

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY  
LUCKNOW**



**Evaluation Scheme & Syllabus**

**for**

**B.Pharma First Year**

**On**

**Choice Based Credit System**

**(Effective from the Session: 2016-17)**

## Scheme of Evaluation (Choice Based Credit System)

### Bachelor of Pharmacy (B. Pharm.)

#### FIRST SEMESTER

S. No.	Subject Code	Subject Name	L--T--P	T/P Marks (ESE)	Sessional		Total	Credit
					Test	Assignment/ Attendance		
<b>Theory</b>								
1.	RPH-101	Pharmaceutical Chemistry-I (Pharmaceutical Inorganic Chemistry)	3---0---0	70	20	10	100	3
2.	RPH-102/ RPH-106	Pharmaceutics-I (General Pharmacy)/ Pharmaceutical Chemistry-II (Pharmaceutical Organic Chemistry)	3---0---0	70	20	10	100	3
3.	RPH-103	Anatomy, Physiology and Pathophysiology-I	3---0---0	70	20	10	100	3
4.	RPH-104/ RPH-109	Pharmaceutical Analysis-I/ Pharmacognosy-I	3---0---0	70	20	10	100	3
5.	RPH-105/ RPH-110	Computer Fundamentals/ Pharmaceutical Mathematics and Biostatistics	3---0---0	70	20	10	100	2
<b>Practical/ Project</b>								
6.	RPH-101P	Pharmaceutical Chemistry-I (Pharmaceutical Inorganic Chemistry) Practical	0---0---4	50		50	100	2
7.	RPH-102P/ RPH-106P	Pharmaceutics-I (General Pharmacy) Practical/ Pharmaceutical Chemistry-II (Pharmaceutical Organic Chemistry) Practical	0---0---4	50		50	100	2
8.	RPH-103P	Anatomy, Physiology and Pathophysiology-I Practical	0---0---4	50		50	100	2
9.	RPH-104P/ RPH-109P	Pharmaceutical Analysis-I Practical/ Pharmacognosy-I Practical	0---0---4	50		50	100	2
10.	RPH-105P/ RPH-110P	Computer Fundamentals Project/ Pharmaceutical Mathematics and Biostatistics Project	0---0---4	50		50	100	2
<b>TOTAL</b>							<b>1000</b>	<b>24</b>

# Bachelor of Pharmacy (B. Pharm.)

## SECOND SEMESTER

S. No.	Subject Code	Subject Name	L--T--P	T/P Marks (ESE)	Sessional		Total	Credit
					Test	Assignment/ Attendance		
<b>Theory</b>								
1.	RPH-206/ RPH-202	Pharmaceutical Chemistry-II (Pharmaceutical Organic Chemistry)/ Pharmaceutics-I (General Pharmacy)	3---0---0	70	20	10	100	3
2.	RPH-207	Pharmaceutical Chemistry-III (Pharmaceutical Physical Chemistry)	3---0---0	70	20	10	100	3
3.	RPH-208	Anatomy, Physiology and Pathophysiology-II	3---0---0	70	20	10	100	3
4.	RPH-209/ RPH-204	Pharmacognosy-I/ Pharmaceutical Analysis-I	3---0---0	70	20	10	100	3
5.	RPH-210/ RPH-205	Pharmaceutical Mathematics and Biostatistics/ Computer Fundamentals	3---0---0	70	20	10	100	2
<b>Practical/ Project</b>								
6.	RPH-206P/ RPH-202P	Pharmaceutical Chemistry-II (Pharmaceutical Organic Chemistry) Practical/ Pharmaceutics-I (General Pharmacy) Practical	0---0---4	50		50	100	2
7.	RPH-207P	Pharmaceutical Chemistry-III (Pharmaceutical Physical Chemistry) Practical	0---0---4	50		50	100	2
8.	RPH-208P	Anatomy, Physiology and Pathophysiology-II Practical	0---0---4	50		50	100	2
9.	RPH-209P/ RPH-204P	Pharmacognosy-I Practical/ Pharmaceutical Analysis-I Practical	0---0---4	50		50	100	2
10.	RPH-210P/ RPH-205P	Pharmaceutical Mathematics and Biostatistics Project/ Computer Fundamentals Project	0---0---4	50		50	100	2
<b>TOTAL</b>							<b>1000</b>	<b>24</b>

# Syllabus

## FIRST SEMESTER

*RPH-101*

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

An outline of methods of preparation, tests of identification and special tests (if any), of the individually mentioned inorganic pharmaceuticals.

#### **Unit I**

Sources of impurities and their control.

Limit tests for iron, arsenic, lead, heavy metals, chloride and sulphate.

Pharmaceutically acceptable glass.

**Gases and vapors:** Inhalants (Oxygen), anesthetics (Nitrous oxide).

#### **Unit II**

**Topical agents:** Protectives (Calamine, Kaolin). Astringents (Zinc sulphate, Alums). Anti-infectives (Boric acid, Hydrogen peroxide, Povidone-Iodine, Silver nitrate).

**Dental products:** Dentifrices (Dicalcium Phosphate), anti-carries agents (Sodium fluoride).

**Antioxidants :** Sodium metabisulphite.

#### **Unit III**

**Gastrointestinal agents:** Antacids (Aluminium hydroxide, Calcium carbonate, Magnesium hydroxide, Magnesium carbonate-light and heavy, Bismuth sub-carbonate), Combination antacids. Cathartics (Disodium hydrogen phosphate, Magnesium sulphate). Protective and Adsorbents (Activated charcoal, Aluminium sulphate).

**Miscellaneous agents:** Expectorants (Ammonium chloride, Potassium iodide). Respiratory stimulants (Ammonium hydroxide).

#### **Unit IV**

**Major intra and extracellular electrolytes:** Physiological ions, electrolytes used for replacement therapy (Sodium chloride, Potassium chloride, Calcium gluconate, Magnesium chloride), Combination therapy including ORS.

**Essential and trace elements:** Iron and haematinics (Ferrous sulphate, Ferrous gluconate, Ferric ammonium citrate). Mineral supplements (Cu, Zn, Cr, Mn, I).

## **Unit V**

**Inorganic radiopharmaceuticals:** Radioactivity, units of radioactivity and radiation dosimetry, measurement of radioactivity, hazards and precautions in handling of radiopharmaceuticals, clinical applications of radiopharmaceuticals.

**Co-ordination compounds and complexation:** Co-ordination theory, chelates and their pharmaceutical importance, poison antidotes (Sodium thiosulphate).

**PHARMACEUTICAL CHEMISTRY-I**  
**(PHARMACEUTICAL INORGANIC CHEMISTRY) PRACTICAL**

1. To perform limit test of chloride, sulphate, iron and heavy metal arsenic in the given sample.  
Identification tests for acidic and basic radicals.
2. Preparation of following compounds-
  - Boric acid
  - Magnesium sulphate
  - Magnesium carbonate
  - Calcium carbonate
  - Alum
  - Zinc sulphate.

**BOOKS RECOMMENDED:**

1. Pharmacopoeia of India, 1996 Edition, The Controller of Publications, Delhi.
2. Block J.H., Roche E., Soine, T. and Wilson, C., Inorganic, Medicinal & Pharmaceutical Chemistry, Lea & Febiger, Philadelphia.
3. Atherden L.M., Bentley and Driver's Text Book of Pharmaceutical Chemistry, Oxford University Press, London.
4. Miessler, G.L. and Tarr, D.A. Inorganic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), New Delhi.
5. Svehla, G. and Sivasankar, B. Vogel's Qualitative Inorganic Analysis, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), New Delhi.
6. Rao K.S. and Suresh, C.V. Pharmaceutical Inorganic Chemistry, PharmaMed Press, Hyderabad.
7. Chenchu Lakshmi, N.V. Pharmaceutical Inorganic Chemistry: Theory and Practice, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), New Delhi.

**PHARMACEUTICS-I**  
**(GENERAL PHARMACY)**

**Unit I**

**History of pharmacy and Pharmacopoeia:** Origin and development of pharmacy, scope of pharmacy, introduction to Pharmacopoeias- IP, BP, USP and International Pharmacopoeia. Introduction to National Formularies and Extra Pharmacopoeia. An introduction to the contents of IP and parts of a monograph.

**Unit II**

**Prescription:** Definition, types of prescription, handling of prescription, legality of prescription and specific Latin terms used in modern day prescription (sos, od, bd, tid, qid).

**Pharmaceutical additives:** Coloring, flavoring and sweetening agents, co-solvents, preservatives and their applications.

**Unit III**

**Pharmaceutical calculations:** Weights and measures, weighing of solids and measurement of liquids.

**Posology:** Introduction, calculation of doses for infants, enlarging and reducing recipes.

Percentage solutions, alligation method, alcohol dilution, proof spirit.

**Unit IV**

**Introduction to Pharmaceutical dosage forms:** Classification, formulation methods of powders, mixtures, syrups and elixirs and their labeling requirements.

**Definitions:** Solutions, spirits, infusions, paints, aromatic waters, mouth washes, gargles, lotions, liniments, pastes, ointments, creams, inhalations, tinctures, lozenges and pastilles.

**Unit V**

**Size Reduction:** Definition, principles, laws and mechanisms governing size reduction, factors affecting size reduction. Study of ball mill and fluid energy mill. Introduction to sieving methods.

**Mixing:** Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing equipments.

**PHARMACEUTICS-I (GENERAL PHARMACY) PRACTICAL**

1. Preparation of following classes of pharmaceutical dosage forms (involving the use of calculations in metrology) as official in I.P., B.P., U.S.P.-N.F.
  - a) Aromatic Waters
    - i. Chloroform Water B.P.
    - ii. Concentrated Peppermint Water B.P.
    - iii. Strong Rose Water U.S.P.-N.F.
  - b) Mixtures
    - i. Mixture of Precipitated Chalk B.P.
    - ii. Kaolin Mixture B.P.
  - c) Syrups
    - i. Simple Syrup B.P./U.S.P./I.P.
    - ii. Ferrous Sulphate Syrup U.S.P.
  - d) Powders
    - i. ORS Powder I.P.
    - ii. Absorbable Dusting Powder U.S.P.-N.F.
    - iii. Effervescent Compound Powder B.P.C.
2. Study of the role of pharmaceutical additives in formulations
  - a) Colouring agent:
    - i. Compound Sodium Chloride Mouthwash B.P.
    - ii. Phenol Gargle B.P.C.
  - b) Flavouring agent:
    - i. Orange Tincture I.P.
    - ii. Potassium Citrate Mixture B.P.
  - c) Sweetening agents:
    - i. Simple Elixir I.P.
  - d) Cosolvents:
    - i. Camphor Water I.P.
    - ii. Compound Iodine Throat Paint I.P. (Mandl's Paint)
  - e) Preservatives:
    - i. Compound Zinc Sulphate Mouthwash B.P.C.
    - ii. Calamine Lotion I.P.
  - f) Surfactants:
    - i. Cresol with Soap Solution I.P.
    - ii. Turpentine Liniment B.P.
3. Experiments to illustrate principles of size reduction using Ball Mill. Effect of size of balls, number of balls and time on the efficiency of ball mill.
4. Experiments to illustrate mixing efficiency.

**BOOKS RECOMMENDED:**

1. Pharmacopoeia of India, The Controller of Publications, Delhi.
2. British Pharmacopoeia, Her Majesty's Stationary Office, University Press, Cambridge.
3. United States Pharmacopoeia (National Formulary).
4. Carter S.J., "Cooper and Gunn's Tutorial Pharmacy, CBS Publishers, Delhi.
5. Rawlins E.A., Bentley's Text Book of Pharmaceutics, ELBS Bailliere Tindall.
6. Lachman L, Lieberman H.A and Kanig J.L., Theory and Practice of Industrial Pharmacy, Lea & Febiger, Philadelphia.
7. Cooper and Gunn's Dispensing for Pharmaceutical Students, CBS Publishers, New Delhi.
8. Aulton M.E, Text Book of Pharmaceutics, Vol., I & II. Churchill Livingstone, London.
9. Remington, The Science and Practice of Pharmacy Vol. I & II. Mack Publishing Co., Pennsylvania.
10. Jain N.K., Modern Dispensing Pharmacy, 2nd Ed, PharmaMed Press/BPS Books, Hyderabad.

**ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY- I**

**Unit I**

Introduction to human body and organization of human body.

Functional and structural characteristics of cell.

Structural and functional characteristics of tissues- epithelial, connective, muscle and nerve.

**Unit II**

**Skeletal system:** Structure, composition and functions of skeleton. Classification of joints, types of movements of joints.

**Muscular system:** Anatomy and physiology of skeletal and smooth muscle, energy metabolism, types of muscle contraction, muscle tone.

**Unit III**

**Sense organs:** Basic anatomy and physiology of the eye (vision), ear (hearing), taste buds, nose (smell), and skin (superficial receptors).

**Unit IV**

**Communicable diseases:** Brief outline, causative agents, modes of transmission and prevention (chicken pox, measles, influenza, diphtheria, tetanus, tuberculosis, leprosy, poliomyelitis, malaria, rabies, dengue).

**Unit V**

Demography and family planning, medical termination of pregnancy.

**First aid:** Emergency treatment of shock, snake bites, burns, poisoning, fractures and resuscitation methods

## ***RPH-103P***

### **ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY-I PRACTICAL**

1. Study of types of microscopes, their parts and functions.
2. To draw and study the organization of human body.
3. To study the human skeletal system.
4. To study various types of joints.
5. To study different prepared slides- such as muscle, nerve cells, epithelial tissues, connective tissues etc.
6. Examination of color vision and acuity of vision.
7. Identification of different tastes.
8. Examination of ear.
9. Techniques of tying of different types of bandages.
10. Study of emergency treatments in case of burns and poisoning.
11. To prepare and study different charts related to pathophysiology of communicable diseases.

#### **BOOKS RECOMMENDED:**

1. Marieb E.N. Human Anatomy and Physiology, Benjamin Cummings (Pearson Education Inc.), San Francisco.
2. Park K., Preventive and Social Medicine, Banarsidas Bhanot Publishers, Jabalpur.
3. Seeley R.R., Stephens T.D. and Tate P. Essentials of Anatomy and Physiology, McGraw-Hill, New York.
4. Tortora G.J, and Anagnostikos NP Principles of Anatomy and Physiology, Harper & Row Publishers, New Delhi.
5. Ross & Wilson Anatomy and Physiology in Health and Illness, Churchill Livingstone, London.
6. Chatterjee C.C. Human Physiology, Medical Allied Agency, Calcutta.
7. Parmar N.S. Health Education and Community Pharmacy, CBS Publishers, Delhi.
8. Keele, C.A., Niel, E and Joels N, Samson Wright's Applied Physiology, Oxford University Press, New York.
9. Dandiya, P.C., Zafer, Z.Y.K., and Zafer, A. Health Education and Community Pharmacy, Vallabh Prakashan, Delhi.

## PHARMACEUTICAL ANALYSIS-I

### Unit I

Fundamentals of volumetric analysis, preliminaries and definitions, precision and accuracy, types of errors, methods of expressing concentration, primary and secondary standards, different techniques of analysis, Factors affecting the choice of analytical methods, significance of quantitative analysis in quality control.

### Unit II

**Acid base titrations:** Acid base concepts, role of solvent, relative strengths of acids and bases, ionization, common-ion effect, pH, hydrolysis of salts, Henderson-Hasselbach equation, buffer solution, neutralization curves, acid base indicators, theory of indicators, choice of indicators, mixed indicators, polyprotic system. Assay of boric acid as per I.P.

### Unit III

**Oxidation reduction titrations:** Concepts of oxidation and reduction, equivalent weights of oxidizing and reducing agents, theory of redox titrations-redox indicators, oxidation reduction curves. Titrations involving ceric sulphate, potassium permanganate, iodimetry and iodometry. Assay of ascorbic acid tablet as per I.P.

### Unit IV

**Complexometric titrations:** Principle, complexing agents, indicators, masking and demasking, types of complexometric titrations and applications. Assay of alum and determination of hardness of water.

**Precipitation titrations:** Precipitation reactions and techniques, solubility products, Mohr's method, Volhard's method and Fajan's method.

### Unit V

**Miscellaneous methods of analysis:** Diazotization titrations, Karl-Fischer titration. Kjeldahl's method of nitrogen determination. Radioassays (Autoradiography, RIA). Assay of sodium iodide ( $^{131}\text{I}$ ) solution as per I.P.

**PHARMACEUTICAL ANALYSIS-I PRACTICAL**

1. Study of general glassware and apparatus required for various analytical procedures.
2. Study of various types of balances, standardization of analytical weights, weighing and calibration of volumetric apparatus.
3. Preparation and standardization of acids and bases (Primary and secondary standards) as per I.P.
4. Assay procedure of various drugs using acid base titrations as per I.P.
5. Preparation and standardization of some redox titrants (potassium permanganate, potassium dichromate, iodine, sodium thiosulphate etc).
6. Assay procedure of various drugs using redox titrations as per I.P.
7. Preparation and standardization of EDTA as per I.P.
8. Assay of magnesium hydroxide and magnesium sulfate as per I.P.
9. Determination of hardness of water as per I.P.
10. Preparation and standardization of sodium nitrite as per I.P.
11. Assay of sulfa drugs using diazotization titration as per I.P.
12. Estimation of nitrogen in some organic compounds using Kjeldahl method.
13. Preparation and standardization of silver nitrate and ammonium thiocyanate as per I.P.
14. Titrations based on Mohr's, Volhard's and Fajan's methods.

**BOOKS RECOMMENDED:**

1. Mendham J., Denney R.C., Barnes J.D., Thomas M, Jeffery G.H., Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education Asia.
2. Connors K.A., A Text book of Pharmaceutical Analysis, Wiley Inter-science.
3. Beckett A.H., and Stenlake J.B., Practical Pharmaceutical Chemistry, Vol. I & II. Athlone Press, University of London.
4. British Pharmacopoeia, Her Majesty's Stationary Office, University Press, Cambridge.
5. Alexeyev V. Quantitative Analysis. CBS Publishers & Distributors, New Delhi.
6. The Pharmacopoeia of India, The Controller of Publications, Delhi.

## **COMPUTER FUNDAMENTALS**

### **Unit I**

Definition and overview of computer, computer classification, computer organization, computer code, input devices, output devices, storage devices. Computer software, types of software. overview of computer networks, LAN, MAN, WAN. Internet, network topology. Internetworking: Bridges, repeaters and routers.

### **Unit II**

**Introduction:** Operating system and function, evolution of operating system, batch, interactive, time sharing and real time system. Single user operating system and multi-user operating system. Basics in MS-DOS, internal and external commands in MS-DOS.

### **Unit III**

Introduction to MS-OFFICE-2007, word 2007 document creation, editing, formatting table handling, mail merge. Excel-2007, editing, working retrieval, important functions, short cut keys used in EXCEL.

### **Unit IV**

MS-Power point 2007-Job Profile, elements of Power point , ways of delivering presentation, concept of Four P's (planning, preparation, practice and presentation) ways of handling presentations, e.g. creating, saving slides show controls, adding formatting, animation and multimedia effects.

### **Unit V**

Computer applications in pharmaceutical and clinical studies, uses of internet in pharmaceutical industry.

**COMPUTER FUNDAMENTALS PRACTICAL**

Software lab to be used for the following:-

1. Windows, Managing Windows, Working with Disk, Folders and files.
2. MS-Office 2003 (MS Word, MS Power point, MS Excel, MS Access).
3. Computer Operating System like DOS and Windows.
4. Internet Features (E-mail, Browser etc.).

**BOOKS RECOMMENDED**

1. Sinha R.K., Computer Fundamentals, BPB Publications, New Delhi.
2. Raja Raman V., Computer Programming in 'C', PHI Publication, New Delhi.
3. Hunt N and Shelley J., Computers and Common Sense, Prentice Hall of India, New Delhi.
4. Tiwari, N.K., Computer fundamentals with Pharmacy Applications, PharmaMed Press, Hyderabad.
5. Rao G.N., Biostatistics and Computer Applications, PharmaMed Press/ BSP Books, Hyderabad.
6. Mansfield R., Working in Microsoft Office, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
7. Leon M. and Leon A., Fundamentals of Computer Science and Communication Engineering", UBS Publishers Distributors Ltd, New Delhi.
8. Norton, P. Peter Norton's Introduction to Computers, Tata McGraw-Hill, New Delhi.

## SECOND SEMESTER

**RPH-206/RPH-106**

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

#### **Unit I**

Introduction, classification and nomenclature of organic compounds.

Electron displacement in organic chemistry (inductive effect, resonance, hyperconjugation). Stereochemistry including geometrical isomerism, optical isomerism, specification of configuration and conformational analysis.

#### **Unit II**

Reaction intermediates (free radicals, carbocations, carbanions, carbenes and nitrenes).

Introduction to aliphatic hydrocarbons and some of their characteristic reactions with mechanisms such as; alkanes (free radical substitution), alkenes and dienes (electrophilic and free radical additions), alkynes, cycloalkanes (types of strain including Baeyer strain theory).

#### **Unit III**

Introduction to aliphatic organic compounds and some of their characteristic reactions with mechanisms such as; alkyl halides and alcohols (nucleophilic substitution and nucleophilic elimination), amines, aldehydes and ketones (nucleophilic addition), carboxylic acids and their derivatives (nucleophilic acyl substitution).

#### **Unit IV**

Introduction to aromatic organic compounds, aromaticity, structure of benzene, electrophilic substitution, orientation and reactivity in electrophilic aromatic substitution, nucleophilic substitution, arenes, phenols. Polynuclear hydrocarbons (naphthalene).

#### **Unit V**

**Introduction to synthetic organic chemistry:**  $\alpha$ ,  $\beta$ - Unsaturated carbonyl compounds. Compounds containing active methylene group (acetoacetic ester), organometallic compounds (Grignard's reagent), aryl diazonium salts and their synthetic importance.

Name reactions (including reaction mechanisms) and synthetic applications: Meerwein-Ponndorf-Verley reduction, Hofmann rearrangement, Mannich reaction, Diels Alder reaction.

**PHARMACEUTICAL CHEMISTRY-II**  
**(PHARMACEUTICAL ORGANIC CHEMISTRY-I) PRACTICAL**

1. Identification of organic compounds (including elements and functional groups).
2. Synthesis of compounds involving acetylation, benzylation, bromination, reduction and oxidation.  
Picric acid.  
Aniline.  
Acetanilide.  
Aspirin.  
Hippuric acid.  
*p*-Bromo acetanilide.  
Iodoform.  
Oxalic acid.
3. Purification of solvents like benzene, chloroform, acetone and preparation of absolute alcohol.

**BOOKS RECOMMENDED:**

1. Morrison R.T., Boyd R.N. and Bhattacharjee, S.K. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), New Delhi.
2. Finar I.L. Organic Chemistry, Vol. I & II, Pearson Education Ltd, New Delhi.
3. Bruice P.Y. and Prasad, K. J. R. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd, New Delhi.
4. Sykes P., A Guidebook to Mechanism in Organic Chemistry, Longman Group Ltd, London.
5. Singh M.S. Advanced Organic Chemistry: Reactions and Mechanisms, Dorling Kindersley (India) Pvt. Ltd, New Delhi.
6. Jain M.K. Organic Chemistry, Sohan Lal Nagin Chand & Co, New Delhi.
7. Mann F.G, and Saunders, B.C., Practical Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), New Delhi.
8. Vogel A.I., Elementary Practical Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), New Delhi.

**PHARMACEUTICAL CHEMISTRY-III**  
**(PHARMACEUTICAL PHYSICAL CHEMISTRY)**

**Unit I**

**Atomic structure and chemical bonding:** Atomic structure, atomic orbital, molecular orbital, hybridization, covalent (sigma and pi) bond, electrovalent bond.

**Chemical kinetics:** Elementary idea of reaction kinetics-zero, first and second order reaction, complex reactions. Characteristics of homogenous and heterogeneous catalysis, acid-base and enzyme catalysis.

**Unit II**

**Distribution law:** Distribution law and application to solvent extraction.

**Matter and its properties:** Physical properties (surface tension, parachor, viscosity, rheochor, refractive index, optical rotation, dipole moment). Liquid crystals, glassy state, crystalline and amorphous solids and polymorphism.

**Unit III**

**Thermodynamics:** Fundamentals, first, second, third and zeroth law, Joule-Thompson's effect, absolute temperature scale, conversion of temperature between different scales.

**Thermo chemistry:** Definition and sign conventions. Heat of reaction: heat of formation, heat of combustion, heat of neutralization, heat of solution, heat of phase changes. Bond enthalpies and Hess's law of constant heat summation.

**Unit IV**

**Electro-chemistry:** Faraday's laws of electrolysis, electric conductance and its measurement, molar and equivalent conductivity and its variation with dilution. Transport number and Kohlrausch law, degree of ionization and Ostwald dilution law. Theory of strong electrolytes (Debye Huckle theory).

**Unit V**

**Adsorption:** Definition, types and mechanism of adsorption, pharmaceutical applications of adsorption.

**Phase equilibria:** Phase, component, degree of freedom, sublimation critical point, cooling curves, phase rule. One and two component systems (e.g. water, KI-H<sub>2</sub>O).

**PHARMACEUTICAL CHEMISTRY-III**  
**(PHARMACEUTICAL PHYSICAL CHEMISTRY) PRACTICAL**

1. Determination refractive index of given liquids.
2. Determination of specific rotation of sucrose at various concentrations and determination of the intrinsic rotation.
3. Determination of rate constant of a simple reaction.
4. Determination of cell constant, verify Ostwald dilution law and perform conductometric titrations.
5. Determination of surface tension.
6. Determination of partition co-efficient.
7. Determination of viscosity.
8. Determine the parachor value.
9. Determine the rheochor value.
10. Determination of solubility.

**BOOKS RECOMMENDED:**

1. Engel T., Reid P. Physical Chemistry, Pearson Education, London.
2. Tinoco I.J., Sauer K., Wang J.C. and Puglisi J.D. Physical Chemistry principles and applications in biological sciences, Pearson Education, New Delhi.
3. Martin A., Bustamante P. and Chun A.H.C- Physical Pharmacy, Lea & Febiger, Philadelphia.
4. Mark L. Introduction to Physical Chemistry, Cambridge University Press, Cambridge.
5. Levine Ira N. Physical Chemistry, Tata McGraw-Hill Publishing Company, New Delhi.
6. Barrow G.M. Physical Chemistry, Tata McGraw-Hill Publishing Company, New Delhi.
7. Atkins P. and Paula, J.D. Atkins Physical Chemistry, Oxford University Press, New Delhi.
8. Bhasin S.K. Pharmaceutical Physical Chemistry, Pearson Education, New Delhi.
9. Negi A.S. and Anand S.C. Textbook of Physical Chemistry, Wiley Eastern Ltd, New Delhi.

## **ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY-II**

### **Unit I**

**Central nervous system:** Anatomy of different parts of brain and spinal cord, reflex action, electroencephalogram, specialized functions of the brain. Cranial nerves and their functions.

### **Unit II**

**Autonomic nervous system:** Physiology of the autonomic nervous system. Neurotransmitters, mechanism of neurohumoral transmission.

### **Unit III**

**Haemopoietic system:** Composition and function of blood and its elements, erythropoiesis, blood groups, blood coagulation, Anemia.

**Lymphatic system:** Composition, formation and circulation of lymph, lymph node and spleen, thymus and pathophysiology of hypersensitivity and allergy.

### **Unit IV**

**Urinary system:** Anatomy and physiology of urinary system, physiology of urine formation, acid-base balance, pathophysiology of renal failure, glomerulonephritis, urinary tract infection.

### **Unit-V**

**Digestive system:** Parts of digestive system, their structure and functions. Various gastro-intestinal secretions and their role.

Pathology of peptic ulcer, ulcerative colitis, irritable bowel syndrome, hepatitis, cirrhosis of liver, pancreatitis.

**ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY-II PRACTICAL**

1. Microscopic study of different tissues.
2. Haematological experiments:
  - a) Estimation of haemoglobin in blood.
  - b) Determination of bleeding time, clotting time.
  - c) R.B.C. Count.
  - d) Total leucocyte count (TLC), Differential leukocyte count (D.L.C.)
  - e) E.S.R. and blood group.
3. Recording of body temperature, pulse rate and blood pressure.

**BOOKS RECOMMENDED:**

1. Difore S.H., Atlas of Normal Histology, Lea & Febiger, Philadelphia.
2. Tortora, G.J., Anagnodokos N.P., Principles of Anatomy and Physiology, Harper & Rave Publishers, New Delhi.
3. Dipiro J.L., Pharmacotherapy- A Pathophysiological Approach, Elsevier, Amsterdam.
4. Seeley R.R., Stephens T.D. and Tate, P. Essentials of Anatomy and Physiology, McGraw-Hill, New York.
5. Guyton A.C., Hall JE., Text book of Medical Physiology, WB Saunders Company, Philadelphia.
6. Ross and Wilson, Anatomy and Physiology in Health and Illness, Churchill Livingstone, London.
7. Chatterjee C.C. Human Physiology, Medical Allied Agency, Calcutta.
8. Zdanowicz, M. M. Essentials of Pathophysiology for Pharmacy, CRC Press, Boca Raton.
9. Chaurasia B.D, Human Anatomy, Regional & Applied Part I, II & III, CBS Publishers & Distributors, New Delhi.
10. Sood, R. Medical Laboratory Technology: Methods and Interpretation, Jaypee Brothers, New Delhi.

**PHARMACOGNOSY– I**

**Unit I**

Definition history, scope and development of pharmacognosy.

**Source of drug:** Biological, marine, mineral and plant tissue culture as source of drugs.

**Classification of drugs:** Morphological, taxonomical, chemical and pharmacological, chemotaxonomy.

**Unit II**

**Plant Description:** Morphology and anatomy of leaves, woods, barks, inflorescences and flowers, fruits and seeds.

**Unit III**

**Propagation, cultivation, collection, processing and storage of crude drugs:**

- a. Factors influencing cultivation of medicinal plants, type of soils and fertilizers of common use.
- b. Pest management and natural pest control agents.
- c. Plant hormones and their applications.
- d. Polyploidy, mutation and hybridization with reference to medicinal plants.
- e. Poly Houses/ Green houses for cultivation.

**Unit IV**

**Quality control of crude drugs:** Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation (including quantitative microscopy).

**Unit V**

**Systematic pharmacognostic study of following:**

**Carbohydrates and derived products:** Agar, Acacia, Honey, Isabgol, Starch, Tragacanth.

**Lipids:** Beeswax, Castor oil, Cocoa butter, Kokum butter, Hydnocarpus oil, Cod liver oil, Linseed oil, Wool fat, Rice-bran oil.

**PHARMACOGNOSY-I PRACTICAL**

1. Morphological characteristics of plant parts mentioned in theory.
2. Microscopical measurements of cell and cell contents-starch grains, calcium oxalate crystals and phloem fibres.
3. Determination of leaf constants such as stomatal index, stomatal numbers, vein islet numbers, vein termination number and palisade ratio.
4. Identification of crude drugs belonging to carbohydrates and lipids.
5. Preparation of herbarium sheets.

**BOOKS RECOMMENDED:**

1. Pharmacopoeia of India, 2010 Edition, The Controller of publications, Vol. III, Delhi.
2. Trease G.E. and Evans W.C., Pharmacognosy, Bailliere Tindall, East Bourne.
3. Wallis T.E., Text book of Pharmacognosy, J & A Churchill, Ltd, London.
4. Wallis T.E., Analytical Microscopy, J & A Churchill Limited, London.
5. Brain K.R. and Turner T D. The Practical Evaluation of Phytopharmaceuticals, Wright-Scientifica, Bristol.
6. Dutta A.C, Botany, Oxford University Press, New Delhi.
7. Schewer P.J., Marine Natural Products, Academic Press, London.
8. Wallis T.E. Practical Pharmacognosy, PharmaMed Press, Hyderabad.
9. Kokate C.K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.

**PHARMACEUTICAL MATHEMATICS AND BIostatISTICS**

**Unit I**

Determinants, properties of determinants, solution of simultaneous equations by Cramer's rule. Matrices, properties of matrices, solution of simultaneous equations by matrices. Pharmaceutical applications of determinants and matrices.

**Unit II**

Limit of functions, differentiation of logarithmic, trigonometric and exponential function (not proof), chain rule, integration as reverse of differentiation, method of substitution, integration by parts.

**Unit III**

Methods of collection of data, diagrammatic representation of data (Pie, Histogram, Bar diagram), types of sampling; mean, median, mode and standard deviation.

**Unit IV**

Karl Pearson's coefficient of correlation, regression, method of least square of straight line, t-test,  $\chi^2$  test, F-test.

**Unit V**

Probability: Simple probability, addition and multiplication of probabilities, binomial, Poisson's and normal distributions.

**PHARMACEUTICAL MATHEMATICS AND BIOSTATISTICS PROJECT**

1. Collection of data by survey methods.
2. Classification and tabulation of data.
3. Frequency distribution table for collected data (discrete and continuous).
4. Calculation of mean, median, mode, standard deviation and coefficient of variation for collected data.
5. Graphical representation of frequency distribution of collected data (histogram, frequency polygram, frequency curve and ogive curve).
6. Chi-square testing for data analysis.

**BOOKS RECOMMENDED:**

1. Blair R.C., Taylor, R.A. Biostatistics for the Health Sciences, Dorling Kindersley India Pvt., Ltd.
2. Gupta S.P. Statistical Methods, Sultan Chand & Sons, New Delhi.
3. Khan I.A. and Khanum, A. Biostatistics for Pharmacy, Ukaaz Publications, Hyderabad.
4. Prasad G. Textbook of Differential Calculus, Pothishala Pvt. Ltd, Allahabad.
5. Prasad G. Textbook of Integral Calculus, Pothishala Pvt. Ltd, Allahabad.
6. A Textbook of Mathematics for XI-XII Students, Vol. I-IV, NCERT Publications, New Delhi.