

**DETAILS OF COURSES FOR PHARM-D
SEMESTER SYSTEM**

FIRST PROFESSIONAL

FIRST SEMESTER

Chem-103 PHARMACEUTICAL CHEMISTRY-IA (Organic) 4(3-1)

THEORY

NOTE: The topics will be taught with special reference to their Pharmaceutical Applications.

1. **BASIC CONCEPTS:** Chemical Bonding and concept of Hybridization, Conjugation, Resonance (Mesomerism), Hyperconjugation, Aromaticity, Inductive effect, Electromeric effect, Hydrogen bonding, Steric effect, Effect of structure on reactivity of compounds, Tautomerism of Carbonyl Compounds, Nomenclature of Organic Compounds.
2. **STEREOCHEMISTRY/ CONFORMATIONAL ANALYSIS:** Stereoisomerism, optical isomerism; Molecules with more than one chiral center, Geometrical isomerism, Resolution of racemic mixture, Conformational analysis.
3. **GENERAL METHODS OF PREPARATION, PROPERTIES, IDENTIFICATION TEST AND PHARMACEUTICAL APPLICATIONS OF THE FOLLOWING CLASSES AND THEIR ANALOGUES:**
 - i. Alkane, Alkenes, Alkynes, Aromatic compounds
 - ii. Alkyl halide, Alcohol, phenols, ethers, amines
 - iii. Ketones, Aldehydes
 - iv. Acids, Esters, Amides and derivatives
4. **NUCLEOPHILIC, ELECTROPHILIC SUBSTITUTION REACTION IN ALIPHATIC AND AROMATIC SYSTEMS:**
5. **ORIENTATION IN ELECTROPHILIC SUBSTITUTION REACTIONS ON BENZENE RING:**

PRACTICAL

Hazards in the chemistry laboratory, hazards from dangerous chemicals (corrosive and toxic chemicals, carcinogens, explosive and flammable chemicals). Good laboratory practices. Organic analysis: Identification of unknown simple organic compounds. Identification of functional groups; Carboxylic, hydroxyl, amino and nitro groups by wet organic analysis.

RECOMMENDED BOOKS

1. Sykes, A.P., 2009. A Guide Book to Mechanism in Organic Chemistry. 6th Ed., Lonsmen Co., London, UK.
2. Eliel, E.L., 2005. Stereochemistry of Carbon Compounds. Tata McGraw-Hill, New Delhi, India.
3. Morrison, R.T. and R.N. Boyd, 2005. Organic Chemistry. 6th Ed., Asoke K. Ghosh Prentice Hall of India Pvt. Ltd., India.

4. Finar, L., 2001. Organic Chemistry. (Vol.1) 6th Ed., Person Education Asia, New Delhi, India.
5. Rahman, U.S. and M. Younis, 1997. Organic Chemistry for B.Sc. Students. Ilmi Kitab Khana, Lahore, Pakistan.
6. Bhal, B.S., 1995. Text Book of Organic Chemistry. 14th Ed., S Chand & Co. New Delhi, India.
7. Naser-ud-Din., 1994. Introduction to Stereochemistry. Ghafoor Stationary Mart, Peshawar, Pakistan.
8. Bansel, R.K., 1998. Organic Reaction Mechanism. Tata MacGraw-Hill, New Delhi, India.
9. Sykes, P., 1991. A Guide Book to Mechanism in Organic Chemistry. 1st Ed., Longman, New York, USA.
10. Roberts, J.D. and M.C. Caserio, 1990. Basic Principles of Organic Chemistry. W.A. Benjamin, New York, USA.

Biochem-105

PHARMACEUTICAL CHEMISTRY IIA (Biochemistry)

4(3-1)

THEORY

1. GENERAL INTRODUCTION AND BASIC BIOCHEMICAL PRINCIPLES:

Role of Pharmaceutical Biochemistry in the health profession. Nature of biochemical reactions.

2. BASIC CHEMISTRY OF BIOMOLECULES: (Nature, Classification etc.)

- a) Carbohydrates: Chemistry, Classification, Reactions of Carbohydrates, Optical activity, Biological and pharmaceutical importance of carbohydrates.
- b) Lipids: Chemistry of Fatty acids and Lipids, Classification (Saponifiable and non-saponifiable lipids, Simple, Complex and Derived lipids), Reactions of Fatty acids and other Lipids, Essential fatty acids, Biological and pharmaceutical importance of lipids.
- c) Proteins and Amino acids: Chemistry, Classification of proteins and amino acids, Reactions of proteins and amino acids, Organizational levels, Macromolecular nature of proteins, Biological and pharmaceutical importance of proteins and amino acids.
- d) Nucleic Acids: Chemistry, Types (DNA, RNA, mRNA, tRNA, rRNA), Purine and Pyrimidine bases, Nucleosides, Nucleotides, Structures of nucleic acids, Biological and pharmaceutical importance of nucleic acids.
- e) Vitamins: Chemistry, Classification (Fat-soluble and water-soluble vitamins), Biological and pharmaceutical importance of vitamins.
- f) Hormones: Chemistry, Classification (Proteinous and nonproteinous hormones, amino acid derivatives, steroids), Biological and pharmaceutical importance of hormones.
- g) Enzymes: Chemistry, Classification, Mode of action, Kinetics (Michaelis Menten Equation and some modifications), Inhibition, Activation, Specificity, Allosteric enzymes, Factors affecting the rate of an enzyme-catalyzed reaction, Biological and pharmaceutical importance, Mechanism of action of some important enzymes (Chymotrypsin, Ribonuclease).

PRACTICAL

Hazards and safety in the clinical biochemistry laboratory. Qualitative analysis of: Carbohydrates, amino acids, peptides and proteins, lipids and sterols (cholesterol), bile salts and bilirubin. Analysis of normal and abnormal components of urine including sugar, uric acid, bilirubin, urea and creatinine.

RECOMMENDED BOOKS

1. Champe, P.C., R.A. Harvey and D.R. Ferrier, 2011. Lippincott's Illustrated Reviews: Biochemistry. 5th Ed. Lippincott William and Wilkins, Philadelphia, USA.
2. Nelson, D.L. and M.M. Cox, 2008. Lehninger Principles of Biochemistry. 5th Ed., W. H. Freeman and Company, New York, USA.

3. Chatterjee, M.N. and R. Shinde, 2012. Textbook of Medical Biochemistry. 8th Ed., Jaypee Brothers, Medical Publishers, New Dehli, India.
4. Berg, J.M., J.L. Tymoczko and L. Stryer. 2007. Biochemistry. 6th Ed., W. H. Freeman and Company, Alibris, UK.
5. Ahmed, M., 2006. Essentials of Medical Biochemistry. Merit Pub. Faisalabad, Pakistan.
6. Gowenlock, A.H., J.R. McMurray and D.M. McLauchlan, 2006. Varley's Practical Clinical Biochemistry, 6th Ed., CBS Publishers and Distributors, New Dehli, India.
7. Koolamn, J. and K.H. Roehm, 2005. Color Atlas of Biochemistry. 2nd Ed., Thieme Stuttgart, New York, USA.
8. Sood, R., 2005. Medical Laboratory Technology: Methods and Interpretations. 5th Ed., Jaypee Brothers, Medical Publishers Ltd., New Delhi, India.
9. Voet, D. and J.G. Voet, 2004. Biochemistry. 3rd Ed., John Wiley and Sons. Inc, New York, USA.
10. Murray, R.K., D.G. Garnner, P.A. Mayes and V.W. Rodwell. 2012. Harper's Illustrated Biochemistry. 29th Ed., McGraw Hill, New Delhi, India.

Pharm-D-101

PHARMACEUTICS-IA (Physical Pharmacy)

4(3-1)

THEORY

1. PHARMACY ORIENTATION:

Introduction and orientation to the Profession of Pharmacy in relation to Hospital Pharmacy, Retail Pharmacy, Industrial Pharmacy, Forensic Pharmacy, Pharmaceutical education and research etc.

2. HISTORY AND LITERATURE OF PHARMACY:

- a. A survey of the history of pharmacy through ancient Greek and Arab periods with special reference to contribution of Muslim scientists to pharmacy and allied sciences.
- b. An introduction of various official books.

3. PHYSICO-CHEMICAL PRINCIPLES:

- a. Solutions: Introduction, types, concentration expressions, ideal and real solution, colligative properties, their mathematical derivations and applications in pharmacy, molecular weight determinations, distribution co-efficient and its applications in pharmacy.
- b. Solubilization: Factors affecting solubility. Surfactants, their properties and types. Micelles; their formulation and types.
- c. Adsorption: Techniques and processes of adsorption in detail.
- d. Ionization: pH, pH indicators, pka, buffers, buffer's equation, isotonic solutions and their applications in pharmacy.
- e. Hydrolysis: Types and protection of drugs against hydrolysis.
- f. Micromeritics: Particle size, shapes and distribution of particles. Methods of determination of particle size and importance of particle size in Pharmacy.

4. DISPERSIONS:

- a. Colloids: Types, methods of preparation, properties (optional, kinetic, electrical). Dialysis and artificial kidney, stability of colloids, protection and sensitization phenomenon and application of colloids in Pharmacy.
- b. Emulsions: Types, theories of emulsification, emulsifying agents their classification and stability of emulsion.

Suspensions: Type, Methods of Preparation, Properties, Suspending agents, their classification and stability.

PRACTICAL

Experiments to demonstrate some of the physico-chemical processes like simple distillation, steam distillation, crystallization, sublimation, centrifugation and dialysis. Determination of particle size and shape, preparation of buffer solutions and isotonic solutions. Determination of pH. Determination of refractive index of various solvents such as: Ethanol, methanol, acetone, polyethylene glycol, hexane and

mineral oils etc. Acid-base titrations: Sulfuric acid, hydrochloric acid, bicarbonate, sodium hydroxide, Sodium bicarbonate etc. Determination of the density and specific gravity of different solvents.

RECOMMENDED BOOKS

1. Sinko, P.J. and A.N. Martin, 2012. Martin's Physical Pharmacy and Pharmaceutical Sciences. 6th Ed., Lippincott Williams & Wilkins, USA.
2. Cherng-ju Kim., 2004. Advanced Pharmaceutics: Physicochemical Principles. CRC Press, USA.
3. Allen, L.V., N.G. Popovich and H.C. Ansel, 2010. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 9th Ed., Lippincott Williams & Wilkins, USA.
4. Amiji, M.M. and B.J. Sandmann, 2003. Applied Physical Pharmacy. McGraw-Hill Professional, USA.
5. Sanjay K.J., Vandana S. 2012. Bentley's Text Book of Phrmaceutics; an Adaptation. 1st Ed. Elsevier. USA
6. Aulton, M.E., 2013. Pharmaceutics: The Science of Dosage Form Design. 4th Ed., Churchill Livingstone, Edinburgh, UK.
7. Banker, G.S. and C.T. Rhodes, 2002. Modern Pharmaceutics. 4th Ed., Informa Health Care, UK.

Pharm- D-102

PHYSIOLOGY -A

4(3-1)

THEORY

1. BASIC CELL FUNCTIONS:

- a. Chemical composition of the body: Atoms, Molecules, Ions, Free Radicals, Polar Molecules, Solutions, Classes of Organic Molecules
- b. Cell structure: Microscopic Observation of Cell, Microscopic, Cell Organelles, Cytoskeleton.
- c. Protein activity and cellular metabolism: Binding Site Characteristics, Regulation of Binding site Characteristics, Chemical Reactions, Enzymes, Regulation of Enzyme Mediated Reactions, Multienzyme metabolic Pathways, ATP, Cellular Energy Transfer, Carbohydrate, Fat, and Protein Metabolism, Essential Nutrients.
- d. Genetic information and Protein Synthesis: Genetic Code, Protein Synthesis, Protein, Degradation, Protein Secretion, Replication and Expression of Genetic Information, Cancer, Genetic Engineering.
- e. Movement of Molecules across Cell Membranes: Diffusion, Mediated Transport Systems, Osmosis, Endocytosis and Exocytosis, Epithelial Transport.

2. BIOLOGICAL CONTROL SYSTEM:

- a. Homeostatic Mechanisms and Cellular Communication: General Characteristics, Components of Homeostatic Control Systems, Intercellular Chemical Massengers, Processes Related to Homeostasis, Receptors, Single Transduction Pathways.
- b. Neural Control Mechanisms: Structure and Maintenance of Neurons, Functional Classes of Neurons, Glial Cells, Neural Growth and Regeneration, Basic Principles of Electricity, The resting Membrane Potential, Graded Potentials and Action Potentials, Functional Anatomy of synapses, Activation of the Postsynaptic Cell, Synaptic Effectiveness, Neurotransmitters and Neuromodulators, Neuroeffector communication, Central Nervous System: Spinal Cord Central Nervous System: Brain, Peripheral Nervous System, Blood Supply, Blood-Brain Barrier Phenomenon, and Cerebrospinal fluid.
- c. The Sensory Systems: Receptors, Neural Pathways in Sensory System, Association Cortex and Perceptual Processing, Primary Sensory Coding, Somatic Sensation, Visio, Hearing, Vestibular System, Chemical Senses.
- d. Principles of Hormonal Control Systems: Hormone Structures and Synthesis, Hormone Transport in the Blood, Hormone Metabolism and Excretion, Mechanisms of Hormone Action, Inputs that control Hormone Secretion, Control Systems Involving the Hypothalamus and Pituitary, candidate Hormones, types of Endocrine Disorders.

- e. Muscle: Structure, Molecular Mechanisms of Contraction, Mechanics of Single fiber Contraction, Skeletal Muscle Energy Metabolism, Types of Skeletal Muscle Fibers, Whole Muscle Contraction, Structure, Contraction and its Control.
- f. Control of Body Movement: Motor Control Hierarchy, Local control of Motor Neurons, The Brain Motor Centers and the Descending Pathways they Control, Muscle Tone, Maintenance of Upright Posture and Balance, Walking.

Consciousness and Behavior: State of consciousness, conscious Experiences, Motivation and Emotion, Altered State of Consciousness, Learning and Memory, Cerebral Dominance and language Conclusion.

PRACTICAL

Eye: Visual activity, far vision and near vision. Field of vision (perimetry). CNS: Nerve muscle preparation in frog. Effect of temperature on muscle activity. Rabbit intestine assay. Demonstration of spinal reflexes.

RECOMMENDED BOOKS

1. Guyton, A.C., 2010. Text Book of Medical Physiology. 12th Ed., W.B. Saunders Company. Philadelphia, USA.
2. Rahman, U.Z., J.A. Khan, T. Khaliq and A. Ali, 2012. Manual of Physiology-I. MAS Computers, Faisalabad, Pakistan.
3. Gillian, P. and D.R. Christopher, 2006. Human physiology: The Basis of Medicine. 3rd Ed., Oxford University Press, UK.
4. Ganong, W.F., 2012. Review of Medical Physiology. 24th Ed., Prentice Hall International Inc., McGraw Hill Professional, New York, USA.
5. Spence, A.P. and E.B Mason, 1992. Human Anatomy and Physiology. St. Paul, West publishing, USA.

Anat-105

ANATOMY

3(3-0)

THEORY

Anatomical terminology, functions and its classification of skeleton, introduction to various bones and joints of the body, arthrology, muscular system of the body. Introduction to various body organ systems: Digestive system: oral cavity, esophagus, stomach, small and large intestine and accessory digestive glands. Respiratory system: nostrils, nasal cavity, pharynx, larynx, trachea, lungs and pleura. Circulatory system: heart with blood and lymph vessels, lymphatic organs including lymph node, spleen, thymus and tonsils. Urinary system: structure of organs of urinary system and their functional interrelationship. Male and female reproductive systems. Nervous system: Central and peripheral nervous system. Autonomic nervous system: sympathetic and parasympathetic nervous system. Endocrine system.

RECOMMENDED BOOKS

1. Henry, G., S. Standring, H. Ellis and B.K.B. Berkovitz, 2008. Gray's Anatomy: The Anatomical Basis of Clinical Practice. 40th Ed., Elsevier Churchill, Livingstone, UK.
2. Romanes, G.J., 1996. Cunningham's Manual of Practical Anatomy. Humphary Kalfom, Oxford University Press, London, UK.
3. Romanes, J.G., 1996. Cunningham's Textbook of Anatomy. Oxford University Press, London, UK.
4. More, K.L. and T.V.N. Persaud, 1996. Clinically Originated Human Anatomy. W.B. Saunders, Philadelphia, USA.
5. Grant, B.A., 1952. Method of Anatomy. 5th Ed., Bailliere Tinal and Co. Ltd., London, UK.
6. Richard. S. Snell. 2000. Clinical Anatomy. 9th Ed. Wolters Cluwer, Lippincott William and Wilkins. Philadelphia. USA

THEORY

Overview of histology, methods of histology. Introduction of cell: Structure of cell organelles, inclusions, cytoskeleton, relationships to cell function. Basic tissues: Epithelium (classification, shape, distribution and function), cell surface specializations. Connective and supportive tissues including blood, cartilage, bone (classification, distribution and function). Muscle tissue (types, distribution and function). Nervous tissue (neuron and its type, neuroglia-classification and distribution). Nervous system: brain, spinal cord, meninges. peripheral nervous system: nerves, ganglia, synapses.

PRACTICAL

Demonstration of preparation and staining of tissue sections. Demonstration of electron micrographs of cell and its component. Identification of microscopic sections of epithelium, connective and supportive tissues, nervous tissues, nervous system.

RECOMMENDED BOOKS

1. Qureshi, A.S. and M.N Chaudhry, 2009. Illustrated Histology and Embryology. Department of Anatomy, University of Agriculture Faisalabad, Pakistan.
2. Cormack, H.D., 2001. Essential Histology. 2nd Ed. J.B Lippincott Co., Philadelphia, USA.
3. Hammersen, F., 1985. Histology: Color Atlas of Microscopic Anatomy. Lee & Febijer Co., Pennsylvania, USA.
4. Bradbury, S., 1984. Hewer's Text Books of Histology. ELBS, London, UK.

THEORY

Basics of Grammar: Parts of speech and use of articles. Sentence structure, active and passive voice; Practice in unified sentence. Analysis of phrase, clause and sentence structure. Transitive and intransitive verbs, punctuation and spelling.

Comprehension: Answers to questions on a given text.

Discussion: General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students).

Listening: Improve listening skills by showing documentaries/films carefully selected by subject teacher.

Translation skills: Urdu to English.

Paragraph writing: Topics to be chosen at the discretion of the teacher.

Presentation skills: Introduction & practice to improve presentation skills.

NOTE: Extensive reading is required for vocabulary building.

SECOND SEMESTER

Chem-105

PHARMACEUTICAL CHEMISTRY-IB (Organic)

4(3-1)

THEORY

Note: The topics will be taught with special reference to their pharmaceutical applications.

1. **HETEROCYCLIC CHEMISTRY:**

- i. Preparation and properties of medicinally important Heterocyclic Compounds such as pyrol, furan, thiophene, pyridine, pyrimidine and pyrazine.
- ii. Preparation and properties of heterocyclic compounds in which benzo-ring is fused with five and six membered ring containing one hetero atom; Indole, Quinoline and Isoquinoline.

2. **REACTION MECHANISM:**

Organic Reaction Mechanism: Arndt-Eistert reaction, Baeyer-Villiger oxidation, Diels Alder reaction; Grignard's reaction, Metal Hydride reduction and Wolff Kishner reduction, Friedel Craft's reaction, Perkin reaction, Cannizzaro's reaction, Mannich reaction.

3. **REACTIVE INTERMEDIATE AND FREE RADICALS:**

Introduction: Generation, stability and Reaction of the following Intermediates; Carbocations, Carbanions, Carbenes, Nitrenes, Benzynes.

Type of reactions: An Overview.

Free radicals: Free radical scavengers and their applications.

4. **CARBONIUM ION REARRANGEMENTS:**

Pinacol-Pinacolone, Wagner-Meerwein, Wolff, Hofmann and Beckmann rearrangements.

5. **CARBANIONS:**

Condensation reaction (Aldol condensation, Favorskii rearrangement, Wittig rearrangement).

PRACTICAL

Estimation of functional groups; Carboxylic, hydroxy, amino and nitro groups; determination of molecular weights of organic compounds. Organic preparations like benzoic acid, aspirin, acetanilide, iodoform, nitrophenol, 3-nitrophthalic acid, benzhydrol, 2, 4-dinitro-cholorbenzene.

RECOMMENDED BOOKS

1. Eliel, E.L., 2005. Stereochemistry of Carbon Compounds. Tata McGraw-Hill, New Delhi, India.
2. Morrison, R.T. and R.N. Boyd, 2005. Organic Chemistry. 6th Ed., Asoke K. Ghosh Prentice Hall of India Pvt. Ltd., India.
3. Finar, L., 2001. Organic Chemistry. (Vol.1) 6th Ed., Person Education Asia, New Delhi, India.
4. Rahman, U.S. and M. Younis, 1997. Organic Chemistry for B.Sc. Students. Ilmi Kitab Khana, Lahore, Pakistan.
5. Bhal, B.S., 1995. Text Book of Organic Chemistry. 14th Ed., S Chand and Co. New Delhi, India.
6. Naser-ud-Din., 1994. Introduction to Stereochemistry. Ghafoor Stationary Mart, Peshawar, Pakistan.
7. Bansel, R.K., 1998. Organic Reaction Mechanism. Tata McGraw-Hill, New Delhi, India.
8. Sykes, P., 1991. A Guide Book to Mechanism in Organic Chemistry. 1st Ed., Longman, New York, USA.
9. Roberts, J.D. and M.C. Caserio, 1990. Basic Principles of Organic Chemistry. W.A. Benjamin, New York, USA.

THEORY**1. METABOLIC FATE OF BIOMOLECULES (Anabolism and Catabolism):**

- a. Carbohydrates: Brief introduction to the digestion and absorption of carbohydrates, Aerobic and anaerobic breakdown of Glucose, Glycolysis, Pentose Phosphate Pathway, Glycogenolysis, Glycogenesis, Gluconeogenesis, Citric acid cycle, Energetics of various metabolic processes.
- b. Lipids: Brief introduction to the digestion and absorption of lipids, Oxidation of fatty acids through β -oxidation, Biosynthesis of fatty acids, neutral lipids and cholesterol.
- c. Proteins and Amino acids: Brief introduction to the digestion and absorption of proteins and amino acids, Metabolism of essential and non-essential amino acids, Biosynthesis and catabolism of Haemins and porphyrin compounds.
- d. Bioenergetics: Principles of bioenergetics, Electron transport chain and oxidative phosphorylation.

2. REGULATION OF METABOLIC PROCESSES:

- a. Role of Vitamins: Physiological role of Fat-soluble (A, D, E and K) and Water-soluble (Thiamin, Riboflavin, Pantothenic acid, Niacin, Pyridoxal phosphate, Biotin, Folic acid, Cyanocobalamin-members of B-complex family and Ascorbic acid), Coenzymes and their role in the regulation of metabolic processes.
- b. Receptor Mediated regulation (Hormones): Mechanism of action of hormones, Physiological roles of various hormones, Site of synthesis and target sites of hormones.
- c. Secondary Messengers: Role of cAMP, Calcium ions and phosphoinositol in the regulation of metabolic processes.
- d. Gene Expression: Replication, Transcription and Translation (Gene expression) Introduction to Biotechnology and Genetic Engineering, Basic principles of Recombinant DNA technology, Pharmaceutical applications, Balance of Catabolic, Anabolic and Amphibolic processes in human metabolism, Acid-Base and Electrolyte Balance in Human body.

3. INTRODUCTION TO CLINICAL CHEMISTRY:

Introduction and importance of the clinical chemistry. Laboratory tests in diagnosis of diseases including Uric acid, Cholesterol, Billirubin and Creatinine.

PRACTICAL

Estimation of glucose, total proteins and albumin by spectrophotometer, serum minerals, lipid profile (total lipids, triglycerides, total cholesterol, HDL cholesterol, etc). Clinical enzyme: Alanine amino transferase (ALT), aspartate aminotransferase (AST), lactate dehydrogemnse (LDH), creatine kinase (CK), alkaline phosphatase. Estimation of vitamin A and C. Units and reference values.

RECOMMENDED BOOKS

1. Champe, P.C., R.A. Harvey and D.R. Ferrier, 2011. Lippincott's Illustrated Reviews: Biochemistry. 5th Ed. Lippincott William and Wilkins, Philadelphia, USA.
2. Nelson, D.L. and M.M. Cox, 2008. Lehninger Principles of Biochemistry. 5th Ed., W. H. Freeman and Company, New York, USA.
3. Chaterjee, M.N. and R. Shinde, 2012. Textbook of Medical Biochemistry. 8th Ed., Jaypee Brothers, Medical Publishers, New Dehli, India.
4. Berg, J.M., J.L. Tymoczko and L. Stryer. 2007. Biochemistry. 6th Ed., W. H. Freeman and Company, Alibris, UK.
5. Ahmed, M., 2006. Essentials of Medical Biochemistry. Merit Pub. Faisalabad, Pakistan.
6. Gowenlock, A.H., J.R. McMurray and D.M. McLauchlan, 2006. Varley's Practical Clinical Biochemistry, 6th Ed., CBS Publishers and Distributors, New Dehli, India.

7. Koolamn, J. and K.H. Roehm, 2005. Color Atlas of Biochemistry. 2nd Ed., Thieme Stuttgart, New York, USA.
8. Sood, R., 2005. Medical Laboratory Technology: Methods and Interpretations. 5th Ed., Jaypee Brothers, Medical Publishers Ltd., New Delhi, India.
9. Voet, D. and J.G. Voet, 2004. Biochemistry. 3rd Ed., John Wiley and Sons. Inc, New York, USA.
10. Murray, R.K., D.G. Garnner, P.A. Mayes and V.W. Rodwell, 2012. Harper's Illustrated Biochemistry. 29th Ed., McGraw Hill, New Delhi, India.

Pharm-D-103

PHARMACEUTICS-IB (Physical Pharmacy)

4(3-1)

THEORY

1. **RHEOLOGY:** Definition and Fundamental concept; Properties contributing to Rheological behaviour; Graphic presentation of Rheological data.
2. **PHYSICOCHEMICAL PROCESSES:**
 - a. **Precipitation:** Process of precipitation and its applications in Pharmacy.
 - b. **Crystallization:** Types of crystals, Mechanism and methods of crystallization and its applications in Pharmacy.
 - c. **Distillation:** Simple distillation, fractional distillation, steam distillation, vacuum distillation, destructive distillation and their applications in Pharmacy.
 - d. **Miscellaneous Processes:** Efflorescence, deliquescence, lyophilization, elutriation, exciccation, ignition, sublimation, fusion, calcination, adsorption, decantation, evaporation, vaporization, centrifugation, dessication, levigation and trituration.
3. **EXTRACTION PROCESSES:**
 - (i) Maceration: Purpose & process.
 - (ii) Percolation: Purpose and Process.
 - (iii) Liquid-Liquid extraction: Purpose and Process.
 - (iv) Large scale extraction: Purpose and Process.
4. **RATE AND ORDER OF REACTIONS:**
5. **KINETIC PRINCIPLES AND STABILITY TESTING:**
THEORETIC CONSIDERATIONS: Degradation:
 - a. **Physical Factors:** Influence of pH, temperature, ionic strength, acid-base catalysis, U.V. light.
 - b. **Chemical Factors:** Complex chemical reactions, Oxidation-reduction reactions, Hydrolysis.

PRACTICAL

Determination of emulsion systems such as oil in Water emulsion system: Olive oil emulsion, mustard emulsion, mineral oil emulsion. Determination of %age composition of solutions by specific gravity method. Determination of partition-coefficient of various acidic and basic drugs, surface tension, viscosity, pH of some basic and acidic drugs. Preparation of emulsions, suppositories. Oxidation-reduction titrations. Argentometric titrations. Determination of specific gravity of liquid paraffin emulsion.

RECOMMENDED BOOKS

1. Sinko, P.J. and A.N. Martin, 2012. Martin's Physical Pharmacy and Pharmaceutical Sciences. 6th Ed., Lippincott Williams & Wilkins, USA.
2. Cherng-ju Kim, 2004. Advanced Pharmaceutics: Physicochemical Principles. CRC Press, USA.
3. Allen, L.V., N.G. Popovich and H.C. Ansel, 2010. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 9th Ed., Lippincott Williams & Wilkins, USA.

4. Amiji, M.M. and B.J. Sandmann, 2003. Applied Physical Pharmacy. McGraw-Hill Professional, USA.
5. Sanjay K.J., Vandana S. 2012. Bentley's Text Book of Phrmaceutics; an Adaptation. 1st Ed. Elsevier. USA
6. Aulton, M.E., 2013. Pharmaceutics: The Science of Dosage Form Design. 4th Ed., Churchill Livingstone, Edinburgh, UK.
7. Banker, G.S. and C.T. Rhodes, 2002. Modern Pharmaceutics. 4th Ed., Informa Health Care, UK.

Pharm-D-104

PHYSIOLOGY-B

4(3-1)

THEORY

Coordinated Body Functions:

- a. Circulation: Plasma, the Blood Cell, Pressure, flow and resistance, Anatomy, Heartbeat coordination, Mechanical Events of the Cardiac Cycle, The Cardiac output, Measurement of Cardiac Function, Arteries, Arterioles, Capillaries, veins, The Lymphatic system, Baroreceptor Reflexes, Blood Volume and Long term Regulation of Arterial Pressure, Other Cardiovascular Reflexes and Responses, Hemorrhage and Other Causes of Hypotension, the Upright Posture, Exercise, Hypertension, Heart Failure, Coronary Artery Disease and Heart Attacks, Formation of Platelet Plug, Blood coagulation: Clot Formation, Anticlotting systems, Anticlotting Drugs.
- b. Respiration: Organization of the Respiratory System, Ventilation and Lung Mechanics, Exchange of Gases in Alveoli and tissues, Transport of Oxygen in Blood, Transport of Carbon dioxide in Blood, Transport of Hydrogen ions between Tissues and Lungs, Control of Respiration, Hypoxia, Nonrespiratory functions of the Lungs.
- c. The kidneys and Regulation of Water and Inorganic Ions: Renal Functions, Structure of the Kidneys and Urinary System, Basic Renal Process, The Concept of Renal Clearance Micturition, Total Body Balance of sodium and Water Basic Renal Process for sodium and Water, Renal Sodium Regulation, Renal Water regulation, A Summary Example: the response to Sweating, Thirst and Salt Appetite, Potassium Regulation, Effector Sites for Calcium Homeostasis, Hormonal controls, Metabolic Bone Disease, Source of Hydrogen Ion gain or loss, Buffering of Hydrogen Ions in the Body, Integration of Homeostatic Controls, Renal Mechanisms, Classification of Acidosis and Alkalosis, Diuretics, Kidney Disease.
- d. The Digestion and Absorption of Food (Overview): Functions of the Gastrointestinal Organs, Structure of the Gastrointestinal Tract Wall, Digestion and Absorption, Regulation of Gastrointestinal Processes, Pathophysiology of the Gastrointestinal Tract.
- e. Regulation of Organic Metabolism, Growth and Energy Balance: Events of the Absorptive and Postabsorptive States, Endocrine and Neural Control of the Absorptive and Postabsorptive States, Fuel Homeostasis in Exercise and Stress Diabetes Mellitus, Hypoglycemia as a Cause of Symptoms, Regulation of Plasma Cholesterol, Bone Growth, Environmental Factors, Influencing Growth, Hormonal Influences on Growth, compensatory Growth, Basic Concepts of Energy Expenditure, Regulation of Total Body Energy Stores, Regulation of Body Temperature.
- f. Reproduction: General Principles of Gametogenesis, Anatomy, Spermatogenesis, Transport of Sperm, Hormonal control of Male Reproductive Functions, Ovarian Function, Control of Ovarian Function, Uterine Changes in the Menstrual Cycle, Other Effects of Estrogen and Progesterone, Androgens in Women, Female Sexual Response, Pregnancy, Sex Determination, Sex Differentiation, Puberty, Menopause.
- g. Defense Mechanisms of the Body: Cells Mediating Immune Defenses, Nonspecific Immune Defenses, Specific Immune Defenses, Systemic Manifestations of Infection Factors that Alter the Body's Resistance to Infection, Harmful Immune Responses, Absorption, Storage Sites, Excretion, Biotransformation, Functions of Cortisol in Stress, Functions of the Sympathetic Nervous System in Stress, Other Hormones Released During Stress Psychological Stress and Disease.

PRACTICAL

Blood: Determination of hemoglobin (Hb), ESR, RBC Count, WBC count, DLC (Differential leukocyte count), bleeding time, coagulation time and determination of blood groups. Respiration: Estimation of vital capacity and its relation to posture and standard vital capacity. Determination of tidal volume, demonstration of artificial respiration. CVS: Recording of arterial pulse, recording of arterial blood pressure and Electro-cardiogram.

RECOMMENDED BOOKS

1. Rahman, Z.U., t. Khaliq and A. Ali, 2013. Manual of Physiology-II. MAS Computers, Faisalabad, Pakistan.
2. Guyton, A.C., 2010. Text Book of Medical Physiology. 12th Ed., W.B. Saunders Company. Philadelphia, USA.
3. Gillian, P. and D.R. Christopher, 2006. Human physiology: The Basis of Medicine. 3rd Ed., Oxford University Press, UK.
4. Ganong, W.F., 2012. Review of Medical Physiology. 24th Ed., Prentice Hall International Inc., McGraw Hill Professional, NewYork, USA.
5. Spence, A.P. and E.B Mason, 1992. Human Anatomy and Physiology. St. Paul, West publishing, USA.

Eng-103

ENGLISH-B (Communication and Writing Skills)

4(4-0)

Paragraph writing: Practice in writing a good, unified and coherent paragraph.

CV and job application:

Translation skills: Urdu to English.

Study skills: Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension.

Academic writing skills: Letter/memo writing, minutes of meetings, use of library and internet. How to write a proposal for research paper/term paper? (emphasis on style, content, language, form, clarity, consistency).

Presentation skills: Personality development (special emphasis on content, confidence, eye contact, style and pronunciation).

Essay writing: Descriptive, narrative, discursive, argumentative.

Technical Report writing: Pharmacy writing and oral communication.

NOTE: Documentaries to be shown for discussion and review. Extensive reading is required for vocabulary building.

SECOND PROFESSIONAL

THIRD SEMESTER

Pharm-D-201

PHARMACEUTICS-IIA (Dosage Form Science)

4(3-1)

THEORY

1. **PHARMACEUTICAL CALCULATIONS:** Some Fundamentals of Measurements and Calculations. The Metric System. The Common Systems. Conversions. Calculation of Doses. Percentage calculations, Reducing and Enlarging Formulas. Weights and Volumes of Liquids. HLB Values. Industrial Calculations. Calculations involving parenteral admixtures. Some calculations involving Hydrogen-ion concentration. Calculations involving isotonic, electrolyte and buffer solutions.
2. **INTRODUCTION:** Dosage form, Ingredient, Product formulation.
3. **GALENICAL PREPARATIONS:** Infusions, Decoctions, Extracts, Fluid extracts, Tinctures, Aromatic waters.
4. **SOLVENTS USED IN PHARMACEUTICAL PREPARATIONS:**
5. **ORAL SOLUTIONS, SYRUPS, ELIXIRS AND SPIRITS:** Solutions: their preparation, dry mixtures for solution, oral rehydrate solutions, oral colonic lavage solution. Syrup: components and preparation of syrups. Elixirs: Preparation of elixirs, Medicated and non-Medicated elixirs. Spirits: Preparation of Spirits.
6. **ORAL SUSPENSIONS, EMULSIONS, MAGMA AND GELS:** Preparations, examples and importance.
7. **TOPICAL AND TRANSDERMAL DRUG DELIVERY SYSTEMS:** Introduction of Ointments, Creams, Pastes, Poultice, Plasters, Lotions, Liniments, Topical gels, Topical Tinctures, Collodions, Topical solutions, Topical powders, Percutaneous absorption, Transdermal systems in use.
8. **OPHTHALMIC, NASAL AND OTIC PREPARATIONS:** Ophthalmic solutions, suspensions, ointment, inserts, contact lens solutions. Nasal decongestant solutions, Decongestant inhalers. Ear preparations: Anti-infective, anti-inflammatory and analgesic.

PRACTICAL

Preparation of simple syrup. Orange syrup. Ferrous sulphate syrup. Cod Liver oil Emulsion. Liquid paraffin emulsion. Suppositories. Throat paint (Mandle's paint). Boroglycerine glycerite. Tannic acid glycerine. Spirit ammonia aromatic. Spirit of Ethyl nitrite, boric acid ear drops, suppositories, passaries, preparation of simple ointment. Introduction to pharmaceutical glassware and pharmaceutical labeling. Preparation and dispensing of cold cream, benzoyl benzoate lotion, KI and ferric chloride solution.

RECOMMENDED BOOKS

1. Turner, J.R., 2007. New Drug Development: Design, Methodology, and Analysis. Wiley-Interscience, New York, USA.
2. Howard. C. A. 2012. Pharmaceutical Calculations. 14th Edition. Volters Kluwer; Lippincott William And Willkins, London, UK

3. Watson, D.G., 2012. *Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists*. 3rd Ed., Elsevier Churchill Livingstone, University of Michigan, UK.
4. Allen, L.V., N.G. Popovich and H.C. Ansel, 2010. *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems*. 9th Ed., Lippincott Williams & Wilkins, USA.
5. Kirschenbaum, H.L. and M.M. Kalis, 2000. *The Pharmacy Practice Handbook of Medication Facts*. CRC Press, USA.
6. Snow, B., 2008. *Drug Information: A Guide to Current Resources*. 4th Ed., Medical Library Association, University of Michigan, UK.

Pharm-D-202

PHARMACOLOGY AND THERAPEUTICS-IA

4(3-1)

THEORY

1. GENERAL PHARMACOLOGY:

- a) Pharmacology: Definition of Pharmacology, history and its various branches. Definition of Drug and its various sources.
- b) Routes of drug administration, advantages and disadvantages.
- c) Pharmacokinetics: Drug solubility and passage of drug across the biological membranes. Absorption, distribution, metabolism and elimination of drugs and factors affecting them. Various pharmacokinetic parameters including volume of distribution (Vd), clearance (Cl), Biological half life ($t_{1/2\beta}$) Bioavailability and various factors affecting it. Dose, Efficacy and Potency of drugs. Hypersensitivity and Idiosyncratic reactions, drug tolerance and dependence. Drug interactions. Plasma protein binding.
- d) Pharmacodynamics: How drugs act? Receptors and their various types with special reference to their molecular structures. Cell surface receptors, signal transduction by cell surface receptors, signaling Mediated by intra cellular receptors, target cell and hyper sensitization, Pharmacological effects not Mediated by receptors (for example anesthetics and cathartics) Ion channel, enzymes, carrier proteins, Drug receptor interactions and theories of drug action. Agonist, antagonist, partial agonist, inverse agonist. Receptors internalization and receptors co-localization. Physiological Antagonism, Pharmacological Antagonism (competitive and non-competitive), Neutralization Antagonism, Neurotransmission and neuro-modulation. Specificity of drug action and factors modifying the action & dosage of drugs. Median lethal dose (LD:50), Median effective dose (ED:50) and Therapeutic Index, Dose-response relationships.

2. DRUGS ACTING ON AUTONOMIC NERVOUS SYSTEM (ANS):

- a. Organization of ANS its subdivisions and innervations.
- b. Neurotransmitters in ANS, their synthesis, release and fate.
- c. Sympathetic agonists: Catecholamines and Noncatecholamines.
- d. Sympathetic antagonists: Adrenergic receptor Blockers and neuron blockers.
- e. Parasympathetic (Cholinergic) agonists and cholinesterase enzyme inhibitors (anticholinesterases) Parasympathetic antagonists.
- f. Ganglion stimulants and Ganglion blockers
- g. Neuromuscular Blockers

3. DRUGS ACTING ON GASTROINTESTINAL TRACT:

- a. Emetic and anti-emetics
- b. Purgatives
- c. Anti-diarrheal agents

- d. Treatment of Peptic & duodenal ulcer: Antacids, H₂-Receptor antagonists, antimuscarinic agents, proton pump inhibitors, prostaglandin antagonists, gastrin receptor antagonist and cytoprotective agents
- e. Drug treatment of chronic inflammatory bowel diseases
- f. Drugs affecting bile flow and Cholelithiasis

PRACTICAL

Preparation of standard solution. Ringer solution. Tyrode solution. Krebs solution. Normal saline solution. To demonstrate the effects of sympathomimetic (Adrenaline) & sympatholytic drugs (propranolol) on frog/rabbit's heart. To demonstrate the effects of parasympathomimetic (acetylcholine) and parasympatholytic (atropine) drugs on frog's/rabbit's heart. To demonstrate the effects of an unknown drug on frog's/rabbit's heart. Routes of administration of drugs. Rabbit intestine assay.

RECOMMENDED BOOKS

1. Richard, F., M. Clark and L. Cubbedu, 2011. Lippincott's Illustrated Reviews, Pharmacology. 5th Ed., Lippincott William & Wilkins, USA.
2. Brunton, L.L., J.S. Lazo and K.L. Parker, 2010. Goodman Gillman's Pharmacological Basis of Therapeutics. 12th Ed., McGraw-Hill Book Company, New York, USA.
3. Katzung, B.G., 2011. Basic and Clinical Pharmacology. 12th Ed., McGraw-Hill Medical Publishers, New York, USA.
4. Rang, H.P., Dale, M.M., 2011. Rang and Dale's Pharmacology. 7th Ed. Elsevier, Churchill Living Stone, London, UK
5. Tripathy, J.D., 2008. Essential of Medical Pharmacology. 6th Ed., Japee Brothers, New Delhi, India
6. Ritter, J.M. and L.D. Levis, 2008. A Text Book of Clinical Pharmacology. 5th Ed. Oxford University Press, New York, USA.
7. Satorkar, R.S. and S.D. Bhandarkar, 2005. Pharmacology and Pharmacotherapeutics. 19th Ed. Popular Prakashan, Bombay, India.
8. Edabi, M., 1993. Pharmacology. Little Brown & Company, London, UK.
9. Winguard, L.B., 1991. Human Pharmacology: Molecular to Clinical. Mosby-Year Book, Boston, USA.

Pharm-D-203

PHARMACOGNOSY-IA (Basic)

4(3-1)

THEORY

1. **GENERAL INTRODUCTION:** Historical development and scope of Pharmacognosy. Terminology used in Pharmacognosy. An introduction of traditional systems (Unani, Ayurvedic and Homoeopathic systems of medicine) with special reference to medicinal plants. Introduction to herbal pharmacopoeia and modern concepts about Pharmacognosy.
2. **Crude Drugs:** Preparation of crude drugs for commercial market. Chemical and Therapeutic classification of crude drugs (Official & Un-official drugs). Methods of Cultivation, Drying, Storage, Preservation and Packing.
3. **THE STUDY OF THE CRUDE DRUGS BELONGING TO VARIOUS FAMILIES OF MEDICINAL IMPORTANCE**

S. No.	Families	Crude Drugs
a.	Ranunculaceae	<i>Aconitum, Larkspur, Pulsatilla, Hydrastis</i>
b.	Papaveraceae	<i>Papaver somniferum, Sanguinaria, Canadensis</i>
c.	Leguminosae	<i>Acacia, Glycyrrhiza, Senna, Cassia, Tamarind</i>
d.	Umbelliferae	<i>Fennel, Carum, Coriander, Conium, Asafoetida</i>
e.	Apocynaceae	<i>Rauwolfia, Catharanthus</i>
f.	Asclepiadaceae	<i>Gymnema sylvestre, Calotropis gigantea</i>

g.	Compositae	<i>Artemisia, Silybum marianum, Echinaceae, Arctium lappa</i>
h.	Solanaceae	<i>Belladonna, Hyoscyamus, Stramonium, Capsicum</i>
i.	Scrophulariaceae	<i>Digitalis, Verbascum (Mullien).</i>
j.	Labiatae	<i>Peppermint, Thyme, Spearmint, Salvia, Ocimum</i>
k.	Liliaceae	<i>Garlic, Colchicum, Aloe</i>
l.	Zingiberaceae	<i>Ginger, Curcuma</i>

4. **EVALUATION AND ADULTRATION OF CRUDE DRUGS:** Evaluation of crude drugs i.e., Organoleptic, Microscopic, Physical, Chemical and Biological. Deterioration and Adulteration of crude drugs. Types of adulteration, inferiority, spoilage, admixture, sophistication and substitution of crude drugs.

PRACTICAL

Introduction of the entire and broken parts of the plant drugs. Microscopic and organoleptic evaluation of crude drugs: Opium, coriander, fennel, ginger, acacia, tragacanth, curcuma, peppermint, bee wax anise, star anise, caraway, glycerhiza, senna, cinchona, clove, cinnamon, aloe, rubarb, nux vomica.

RECOMMENDED BOOKS

1. Cseke, L.J., A. Kirakosyan, P.B. Kaufman, S. Warber and J.A. Duke, 2010. Natural Products from Plants. 2nd Ed., CRC Press, USA.
2. Samuelsson, G., 2010. Drugs of Natural Origin: A Treatise of Pharmacognosy. 6th Ed., Apotekarsocieteten, Stockholm, Sweden.
3. Heinrich, M., J. Barnes, S. Gibbons and E.M. Williamson, 2012. Fundamentals of Pharmacognosy and Phytotherapy, 2nd Ed., Elsevier Health Sciences, UK.
4. Evans, W.C., G.E. Trease and D. Evans, 2009. Trease and Evans' Pharmacognosy. 16th Ed., W.B. Saunders, Toronto, Canada.

Micro-413 PHARMACEUTICS-III (Pharmaceutical Microbiology and Immunology) 4(3-1)

THEORY

Note: The topics will be taught with special reference to their pharmaceutical applications.

1. **GENERAL MICROBIOLOGY:** Historical Introduction, Scope of Microbiology with special reference to Pharmaceutical Sciences. Nomenclature and classification of Micro-organisms.
2. **MICRO-ORGANISMS:**
 - a) **The Bacteria:** General and cellular Morphology, structure and function. Classification of Bacteria. Growth curve, growth factors and growth characteristics. Nutrition Requirements and Nutrition factors affecting growth. Culture Media, Bacterial cultures and staining methods.
 - b) **The Viruses:** Introduction, Classification (and detail of at least one species from every group), cultivation and replication.
 - c) **The Fungi/Yeast/Molds:**
 - d) **The Protozoa:**
3. **THE NORMAL FLORA:**
 - (a) Microbiology of air, water and soil (general introduction and normal inhabitants of air, water and soil).
 - (b) Normal flora of Skin, Intestinal tract, Ear, Nose etc.

PRACTICAL

Preparation of general and selective media and culturing of micro-organisms. Total and viable counts of microorganism. Morphological and selective biochemical characterization of some specimen. Staining of bacteria: Gram method. Acid fast. Giemsa's staining. Capsule staining. Flagella staining and spore staining. Microbiological analysis of air, water and soil.

RECOMMENDED BOOKS

1. Pommerville, J.C., 2013. Alcamo's Fundamentals of Microbiology. 2nd Ed., Jones and Bartlett Publishers, Massachusetts, USA.
2. Richard, A.H., P.C. Champe, B.D. Fisher and W.A. Strohl, 2012. Lippincott's Illustrated Reviews: Microbiology. 3rd Ed., Lippincott William & Willkins, USA.
3. Levinson, W. and E. Jawetz, 2012. Medical Microbiology and Immunology: Examination Board and Review. 12th Ed., McGraw Hill Education, London, UK.
4. Singleton, P. and D. Sainsbury, 2006. Dictionary of Microbiology and Molecular Biology. 3rd Ed Revised., John Wiley & Sons, New York, USA.
5. Hugo, W.B. and A.D. Russell, 2011. Pharmaceutical Microbiology. 8th Ed., Black Well Science Ltd., London, UK,
6. Collin, C.H., P.M. Lynes and J.M. Grange, 2004. Collins and Lyne's Microbiological Methods. 8th Ed., Butterworth Heinemann, Oxford, UK.

IS-201

ISLAMIC STUDIES

3(3-0)

1. INTRODUCTION TO QURANIC STUDIES:

1. Basic Concepts of Quran
2. History of Quran
3. Uloom-ul -Quran

2. STUDY OF SELECTED TEXT OF HOLLY QURAN:

1. Verses of Surah Al-Baqra Related to Faith (Verse No. 284-286).
2. Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No. 1-18).
3. Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No. 1-11).
4. Verses of Surah al-Furqan Related to Social Ethics (Verse No. 63-77).
5. Verses of Surah Al-Inam Related to Ihkam (Verse No. 152-154).

3. STUDY OF SELECTED TEXT OF HOLLY QURAN:

1. Verses of Surah Al-Ihzab Related to Adab-al-Nabi (Verse No. 6, 21, 40, 56, 57, 58).
2. Verses of Surah Al-Hashar (18, 19, 20) Related to thinking, Day of Judgment.
3. Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No. 1, 14).

4. SEERAT OF HOLY PROPHET (S.A.W) I:

1. Life of Muhammad Bin Abdullah (Before Prophet Hood)
2. Life of Holy Prophet (S.A.W.) in Makkah
3. Important Lessons Derived from the life of Holy Prophet (S.A.W.) in Makkah

5. SEERAT OF HOLY PROPHET (S.A.W) II:

1. Life of Holy Prophet (S.A.W.) in Madina
2. Important Events of Life Holy Prophet (S.A.W.) in Madina
3. Important Lessons Derived from the life of Holy Prophet (S.A.W.) in Madina

6. INTRODUCTION TO SUNNAH:

1. Basic Concepts of Hadith
2. History of Hadith
3. Kinds of Hadith
4. Uloom –ul-Hadith
5. Sunnah & Hadith
6. Legal Position of Sunnah

7. SELECTED STUDY FROM TEXT OF HADITH:

8. INTRODUCTION TO ISLAMIC LAW & JURISPRUDENCE:

1. Basic Concepts of Islamic Law & Jurisprudence
2. History & Importance of Islamic Law & Jurisprudence
3. Sources of Islamic Law & Jurisprudence
4. Nature of Differences in Islamic Law
5. Islam and Sectarianism

9. ISLAMIC CULTURE & CIVILIZATION:

1. Basic Concepts of Islamic Culture & Civilization
2. Historical Development of Islamic Culture & Civilization
3. Characteristics of Islamic Culture & Civilization
4. Islamic Culture & Civilization and Contemporary Issues

10. ISLAM & SCIENCE:

1. Basic Concepts of Islam & Science
2. Contributions of Muslims in the Development of Science
3. Quranic & Science

11. ISLAMIC ECONOMIC SYSTEM:

1. Basic Concepts of Islamic Economic System
2. Means of Distribution of wealth in Islamic Economics
3. Islamic Concept of Riba
4. Islamic Ways of Trade & Commerce

12. POLITICAL SYSTEM OF ISLAM:

1. Basic Concepts of Islamic Political System
2. Islamic Concept of Sovereignty
3. Basic Institutions of Govt. in Islam

13. ISLAMIC HISTORY:

1. Period of Khlaft-E-Rashida
2. Period of Ummayyads
3. Period of Abbasids

14. SOCIAL SYSTEM OF ISLAM:

1. Basic Concepts of Social System of Islam
2. Elements of Family
3. Ethical Values of Islam

THEORY**1. ALGEBRA:**

- (a) Solution of Linear and Quadratic Equations. Equations reducible to Quadratic Form. Solution of simultaneous Equations.
- (b) Arithmetic, Geometric and Harmonic Progressions: Arithmetic, Geometric and Harmonic Means.
- (c) Permutations and Combinations:
- (d) Binomial Theorem: Simple application.

2. **TRIGONOMETRY:** Measurement of angles in Radian and Degrees. Definitions of circular functions. Derivation of circular function for simple cases.

3. **ANALYTICAL GEOMETRY:** Coordinates of point in a plane. Distance between two points in a plane. Locus, Equations of straight line, Equation of Parabola, Circle and Ellips.

4. **DIFFERENTIAL CALCULUS:** Functions, variations in functions, limits, differential coefficient, differentiation of algebraic, trigonometric, exponential and logarithmic functions, partial derivatives. Maxima and minima values. Points of inflexion.

5. **INTEGRAL CALCULUS:** Concept of integration Rules of integration. Integration of algebraic, exponential, logarithmic and trigonometric functions by using different techniques, and numerical integration.

RECOMMENDED BOOKS

- 1. Kreyszig, E., 2008. Advanced Engineering Mathematics. 8th Ed., John Wiley and Sons, New York, USA.
- 2. Lodhi, M.S., S.B. Ghauri and S. Khalid, 2002. Algebra and Trigonometry. Istiqlal Press, Lahore, Pakistan.
- 3. Edwards, J.C.H. and D.E. Pennsy, 1995. Calculus and Analytic Geometry. Prentice Hall Inc., New Jersey, USA.
- 4. Ahmed, B. and M. Khan, 1993. Mathematics for Pharmacists. Arsalan Paper Mart, Multan, Pakistan.

FOURTH SEMESTER**THEORY**

- 1. **SUPPOSITORIES AND ENEMAS:** Semi-solid preparations, Suppositories: Bases, preparation, packaging and storage, Solutions/Enemas: preparation, packing & storage.
- 2. **AEROSOLS, INHALATIONS AND SPRAYS:** Aerosol: Principle, container and valve assembly, propellants, filling, testing, packaging, labelling and storage. Inhalations: Principle, container and valve assembly, propellants, filling, testing, packaging, labelling and storage. Sprays: Principle, container and valve assembly, propellants, filling, testing, packaging, labelling and storage.
- 3. **POWDERS, CAPSULES, TABLET DOSAGE FORMS:** Preparation of Powders, mixing of powders, uses and packaging of powders, granules, effervescent granulated salts. Hard gelatin capsules: capsule

sizes, preparation of filled hard gelatin capsules. Soft gelatin capsules, preparation and its application. Tablets: types, characteristics and methods of preparation.

4. **INTRODUCTION TO PARENTERALS:** Official types of injections, solvents and vehicles for injections, added substances.
5. **A BRIEF INTRODUCTION TO ORAL HYGIENE PRODUCTS:**

PRACTICAL

Preparation of methyl salicylate ointment, sulphur ointment, zinc oxide ointment, iodine ointment, red iodide of mercury lotion, calamine lotion, iodine tincture, ferrous sulfate tincture, tincture benzoin co, liniment terpenite. Preparations of oral hygiene products e.g., mouth wash, poultice of kaolin, effervescent granules e.g, ENO, calc, distilled water for injections. To appear or reject the given batch of tablets during in process quality control. Preparation of aromatic ammonium spirit, effervescent granules, kaoline poultics, calamine lotion, castor oil emulsion.

RECOMMENDED BOOKS

1. Turner, J.R., 2007. New Drug Development: Design, Methodology, and Analysis. Wiley-Interscience, New York, USA.
2. Watson, D.G., 2012. Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists. 3rd Ed., Elsevier Churchill Livingstone, University of Michigan, UK.
3. Allen, L.V., N.G. Popovich and H.C. Ansel, 2010. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 9th Ed., Lippincott Williams & Wilkins, USA.
4. Kirschenbaum, H.L. and M.M. Kalis, 2000. The Pharmacy Practice Handbook of Medication Facts. CRC Press, USA.
5. Snow, B., 2008. Drug Information: A Guide to Current Resources. 4th Ed., Medical Library Association, University of Michigan, UK.

Pharm-D-206

PHARMACOLOGY & THERAPEUTICS-IB

4(3-1)

THEORY

1. **AUTACOIDS AND THEIR ANTAGONISTS:** Histamine and anti-histamines, serotonin and serotonin antagonist, prostaglandins and their antagonists.
2. **DRUGS ACTING ON RESPIRATORY SYSTEM:**
 - a. Drugs used in cough (Anti-tussives, Expectorants and Mucolytic agents).
 - b. Drugs used in Bronchial Asthma. Bronchodilators: Sympathomimetic, Xanthine derivatives, Leukotriene receptor antagonists and synthesis inhibitors, Muscarinic receptor antagonists, Cromoglycate, Nedocromil, Cortecosteroids & other Anti-inflammatory drugs.
3. **DRUGS ACTING ON CARDIO-VASCULAR SYSTEM:**
 - a. Angina pectoris and its drug treatment
 - b. Congestive heart failure & its treatment.
 - c. Anti-arrhythmic drugs
 - d. Anti-hyperlipidemic.

- e. Coagulants and Anti-coagulants
 - f. Anti-hypertensive
 - g. Diuretics
4. **DRUGS ACTING ON GENITOURINARY SYSTEM:** Oxytocin, Ergot alkaloids and uterine relaxants.
 5. **ANTI-ANAEMIC DRUGS:**
 6. **HORMONES, ANTAGONISTS AND OTHER AGENTS AFFECTING ENDOCRINE FUNCTION:** Endocrine function and dysfunctions. Drug used for therapy of Diabetes Mellitus: Insulin and Oral Hypoglycemic agents, Corticosteroids, Thyroid hormone and anti-thyroid drugs.

PRACTICAL

To demonstrate the effects of vasoconstrictor drugs on frog's blood vessels. To demonstrate the effects of stimulant drugs on rabbit's intestine (acetyl choline, barium chloride). To demonstrate the effects of depressant drugs on rabbit's intestine (atropine). To differentiate the effect of an unknown drug on rabbit's intestine and identify the (unknown) drug. To study the effects of adrenaline on rabbit's eyes. To study the effects of local anaesthetic drug (e.g. cocaine) on Rabbit's Eyes. To identify the unknown drug & differentiate its effects on Rabbit's eyes.

RECOMMENDED BOOKS

1. Richard, F., M. Clark and L. Cubbedu, 2011. Lippincott's Illustrated Reviews, Pharmacology. 5th Ed., Lippincott William & Wilkins, USA.
2. Brunton, L.L., J.S. Lazo and K.L. Parker, 2010. Goodman Gillman's Pharmacological Basis of Therapeutics. 12th Ed., McGraw-Hill Book Company, New York, USA.
3. Katzung, B.G., 2011. Basic and Clinical Pharmacology. 12th Ed., McGraw-Hill Medical Publishers, New York, USA.
4. Rang, H.P., Dale, M.M., 2011. Rang and Dale's Pharmacology. 7th Ed. Elsevier, Churchill Living Stone, London, UK
5. Tripathy, J.D., 2008. Essential of Medical Pharmacology. 12th Ed., Japee Brothers, New Delhi, India.
6. Ritter, J.M. and L.D. Levis, 2008. A Text Book of Clinical Pharmacology. 5th Ed. Oxford University Press, New York, USA.
7. Satorkar, R.S. and S.D. Bhandarkar, 2005. Pharmacology and Pharmacotherapeutics. 19th Ed. Popular Prakashan, Bombay, India.
8. Edabi, M., 1993. Pharmacology. Little Brown & Company, London, UK.
9. Winguard, L.B., 1991. Human Pharmacology: Molecular to Clinical. Mosby-Year Book, Boston, USA.

Pharm-D-207

PHARMACOGNOSY-IB (Basic)

4(3-1)

THEORY

1. **DRUGS OF ANIMAL ORIGIN:** General introduction and discussion about honey, gelatin, shellac, musk, civet, ambergris, cod liver oil, cantharides and spermaceti.
2. **BIOLOGICS:** Sources, structure, preparation, description and uses of vaccines, toxins, antitoxins, venoms, antivenoms, antiserums.

3. **SURGICAL DRESSINGS:** Classification of fibers as vegetable, animals and synthetic fibers. Evaluation of fibers in surgical dressings, BPC standards for dressings and sutures. Discussion on cotton, wool, cellulose, rayon, catgut and nylon.
4. **PESTICIDES:** Introduction, methods and control of pests with special reference to pyrethrum, tobacco, and other natural pesticides.
5. **GROWTH REGULATORS:** General account with special reference to plant hormones; Auxins, Gibberellins, Abscisic acid and Cytokinins.
6. **POISONOUS PLANTS INCLUDING ALLERGENS AND ALLERGENIC PREPARATIONS:** General introduction, case history, skin test, treatment of allergy, inhalant, ingestant, injectant, contactant, infectant and infestant allergens. Mechanism of allergy.
7. **ENZYMES:** Enzymes obtained from plant source. (Phytoenzymes). Papain, Bromelain and Malt Extract. Enzymes obtained from Animal source. Rennin, pepsin, Pancreatin and Pancrealipase.

PRACTICAL

Microscopic examination of powders and selections of plant drugs. Microscopic study of commercial fibers (cotton, silk, wool fibers etc.). Microscopic study of commercial starches (wheat starch, rice starch, maize starch). Microscopic study of powders cinchona, cinnamon, stramonium, senna leaf powder, liquirice powder. A study tour will be an integral part of the syllabus and will be arranged at the end of the session for collection of medicinal plants from various hilly areas of the country.

RECOMMENDED BOOKS

1. Cseke, L.J., A. Kirakosyan, P.B. Kaufman, S. Warber and J.A. Duke, 2010. Natural Products from Plants. 2nd Ed., CRC Press, USA.
2. Samuelsson, G., 2010. Drugs of Natural Origin: A Treatise of Pharmacognosy. 6th Ed., Apotekarsocieteten, Stockholm, Sweden.
3. Heinrich, M., J. Barnes, S. Gibbons and E.M. Williamson, 2012. Fundamentals of Pharmacognosy and Phytotherapy, 2nd Ed., Elsevier Health Sciences, UK.
4. Evans, W.C., G.E. Trease and D. Evans, 2009. Trease and Evans' Pharmacognosy. 16th Ed., W.B. Saunders, Toronto, Canada.

Micro-414 PHARMACEUTICS-IIIB (Pharmaceutical Microbiology and Immunology) 4(3-1)

THEORY

Note: The topics will be taught with special reference to their pharmaceutical applications.

1. **INDUSTRIAL MICROBIOLOGY:** Introduction to Sterilization/ Disinfection. Fermentation. Pharmaceutical products produced by fermentation process (Penicillins, Cepalosporins, Gentamycin, Erythromycin, Tetracyclines, Rifamycin, Griseofulvin).
2. **IMMUNOLOGY:** Introduction and types of Immunity: Specific and non-specific (Cellular basis of Immune response. Immunity, autoimmunity, tolerance. Antigen. Anti-bodies). Antigen-Antibody reactions and their clinical and diagnostic applications. Hypersensitivity and allergy. Drug allergy mechanism. Vaccination: Introduction and aims. Types of Vaccines. Current vaccine practices.

3. **FACTORY & HOSPITAL HYGIENE including GOOD MANUFACTURING PRACTICES:**
Introduction, Control of Microbial contamination during manufacture. Manufacture of Sterile products, A Guide to Current Good Pharmaceutical Manufacturing Practices.
4. **INTRODUCTION TO DISEASES:** Dengue fever, Bird flu, SARS, or other prevailing diseases of bacteria and virus.

PRACTICAL

Sterilization of glassware and pharmaceutical products by various methods. Microbiological assays of antibiotics and vitamins.

RECOMMENDED BOOKS

1. Pommerville, J.C., 2013. Alcamo's Fundamentals of Microbiology. 2nd Ed., Jones and Bartlett Publishers, Massachusetts, USA.
2. Richard, A.H., P.C. Champe, B.D. Fisher and W.A. Strohl, 2012. Lippincott's Illustrated Reviews: Microbiology. 3rd Ed., Lippincott William & Wilkins, USA.
3. Levinson, W. and E. Jawetz, 2012. Medical Microbiology and Immunology: Examination Board and Review. 12th Ed., McGraw Hill Education, London, UK.
4. Singleton, P. and D. Sainsbury, 2006. Dictionary of Microbiology and Molecular Biology. 3rd Ed Revised., John Willey & Sons, New York, USA.
5. Hugo, W.B. and A.D. Russell, 2011. Pharmaceutical Microbiology. 8th Ed., Black Well Science Ltd., London, UK,
6. Collin, C.H., P.M. Lynes and J.M. Grange, 2004. Collins and Lyne's Microbiological Methods. 8th Ed., Butterworth Heinemann, Oxford, UK.

SSH-201

PAKISTAN STUDIES

2(2-0)

THEORY

Introduction/Objectives:

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

1. HISTORICAL PERSPECTIVE:

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Dr. Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
 - i. Indus Civilization
 - ii. Muslim advent
 - iii. Location and geo-physical features

2. GOVERNMENT AND POLITICS IN PAKISTAN:

Political and constitutional phases:

- a. 1947-58
- b. 1958-71
- c. 1971-77
- d. 1977-88
- e. 1988-99
- f. 1999-onward

3. **CONTEMPORARY PAKISTAN:**
 - a. Economic institutions and issues
 - b. Society and social structure
 - c. Ethnicity
 - d. Foreign policy of Pakistan and challenges
 - e. Futuristic outlook of Pakistan

RECOMMENDED BOOKS

1. Khan, H, 2013. Constitutional and political History of Pakistan. Oxford University Press, Karachi, Pakistan.
2. Ikram, R., 2008. Pakistan Studies. Carvan Book House, Lahore, Pakistan.
3. Rashid, A., 2008. An essential book of Pakistan studies, White Rose Publishers and Booksellers, Lahore, Pakistan.
4. Khan, S., 2008. Pakistan Affairs. Famous book publishers, Pakistan.
5. Safdar, M., International Affairs: 2007-2008. JBD Press.
6. Zia-Ud-Din., 2005. The Analytical and Critical essay on Pakistan Affairs. Azeem Academy, Lahore, Pakistan.

Stat-101

PHARMACY PRACTICE-IB (Biostatistics)

4(4-0)

THEORY

1. **DESCRIPTION OF STATISTICS:** Descriptive Statistics: What is Statistics? Importance of Statistics. What is Biostatistics? Application of Statistics in Biological and Pharmaceutical Sciences. How samples are selected?
2. **ORGANIZING and DISPLAYING DATA:** Variables, Quantitative and Qualitative Variables, Univariate Data, Bivariate Data, Random Variables, Frequency Table, Diagrams, Pictograms, Simple Bar Charts, Multiple Bar Charts, Histograms.
3. **SUMMARIZING DATA and VARIATION:** The Mean, the Median, the Mode, the Mean Deviation, the Variance and Standard Deviation, Coefficient of Variation.
4. **CURVE FITTING:** Fitting a Straight Line. Fitting of Parabolic or High Degree Curve.
5. **PROBABILITY:** Definitions, Probability Rules, Probability Distributions (Binomial & Normal Distributions).
6. **SIMPLE REGRESSION AND CORRELATION:** Introduction. Simple Linear Regression Model. Correlation co-efficient.
7. **TEST OF HYPOTHESIS AND SIGNIFICANCE:** Statistical Hypothesis. Level of Significance. Test of Significance. Confidence Intervals, Test involving Binomial and Normal Distributions.
8. **STUDENT “t”, “F” and Chi-Square Distributions:** Test of Significance based on “t”, “F” and Chi-Square distributions.

9. **ANALYSIS OF VARIANCE:** One-way Classification, Two-way Classification, Partitioning of Sum of Squares and Degrees of Freedom, Multiple Comparison Tests such as LSD, The analysis of Variance Models.
10. **STATISTICAL PACKAGE:** An understanding of data analysis by using different statistical tests using various statistical software's like SPSS, Minitab, Statistica etc.

RECOMMENDED BOOKS

1. Daniel, W.W., 2013. Biostatistics: A Foundation for Analysis in the Health Sciences. 10th Ed., John Wiley and Sons, New York, USA.
2. Chaudhry, R., 2004. Modern Statistics: Part-I and Part-II. Polymer Publications, Urdu Bazar, Lahore, Pakistan.
3. Zar, J.H., 2009. Bio-Statistical Analysis. 5th Ed., Prentice Hall, New Jersey, USA.
4. Nilton, J.S. and J.D. Tsokos, 1999. Statistical Methods in Biological and Health Sciences. 3rd Ed. McGraw-Hill, USA.

THIRD PROFESSIONAL

FIFTH SEMESTER

PATH-302

PATHOLOGY

4(3-1)

THEORY

1. **SCOPE OF PATHOLOGY & CONCEPT OF DISEASES:**
2. **DEFINITION AND TERMINOLOGY:** Ischemia, Hypoxia, Necrosis, sInfarction, Atrophy, Hypertrophy, Hyperplasia, Metaplasia, Aplasia, Anaplasia.
3. **RESPONSE OF BODY TO INJURY AND INFECTION:** Acute and Chronic inflammation, Immunity, Allergy, Hyper Sensitivity.
4. **SPECIFIC DISEASES:** Ulcer (Peptic, Duodenal), Hypertension, Leukemia or Blood Cancer (Malignant Carcinoma, Sarcoma & Lymphomas), Diagnosis and treatment of Cancer in general, fate, survival and prognosis with tumors.

PRACTICAL

Introduction to pathology lab, proficiency to recognize and describe gross lesions and histopathological changes, techniques for tissue processing for histopathological examination, staining procedures, special staining techniques, Microscopically orientation of basic cellular changes, slides of inflammatory changes, circulatory disturbances and tumors.

RECOMMENDED BOOKS

1. Suvarna, S.K., C. Layton and J.D. Bancroft, 2012. Theory and Practice of Histological Techniques. 7th Ed., Churchill Livingstone Publishers, London, UK.
2. Kumar, V., A.K. Abbas, N. Fausto and R. Mitchell, 2012. Robbins Basic Pathology. 9th Ed., W. B. Saunders Company, USA.

3. Slauson, D.O. and B.J. Cooper, 2003. Mechanism of Disease. A textbook of Comparative General Pathology. 3rd Ed., Elsevier Health Science Div. London, UK.

Pharm-D-301

PHARMACOLOGY & THERAPEUTICS-IIA

4(3-1)

THEORY

1. DRUGS ACTING ON CENTRAL NERVOUS SYSTEM:

- a. Sedatives & Hypnotic
- b. Anxiolytics, antidepressants and antimanic drugs
- c. Antiepileptics
- d. Antiparkinsonian and drug used in other neurodegenerative diseases.
- e. Antipsychotics
- f. Opioid analgesics
- g. Therapeutic gases (Oxygen, Carbon-dioxide, Nitric oxide and Helium).
- h. Cerebral Stimulants, Medullary stimulants, Spinal Cord Stimulants.
- i. Anesthetics: General and local

NON-STEROIDAL ANTI-INFLAMMATORY DRUGS: Disease modifying drugs, antirheumatic drugs, non-opioid analgesics and drugs used in the treatment of gout.

PRACTICAL

To study the convulsant effect of strychnine and picrotoxin in frogs and to determine the site of action. To identify the unknown (convulsant) drug and determine its site of action. To study the effects of adrenaline on human eyes.

Demonstration of gaseous and volatile general anesthesia in laboratory animals. Demonstration of intravenous general anesthesia in laboratory animals. Demonstrations of various local anesthesia such as topical/surface, infiltration, nerve block, para vertebral, and epidural in laboratory animals.

RECOMMENDED BOOKS

1. Richard, F., M. Clark and L. Cubbedu, 2011. Lippincott's Illustrated Reviews, Pharmacology. 5th Ed., Lippincott William & Wilkins, USA.
2. Brunton, L.L., J.S. Lazo and K.L. Parker, 2010. Goodman Gillman's Pharmacological Basis of Therapeutics. 12th Ed., McGraw-Hill Book Company, New York, USA.
3. Katzung, B.G., 2011. Basic and Clinical Pharmacology. 12th Ed., McGraw-Hill Medical Publishers, New York, USA.
4. Rang, H.P., Dale, M.M., 2011. Rang and Dale's Pharmacology. 7th Ed. Elsevier, Churchill Living Stone, London, UK
5. Tripathy, J.D., 2008. Essential of Medical Pharmacology. 12th Ed., Japee Brothers, New Delhi, India.
6. Ritter, J.M. and L.D. Levis, 2008. A Text Book of Clinical Pharmacology. 5th Ed. Oxford University Press, New York, USA.
7. Satorkar, R.S. and S.D. Bhandarkar, 2005. Pharmacology and Pharmacotherapeutics. 19th Ed. Popular Prakashan, Bombay, India.
8. Edabi, M., 1993. Pharmacology. Little Brown & Company, London, UK.
9. Wingard, L.B., 1991. Human Pharmacology: Molecular to Clinical. Mosby-Year Book, Boston, USA.

THEORY

1. **SEPARATION AND ISOLATION OF PLANT CONSTITUENTS:** Introduction and use of spectroscopic and chromatographic techniques for the identification of natural products. Description and interpretation of ultraviolet, infrared, mass, nuclear magnetic resonance ($^1\text{H-NMR}$ and $^{13}\text{C-NMR}$) spectra and other advance techniques to elucidate the structure of natural products.
2. **CARBOHYDRATES AND RELATED COMPOUNDS:** Introduction and classification of carbohydrates, sugars as adjuvant in drugs, role of impurities in sugar substances.
 - a. Sucrose and Sucrose containing drugs: Sucrose, Dextrose, Liquid glucose, Fructose, Lactose, Xylose, Caramel, Starch, Inulin, Dextrine etc.
 - b. Cellulose and Cellulose Derivatives: Powdered cellulose, Microcrystalline cellulose, Methyl cellulose, Sodium Carboxy-methyl cellulose.
 - c. Gums and Mucilage: Tragacanth, Acacia, Sodium Alginate, Agar, Pectin.
3. **ALKALOIDS:** Introduction, Properties, Classification, Function of alkaloids in plants, Methods of extraction and identification tests.
 - a. Pyridine-Piperidine Alkaloids: Areca nut, Lobelia.
 - b. Tropane Alkaloids: Belladonna, Hyoscyamus, Stramonium.
 - c. Quinoline Alkaloids: Cinchona.
 - d. Isoquinoline Alkaloids: Ipecacuanha, Opium.
 - e. Indole alkaloids: Rauwolfia, Catharanthus, Nux vomica, Physostigma, Ergot.
 - f. Imidazole alkaloids: Pilocarpus.
 - g. Steroid alkaloids: Veratrum.
 - h. Alkaloidal amines: Ephedra, Colchicum.
 - i. Purine Bases: Tea, Coffee.
4. **GLYCOSIDES:** Introduction, classification, chemistry, extraction, isolation and medicinal uses of:
 - a. Cardioactive glycosides: Digitalis, Strophanthus and White squill.
 - b. Anthraquinone glycosides: Cascara, Aloe, Rhubarb, Cochineal & Senna.
 - c. Saponin glycosides: Glycyrrhiza, Sarsaparilla.
 - d. Cyanophore glycosides: Wild cherry.
 - e. Isothiocyanate glycosides: Black mustard.
 - f. Lactone glycosides: Cantharide.
 - g. Aldehyde glycosides: Vanilla.
 - h. Miscellaneous glycosides: Gentian, Quassia, Dioscorea.
1. **PLANT STEROIDS:** Introduction, extraction, isolation, nomenclature, sources and uses of bile acids, plant sterols, steroidal sapogenins, steroid hormones, withanolides and ecdysons.
2. **LIPIDS:** Introduction, classification, source, active constituents and pharmacological uses of:
 - a. Fixed Oils: Castor oil, cotton seed oil, olive oil, peanut oil, sun flower oil, corn oil, coconut oil, almond oil, linseed oil, mustard oil, sesame oil and soybean oil.
 - b. Fats and Related Compounds: Theobroma oil and Lanolin.
 - c. Waxes: Bees wax, carnauba wax, spermaceti and Jojoba oil.

PRACTICAL

Extraction of the active constituents of crude drugs and chemical tests for their identification: Extraction and identification of nicotine from tobacco leaves, extraction and identification of tannins from clove and cinnamon, extraction and identification of alkaloids from nux vomica seeds. Identification of resin in rosen (clove honey). Separation of ink by paper chromatography. Separation of amino acids by paper chromatography. Extraction and identification of cardiac glycosides from nerium indicum. Extraction and identification of anthraquinone glycosides from aloe and rhubarb. Soxhlet's extraction, water and ethanol extraction. Qualitative tests for various alkaloids and glycosides.

RECOMMENDED BOOKS

1. Cseke, L.J., A. Kirakosyan, P.B. Kaufman, S. Warber and J.A. Duke, 2010. Natural Products from Plants. 2nd Ed., CRC Press, USA.
2. Samuelsson, G., 2010. Drugs of Natural Origin: A Treatise of Pharmacognosy. 6th Ed., Apotekarsocieteten, Stockholm, Sweden.
3. Heinrich, M., J. Barnes, S. Gibbons and E.M. Williamson, 2012. Fundamentals of Pharmacognosy and Phytotherapy, 2nd Ed., Elsevier Health Sciences, UK.
4. Evans, W.C., G.E. Trease and D. Evans, 2009. Trease and Evans' Pharmacognosy. 16th Ed., W.B. Saunders, Toronto, Canada.

Chem-305 PHARMACEUTICAL CHEMISTRY-III A (Pharmaceutical Analysis) 4(3-1)

THEORY

NOTE: The topics will be taught with special reference to their Pharmaceutical Applications. The quantitative and qualitative analysis of drugs and drug products utilizing the instrumental techniques and titrimetric techniques.

1. **SPECTROSCOPIC METHODS:** Theory, Instrumentation and Pharmaceutical Applications of the following Spectroscopic Methods:
 - a. Atomic Absorption and Emission Spectroscopy
 - b. Molecular Fluorescence Spectroscopy
 - c. Flame Photometry
 - d. I.R. Spectroscopy
 - e. Mass Spectroscopy
 - f. NMR Spectroscopy
 - g. U.V./Visible Spectroscopy
2. **CHROMATOGRAPHIC METHODS:** Column Chromatography, Thin Layer Chromatography, Gas Liquid Chromatography, HPLC, LCMS, GCMS, Capillary Electrophoresis.

PRACTICAL

Determination of the purity and composition of the unknown drugs by using at least each of the above techniques. Implementation of ICH guidelines for method development, quality control and assurance. Spectral interpretation of drugs with reference to above mentioned techniques. Quantitative determination of Lithium by flame photometry. Quantitative determination of iron by Atomic Absorption Spectroscopy. Quantitative spectrophotometric determination of drug by UV, Visible and fluorescent detection.

RECOMMENDED BOOKS

1. Gowenlock, A.H., J.R. McMurray and D. M. McLauchlan. 2006. Varley's Practical Clinical Biochemistry, 6th ed. CBS Publishers and Distributors. New Delhi, India.
2. ICH Harmonised Tripartite Guideline. 2005. International Conference on Harmonization (ICH) of Technical Requirements for the Registration of Pharmaceuticals for Human use. Validation of Analytical Procedures: Text and Methodology. Q2(R1). Geneva.
3. Beckett, A.H. and J.B. Stenlake, 2001. Practical Pharmaceutical Chemistry. Part-II. 4th Ed., Continuum International Publishing Group, London, UK.
4. Aminuddin, M. and J. Iqbal, 2000. Theory and Practice of Chromatography. University Grants Commission, Islamabad, Pakistan.
5. Lough, W.J., 1996. High Performance Liquid Chromatography. Blacken Academic Press, New York, USA.
6. Braithwaite, A. and F.J. Smith, 1996. Chromatographic Methods. 5th Ed. Chapman and Hall, London, UK.
7. William, K., 1990. Organic Spectroscopy. Ellsi Horwood, London, UK.
8. Hamilton, R., 1982. Introduction to HPLC. P.A Sewell, Chapman & Hall, London, UK.
9. Pryde, A. and M.J. Gilbert, 1979. Applications of High Performance Liquid Chromatography. Chapman & Hall, London, UK.

Pharm-D-303

PHARMACY PRACTICE-IIA (Dispensing Pharmacy)

4(3-1)

THEORY

1. **BASIC PRINCIPLES OF COMPOUNDING AND DISPENSING INCLUDING:** Fundamental operations in Compounding, Containers and closures for Dispensed Products, Prescription-Handling (Parts of Prescription, Filling, Interpretation, Pricing) and Labelling of Dispensed Medication.
2. **EXTEMPORANEOUS DISPENSING OF:** Solutions, Suspensions, Emulsions, Creams, Ointments, Pastes and gels, Suppositories and pessaries, Powders and granules and Oral unit dosage form.
3. **PHARMACEUTICAL INCOMPATIBILITIES:** Types of Incompatibilities, Manifestations, Correction and Prevention with reference to typical examples.

PRACTICAL

Practical introduction to prescription-handling interpretation, filling and labeling. Mixtures: Dispensing of simple mixtures containing soluble substances only, mixtures containing diffusible substances, indiffusible substances and mixtures forming precipitate. Powders: Dispensing of simple powders, compound powders and effervescent powders for external use. Incompatibility: Practical importance of incompatibilities. Ointments and creams: Dispensing of iodine and methyl salicylate ointment. Dispensing of cold cream and vanishing creams. Cosmetics: Lipstick, talcum powder, after shave lotion, shaving cream. Prepare and dispense: Iodine solution USP, soap liniment, paracetamol elixir, aspirin effervescent granules.

RECOMMENDED BOOKS

1. Allen, L.V., N.G. Popovich and H.C. Ansel, 2010. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 9th Ed., Lippincott Williams & Wilkins, USA.
2. Aulton, M.E., 2013. Pharmaceutics: The Science of Dosage Form Design. 4th Ed., Churchill Livingstone, UK.
3. Gennaro, A.R., 2006. Remington's Pharmaceutical Sciences. 21st Ed., Mack Publishing Company, Pennsylvania, USA.

SIXTH SEMESTER

CS-502 PHARMACY PRACTICE-III (Computer and Its Application in Pharmacy) 4(3-1)

THEORY

1. **FUNDAMENTALS OF COMPUTERS:**

- a. History of Data Processing
- b. Types of Computers
- c. Components of a Computer
- d. Computer System and Business Computer System
- e. Backing Storage Devices
- f. Unit of Memory
- g. Viruses and Anti-viruses Issues

2. **RESEARCH METHODOLOGIES:**

3. **SYSTEM ANALYSIS AND DESIGN:**

- a. What is a System?
- b. Steps in system life cycle
- c. Data Gathering and Data Analysis
- d. Designing a New System
- e. Development and Implementation of New System
- f. Documentation.

4. **DATA PROCESSING:**

- a. Data Processing
- b. The Data Processing Cycle
- c. The Collection and Computing of data
- d. Manual collection of data
- e. The main methods of data input
- f. Devices used to collect data
- g. Data Verification
- h. Data Validation
- i. Output and Recording of data
- j. Types of data processing systems
- k. Types of Computer Operation
- l. Batch Processing and Real-time Processing

5. **APPLICATION OF COMPUTERS IN HOSPITAL PHARMACY:**

- a. Patterns of Computer use in Hospital Pharmacy
- b. Patient record database management
- c. Medication order entry
- d. Drug labels and list
- e. Intravenous solution and admixture
- f. Patient Medication profiles
- g. Inventory control
- h. Management report & Statistics

6. APPLICATION OF COMPUTER IN COMMUNITY PHARMACY:

- a. Computerizing the Prescription Dispensing process,
- b. Use of Computers for Pharmaceutical Care in community pharmacy,
- c. Accounting and General ledger system.

7. APPLICATION OF DRUG INFORMATION RETRIEVAL & STORAGE:

- a. Introduction
- b. Advantages of Computerized Literature
- c. Retrieval use of Computerized Retrieval

DATA ANALYSIS: Introduction and implementations of statistical design and test. Students T-test, Chi Square, ANOVA using statistical packages like SPSS, Med Calc, Kinetica etc.

PRACTICAL

Operating System: Basic concepts of windows, explanation of start menu, taskbar, desktop, control panel, add/remove software/hardware, windows explorer, my computer, recycle bin.

Microsoft Word: Introduction to MS word, file operations (create, open, save, close etc), editing (cut, copy, paste etc). Different types of views. Inserting operations. Document formatting. Utilities. Table operations. Windows operations.

Microsoft power point: Introduction to MS power point, file operations (create, open, save, close etc), Editing (cut, copy, paste etc). Different types of views. Inserting operations. Document formatting. Utilities. Table operations. Slide shows. Windows operations.

Microsoft Excel: Introduction to MS excel, file operations (create, open, save, close etc), editing (cut, copy, paste etc). Different types of views. Inserting operations. Different types of graphs. Worksheet formatting. Utilities. Data sorting and validations. Windows operation.

Microsoft Front Page: Introduction to front page, creating a first web site, basic formatting techniques, manipulating tables within front page, front page picture and multimedia, hyper linking, bookmarks and image maps, introducing front-page "components", front page and frames, managing your web, good site design, publishing and publicizing.

internet: network, how internet work, ISP, WSP, internet address, DNS, www< web browser, URL, web server, search engine, type of web pages, web casting, e-commerce, web publishing, e-mail, newsgroup & message board, mailing list and chat room.

Statistical package for special sciences (SPSS):introduction to SPSS and its uses, file operations, transforming data values, aggregating data, data editing features, different viewing patterns, data processing, data analysis, regression and correlation, graphical analysis, utilities for analysis, managing windows.

RECOMMENDED BOOKS

1. Mustafa, T. and T. Mahmood, 2008. Computer Application in Business. Kitab Merkez, Faisalabad, Pakistan.
2. Mahmood, T. and I. Saeed, 2008. Introduction to Information Technology, Kitab Merkez, Faisalabad, Pakistan.
3. Sams, P.G., 2006. Teach Yourself Microsoft Office 2006 in 24 hours. Sams Publishers, USA.
4. Zagumny, M. J., 2001. A Student Guide to Statistical Package for the Social Sciences. Author House Publisher, USA.

THEORY**1. CHEMOTHERAPY:**

- a) Basic principles of chemotherapy.
- b) Antibacterials: (Folate antagonists; sulphonamides. Cell wall synthesis inhibitors; Penicillin, Cephalosporins, Carbapenam, Monobactam. Protein synthesis inhibitors; Aminoglycosides, Tetracyclines, Chloramphenicol, Macrolides. Nucleic acid synthesis inhibitors; Quinolones and miscellaneous Antibiotics), Antimycobacterial drugs, Urinary tract antiseptics.
- c) Anti-fungals:
- d) Anti-virals:
- e) Anti-protozoals: (anti-malarias, anti-amebiasis, anthelmintics and anti-leishmanials).
- f) Anti-neoplastic drugs:

2. IMMUNOPHARMACOLOGY: Pharmacology of immuno-suppressants and stimulants.**3. TOXICOLOGY:**

- (a) Pollution and its types (water, air, food)
- (b) Poison and principle of treatment of poisoning.
- (c) Poisoning (Sign & symptom and treatment): Ethanol, Barbiturates, Digitalis, Salicylates, Strychnine, Narcotics, Nicotine, Paracetamol, Benzodiazepines and organophosphorous compounds.
- (d) Chelating agents and their role in poisoning: Dimercaprol, Calcium disodium edentate (Calcium EDTA), Pencillamine and Defroxamine.

NOTE:

- Only an introduction will be given of the banned and obsolete drug products.
- While dealing with Pharmacology stress should be laid to the group actions of related drugs and only important differences should be discussed of the individual drugs placed in same group.
- Newly introduced drugs should be included in the syllabus while drugs with no clinical and therapeutic values ought to be excluded from syllabus at any time.
- The prototype drugs in each group from the latest edition of the recommended books.

PRACTICAL

Antibiotic sensitivity tests (disk method, valve method), microbiological assay, calculations of minimum inhibitory concentrations of various antibiotics, competitive antagonism of drugs such as acetylcholine and atropine in rabbits. Demonstration of strychnine poisoning in laboratory animals.

RECOMMENDED BOOKS

1. Richard, F., M. Clark and L. Cubbedu, 2011. Lippincott's Illustrated Reviews, Pharmacology. 5th Ed., Lippincott William & Wilkins, USA.
2. Brunton, L.L., J.S. Lazo and K.L. Parker, 2010. Goodman Gillman's Pharmacological Basis of Therapeutics. 12th Ed., McGraw-Hill Book Company, New York, USA.
3. Katzung, B.G., 2011. Basic and Clinical Pharmacology. 12th Ed., McGraw-Hill Medical Publishers, New York, USA.
4. Tripathy, J.D., 2008. Essential of Medical Pharmacology. 12th Ed., Japee Brothers, New Delhi, India.
5. Ritter, J.M. and L.D. Levis, 2008. A Text Book of Clinical Pharmacology. 5th Ed. Oxford University Press, New York, USA.
6. Rang, H.P., Dale, M.M., 2011. Rang and Dale's Pharmacology. 7th Ed. Elsevier, Churchill Living Stone, London, UK

7. Satorkar, R.S. and S.D. Bhandarkar, 2005. Pharmacology and Pharmacotherapeutics. 19th Ed. Popular Prakashan, Bombay, India.
8. Edabi, M., 1993. Pharmacology. Little Brown & Company, London, UK.
9. Winguard, L.B., 1991. Human Pharmacology: Molecular to Clinical. Mosby-Year Book, Boston, USA.

Pharm-D-305

PHARMACOGNOSY-IIB (Advanced)

4(3-1)

THEORY

1. **VOLATILE OILS (ESSENTIAL OILS):** Introduction, significance, sources, active constituents, methods of obtaining volatile oils, chemistry and classification of:
 - (a) Hydrocarbon volatile oils: Cubeb and Turpentine oil.
 - (b) Alcoholic volatile oils: Peppermint, Coriander and Cardamom.
 - (c) Aldehydic volatile oils: Bitter orange peel, sweet orange peel, Lemon, cinnamon and bitter almond oil
 - (d) Ketonic volatile oils: Camphor, spearmint, caraway, Buchu
 - (e) Phenolic volatile oils: Clove, Thyme.
 - (f) Phenolic ether volatile oils: Fennel, Anise, Myristica.
 - (g) Oxide volatile oils: Eucalyptus, chenopodium.
 - (h) Ester volatile oils: Rosemary.
 - (i) Miscellaneous volatile oils: Allium, Anethum.

2. **RESINS AND OLEORESINS:** Introduction, classification, active constituents and pharmacological uses of jalap, turpentine, asafoetida, benzoin, rosin, cannabis, podophyllum, ipomea, myrrh, and balsam.

3. **TANNINS:** Introduction, classification, biosynthesis, extraction, identification, occurrence in plants, their role in plant life and chemical study of tannins in kino, myrobalan, catechu, nutgall, castanea, and krameria.

4. **NATURAL TOXICANTS:**
 - a) General Introduction to Plant Toxicology: Definition, classification and chemical nature of plant toxins. Plant toxicities in humans and animals
 - b) Higher Plant Toxins: Essential oils: Terpene (cineol, pine oil), Phenyl propane (apiol, safole, myristicin), Monoterpene (thujone, menthafuran) Plant acids (oxalic acid, amino acid, resin acid), Glycosides (cardiotonic, cyanogenic), Alkaloids (imidazole, pyrrolizidine, tropane).
 - c) Lower Plant Toxins: Bacterial toxins (Staphylococcus aureus, Clostridium botulinum), Algal toxins (Microcystis aeruginosa, Cyanobacteria, Gonyaulax cantenella).
 - d) Mycotoxins: Fungal toxins (Aspergillus spp., Claviceps purpurea), Mushrooms (Amanita spp.).
 - e) Study of Toxins, their Prevention and Control Methods: Description, pharmacognostic features, pharmacological actions, chemical constituents, treatment, side-effects, contra-indications, warnings, prevention and control methods of Abrus precatorius, Papaver somniferum, Eucalyptus spp., Nicotiana tabaccum, Cannabis sativa, Digitalis purpurea, Datura stramonium poisoning.

5. **AN INTRODUCTION TO NUTRACEUTICALS AND COSMECEUTICALS:**

6. **TUMOR INHIBITORS FROM PLANTS:** Introduction of anticancer agents of natural origin, as Catharanthus roseus, Colchicum autumnale, Podophyllum peltatum, rifamycin antibiotics, macrolide antibiotics, anti-AIDS agents and immunostimulants.

7. INTRODUCTION TO CLINICAL PHARMACOGNOSY: General introduction and historical background of clinical Pharmacognosy. Study of treatment by herbal medicines

8. CLINICAL USE OF HERBS & HERBAL MEDICINE:

Diabetes:	<i>Gymnema sylvestre, Melia azadirchta, Momordicacharantia, Syzygium jambulana.</i>
Cardiac diseases:	<i>Digitalis spp., Convallaria majalis, Urgenia indica, Allium sativum, Punica granatum.</i>
Hepatitis:	<i>Berberis vulgaris, Picrorhiza kurroa, Lawsonia innermis.</i>
Respiratory diseases:	<i>Ficus religiosa, Adhatoda vasica.</i>
Skin diseases:	<i>Aloe vera, Angelica archangelica, Mentha piperita, Citrus spp., Commiphora mukul.</i>
CNS disorders:	<i>Strychnos nux-vomica, Datura stramonium, Cannabis sativa, Papaver somniferum, Atropa belladonna.</i>
Musculo-skeletal disorders:	<i>Nigella sativa, Phycotis ajowan, Trigonella foenum-graecum, Zingiber officinale.</i>
Renal disorders:	<i>Cucumis melo, Berberis vulgaris, Zea mays, Tribulus terrestris.</i>
Reproductive disorders:	<i>Saraca indica, Ruta graveolens, Nigella sativa, Glycyrrhiza glabra, Claviceps purpurea, Myristica fragrance.</i>
G.I.T. disorders:	<i>Foeniculum vulgare, Ferula foetida, Cuminum cyminum, Aegle marmelos, Prunus domestica.</i>

PRACTICAL

Isolation and separation of active constituents of crude drugs (nux vomica seeds, clove honey, by thin layer chromatography and paper chromatography. Extraction and identification of cardiac glycosides from nerium indicum. Extraction and identification of anthraquinone glycosides from aloe and rhubarb by paper and thin layer chromatography.

RECOMMENDED BOOKS

1. Cseke, L.J., A. Kirakosyan, P.B. Kaufman, S. Warber and J.A. Duke, 2010. Natural Products from Plants. 2nd Ed., CRC Press, USA.
2. Samuelsson, G., 2010. Drugs of Natural Origin: A Treatise of Pharmacognosy. 6th Ed., Apotekarsocieteten, Stockholm, Sweden.
3. Heinrich, M., J. Barnes, S. Gibbons and E.M. Williamson, 2012. Fundamentals of Pharmacognosy and Phytotherapy, 2nd Ed., Elsevier Health Sciences, UK.
4. Evans, W.C., G.E. Trease and D. Evans, 2009. Trease and Evans' Pharmacognosy. 16th Ed., W.B. Saunders, Toronto, Canada.

Chem-306

**PHARMACEUTICAL CHEMISTRY-IIIB
(Pharmaceutical Analysis)**

4(3-1)

THEORY

1. **ELECTRO CHEMICAL METHODS:** Potentiometry, Polarography and Radiochemical Techniques.
2. **THERMAL ANALYSIS:** Differential Scanning Calorimetry, Differential Thermal Analysis, Thermo Gravimetric Analysis.

3. **TITRIMETRIC ANALYSIS:** Titrimetric analysis of drugs based on neutralization, hydrolysis, oxidation, reduction and non-aqueous titration.

OCCURENCE, PROPERTIES, PREPARATION AND APPLICATION OF OFFICIAL INORGANIC COMPOUNDS: Aluminium Hydroxide, Ammonium Chloride, Sodium Carbonate, Magnesium Carbonate, Lithium Carbonate, Sodium Nitrite, Calcium Gluconate, Antimony Gluconate, Ferrous Fumarate, Ferrous Sulfate and Silver Nitrate.

PRACTICALS

Determination of the purity and composition of the unknown drugs by using at least each of the above techniques. Validation of analytical procedures: Text and methodology ; Specificity, linearity and range, accuracy, precision, limit of detection, limit of quantification, stability, ruggedness, robustness and system suitability. Quantitative determination of various drugs in pharmaceutical preparations by chromatographic methods and radioimmuno assays.

RECOMMENDED BOOKS

1. Beckett, A.H. and J.B. Stenlake, 2001. Practical Pharmaceutical Chemistry. Part-II. 4th Ed., Continuum International Publishing Group, London, UK.
2. Aminuddin, M. and J. Iqbal, 2000. Theory and Practice of Chromatography. University Grants Commission, Islamabad, Pakistan.
3. Lough, W.J., 1996. High Performance Liquid Chromatography. Blacken Academic Press, New York, USA.
4. Braithwaite, A. and F.J. Smith, 1996. Chromatographic Methods. Chapman and Hall, London, UK.
5. William, K., 1990. Organic Spectroscopy. Ellsi Horwood, London, UK.
6. Hamilton, R., 1982. Introduction to HPLC. P.A Sewell, Chapman & Hall, London, UK.
7. Pryde, A. and M.J. Gilbert, 1979. Applications of High Performance Liquid Chromatography. Chapman & Hall, London, UK.
8. Knevel, A.M. and F.E Digangi, 1977. Jenkins's Quantitative Pharmaceutical Chemistry. 7th Ed., McGraw-Hill Book Company, New York, USA.

Pharm-D-306

PHARMACY PRACTICE-IIB
(Community, Social and Administrative Pharmacy)

3(3-0)

THEORY

1. **DEFINITIONS AND BACKGROUND:**
2. **PUBLIC HEALTH AND COMMUNITY PHARMACY:** Epidemiology & its Control, Epidemiological methodology with a focus on specific disease states, Pharmacoepidemiology (including Drug Utilization Review). Preventive Health (EPI & CDC), Family Planning and Health Policy.
3. **MEDICAL COMPLICATION OF DRUG TAKING:** General and Socio-economic aspects.
4. **PATIENT EDUCATION AND COUNSELLING:**
5. **CONTROL OF DRUG ABUSE AND MISUSE:**
6. **ROLE OF PHARMACIST:** As Public Health Educator in the Community for Drug Monitoring and Drug Information.

7. **HEALTH SYSTEM RESEARCH:** Knowledge skills of research methods, epidemiologic study design, experimental study design, Pre- and post-marketing surveys. Application of various statistical procedures in Pharmacy and Medical Research, causality assessment as well as the sensitivity and specificity tests in pharmacy practice.
8. **PHARMACOECONOMICS:** Pharmacoeconomic modeling & interpretation.
9. **ALTERNATIVE THERAPIES:** Background, philosophy and use of complementary and alternative therapies including herbal medicines, homoeopathy, acupuncture, acupressure, Bach Flower remedies, aromatherapy and reflexology.
10. **PHARMACY LAYOUT DESIGN:** Objectives of Layout Design, Types of Community Pharmacies (Pharmaceutical Centre, Prescription-oriented Pharmacies, Traditional Pharmacies and The Super Drug Store), Consumer goods and purchases, Classes of Layout designs, Principles and characteristics of Layout Design and Traffic Flow analysis.

RECOMMENDED BOOKS

1. David, B.T. and P. Bringer, 2006. Remington: The Science and Practice of Pharmacy. 21st Ed., Lippincott William and Wilkins, USA.
2. Paul R., David N. 2012. Community Pharmacy; Symptoms Diagnosis and Treatment. 2nd Ed. Elsevier, Churchill Living Stone, London, UK
3. Robertson, R., 1998. Management of Drug Users in the Community: A Practical Handbook. London, UK.
4. James, E.F.R. and W. Martindale, 1996. The Extra Pharmacopoeia. 35th Ed., Royal Pharmaceutical Society, London, UK.

FOURTH PROFESSIONAL

SEVENTH SEMESTER

Pharm-D-401 PHARMACY PRACTICE-IVA (Hospital Pharmacy) 3(3-0)

THEORY

1. **INTRODUCTION:**
 - a. Role of Pharmacist in Hospital
 - b. Minimum standards for pharmacies in Institutions/Hospitals
 - c. Research in Hospital Pharmacy
2. **HOSPITAL AND ITS ORGANIZATION:**
 - a. Classification of Hospitals
 - b. Organizational Pattern
 - c. Administration
 - d. Clinical Departments
 - e. Nursing, Dietetic, Pathology, Blood Bank, Radiology and other supportive services
 - f. Role of Pharmacy in Hospital
 - g. Hospital Finances

3. **PHARMACY, ITS ORGANIZATION AND PERSONNEL:**
 - a. Pharmacy specialist
 - b. Drug information Centre
 - c. Poison Control Centre and Antidote Bank
 - d. Pharmacy Education
 - e. Determining the Need of Professional and other departmental staff
 - f. Professional services rendered
4. **PHARMACY AND THERAPEUTIC COMMITTEE:**
5. **THE HOSPITAL FORMULARY:**
 - a. General Principles and guidelines to develop Formulary
 - b. Format
 - c. Preparation of the Formulary
 - d. Role of Pharmacist
 - e. Benefits and problems
 - f. Keeping up to date Formulary
6. **DISPENSING TO INPATIENTS:**
 - a. Methods of Dispensing & SOP's
 - b. Unit dose dispensing
 - c. Other concepts of dispensing, Satellite Pharmacy etc.
7. **DISPENSING TO AMBULATORY PATIENTS:**
8. **DISTRIBUTION OF CONTROL SUBSTANCES:**
9. **DISPENSING DURING OFF-HOURS:**
10. **SAFE USE OF MEDICATION IN THE HOSPITAL:** Medication error; Evaluation & Precautions of Medication Error; Role of Pharmacist in Controlling Medication Error.

RECOMMENDED BOOKS

1. Stephen, M., 2011. Hospital Pharmacy. 2nd Ed. Pharmaceutical Press, London, UK.
2. Taylor, K. and G. Harding, 2001. Pharmacy Practice. CRC press, USA.
3. Bukhari, N.I., 2000. Hospital Pharmacy. Aziz Book Depot, Lahore, Pakistan.

Pharm-D-402

PHARMACY PRACTICE-VA (Clinical Pharmacy)

4(3-1)

THEORY

1. GENERAL INTRODUCTION TO CLINICAL PHARMACY:

- Introduction to clinical pharmacy and related terms, definition, basic components, comparison with other clinical fields, scope of services.
- General guidelines for clinical pharmacy practice.
- Patient Counseling Compliance
- Laboratory Data interpretation
- Electrolytes management
- Clinical literature evaluation
- Drug interactions

- Medication errors

2. **PATIENT PROFILE & PATIENT COUNSELING:**

- a. Patient disease profile
- b. Taking case history
- c. Drug Profile of atleast 25 Important Medications e.g. Adrenaline, Aminoglycosides, Anti TB Drugs, Antiepileptics, Atropine, Benzodiazepines, Cephalosporins, Chlorpheniramine, Cimetidine, Digoxin, Dobutamine, Dopamine, Fluroquinolone, Frusemide, Lactulose, Macrolides, Metoclopramide, Morphine/Pethidine, Nifedipine, NSAIDS, ORS, Penicillins, Prednisolone, Salbutamol, Vancomycin.
- d. Patient Counseling

3. **CLINICAL TRIALS OF DRUG SUBSTANCES:** Designing of clinical trials, Types of trials, Choice of patients, Exclusion of patients and Monitoring a clinical trial.

4. **EMERGENCY TREATMENT:** For example, Cardiopulmonary resuscitation (CPR), Cold Blue.

5. **DRUG INTERACTIONS:** Mechanism, Physiological factors affecting interaction, Types and level of drug interactions, Role of pharmacist in evaluating drug interaction & its management.

6. **PHARMACOVIGILANCE:**

- a) Scope, definition and aims of Pharmacovigilance
- b) Adverse Drug Reactions and Side Effects: Classification, Excessive pharmacological response, Idiosyncrasy, Secondary pharmacological effects, Allergic drug reactions, Detection, Management of ADR, reporting of ADR in light of international health monitoring system.

PRACTICAL

Clerkship in the clinical setting. A project related to clinical pharmacy practices will be completed by the students and will be evaluated by the external examiner.

RECOMMENDED BOOKS

1. Cook, S., 2004. Clinical Studies Management: A Practical Guide to Success. Sue Harwood Publishing Limited, West Sussex, UK.
2. Walker, R., 2012. Clinical Pharmacy and Therapeutics. 5th Ed., Churchill Livingstone, London, UK.
3. Brian K.A., Robin L.C., Pamala A.J., Michael E. Earnst.2012. Applied Therapeutics; The Clinical Use Of Drugs. 10th Ed. Volter Kluwer; Lippincott William and Wilkins, Philadelphia, USA
4. Winfield, A.J., R. Michael and E. Richards, 2009. Pharmaceutical practice. 4th ed., Elsevier Health Sciences, UK.
5. Dipiro, J.T., 2003. Encyclopedia of Clinical Pharmacy. Marcel Dekker Publishing, New York, USA.
6. Stone, P. and S.J. Curtis, 2002. Pharmacy Practice. 3rd ed., Pharmaceutical Press, University of Michigan, UK.
7. Grahame-Smith, D.G. and J.K. Aronson, 2002. Oxford Textbook of Clinical Pharmacology and Drug Therapy. 3rd ed., Oxford University Press, UK.
8. Taylor, K. and G. Harding, 2001. Pharmacy Practice. CRC press, USA.
9. Rosenbaun, D., 2004. Clinical Research Coordinator Hand Book. 3rd Ed., Sarrison, Inch, North Carolina, USA.
10. Donnelly, R. and J.D. Hughes, 2001. Society of Hospital Pharmacists of Australia, Greta James-Chatgilaou. Clinical Pharmacy: A Practical Approach. 2nd ed., Macmillan Publishers, Australia.
11. Paul, G., 2000. A Behavioral Approach to Pharmacy Practice. Black Well, USA.

THEORY

1. **MASS TRANSFER:**
2. **HEAT TRANSFER:**
3. **DRYING:** Theories of drying, Drying of Solids, Classification of dryers, General Methods, Fluidized Bed systems, Pneumatic systems, Spray dryer, Freeze drying.
4. **COMMUNITON (SIZE REDUCTION):** Reasons for size reduction, Factors affecting size reduction, size analysis, Sieving, Energy Mills (Ball Mill, Endrumer, Edge Rumer, Disintegrant, Colloid Mill, Hammer Mill, Cutter Mill and Fluid Energy Mill etc).
5. **MIXING:** Fundamentals, Mechanisms, Mixing Equipment used in Liquid/Liquid, Liquid/Solid and Solid/Solid mixing.
6. **CLARIFICATION AND FILTRATION:** Theory, Filter Media, Filter aids, Filter selection and Equipment (Leaf filter, Filter press, Melta filters and Rotary filters).
7. **EVAPORATION:** General principles of Evaporation, Evaporators and Evaporation under reduced pressure.
8. **COMPRESSION AND COMPACTION:** The solid-air Interface, Angle of Repose, Flow rates, Mass volume relationship, Density, Heckel Plots, Consolidation, Granulation, Friability, Compression (dry method, wet method, slugging), Physics of Tableting, tableting machines and other equipment required, problems involved in tableting, tablet coating. **Capsulation:** Hard and soft gelatin capsules.

PRACTICAL

Manufacture of tablets by wet granulation method, by slugging and by direct compression. Coating of tablets (sugar coating, film coating and enteric coating), excipients e.g., Flavoring agents, sweeteners, binders etc and shapes of tablets. Classification of liquids by various processes. Size reduction. Homogenization.

RECOMMENDED BOOKS

1. Swarbrick, J. and J. Swarbrick, 2007. Encyclopedia of Pharmaceutical Technology. 3rd Ed., Informa Health Care, USA.
2. Allen, L.V., N.G. Popovich and H.C. Ansel, 2010. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 9th Ed., Lippincott Williams & Wilkins, USA.
3. Banker, G.S. and T.C. Rhodes, 2002 Modern Pharmaceutics. 4th ed., Informa health care, USA.
4. Gennaro, A.R., 1990. Remington's Pharmaceutical Sciences. 18th Ed., Mack Publishing Company, Pennsylvania, USA.

THEORY

1. **DEFINITIONS AND TERMINOLOGY:** Biopharmaceutics, Generic Equivalence, Therapeutic Equivalents, Bioavailability, Bioequivalence, Drug Disposition, Pharmacokinetics (LADMER; Liberation, absorption, distribution, metabolism, elimination and response).
2. **GASTRO-INTESTINAL ABSORPTION:** Forces which help in transmembrane movements, Anatomical and physiological factors influencing absorption of drugs. Physicochemical properties of drugs affecting absorption. Absorption of different oral dosage forms.
3. **BIOLOGICAL HALF LIFE AND VOLUME OF DISTRIBUTION:** Introduction, types, methods of determination and application.
4. **DRUG CLEARANCE:** Introduction, Mechanism, Models, determination and relationship of clearance with half-life.
5. **PHARMACOKINETICS:** Introduction, Linear and Non-linear Pharmacokinetics Application of pharmacokinetics in clinical situations.
6. **MULTIPLE DOSAGE REGIMEN:**
 - a. Introduction, principles of superposition
 - b. Factors: persistent, accumulation and loss factors
 - c. Repetitive Intravenous injections – One Compartment Open Model
 - d. Repetitive Extravascular dosing – One Compartment Open model
 - e. Multiple Dose Regimen – Two Compartment Open Model
7. **CONCEPT OF COMPARTMENT(S) MODELS:**
 - I. One compartment open model.
 - a. Intravenous Injection (Bolus)
 - b. Intravenous infusion.
 - II. Multicompartment models.
 - a. Two compartment open model.
 - b. IV bolus, IV infusion and oral administration
 - III. Non-compartmental Model.
 - a. Statistical Moment Theory
 - b. MRT for various compartment models
 - c. Physiological Pharmacokinetic model

PRACTICAL

Blood Sampling techniques: In laboratory animals like dog, rabbits, mice etc. In human beings, in-vitro dissolution studies, optional dose determination, measurement of rate of bioavailability of commonly used drugs, powders, parenterals, syrups etc. Determination of relative and absolute bioavailability of most commonly used drugs as Paracetamol, dispirin, tetracyclines. Plasma level-time curve (Determination of Pharmacokinetic parameters). Determination of plasma protein binding. Urinary sampling techniques in laboratory animals. Renal excretion of drugs or drug disposition in animals and humans

RECOMMENDED BOOKS

1. Li, A.P., 2004. In Vitro Approaches for Evaluation of Drug Efficiency and Toxicity. CRC Press, LLC, USA.
2. Niazi, S., 2009. Handbook of Pharmaceutical Manufacturing Formulations: Compressed Solid Products. 2nd Ed. Informa Health Care, USA.
3. Shargel, L., S. Wu-Pong and A.B.C. Yu, 2012. Applied Biopharmaceutics and Pharmacokinetics. 6th ed., McGraw-Hill, Medical Pub. Division, New Delhi, India.
4. Schoenwald, R.D., 2002. Pharmacokinetics in Drug Discovery and Development, CRC Pres, LLC, USA.

THEORY**1. INTRODUCTION:**

- (a) Basic concepts and introduction of pharmaceutical industry in relevance to quality assurance and quality control departments, testing, quality management system, quality assurance, quality control and quality standards.
- (b) General understanding of good laboratory practices and validation

2. QUALITY CONTROL OF SOLID DOSAGE FORMS:

- (a) Physical tests: Hardness, Thickness and Diameter, Friability, Disintegration, Weight Variation.
- (b) Chemical tests: Content uniformity, Assay of active Ingredient and dissolution tests of Powders, Granules, Tablets and Capsules.

3. QUALITY CONTROL OF SYRUPS, ELIXIRS and DISPERSE SYSTEM: Viscosity, its determination and application in the Quality Control of Pharmaceuticals, Weight per ml and Assay of active Ingredient.**4. QUALITY CONTROL OF SUPPOSITORIES:** Dissolution test, Uniformity of weight, Assay of active Ingredient, Liquefaction time test and Breaking test.**5. QUALITY CONTROL OF STERILE PRODUCTS (PARENTERALS):** Sterility Test and Sterile section management, Leaker's test, Clarity test, Pyrogen test for Parenteral and other sterile preparations, Assay for active Ingredient.**6. STANDARDIZATION OF PHARMACEUTICALS:** An understanding of quality assurance system adopted in pharmaceutical industry. Good Manufacturing Practices and Current Good Manufacturing Practices.**PRACTICAL**

Assay of various spirits, tinctures, extracts, syrups and elixirs, assay of ointments and suppositories, assay of tablets and capsules, test for alkalinity of glass, determination of alcohol contents in the pharmaceutical preparations and Pyrogen tests in rabbits and guinea Pigs. Determination of Ash contents, Determination of Moisture contents, Determination of total solids, Determination of viscosity of syrups, gels, etc., Determination of emulsion types.

RECOMMENDED BOOKS

1. Desselle, S.P., P. D. Zgarrick and D. Shane, 2008. Pharmacy Management: Essentials for All Practice Settings. 2nd ed., McGraw-Hill Professional, New Delhi, India.
2. Bismuth, G. and S. Neumann, 2003. Cleaning Validation: A Practical Approach. CRC Press, LLC, USA.
3. Bladon, C.M., 2002. Pharmaceutical Chemistry: Therapeutic Aspects of Biomacromolecules. John Wiley and Sons, USA.
4. Beckett, A.H. and J.B. Stenlake, 2001. Practical Pharmaceutical Chemistry. Part-II. 4th Ed., Continuum International Publishing Group, London, UK.
5. Dogramatzis, D., 2001. Pharmaceutical Marketing: A Practical Guide. Informa Health Care, USA.
6. Carstensen, J.T. and C.T. Rhodes, 2000. Drug Stability: Principles and Practices. 3rd Ed., Merce Dekker, New York, USA.
7. Lighter, D.E. and D.C. Fair, 2004. Principles and Methods of Quality Management in Health Care. 2nd Ed. Jones & Bartlett Publishers, USA.

EIGHTH SEMSTER

Pharm-D-406

PHARMACY PRACTICE-IVA (Hospital Pharmacy)

3(3-0)

THEORY

1. **MANUFACTURING BULK AND STERILE:**
2. **THE PHARMACY; CENTRAL STERILE SUPPLY ROOM:**
3. **ASEPTIC DISPENSING:** TPN, I/V Admixtures, Cytotoxic Dispensing, Semi-sterile Dispensing (Eye drops, Ear drops) and Hyperalimentation.
4. **ROLE OF PHARMACIST IN SMALL HOSPITALS, NURSING HOMES etc.**
5. **PURCHASING, DISTRIBUTION AND CONTROL OF HOSPITAL MEDICINES, MEDICAL & SURGICAL SUPPLIES:** Purchasing, Stocking, Stock Control, Inventory Management, Drug Distribution, Relationship between purchasing, Distribution and Clinical Pharmacy Services.
6. **NUCLEAR PHARMACY:**
7. **THE PHYSICAL PLANT AND ITS EQUIPMENT:**
8. **INVESTIGATIONAL USE OF DRUGS:**
9. **HEALTH ACCESSORIES:**
10. **SURGICAL SUPPLIES:**
11. **INSPECTION OF WARDS WITH REFERENCE TO DRUG STORAGE AND ADMINISTRATION:**
12. **MANAGEMENT OF ACCIDENT & EMERGENCY PHARMACY (A & E):**

RECOMMENDED BOOKS

1. Stephen, M., 2011. Hospital Pharmacy. Pharmaceutical Press, London, UK.
2. Bukhari, N.I., 2000. Hospital Pharmacy. Aziz Book Depot, Lahore, Pakistan.
3. Hassan, W.1986. Hospital Pharmacy. 5th Ed., Lee & Fibiger, Washington, USA.

Pharm-D-407

PHARMACY PRACTICE-VB (Clinical Pharmacy)

4(3-1)

THEORY

1. **PHARMACOTHERAPY PLAN:**
 - a. **Developing, Implementing and Monitoring Drug Therapy Plans:**
 - Pharmacist work up of drug therapy (PWDT)
 - Documentation of Pharmacotherapy Plan
 - SOAP note
 - CORE Pharmacotherapy Plan
 - PRIME Pharmacotherapy problems

- FARM note
 - Implementation of Drug Therapy Plan
 - Monitoring of Pharmacotherapeutic plan
 - Pharmaceutical care plan as ongoing process
 - Importance of drug therapy plan in today's pharmacy practice.
- b. Pharmacotherapy Decision-Making:
- Pursue the role of drug therapy practitioner over that of drug therapy advisor.
 - Participate in pharmacotherapy decision-making by:
 - a) Identifying opportunities for decision-making.
 - b) Proactively engaging decision-making opportunities.
 - c) Formulating decision rationale that is the result of rigorous inquiry, scientific reasoning, and evidence.
 - d) Pursuing the highest levels of decision-making.
 - e) Seeking independence in making decisions and accepting personal responsibility for the outcomes to patients resulting from one's decisions.
 - f) Personally enacting decisions.

2. **DRUG INDUCED DISEASES:**

3. **UTILIZATION OF CLINICAL DRUG LITERATURE:** Introduction, Drug literature selection, Drug literature evaluation and Drug literature communication.

1. **ON LINE PHARMACEUTICAL CARE SERVICES AND GLOBALIZATION:**

2. **PROVISION OF PHARMACEUTICAL CARE IN MULTIPLE ENVIRONMENTS:** Professionalism, physical assessment, body substance precautions and the relationships between culture, race and gender to pharmaceutical care.

6. **DISEASE MANAGEMENT:** Disease management should be covered by considering aspects like definition of disease, etiology, pathogenesis, clinical presentation, diagnostic work out (briefly), pharmacotherapy.

- Unit I: Cardiovascular unit (hypertension, ischemic heart diseases e.g. angina pectoris. MI, Heart failure)
- Unit II: Pulmonary unit (Asthma e.g. acute & chronic, status asthmaticus, childhood asthma, Pneumonia, COPD includes emphysema & chronic bronchitis)
- Unit III: Gastroenterology unit (ulcer, liver cirrhosis, portal hypertension, hepatitis, inflammatory bowel disease, diarrhoea)

PRACTICAL

- Clerkship in the Clinical Setting. A report Related to Clinical Pharmacy Practices will be completed by the students and will be evaluated by the external examiner.
- Students will also complete a report independently or in a group on a Drug Use Evaluation.
- Students will take the assignment tasks to enhance verbal presentation, communication, written and problem-solving skills, critical analysis of data and provision of care through a weekly conference and projects.

RECOMMENDED BOOKS

1. Cook, S., 2004. Clinical Studies Management: A Practical Guide to Success. Sue Harwood Publishing Limited, West Sussex, UK.
2. Walker, R., 2012. Clinical Pharmacy and Therapeutics. 5th Ed., Churchill Livingstone, London, UK.
3. Brian K.A., Robin L.C., Pamala A.J., Michael E. Earnst.2012. Applied Therapeutics; The Clinical Use Of Drugs. 10th Ed. Volter Kluwer; Lippincott William and Wilkins, Philadelphia, USA
4. Winfield, A.J., R. Michael and E. Richards, 2009. Pharmaceutical practice. 4th ed., Elsevier Health Sciences, UK.
5. Dipiro, J.T., 2003. Encyclopedia of Clinical Pharmacy. Marcel Dekker Publishing, New York, USA.
6. Stone, P. and S.J. Curtis, 2002. Pharmacy Practice. 3rd ed., Pharmaceutical Press, University of Michigan, UK.
7. Grahame-Smith, D.G. and J.K. Aronson, 2002. Oxford Textbook of Clinical Pharmacology and Drug Therapy. 3rd ed., Oxford University Press, UK.
8. Taylor, K. and G. Harding, 2001. Pharmacy Practice. CRC press, USA.
9. Rosenbaun, D., 2004. Clinical Research Coordinator Hand Book. 3rd Ed., Sarrison, Inch, North Carolina, USA.
10. Donnelly, R. and J.D. Hughes, 2001. Society of Hospital Pharmacists of Australia, Greta James-Chatgilaou. Clinical Pharmacy: A Practical Approach. 2nd ed., Macmillan Publishers, Australia.
11. Paul, G., 2000. A Behavioral Approach to Pharmacy Practice. Black Well, USA.

Pharm-D-408

PHARMACEUTICS-IVB (Industrial Pharmacy)

4(3-1)

THEORY

1. **EMULSIONS:** Mechanical Equipments, Specific formulation consideration and Emulsion stability.
2. **SUSPENSIONS:** Formulation of suspensions, Equipment used in preparation and test methods for pharmaceutical suspensions.
3. **SEMISOLIDS:** Equipment used for Ointments, Pastes, Gels and Jellies. Packaging of ointments.
4. **EQUIPMENTS USED FOR:** Patches, Sprays, Implants, Sutures, Plasters and Sachet packing.
5. **STERILE PRODUCTS:** Sterile area and its Classification, Ophthalmic ointments, Preparation of parenterals (Building, Equipment), Complete Sterility (Aseptic area), air control, (Laminar flow etc.), air locks, Environmental monitoring methods, Sterilization, Filling/Packaging (Plastic and glass containers), Added substances (Preservatives, anti-oxidants, solubilizer, suspending agents, buffers, stabilizers etc.), Inprocess Quality Control of Parenterals (Sterility, leakage, pyrogens, clarity etc.).
6. **PACKING & PACKAGING:** Influence of Packaging materials, Stability, Packaging Lines, Packaging Area, Packaging Equipment.
7. **SAFETY METHODS IN PHARMACEUTICAL INDUSTRY:**
 - (a) Mechanical, chemical and fire hazards problems.
 - (b) Inflammable gases and dusts.

NOTE: STUDY TOUR: A visit to the pharmaceutical industries will be an integral part of the syllabus and will prepare and submit a report about operations in Pharmaceutical industry that will be evaluated in practical examination.

PRACTICAL

Ampule filling, sealing and sterilization of parenterals, clarity and leakage tests in injectable. Packaging materials. Capsule filling by semi automatic machines. Manufacture of sustained action drugs. Tablets tests like disintegration, dissolution, friability, hardness and thickness tests. Determination of weight variation in tablets. Density of powder. Particle size analysis.

RECOMMENDED BOOKS

5. Swarbrick, J. and J. Swarbrick, 2007. Encyclopedia of Pharmaceutical Technology. 3rd Ed., Informa Health Care, USA.
6. Allen, L.V., N.G. Popovich and H.C. Ansel, 2010. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 9th Ed., Lippincott Williams & Wilkins, USA.
7. Banker, G.S. and T.C. Rhodes, 2002 Modern Pharmaceutics. 4th ed., Informa health care, USA.
8. Gennaro, A.R., 1990. Remington's Pharmaceutical Sciences. 18th Ed., Mack Publishing Company, Pennsylvania, USA.

Pharm-D-409 PHARMACEUTICS-VB (Biopharmaceutics and Pharmacokinetics) 4(3-1)

THEORY

1. ELIMINATION OF DRUGS:

- a) Hepatic Elimination: Percent of Drug Metabolized, Drug Biotransformation reactions, (Phase-I reactions and phase-II reactions), First pass effect, Hepatic clearance of protein bound drugs and Biliary excretion of drugs.
- b) Renal Excretion of Drugs: Renal clearance, Tubular Secretion and Tubular Reabsorption.
- c) Elimination of Drugs through other organs: Pulmonary excretion, salivary excretion, Mammary excretion, Skin excretion and Genital excretion.

2. **PROTEIN BINDING:** Introduction, types, kinetics, determination and clinical significance of drug-protein binding.

3. **PHARMACOKINETICS VARIATIONS IN DISEASE STATES:** Determination of pharmacokinetics variations in renal and hepatic diseases, general approaches for dose adjustment in renal disease and hepatic diseases.

4. PHARMACOKINETICS OF INTRAVENOUS INFUSIONS:

5. **BIOPHARMACEUTICAL ASPECTS IN DEVELOPING A DOSAGE FORM:** Drug considerations, drug product considerations, patient considerations, manufacturing considerations, pharmacodynamic considerations, pharmacokinetic considerations.

6. BIOAVAILABILITY AND BIOEQUIVALENCE:

- a. Introduction.
- b. Bioavailability types, parameters, significance and study protocol.
- c. Methods of Assessment of Bioavailability.
- d. Bioequivalence study designs, components and application, report format.

IN-VITRO-IN-VIVO CORRELATION (IVIVC): Introduction, levels and determination of in-vitro/in-vivo correlation.

PRACTICAL

Plasma level-time curve: Determination of pharmacokinetic parameters. Determination of plasma protein binding. Urinary sampling techniques. In laboratory animals. In humans, renal excretion of drugs or drug disposition.

RECOMMENDED BOOKS

1. Li, A.P., 2004. In Vitro Approaches for Evaluation of Drug Efficiency and Toxicity. CRC Press, LLC, USA.
2. Niazi, S., 2009. Handbook of Pharmaceutical Manufacturing Formulations: Compressed Solid Products. 2nd Ed. Informa Health Care, USA.
3. Shargel, L., S. Wu-Pong and A.B.C. Yu, 2012. Applied Biopharmaceutics and Pharmacokinetics. 6th ed., McGraw-Hill, Medical Pub. Division, New Delhi, India.
4. Schoenwald, R.D., 2002. Pharmacokinetics in Drug Discovery and Development, CRC Pres, LLC, USA.

Pharm-D-410

**PHARMACEUTICS-VIB
(Pharmaceutical Quality Management)**

4(3-1)

THEORY

1. **BIOLOGICAL ASSAYS:** Biological methods, Standard preparations and units of activity, Bioassay of antibiotics, Bioassay of insulin injection, Assay of prepared digitalis and Assay of Vitamin D.
2. **ALCOHOL DETERMINATION:** Alcoholometric methods, Problem during distillation of alcohol, Method for liquids containing less than 30% or more than 30% alcohol and special treatment before distillation.
3. **ALKALOIDAL DRUG ASSAY:** Weighing for assay, Extraction of drugs, Maceration, Percolation, Continuous extraction, Purification of Alkaloids and determination of alkaloids.
4. **QUALITY ASSURANCE OF VACCINES:** Introduction, Quality measures for stability of vaccines, potency testing, and post market surveillance of vaccines.
5. **MISCELLANEOUS DETERMINATIONS AND TESTS:** Determination of weight/ml, Water/Moisture content, Loss on Drying, Evaluation of Ointments, Ash contents and Alkalinity of Glass.
6. **STATISTICAL INTERPRETATION OF QUALITY CONTROL CHARTS DURING MANUFACTURING PROCESSES:**

PRACTICAL

Sterility test of various pharmaceutical preparations e.g., parenterals, determination of ash contents, determination of moisture contents of tablets, powders, granules etc, determination of total solids, determination of viscosity of syrups, gels, etc. Determination of emulsion types of lotion, liniments, milk etc.

RECOMMENDED BOOKS

1. Desselle, S.P., P. D. Zgarrick and D. Shane, 2008. Pharmacy Management: Essentials for All Practice Settings. 2nd ed., McGraw-Hill Professional, New Delhi, India.
2. Farb, D. A. Luttrell and R. Kirsch, 2005 Pharmaceutical Quality Control Lab: Guidebook. University of HealthCare, USA.
3. Bismuth, G. and S. Neumann, 2003. Cleaning Validation: A Practical Approach. CRC Press, LLC, USA.
4. Bladon, C.M., 2002. Pharmaceutical Chemistry: Therapeutic Aspects of Biomacromolecules. John Wiley and Sons, USA.
5. Beckett, A.H. and J.B. Stenlake, 2001. Practical Pharmaceutical Chemistry. Part-II. 4th Ed., Continuum International Publishing Group, London, UK.
6. Dogramatzis, D., 2001. Pharmaceutical Marketing: A Practical Guide. Informa Health Care, USA.

7. Carstensen, J.T. and C.T. Rhodes, 2000. Drug Stability: Principles and Practices. 3rd Ed., Merce Dekker, New York, USA.
8. Lighter, D.E. and D.C. Fair, 2004. Principles and Methods of Quality Management in Health Care. 2nd Ed. Jones & Bartlett Publishers, USA.

FIFTH PROFESSIONAL

NINTH SEMESTER

Chem-504

**PHARMACEUTICAL CHEMISTRY-IVA
(Medicinal Chemistry)**

4(3-1)

THEORY

NOTE: The topics will be taught with special reference to their Pharmaceutical Applications.

1. **INTRODUCTION TO MEDICINAL CHEMISTRY:** Chemical constitution and biological activity: (Receptor, Theory, Structure Activity Relationships (SAR) and Drug Metabolism). Modern concept of rational drug design, prodrug, combinatorial chemistry and computer aided drug design (CADD) and concept of antisense molecules.
2. **DRUG TARGETS AND DRUG DESIGNING:**
 - a. Introduction and types of drug targets
 - b. Introduction to molecular modeling and computational chemistry
 - c. Structure based designing
 - d. Ligand based designing
 - e. Various techniques in drug synthesis
3. **GENERAL PROPERTIES, CHEMISTRY, BIOLOGICAL ACTION, STRUCTURE ACTIVITY RELATIONSHIP AND THE THERAPEUTIC APPLICATIONS OF THE FOLLOWING:**
 - a. Hormones: Steroidal Hormones (Testosterone, Progesterone, Estrogen, Aldosteron and Cortisol), Proteinous Hormones (Insulin, Glucagon, Oxytocin and Vassopressin).
 - b. Anti-neoplastic Agents: Tamoxifen, Fluorouracil, Mercapturine, Methotrexate and Vincristine.
 - c. Sedatives & Hypnotics: Benzodiazepines, Barbiturates, Paraldehyde, Glutethimide, Chloral hydrate, and alcohols.
 - d. Anaesthetics: Local anaesthetics (Procaine, Lignocaine, Eucaine, Cocaine and Benzocaine), General anaesthetics (Cyclopropane, Halothane, Nitrous oxide, Chloroform, Thiopental Sodium, Ketamine, Methohexital, Thioamylal Sodium, Fantanyl Citrate, Tribromo ethanol).
 - e. Analgesics and Antipyretics: Paracetamol, Salicylic acid analogues, Quinolines derivatives, Pyrazolone and Pyrazolodiones, N- arylanthranilic acids, Aryl and heteroaryl acetic acid derivatives.

PRACTICAL

Estimation of functional groups; Carboxylic, Hydroxy, Amino and Nitro groups; Determination of Molecular weights of Organic Compounds. Synthesis of paracetamol, salicylic acid, methyl salicylate, azobenzene, benzoic acid, 5-hydroxy-I, 3-benzoxazol-2-one, aspirin, p-nitrosophenol, 3-nitrophthalic acid, o-chloro-benzoic acid. Inorganic preparations and assay.

RECOMMENDED BOOKS

1. Hardman, J.G., L.E. Limbird and A.G. Gilman, 2010. Goodman and Gilman's The Pharmacological Basis of Therapeutics. 12th Ed., McGraw Hill, New York, USA.
2. Katzung, B.G., 2009. Basic and Clinical Pharmacology. 11th Ed., McGraw Hill company, New York, USA.
3. Patrick, G.L., 2013. An Introduction to Medicinal Chemistry. 5th Ed., Oxford University Press, London, UK.
4. Burger, A., 1996. Medicinal Chemistry. John Willey & Sons, New York, USA.
5. Foye, W.O., 1995. Principles of Medicinal Chemistry. Varghese Publishing House, Bombay, India.
6. Tyagi, O.D., 2011. Text Book of Synthetic Drugs. Anmol Publication, New Delhi, India.
7. Leon S., Alan H.M., Paul F.S. 2009. Comprehensive Pharmacy Review. 7th Ed. Volter Kluwer; Lippincott William and Wilkins, Philadelphia, USA

Pharm-D-501 PHARMACY PRACTICE-VIA (Advanced Clinical Pharmacy) 4(3-1)

THEORY

1. **RATIONAL USE OF DRUGS:** Rational Prescribing, Rational Dispensing, Problems of Irrational Drug Use, Learning about drug use problem, Sampling to study drug use, Indicators of drug use.
2. **INTRODUCTION TO ESSENTIAL DRUGS:** Criteria for selection, Usage and Advantages. Development of EDL.
3. **DISEASE MANAGEMENT:**
 - Unit V: Central nervous system unit (Stroke, epilepsy, Psychosis)
 - Unit VI: Infectious diseases (Meningitis, tuberculosis, dermatological infections, Rabies, Urinary track infection, Malaria fever, typhoid fever, fungal infections of skin, Dengue Fever, Common Cold, Pharyngitis & Tonsillitis, Conjunctivitis)
 - Unit VII: Endocrinology Unit (Diabetes Mellitus, Hyper/Hypo thyroidism, pituitary gland non-malignant disorders)
4. **DRUG UTILIZATION EVALUATION & DRUG UTILIZATION REVIEW (DUE/DUR):** Development of protocol of use of few very low therapeutic index drug groups like Steroids, Vancomycin and Cimetidine.
5. **CLINICAL PHARMACOKINETICS:** Therapeutic Drug Monitoring of Digoxin, Theophylline, Gentamycin, Lithium, Phenytoin, Cabamazepine, Phenobarbitone, Valproic Acid, Cyclosporins and Vancomycin.

PRACTICAL

- Clerkship in the Clinical Setting. A project Related to Clinical Pharmacy Practices will be completed by the students and will be evaluated by the external examiner.
- Students are required to participate in verbal presentation, communication, written and problem-solving skills, critical analysis of data and provision of care through a weekly conference and projects.

RECOMMENDED BOOKS

1. Cook, S., 2004. Clinical Studies Management: A Practical Guide to Success. Sue Harwood Publishing Limited, West Sussex, UK.
2. Walker, R., 2012. Clinical Pharmacy and Therapeutics. 5th Ed., Churchill Livingstone, London, UK.
3. Brian K.A., Robin L.C., Pamala A.J., Michael E. Earnst.2012. Applied Therapeutics; The Clinical Use Of Drugs. 10th Ed. Volter Kluwer; Lippincott William and Wilkins, Philadelphia, USA

4. Winfield, A.J., R. Michael and E. Richards, 2009. Pharmaceutical practice. 4th ed., Elsevier Health Sciences, UK.
5. Dipiro, J.T., 2003. Encyclopedia of Clinical Pharmacy. Marcel Dekker Publishing, New York, USA.
6. Stone, P. and S.J. Curtis, 2002. Pharmacy Practice. 3rd ed., Pharmaceutical Press, University of Michigan, UK.
7. Grahame-Smith, D.G. and J.K. Aronson, 2002. Oxford Textbook of Clinical Pharmacology and Drug Therapy. 3rd ed., Oxford University Press, UK.
8. Taylor, K. and G. Harding, 2001. Pharmacy Practice. CRC press, USA.
9. Rosenbaun, D., 2004. Clinical Research Coordinator Hand Book. 3rd Ed., Sarrison, Inch, North Carolina, USA.
10. Donnelly, R. and J.D. Hughes, 2001. Society of Hospital Pharmacists of Australia, Greta James-Chatgilaou. Clinical Pharmacy: A Practical Approach. 2nd ed., Macmillan Publishers, Australia.
11. Paul, G., 2000. A Behavioral Approach to Pharmacy Practice. Black Well, USA.

Pharm-D-502

**PHARAMCEUTICS-VIIA
(Pharmaceutical Technology)**

4(3-1)

THEORY

1. **PRINCIPLES OF PHARMACEUTICAL FORMULATION AND DOSAGE FORM DESIGN:** Need for dosage form; Preformulation Studies; Product Formulation.
2. **ADVANCED GRANULATION TECHNOLOGY (DESIGN & PRACTICE):** Spray Drying Granulation Technology; Roller Compaction Technology; Extrusion/Spheronization as a Granulation Technique; Single Pot Processing.
Granulation Technology: Rapid Release Granulation Technique; Particle Coating by Centrifugation Granulation Technology.
3. **POLYMERS USED IN DRUG DELIVERY SYSTEMS:**
4. **NOVEL DRUG DELIVERY SYSTEM (DDS):**
Sustained/ Controlled Release Drug Delivery System
 - i) Microencapsulation technique
 - Coacervation
 - Solvent evaporation
 - Interfacial polymerization
 - Spray drying
 - ii) Developmental aspects of Matrix and Reservoir Systems

PRACTICAL

Various techniques to develop the formulation, granulation technology, study of drug delivery systems, bio-technological aspect of product development, In-vitro quality control of various dosage forms (tablets, capsules, syrups, elixirs, powders, lotion, suppositories etc).

RECOMMENDED BOOKS

1. Augsburge, L.L. and S.W. Hoag, 2008. Pharmaceutical Dosage Forms: Tablets. Vol. 2: Rational Design and Formulation. 3rd Ed., Informa Health Care, USA.
2. Allen, L.V., N.G. Popovich and H.C. Ansel, 2010. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 9th Ed., Lippincott Williams & Wilkins, USA.
3. Hellery, A.M., 2002. Drug Delivery and Targeting. Taylor & Francis, London, UK.
4. Liu, D., 2008. Water Insoluble Drug Formulations. 2nd Ed. CRC Press. LLC, USA.
5. Ahuja, S. and S. Scypinski, 2010. Handbook of Modern Pharmaceutical Analysis. 2nd Ed. Academic Press, USA.

6. Park, K. and R.J. Mersny, 2000. American Chemical Society Meeting Controlled Drug Delivery: Designing Technologies for the Future. American Chemical Society, USA.
7. Banker, G.S. and T.C.T. Rhodes, 2002. Modern Pharmaceutics. 4th ed., Informa Health Care, USA.
8. Blaisdell, P., 2000. Twenty First Century Pharmaceutical Development. CRC Press, LLC, USA.
9. Gupta, P.k., 1999. Injectable Drug Development. CRC Press, LLC, USA.
10. Rahman, U.A. and M.I. Chaudry, 2001. Bioassay Techniques for Drug Development. CRC Press, USA.

Pharm-D-503 PHARMACY PRACTICE-VIIA (Forensic Pharmacy)

3(3-0)

THEORY

1. **GENERAL INTRODUCTION:** Forensic Pharmacy & Forensic Pharmacist, History of Drug Legislation and Pharmacy Profession in Pakistan, National Health Policy, National Drug Policy, Essential Drugs, Prescription handling at Retail level and Recordkeeping, Drug Control Administration at Federal and Provincial level.
2. **ROLE OF FORENSIC PHARMACIST:** Forensic drug Measurement, Post-mortem redistribution (PMR), Medication errors, prescription forgery, product tampering, Insurance fraud, Use of drugs or alcohol in car accidents or violent actions, Legal and illegal pharmaceutical evidence in criminal investigations, use of abused drugs in the workplace, professional malpractice, quackery and health care fraud.
3. **PHARMACEUTICAL ETHICS:** Patents and Generics, Ethics in Sale, Ethics in Industry, Ethics in Research.
4. **STUDY OF DRUG LAWS:**
 - a. The Drugs Act 1976 and rules framed there under.
 - b. Provincial Drug Rules (Respective Drug Rules will be taught in the relevant province).
 - c. Advertisement rules.
 - d. Other Related rules and Legal aspects.

RECOMMENDED BOOKS

1. Hussain, R.Z., 2012. The Manual of Drug Laws in Pakistan. Irfan Law Book House, Lahore, Pakistan.
2. Control of Narcotics Substances Act, 1997. Government of Pakistan.
3. Shop and Establishment Ordinance, 1969. Government of Pakistan.
4. The Pharmacy Act, 1967. Government of Pakistan.

AE-504

**PHARMACY PRACTICE-VIIIA
(Pharmaceutical Management & Marketing)**

3(3-0)

THEORY

1. **MANAGEMENT & MARKETING:**
 - a. Nature and Principles of Management
 - b. Types and Functions of Managers
 - c. Planning: Purpose and types of Planning, Steps in Planning
 - d. Organizing
 - e. Management Control Systems. Purpose: Steps in the Control Process, Forms of Operations control. Requirements for adequate control, Critical control points and standards
 - f. Motivation
 - g. Innovation and creativity

- h. Principals of Marketing
 - i. Product Management
 - j. Marketing Research
2. **PRODUCTION MANAGEMENT:** Material Management, Planning of production, Batch record maintenance.

TEXT BOOKS

1. McConnell, C.R., Brue, S.L., and Flynn, S.M. 2009. Economics: Principles, Problems and Policies, 9th edition, McGraw Hill, Inc.
2. Salvatore, D. 2011. Managerial Economics in the Global Economy. 7th edition, Fordham University Press.

RECOMMENDED BOOKS

1. Baye, M. 2010. Managerial Economics and Business Strategy. 7th edition. McGraw Hill Inc. Boston, USA.
2. Dogramatzis, D., 2001. Pharmaceutical Marketing: A Practical Guide. Informa Health Care, USA.
3. Wilkison, N. 2005. Managerial Economics: a problem-solving approach. Cambridge University Press, UK.
4. Mansfield, E. 2002. Managerial Economics. 5th edition. W.W. Norton & Co., New York, USA.
5. Desselle, S.P., P.D. Zgarrick & D.Se. 2012. Pharmacy Management: Essentials for all practices settings, 3rd edition, McGraw Hills Professional, New Delhi, India.

TENTH SEMESTER

Chem-505

**PHARMACUETICAL CHEMISTRY-IVB
(Medicinal Chemistry)**

4(3-1)

THEORY

NOTE: The topics will be taught with special reference to their Pharmaceutical Applications.

GENERAL PROPERTIES, CHEMISTRY BIOLOGICAL ACTION, STRUCTURE ACTIVITY RELATIONSHIP AND THERAPEUTIC APPLICATIONS OF THE FOLLOWING:

- a. Sulphonamides: Prontosil, sulphanilamide, Sulphapyridine, sulphadimidine, Sulfamethoxazole, Sulfadiazine and Sulfafurazole.
- b. Antimalarials: 4-Aminoquinolines, 8-Aminoquinolines, 9-Amino acridines, Biguanides, Pyrimidine analogues, Mefloquine and Cinchona alkaloids.
- c. Diuretics: Mercaptopmerin, Meralluride, Thiazides, Spirironolactone, Theophylline, Furosemide, Acetazolamide, Ethacrynic acid and Triameterene.
- d. Antitubercular Drugs: Ethambutol, Isonicotinic acid, Hydrazid, Rifampacin, Thioguanine, Pyrazinamide, cycloserine, Ethunamide, Cytarabine, 5-Flourouracil and Dacarbazine.
- e. Antiviral Drugs: Acyclovir, Tromantadine Hydrochloride and Ribavirin.
- f. Immunosuppressant Agents: Azathioprine and Cyclosporin.
- g. Antibiotics: Penicillins, Cephalosporins, Streptomycin, Chloramphenicol, Tetracyclines, Kanamycin and Erythromycin.

PRACTICAL

Assay of the drugs (10) like, Sulpha drugs, aspirin, paracetamol, benzyl penicillin, isoniazid, kenamycin etc and some of their metabolites in biological samples. Determination of drug level (cannabinoids or other drugs of addiction) in biological fluids (blood/plasma, urine).

RECOMMENDED BOOKS

1. Hardman, J.G., L.E. Limbird and A.G. Gilman, 2010. Goodman and Gilman's The Pharmacological Basis of Therapeutics. 12th Ed., McGraw Hill, New York, USA.
2. Katzung, B.G., 2009. Basic and Clinical Pharmacology. 11th Ed., McGraw Hill company, New York, USA.
3. Patrick, G.L., 2013. An Introduction to Medicinal Chemistry. 5th Ed., Oxford University Press, London, UK.
4. Burger, A., 1996. Medicinal Chemistry. John Wiley & Sons, New York, USA.
5. Foye, W.O., 1995. Principles of Medicinal Chemistry. Varghese Publishing House, Bombay, India.
6. Tyagi, O.D., 2011. Text Book of Synthetic Drugs. Anmol Publication, New Delhi, India.
7. Block, J.H., 1974. Inorganic Medicinal and Pharmaceutical Chemistry. Varghese Publishing House, Bombay, India.
8. Leon S., Alan H.M., Paul F.S. 2009. Comprehensive Pharmacy Review. 7th Ed. Volter Kluwer; Lippincott William and Wilkins, Philadelphia, USA

Pharm-D-505 PHARMACY PRACTICE-VIB (Advanced Clinical Pharmacy) 4(3-1)

THEORY

1. **PHARMACEUTICAL CARE, ITS SCOPE, MANAGEMENT AND APPLICATIONS:**
2. **CLINICAL THERAPEUTICS:**
General Strategy: Terminology of Disease. Management and treatment. Drug selection.
3. **DISEASE MANAGEMENT:**
 - **Unit VIII : Oncology Unit** (Types of tumors, Introduction to Oncological diseases e.g., Prostate cancer, Breast cancer, Lungs cancer)
 - **Unit IX: Nephrology Unit** (Renal failure, nephrotic syndrome)
 - **Unit X: Hematology Unit** (Bleeding disorders/coagulopathies/ clotting disorders e.g. thrombocytopenia, hemophilia, Vit. K deficiency, Anemia)
4. **CLINICAL TOXICOLOGY:**
 - a. General information. Role of pharmacist in treatment of poisoning and general management of poisoning & over dosage. Role and status of Poison Control Centre.
 - b. Antidotes and their mechanism of action.**SAFE INTRAVENOUS THERAPY & HAZARDS OF I.V. THERAPY:**
NON-COMPLIANCE: Definition, introduction and importance, Extent of non-compliance, Methods of assessment, Reasons for non-compliance, Strategies for improving compliance.

PRACTICAL

- Clerkship in the Clinical Setting. A project Related to Clinical Pharmacy Practices will be completed by the students and will be evaluated by the external examiner.
- Students are required to take/present verbal presentation, communication, written and problem-solving skills, critical analysis of data and provision of care through a weekly conference and projects.

RECOMMENDED BOOKS

1. Cook, S., 2004. Clinical Studies Management: A Practical Guide to Success. Sue Harwood Publishing Limited, West Sussex, UK.
2. Walker, R., 2012. Clinical Pharmacy and Therapeutics. 5th Ed., Churchill Livingstone, London, UK.
3. Winfield, A.J., R. Michael and E. Richards, 2009. Pharmaceutical practice. 4th ed., Elsevier Health Sciences, UK.
4. Dipiro, J.T., 2003. Encyclopedia of Clinical Pharmacy. Marcel Dekker Publishing, New York, USA.
5. Stone, P. and S.J. Curtis, 2002. Pharmacy Practice. 3rd ed., Pharmaceutical Press, University of Michigan, UK.
6. Grahame-Smith, D.G. and J.K. Aronson, 2002. Oxford Textbook of Clinical Pharmacology and Drug Therapy. 3rd ed., Oxford University Press, UK.
7. Taylor, K. and G. Harding, 2001. Pharmacy Practice. CRC press, USA.
8. Rosenbaun, D., 2004. Clinical Research Coordinator Hand Book. 3rd Ed., Sarrison, Inch, North Carolina, USA.
9. Donnelly, R. and J.D. Hughes, 2001. Society of Hospital Pharmacists of Australia, Greta James-Chatgilaou. Clinical Pharmacy: A Practical Approach. 2nd ed., Macmillan Publishers, Australia.
10. Paul, G., 2000. A Behavioral Approach to Pharmacy Practice. Black Well, USA.

Pharm-D-506

PHARMACUETICS-VIIB (Pharmaceutical Technology)

4(3-1)

THEORY

1. **NOVEL GIT DRUG DELIVERY SYSTEM:**

- a. Oral Osmotic Pumps
- b. Ion-Exchange Controlled DDS
- c. pH-Controlled DDS
- d. Bio/mucoadhesive DDS
- e. Floating DDS

2. **DRUG CARRIER SYSTEM:**

- a. Liposomes
- b. Niosomes

3. **TARGETED DRUG DELIVERY SYSTEM:**

- a. Active Drug Delivery System
- b. Passive Drug Delivery System

4. **PHARMACEUTICAL BIOTECHNOLOGY:**

- a. Introduction to Biotechnology: Genetics/Genomics, Proteomics, Biomolecular target Identification, Pharmacogenomics, Gene therapy and Nucleic acid therapeutics.
- b. Techniques Used in Pharmaceutical biotechnology: PCR, DNA Sequencing, Affinity Protein Purification.
- c. Fundamentals of Genetic Engineering and its Application in Medicine.
- d. Pharmaceutical Recombinant therapeutic Proteins, Growth factors, Therapeutic antibodies, High-throughput screening of putative therapeutic compounds.
- e. Biotechnological aspects in the product development.
- f. Principle, Synthesis and Application of Monoclonal Antibodies.
- g. Immobilized Enzymes and their application in Medicine.

PRACTICAL

Microbial assay of various pharmaceutical preparations as syrups, elixirs, ointments, lotions, liniments etc, Particle size analysis using various methods e.g., sieving, Stability studies of pharmaceuticals as powders, tablets, granules etc, coating of particles and to prepare, examine and control specifications of packaging materials and packaging methods.

RECOMMENDED BOOKS

1. Augsburge, L.L. and S.W. Hoag, 2008. Pharmaceutical Dosage Forms: Tablets. Vol. 2: Rational Design and Formulation. 3rd Ed., Informa Health Care, USA.
2. Allen, L.V., N.G. Popovich and H.C. Ansel, 2010. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 9th Ed., Lippincott Williams & Wilkins, USA.
3. Hellery, A.M., 2002. Drug Delivery and Targeting. Taylor & Francis, London, UK.
4. Liu, D., 2008. Water Insoluble Drug Formulations. 2nd Ed. CRC Press. LLC, USA.
5. Ahuja, S. and S. Scypinski, 2010. Handbook of Modern Pharmaceutical Analysis. 2nd Ed. Academic Press, USA.
6. Park, K. and R.J. Murny, 2000. American Chemical Society Meeting Controlled Drug Delivery: Designing Technologies for the Future. American Chemical Society, USA.
7. Banker, G.S. and T.C.T. Rhodes, 2002. Modern Pharmaceutics. 4th ed., Informa Health Care, USA.

Pharm-D-507

PHARMACY PRACTICE-VIIB (Forensic Pharmacy)

3(3-0)

THEORY

1. **THE PHARMACY ACT 1967:**
2. **CONTROL OF NARCOTICS SUBSTANCES ACT 1997:** Laws relating to Narcotic drugs and psychotropic substances.
3. **THE POISONS ACT 1919:**
4. **THE FACTORIES ACT 1934:**
5. **SHOPS AND ESTABLISHMENTS ORDINANCE 1969 WITH RULES:**

RECOMMENDED BOOKS

1. Hussain, R.Z., 2012. The Manual of Drug Laws in Pakistan. Irfan Law Book House, Lahore, Pakistan.
2. Control of Narcotics Substances Act, 1997. Government of Pakistan.
3. Shop and Establishment Ordinance, 1969. Government of Pakistan.
4. The Pharmacy Act, 1967. Government of Pakistan.

MAB-508

**PHARMACY PRACTICE-VIIB
(Pharmaceutical Management & Marketing)**

3(3-0)

THEORY

1. **MARKETING MANAGEMENT:**
 - a. Ethical consideration of Pharmaceutical Marketing
 - b. Difference between Pharmaceutical Marketing and Consumer Marketing
 - c. Major stakeholders within pharmaceutical market environment.

- d. Marketing Research (Process and Methodology)
 - e. Market Analysis Techniques 3Cs (Customer analysis, Company analysis, competitors analysis)
 - f. Evaluating the marketing performance (audit tools and audit process)
 - g. Designing sales force structure, sales force size and sales quota
 - h. Marketing channels, Promotion and Advertising and Salesmanship.
2. **SALES MANAGEMENT:** Personnel, Buying, Receiving, Pricing, Sales promotion and Customer Services.
 3. **BUSINESS DEVELOPMENT MANAGEMENT:** General principles, strategies, short and long term planning and objectives.
 4. **BUSINESS COMMUNICATION:** Importance and benefits of business communication, components of communication, concept and problems of communication, 7C's of communications.
 5. **STRATEGIES FOR SUCCESSFUL BUSINESS AND GLOBAL MEETINGS:** Background information on groups, purpose and kinds of meetings, solving problems in meetings, leadership responsibilities in meetings, participant's responsibilities in meetings.

RECOMMENDED BOOKS

1. Kotler, P., and G. Armstrong. 2010. Principles of Marketing. 13th edition. Dorling Kindersley Pvt. Ltd. India.
2. Downy, D., and S.P. Erickson. 2003. Agribusiness Management. 2nd edition. McGraw Hill Inc.
3. Desselle, S.P., P. D. Zgarrick and D. Shane, 2012. Pharmacy Management: Essentials for All Practice Settings. 3rd Ed., McGraw-Hill Professional, New Delhi, India.
4. Ahmad, M., and N.I. Bukhari, 2002. Pharmaceutical Management and Marketing. Tariq Academy, Faisalabad, Pakistan.
5. Carstensen, J.T. and C.T. Rhodes, 2000. Drug Stability: Principles and Practices. 3rd edition. Merceel Dekker, New York, USA.

SCHEME OF STUDY FOR PHARM-D DEGREE PROGRAM

FIRST SEMESTER		
Course No.	Title	Credit hours
Chem-103	Pharmaceutical chemistry-IA (Organic)	4(3-1)
Biochem-105	Pharmaceutical chemistry-IIA (Biochemistry)	4(3-1)
Pharm-D-101	Pharmaceutics-IA (Physical Pharmacy)	4(3-1)
Pharm-D-102	Physiology-A	4(3-1)
Anat-105	Anatomy	3(3-0)
Anat-106	Histology	3(2-1)
Eng-102	English-A (Functional English)	2(2-0)
Total:		24
SECOND SEMESTER		
Chem-105	Pharmaceutical Chemistry-IB (Organic)	4(3-1)
Biochem-106	Pharmaceutical Chemistry-IIB (Biochemistry)	4(3-1)
Pharm-D-103	Pharmaceutics-IB (Physical Pharmacy)	4(3-1)
Pharm-D-104	Physiology-B	4(3-1)
Eng-103	English-B (Communication and writing skills)	4(4-0)
Total:		20
THIRD SEMESTER		
Pharm-D-201	Pharmaceutics-IIA (Dosage Form Science)	4(3-1)
Pharm-D-202	Pharmacology & Therapeutics-IA	4(3-1)
Pharm-D-203	Pharmacognosy-IA (Basic)	4(3-1)
Micro-413	Pharmaceutics-IIIA (Pharmaceutical Microbiology and Immunology)	4(3-1)
IS-201	Islamic Studies	3(3-0)
Math-101	Pharmacy Practice-IA (Pharmaceutical Mathematics)	3(3-0)
Total:		22
FOURTH SEMESTER		
Pharm-D-204	Pharmaceutics-IIB (Dosage Form Science)	4(3-1)
Pharm-D-206	Pharmacology & Therapeutics-IB	4(3-1)
Pharm-D-207	Pharmacognosy-IB (Basic)	4(3-1)
Micro-414	Pharmaceutics-IIIB (Pharmaceutical Microbiology and Immunology)	4(3-1)
SSH-201	Pakistan Studies	2(2-0)
Stat-101	Pharmacy Practice-IB (Bio-statistics)	4(4-0)
Total:		22
FIFTH SEMESTER		
Path-302	Pathology	4(3-1)
Pharm-D-301	Pharmacology & Therapeutics-IIA	4(3-1)
Pharm-D-302	Pharmacognosy-IIA (Advanced)	4(3-1)
Chem-305	Pharmaceutical Chemistry-IIIA (Pharmaceutical Analysis)	4(3-1)
Pharm-D-303	Pharmacy Practice-IIA (Dispensing Pharmacy)	4(3-1)
Total:		20

SIXTH SEMESTER		
Course No.	Title	Credit hours
CS-502	Pharmacy Practice-III (Computer and its Application in Pharmacy)	4(3-1)
Pharm-D-304	Pharmacology and Therapeutics-IIB	4(3-1)
Pharm-D-305	Pharmacognosy-IIB (Advanced)	4(3-1)
Chem-306	Pharmaceutical Chemistry-IIIB (Pharmaceutical Analysis)	4(3-1)
Pharm-D-306	Pharmacy Practice-IIB (Community, Social and Administrative Pharmacy)	3(3-0)
Total:		19
SEVENTH SEMESTER		
Pharm-D-401	Pharmacy Practice-IVA (Hospital Pharmacy)	3(3-0)
Pharm-D-402	Pharmacy Practice-VA (Clinical Pharmacy)	4(3-1)
Pharm-D-403	Pharmaceutics-IVA (Industrial Pharmacy)	4(3-1)
Pharm-D-404	Pharmaceutics-VA(Biopharmaceutics and Pharmacokinetics)	4(3-1)
Pharm-D-405	Pharmaceutics-VIA (Pharmaceutical Quality Management)	4(3-1)
Total:		19
EIGHTH SEMESTER		
Pharm-D-406	Pharmacy Practice-IVB (Hospital Pharmacy)	3(3-0)
Pharm-D-407	Pharmacy Practice-VB (Clinical Pharmacy)	4(3-1)
Pharm-D-408	Pharmaceutics-IVB (Industrial Pharmacy)	4(3-1)
Pharm-D-409	Pharmaceutics-VB (Biopharmaceutics and Pharmacokinetics)	4(3-1)
Pharm-D-410	Pharmaceutics-VIB (Pharmaceutical Quality Management)	4(3-1)
Total:		19
NINTH SEMESTER		
Chem-504	Pharmaceutical Chemistry-IVA (Medicinal Chemistry)	4(3-1)
Pharm-D-501	Pharmacy Practice-VIA (Advanced Clinical Pharmacy)	4(3-1)
Pharm-D-502	Pharmaceutics-VIIA (Pharmaceutical Technology)	4(3-1)
Pharm-D-503	Pharmacy Practice-VIIA (Forensic Pharmacy)	3(3-0)
AE-504	Pharmacy Practice-VIIIA (Pharmaceutical Management and Marketing)	3(3-0)
Total:		18
TENTH SEMESTER		
Chem-505	Pharmaceutical Chemistry-IVB (Medicinal Chemistry)	4(3-1)
Pharm-D-505	Pharmacy Practice-VIB (Advanced Clinical Pharmacy)	4(3-1)
Pharm-D-506	Pharmaceutics-VIIB (Pharmaceutical Technology)	4(3-1)
Pharm-D-507	Pharmacy Practice-VIIB (Forensic Pharmacy)	3(3-0)
MAB-508	Pharmacy Practice-VIIIB (Pharmaceutical Management and Marketing)	3(3-0)
Total:		18

Grand Total: 201