sulphamethoxazole, Trimethoprim, Chloramphenicol, Nalidixic acid, Norfloxacin, Nitorfurantoin, Isoniazid, Ethambutol, Clofazimine, Ketoconazole, Clotrimazole, Chlorambucil, Melphalan, Thio-TEPA, 5-Fluorouracil, Cisplatin.

## PRACTICALS

( 6 hrs / week )

1. Number of experiments based on QSAR
2. Synthesis of Methyl orange; Adduct of anthracene and maleic anhydride; P-nitroaceanilide; Sulfanilic acid; Sorbic acid; Mannich reaction; Methyl salicylate; Bentriazole; Benzamide; Bakelite

### List of Books Recommended

#### Text Books

1. Wilson and Gisvold's "Textbook of Organic Medicinal and Pharmaceutical Chemistry", J. Lippincot Co., Philadelphia.
2. W O Foye, "Principles of Medicinal Chemistry", Lea and Febiger, Philadelphia.

#### Reference Books

3. C. Hansch, "Comprehensive Medicinal Chemistry", Pregman Press Oxford.
4. M. E. Wolff, Ed., "Burger's Medicinal Chemistry", John Wiley & Sons, New York.
5. T. Nogardy, "Medicinal Chemistry – A Biochemical Approach", Oxford University Press, New York, Oxford.
6. B. N. Ladu, H. G. Mandel and E. L. Way, "Fundamentals of Drug metabolism and Disposition", William and Walkins Co., Preston Street, Baltimore.
7. Martindale, "The Extra Pharmacopoeia", The Pharmaceutical Press, London.

BPH – 8.2

PHARMACOLOGY V

## THEORY

Lectures: 6 hrs / week

### Unit-I

1. **Drugs acting on the Gastrointestinal Tract:**
  - a. Antacids, antisecretory and anti-ulcer drugs.
  - b. Laxative and antidiarrhoeal drugs.
  - c. Appetite stimulants and suppressants.
  - d. Emetics and anti-emetics.
  - e. Miscellaneous: carminatives, demulcents, protectives, adsorbents, astringents, digestants, enzymes and mucolytics.
2. **Pharmacology of Cardiovascular system**
  - a. Digitalis and cardiac glycosides

- b. Anti-hypertensive drugs
  - c. Anti-anginal and vasodilator drugs
  - d. Anti-arrhythmic drugs.
  - e. Anti-hyperlipidemic drugs
  - f. Drugs used in therapy of shock
- 3. Drugs acting on the urinary system**
- a. Fluid and electrolytic balance
  - b. Diuretics
- 4. Drugs acting on the Haematopoietic system**
- a. Haematinics
  - b. Anticoagulants, vitamin K and haemostatic agents
  - c. Fibrinolytic and Anti-platelet drugs
  - d. Blood and plasma volume expanders

#### Unit II

- 5. Drugs acting on the respiratory system**
- a. Anti-asthmatic drugs including bronchodilators
  - b. Anti-tussive and Expectorants
  - c. Respiratory stimulants
- 6. Chemotherapy:**
- a. General principles of chemotherapy.
  - b. Sulphonamides and co-trimoxazole.
  - c. Antibiotics, penicillins, cephalosporins, betalactamas, tetracyclines, aminoglycosides, chloramphenical, erythromycin, quinolones and miscellaneous antibiotics.
  - d. Chemotherapy of tuberculosis, leprosy, fungal diseases, viral diseases, urinary tract infections and sexually transmitted diseases.
  - e. Chemotherapy of malignancy and Immunosuppressive agents.

#### Unit III

- 7. Principles of Toxicology:**
- a. Definition of poison, general principles of treatment of poisoning with particular reference to barbiturates, opioids, organophosphorus and atropine poisoning.
  - b. Heavy metals and heavy metal antagonists
- 8. Introduction to Clinical Pharmacy.**
- 9. Therapeutic drug monitoring.**
- 10. Concept of essential drugs and rationale drug use.**
- 11. Basic concepts of Pharmacotherapy:**
- a. Clinical Pharmacokinetics and individualisation of drug therapy.
  - b. Drug delivery systems and their biopharmaceutic and therapeutic considerations.
  - c. Drug use during infancy and in the elderly (Paediatrics & Geriatrics).
  - d. Drug use during pregnancy.
  - e. Drug induced disease.
  - f. The basics of drug interactions.
  - g. General principles of clinical toxicology.
  - h. Interpretation of clinical laboratory tests.

#### Unit IV

- 12. Important disorders of organ system and their management:**
- a. Cardiovascular disorders: hypertension, congestive heart failure, angina, acute myocardial infarction and cardiac arrhythmias.
  - b. Respiratory disease: asthma.
  - c. Gastrointestinal disorders: peptic ulcer disease, ulcerative colitis, hepatitis and cirrhosis.
  - d. Haematopoietic disorders: anemias.
  - e. Infections disease: tuberculosis, urinary tract infection, enteric infections, upper respiratory infections.
  - f. Neoplastic disease: acute leukemias, Hodgkin's disease and Carcinoma of breast.

#### **PRACTICALS**

**(6 hrs / week )**

#### **Demonstration of effect of various drugs on following pathologies using suitable animal models:**

1. Stress
2. Alzheimer's disease
3. Parkinson's disease
4. Diabetes
5. Diarrhoea
6. Hypertension

#### **Demonstration of techniques and equipments utilized in pharmacological Research**

7. Microtome
8. Langendorff's apparatus
9. Autoanalyzer
10. Electrophoresis
11. Neurotransmitter estimation

12. Estimation of Oxidative stress

#### **Demonstration of Bioassay procedures**

13. matching bioassay
14. bracketing bioassay
15. interpolation bioassay
16. 4 point bioassay
17. pA2 determination
18. pD2 determination
19. Delineation of mechanism of action by drug antagonism
20. Delineation of mechanism of action by drug agonism

#### **Simulations on pharmacological experimentation**

#### **Alternatives to Animal Experimentation**

To demonstrate the procedures for recording the effects of self chosen placebos or samples on human behaviors:

21. anxiety
22. sedation
23. Analgesia
24. Skin irritation
25. inflammation

#### **List of Books Recommended**

##### **Text Books**

1. Katzung, B G, "*Basic and Clinical Pharmacology*", Prentice Hall International
2. *Davidson's Principles and Practice of Medicine*", Churchill Livingstone

##### **Reference Books**

3. Goodman and Gilman's, "*The Pharmacological Basis of Therapeutics*", Pregman Press.
4. Paul L, "*Principles of Pharmacology*", Chapman and Hall.
5. H. P. Rang and M M Dale, "*Pharmacology*", Churchill Livingstone..
6. Herfindal E T and Hirschman, J L, "*Clinical Pharmacy and Therapeutics*", Williams and Willkins.
7. Dipiro, J L, "*Pharmacotherapy: A Pathophysiological Approach*", Elsevier.
7. Laurence, D R and Bennet, P N, "*Clinical Pharmacology*", Churchill Livingstone."

**BPH – 8.3**

**PHARMACEUTICS XII**

**(Biopharmaceutics)**

#### **THEORY**

**Lectures: 6 hrs / week**

##### **Unit - I**

1. Introduction to Biopharmaceutics and Pharmacokinetics and their role in formulation development and clinical setting.
2. Passage of drugs across biological barrier (passive diffusion, active transport, facilitated diffusion and pinocytosis).
3. Factors influencing absorption-physiochemical, physiological and pharmaceutical.
4. Drug distribution in the body, barriers to distribution of drugs in the body.
5. Models in Biopharmaceutics – Introduction to compartment models, non-compartmental models, physiological models and pharmacological models.

##### **Unit - II**

6. One compartmental kinetics – determination of various pharmacokinetic parameters, such as K, t<sub>1/2</sub>, V<sub>d</sub>, etc., after drug administration by intravascular route and oral route, from plasma and urine data. Significance of plasma drug concentration measurements and various pharmacokinetic parameters as above. Application of method of residuals in compartmental kinetics.
7. Two compartmental kinetics – determination of various pharmacokinetic parameters, such as K, t<sub>1/2</sub>, V<sub>d</sub>, etc., after drug administration by intravascular route and oral route, from plasma and urine data. Significance of plasma drug concentration measurements and various pharmacokinetic parameters as above. Application of method of residuals in compartmental kinetics. Application of Wagner nelson method and Loo-Riegelmann method.
8. Pharmacokinetics of drug administration by slow intravenous infusion route.
9. Multiple dosage regimen – oral and iv route. Principle of superposition.

##### **Unit - III**

10. Binding of drugs to plasma proteins, kinetics of plasma protein binding, plasma protein binding displacement interactions.
11. Metabolism of drugs : Hepatic metabolism of drugs, first pass effect, extraction ratio, biliary excretion of drugs, enterohepatic circulation.

12. Elimination of drugs : Renal and non-renal excretion of drugs, concept of clearance, renal clearance.
  13. Non-linear pharmacokinetics with special reference to one compartment model after I.V. drug administration, Michaelis Menten equation, determination of non-linearity (saturation mechanism).
- Unit - IV**
14. Non-linear pharmacokinetics with special reference to one compartment model after I.V. drug administration, Michaelis Menten equation, determination of non-linearity (saturation mechanism).
  15. Adjustment of dosage regimen in patients of renal failure.
  16. Introduction to pharmacokinetic drug interactions and their significance in combination therapy.
  17. Bioavailability and bioequivalence. Measures of bioavailability – C<sub>max</sub>, t<sub>max</sub> and Area under the curve, AUC. Design of single dose bioequivalence study. Overview of regulatory requirements for bioavailability and bioequivalency.

## PRACTICALS

(6 hr / wk )

Number of experiments based on aforementioned theory topics, should be conducted.

### List of Books Recommended

#### Text Books

1. L Shargel and B C Andrew, "*Applied Biopharmaceutics and Pharmacokinetics*", Prentice Hall International, USA.
2. Brahmanekar, CBS Publishers

#### Reference Books

3. J G Wagner, "*Fundamental of Clinical Pharmacokinetics*", Drug Intelligence Publications, Hamilton.
4. R E Notari, "*Biopharmaceutics and Pharmacokinetics- an Introduction*", Marcel Dekker Inc, NY
5. Sarfaraz Niazi, "*Textbook of Biopharmaceutics and Clinical Pharmacokinetics*", Appelton – Century Crofts, New York.
6. M Gibaldi and D Parrier, "*Pharmacokinetics*", Marcel Dekker Inc, NY
7. J G Wagner, "*Pharmacokinetics for the Pharmaceutical Scientist*", Technomic Publishing A G Basel, Switzerland.
8. Milo Gibaldi, "*Biopharmaceutics and Clinical Pharmacokinetics*", Lea and Fibiger, Philadelphia.

**BPH – 8.4**

**PHARMACEUTICS XIII**

**(Pharmaceutical Packaging)**

## THEORY

**Lectures: 4 hrs / week**

### Unit - I

1. **Introduction:** Purpose of packaging, selection of the ideal package, hazards encountered by the package, various types of inner and outer packages, selection of a suitable package .
2. **Child resistant package** and **Tamper Evident Packaging**.
3. **Packaging materials:** Detailed study with regard to composition packaging characteristics, advantages, economics and limitations of various packaging materials with special emphasis on glass, plastics, metals and rubber. Evaluation of packaging materials.
4. **Environmental considerations of packaging**

### Unit - II

5. Production of **oriented** and **non-oriented films** and **laminates**.
6. **Strip Packing:** Significance of Strip Packing, advantages, economics and limitation of Strip Packing, Strip Packing machinery, films employed in Strip Packing (including composites and laminates) and evaluation of films and strips packs.
7. **Blister Packaging:** Blister packing materials, significance of Blister packing, advantages, economics and limitation of blister packing, blister packing machinery, various types of blister packages, evaluation of blister package.
8. **Pouch packaging:** Materials used, advantages, economics and limitation of pouch packing, pouch packing machinery, spectrum of applications, evaluation of pouch packing.

### Unit - III

6. **Liquid Formulation Packaging:** Various containers/closures employed for liquid formulations. Machinery employed for liquid filling – constant level, volumetric, gravimetric etc. Evaluation of liquid formulation packages.
7. **Semi-Solid Packaging:** Various types of containers/packages used for semi-solid products, filling and sealing machinery (including collapsible tube filling and sealing machine) merits and limitations of various packages, evaluation of semi-solid product package.
8. **Labelling:** Types of label (including Bar code, RF, structured program, in- mould and decorative labeling), Legal requirements of Labelling, packaging inserts and outserts. Adhesives and machinery employed for labelling. Concept of paperless labeling.

#### Unit - IV

9. **Sterile Product Packaging:** General principles of packaging of sterile products. Various types of containers used for sterile products including small volume and large volume parenterals. Types of closures used for the sterile products. Sterile product filling and sealing machinery i.e. ampoule filling and sealing machine. Limitations and merits of various packages. Evaluation of the sterile product packages

#### Books Recommended

1. Al Brody & K S Marsh, *"The Wiley Encyclopedia of Packaging Technology"*, John Wiley & Sons, New York
2. Leon Lachman, H A Liberman and J L Kanig, *"The Theory and Practice of Industrial Pharmacy"*, Lea & Febiger, Philadelphia
3. Deans .
4. Sanju Nanda, Rakesh Pahwa and Arun Nanda. "Pharmaceutical Packaging Technology, New Age Publications, New Delhi.
5. T C KacChesney, *"Packaging of Cosmetics and Toiletries"*, Newness- Butterworth, London
6. *"Remington' Pharmaceutical Sciences"*, Mack Publishing Co., P.A