COURSE CURRICULUM OF PHARM D PROGRAM

ABBOTTABAD UNIVERSITY OF SCIENCE AND TECHNOLOGY

Pharmacy Program Description & Learning Outcomes

About the Course:

PHARM-D DEGREE PROGRAMME ABBOTTABAD UNIVERSITY:

In pursuance of the Higher Education Commission Ordinance 2002 along with the professional mandate of the Pharmacy Council of Pakistan under the Pharmacy Act 1967, Abbottabad University , through its Academic Council adopted the Curriculum for its Doctor of Pharmacy (Pharm D) Program in toto.

Aims & Objectives of the Pharm D Program:

The aims and objectives of Doctor of Pharmacy (Pharm D) curriculum are to prepare graduates who will have the capacity, UpToDate knowledge, strong ethical values, behaviour, communication, writing and social skills that will enable them to pursue careers in:

1. Pharmaceutical care in health systems and community environment where appropriate medication usage and patient's safety is paramount.
2. Pharmaceutical industry and its quality systems.
3. Academia, research and development.

Aims:

To prepare pharmacy graduates whose scientific knowledge and skills enable them to work with the pace to ensure the quality in the design, manufacture, distribution and safe and effective use of pharmaceuticals in the society and clinical setting.

Objectives:

1. To keep pace with the advancements in the modern sciences.
2. To prepare the students to fulfill the industrial needs and they should be well-versed with the basic medical and pharmaceutical sciences in order to prepare a dosage regimen for an individual patient.
3. Community pharmacy practice should be comprehensive.
4. Internship in various disciplines of Pharmacy should be implemented.
5. Update the syllabi of the Pharmacy keeping in view the current proposals, requirements and the Needs of the profession.
6. To make our graduates more skillful, competitive and knowledgeable both practically and theoretically.
7. To cater the local and international pharmacy needs.
8. Uniformity in the curriculum of Pharmacy at national level.
9. Credit hours should be harmonized i.e. practical and theory credit hours.
10. To make a health care practitioner who is expert in the use of medicine in all practical fields and are capable of disease state management specially to improve public health at large.
11. Upon graduation, the graduates should have the capacity, knowledge and capability to undertake career in;
12. Enhance patient safety to safe medication usage in community and health care systems

13. To work in the pharmaceutical industry and its quality system
14. To engage in academics and research i.e. Practice and Academics.
15. To prepare students as good human beings in serving the community i.e., ethics, communication skills, writing skills, behavior etc.
16. After graduation, he should become a member of health care team.
17. To help the stakeholders of pharmacy about the implications of WTO and TRIPS.
18. The syllabi should be more practical rather theoretical.
19. To include new things regarding OTC Pharmacy (Patient Pharmacist interaction).
20. To prepare pharmacy graduates for better pharmacy practice in the areas including clinical pharmacy, community pharmacy, hospital pharmacy and industrial pharmacy.
21. To add further in the curriculum clinical oriented areas as per demand of Pharm D degree.
22. To update the current syllabi according to the needs of the national and international demand.
23. To develop graduates capable of catering the needs of national and international health organizations or authorities to help adapt the paradigm shift in the health care system.
24. To bring uniformity in the contents of the syllabi in line with International trends/ international universities imparting Pharm.D education.
25. To produce the graduates to meet the challenges of 21st century of health care problems.

Pharm. D Program Learning Outcomes:

Knowledge and Understanding:

1. Recall the scientific knowledge derived from pharmaceutical sciences including natural and synthetic drugs, pharmacodynamics pharmacokinetic profile, drug formulation and delivery and other disciplines.
2. Define scientific information related to biomedical sciences including functions of the human body,biological, genetics, biotechnological, microbiological, and other aspects.
3. Recognize the basic principles of pharmacy practice involving therapeutics, evidence-based pharmaceutical care, pharmacy management, pharmacoeconomics, pharmacepidemiology, and other areas.
4. Recall necessary foundational knowledge of research and administrative skills required in pharmacy profession.

Skills :

1. Utilize evidence-based drug information retrieved from authentic resources to fulfill inappropriate patient- centered treatment plan.
2. Utilize evidence-based drug information retrieved from authentic resources to fulfill an appropriate patient- centered treatment plan.
3. Utilize evidence-based drug information retrieved from authentic resources to fulfill an appropriate patient- centered treatment plan.
4. Demonstrate effective verbal and written communication and counseling skills when interacting with patients, healthcare professionals and the public.

5. Interpret information obtained from various pharmacy-related resources regarding drug dosing, clinical pharmacokinetic parameters, and statistical data relevant to pharmacy practice and research.

6. Contribute to decision making process by constructing patient-centered evidence-based pharmaceutical care plan and medical recommendations.

Values :

1. Show responsibility and accountability through advocating patients' right to safe and effective medication use.

2. Demonstrate leadership abilities through professionalism, self- and time-management, and team
work skills that help resolving challenges in the pharmacy profession.

3. Demonstrate high level of professional and ethical behavior with mutual respect towards patients
and other healthcare professionals.

4. Participate actively in enhancing the health care profession and general public awareness.

5. Illustrate life-long learning in the field of pharmaceutics, biomedical sciences and pharmacy practice.

Pharmacy Scheme of Studies

Pharm - D (Five Year Course - Annual System)

	Paper	Subject	Marks	Teaching Hours per Week	
First Professional	1	Pharmaceutical Chemistry-I (Organic)	100	4	Theory
	2	Pharmaceutical Chemistry-II (Biochemistry)	100	4	
	3	Pharmaceutics-I (Physical Pharmacy)	100	4	
	4	Physiology	100	4	
	5	Anatomy & Histology	50	2	
	6	English	100	4	
	7	Pharmaceutical Chemistry-I (Organic)	100	2	Practical Training
	8	Pharmaceutical Chemistry-II (Biochemistry)	100	2	
	9	Pharmaceutics-I (Physical Pharmacy)	100	2	
	10	Physiology	100	2	
	11	Anatomy & Histology	50	2	
Total			**1000**	**32**	

Pharm - D (Five Year Course - Annual System)

	Paper	Subject	Marks	Teaching Hours per Week	
Second Professional	1	Pharmaceutics-II (Dosage Forms Science)	100	4	Theory
	2	Pharmacology and Therapeutics-I	100	4	
	3	Pharmacognosy-I (Basic)	100	4	
	4	Pharmaceutics-III (Pharmaceutical Microbiology & Immunology)	100	4	
	5	Pakistan Studies and Islamic Studies (Compulsory)	100	4	
	6	Pharmacy Practice-I (Pharmaceutical Mathematics and Biostatistics)	100	4	
	7	Pharmaceutics-II (Dosage Forms Science)	100	2	Practical Training
	8	Pharmacology and Therapeutics-I	100	2	
	9	Pharmacognosy-I (Basic)	100	2	
	10	Pharmaceutics-III (Pharmaceutical Microbiology & Immunology)	100	2	
Total			**1000**	**32**	

Pharm - D (Five Year Course - Annual System)

	Paper	Subject	Marks	Teaching Hours per Week	
Third Professional	1	Pathology	50	2	Theory
	2	Pharmacology and Therapeutics -II	100	4	
	3	Pharmacognosy- II (Advance)	100	4	
	4	Pharmacy Practice- II (Dispensing, Community, Social & Administrative Pharmacy)	100	4	
	5	Pharmaceutical Chemistry- III (Pharmaceutical Analysis)	100	4	
	6	Pharmacy Practice -VIII (Computer & its Application In Pharmacy)	50	2	
	7	Pathology	50	2	Practical Training
	8	Pharmacology and Therapeutics-II	100	2	
	9	Pharmacognosy-II (Advanced)	100	2	
	10	Pharmacy Practice- II (Dispensing, Community, Social & Administrative Pharmacy)	100	2	
	11	Pharmaceutical Chemistry- III (Pharmaceutical Analysis)	100	2	
	12	Pharmacy Practice -VIII (Computer & its Application In Pharmacy)	50	2	
		Total	**1000**	**32**	

Pharm - D (Five Year Course - Annual System)

	Paper	Subject	Marks	Teaching Hours per Week	
Fourth Professional	1	Pharmacy Practice –III (Hospital Pharmacy)	100	4	Theory
	2	Pharmacy Practice –IV (Clinical pharmacy –I)	100	4	
	3	Pharmaceutics –IV (Industrial Pharmacy)	100	4	
	4	Pharmaceutics –V (Biopharmaceutics) and Pharmacokinetics	100	4	
	5	Pharmaceutics –VI (Pharmaceutics Quality Management)	100	4	
	6	Pharmacy Practice –IV (Clinical Pharmacy- I A. Departmental Lab B. Clinical Pharmacy Clerkship **(A total of 150 hours)**	100	2	Practical Training
	7	Pharmaceutics –IV (Industrial Pharmacy)	100	2	
	8	Pharmaceutics –V (Biopharmaceutics) and Pharmacokinetics	100	2	
	9	Pharmaceutics –VI (Pharmaceutics Quality Management)	100	2	
Total			**900**	**28**	

Pharm - D (Five Year Course - Annual System)

	Paper	Subject	Marks	Teaching Hours per Week	
Fifth Professional	1	Pharmaceutical Chemistry-IV (Medicinal Chemistry)	100	4	Theory
	2	Pharmacy Practice -V (Advanced Clinical Pharmacy-II)	100	4	
	3	Pharmaceutics-VII (Pharmaceutical Technology)	100	4	
	4	Pharmacy Practice -VI (Forensic Pharmacy)	100	4	
	5	Pharmacy Practice-VII (Pharmaceutical Management and Marketing)	100	4	
	6	Pharmaceutical Chemistry-IV (Medicinal Chemistry)	100	2	Practical Training
	7	Pharmacy Practice -V (Advanced Clinical Pharmacy-II) **[Clinical Pharmacy Clerkship along with research project and report] {A total of 200 hours per year}**	100	2	
	8	Pharmaceutics-VII (Pharmaceutical Technology)	100	2	
		Total	**800**	**26**	

Duration of Program : 5 years

Syllabus / Course Outline :

Pharmacy-2010-11(Revised) (1).pdf

Professional Training

Clinical Pharmacy (4th & 5th Professions) Clerkship a total of : 350 hrs.
An Internship, in any of the given tracks is mandatory for the award of degree i.e., Pharmaceutical Industry, Community Pharmacy, Hospital / Clinical Pharmacy,

Pharmaceutical Marketing, Management & Regulatory Affairs a total of 350 hrs.

Training Plan

Pharmacy practice experience is divided into two phases: Introductory Pharmacy Practice Experience (IPPE) and Advanced Pharmacy Practice Experiences (APPE) phase.
Introductory Pharmacy Practice Experience (IPPE) focus on inpatient and outpatient settings. Advanced Pharmacy Practice Experiences (APPE) has different type of rotations that take place in different hospitals and pharmaceutical sectors.

CLINICAL PHARMACY CLERKSHIP TRAINING:

- Outcome of the Training Program
- Training location
- Evaluation method

Outcome of the Training Program

- ## Real-World Preparedness:

  Equipping graduates to handle real-world scenarios, including training to monitor pharmacotherapy-related clinical outcomes and address complications arising from medication.

- ## Medication System Navigation:

  Safely and efficiently navigating the medication system, encompassing pharmacy informatics,medication order validation, medication safety principles, and handling both sterile and non-sterile products.

- ## Pharmacist Care Practices:

  Practicing pharmacist care by conducting effective patient assessments, follow-ups, and identifying,resolving, and preventing drug-related problems.

- ## Research Project Completion:

Developing skills in project management, organization, problem-solving, critical appraisal of literature, data analysis, evaluation, and presentation through the completion of a research project.

- **Clinical knowledge:**
Undertaking practical training during clinical clerkships, where students engage in different hospital units, such as pediatrics, psychiatry, pulmonology, cardiology, dermatology, and gynecology.

- **Dose Adjustments and Interactions Monitoring:**
Collecting patient cases and monitoring for drug-related problems, dose adjustments in hepatic and renal impairments, and drug-drug interactions.

- **Hospital Exposure:**
Participating in medical rounds, familiarizing themselves with drug distribution, procurement, and consumption through hospital management and information systems (HMIS).

- **Effective Communication :**
Developing effective interpersonal and communication skills to enhance patient care and contribute to hospital pharmacy practice.

- **Training Locations:**
Gaining exposure in diverse healthcare settings, including public medical teaching institutions/hospitals and private tertiary care hospitals. These training centers have well developed and organized pharmacy services and includes:

    - District Head Quarters (DHQ) Haripur
    - Ayub Teaching Hospital Complex (AMC) Abbottabad.
    - Combined Military Hospital (CMH) Abbottabad.

Description of Training Program

4th Profession Pharm D:

- The training plan entails **150 contact hrs.** in hospital settings. Students, organized into groups, monitor patient cases for drug-related issues, dose adjustments, and interactions.

- Departmental Lab Work: **2 hrs.** per week.

5th Profession Pharm D:

- The 5th-year clerkship spans **200 contact hrs.** in hospital settings involving medical rounds, familiarity with hospital management systems, and weekly patient case presentations aligned with standard treatment guidelines.
- **Clinical pharmacy project: Short research projects** enhance interpersonal and communication skills for effective patient care.

Clinical Training Evaluation:

4th Profession Pharm D:

- External Examiner evaluation of cases collected during training.
- Written paper on topics related to clinical pharmacy practice.
- Viva-Voce examination.
- Total 100 Marks.

5th Profession Pharm D:

- These evaluation methods aim to provide a holistic assessment of the students' knowledge, skills, and abilities acquired during the pharmacy clinical training. The inclusion of external examiner assessments ensures an unbiased and thorough evaluation process.
- External Examiner evaluates the project report completed by students during clinical pharmacy training that involves the following: Comprehensive research project completion demonstrating various skills.
    - Showcasing project management abilities in organizing and executing the research.
    - Critical appraisal of existing literature relevant to the chosen research topic.
    - Proficiency in data analysis and interpretation.
    - Effective evaluation and presentation of research findings.
    - External examiner assessment to maintain objectivity and rigor in evaluation
- **Internship:**

An Internship, in any of the given tracks is mandatory for the award of degree i.e., Pharmaceutical Industry, Community Pharmacy, Hospital / Clinical Pharmacy, Pharmaceutical Marketing, Management & Regulatory Affairs a total of 350 hours.

DETAILS OF COURSES (ANNUAL SYSTEM)

FIRST PROFESSIONAL

PHARMACEUTICAL CHEMISTRY-I (ORGANIC) (Theory) Paper 1
Marks 100

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:**

   a. Alkane, Alkenes, Alkynes, Aromatic compounds
   b. Alkyl halide, Alcohol, phenols, ethers, amines
   c. Ketones, Aldehydes
   d. Acids, Esters, Amides and derivatives

4. **NUCLEOPHILIC, ELECTROPHILIC SUBSTITUTION REACTION IN ALIPHATIC AND AROMATIC SYSTEMS:**

5. **ORIENTATION IN ELECTROPHILIC SUBSTITUTION REACTIONS ON BENZENE RING:**

6. **HETEROCYCLIC CHEMISTRY**:

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

7. **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.

8. REACTIVE INTERMEDIATE AND FREE RADICALS:

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

b. Types of reactions: An Overview.

c. Free radicals: Free radical scavengers and their applications.

9. CARBONIUM ION REARRANGEMENTS:

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

10. CARBANIONS REARRANGEMENTS:

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

PHARMACEUTICAL CHEMISTRY-I (ORGANIC) (Practical) Paper 7
Marks 100

NOTE: Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g.

1. Organic analysis: Identification of unknown simple organic compounds.
2. Organic Preparations: Benzoic acid, Aspirin, Acetanilide, Iodoform, Nitrophenol, 3nitrophthalic acid, Benzhydrol and 2, 4-Dinitrochlorobenzene.

PHARMACEUTICAL CHEMISTRY-II (BIOCHEMISTRY) (Theory)

Paper 2 **Marks 100**

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 nonsaponifiable 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, Nucelosides, Nucelotides, 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).

3. 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.

4. 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.

5. **INTRODUCTION TO CLINICAL CHEMISTRY:** Introduction and Importance of the clinical chemistry. Laboratory tests in diagnosis of diseases including Uric acid, Cholesterol, Billirubin and Creatinine.

PHARMACEUTICAL CHEMISTRY-II (BIOCHEMISTRY) (Practical) Paper 8 Marks 100

Qualitative analysis of: Carbohydrates, Amino acids, Peptides and Sugar, Uric acid, Proteins, Lipids and Sterols (Cholesterol), Bile salts, Billirubin, Analysis of Cholesterol and Creatinine in Blood.

Quantitative analysis of: Carbohydrates-Glucose (reducing sugar) and any other carbohydrate using Benedict and Anthrone method, Amino acids, Peptides and Proteins using Biuret and Ninhydrin (Spectrophotometric) method. Analysis of normal and abnormal components of UrineSugar, Uric acid, Billirubin, Cholesterol and Creatinine.

PHARMACEUTICS-I (PHYSICAL PHARMACY) (Theory) Paper 3 Marks 100

1. **PHARMACY ORIENTATION:** Introduction and orientation to the Professional 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: Solubility, 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 and shapes, 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.

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

5. **RHEOLOGY:** Definition and Fundamental concept; Properties contributing to Rheological behaviour; Graphic presentation of Rheological data.

6. **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, fractional, steam distillation, vacuum distillation, destructive distillation and their applications in Pharmacy.

d. Miscellaneous Processes: Efflorescence, deliquescence, lyophillization, elutrition, exiccation, ignition, sublimation, fusion, calcination, adsorption, decantation, evaporation, vaporization, centrifugation, dessication, levigation and trituration.

7. **EXTRACTION PROCESSES:**

a. Maceration: Purpose & process.

b. Percolation: Purpose and Process.

c. Liquid-Liquid extraction: Purpose and Process.

d. Large scale extraction: Purpose and Process.

8. **RATE AND ORDER OF REACTIONS:**

9. **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.

PHARMACEUTICS-I (PHYSICAL PHARMACY) (Practical) Paper 09
Marks 100

NOTE: Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g.

1. Experiments to demonstrate some of Physico-chemical processes like simple distillation, steam distillation, crystallization, dialysis.
2. Determination of Emulsion systems.
3. Determination of particle size.
4. Density, Specific Volume, Weights and Volumes of Liquids.
5. Preparation of Buffer solutions and isotonic solution.
6. Determination of %age composition of solutions by specific gravity method.
7. Partition-coefficient, surface tension, viscosity.

PHYSIOLOGY (Theory)

Paper 4 **Marks 100**

Course objective: After the completion of this course the students should be able to describe all the basic physiological processes which are the basis of pathophysiology of various diseases and their ultimate link with pharmacology for their treatment.

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 EnzymeMediated Reactions, Multi-enzyme 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 Messengers, 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 Neuro-modulators, Neuro-effector 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, type 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.

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

3. 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, Anatomy, 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.

NOTE: Special emphases should be given on the normal physiological values and their changes during respective pathological conditions. Furthermore, the physiological link will be developed with pathology as well as pharmacology.

PHYSIOLOGY (Practical) Paper

10 **Marks 100**

NOTE: Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Experimental Physiology includes:

1. BLOOD: Determination of Haemoglobin (Hb), Determination of ESR, RBC Count, WBC Count, DLC (Differential Leucocyte Count), Bleeding Time, Coagulation Time and Blood groups.

2. RESPIRATION: Estimation of vital capacity and its relation to posture and standard vital capacity, Determination of Tidal volume and Demonstration of Artificial Respiration.

3. CARDIOVASCULAR SYSTEM: Recording of Arterial Pulse, Recording of Arterial Blood Pressure and Electro-cardiogram.

4. SENSORY SYTEM: Visual activity, far vision, near vision and Field of vision (Perimetry).

5. NEURAL CONTROL MECHANISM: Nerve Muscle Preparation in frog, Effect of Temperature on muscle and Demonstration of spinal reflexes.

ANATOMY & HISTOLOGY (Theory)

Paper 5 **Marks 50**

Course Objectives: After the completion of this course the students should be able to understand the basic structure of various organs of our body not only at gross level but also at tissues or cell level

1. **INTRODUCTION: ANATOMICAL TERMINOLOGY:** Definition. Cell, tissue, organ system.
2. **STRUCTURE OF CELL:** Cell Membrane, Cytoplasm, Organelles, Nucleus, Cell cycle.
3. **TISSUES OF BODY:** Types of tissues with examples;
    a. Epithelial Tissue: General characters, classification.
    b. Connective Tissue: Structure and types of Connective tissue and Cartilage.
    c. Bones: Structure and types of bones and joints.
    d. Muscles: Structure of skeletal muscle, smooth muscle and cardiac muscle.
4. **INTEGUMENTARY SYSTEM:**
    a. Skin Structure: (Epidermis, dermis).
    b. Glands of Skin: (Sweat, Sebaceous).
    c. Hair: Structure, function.
    d. Nail: Structure, function.
5. **CARDIOVASCULAR SYSTEM:**

a. Heart: Structure of Heart, Location of Heart, Blood Supply to Heart.

b. Blood Vessels: Main blood vessels arising & entering the heart. Types of blood vessels with examples.

6. **ALIMENTARY SYSTEM:** Name and structure of different parts of alimentary system and their inter-relationship.

7. **URINARY SYSTEM:** Name and structure of organs of urinary system and their inter-relationship.

8. **REPRODUCTIVE SYSTEM:** Male and Female reproductive systems. Name, structure and association of the organs.

9. **ENDOCRINE SYSTEM:**

   a. Pituitary gland: Structure and relation to hypothalamus.
   b. Thyroid gland: Structure.
   c. Adrenal gland: Structure.

10. **NERVOUS SYSTEM:** Introduction: Cells of Nervous System (Neuron), Accessory cells of N.S. and Organization of N.S.

    (a) Brain; Meninges (Cerebrum cerebral Lobes. Ventricles, Cerebellum Anatomy of Cerebellum, Brain Stem Mid-Brain. Pons. Medulla Oblongata, Diencephalon. Thalamus Hypothalamus and Cranial Nerves).

    (b) Spinal Cord Meninges (C.S.F. Internal Structure, Sensory and Motor Pathway, Spinal Reflexes, Peripheral spinal Nerves, Autonomic Nervous System includes Sympathetic N.S. and Parasympathetic Nervous System).

11. **HISTOLOGY (Theory):**

    (a) Underlying principles of histological techniques and staining specific tissues should be explained.

    (b) Staining of paraffin and frozen sections will be given to the students.

    (c) Most of the teaching should be done on stained and mounted sections and every type of normal tissue will be covered.

ANATOMY & HISTOLOGY (Practical)

Paper 11 **Marks 50**

NOTE: Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities.

1. Demonstration of the preparation and staining of slides.

2. Histological examination of slides: Epithelium, Muscle tissue and Connective tissue.
3. Organ system: Lung, Kidney, Stomach, Appendix, Skin, Intestine and Gall bladder.

ENGLISH COMPULSORY (Written)	
Paper 6	**Marks 100**

Part: A (Functional English):

Objectives: Enhance language skills and develop critical thinking.

Course Contents:

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: To be improved by showing documentaries/films carefully selected by subject teachers

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.

Part: B (Communication Skills):

Objectives: Enable the students to meet their real life communication needs.

Course Contents:

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

Essay writing: Introduction, Descriptive, narrative, discursive, argumentative

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 skills: Letter/memo writing, minutes of meetings, use of library and internet.

NOTE: Documentaries to be shown for discussion and review.

Part: C (Technical Writing and Presentation Skills):

Objectives: Enhance language skills and develop critical thinking.

Course Contents:

Presentation skills:

Essay writing: Descriptive, narrative, discursive, argumentative

Academic writing: How to write a proposal for research paper/term paper, (emphasis on style, content, language, form, clarity, consistency).

Technical Report writing:

Progress report writing:

NOTE: Extensive reading is required for vocabulary building.

SECOND PROFESSIONAL

PHARMACEUTICS-II (DOSAGE FORMS SCIENCE) (Theory) Paper 1
Marks 100

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: Preparation, dry mixtures for solution, oral rehydrate solutions, oral colonic lavage solution. Syrup: components and preparation of syrups. Elixirs: Preparation of elixirs, Medicated and nonMedicated 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.

9. **SUPPOSITORIES AND ENEMAS:** Semi-solid preparations, Suppositories: Bases, preparation, packaging and storage; Solutions/Enemas: Preparation, packaging and storage.

10. **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.

11. **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, their types, characteristics and methods of preparation.

12. **INTRODUCTION TO PARENTERALS:** Official types of injections, solvents and vehicles for injections, added substances.

13. **A BRIEF INTRODUCTION TO ORAL HYGIENE PRODUCTS:**

PHARMACEUTICS-II (Dosage Forms Science) (Practical) Paper 7
Marks 100

NOTE: Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Prepartion of simple syrup, Orange syrup, Ferrous sulphate syrup, Cod Liver oil Emulsion, Liquid paraffin Emulsion, Throat paint (Mandle's paint), Boroglycerine glycerite, Tannic acid glycerin, Spirit ammonia aromatic, Spirit of

Ethyl Nitrite. Preparation of Methyl salicylate ointment, Sulphur ointment, Calamine lotion, Iodine tincture, Preparations of oral hygiene products, Poultice of Kaolin, Effervescent granules, Distilled Water for injections (A minimum of 20 practicals will be conducted).

PHARMACOLOGY AND THERAPEUTICS-I (Theory)

Paper 2 **Marks 100**

1. GENERAL PHARMACOLOGY:

a. Pharmacology: Definition, History, and its various branches. Drug: Definition and its various sources.

b. Routes of drugs 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 (V_d), 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 noncompetitive),

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 agonist drugs: Catecholamines and Non-catecholamines.

d. Sympathetic antagonist drugs: Adrenergic receptor Blockers and neuron blockers.

e. Parasympathetic (Cholinergic) agonists and Anticholinestrase inhibitors.

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 ulcer: Antacids, H_2-Receptor antagonists, antimuscarinic agents, proton pump inhibitors, prostaglandin agonists, gastrin receptor antagonist and cytoprotective agents.
   e. Drug treatment of chronic inflammatory bowel diseases.
   f. Drugs affecting bile flow and Cholelithiasis.

4. **AUTACOIDS AND THEIR ANTAGONISTS:** Histamine and Anti-histamines, Serotonin and Serotonin Antagonists, Prostaglandins and their antagonists.

5. **DRUGS ACTING ON RESPIRATORY SYSTEM:**
   a. Drugs used for cough (Anti-tussives, Expectorants and Mucolytic Agents).
   b. Drugs used for Bronchial Asthma (Bronchodilators, Cromoglycate, Nedocromil, Cortecosteroids & other Anti-inflammatory drugs and Muscarinic receptor antagonists. Cromoglycate, Nedocromil, Cortecosteroids & other Anti-inflammatory drugs.

6. **DRUGS ACTING ON CARDIO-VESCULAR SYSTEM:**
   a. Angina pectoris and its drug treatment
   b. Congestive heart failure & its treatment
   c. Anti-arrhythmic drugs
   d. Anti-hyperlipidemia
   e. Coagulants and Anti-coagulants
   f. Anti-hypertensives
   g. Diuretics

7. **DRUGS ACTING ON GENITO-URINARY SYSTEM:** Oxytoxic drugs, Ergot alkaloids and uterine relaxants.

8. **ANTI-ANAEMIC DRUGS:**

9. **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 antithyroid drugs.

NOTE:

1. Only an introduction will be given of the banned and obsolete drug products.
2. 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.
3. 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.
4. The prototype drugs in each group from the latest edition of the recommended books.

PHARMACOLOGY AND THERAPEUTICS-I (Practical) Paper 8
Marks 100

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities e.g.

- Introduction to instruments: such as Organ Bath, Kymograph, Oscilograph polygraph Patch Clamp Technique and Power Lab.
- Preparation of standard solution: Ringer solution. Tyrode solution. Kreb solution. Normal saline solution. To demonstrate the effects of sympathomimetic (Adrenaline) & sympatholytic drugs (Propranolol) on Frog's heart.
- To demonstrate the effects of parasympathomimetic (Acetylcholine) and parasympatholytic (Atropine) drugs on Frog's heart.
- To demonstrate the effects of an unknown drug on Frog's heart. Routes of Administration of drugs.
- To demonstrate the effects of vasconstrictor 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 effects 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 Homatropine on Rabbit's Eyes.
- To study the effects of Pilocarpine 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. To demonstrate emetic effects of various drugs in pigeons.

(Note: A minimum of 20 practicals will be conducted).

PHARMACOGNOSY-I (Basic) (Theory)

Paper 3 **Marks 100**

1. **General Introduction and Scope of Pharmacognosy:** Historical development and scope of Pharmacognosy. Terminology Used in Pharmacognosy. An introduction of traditional Medical systems (Unani, Ayurvedic and Homoeopathic systems of medicine) with special reference to medicinal plants. Introduction to herbal pharmacopoeias and modern concepts about Pharmacognosy.

2. **Crude Drugs:** Crude drugs, commerce, preparation, chemical and therapeutic classifications of crude drugs (official and 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	Aconitum, Larkspur, Pulsatilla, Hydrastis
b.	Papaveraceae	Papaver somniferum, Sanguinaria, Canadensis
c.	Leguminosae	Acacia, Glycyrrhiza, Senna, Cassia, Tamarind
d.	Umbelliferae	Fennel, Carum, Coriander, Conium, Asafoetida
e.	Apocynaceae	Rauwolfia, Catharanthus
f.	Asclepiadaceae	Gymnema sylvestre, Calotropis gigantean
g.	Compositae	Artemisia, Silybum marianum, Echinaceae, Arctium lappa
h.	Solanaceae	Belladonna, Hyoscyamus, Stramonium, Capsicum
i.	Scrophulariaceae	Digitalis, Verbascum (Mullien).
j.	Labiatae	Peppermint, Thyme, Spearmint, Salvia, Ocimum
k.	Liliaceae	Garlic, Colchicum, Aloe
l.	Zingiberaceae	Ginger, Curcuma

4. **Evaluation and Adulteration 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.

5. **Drugs of Animal Origin:** General introduction and discussion about honey, gelatin, shellac, musk, civet, ambergris, cod liver oil, cantharides and spermaceti.

6. **Biologics:** Sources, structure, preparation, description and uses of vaccines, toxins, antitoxins, venoms, antivenoms, antiserums.

7. **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

8. **Pesticides:** Introduction, methods and control of pests with special reference to pyrethrum, tobacco, and other natural pesticides.

9. **Growth Regulators:** General account with special reference to plant hormones; Auxins, Gibberellins Abscisic acid and Cytokinins.

10. **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.

11. **Enzymes:** Enzymes obtained from plant source (Phytoenzymes). Papain Bromelain and Malt Extract. Enzymes obtained from Animal source. Rennin, pepsin, Pancreatin and Pancrealipase.

PHARMACOGNOSY-I (Basic) (Practical)
Paper 9 **Marks 100**

NOTE: Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Introduction of the entire and broken parts of the plant drugs (Macro and organoleptic characters). Microscopic examination of powders and sections of plant drugs. Physicochemical and Microscopic testing of surgical dressings (Note: A minimum of 20 practicals will be conducted).

NOTE: 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 the country.

PHARMACEUTICS-III (PHARM. MICROBIOLOGY & IMMUNOLOGY) (Theory)
Paper 4 **Marks 100**

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:** Microbiology of air, water and soil (general introduction and normal inhibitants of air, water and soil).

4. **INDUSTRIAL MICROBIOLOGY:** Introduction to Sterilization/ Disinfection. Fermentation. Pharmaceutical products Produced by fermentation process (Penicillins, Cepalosporins, Gentamycin, Erythromycin, Tetracyclines, Rifamycin, Griseofulvin).

5. **IMMUNOLOGY:** Introduction and types of Immunity: Specific and non-specific (Cellular basis of Immune response. Immunity, autoimmunity, tolerance. Antigen. Antibodies). AntigenAntibody reactions and their clinical and diagnostic applications. Hypersensitivity and allergy. Drug allergy mechanism. Vaccination: Introduction and aims. Types of Vaccines. Current vaccine practices.

6. **FACTORY AND HOSPITAL HYGIENE AND GOOD MANUFACTURING PRACTICES:** Introduction, Control of microbial contamination during manufacture, Manufacturing of Sterile products, A Guide to Current Good Pharmaceutical Manufacturing Practices.

7. **INTRODUCTION TO DISEASES:** Dengue fever, Bird flu, SARS or other prevailing diseases of bacteria and virus.

PHARMACEUTICS-III (PHARM. MICROBIOLOGY & IMMUNOLOGY) (Practical)

Paper 10 **Marks 100**

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Sterilization of Glassware and pharmaceutical products by various methods. Microbiological assays of Anti-biotics and vitamins. 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, Giemasas staining, Capsule staining, Flagella staining and Spore staining. Microbiological analysis of air, water and soil (Note: A minimum of 20 practicals will be conducted).

PAKISTAN STUDIES AND ISLAMIYAT (Compulsory) (Theory) Paper 5
Marks 100

PART: A PAKISTAN STUDIES: **40 MARKS**

1. **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.
2. **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
3. **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
4. **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

PART: B ISLAMIC STUDIES: **60 MARKS**

Course Objectives: This course is aimed at:

1 To provide Basic information about Islamic Studies
2 To enhance understanding of the students regarding Islamic Civilization
3 To improve Students skill to perform prayers and other worships
4 To enhance the skill of the students for understanding of issues Related to faith and religious life.

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) Quran & 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 Umayyads
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

PHARMACY PRACTICE-I (PHARM. MATHEMATICS AND BIOSTATISTICS) (Theory)

Paper 6 **Marks 100**

PART A: (PHARMACEUTICAL MATHEMATICS) **(40 MARKS)**

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.

PART B: (BIOSTATISTICS) **(60 MARKS)**

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: Vriables, 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 —tǁ, —Fǁ and Chi-Square distributions.

9. **ANALYSIS OF VARIANCE:** One-way Classification, Two-way Classification, Partitioning of Sum of Squares and Degrees of Freedom, Multiple Compression 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.

THIRD PROFESSIONAL

PATHOLOGY (Theory)

Paper 1 **Marks 50**

SCOPE OF PATHOLOGY & CONCEPT OF DISEASES:

1.

2. **DEFINITION AND TERMINOLOGY:** Ischemia, Hypoxia, Necrosis, Infarction, 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.

PATHOLOGY (Practical)

Paper 7 **Marks 50**

Study of Pathological Slides of various Pathological Conditions: Acute inflammation, Chronic inflammation, Chronic specific inflammation, Different types of Degeneration, Thrombosis, Embolism, Infarction, Necrosis, Gangrene, Hyperplasia, Metaplasia, Pigmentation, Calcification, CVC, Papilloma, Adenoma, Chondroma, Fibroma, Leomyoma, Neofibroma, Squamous Cell

Carcinoma, Basal Cell Carcinoma, Transitional Cell Carcinoma, Adenocarcinoma, Fibrocarcinoma, Rhadomyo sarcoma, Leomyo sarcoma, Lymphosarcoma, Liposarcoma, Reticular Cell Sarcoma, Hodgkins disease, Breast Carcinoma, Osteogenic Sarcoma, Osteoclastoma, Hapatitis, Diabetes.

Examination of different body fluids in various Pathological Conditions: Urine Complete Examination, Stool Examination, Blood Complete Examination, Semen Examination, Cerebrospinal Fluid Examination, Pericardial Fluid Examination, Pleural Fluid Examination, Ascitic Fluid Examination, Blood Sugar, Blood Urea, Blood Cholesterol etc.

Tests for various specimens of clinical importance: Techniques of Clinical Blood Examination for various disases, Gastric Analysis, Tests for liver function, Renal function test, Tests for endocrine abnormalities, Biopsies and cytologic techniques.

PHARMACOLOGY AND THERAPEUTICS-II (Theory)

Paper 2 **Marks 100**

1. **DRUGS ACTING ON CENTRAL NERVOUS SYSTEM:**
   - (a) Sedatives & Hypnotic
   - (b) Anxiolytics, antidepressants and anti-manic 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

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

3. **CHEMOTHERAPY**
   - Basic principles of chemotherapy
   - 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), Anti-mycobacterial drugs, Urinary tract antiseptics,
   - Anti-fungals
   - Anti-virals
   - Anti-protozoals: anti-malarias, anti-amebiasis, anthelmintics and anti-leishmanials.
   - Anti-neoplastic drugs

4. **IMMUNOPHARMACOLOGY:** Pharmacology of immune-suppressants and stimulants

5. **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 Edetate (Calcium EDTA), Pencillamine and Defroxamine.

NOTE:

1. Only an introduction will be given of the banned and obsolete drug products.
2. 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.
3. 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.
4. The prototype drugs in each group from the latest edition of the recommended books.

PHARMACOLOGY AND THERAPEUTICS-II (Practical) Paper 8
Marks 100

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g.

- To study the convulsant effects 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.
- To study the effects of Pilocarpine on Human Eyes.
- To study the effect of Homatropine on Human Eyes.
- To identify and observe the effects of unknown drugs on Human Eyes.
- To study the effects of local anaesthetic drugs on human and the nerve plexus of frog.
- To identify and differentiate the effects of unknown drug on human and the nerve plexus of frog.
- To demonstrate the effects of Acetylcholine on the Rectus abdominus muscle of frog and competitive pharmacological antagonism by Neuromuscular blocking agent e.g. Gallamine.
- To identify the unknown drug by performing pharmacological competitive antagonism on Rectus abdominus muscle of Frog.
- To study the anti-coagulant effects of Heparin and oral anti-coagulants on Rabbits.
- To identify the unknown anticoagulant drug using Rabbits.
- To demonstrate the Graded Dose-Response curve of Acetylcholine on Rabbit intestine.
- To identify unknown concentration of Acetycholine from Graded Dose Response curves.
- To demonstrate the general anesthetic effect on rabbits.
- To demonstrate the effect of sedatives and hypnotics on rabbits.
- To demonstrate the anti-nociceptive (analgesic) effect on mice.
- To demonstrate antidepressant effect in rats (forced swimming test, tail suspension test Yohimbin lethality test).

(Note: A minimum of 20 practicals will be conducted).

PHARMACOGNOSY-II (ADVANCED) (Theory)

Paper 3 **Marks 100**

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}H-NMR and ^{13}C-NMR) 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) Steroidal 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 and 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.

5. **PLANT STEROIDS:** Introduction, extraction, isolation, nomenclature, sources and uses of bile acids, plant sterols, steroidal sapogenins, steroid hormones, withanolides and ecdysons.

6. **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.

7. **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.

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

9. **TANNINS:** Introduction, classification, biosynthesis, extraction, identification, occurrence in plants, role in plant life and chemical study of tannins in Kino, Myrobalan, Catechu, Nutgall, Castanea and krameria.

10. **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, safrole, 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, Cyanobecteria, 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 etc. poisoning.

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

12. **TUMOUR 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.

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

14. CLINICAL USE OF HERBS & HERBAL MEDICINE:

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

PHARMACOGNOSY-II (ADVANCED) (Practical)

Paper 9 **Marks 100**

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Extraction of the active constituents of crude drugs and chemical tests for their identification. Isolation and separation of active constituents of crude drugs by paper and thin layer chromatography.

Also include the following experiments;

- Determination of Iodine value; Saponification value and unsaponifiable matter; ester value; Acid value.
- Chemical tests for Acacia, Tragacanth, Agar, Starch, Lipids, (Castor oil, Sesame oil, Shark liver oil, Bees wax), Gelatin.

(Note: A minimum of 20 practicals will be conducted).

PHARMACY PRACTICE-II (DISPENSING, COMMUNITY, SOCIAL & ADMNISTRATIVE PHARMACY) (Theory)

Paper 4 **Marks 40+60**

PART A: (DISPENSING): **(40 MARKS)**

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:** 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.

PART B: (COMMUNITY, SOCIAL & ADMINISTRATIVE PHARMACY): **(60 MARKS)**

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 modelling and 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.

PHARMACY PRACTICE-II (DISPENSING, COMMUNITY, SOCIAL & ADMNISTRATIVE PHARMACY

(Practical)

Paper 10 **Marks 100**

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities e.g. Practical introduction to prescription-handling, interpretation, filling and labelling.

Mixtures: Dispensing of simple mixtures containing soluble substances only, mixtures containing diffusible substances, in-diffusible 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.

(Note: A minimum of 20 practicals will be conducted).

Health Science Research Project: In the area of health care system, community pharmacy. Establishment of DIC, PCC,

PHARMACEUTICAL CHEMISTRY-III (PHARMACEUTICAL ANALYSIS) (Theory)

Paper 5 **Marks 100**

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

1. **SPECTROSCOPIC METHODS:** Theory, Instrumentation and Pharmaceutical applications of the following Spectroscopic Methods:
    b. Atomic Absorption and Emission Spectroscopy
    c. Molecular fluorescence spectroscopy
    d. Flame Photometry
    e. I.R. Spectroscopy
    f. Mass Spectroscopy
    g. NMR Spectroscopy
    h. U.V./Visible Spectroscopy

2. **CHROMATOGRAPHIC METHODS:** Column Chromatography, Thin Layer Chromatography, Gas Liquid Chromatography, HPLC, LCMS, GCMS, Capillary Electrophoresis.

3. **ELECTRO CHEMICAL METHODS:** Potentiometry, Polarography and Radiochemical Techniques.

4. **THERMAL ANALYSIS:** Differential Scanning Calorimetry, Differential Thermal Analysis, Thermo Gravimetric Analysis.

5. **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.

6. **TITRIMETRIC ANALYSIS:** Acid-base titration, Oxidation-reduction titration, Argentometric titration, Complexometric titration, Non-aqueous titration etc.

PHARMACEUTICAL CHEMISTRY-III (PHARMACEUTICAL ANALYSIS) (Practical) Paper 11	**Marks 100**

NOTE:- Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the requirements e.g. Determination of the Purity and

Composition of the unknown drugs by using at least each of the above techniques. (Note: A minimum of 20 practicals will be conducted).

PHARMACY PRACTICE-III (COMPUTER AND ITS APPLICATION IN PHARMACY) (Theory)

Paper 6 **Marks 50**

1. **FUNDAMENTALS BASIC CONCEPT OF COMPUTERS:** History of Data Processing, Types of Computers, Components of a Computer, Computer System and Business Computer System, Backing Storage Devices, Unit of Memory, Viruses and Anti-viruses Issues.

2. **RESEARCH METHODOLOGIES:**

3. **SYSTEM ANALYSIS AND DESIGN:** What is a System?, Steps in system life cycle, Data Gathering and Data Analysis, Designing a New System, Development and Implementation of New System, Documentation.

4. **DATA PROCESSING:** Data Processing, The Data Processing Cycle, The Collection and Computing of data, Manual collection of data, The main methods of data input, Devices used to collect data, Data Verification, Data Validation, Output and Recording of data, Types of data processing systems, Types of Computer Operation, Batch Processing and Real-time Processing.

5. **APPLICATION OF COMPUTERS IN HOSPITAL PHARMACY:** Patterns of Computer use in Hospital Pharmacy, Patient record database management, Medication order entry, Drug labels and list, Intravenous solution and admixture, Patient Medication profiles, Inventory control, Management report & Statistics.

6. **APPLICATION OF COMPUTER IN COMMUNITY PHARMACY:** Computerizing the Prescription Dispensing process, Use of Computers for Pharmaceutical Care in community pharmacy, Accounting and General Ledger system.

7. **APPLICATION OF DRUG INFORMATION RETRIEVAL & STORAGE:** Introduction Advantages of Computerized Literature Retrieval use of Computerized Retrieval.

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

PARMACY PRACTICE-III (COMPUTER AND ITS APPLICATION IN PHARMACY) Practical

Paper 12 **Marks 50**

1. **INTERNET AND E-MAIL**: Internet and Microsoft Internet Explorer 5, Addresses, Links and Downloading, Searching the Internet, E-mail and Newsgroups, Favourites, security and Customizing Explorer.

2. **WEB PAGE DEVELOPMENT**: 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 —componentsll, Front-page and Frames, Managing your Web, Good site design, Publishing and publicizing.

3. **DATA PRESENTATION SKILLS**: MS-Word, MS-Excel, MS-Power point.

4. **UNDERSTANDING AND APPLICATION OF STATISTICAL PACKAGES:** SPSS, Kinetica, Med Calc.

FOURTH PROFESSIONAL

PHARMACY PRACTICE-IV (HOSPITAL PHARMACY) (Theory) Paper 1
Marks 100

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 etc. 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 IN-PATIENTS:**
   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.

11. **MANUFACTURING BULK AND STERILE:**

12. **THE PHARMACY; CENTRAL STERILE SUPPLY ROOM:**

13. **ASEPTIC DISPENSING:** TPN, I/V Admixtures, Cytotoxic Dispensing, Semi-sterile Dispensing (Eye drops, Ear drops) and Hyperalimentation.

14. ROLE OF PHARMACIST IN SMALL HOSPITALS, NURSING HOMES etc:

15. 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.

16. NUCLEAR PHARMACY:

17. THE PHYSICAL PLANT AND ITS EQUIPMENT:

18. INVESTIGATIONAL USE OF DRUGS:

19. HEALTH ACCESSORIES:

20. SURGICAL SUPPLIES:

21. INSPECTION OF WARDS WITH REFERENCE TO DRUG STORAGE AND ADMINISTRATION:

22. MANAGEMENT OF ACCIDENT & EMERGENCY PHARMACY (A & E):

PHARMACY PRACTICE-V (CLINICAL PHARMACY-I) (Theory)

Paper 2 **Marks 100**

1. GENERAL INTRODUCTION TO CLINICAL PHARMACY:

a. Introduction to clinical pharmacy and related terms, definition, basic components, comparison with other clinical fields, scope of services.
b. Guidelines (General guidelines for Clinical Pharmacy Practice)
c. Patient counseling compliance
d. Laboratory Data interpretation
e. Electrolytes management
f. Clinical literature evaluation
g. Drug interactions
h. Medication errors

2. DISEASE MANAGEMENT:

Disease management should be covered by considering aspects like diseases definition, etiology, pathogenesis, clinical presentation, diagnostic work out (briefly), pharmacotherapy.

MODULES:

- 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 asthamaticus, childhood asthma, Pneumonia, COPD includes emphysema & chronic bronchitis)
- Unit III: Gastroenterology unit [ulcer, liver cirrhosis, portal hypertension, hepatitis, diarrhea, inflammatory bowel disease (IBD)].

3. **PATIENT PROFILE & PATIENT COUNSELING:**
   a. Patient disease profile
   b. Taking case history
   c. Drug profile of at least 25 Important Medications e.g. Adrenaline, Aminoglycosides, Anti-TB Drugs, Antiepileptics, Atropine, Benzodiazepines, Cepahlosporins, Chlorpheniramine, Cimetidine, Digoxin, Dobutamine, Dopamine, Fluroquinolone, Furosemide, Lactulose, Macrolides, Metoclopramide, Morphine/Pethedine, Nifedipine, NSAIDS, ORS, Penicillins, Prednisolone, Salbutamol, Vancomycin.
   d. Patient Counseling

4. **CLINICAL TRIALS OF DRUG SUBSTANCES:** Designing of clinical trials, types of trials, Choice of patients, exclusion of patients and monitoring a clinical trial.

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

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

7. **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.

8. **PHARMACOTHERAPY PLAN:**
   I. Development, Implementation and Monitoring of Drug Therapy Plans:

a. Pharmacist work up of drug therapy (PWDT)
b. Documentation of Pharmacotherapy Plan
   - SOAP note
   - CORE Pharmacotherapy Plan
   - PRIME Pharmacotherapy problems
   - FARM note
c. Implementation of Drug Therapy Plan
d. Monitoring of Pharmacotherapeutic plan
e. Pharmaceutical care plan as ongoing process
f. Importance of drug therapy plan in today's pharmacy practice

II. Pharmacotherapy Decision-Making:

A. Pursue the role of drug therapy practitioner over that of drug therapy advisor.
B. 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

9. DRUG INDUCED DISEASES:

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

11. ONLINE PHARMACEUTICAL CARE SERVICES AND GLOBALIZATION:

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

PHARMACY PRACTICE-IV (CLINICAL PHARMACY-I) (Practical) Paper 6 Marks 100

1. PHARMACY PRACTICE-V (CLINICAL PHARMACY-I) (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

PHARMACEUTICS-IV (INDUSTRIAL PHARMACY) (Theory) Paper 3
Marks 100

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. **COMMINUTION (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, Meta 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 Tabletting, tabletting machines and other equipment required, problems involved in tabletting, tablet coating, **Capsulation**: (Hard and Soft gelatin capsules).

9. **SAFETY METHODS IN PHARMACEUTICAL INDUSTRY:**

(a) Mechanical, chemical and fire hazards problems.
(b) Inflammable gases and dusts.

10. **EMULSIONS:** Mechanical Equipments, Specific formulation Considerations and Emulsion stability.

11. **SUSPENSIONS:** Formulation of suspensions, Equipment used in preparation and test methods for pharmaceutical suspensions.

12. **SEMISOLIDS:** Equipment used for Ointments, Pastes, Gels and Jellies, Packaging of ointments.

13. **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.), In-process Quality Control of Parenterals (Sterility, leakage, pyrogens, clarity etc.).
14. **PACKING & PACKAGING:** Influence of Packaging materials, Stability, Packaging Lines, Packaging Area, Packaging Equipment.

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

PHARMACEUTICS-IV (INDUSTRIAL PHARMACY) (Practical) Paper 7
Marks 100

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g.

- Manufacture of Tablets by Wet Granulation Method, by Slugging and by Direct Compression.
- Coating of Tablets (Sugar Coating, Film coating and Enteric Coating).
- Clarification of liquids by various processes.
- Size Reduction, Homogenization.
- Ampoule filling, sealing and sterilization clarity and leakage tests in injectables.
- 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 (Note: A minimum of 20 practicals will be conducted).

PHARMACEUTICS-V (BIOPHARMACEUTICS & PHARAMCOKINETICS) (Theory)

Paper 4 **Marks 100**

1. **DEFINITIONS AND TERMINOLOGY:** Biopharmaceutics, Generic Equivalence, Therapeutic Equivalents, Bioavailability, Bioequivalence, Drug Disposition, Pharmacokinetics (LADMER: Libration, 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. **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

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

8. **MULTIPLE DOSAGE REGIMENS:**
    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

9. **ELIMINATION OF DRUGS:**
    d) 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.
    e) Renal Excretion of Drugs: Renal clearance, Tubular Secretion and Tubular Reabsorption.
    f) Elimination of Drugs through other organs: Pulmonary excretion, salivary excretion, Mammilary excretion, Skin excretion and Genital excretion.

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

11. **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.

12. **PHARMACOKINETICS OF INTRAVENOUS INFUSIONS:**

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

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

PHARMACEUTICS-V (BIOPHARMACEUTICS & PHARAMCOKINETICS) (Practical)
Paper 8 **Marks 100**

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. 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, Determination of relative and absolute bioavailability. 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.

PHARMACEUTICS-VI (PHARMACEUTICAL QUALITY MANAGEMENT) (Theory)

Paper 5
Marks 100

1. **INTRODUCTION:**
   Basic concepts and introduction of pharmaceutical industry in relevance to quality control departments, Testing, Quality Management System, Quality Assurance, Good Manufacturing Practices and Current Good Manufacturing Practices. General understanding of good laboratory practices and validation.

2. **QUALITY CONTROL OF SOLID DOSAGE FORMS** (conventional and modified release dosage forms):
   (a) Physical tests: Hardness, Thickness, Diameter, Friability, Disintegration, Weight Variation.
   (b) Chemical tests: Content uniformity, Assay of active Ingredient.

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. **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.

7. **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.

8. **ALKALOIDAL DRUG ASSAY:** Weighing for assay, Extraction of drugs, Maceration, Percolation, Continuous extraction, Purification of Alkaloids and determination of alkaloids.

9. **QUALITY ASSURANCE OF VACCINES:** Introduction, Quality measures for stability of vaccines, potency testing, and post market surveillance of vaccines.

10. **MISCELLANEOUS DETERMINATIONS AND TESTS:** Determination of weight/ml, Water/Moisture content, Loss on Drying, Evaluation of Ointments, Ash contents and Alkalinity of Glass.

11. **STANDARDIZATION OF PHARMACEUTICALS:** An understanding of quality assurance system adopted in pharmaceutical industry. Good Manufacturing Practices and Current Good Manufacturing Practices.

12. **STATISTICAL INTERPRETATION OF QUALITY CONTROL CHARTS DURING MANUFACTURING PROCESSES:**

PHARMACEUTICS-VI (PHARMACEUTICAL QUALITY MANAGEMENT) (Practical)
Paper 9 **Marks 100**

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities e.g. 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 test. Sterility test, Determination of Ash contents, Determination of Moisture contents, Determination of total solids, Determination of viscosity of syrups, gels etc. Determination of emulsion types (Note: A minimum of 20 practicals will be performed).

FINAL PROFESSIONAL

PHARMACEUTICAL CHEMISTRY-IV (MEDICINAL CHEMISTRY) (Theory)	**Paper 1** **Marks 100**

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, pro drug, 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 THERAPEUTIC APPLICATIONS OF THE FOLLOWING:**

a. Hormones: Steroidal Hormones (Testosterone, Progesterone, Estrogen, Aldosteron and Cortisol), Proteinous Hormones (Insulin, Glucagon, Oxytocin and Vassopressin).
b. Anti-neoplasticAgents: Tamoxifen, Fluorouracil, Mercapturine, Methotrexate and Vincristine.
c. Sedatives and 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.
f. Sulphonamides: Prontosil, sulphanilamide, Sulphapyridine, sulphadimidine, Sulfamethoxazole, Sulfadiazine and Sulfafurazole.
g. Antimalarials: 4-Aminoquinolines, 8-Aminoquinolines, 9-Amino acridines, Biguanides, Pyrimidine analogues, Mefloquine and Cinchoha alkaloids.
h. Diuretics: Mercaptomerin, Meralluride, Thiazides, Sprironolac-tone, Theophylline, Furosemide, Acetazolamiode, Ethacrynic acid and Triameterene.
i. Antitubercular Drugs: Ethambutol, Isonicotinic acid, Hydrazid, Rifampacin, Thioguanine, Pyrazinamide, cycloserine, Ethunamide, Cytarabine, 5-Flourouracil and Dacarbazine.
j. Antiviral Drugs: Acyclovir, Tromantadine Hydrochloride and Ribavirin.
k. Immunosuppressant Agents: Azathioprine and Cyclosporin.
l. Antibiotics: Penicillins, Cephalosporins, Streptomycin, Chloramphenicol, Tetracyclines, Kanamycin and Erythromycin.

PHARMACEUTICAL CHEMISTRY-IV (MEDICINAL CHEMISTRY) (Practical)

Paper 6 **Marks 100**

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities e.g. 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-1, 3-benzoxazol-2-one, Aspirin, P-nitrosophenol, 3-nitrophthalic acid, Chloro-benzoic acid. Assay of the Drugs like Sulpha drugs, Aspirin, Paracetamol, Benzyl Penicillin. Inorganic Preparations **(Note:** A minimum of 20 practicals will be conducted).

PHARMACY PRACTICE-VI (CLINICAL PHARMACY-II) (Theory) Paper 2
Marks 100

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. **DRUG UTILZATION EVALUATION & DRUG UTILIZATIONREVIEW (DUE/DUR):** Development of protocol of use of few very low therapeutic index drug groups like Steroids, Vancomycin and Cimetidine.

4. **CLINICAL PHARMACOKINETICS:** Therapeutic Drug Monitoring of Digoxin, Theophyline, Gentamycin, Lithium, Phenytoin, Cabamazepine, Phenobarbitone, Valproic Acid, Cyclosporins and Vancomycin.

5. **PHARMACEUTICAL CARE, ITS SCOPE, MANAGEMENT AND APPLICATION OF CARE PLAN:**

6. **CLINICAL THERAPEUTICS:** General Strategy: Terminology of Disease. Management and Treatment. Drug Selection.

7. **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.

8. **SAFE INTRAVENOUS THERAPY & HAZARDS OF IV THERAPY**

9. **NON-COMPLIANCE:** Definition, introduction and importance, Extent of non-compliance, Methods of assessment, Reasons for non-compliance, Strategies for improving compliance.

10. **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, AIDS, Dengue fever, Common Cold, Pharyngitis & Tonsillitis, Conjunctivitis)
    - Unit VII: Endocrinology Unit (Diabetes Mellitus, Hyper/Hypo-thyroidism, pituitary gland non-malignant disorders)
    - Unit VIII: Oncology Unit (Types of tumors, Brief introduction to oncological diseases e.g.

prostate cancer, breast cancer, lungs cancer)

- Unit IX: Nephrology Unit (Renal failure, nephrotic syndrom)
- Unit X: Hematology Unit (Bleeding disorders/coagulopathies/clotting disorders e.g. thrombocytopenia, hemophilia, Vit. K deficiency, Anemia).

PHARMACY PRACTICE-VI (CLINICAL PHARMACY-II) (Practical)

Paper 7 **Marks 100**

- 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.
- Student 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

PHARMACEUTICS-VII (PHARMACEUTICAL TECHNOLOGY) (Theory)

Paper 3 **Marks 100**

1. **PRINCIPLES OF PHARMACEUTICAL FORMULATION AND DOSAGE FORM DESIGN:**
   Need for dosage form; Pre-formulation 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

5. **NOVEL GIT DRUG DELIVERY SYSTEM (DDS):** Oral Osmotic Pumps

- Ion-Exchange Controlled DDS
- pH-Controlled DDS
- Bio/mucoadhesive DDS
- Floating DDS

6. **DRUG CARRIER SYSTEM:** □ Liposomes
   □ Niosomes

7. **TARGETED DRUG DELIVERY SYSTEM:**
   - Active Drug Delivery System
   - Passive Drug Delivery System

8. **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

PHARMACEUTICS-VII (PHARMACEUTICAL TECHNOLOGY) (Practical)	
Paper 8	**Marks**
	100

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the requirements, e.g.

- Various techniques to develop the formulation,
- Granulation technology,
- Study of drug delivery systems,
- Biotechnological aspect of product development, □ In-vitro Quality Control of various dosage forms.
- Microbial assay,

- Particle size analysis using various methods,
- Stability studies of Pharmaceuticals,
- Coating of particles and to prepare,
- Examine and control specifications of packaging materials.

PHARMACY PRACTICE-VII (FORENSIC PHARMACY) (Theory)

Paper 4 **Marks 100**

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 Record keeping, 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.

5. **THE PHARMACY ACT 1967:**

6. **CONTROL OF NARCOTICS SUBSTANCES ACT 1997:** Laws relating to Narcotic drugs and psychotropic substances.

7. **THE POISONS ACT 1919:**

8. **THE FACTORIES ACT 934:**

9. **SHOPS AND ESTABLISHMENTS ORDINANCE 1969 WITH RULES:**

PHRAMACY PRACTICE-VIII (PHARMACEUTICAL MANAGEMENT & MARKETING) (Theory)

Paper 5 **Marks 100**

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.

3. **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.

4. **SALES MANAGEMENT:** Personnel, Buying, Receiving, Pricing, Sales promotion and Customer Services.

5. **BUSINESS DEVELOPMENT MANAGEMENT:** General principles, strategies, short and long term planning and objectives.

6. **BUSINESS COMMUNICATION:** Importance and benefits of business communication, components of communication, concept and problems of communication, 7C's of communications.

7. **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.

NOTE: Upon completion of recognized Pharm.D. degree, a pharmacy graduate is required to undergo residency based training for a period of 1 year in any area; at public or private Hospital, Pharmaceutical Industry, Community Pharmacy, Pharmaceutical Marketing, Research & Development and Public health recognized by the Pharmacy Council of Pakistan. The objective of the residency is to undergo a planned training on aspects of pharmacy practice under the supervision of a registered pharmacist.

LIST OF RECOMMENDED BOOKS

ENGLISH

Functional English

Grammar:

1. Thomson AJ, Martinet AV. **Practical english grammar**. 3rd Ed. Oxford University Press; 1986.

Writing:

2. Kirszner LG, Mandell SR. **Patterns of College Writing**: A Rhetorical Reader and Guide. 10th Ed. Stephen Martin's Press; 2006.
3. Maley A. **Oxford supplementary skills**: 1st Ed. Writing Intermediate. Cornelsen & Oxford University Press; 1998.

Reading/Comprehension:

4. Langan J. **Reading and Study Skills**. 9th Ed. McGraw Hill Humanities; 2009.

Speaking:

5. Nolasco R. **Speaking: Elementary**: Oxford Supplementary Skills. 4th Ed. Oxford University Press; 1987.

Communication Skills:

Reading/Comprehension:

6. Tomlinson B, Ellis R. **Reading Advanced**. Oxford Supplementary Skills. 3rd Ed. Oxford University Press; 1992.

Technical Writing and Presentation Skills:

Essay Writing and Academic Writing;

7. Langan J**. College Writing Skills with Readings**. 8th Ed. McGraw Hill; 2010.

Presentation Skills;

8. Gilbert MD. **English for Pharmacy writing and oral communication**. 1st Ed. Lippincott Williams & Wilkins; 2008.

Reading;

9. Neulib J, Cain KS, Ruffus S, Scharton M. **The Mercury Reader**: A custom publication. 4th Ed. Pearson; 2011.
10. White R. **Advanced**: Oxford Supplementary Skills. 3rd Ed. Oxford University Press; 1992.
11. Wong L. **Essential Study Skills**. 7th Ed. Wadsworth Publishing; 2011.

PHYSICAL PHARMACY

1. Allen LV, Popovich NG. **Ansel's pharmaceutical dosage forms and drug delivery systems**. 8th Ed. Lippincott Williams & Wilkins New York; 2005.
2. Attwood D, Flocence AT. Surfactant Systems: Their Chemistry, Pharmacy and Biology. 1st Ed. London: Chapman and Hall Ltd; 1982.
3. Aulton ME. **Aulton's pharmaceutics: the design and manufacture of medicines**. Churchill Livingstone; 2007.
4. Britain MD. **British national formulary**. 54th Ed. British Medical Association; 2001.
5. Carstensen JT. **Pharmaceutics of solids and solid dosage forms**. 1st Ed. Wiley; 1977.
6. Connors KA, Mecozzi S. **Thermodynamics of pharmaceutical systems**: An introduction to Theory and Applications. 2nd Ed. Wiley & Sons; 2010.
7. Cooper JW, Gunn C, Carter SJ. **Cooper and Gunn's Tutorial Pharmacy**. 6th Ed. New Delhi: CBS Publishers & Distributors; 2004.
8. Davis H. **Bentley's Text Book of Pharmaceutics**. 2nd Ed. Tindall and Cox Publishers; 1961.
9. Finlay WH. **The mechanics of Inhaled pharmaceutical aerosols**: An introduction. 1st Ed. Academic Press; 2001.
10. Florence AT, Attwood D. **Physicochemical Principles of Pharmacy**. 5th Ed. Pharmaceutical Press; 2011.
11. Florence AT, Siepmann J. **Moderen Pharmaceutics**: Basic Principles and Systems: (Drugs and the Pharmaceutical Sciences). 5th Ed. Taylor & Francis; 2008.
12. Ganderton D, Jones T, McGinity J. **Advances in Pharmaceutical Sciences**. 1st Ed. Academic Press; 1995.
13. Ghosh TK, Jasti BR. **Theory and practice of contemporary pharmaceutics**. 1st Ed. CRC Press; 2005.
14. Kleemann A, Engel J, Kutscher B, Reichert D. **Pharmaceutical substances**: Syntheses, Patents, Applications of the most relevant APIs. 5th Ed. Thieme; 2008.
15. Lewis GA, Mathieu D, Phan RTL. **Pharmaceutical experimental design**: (Drugs & the Pharmaceutical Sciences). 1st Ed. Informa HealthCare; 1998.

16. Lund W. **The pharmaceutical Codex**: Principles and practice of pharmaceutics. 16th Ed. Co CBS Publishers; 2009.
17. Rienger M, Scott-Blair GW. **Rheology**. 3rd Ed. Academic Press; 1990.
18. Rowe RC, Sheskey PJ, Quinn ME. **Handbook of pharmaceutical excipients**. 6th Ed. Pharmaceutical Press; 2009.
19. Sinko PJ, Martin AN. **Martin's physical pharmacy and pharmaceutical sciences:** physical chemical and biopharmaceutical principles in the pharmaceutical sciences. 5th Ed. Lippincott Williams & Wilkins; 2006.
20. Sinko PJ. **Martin's Physical Pharmacy and Pharmaceutical Sciences**. 6th Ed. Lippincott Williams & Wilkins; 2010.
21. Winfield AJ, Richards RME. **Pharmaceutical practice**. Elsevier Health Sciences; 2004.
22. Zinc G. **Remington: The Science and Practice of Pharmacy**. Philadelphia College of Pharmacy and Science; 2005.

PHARMACEUTICAL CHEMISTRY (ORGANIC)

1. Bansel RK. **Organic Reaction Mechanism**. 3rd Ed. Tata McGraw Hill; 1992.
2. Bhal BS. **Textbook of Organic Chemistry**. 16th Ed. S. Chand & Co; 2007.
3. Block JH, Beale JM. **Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry**. 20th Ed. Lippincott Williams & Wilkins; 2010.
4. Eliel EL, Wilen SH. **Stereochemistry of Carbon Compounds**. 1st Ed. Tata McGraw Hill; 1994.
5. Finar IL. **Organic Chemistry**. 6th Ed. Person Education Asia; 2001.
6. Roberts JD, Caserio MC. **Basic Principles of organic Chemistry**. 3rd Ed. Addison Wesley; 1990.
7. Sykes P. **Guide Book to Mechanism in Organic Chemistry**. 6th Ed. Longman Co; 1991.Vogel AI, Tatchell AR, Furnis BS, Hannaford AJ, Smith PWG. **Vogel's Textbook of Practical Organic Chemistry**. 5th Ed. Pearson Education Limited; 1996.
8. Wade LG. **Organic Chemistry**. 7th Ed. Prentice Hall; 2010.

PHARMACEUTICAL CHEMISTRY (BIOCHEMISTRY)

1. Berg JM, Tymoczko JL, Stryer L. **Biochemistry**. 7th Ed. WH Freeman and Company; 2010.
2. Bishop ML, Fody EP, Schoeff LE. **Clinical Chemistry:** Techniques, Principles and Correlations. 6th Ed. Lippincott Williams & Wilkins; 2009.
3. Champe PC, Harvey RA. **Illustrated Biochemistry**. 4th Ed. Lippincot Company; 2007.
4. Chaterjee MN. **Medical Biochemistry**. 7th Ed. Jaypee Brothers Medical Publishers; 2007.

5. Conn EE, Stumpf PK. **Outlines of Biochemistry**. 5th Ed. John Willey & Sons; 1999.
6. Lehninger AL. **Principles of Biochemistry**. 4th Ed. CBS Publisher; 2004.
7. Murray R, Rodwell V, Bender D, Kathleen M, Botham P, Weil A et al. **Harper's Illustrated Biochemistry**. 28th Ed. Print-Hall; 2009.
8. West ES, Todd RW, Van BTJ. **Text Book of Biochemistry**. The MacMillan Co; 1996.

PHYSIOLOGY

1. Chatterjee CC. **Human Physiology**. 9th Ed. Medical Allied Agency; 1994.
2. Cyril A, Neil E, Joels N. **Samson Wright's Applied Physiology**. 13th Ed. Oxford University Press; 1992.
3. Guyton AC. **Text Books of Medical Physiology**. 9th Ed. W B Saunders Company; 2011.
4. Kuntzman AJ, Tortora GJ. **Anatomy and physiology for the manual therapies**. 1st Ed. John Wiley & Sons; 2009.
5. Martini F. **Fundamentals of anatomy and physiology**. 8th Ed. Prentice Hall; 2010.
6. Saladin KS, Miller L. **Anatomy & physiology**: The Unity of Form and Function. 6th Ed. McGraw-Hill; 1998.
7. Snell RS. **Clinical Anatomy for Medical Students**. 1st Ed. Litle Brown & CoInc; 1992.
8. Spence AP, Elliot B, Mason EB. **Human Anatomy and Physiology**. 3rd Ed. West Publishing Company; 1992.
9. Stuart Ira. **Human Physiology**. 11th Ed. Fox; 2008.
10. Tortora GJ, Derrickson B. **Principles of anatomy and physiology**. 13th Ed. Wiley; 2010.
11. Widmaier E, Raff H, Strang K. **Vander's Human Physiology**. 12th Ed. McGraw Hill; 2010.
12. William F, Ganong WF. **Review of Medical physiology.** 22nd Ed. Prentice Hall International Inc; 2005.

ANATOMY & HISTOLOGY

Anatomy

1. Drake RL, Vogl WA, Mitchell AWM. **Gray's Anatomy**: Descriptive and Applied. 2nd Ed. Churchil Living Stone; 2009.
2. Grant B. **A Method of Anatomy**. 9th Ed. Bailliere Tinal and Co Ltd; 1975.
3. Hamilton WJ. **A Textbook of Anatomy**. 2nd Ed. Macmillan and Co; 1976.
4. Kuntzman AJ, Tortora GJ. **Anatomy and physiology for the manual therapies**. 1st Ed. John Wiley & Sons; 2009.
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RECOMMENDATIONS:

1. The up-dated curriculum of Doctor of Pharmacy program after the approval from Pharmacy Council of Pakistan (PCP) and Higher Education Commission (HEC) shall be binding on every Pharmacy Institution/ University (Public and Private) to adopt revised curricula.
2. The revised curricula shall be adopted from the 2012 session.
3. Violation in adoption of the approved curriculum shall be liable to penalty under section 17 & 19 of Pharmacy Act, 1967 and rules framed there-under, which may lead to revoking of affiliation/ accreditation by the PCP.
4. No omission and changes are allowed in the said curriculum approved by PCP and HEC, by any institution.
5. Doctor of Pharmacy degree holders will be allowed for direct admission in M.S. /M. Phil leading to PhD program.