

**B. Pharmacy Part-I (RS) 2002-2003**  
**Courses of study for B. Pharmacy Part-I (Revised scheme)**

S.N.	Subject to be taught	Teaching Load Theory (Hours/week)	Teaching Load Practicals (Hours/week)
1.	PHARMACEUTICAL CHEMISTRY-I (Pharmaceutical organic chemistry)	03	03
2.	PHARMACEUTICAL MATHEMATICS	03	----
3.	PHARMACOGNOSY-I	02	03
4.	PHARMACEUTICAL CHEMISTRY-II (Pharmaceutical Inorganic Chemistry)	02	03
5.	PHARMACEUTICS-I (Dispensing and hospital Pharmacy)	02	03
6.	PHARMACEUTICS-II (General Pharmacy)	02	03
7.	PHARMACOLOGY-I (Anatomy, Physiology & Health Education)	03	03
8.	REMEDIAL BIOLOGY (For Candidates having only Mathematics at 10+2 level)	02	02
	Total	----- 19 -----	----- 20 -----

**B. Pharmacy Part – II (Revised Scheme) 2003-04**  
**Course of study for B.Pharmacy Part –II (Revised Scheme)**

S.N.	Subject to be taught	Teaching Load Theory (Hours/week)	Teaching Load Practical (Hours/week)
9.	PHARMACEUTICS-III (Pharmaceutical Engineering-I)	03	--
10.	PHARMACEUTICS-IV (Pharmaceutical Engineering Drawing)	--	03
11.	PHARMACEUTICS-V (Pharmaceutical Microbiology)	02	03
12.	COMPUTER SCIENCE	02	03
13.	PHARMACEUTICAL CHEMISTRY – III (Pharmaceutical Biochemistry)	02	03
14.	PHARMACEUTICAL CHEMISTRY – IV (Pharmaceutical Physical Chemistry)	02	03
15.	<u>PHARMACEUTICAL CHEMISTRY - V</u> (Pharmaceutical Analysis -I)	03	03
16.	PHARMACOGNOSY-II	02	03
17.	PHARMACEUTICAL CHEMISTRY-VI (Heterocyclic compounds and Natural products)	02	---
	Total	16	21

**B. Pharmacy Part – III (Revised Scheme) 2003-04**  
**Course of study for B.Pharmacy Part –III (Revised Scheme)**

S.N.	Subject to be taught	Teaching Load Theory Lecturers (hours/week)	Teaching Load Practical (hours/week)
18.	PHARMACEUTICS -VI (Physical Pharmacy)	02	03
19.	PHARMACEUTICS-VII (Pharmaceutical Engineering)	02	03
20.	PHARMACEUTICS-VIII (Dosage Form Design)	03	03
21.	PHARMACEUTICS -IX (Forensic Pharmacy)	02	--
22.	PHARMACEUTICAL CHEMISTRY-VII (Medicinal chemistry-I)	02	03
23.	PHARMACOLOGY- II	03	03
24.	PHARMACOLOGY-III (Pharmaceutical Biotechnology)	02	--
25.	PHARMACOGNOSY-III	02	03
	Total	18	18

**B. Pharmacy Part – IV (Revised Scheme) 2003-04**  
**Course of study for B.Pharmacy Part –IV (Revised Scheme)**

S.N.	Subject to be taught	Teaching Load Theory (hours/week)	Teaching Load Practical (hours/week)
26.	PHARMACEUTICS-X (Biopharmaceutics and Pharmacokinetics)	02	04
27.	PHARMACEUTICS-XI (Pharmaceutical Technology)	03	03
28.	PHARMACEUTICS-XII (Pharmaceutical Management)	02	--
29.	PHARMACEUTICS-XIII (Packaging Technology)	02	--
30.	PHARMACEUTICAL CHEMISTRY-VIII (Medicinal Chemistry-II)	03	03
31.	PHARMACOLOGY- IV	02	04
32.	<u>PHARMACEUTICAL CHEMISTRY-IX</u> (Pharmaceutical Analysis-II)	03	03
33.	PHARMACOGNOSY-IV	02	03
	Total	19	20

**Examination of B. Pharmacy Part-I (RS) 2002-2003**

S.N.	Subject to be taught	Total marks for Theory examination including sessional	Total marks for Practical examination including sessional
1.	PHARMACEUTICAL CHEMISTRY-I (Pharmaceutical organic chemistry)	100	100
2.	PHARMACEUTICAL MATHEMATICS	100	-----
3.	PHARMACOGNOSY-I	100	100
4.	PHARMACEUTICAL CHEMISTRY-II (Pharmaceutical Inorganic Chemistry)	100	100
5.	PHARMACEUTICS-I (Dispensing and hospital Pharmacy)	100	100
6.	PHARMACEUTICS-II (General Pharmacy)	100	100
7.	PHARMACOLOGY-I (Anatomy, Physiology & Health Education)	100	100
8.	REMEDIAL BIOLOGY (For Candidates having only Maths at 10+2 level)	100	100
	Total	----- 800 -----	----- 700 -----

**Examination of B.Pharmacy Part –II (Revised Scheme)**

S.N.	Subject to be taught	Total marks for Theory examination including sessional	Total marks for practical examination including sessional
9.	PHARMACEUTICS-III (Pharmaceutical Engineering-I)	100	---
10.	PHARMACEUTICS-IV (Pharmaceutical Engineering Drawing)	---	100
11.	PHARMACEUTICS-V (Pharmaceutical Microbiology)	100	100
12.	COMPUTER SCIENCE	100	100
13.	PHARMACEUTICAL CHEMISTRY – III (Pharmaceutical Biochemistry)	100	100
14.	PHARMACEUTICAL CHEMISTRY – IV (Pharmaceutical Physical Chemistry)	100	100
15.	<u>PHARMACEUTICAL CHEMISTRY – V</u> (Pharmaceutical Analysis –I)	100	100
16.	PHARMACOGNOSY-II	100	100
17.	PHARMACEUTICAL CHEMISTRY-VI (Heterocyclic compounds and Natural products)	100	---

**Examination of B.Pharmacy Part –III (Revised Scheme)**

S.N.	Subject to be taught	Total marks for Theory examination including sessional	Total marks for practical examination including sessional
18.	PHARMACEUTICS -VI (Physical Pharmacy)	100	100
19.	PHARMACEUTICS-VII (Pharmaceutical Engineering)	100	100
20.	PHARMACEUTICS-VIII (Dosage Form Design)	100	100
21.	PHARMACEUTICS -IX (Forensic Pharmacy)	100	----
22.	PHARMACEUTICAL CHEMISTRY-VII (Medicinal chemistry-I)	100	100
23.	PHARMACOLOGY- II	100	100
24.	PHARMACOLOGY-III (Pharmaceutical Biotechnology)	100	----
25.	PHARMACOGNOSY-III	100	100

**Examination of B.Pharmacy Part –IV (Revised Scheme)**

S.N.	Subject to be taught	Total marks for Theory examination including sessional	Total marks for practical examination including sessional
26.	PHARMACEUTICS-X (Biopharmaceutics and Pharmacokinetics)	100	100
27.	PHARMACEUTICS-XI (Pharmaceutical Technology)	100	100
28.	PHARMACEUTICS-XII (Pharmaceutical Management)	100	--
29.	PHARMACEUTICS-XIII (Packaging Technology)	100	----
30.	PHARMACEUTICAL CHEMISTRY-VIII (Medicinal Chemistry-II)	100	100
31.	PHARMACOLOGY- IV	100	100
32.	<u>PHARMACEUTICAL CHEMISTRY-IX</u> (Pharmaceutical Analysis-II)	100	100
33.	PHARMACOGNOSY-IV	100	100



**B. Pharmacy Part-I (RS) 2002-2003**  
**Scheme of examination for B. Pharmacy Part-I (Revised scheme)**

S.N.	Subject	Duration of Examination		Theory & Practical Max. Marks	
		Theory	Practical	Annual	Sessional
1.	PHARMACEUTICAL CHEMISTRY-I (Pharmaceutical organic chemistry)	03	03	80	20
2.	PHARMACEUTICAL MATHEMATICS	03	----	80	20
3.	PHARMACOGNOSY-I	03	03	80	20
4.	PHARMACEUTICAL CHEMISTRY-II (Pharmaceutical Inorganic Chemistry)	03	03	80	20
5.	PHARMACEUTICS-I (Dispensing and hospital Pharmacy)	03	04	80	20
6.	PHARMACEUTICS-II (General Pharmacy)	03	04	80	20
7.	PHARMACOLOGY-I (Anatomy, Physiology & Health Education)	03	04	80	20
8.	REMEDIAL BIOLOGY (For Candidates having only Maths at 10+2 level)	03	03	80	20

**B. Pharmacy Part – II (Revised Scheme) 2003-04**  
**Scheme of Examination for B.Pharmacy Part –II (Revised Scheme)**

S.N.	Subject to be taught	Duration of Examination		Theory and Practical Max. Marks	
		Theory	Practical	Annual	Sessional
9.	PHARMACEUTICS-III (Pharmaceutical Engineering-I)	03	-----	80	20
10.	PHARMACEUTICS-IV (Pharmaceutical Engineering Drawing)	-----	03	80	20
11.	PHARMACEUTICS-V (Pharmaceutical Microbiology)	03	06	80	20
12.	COMPUTER SCIENCE	03	03	80	20
13.	PHARMACEUTICAL CHEMISTRY – III (Pharmaceutical Biochemistry)	03	04	80	20
14.	PHARMACEUTICAL CHEMISTRY – IV (Pharmaceutical Physical Chemistry)	03	03	80	20
15.	<u>PHARMACEUTICAL CHEMISTRY - V</u> (Pharmaceutical Analysis -I)	03	04	80	20
16.	PHARMACOGNOSY-II	03	03	80	20
17.	PHARMACEUTICAL CHEMISTRY-VI (Heterocyclic compounds and Natural products)	03	----	80	20

**B. Pharmacy Part – III (Revised Scheme) 2003-04**  
**Scheme of Examination for B.Pharmacy Part –III (Revised Scheme)**

S.N.	Subject to be taught	Duration of Examination		Theory and Practical Max. Marks	
		Theory	Practical	Annual	Sessional
18.	PHARMACEUTICS -VI (Physical Pharmacy)	3	4	80	20
19.	PHARMACEUTICS-VII (Pharmaceutical Engineering)	3	4	80	20
20.	PHARMACEUTICS-VIII (Dosage Form Design)	3	4	80	20
21.	PHARMACEUTICS -IX (Forensic Pharmacy)	3	---	80	20
22.	PHARMACEUTICAL CHEMISTRY-VII (Medicinal chemistry-I)	3	4	80	20
23.	PHARMACOLOGY- II	3	6	80	20
24.	PHARMACOLOGY-III (Pharmaceutical Biotechnology)	3	--	80	20
25.	PHARMACOGNOSY-III	3	3	80	20

**B. Pharmacy Part – IV (Revised Scheme) 2003-04**  
**Scheme of Examination for B.Pharmacy Part –IV (Revised Scheme)**

S.N.	Subject to be taught	Duration of Examination		Theory and Practical Max. Marks	
		Theory	Practical	Annual	Sessional
26.	PHARMACEUTICS-X (Biopharmaceutics and Pharmacokinetics)	03	06	80	20
27.	PHARMACEUTICS-XI (Pharmaceutical Technology)	03	06	80	20
28.	PHARMACEUTICS-XII (Pharmaceutical Management)	03	--	80	20
29.	PHARMACEUTICS-XIII (Packaging Technology)	03	--	80	20
30.	PHARMACEUTICAL CHEMISTRY-VIII (Medicinal Chemistry-I)	03	06	80	20
31.	PHARMACOLOGY- IV	03	06	80	20
32.	<u>PHARMACEUTICAL CHEMISTRY-IX</u> (Pharmaceutical Analysis-II)	03	06	80	20
33.	PHARMACOGNOSY-IV	03	04	80	20

## B. Pharmacy Part- I

### PHARMACEUTICAL MATHEMATICS

Theory

Total Lectures: 75

#### Section-A

1. Algebra: revision on equation reducible to quadratics and simultaneous equations (linear and quadratics) up to two variables only.  
Determinants and their six important properties, solutions of simultaneous equations by Cramer's rule. Matrices, definition of special matrices (like unit, singular, diagonal matrices etc.), arithmetic operations on matrices, transpose, adjoint reciprocal and inverse of a matrix, solutions of simultaneous equations using matrices. Partial fractions and resolution of linear and quadratic (non-reported) partial functions. Evaluation of  $E_n$ ,  $E_n^2$  and  $E_n^3$ , pharmaceutical applications. [10]
2. Trigonometry: revision on angle measurement and T-ratios, addition, subtraction and transformation formulae, T-ratio of multiple, sub multiple and allied angles, solution of simple trigonometric identities based on above concepts, pharmaceutical applications of logarithms. [8]
3. Analytical plane geometry: Cartesian co0ordinates, distance between two points, area of triangle, locus of a point, straight line, slope and intercept form, general equation of first degree. [7]

#### Section-B

4. Calculus: [20]
  - A. Differential: limits and functions, differential coefficient, differentiation of standard functions, including function of a function (chain rule), differentiation of implicit functions, logarithmic differentiation, parametric differentiation, elements of successive differentiation.
  - B. Integral: integration as inverse of differentiation, indefinite integrals of standard forms, integration by parts, by partial fractions and by substitution, formal evaluation of definite integrals.
5. Differential equations: definition and formation of ordinary differential equations of first order and first degree, variable separable, homogeneous equations, linear equations (Liebnitz form) and differential equations reducible to these types. Linear differential equations of order greater than one with constant coefficients, complementary function and particular integrals of  $e^x$ ,  $X \sin(ax + b)$  or  $\cos(ax + b)$  types of functions, solution of simple simultaneous linear differential equations. Pharmaceutical applications. [5]
6. Laplace transforms: definition, properties, of linearity and shifting, transforms of elementary function (without proof) and inverse laplace transforms not involving

Euler's theorem, transforms of derivatives, solutions of ordinary and simultaneous differential equations. [5]

### Section-C

7. Pharmaceutical statistics: concept, mathematical computations (wherever applicable) and pharmaceutical applications (wherever possible) on: [20]
- 7.1 Significant digits and routing of numbers, collection of primary and secondary data through experiments or surveys sampling and complete enumeration survey, merits and limitations of various random and non-random sampling methods, data organization including frequency distributions and tabulation, diagrammatic representation of data, simple multiple, sub-divided and floating bar diagrams, pie diagrams, 2-D and 3-D pictorial representation, graph of frequency distribution.
- 7.2 Measures of central tendency, ideal characteristics, mean, median, mode, GM, HM and weighted arithmetic mean from discrete and continuous frequency distributions, quartiles, deciles, and percentiles, measures of dispersion, range, quartile deviation, mean deviation, standard deviation, calculation of standard deviation from discrete and continuous frequency distributions, standard error of means, coefficients of variation.
- 7.3 Probability and events, Bayes theorem, probability theorems, probability distributions, elements of binomial and Poisson distributions, normal distribution, normal distribution curves, and properties, calculation of areas under normal curve and standard normal curve (Z statistics), confidence limits, deviations from normality, Kurtosis and skewness, elements of central limit theorem.
- 7.4 Linear correlation and regression analysis scatter plots, methods of least squares, Pearsonian coefficients of correlation and determination, definitions of amount of explained variance, standard error of estimates and significance of regression (F).
- 7.5 Statistical inference, type I and II errors, t- test (paired and unpaired).

### List of Books Recommended

#### Text Books

- 1) T. W. Hungerford, "*Algebra*".
- 2) S. T. Rizvi, "*Algebra and Its Applications*".
- 3) Leithold, "*The Calculus*", Harper and Row.
- 4) John E. Freund, "*Mathematical Statistics*".
- 5) Bradley and Smith, "*Calculus*", Prentice hall.

#### Reference Books

- 6) D. C. Montgomery, "*Applied Statistics and Probability for Engineers*"
- 7) N. Piskunov, "*Differential and Integral Calculus, Vol. II*"
- 8) Bauer, "*Probability Theory*"
- 9) W. E. Fitzgibbon III, "*Partial Differential Equations and Dynamical Systems*", Pitman Advanced Publishing Program.

# PHARMACOGNOSY-I

## THEORY

Total Lectures: 50

### Section-A

1. Definition, history, scope and development of Pharmacognosy. [2]
2. Sources of drugs: biological, marine, geographical and plant tissue cultures as sources of drugs. [2]
3. Classification of drugs alphabetical, morphological, taxonomical, pharmacological, chemical and others with their merits and demerits. [2]
4. Plant taxonomy: study of the following families with special reference to medicinally important plants- Apocynaceae, Solanaceae, Rutaceae, Umbelliferae, Leguminosae, Rubiaceae, Liliaceae, Graminae, Labiate, Cruciferae, Papaveraceae. [6]
5. Cultivation, collection, processing and storage of crude drugs: factors influencing cultivation of medicinal plants, types of soils and fertilizers of common use, pest management and natural pest control agents, plant hormones and their applications, Polyploidy, mutation and hybridization with reference to medicinal plants. [5]
6. Quality control of crude drugs: Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical, and biological methods of evaluations. [6]

### Section-B

7. An introduction to active constituents of drugs: their isolation, classification and properties. [3]
8. Systematic pharmacognostic study of the following: (A.) Carbohydrates and derived products: Agar, Gaur gum, Gum acacia, Honey, Isabgol, Pectin, Starch, Stercullia and Tragacanth. (B.) Lipids: Bees wax, Castor oil, Cocoa butter, Cod liver oil, Hydnocarpus oil, Kokum butter, Lard, Linseed oil, Rice bran oil, Shark liver oil and Wool fat. [8]
9. Study of drugs containing resins and resin combinations: colophony, Podophyllum, Jalap, Cannabis, Capsicum, Myrrh, Asafoetida, Balsam of tolu, Balsam of peru, Benzoin, Turmeric, Ginger. [4]
10. Volatile oil: General methods of obtaining volatile oils from plants, study of volatile oils of Mentha, Coriander, Cinnamon, Cassia, Lemon peel, Orange peel, Lemon grass, Citronella, Caraway, Cumin, Dill, Spearmint, Clove, Fennel, Nutmeg, Eucalyptus, Chenopodium, Cardamom, Valerian, Musk, Palmarosa, Gaultheria, Sandal wood. [8]
11. Study of pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatin, and natural colorants. [4]

## PRACTICALS

Number of practicals based on aforementioned theory portion and including the following:

1. Morphological characteristics of plant families mentioned in theory.
2. Microscopic measurements of cells and cell contents: starch grains, calcium oxalate crystals and phloem fibers.

3. Determination of leaf constants such as stomatal index, stomatal number, vein-islet number, vein termination number and palisade ratio.
4. Identification of crude drugs mentioned in theory.

### **List of Books Recommended**

#### **Text 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*".

#### **Reference Books**

7. Clarke, E. C. G., "*Isolation and Identification of Drugs*", the Pharmaceutical Press, London.
8. Fahn, A., "*Plant Anatomy*", Pergamon Press, Oxford
9. Jean Brunton, "*Text Book of Pharmacognosy, Phytochemistry and Medicinal Plants*", Intercept Limited, Andover, England, U.K.

## **PHARMACEUTICAL CHEMISTRY- II (PHARMACEUTICAL INORGANIC CHEMISTRY)**

### **THEORY**

Total Lectures: 50

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.

#### **Section-A**

1. Acids and bases: Buffers, water. [3]
2. Gastrointestinal agents: acidifying agents, antacids, protectives and adsorbents, cathartics. [4]
3. Major extra and intra cellular electrolytes: physiological anions, electrolytes used for replacement therapy, acid base balance and combination therapy. [4]
4. Essential and trace elements: transition elements and their compounds of pharmaceutical importance: iron and haematinics, mineral supplements. [4]
5. Cationic and anionic compounds of inorganic drug useful for systemic effects. [3]
6. Topical agents: protectives, astringents and anti-infectives. [5]



## Section-B

7. Gases and vapours: oxygen, anesthetics and respiratory stimulants. [4]
8. Dental products: dentifrices, anti-caries agent. [3]
9. Complexing and chelating agents used in therapy. [3]
10. Miscellaneous agents: sclerosing agents, expectorants, emetics, poisons and antidotes, sedatives etc. [5]
11. Pharmaceutical aids used in pharmaceutical industry: antioxidants, preservatives, filter aids, adsorbents, diluents, excipients, suspending agents, colorants etc. [6]
12. 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. [6]

## PRACTICALS

The background and systemic qualitative analysis of inorganic mixtures up to 4 radicals. Six mixtures to be analyzed, preferably by semi-micro methods.

All identification tests for pharmaceutical, inorganic pharmaceutical and qualitative tests for cations and anions as included in the appendix of IP should be carried out.

## 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”*.

## PHARMACOLOGY-I (Anatomy, Physiology & Health Education)

### THEORY

Total Lectures: 75.

#### Section-A

1. Scope of anatomy, physiology and basic terminology used in these subjects. [2]
2. Structure of cell, its components and their function. [3]
3. Elementary tissues of the human body: epithelial, connective, muscular and nervous tissue, their sub-types and characteristics. [4]
4. Osseous system: structure, composition and functions of skeleton, classification of joints, types of movements at joints, disorders of joints. [3]
5. Skeletal muscles: Their gross anatomy, physiology of muscle, contraction, physiological properties of skeletal muscles and their disorders. [3]
6. Haemopoietic system: Composition and function of blood and its elements, their disorders, blood groups, and their significance, mechanism of coagulation, disorders of platelets and coagulation. [3]

7. Lymph and lymphatic system: Composition, formulation and circulation of lymph, disorders of lymph and lymphatic system, basic physiology and functions of spleen. [2]
8. Cardiovascular system: Basic anatomy of the heart, physiology of the 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 infraction, congestive heart failure and cardiac arrhythmias. [4]

### **Section-B**

9. 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. Disorders of digestive system. [5]
10. Respiratory system: Anatomy of respiratory organs, functions of respiration mechanism and regulation of respiration, respiratory volumes and vital capacity. [5]
11. 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. [6]
12. Autonomic nervous system: Physiology and functions of the autonomic nervous system. Mechanism of neurohumoral transmission in the autonomic nervous system. [3]
13. 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. [4]
14. 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. [5]
15. Endocrine system: basic anatomy and physiology of pituitary, thyroid, parathyroid, adrenals, pancreas, testes and ovary, their hormones and functions. [4]
16. Sense organs: Basic anatomy and physiology of the eye (vision), ear (hearing), taste buds, smell and skin (superficial receptors). [7]

### **Section-C**

17. Health Education: [15]
  - A.) Concepts of health & disease, disease causing agents and prevention of disease.
  - B.) Classification of food requirements, balance diet, nutritional deficiency disorders, their treatment and prevention, specification of drinking water.
  - C.) Demography and family planning: Demography cycle, family planning, and various contraceptive methods. Medical termination of pregnancy.
  - D.) 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).

E.) First aid: emergency treatment of shock, snakebites, burns, poisoning, fractures and resuscitation methods.

#### PRACTICALS

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 Willkins, Baltimore.
7. B D Chaurasia, "*Human Anatomy*", CBS Publishers and Distributors, New Delhi.

## REMEDIAL BIOLOGY

#### THEORY

Total Lectures: 50

1. Methods of classification of plants. [10]
2. Plant cell: its structure and non-living inclusions, mitosis and meiosis, different types of plant tissues and their functions. [10]
3. Morphology and histology of root, stem, bark, wood, leaf, flower, fruit and seed. Modification of root and stem. [10]
4. General survey of animal kingdom, structure and life history of parasites as illustrated by amoeba, trypanosoma, plasmodium, taenia, ascaris. [10]
5. General structure and life history of insects like mosquito, houseflies and silkworm. [10]

## PRACTICAL

1. Morphology of plant parts indicated in theory.
2. Care, use and type of microscope.
3. Gross identification of slides of structures and life cycle of lower plants/animals mentioned in theory.
4. Preparation, microscopic examination of stem, root and leaf of monocot and dicot leaf.
5. Structure of human parasite and insects 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.

### **Reference Books**

5. Clarke, E. C. G., "*Isolation and Identification of Drugs*", The Pharmaceutical Press, London.
6. Irwin P., "*Plant Physiology*", Addison Wesley Publishing Co., London.
7. Scott F. Gilbert, "*Developmental Biology*", Sinauer Associates, Inc. Publisher, Sunderland.
8. Edward O. Wilson, "*Life: Cells, Organisms, Populations*", Sinauer Associates, Inc. Publisher, Sunderland

## PHARMACEUTICAL CHEMISTRY – I **(Pharmaceutical Organic Chemistry)**

### THEORY

Total Lectures: 75.

#### **Section-A**

1. 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. [10]
2. Stereochemistry: introduction, optical activity, stereoisomerism, specifications of configuration, reactions involving stereoisomers. [15]

#### **Section-B**

3. 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, carbauions, aldol condensation, claisen condensation, malonic esters and acetoacetic ester synthesis. [35]
4. Nucleophilic aromatic substitutions: unsaturated carbonyl compounds.

Electro cyclic reactions, sigmatropic reactions, neighbouring gp. Effects. Catalysis by transition metal complexes, Stereoselective and Stereospecific reactions. New organic reagents used drug synthesis. [15]

#### PRACTICALS

1. Synthesis of selected organic compounds.
2. Identification of organic compounds and their derivatisations.
3. Introduction to the use of stereomodels.

#### **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

## **PHARMACEUTICS-I** **(Dispensing and Hospital Pharmacy)**

THEORY

Total Lectures: 50 hrs.

Pharmaceutical Dispensing

#### **Section-A**

1. Definitions and General Dispensing Procedures [1]
2. Sources of information required for Pharmacists [1]
3. Types of Dispensed products [2]
4. Containers, closures and labelling for dispensed products [3]
5. Sources of error and care required in dispensing prescriptions [1]
6. Principles involved and procedures adopted in dispensing of typical preparations like mixtures, solutions, emulsion, creams, ointments, powders, pastes, jellies, suppositories, ophthalmics, pastilles, lozenges, pills, lotions, liniments, inhalations, paints, sprays etc. [8]

### Section-B

7. Incompatibilities-physical and chemical, occurrence and methods adopted in corrections. [3]
8. Colours, flavours, sweeteners and other additives used in prescriptions [2]
9. Pharmaceutical Latin-Latin terms used in prescriptions and their English equivalents [1]
10. Pharmaceutical Calculations- calculation of doses, enlarging and reducing recipes, percentage solutions, alligation, alcohol dilutions, proof spirit, isotonic solutions, displacement value etc. [8]

### Section-C

11. Hospital and its organisation [20]
  - 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) Dispensing of controlled drugs
  - h) Drug charges
  - i) Pre-packaging
  - j) Central sterile supply
  - k) Drug information centre
  - l) Maintenance of records
  - m) Safe use of medicines
  - n) Professional practices

PRACTICAL: 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

# PHARMACEUTICS-II

## (General Pharmacy)

THEORY

Total Lectures: 50

### Section-A

**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. [6]

**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. [12]

**3. Glandular Products:** Introduction, extraction methods and preparation of thyroid, liver, pancreas and pituitary gland. [5]

### Section-B

**4. 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, Botulinum antitoxins), brief control of immunological products-identification tests, toxicity tests, sterility tests, potency tests and storage of immunological products. [12]

**5. 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. [5]

**6. Surgical dressings:** like fibres, fabrics, bandages, surgical ligatures and sutures i.e. catgut and other absorbable and non-absorbable products [5]

**7. 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 [5]

**PRACTICALS:** 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' 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.



## B. Pharmacy Part-II

### PHARMACEUTICS-III (Pharmaceutical Engineering-I)

#### THEORY

Total Lectures: 75

**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 [12]

**Heat Transfer:** Modes of heat transfer, Fourier's law, overall heat transfer coefficient, Stefan-Boltzmann's law, single pass heater, multipass heater, liquid-liquid heat interchanger and finned tubes. [7]

**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 [10]

**Drying:** Theory, behaviour of solids during drying, static bed dryers, moving bed dryers, fluidised bed dryer and pneumatic bed dryers. [13]

**Centrifugation:** theory, industrial centrifugal filters and industrial centrifugal sedimenters [5]

**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. [8]

**Humidification, dehumidification and air conditioning:** Principles of Humidification, dehumidification and air conditioning, psychrometry, humidity measurement, large-scale equipment for humidification and dehumidification, cooling towers [5]

**Refrigeration:** Principle and equipment employed for vapor compression refrigeration, lithium bromide absorption refrigeration and steam jet refrigeration..Applications of refrigeration in Pharmacy [6]

**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. [9]

## **List of Books Recommended**

### **Text Books**

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 MaCabe 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.

## **PHARMACEUTICS-IV**

### **(Pharmaceutical Engineering Drawing)**

- 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*"

# **PHARMACEUTICS-V**

## **(Pharmaceutical Microbiology)**

Theory

Total Lectures: 50

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]
2. Microscopy: Microscopes, their magnification, resolution, illumination and filters, working of different types of microscopes, micrometry. [4]
3. Classification of microbes and their taxonomy. [2]
4. Nutrition, cultivation isolation and identification of bacteria, fungi and viruses. [14]
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. [4]
6. Disinfection, factors affecting disinfection, dynamics of disinfection, disinfectants and antiseptics and their evaluation. [5]
7. Sterilization, different methods, applications and evaluation of sterilization methods. [9]
8. Aseptic technique. [1]
9. Microbial standardisation of antibiotics ( ampicillin, streptomycin ), Vitamins ( Vitamin B-12, Niacin ) and calcium pantothenate. [3]
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:** 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.

# COMPUTER SCIENCE

THEORY

Total Lectures: 50

**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, elementary concepts of operating systems and their types, computer viruses. [5]

**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. [17]

**Office automation:** Introduction to Windows operating system and a detailed study of following office packages. [23]

- a. 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, using thesaurus, auto correct, word count, mail merge, table and charts).
- b. 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.
- c. 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).

**Introduction to Internet:** Concepts of Internet, WWW, Gopher, e-mail and applications of Internet. [5]

PRACTICALS:

Number of experiments based on aforementioned theory.

## List of Books Recommended

### Text Books

1. Chanchal Mittal, *“Fundamentals of Information Technology”*, Unnati Prakashan, Meerut
2. *“Internet for Dummies”*- Pustak mahal, New Delhi.
3. V. K. Jain, *“O level Modul - M 1.2- Internet & Web Page Designing”*, BPB Publication.
4. E. Balagurusamy., *“Programming in BASIC”*.

### Reference Books

5. Alexis Leon and Mathews Leon, *“Fundamentals of Information technology”*.
6. Gini Courter and Annette Marquis, *“Microsoft Office 97”*, BPB Publication.  
Alexis Leon and Mathews Leon, *“Internet for Everyone”*.

## PHARMACEUTICAL CHEMISTRY-V (Pharmaceutical Analysis -I)

### THEORY

Total Lectures: 75

1. 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. [5]
2. 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, pH, hydrolysis of salts, Henderson\_hasselbach equation, buffer solutions, neutralization curves, acid-base indicators, theory of indicators, choice of indicators, mixed indicators, polyprotic system, polyamine and aminoacid systems, amino acid titration, application in assay of  $H_3 PO_4$ , NaOH,  $CaCO_3$  etc. [6]
3. 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-rductions, potassium iodate titrations, potassium bromate titrations, titanous chloride titrations, sodium 2,6- dichlorophenol idophenol titration, pharmaceutical applications. [6]
4. Precipitations Titrations: precipitation reactions, solubility products, effects of acids, temperature and solvent upon the solubility of a precipitate. Argentimetric titrations, ammonium of potassium thiocyanate titrations, mercuric nitrate titrations, methods: Mohr's method, Volhards method, Fajans method and pharmaceutical applications. [6]
5. Gravimetric Analysis; preparation of Gooch crucible for filtration and use of sintered glass crucible, determinationof water of hydration, some exercises to gravimetric analysis shall be covered. [4]

6. 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. [3]
7. Complexometric Titrations: concept of complexation and chelation, Warner's coordination 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. [5]
8. Miscellaneous method of analysis; Diazotisation titration, Kjeldahl nitrogen determination, Karl fishcher titration, determination of alcohol in liquid galenicals, oxygen flask combustion, gasometry. [4]
9. Extraction procedure, separation of drug from excipients, liquid-liquid extraction, separation of mixtures by extraction, distribution law, successive extraction, the Craige method of multiple extraction, continuous counter-current extraction, effect of temperature, pH, inert solute, association, ion-pair formation, the emulsion problem in extraction. [4]
10. 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. [4]
11. 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. [5]
12. HPLC: introduction and nomenclature, instrumentation, liquid solid chromatography, liquid liquid chromatography, exclusion chromatography, HPLC columns, solvent selection in HPLC, data handling in HPLC, application of HPLC. TLC quantitative estimate. Ion exchange and molecular sieve processes. Theory of ion exchange, types of exchangers, ion-exchange equilibria, ion-exchange capacity, ion-exchange separation, applications in pharmaceutical analysis, molecular sieve separation and application. [6]
13. Electrochemistry: [15] 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.
14. Phase solubility analysis: theory, experimental procedure, applications in pharmaceutical analysis. [2]

**PRACTICALS:** Number of experiments based on aforementioned theory.

### **List of Books Recommended**

#### **Text Books**

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

#### **Reference Books**

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

## **PHARMACEUTICAL CHEMISTRY – III (Pharmaceutical Biochemistry)**

### **THEORY**

Total Lectures: 50

1. Energy, rich compounds, production of ATP, and its biological significance. [4]
2. Election transport and biological oxidation. [5]
3. 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. [8]
4. 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. [8]
5. 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. [7]
6. 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. [7]
7. 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. [9]
8. Biochemical role of trace elements. [2]

### **PRACTICALS**

Number of experiments based on aforementioned theory portion and including the following;

1. Estimation of glucose, liver glycogen, creatinine, cholesterol, uric-acid in blood/urine.
2. Estimation of protein in serum.

3. Estimation of chloride in urine.
4. Determination of SGOT and SGPT.
5. Determination of serum bilirubin.
6. Estimation of RNA and DNA.
7. Estimation of acid and alkaline phosphates.
8. Electrophoretic separation of serum proteins.
9. Qualitative analysis of urine.
10. Immobilization of enzymes and study the effect of immobilization on the activity of enzyme.
11. Titration curve for amino acids.
12. Quantitative estimation of glucose.
13. Determination of glucose by means of enzyme glucose oxidase.

### **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

## **PHARMACEUTICAL CHEMISTRY – IV** **(Pharmaceutical Physical Chemistry)**

#### **THEORY**

Total Lectures: 50

1. Behaviour of gases: kinetic theory of gases, deviation from ideal behaviours and explanation. [3]
2. The liquid state: Physical properties (surface tension, parachor, viscosity, refractive index, optical rotation, dipole moments and chemical constituents. [5]
3. Solutions: Ideal and real solutions, solutions of gases in liquids, colligative properties, partitions coefficient, conductance and its measurement, Debye huckel theory. [5]
4. Thermodynamics; first, second and third laws, zero law, absolute temperature scale, thermochemical equations, phase equilibrium and phase rule. [7]
5. Adsorption: Frudlich and Gibbs adsorption isotherms, Langmuir theory of adsorption. . [6]
6. Photochemistry: Consequences of light absorption, Jablenski diagram, Lambert-Beer law, Quantum efficiency. [4.]



7. 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. [7]
8. Quantum mechanics: Postulates of quantum mechanics, operators in quantum mechanics, and the Schrodinger wave equation. [3]
9. Solution of electrolytes: Arrhenius theory of electrolytic dissociation, modern theory of strong electrolytes, and other coefficients for expressing colligative properties. [4]
10. 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. [3]
11. Electromotive force and oxidation-reduction systems: Nernst theory of electrode potential, reference electrodes, indicator electrodes, oxidation and reduction potential. . [3]

## PRACTICALS

Number of experiments based on aforementioned theory

### 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

## PHARMACOGNOSY-II

### THEORY

Total Lectures: 50

#### 1. Phytochemical screening [4]

- a. Preparation of extracts.
- b. screening for alkaloids, saponins, sterols, cardenolides, bufadenolides, flavonoids and leucoanthocyanidins, tannins and polyphenols, anthraquinones, cyanogenetic glycosides, amino acids in plant extract.

#### 2. Study of the biological sources, cultivation, collection, commercial verities, chemical constituents, substituents, adulterants used, diagnostic microscopic and macroscopic features and specific chemical tests of following group of drugs containing glycosides: [10]

- (i). Saponins: liquorice, ginseng, dinseng, dioscorea, sarsaparilla and senega.
- (ii). Cardio-active sterols: digitalis, squill, strophanthus and thevetia.
- (iii). Anthraquinones cathartics: aloe, senna, rhubarb and cascara.
- (iv). Others: Psoralea, ammi, gentian, saffron, chirata, quassia.

3. Study of tannins and tannin containing drugs like gambir, black catechu, gall, and myrobalan. [2]

4. Studies of traditional drugs, common vernacular names, botanical sources, morphology, chemical nature of chief constituents, pharmacology, categories and common uses and marketed formulations of following indigenous drugs:

Amla, Kantkari, Satavari, Tylophora, Bhilava, Kalijiri, Bach, Rasna, Punarnava, Chitrak, Apamarg, Gokhru, Shankhpushpi, Gaduchi, Brahmi, Adusa, Arjuna, Ashoka, Methi, Lehsun, Palash, Guggal, Gymnema, Shilajit, Nagarmotha and Neem. [8]

5. Holistic concepts of Drugs administration in traditional systems of medicine.

Introduction to ayurvedic preparations like arishtas, asavas, gutikas, tailas, churnas, lehas and bhasmas. [2]

6. Systematic study of source, cultivation, collection, processing, commercial verities, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following alkaloid containing drugs: [12]

(a). Pyridine-piperidine: tobacco, areca and lobelia.

(b). Tropane: belladonna, hyoscymous, datura, duboisia, coca and withania.

©. Quinoline and isoquinoline : Cinchona, ipecac, opium.

(d). Indole: ergot, rauwolfia, catharanthus, nux-vomica and physostigma.

(e). Imidazoles: pilocarpus.

(f). Steroidal: vertrum, kuruchi.

(g). alkaloidal amines: ephedra and colchicum.

(h). Glycoalkaloids: solanum.

(i). Purines: Coffee, tea and cola.

7. Biological sources, preparation, identification test and uses of the following enzymes: Diastase, papain, pepsin, trypsin and pancreatin. [2]

8. Study of fibers used in pharmacy such as cotton, silk, wool, polyester and asbestos. [2]

9. Plant bitters and sweeteners. [1]

10. Introduction, classification and study of different chromatographic methods and their application in evaluation of herbal drugs. [5]

11. Study of Pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatin and natural colours. [2]

## PRACTICALS

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

1. Identification of crude drugs listed in theory.

2. Microscopic study of some important glycosides containing crude drugs as underlined above. Study of powdered drugs.
3. Standardisation of some traditional drug formulations.
4. Studies of microscopic characters of some important drugs in entire and powdered form.
5. Chemical evaluation of powdered drugs and enzymes.
6. Chromatographic studies of some herbal drugs.

### **List of Books Recommended**

#### **Text Books.**

10. Kokate C. K., Purohit A. P. and Kokhale S.B., "*Text Book of Pharmacognosy*", Nirali Publication, Pune.
11. Trease, G. E. and Evans, W. C., "*Text Book of Pharmacognosy*", Bailliere Tindall, Eastbourne, U. K.
12. Tyler, V. C., Brady, L. R. and Robers, J.E., "*Text Book of Pharmacognosy*", 8<sup>th</sup> Ed. Lea and Febiger, Philadelphia.
13. Tyler, V. E. Jr. and Schwarting, A.E. "*Experimental Pharmacognosy*", Burgess Pub. Co., Minneapolis, Minnesota.
14. Wallis, T. E., "*Text Book of Pharmacognosy*", J. and A Churchill limited, London..

#### **Reference Books**

15. Clarke, E. C. G., "*Isolation and Identification of Drugs*", the Pharmaceutical Press, London.
16. Fahn, A., "*Plant Anatomy*", Pergamon Press, Oxford
17. Jean Brunton, "*Text Book of Pharmacognosy*", Phytochemistry and Medicinal Plants, Intercept Limited, Andover, England, U.K

## **PHARMACEUTICAL CHEMISTRY-VI (Heterocyclic compounds and Natural products)**

#### **THEORY**

Total Lectures: 50

- (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, Triazole and Tetrazole.  
Six membered Heterocycles: Pyridine, pyridazine, Pyrimidine, Pyrazine, Pyrones.  
Benz-fused Heterocycles: Quinoline, Isoquinoline, Indole, Purines, Acidine, and lanthone. [12]
- (ii) Carbohydrates: An account of the chemistry of Arabonose, Ribose, mannose, Glucose, fructose, Sucrose, Lactose, Cellulose, starch, Glycogen and dextrans, Structure elucidation of glucose, sucrose, starch. [8]
- (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. [8]
- (iv) Study of chemistry of fixed oils, fats and waxes. [6]

- (v) 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. [8]
- (vi) Glycosides: Classification and method of isolation of  $\alpha$  and  $\beta$ - d-methyl glucoside. Chemistry of salicin, cardiac glycosides, anthraquinone glycosides, saponins. Structure elucidation of cardiac glycosides. [8]

### **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

## **B. Pharmacy Part-III**

### **PHARMACEUTICS -VI (Physical Pharmacy)**

#### **THEORY**

Total Lectures: 50

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, gases, aerosols-inhalers, relative humidity, liquid complexes, liquid crystals, glassy state, solid-crystalline and amorphous polymorphism. [6]
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. [6]
3. 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. [6]
4. 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. [6]
5. Dispersion system
  - a. Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloid in pharmacy. [5]
  - b. 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. [6]
6. Complexation: Classification of complexes, method of preparation and analysis, application. [4]
7. 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. [6]

8. 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. [5]

PRACTICALS: 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.
15. Experiments involving tonicity adjustments

### **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

# **PHARMACEUTICS-VII**

## **(Pharmaceutical Engineering)**

### **THEORY**

Total Lectures: 50

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. [7]
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. [6]
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. [10]
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. [4]
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]
6. Corrosion and its prevention: Types of corrosion causes of corrosion and method for combating corrosion. [3]
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. [3]
8. Industrial hazards and safety precautions: Mechanical-chemical-electrical-fire-dust hazards, safety requirements, accident records etc. [3]
9. 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. [8]

### **PRACTICALS**

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**

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

#### **Reference Books**

5. W L MaCabe 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.

## **PHARMACEUTICS-VIII (Dosage Form Design)**

THEORY

Total Lectures: 75

1. Preformulation studies: [13]
  - a) Study of physical properties of drug like physical form, particle size, shape, density, wetting dielectric constant, solubility, dissolution and organoleptic properties and their effect on formulation, stability and bioavailability.
  - b) Study of chemical properties of drug like hydrolysis, oxidation, reduction, recemization, polymerization etc., and their influence on formulation and stability of products.
  - c) Study of prodrugs in solving problems related to stability, bioavailability and elegancy of formulation.
2. Design, development and process validation methods for pharmaceuticals operations involved in the production of pharmaceutical products with special reference to liquid dosage forms. [6]
3. Stabilization and stability testing protocol for various pharmaceutical products. [4]
4. GMP, Quality assurance, Quality audit. [6]
5. Radiopharmaceuticals: fundamentals of radiopharmacy, therapeutic applications of isotopes, diagnostic applications of isotopes, use of radioisotopes in basic research, product development, product production, process control and quality control. [8]



6. Liquid formulations, theory of disperse systems, formulation and industrial production of liquid and semi-solid formulation like suspension, syrup, emulsions and ointments. [8]
7. Skin: structure and physiology, physiology of sweating, physiology of skin secretions formulations, preparations for skin of face and hands, formulation, preparation and evaluation of cleansing creams, cold creams, cleansing lotions, foundation creams, moisturising creams, skin tonics, handy and body lotion. [15]
8. Hairs, structure and functions, formulation, preparation and evaluation of shampoos, dandruff preparation, hair creams, and fixers, hair colorants, hair remover (depilatories), shaving sticks and after shave lotion. [6]
9. Formulation, preparation and evaluation of lipsticks. [3]
10. Formulation, preparation and evaluation of other cosmetics like nail lacquers, anti-perspirants and deodorants, tooth powders and tooth paste [6]

### PRACTICALS

Experiments illustrative of the portion covered in the theory portion of the syllabi and including the following:

1. Formulation, preparation, packing and presentation of the following class of dosage forms using laboratory scale equipment's syrups, dry syrups drops, suspensions, solubilized systems, emulsions and topical applications.
2. Preparation and quality control of (a) cold cream (b) vanishing cream (c) Cleansing lotion and creams (d) moisturizing creams (e) skin tonics, (f) hair creams and hair conditioners (g) shampoos (h) hair colorant (i) depilatory (j) shaving creams and sticks (k) tooth powder (l) tooth pastes (m) after shave lotions and other cosmetics.
3. Experiments to illustrate comparative study of suspending agents, emulsifying agent and antioxidant preservatives.
4. Preformulation studies including drug-excipient, compatibility studies, effect of stabilizers, preservatives etc. in dosage form design.
5. Stability evaluation of various dosage forms and their expiring dating.

### List of Books Recommended

#### Text Books

1. H C Ansel, "*Introduction to Pharmaceutical Dosage Forms*", K M Varghese & Co., Mumbai.
2. Leon Lachman, H A Liberman and J L Kanig, "*The Theory and Practice of Industrial Pharmacy*", Lea & Febiger, Philadelphia

#### Reference Books

3. "*Cosmetic Science and Technology*", John Wiley & Sons, NY
4. J s Jellinek, "*Formulation and Functions of cosmetics*", John Wiley & Sons, NY
5. S G Thompson, "*Modern Cosmetics*", Universal Publishing Corporation, Mumbai
6. H S Bean, A H Beckett and J E Carless, "*Advance in Pharmaceutical Sciences*", Academic Press, London
7. K A Connors, G L Amidon and V J Stella, "*Chemical stability of Pharmaceuticals*".
8. A Owunwonne, "*Hand Book of Radiopharmaceuticals*", Narosa Publishing House, New Delhi.

## **PHARMACEUTICS -IX** **(Forensic pharmacy)**

### THEORY

Total Lectures: 50

1. Introduction [3]
  - a. Pharmaceutical legislation- a brief reviews.
  - b. Drug and Pharmaceutical Industry- a brief reviews.
  - c. Pharmaceutical education- a brief reviews.
2. An elaborate (practical oriented) study of the following: [34]
  - a. Pharmaceutical Ethics
  - b. Pharmacy Act 1948
  - c. Drug and cosmetics Act 1940 and rules 1945.
  - d. Medicinal and Toilet preparations (Excise duties) Act 1955.
  - e. Narcotic Drugs and Psychotropic Substances Act 1985 and Rules.
  - f. Price Control Act 1995.
3. A brief study of the following with special reference to the main provisions ( with amendments ): [13]
  - a. Poisons Act 1919.
  - b. Drug and Magic remedies (objectionable advertisements) Act 1954.
  - c. Medical termination of Pregnancy Act 1970 and Rules 1975.
  - d. Prevention of cruelty to Animal Act 1960.
  - e. States shops and establishments Act and Rules.
  - f. Insecticides Act 1968.
  - g. AICTE Act 1987.
  - h. Minimum Wages Act 1948 & Rules 1950.
  - i. Patents Act 1970 and Rules 1972

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

### **List of Books Recommended**

#### **Text Books**

1. B M Mithal, "*Text Book of Forensic Pharmacy*", Calcutta.
2. N K Jain, "*Text Book of Forensic Pharmacy*", Vallabh prakashan, Delhi.

#### **Reference Books**

3. Original acts published on behalf of Government of India.
4. H K Bharati, "*Drug and Pharmacy Laws in India*", Sadhana Mandir, Indore.

## **PHARMACEUTICAL CHEMISTRY-VI** **(Medicinal chemistry-I)**

### THEORY

Total Lectures: 50

1. Basic Principles of Medicinal Chemistry: [15]

- a. Physio-chemical aspects of Drug action- Stereochemical aspects of drug action (Optical, geometric and bioisotermism of drug molecules with biological action), conformational isomerism, solubility and partition coefficient, chemical bonding.
  - b. Drug-receptor interactions- receptor concept, receptor- effector theories, types of receptor and their action including transduction mechanism and G proteins.
  - c. Principles of drug design (Theoretical aspects).
    - a. Traditional analog (QSAR)
    - b. Computer aided drug designing (CADD)
    - c. Molecular modelling.
    - d. Combinatorial chemistry
2. Synthetic procedures of selected drugs, mode of action, uses, Structure activity relationship including physiochemical properties of the following classes of drugs. [35]
- A. 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.
  - B. Autocoids: Antihistamines, Ecosanoids, Anti-inflammatory agents (nonsteroidal), analgesic and antipyretics.
  - C. Drugs affecting Uterine Motility: Oxytocics including oxytocin, ergot alkaloids and prostaglandins.
  - D. Diuretics and Antidiuretics.
  - E. Cardiovascular agents: Antihypertensives, Cardiotonics, Antiarrhythmics, antianginals, anticoagulants and antiplatelets, thrombolytics, antithrombolytics, hypolipoproteinemic drugs.
  - F. Vitamins- Classification, chemistry of thiamine, pyridoxine, folic acid, ascorbic acid and vitamin A.
  - G. Insulin and oral hypoglycemic agents.
  - H. Thyroid and Antithyroid drugs.

## PRACTICALS

Number of experiments based on the above mentioned theory portion and including the following:

1. Exercises based on QSAR.
2. Synthesis of selected drugs from the course content.
3. Spectral analysis of the drug synthesized.
4. Establishing the pharmacopoeial standards of drug synthesized.
5. Determination of partition coefficient, dissociation constant and molar refractivity.

## List of Books Recommended

### Text Books

16. Wilson and Gisvold's "*Textbook of Organic Medicinal and Pharmaceutical Chemistry*", J. Lippincot Co., Philadelphia.

17. W. O. Foye, "*Principles of Medicinal Chemistry*", Lea and Febiger, Philadelphia.

#### **Reference Books**

18. C. Hansch, "*Comprehensive Medicinal Chemistry*", Pergamon Press Oxford.
19. Y. C. Martin, "*Quantitative Drug Design*", Marcel Dekker, Inc. New York.
20. 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.
21. M. E. Wolff, Ed. "*Burger's Medicinal Chemistry*", John Wiley & Sons, New York.
22. T. Nogard, "*Medicinal Chemistry – A Biochemical Approach*", Oxford University Press, New York, Oxford.
23. Popst and Perrum, "*Computer Aided Drug Design*", Academic Press, New York

## PHARMACOGNOSY-III

### THEORY

Total Lectures: 50

1. General technique of biosynthetic studies and basic metabolic pathways. An introduction to biogenesis of secondary Metabolites of pharmaceutical importance. [4]
2. Chemistry and biogenesis of medically important Monoterpenes, sesquiterpenes, diterpenes, and triterpenoids. [10]
3. Chemical and spectral approaches to simple molecules of natural origin. [6]
4. Concept of stereoisomerism taking examples of natural products. [4]
5. Carotenoids, beta-carotenoids, alpha-carotenes, vitamin A, xanthophylls of medicinal importance. [4]
6. Steroids: chemistry in biosynthesis of hecogenin, diosgenin and sarasapogenin. [4]
7. Alkaloids: chemistry and biogenesis of atropine and related compounds, quinine, reserpine, morphine, papaverine, ephedrine, ergot and Vinca-alkaloids. [12]
8. Chemistry of medicinal important irridoids. [3 hrs.]
9. Chemistry of penicillins, streptomycin and tetracyclines. [3]

### PRACTICALS

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

1. Laboratory experiments on isolation, separation, purification of various groups of chemical constituents of pharmaceutical importance.
2. Exercises on paper and thin layer chromatographic evaluation of herbal drug constituents.

### List of Books Recommended

#### Text Books

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

#### Reference Books

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

## PHARMACOLOGY- II

### THEORY

Total Lectures: 50

1. General pharmacology: [8]
  - 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: [8]
  - a) Neurohumoral transmission (autonomic and somatic)
  - b) Parasympathomimetics, Parasympatholytics, Sympathomimetics, Sympatholytics, Ganglion blocking and Stimulating agents
  - c) Neuromuscular blocking agents.
  - d) Local anaesthetic agents.
  
3. Pharmacology of Central Nervous System [12]
  - 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
  
4. Pharmacology of Cardiovascular system [8]
  - 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
  
5. Drugs acting on the Haematopoietic system [4]
  - a) Haematinics
  - b) Anticoagulants, vitamin K and haemostatic agents
  - c) Fibrinolytic and Anti-platelet drugs

- d) Blood and plasma volume expanders
- 6. Drugs acting on the urinary system [2]
  - a) Fluid and electrolytic balance
  - b) Diuretics
- 7. Autocoids [5]
  - a) Histamine, 5-HT and their antagonists
  - b) Prostaglandins, thromboxane and Leukotrienes
  - c) Pentagastrin, cholecystokinins, angiotensin, bradykinin and substance P.
- 8. Drugs acting on the respiratory system [3]
  - a) Anti-asthmatic drugs including bronchodilators
  - b) Anti-tussive and Expectorants
  - c) Respiratory stimulants

### **PRACTICALS**

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

1. Introduction to experimental pharmacology
  - a) Preparation of different solutions for experiment
  - b) Drug dilutions, use of molar and wt/volume solution in experimental pharmacology.
  - c) Common laboratory animals and anaesthetic used in animal studies.
  - d) Commonly used instruments in experimental pharmacology
  - e) Some common and standard techniques  
Bleeding and intravenous injection, intra-gastric administration, procedures for rendering animals unconscious-stunning of rodents, pithing of frogs, chemical euthanasia.
2. Experiment on intact preparation
  - a) Study of different routes of administration of drugs in mice/rats
  - b) To study the effect of hepatic microsomal enzyme inhibitors and induction on the pentobarbital sleeping time in mice
3. Experiments on central nervous system  
Recording of spontaneous motor activity, stereotype, analgesic, anticonvulsant, anti-inflammatory activity, and muscle relaxation activity of drugs using simple experiments.
4. To study the effect of autonomic drugs on rabbit eye.
5. To study the effect of various agonists and antagonists and their characterization using isolated preparations like frog's rectus abdominus muscle and isolated ileum preparations of rat, guinea pig and rabbit.
6. Experiments on isolated preparations:

- a) To record the CRC of acetylcholine using rectus abdominus muscle preparations of frog.
  - b) To study the effects of Physostigmine and d-tubocurarine on the CRC of Ach using rectus abdominus muscle preparation of frog.
  - c) To record the CRC of 5-HT on rat fundus preparation
  - d) To record the CRC of Histamine on guinea pig ileum preparation.
  - e) To record the CRC of Nor-adrenaline on Rat anococcygenus muscle preparation.
  - f) To record the CRC of oxytocin using rat uterus preparation.
7. Pharmacology of cardiovascular system
- a) To study the inotropic and chronotropic effects of drugs on isolated frog heart.
  - b) To study the effect of drugs on normal and hypodynamic frog heart.
8. To demonstrate the effect of various drugs on B.P. and respiration including the vasomotor reversal of Dale and Nicotinic action of acetylcholine.

### **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*", Pergman 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.
7. Herfindal E T and Hirschman, J L, "*Clinical Pharmacy and Therapeutics*", Williams and Wilkins

## **PHARMACOLOGY-III PHARMACEUTICAL BIOTECHNOLOGY**

Theory

Total Lectures: 50

### **1. Introduction to Biotechnology: [3]**

- a) Definition, history, different branches and scope of biotechnology.
- b) Therapeutical and pharmaceutical applications of biotechnology.

### **2. Genetic engineering: [10]**

- a) Concept and techniques of Genetic engineering (gene transfer via transduction, transformation, conjugation, protoplast fusion and gene cloning), DNA replication, its repair and recombination.



- b) Applications of genetic engineering for production of pharmaceuticals

**3. Enzymes: [8]**

- 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.

**4. Tissue Culture and Cell Culture Technology: [10]**

- a) History and scope of cell culture and culture media
- b) Culture procedures and primary cultures
- c) Evolution of mammalian cell lines
- d) Cloning of cell lines, molecular basis of established cell lines and transformation in animals.
- e) Animal tissue culture and organ culture
- f) Embryo culture and egg culture
- g) Culturing of embryonic stem cells in humans
- h) *In vitro* fertilization in humans

**5. Biotechnology in the field of pharmacy: [10]**

- 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

**Oncogenes and Tumor Suppressor Genes: [9]** Viral and cellular oncogenes, tumor suppressor genes from humans, 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. 4. Prescott and Dunn, "Industrial Microbiology", Mcgraw Hill Book Company Inc.

## **B. Pharmacy Part-IV**

### **Pharmaceutics-X (Biopharmaceutics and Pharmacokinetics)**

#### **THEORY**

Total Lectures: 50

1. Introduction to Biopharmaceutics and Pharmacokinetics and their role in formulation development and clinical setting. [1]
2. Biopharmaceutics: [9]
  - 2.1 Passage of drug across biological barrier (passive diffusion, active transport, facilitated diffusion and pinocytosis).
  - 2.2 Factors influencing absorption-physiochemical, physiological and pharmaceutical.
  - 2.3 Drug distribution in the body, plasma protein binding.
3. Pharmacokinetics [25]
  - 3.1 Significance of plasma drug concentration measurement.
  - 3.2 Compartmental model: definition and scope.
  - 3.3 Pharmacokinetics of drug absorption-zero order and first order absorption rate constant using wagner-Nelson and Loo-piegelman method.
  - 3.4 Volume of distribution and distribution coefficient.
  - 3.5 Compartment kinetics-one compartment and two compartment models. Determination of pharmacokinetics parameters from plasma and urine data after drug administration by intravascular and oral route.
  - 3.6 Curve fitting (method of residuals), regression procedures.
  - 3.7 Clearance concept, mechanism of renal clearance, clearance ratio, determination of renal clearance.
  - 3.8 Hepatic elimination of drugs, first pass effect, extraction ratio, hepatic clearance, biliary excretion, enterohepatic circulation.
  - 3.9 Non-linear pharmacokinetics with special reference to one compartment model after I.V. drug administration, Michaelis Menten equation, determination of non-linearity (saturation mechanism).
4. Clinical pharmacokinetics; [11]
  - 4.1 Definition and scope.
  - 4.2 Dosage adjustment in patients with and without renal and hepatic failure.
  - 4.3 Dosage regimen adjustment for repeated therapy.
  - 4.4 Introduction to Pharmacokinetics drug interactions and its significance in combination therapy.
5. Bioavailability and bioequivalence: [4]
  - 5.1 Measures of bioavailability,  $C_{max}$ ,  $t_{max}$  and Area under Curve(AUC).
  - 5.2 Design of single dose bio-equivalence study and relevant statistics.
  - 5.3 Overview of regulatory requirements for conduction of bio-equivalence study.

#### **PRACTICALS**

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. Brahmankar, 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.

## Pharmaceutics-XI (Pharmaceutical Technology)

THEORY

Total Lectures: 75

1. Tablets: [31] 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.

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

Tablet coating: 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. Process validation.

2. Capsules: advantages, applications, formulation, large-scale production and quality control of hard and soft capsules. . [8]

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. [8]

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. . [8]

5. Parenterals: types of parenteral products, formulation, containers, pyrogens, production facilities, production procedures for small volume and large volume Parenterals, large scale production of injectable grade water and quality control of parenterals. . [12]

6. Design, development, production and evaluation of controlled release preparations. . [8]

## PRACTICALS

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

1. Microencapsulation by coacervation phase separation brought about by change of temperature.
2. Microencapsulation by coacervation phase separation brought about by addition of nonsolvent.
3. Formulation, preparation and evaluation of paediatric tablets.
4. Preparation and evaluation of aspirin tablets.
5. Coating of tablets.
6. Evaluation of coatings.
7. Granulation by slugging.
8. Determination of BA and M/G factor.
9. Formulation of hard capsules.
10. Quality control of soft and hard capsules.
11. Preparation of small volume parenterals.
12. Test for pyrogen.
13. Preparation and evaluation of large volume parenteral.
14. Formulation, preparation and evaluation of aerosol.
15. Microencapsulation by complex emulsion method.

## List of Books Recommended

### Text Books

1. “*Remington’ 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

### Reference Books

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 M Chitton and R L Witcofski, “*Nuclear Pharmacy*”, Lea & Febiger, Philadelphia
7. H A Liberman, L Lachman and J B Schwartz, “*Pharmaceutical Dosage Forms: Tablets*”, Vol. 1, Marcel Dekker Inc, NY

# Pharmaceutics-XII

## Pharmaceutical Management

### THEORY

Total Lectures: 50

1. Pre-requisites: (Basic Information Services) [10]  
Concept of Management.  
Administrative Management (Planning, Organising, Staffing, Directing and controlling).  
Operative Management (Personnel, Materials, Production, Financial, Marketing, Time/Space, Margin/Morale).  
Principles of Management (Co-ordination, Communication, Motivation, Decision-making, Leadership, Innovation, Creativity, Delegation of Authority/Responsibility, Record Keeping).  
Identification of key points to give maximum thrust for development and perfection.
2. Accountancy: [7]  
Principles of Accountancy, ledger posting and book entries, columns of a cash book, preparation of trial balance, profits and loss account, balance sheet.
3. Economics: [5]  
Principles of economics with special reference to the laws of demand and supply, demand schedule, demand curves, labour welfare, general principles of insurance and inland and foreign trade, procedure of exporting and importing goods.
4. Pharmaceutical Marketing: [5]  
Functions Buying, selling, transportation, storage, finance, feedback, information, channels of distribution, wholesale, retail, departmental store, multiple shop and mail order business.
5. Salesmanship: [4]  
Principles of sales promotion, advertising, ethics of sales, merchandising, literature, detailing.
6. Market Research: [4]  
Recruitment, training, evaluation, compensation to the pharmacist.
7. Material management: [5]  
A brief exposure of the basic principles of material management, purchase, store and inventory management.
8. Production Management: [5]  
A brief exposure of the different aspects of production management (visible and invisible inputs, methodology of activities, performance evaluation, technique, process-flow, process know-how).
9. Personnel Management: [5]

Eligibility, efficiency, evaluation, recruitment methodology, service conditions, termination, performance evaluation etc.

#### **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

## **Pharmaceutics-XIII (Packaging Technology)**

### **Theory**

Total Lectures: 50

1. Introduction: Definition, life history of a package, qualities of the package, purpose of packaging, choosing the form of package, hazards encountered by the package, various types of inner and outer packages, selection of a suitable package and child resistant package. [4]
2. 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. Production of oriented and non-oriented films and laminates. . [8]
3. 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. . [4]
4. 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. . [5]
5. Pouch packaging: Materials used, advantages, economics and limitation of pouch packing, pouch packing machinery, spectrum of applications, evaluation of pouch packing. . [5]
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. . [5]
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. . [7]
8. 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. [8]

9. Labelling: Labelling requirements, packaging inserts and machinery employed for labelling. [4]

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

##### **Text Books**

1. Leon Lachman, H A Liberman and J L Kanig, "*The Theory and Practice of Industrial Pharmacy*", Lea & Febiger, Philadelphia
2. Cooper and Gunn's, "*Dispensing for Pharmaceutical Students*", CBS Publishers, Delhi.
3. Cooper and Gunn's "*Tutorial Pharmacy*", CBS Publishers, Delhi.
4. T C KacChesney, "*Packaging of Cosmetics and Toiletries*", Newness- Butterworth, London

##### **Reference Books**

5. "*Remington' Pharmaceutical Sciences*", Mack Publishing Co., P.A
6. AI Brody & K S Marsh, "*The Wiley Encyclopedia of Packaging Technology*", John Wiley & Sons, New York

## **Pharmacognosy-IV**

### **THEORY**

Total Lectures: 50

1. Role of medicinal and aromatic plants in national economy. [2]
2. World-wide trade in medicinal plants and derived products with special reference to diosgenin (dioscorea), taxol (taxus sps), digitalis, tropane alkaloid containing plants, papain, cinchona, ipecac, liquorice, ginseng, Aloe vera, Valerian, rouwolfia and plant containing laxatives. [8]
3. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India, Utilization and production of phytoconstituents of poppy, ergot, cinchona, ipecac, tropane alkaloids, vinca, aloes, senna, ispaghula, digitalis, dioscorea and solanum Khasianum. [10]
4. Utilization of aromatic plants and derived products with special reference to menthol, citral, sandwood oil, vetiver oil, geronium oil and eucalyptus oil. [8]
5. Historical development of plant tissue culture, types of cultures, nutritional requirements, growth and their maintenance. Application of plant tissue culture in pharmacognosy. [8]
6. Chemotaxonomy of medicinal plants. [5]
7. Marine pharmacognosy, novel medicinal agents from marine sources. [4]
8. Natural allergens and photosensitizing agents. [5]

### **PRACTICALS**

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

1. Isolation of some selected phytoconstituents studied in theory.
2. Extraction of volatile oils and their chromatographic profiles.
3. Some experiments in plant tissue culture.

## List of Books Recommended

### Text Books

1. Brain, K. R. and Turner, T. D., *“The Practical Evaluation of Phytopharmaceuticals”*, Wright – Sciencetechnica, Bristol.
2. *“Export Potential of Selected Medicinal Plants”*, Prepared by Basic Chemicals, Pharmaceuticals and Cosmetic export Promotion Council, Bombay, and other reports..
3. Reinert, J. and Bajaj, Y. P. S., *“Applied and Fundamental aspects of Plant Cell, Tissue and Organ Culture”*, Berlin.
4. *“Herbal Drug Industry”*, Eastern Publishers

### Reference Books

5. Pridham, J. B. and Swain, T., *“Biosynthetic Pathways in Higher Plants”*, Academic Press, New York
6. Wealth of India.
7. *“Supplement to Cultivation and Utilization of Medicinal Plants”*, RRL, Jammu-Tavi
8. Chopra, R. N., Nayar S. L. and Chopra, I. C., *“Glossary of Indian Medicinal Plants”*, C S I R, New Delhi.
9. *“Cultivation and Utilization of Aromatic Plants”*, RRL-Jammu Tavi

## PHARMACOLOGY – IV

### THEORY

Total Lectures: 50

1. Drugs acting on the Gastrointestinal Tract: [4]
  - 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 Endocrine system: [6]
  - a) Hypothalamic and pituitary hormones
  - b) Thyroid hormones and antithyroid drugs, parathormone calcitonin and vitamin D.
  - c) Insulin, oral hypoglycemic agents and glucagon.
  - d) ACTH and corticosteroids.
  - e) Androgens and anabolic steroids.
  - f) Drugs acting on the uterus.
3. Chemotherapy: [12]
  - a) General principles of chemotherapy.
  - b) Sulphonamides and co-trimoxazole.
  - c) Antibiotics, penicillins, cephalosporins, betalactamas, tetracyclines, aminoglycosides, chloramphenicol, 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.



4. Principles of Toxicology: [4]
  - 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.
  
5. Introduction to Clinical Pharmacy [1]
6. Basic concepts of Pharmacotherapy [6]
  - 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.
  
7. Important disorders of organ system and their management: [15]
  - a) Cardiovascular disorders: hypertension, congestive heart failure, angina, acute myocardial infarction and cardiac arrhythmias.
  - b) CNS disorders: epilepsy, parkinsonism, schizophrenia, depressions.
  - c) Respiratory disease: asthma.
  - d) Gastrointestinal disorders: peptic ulcer disease, ulcerative colitis, hepatitis and cirrhosis.
  - e) Endocrine disorders: Diabetes Mellitus and thyroid disorders.
  - f) Infections disease: tuberculosis, urinary tract infection, enteric infections, upper respiratory infections.
  - g) Hematopoietic disorders: anemias.
  - h) Joint and connective tissue disorders: rheumatic disease, gout and hyperuricemia.
  - i) Neoplastic disease: acute leukaemias, Hodgkin's disease and Carcinoma of breast.
  
8. Therapeutic drug monitoring [1]
  
9. Concept of essential drugs and rationale drug use. [1]

## PRACTICALS

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

1. Experiments on isolated preparations:
  - a) To calculate the  $PA_2$  value of atropine using acetylcholine as an agonist on rat ileum preparation.
  - b) To calculate the  $PA_3$  value of mepyramine or chlorpheniramine using histamine as agonist on guinea pig ileum.
  - c) To find out the strength of the given sample on agonist (e.g. Acetylcholine, Histamine, 5-HT, Oxytocin etc.) using a suitable isolated muscle preparation by-
    - Matching Assay
    - Two Point Assay
    - Three Point Assay

2. Pharmacology of the Gastrointestinal Tract:  
To study the anti-secretory and anti-ulcer activity using pylorus ligated rats.
3. Clinical Pharmacology:  
To demonstrate the effects of certain clinically useful drugs on human volunteers like:
  - a) Anti-histamines
  - b) Anti-anxiety and sedative drugs
  - c) Analgesics.
  - d) Betablockers.

#### **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*", Pergman 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.
8. Laurence, D R and Bennet, P N, "*Clinical Pharmacology*", Churchill Livingstone."

## **Pharmaceutical Chemistry-VIII (Medicinal Chemistry-II)**

THEORY

Total Lectures: 75

1. Drug metabolism [5]
  - b. Functionlization reactions (Phase I)-  
Oxidation, reduction and hydrolytic reactions.
  - c. Conjugation reactions:  
Glucuronic acid conjugation, sulphate conjugation, conjugation with amino acids, glutathione conjugation, acetylation, methylation.
2. Chemistry and principles of prodrug design. [3]
3. Synthetic procedure of selected drugs, mode of action, uses, and structure activity relationship including physico-chemical properties of the following classes of drugs: [32]
  - a. 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).

- e. Steroids and related drugs: Steroidal nomenclature and stereochemistry; androgens and anabolic agents; oestrogens and parogestational agents; adrenocorticoids.
4. Chemotherapeutic agents: [32]
- a. Antibacterials including antimetabolites.
  - b. Antibiotics (b-lactams, tetracyclines, aminoglycosides, polyenes, cycloserine, chloramphenicol)
  - c. Antiviral agents including anti- HIV agents
  - d. Antineoplastics
  - e. Immunomodulators
  - f. Antifungals
  - g. Antimycobacterials
  - h. Antihelmentics
  - i. Antiprotozoals
  - j. Antiseptics and disinfectants
  - k. Urinary antiseptics
5. Miscellaneous- [3]
- i. Diagnostic agents.
  - ii. Pharmaceutical aids.

#### PRACTICALS

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

1. Experiments designed on drug metabolism.
  - a) Preparation of S-9 and microsomes from tissue homogenitics and standardisation of protien.
  - b) Effects of phenobarbital pretreatment on microsomal cytochrome P-450, cytochrome b5, and NADPH-cytochrome C-reductase and comparison of microsomes from control.
  - c) Determination of microsomal aminopyrine demethylase and p-nitroanisole o-demethylase activity.
  - d) Determination of microsomal azo and nitroreductase activities.
2. Submission of pilot project (work-up on all pilot scale) along with the economics of one drug.
3. Synthesis of selected drugs.
4. Establishment of the pharmaceutical standard and spectral studies.

#### 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.

## **Pharmaceutical Chemistry-IX (Pharmaceutical Analysis-II)**

### THEORY

Total Lectures: 75

- A. Quality Assurance: [15]
  - a) Philosophy of GLP, ISO-9000, TQM, quality Review and Quality documentation.
  - b) Regulatory aspects:
    - Legislation & regulatory control, regulatory drug analysis, interpretation of analytical data.
  - c) Validation /Quality audit
    - Quality of equipment,
    - Validation of equipment,
    - Validation of analytical procedures.
- B. The theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications of the following analytical techniques should be thoroughly studied: [60]
  - a) Ultraviolet and Visible Spectrophotometry.
  - b) Fluorimetry.
  - c) Infrared spectrophotometry.
  - d) Nuclear magnetic resonance spectroscopy including  $^{13}\text{C}$  NMR.
  - e) Mass spectroscopy.
  - f) Flame photometry.
  - g) Emission spectroscopy.
  - h) Atomic absorption spectroscopy.
  - i) Radioimmunoassay and radioactivity as an analysis tool; basic nuclear properties, measurement of radioactivity, analytical applications of radioactivity, interaction of radiation with matter, counting statistics errors and corrections and radiation safety.

### PRACTICALS

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

1. Using official procedure involving instrumental techniques, carry out the quantitative estimation of atleast ten formulations containing single drug or more than one drug.
2. Using flame photometry, carry out the estimation of  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$  ions.
3. Carry out the IR of samples having different functional groups (-COOH; -COOR, CONHR-1°, 2°, 3°; -NH<sub>2</sub>, -NHR, -OH, etc.)
4. Workshop to interpret the structure of samples organic compounds using UV, IR, NMR and MS.

## **List of Books Recommended**

### **Text Books**

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

### **Reference Books**

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

**Note:** Number of lectures to be conducted for each chapter has been specified in brackets after every chapter in all the theory subjects.