**Scheme of Studies**

**Pharm.D. ProgrammeBy Pharmacy Council of Pakistan**

**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, behavior, 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 isparamount.
2. Pharmaceutical industry and its qualitysystems.
3. Academia, research anddevelopment.

**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 modernsciences.
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 individualpatient.
3. Community pharmacy practice should becomprehensive.
4. Internship in various disciplines of Pharmacy should beimplemented.
5. Update the syllabi of the Pharmacy keeping in view the current proposals, requirements and the Needs of theprofession.
6. To make our graduates more skillful, competitive and knowledgeable both practically and theoretically.
7. To cater the local and international pharmacyneeds.
8. Uniformity in the curriculum of Pharmacy at nationallevel.
9. Credit hours should be harmonized i.e. practical and theory credithours.
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 atlarge.
11. Upon graduation, the graduates should have the capacity, knowledge and capability to undertake career in;
    1. Enhance patient safety to safe medication usage in community and health caresystems
    2. To work in the pharmaceutical industry and its qualitysystem
    3. To engage in academics and research i.e. Practice andAcademics.
    4. To prepare students as good human beings in serving the community i.e., ethics, communication skills, writing skills, behavioretc.
    5. After graduation, he should become a member of health careteam.
    6. To help the stakeholders of pharmacy about the implications of WTO andTRIPS.
12. The syllabi should be more practical rathertheoretical.
13. To include new things regarding OTC Pharmacy (Patient Pharmacistinteraction).
14. To prepare pharmacy graduates for better pharmacy practice in the areas including clinical pharmacy, community pharmacy, hospital pharmacy and industrialpharmacy.
15. To add further in the curriculum clinical oriented areas as per demand of Pharm.Ddegree.
16. To update the current syllabi according to the needs of the national and international demand.
17. 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 caresystem.
18. To bring uniformity in the contents of the syllabi in line with International trends/ international universities imparting Pharm.Deducation.
19. To produce the graduates to meet the challenges of 21st century of health careproblems.

**First Professional**

|  |  |  |
| --- | --- | --- |
| **Theory** | | |
| Paper 1 | Pharmaceutical Chemistry-I (Organic) | 100 |
| Paper 2 | Pharmaceutical Chemistry-II (Biochemistry) | 100 |
| Paper 3 | Pharmaceutics-I (Physical Pharmacy) | 100 |
| Paper 4 | Physiology | 100 |
| Paper 5 | Anatomy & Histology | 50 |
| Paper 6 | English | 100 |
| **Practical** | | |
| Paper 7 | Pharmaceutical Chemistry-I (Organic) | 100 |
| Paper 8 | Pharmaceutical Chemistry-II (Biochemistry) | 100 |
| Paper 9 | Pharmaceutics-I (Physical Pharmacy) | 100 |
| Paper 10 | Physiology | 100 |
| Paper 11 | Anatomy & Histology | 50 |
| **Total Marks:** | | **1000** |

**Second Professional**

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

**Third Professional**

|  |  |  |
| --- | --- | --- |
| **Theory** | | |
| Paper 1 | Pathology | 50 |
| Paper 2 | Pharmacology and Therapeutics-II | 100 |
| Paper 3 | Pharmacognosy-II (Advanced) | 100 |
| Paper 4 | Pharmacy Practice-II (Dispensing, Community, Social & Administrative Pharmacy) | 100 |
| Paper 5 | Pharmaceutical Chemistry-III (Pharmaceutical Analysis) | 100 |
| Paper 6 | Pharmacy Practice -III (Computer and its Applications in Pharmacy) | 50 |
| **Practical** | | |
| Paper 7 | Pathology | 50 |
| Paper 8 | Pharmacology and Therapeutics-II | 100 |
| Paper 9 | Pharmacognosy-II (Advanced) | 100 |
| Paper 10 | Pharmacy Practice-II (Dispensing, Community and Social & Administrative Pharmacy) | 100 |
| Paper 11 | Pharmaceutical Chemistry-III (Pharmaceutical Analysis) | 100 |
| Paper 12 | Pharmacy Practice -III (Computer and its Applications in Pharmacy) | 50 |
| **Total Marks:** | | **1000** |

**Fourth Professional**

|  |  |  |
| --- | --- | --- |
| **Theory** | | |
| Paper 1 | Pharmacy Practice-IV (Hospital Pharmacy) | 100 |
| Paper 2 | Pharmacy Practice -V (Clinical Pharmacy-I) | 100 |
| Paper 3 | Pharmaceutics-IV (Industrial Pharmacy) | 100 |
| Paper 4 | Pharmaceutics-V (Biopharamceutics and Pharmacokinetics) | 100 |
| Paper 5 | Pharmaceutics-VI (Pharmaceutical Quality Management) | 100 |
| **Practical** | | |
| Paper 6 | Pharmacy Practice -V (Clinical Pharmacy-I) | 100 |
| Paper 7 | Pharmaceutics-IV (Industrial Pharmacy) | 100 |
| Paper 8 | Pharmaceutics-V (Biopharamceutics and Pharmacokinetics) | 100 |
| Paper 9 | Pharmaceutics-VI (Pharmaceutical Quality Management) | 100 |
| **Total Marks:** | | **900** |

**Fifth Professional**

|  |  |  |
| --- | --- | --- |
| **Theory** | | |
| Paper 1 | Pharmaceutical Chemistry-IV (Medicinal Chemistry) | 100 |
| Paper 2 | Pharmacy Practice -VI (Advanced Clinical Pharmacy-II) | 100 |
| Paper 3 | Pharmaceutics-VII (Pharmaceutical Technology) | 100 |
| Paper 4 | Pharmacy Practice -VII (Forensic Pharmacy) | 100 |
| Paper 5 | Pharmacy Practice-VIII (Pharmaceutical Management and Marketing) | 100 |
| **Practical** | | |
| Paper 6 | Pharmaceutical Chemistry-IV (Medicinal Chemistry) | 100 |
| Paper 7 | Pharmacy Practice -VI (Advanced Clinical Pharmacy-II) | 100 |
| Paper 8 | Pharmaceutics-VII (Pharmaceutical Technology) | 100 |
|  |  |  |
| **Total Marks:** | | **800** |

#### Grand Total Marks: 4700

**FIRSTPROFESSIONAL**

**PHARMACEUTICAL CHEMISTRY-I (ORGANIC) (Theory)**

**Paper1 Marks100**

**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 OrganicCompounds.
2. **STEREOCHEMISTRY/CONFORMATIONAL ANALYSIS:** Stereoisomerism, optical isomerism; Molecules with more than one chiral center Geometrical isomerism, Resolution of racemic mixture, Conformationalanalysis**.**

#### GENERAL METHODS OF PREPARATION, PROPERTIES, IDENTIFICATION TEST AND PHARMACEUTICAL APPLICATIONS OF THE FOLLOWING CLASSES AND THEIRANALOGUES:

* 1. Alkane, Alkenes, Alkynes, Aromaticcompounds
  2. Alkyl halide, Alcohol, phenols, ethers,amines
  3. Ketones,Aldehydes
  4. Acids, Esters, Amides andderivatives

#### NUCLEOPHILIC, ELECTROPHILIC SUBSTITUTION REACTION IN ALIPHATIC AND AROMATICSYSTEMS:

1. **ORIENTATION IN ELECTROPHILIC SUBSTITUTION REACTIONS ON BENZENE RING:**
2. **HETEROCYCLICCHEMISTRY**:
   1. Preparation and properties of medicinally important Heterocyclic Compounds such as pyrol, furan, thiophene, pyridine, pyrimidine and pyrazine.
   2. Preparation and properties of hetrocyclic compounds in which benzo-ring is fused with five and six membered ring containing one hetero atom; Indole, Quinoline andIsoquinoline.

#### REACTIONMECHANISM:

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, Mannichreaction.

#### REACTIVE INTERMEDIATE AND FREERADICALS:

* 1. Introduction: Generation, stability and reaction of the followingIntermediates; Carbocations, Carbanions, Carbenes, Nitrenes, Benzynes,
  2. Types of reactions: AnOverview.
  3. Free radicals: Free radical scavengers and theirapplications.

#### CARBONIUM IONREARRANGEMENTS:

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

#### CARBANIONS REARRANGEMENTS:

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

**PHARMACEUTICAL CHEMISTRY-I (ORGANIC) (Practical)**

**Paper7 Marks100**

**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 organiccompounds.
2. Organic Preparations: Benzoic acid, Aspirin, Acetanilide, Iodoform, Nitrophenol, 3 - nitrophthalic acid, Benzhydrol and 2,4-Dinitrochlorobenzene.

**PHARMACEUTICAL CHEMISTRY-II (BIOCHEMISTRY) (Theory)**

**Paper2 Marks100**

#### GENERAL INTRODUCTION AND BASIC BIOCHEMICALPRINCIPLES:

Role of pharmaceutical biochemistry in the health profession. Nature of biochemical reactions.

#### BASIC CHEMISTRY OF BIOMOLECULES (Nature, Classificationetc.):

* 1. Carbohydrates: Chemistry, Classification, Reactions of Carbohydrates, Optical activity, Biological and pharmaceutical importance ofcarbohydrates.
  2. Lipids: Chemistry of Fatty acids and Lipids, Classification (Saponifiable and non- saponifiable lipids, Simple, Complex and Derived lipids), Reactions of Fatty acids and otherLipids,Essentialfattyacids,Biologicalandpharmaceuticalimportanceoflipids.
  3. 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 aminoacids.
  4. Nucleic acids: Chemistry, Types (DNA, RNA, mRNA, tRNA, rRNA), Purine and Pyrimidine bases, Nucelosides, Nucelotides, Structures of nucleic acids, Biological and pharmaceutical importance of nucleicacids.
  5. Vitamins: Chemistry, Classification (Fat-soluble and water-soluble vitamins), Biological and pharmaceutical importance ofvitamins.
  6. Hormones: Chemistry, Classification (Proteinous and nonproteinoushormones, amino acid derivatives, steroids), Biological and pharmaceutical importance ofhormones.
  7. 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).

#### METABOLIC FATE OF BIOMOLECULES (Anabolism andCatabolism):

* 1. 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 metabolicprocesses.
  2. Lipids: Brief introduction to the digestion and absorption of lipids, Oxidation of fatty acids through β-oxidation, Biosynthesis of fatty acids, neutral lipids andcholesterol.
  3. 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 porphyrincompounds.
  4. Bioenergetics: Principles of bioenergetics. Electron transport chain and oxidative phosphorylation.

#### REGULATION OF METABOLICPROCESSES:

1. 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 metabolicprocesses.
2. Receptor mediated regulation (Hormones): Mechanism of action of hormones, Physiologicalrolesofvarioushormones,Siteofsynthesisandtargetsitesofhormones.
3. Secondary Messengers: Role of cAMP, Calcium ions and phosphoinositol in the regulation of metabolicprocesses.
4. 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 andCreatinine.

**PHARMACEUTICAL CHEMISTRY-II (BIOCHEMISTRY) (Practical)**

**Paper8 Marks100**

**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 Urine- Sugar, Uric acid, Billirubin, Cholesterol andCreatinine.

**PHARMACEUTICS-I (PHYSICAL PHARMACY) (Theory)**

**Paper3 Marks100**

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 researchetc.

#### HISTORY AND LITERATURE OFPHARMACY:

* 1. A survey of the history of pharmacy through ancient, Greek and Arab periods with special reference to contribution of Muslim scientists to pharmacy and alliedsciences.
  2. An introduction of various officialbooks.

#### PHYSICO-CHEMICALPRINCIPLES:

* 1. 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 inpharmacy.
  2. Solubilization: Solubility, factors affecting solubility, surfactants, their properties and types. Micelles, their formulation andtypes.
  3. Adsorption: Techniques and processes of adsorption indetail.
  4. Ionization: pH, pH indicators, pka, buffers, buffer’s equation, Isotonic solutions and their applications inpharmacy.
  5. Hydrolysis: Types and protection of drugs againsthydrolysis.
  6. Micromeritics: Particle size and shapes, distribution of particles methods of determination of particle size and importance of particle size inPharmacy.

#### DISPERSIONS:

1. Colloids: Types, methods of preparation, properties (optional, kinetic, electrical) Dialysis and artificial kidney, stability of colloids, protection and sensitization phenomenon and application of colloids inPharmacy.
2. Emulsions: Types, theories of emulsification, Emulsifying agents their classification and stability of emulsion.
3. Suspensions: Type, Methods of Preparation, Properties, Suspending agents, their classification andstability.
4. **RHEOLOGY:** Definition and Fundamental concept; Properties contributing to Rheological behaviour; Graphic presentation of Rheologicaldata.

#### PHYSICOCHEMICALPROCESSES:

* 1. Precipitation: Process of precipitation and its applications inPharmacy.
  2. Crystallization: Types of crystals, Mechanism and methods of crystallization and its applications inPharmacy.
  3. Distillation: Simple, fractional, steam distillation, vacuum distillation, destructive distillation and their applications inPharmacy.
  4. Miscellaneous Processes: Efflorescence, deliquescence, lyophillization, elutrition,exiccation,
  5. ignition, sublimation, fusion, calcination, adsorption, decantation, evaporation, vaporization, centrifugation, dessication, levigation and trituration.

#### EXTRACTIONPROCESSES:

* 1. Maceration: Purpose &process.
  2. Percolation: Purpose andProcess.
  3. Liquid-Liquid extraction: Purpose andProcess.
  4. Large scale extraction: Purpose andProcess.

#### RATE AND ORDER OFREACTIONS:

1. **KINETIC PRINCIPLES AND STABILITY TESTING: THEORETIC CONSIDERATIONS:(Degradation)**
   1. Physical Factors:Influence of pH, temperature, ionic strength, acid-base catalysis, U.V. light.
   2. Chemical Factors: Complex chemical reactions. Oxidation-reduction reactions,Hydrolysis.

**PHARMACEUTICS-I (PHYSICAL PHARMACY) (Practical)**

**Paper09 Marks100**

**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 Emulsionsystems.
3. Determination of particlesize.
4. Density, Specific Volume, Weights and Volumes ofLiquids.
5. Preparation of Buffer solutions and isotonicsolution.
6. Determination of %age composition of solutions by specific gravitymethod.
7. Partition-coefficient, surface tension,viscosity.

**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.

#### BASIC CELLFUNCTIONS:

**PHYSIOLOGY (Theory)**

**Paper 4**

**Marks 100**

* 1. Chemical composition of the body: Atoms, Molecules, Ions, Free Radicals, Polar Molecules, Solutions, Classes of OrganicMolecules
  2. Cell structure: Microscopic Observation of Cell, Microscopic, Cell Organelles, Cytoskeleton.
  3. Protein activity and cellular metabolism: Binding Site Characteristics, Regulation of Binding site Characteristics, Chemical Reactions, Enzymes, Regulation of Enzyme- Mediated Reactions, Multi-enzyme metabolic Pathways, ATP, Cellular EnergyTransfer,

Carbohydrate, Fat, and Protein Metabolism, Essential Nutrients.

* 1. Genetic information and Protein Synthesis: Genetic Code, Protein Synthesis, Protein, Degradation, Protein Secretion, Replication and Expression of Genetic Information, Cancer, GeneticEngineering.
  2. Movement of Molecules across Cell Membranes: Diffusion, Mediated- Transport Systems, Osmosis, Endocytosis and Exocytosis, EpithelialTransport.

#### BIOLOGICAL CONTROLSYSTEM:

* 1. Homeostatic Mechanisms and Cellular Communication: General Characteristics, Components of Homeostatic Control Systems, Intercellular Chemical Messengers, Processes Related to Homeostasis, Receptors, single TransductionPathways.
  2. 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 Cerebrospinalfluid.
  3. The Sensory Systems: Receptors, Neural Pathways in Sensory System, Association Cortex and Perceptual Processing, Primary Sensory Coding, Somatic Sensation, Visio, Hearing, Vestibular System, ChemicalSenses.
  4. 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 EndocrineDisorders.
  5. 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 itsControl.
  6. 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.
  7. Consciousness and Behavior: State of consciousness, conscious Experiences, Motivation and Emotion, Altered State of Consciousness, Learning and Memory, Cerebral Dominance and languageConclusion.

#### COORDINATED BODYFUNCTIONS:

* 1. 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, AnticlottingDrugs.
  2. 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 theLungs.
  3. 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, KidneyDisease.
  4. The Digestion and Absorption of Food (Overview): Functions of the Gastrointestinal Organs, Structure of the Gastrointestinal Tract Wall, Digestion and Absorption, RegulationofGastrointestinalProcesses,PathophysiologyoftheGastrointestinalTract.
  5. 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 BodyTemperature.
  6. 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.
  7. 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 andDisease.

**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 ArtificialRespiration.
3. CARDIOVASCULAR SYSTEM: Recording of Arterial Pulse, Recording of Arterial Blood Pressure andElectro-cardiogram.
4. SENSORYSYTEM:Visualactivity,farvision,nearvisionandFieldofvision(Perimetry).
5. NEURAL CONTROL MECHANISM: Nerve Muscle Preparation in frog, Effect of Temperature on muscle and Demonstration of spinalreflexes.

**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, organsystem.
2. **STRUCTURE OF CELL:**Cell Membrane, Cytoplasm, Organelles, Nucleus, Cellcycle.
3. **TISSUES OF BODY:**Types of tissues withexamples;
   1. Epithelial Tissue: General characters,classification.
   2. Connective Tissue: Structure and types of Connective tissue andCartilage.
   3. Bones: Structure and types of bones andjoints.
   4. Muscles: Structure of skeletal muscle, smooth muscle and cardiacmuscle.

#### INTEGUMENTARYSYSTEM:

* 1. Skin Structure: (Epidermis,dermis).
  2. Glands of Skin: (Sweat,Sebaceous).
  3. Hair: Structure,function.
  4. Nail: Structure,function.

#### CARDIOVASCULARSYSTEM:

* 1. Heart: Structure of Heart, Location of Heart, Blood Supply toHeart.
  2. BloodVessels:Mainbloodvesselsarising&enteringtheheart.Typesofbloodvessels

with examples.

1. **ALIMENTARY SYSTEM:**Name and structure of different parts of alimentary system and their inter-relationship.
2. **URINARYSYSTEM:**Nameandstructureoforgansofurinarysystemandtheirinter-relationship.
3. **REPRODUCTIVE SYSTEM:**Male and Female reproductive systems. Name, structure and association of theorgans.

#### ENDOCRINESYSTEM:

* 1. Pituitary gland: Structure and relation tohypothalamus.
  2. Thyroid gland:Structure.
  3. Adrenal gland:Structure.

1. **NERVOUS SYSTEM:**Introduction: Cells of Nervous System (Neuron), Accessory cells of N.S. and Organization ofN.S.
2. Brain; Meninges (Cerebrum cerebral Lobes. Ventricles, Cerebellum Anatomy of Cerebellum, Brain Stem Mid-Brain. Pons. Medulla Oblongata, Diencephalon. Thalamus Hypothalamus and CranialNerves).
3. Spinal Cord Meninges (C.S.F. Internal Structure, Sensory and Motor Pathway, Spinal Reflexes, Peripheral spinal Nerves, Autonomic Nervous System includesSympathetic

N.S. and Parasympathetic Nervous System).

1. **HISTOLOGY(Theory):**
2. Underlying principles of histological techniques and staining specific tissues should be explained.
3. Staining of paraffin and frozen sections will be given to thestudents.
4. Most of the teaching should be done on stained and mounted sections and every type of normal tissue will becovered.

**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 thefacilities.

1. Demonstration of the preparation and staining ofslides.
2. Histologicalexaminationofslides:Epithelium,MuscletissueandConnective tissue.
3. Organ system: Lung, Kidney, Stomach, Appendix, Skin, Intestine andGall 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.

#### CourseContents:

Presentationskills:

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.

## S E C O N D P R O F E S S I O N A L

**PHARMACEUTICS-II (DOSAGE FORMS SCIENCE) (Theory)**

**Paper1 Marks100**

* 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 buffersolutions.
  2. **INTRODUCTION:**Dosage form, Ingredient, Productformulation.
  3. **GALENICAL PREPARATIONS:**Infusions, Decoctions, Extracts, Fluid extracts, Tinctures, Aromaticwaters.

#### SOLVENTS USED IN PHARMACEUTICALPREPARATIONS:

* 1. **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 non- Medicated elixirs. Spirits: Preparation ofSpirits.
  2. **ORAL SUSPENSIONS, EMULSIONS, MAGMA AND GELS:**Preparations, examples andimportance.
  3. **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 inuse.
  4. **OPHTHALMIC, NASAL AND OTIC PREPARATIONS:**Ophthalmic solutions, suspensions, ointment, inserts, contact lens solutions. Nasal decongestant solutions, Decongestant inhalers. Ear preparations: Anti-infective, anti-inflammatory andanalgesic.
  5. **SUPPOSITORIES AND ENEMAS:**Semi-solid preparations, Suppositories: Bases, preparation,packagingandstorage;Solutions/Enemas:Preparation,packagingandstorage.
  6. **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 andstorage.
  7. **POWDERS, CAPSULES, TABLET DOSAGE FORMS:**Preparation of Powders, mixingof 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 ofpreparation.
  8. **INTRODUCTION TO PARENTERALS:**Official types of injections, solvents and vehicles for injections, addedsubstances.

#### A BRIEF INTRODUCTION TO ORAL HYGIENEPRODUCTS:

**PHARMACEUTICS-II (Dosage Forms Science) (Practical)**

**Paper7 Marks100**

**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)**

**Paper2 Marks100**

#### GENERALPHARMACOLOGY:

* 1. Pharmacology: Definition, History, and its various branches. Drug: Definition and its varioussources.
  2. Routes of drugs administration, advantages anddisadvantages.
  3. Pharmacokinetics: Drug solubility and passage of drug across the biological membranes. Absorption, distribution, metabolism and elimination of drugs and factors affecting them. Various pharmacokinetic parameters including volume of distribution (Vd), clearance (Cl), Biological half life(t1/2β), Bioavailability and various factors affecting it. Dose, Efficacy and potency of drugs. Hypersensitivity and Idiosyncratic reactions, drug tolerance and dependence. Drug interactions. Plasma proteinbinding.
  4. 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. Specificityofdrug 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.

#### DRUGS ACTING ON AUTONOMIC NERVOUS SYSTEM(ANS):

* 1. Organization of ANS its subdivisions andinnervations.
  2. Neurotransmitters in ANS, their synthesis, release andfate.
  3. Sympathetic agonist drugs: Catecholamines andNon-catecholamines.
  4. Sympathetic antagonist drugs: Adrenergic receptor Blockers and neuronblockers.
  5. Parasympathetic (Cholinergic) agonists and Anticholinestrase inhibitors. Parasympatheticantagonists.
  6. Ganglion stimulants and Ganglionblockers
  7. NeuromuscularBlockers

#### DRUGS ACTING ON GASTROINTESTINALTRACT:

* 1. Emetic andanti-emetics.
  2. Purgatives.
  3. Anti-diarrhealagents.
  4. Treatment of Peptic ulcer: Antacids, H2-Receptor antagonists, antimuscarinic agents, proton pump inhibitors, prostaglandin agonists, gastrin receptor antagonist and cytoprotectiveagents.
  5. Drug treatment of chronic inflammatory boweldiseases.
  6. Drugs affecting bile flow andCholelithiasis.

1. **AUTACOIDS AND THEIR ANTAGONISTS:**Histamine and Anti-histamines, Serotonin and Serotonin Antagonists, Prostaglandins and theirantagonists.

#### DRUGS ACTING ON RESPIRATORYSYSTEM:

* 1. Drugs used for cough (Anti-tussives, Expectorants and MucolyticAgents).
  2. Drugs used for Bronchial Asthma (Bronchodilators, Cromoglycate, Nedocromil, Cortecosteroids& other Anti-inflammatory drugs and Muscarinic receptor antagonists. Cromoglycate, Nedocromil, Cortecosteroids& other Anti-inflammatorydrugs.

#### DRUGS ACTING ON CARDIO-VESCULARSYSTEM:

* 1. Angina pectoris and its drugtreatment
  2. Congestive heart failure & itstreatment
  3. Anti-arrhythmicdrugs
  4. Anti-hyperlipidemia
  5. Coagulants andAnti-coagulants
  6. Anti-hypertensives
  7. Diuretics

1. **DRUGS ACTING ON GENITO-URINARY SYSTEM:**Oxytoxic drugs, Ergot alkaloids and uterinerelaxants.

#### ANTI-ANAEMICDRUGS:

1. **HORMONES, ANTAGONISTS AND OTHER AGENTS AFFECTING ENDOCRINE FUNCTION:**Endocrine function and dysfunctions. Drug used for therapy of Diabetes Mellitus: Insulin and Oral Hypoglycemic agents, Corticosteroids, Thyroid hormone and anti- thyroiddrugs.

#### NOTE:

1. Only an introduction will be given of the banned and obsolete drugproducts.
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 anytime.
4. The prototype drugs in each group from the latestedition of the recommended books.

**PHARMACOLOGY AND THERAPEUTICS-I (Practical)**

**Paper8 Marks100**

**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 PowerLab.
* 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’sheart.
* To demonstrate the effects of parasympathomimetic (Acetylcholine) and parasympatholytic (Atropine) drugs on Frog’sheart.
* 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, Bariumchloride).
* 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’sEyes.
* To study the effects of Homatropine on Rabbit’sEyes.
* To study the effects of Pilocarpine on Rabbit’sEyes.
* To study the effects of Local Anaesthetic drug (e.g Cocaine) on Rabbit’sEyes.
* To identify the unknown drug & differentiate its effects on Rabbit’sEyes.
* To demonstrate emetic effects of various drugs in pigeons. (Note: A minimum of 20 practicals will beconducted).

**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 andPacking.

#### Thestudyofthecrudedrugsbelongingtovariousfamiliesofmedicinalimportance

|  |  |  |
| --- | --- | --- |
| **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 | Gymnemasylvestre, 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 |

1. **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.
2. **Drugs of Animal Origin:**General introduction and discussion about honey, gelatin,shellac, musk, civet, ambergris, cod liver oil, cantharides and spermaceti.
3. **Biologics:**Sources, structure, preparation, description and uses of vaccines, toxins, antitoxins, venoms, antivenoms,antiserums.
4. **Surgical Dressings:** Classification of fibers as vegetable, animals and synthetic fibers. Evaluation of fibers in surgical dressings, BPC standards for dressings and sutures. Discussionon cotton, wool, cellulose, rayon, catgut andnylon
5. **Pesticides:**Introduction, methods and control of pests with special reference topyrethrum, tobacco, and other naturalpesticides.
6. **Growth Regulators:**General account with special reference to plant hormones; Auxins, Gibberellins Abscisic acid andCytokinins.
7. **Poisonous Plants including Allergens and Allergenic Preparations:**General introduction, case history, skin test, treatment of allergy, inhalant, ingestant, injectant, contactant, infectant andinfestant allergens. Mechanism ofallergy.
8. **Enzymes:**Enzymes obtained from plant source (Phytoenzymes). Papain Bromelain and Malt Extract.EnzymesobtainedfromAnimalsource.Rennin,pepsin,PancreatinandPancrealipase.

**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 beconducted).

**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)**

**Paper4 Marks100**

**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 classificationof Micro-organisms.

#### MICRO-ORGANISMS:

* 1. 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.
  2. The Viruses: Introduction, Classification (and detail of at least one species from every group), cultivation andreplication.
  3. TheFungi/Yeast/Molds:
  4. TheProtozoa:

1. **THE NORMAL FLORA:**Microbiology of air, water and soil (general introduction and normal inhibitants of air, water andsoil).
2. **INDUSTRIAL MICROBIOLOGY:**Introduction to Sterilization/ Disinfection. Fermentation. Pharmaceutical products Produced by fermentation process (Penicillins, Cepalosporins, Gentamycin, Erythromycin, Tetracyclines, Rifamycin,Griseofulvin).
3. **IMMUNOLOGY:**Introduction and types of Immunity: Specific and non-specific (Cellular basis of Immune response. Immunity, autoimmunity, tolerance. Antigen. Antibodies). Antigen- Antibody reactions and their clinical and diagnostic applications. Hypersensitivity and allergy. Drug allergy mechanism. Vaccination: Introduction and aims. Types of Vaccines. Current vaccinepractices.
4. **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.
5. **INTRODUCTION TO DISEASES:** Dengue fever, Bird flu, SARS or other prevailing diseases of bacteria andvirus.

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

**Paper10 Marks100**

**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 micro- organism. 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)**

**Paper5 Marks100**

#### PART: APAKISTANSTUDIES: 40 MARKS

1. **INTRODUCTION/OBJECTIVES:**
   * Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background ofPakistan.
   * Study the process of governance, national development, issues arising in the modern age and posing challenges toPakistan.

#### HISTORICALPERSPECTIVE:

1. Ideological rationale with special reference to Sir Syed Ahmed Khan, Dr. Allama Muhammad Iqbal and Quaid-i-Azam Muhammad AliJinnah.
2. Factors leading to Muslimseparatism
3. People andLand
   1. IndusCivilization
   2. Muslimadvent
   3. Location and geo-physicalfeatures

#### GOVERNMENT AND POLITICS INPAKISTAN:

Political and constitutional phases:

a. 1947-58

b. 1958-71

c. 1971-77

d. 1977-88

e. 1988-99

f. 1999-onward

#### CONTEMPORARY PAKISTAN:

1. Economic institutions andissues
2. Society and socialstructure
3. Ethnicity
4. Foreign policy of Pakistan andchallenges
5. Futuristic outlook ofPakistan

#### PART: BISLAMICSTUDIES: 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 IslamicCivilization
3. To improve Students skill to perform prayers and otherworships
4. To enhance the skill of the students for understanding of issues Related to faith and religiouslife.

#### Introduction to QuranicStudies:

* 1. Basic Concepts ofQuran
  2. History ofQuran
  3. Uloom-ul-Quran

#### Study of Selected Text of HollyQuran:

* 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)

#### Study of Selected Text of HollyQuran:

* 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 ofJudgment
  3. Verses of Surah Al-Saf related to Tafakar, Tadabar (Verse No.1,14)

#### Seerat of Holy Prophet (S.A.W)I:

* 1. Life of Muhammad Bin Abdullah ( Before ProphetHood)
  2. Life of Holy Prophet (S.A.W) inMakkah
  3. Important Lessons derived from the life of Holy Prophet (S.A.W) inMakkah

#### Seerat of Holy Prophet (S.A.W)II

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

#### Introduction toSunnah:

* 1. Basic Concepts ofHadith
  2. History ofHadith
  3. Kinds ofHadith
  4. Uloom-ul-Hadith
  5. Sunnah &Hadith
  6. Legal Position ofSunnah

#### Selected Study from Text ofHadith:

1. **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 IslamicLaw
   5. Islam andSectarianism

#### 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 ContemporaryIssues

#### Islam &Science:

* 1. Basic Concepts of Islam &Science
  2. Contributions of Muslims in the Development ofScience
  3. Quran &Science

#### Islamic EconomicSystem:

* 1. Basic Concepts of Islamic EconomicSystem
  2. Means of Distribution of wealth in Islamic Economics
  3. Islamic Concept ofRiba
  4. Islamic Ways of Trade &Commerce

#### Political System ofIslam:

* 1. Basic Concepts of Islamic Political System
  2. Islamic Concept ofSovereignty
  3. Basic Institutions of Govt. inIslam

#### IslamicHistory:

* 1. Period ofKhlaft-e-Rashida
  2. Period ofUmayyads
  3. Period ofAbbasids

#### Social System ofIslam:

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

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

**Paper6 Marks100**

#### PART A:(PHARMACEUTICALMATHEMATICS) (40MARKS)

1. **ALGEBRA:**
   1. Solution of Linear and Quadratic Equations:Equations reducible to Quadratic Form. Solution of simultaneousEquations.
   2. Arithmetic, Geometric and Harmonic Progressions: Arithmetic, Geometric and HarmonicMeans.
   3. Permutations andCombinations:
   4. Binomial Theorem: Simpleapplication.
2. **TRIGONOMETRY:**Measurement of Angles in Radian and Degrees. Definitions of circular functions. Derivation of circular function for simplecases.
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 andEllips.
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 ofinflexion.
5. **INTEGRAL CALCULUS:**Concept of integration, Rules of integration, Integration of algebraic, exponential, logarithmic and trigonometric functions by using different techniques and numericalintegration.

#### PARTB: (BIOSTATISTICS) (60MARKS)

**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 areselected?

**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.

1. **SUMMARIZING DATA and VARIATION:**The Mean, The Median, The Mode, The Mean Deviation, The Variance and Standard Deviation, Coefficient ofVariation.
2. **CURVE FITTING:**Fitting a Straight Line. Fitting of Parabolic or High Degree Curve.
3. **PROBABILITY:**Definitions, Probability Rules, Probability Distributions (Binomial & NormalDistributions).
4. **SIMPLE REGRESSION AND CORRELATION:** Introduction. Simple Linear Regression Model. Correlationco-efficient.
5. **TEST OF HYPOTHESIS AND SIGNIFICANCE:**Statistical Hypothesis. Level of Significance. Test of Significance. Confidence Intervals, Test involving Binomial and NormalDistributions.
6. **STUDENT “t”, “F” and Chi-Square Distributions:**Test ofSignificance based on

―t‖,―F‖andChi-Square distributions.

1. **ANALYSIS OF VARIANCE:**One-wayClassification,Two-way Classification, Partitioning of Sum of Squares and Degrees ofFreedom, Multiple

Compression Tests such as LSD, The analysis of VarianceModels.

1. **STATISTICAL PACKAGE:** An understanding of data analysis by using different statistical tests using various statistical software’s like SPSS, Minitab, Statisticaetc.

## T H I R D P R O F E S S I O N A L

**PATHOLOGY (Theory)**

**Paper 1**

**Marks 50**

#### SCOPE OF PATHOLOGY & CONCEPT OFDISEASES:

1. **DEFINITION AND TERMINOLOGY:**Ischemia, Hypoxia, Necrosis, Infarction, Atrophy, Hypertrophy, Hyperplasia, Metaplasia, Aplasia,Anaplasia.
2. **RESPONSE OF BODY TO INJURY AND INFECTION:**Acute and Chronic inflammation, Immunity, Allergy, HyperSensitivity.
3. **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 withtumors.

**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 CellCarcinoma, 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)**

**Paper2 Marks100**

#### DRUGS ACTING ON CENTRAL NERVOUSSYSTEM:

* 1. Sedatives &Hypnotic
  2. Anxiolytics, antidepressants and anti-manicdrugs
  3. Antiepileptics
  4. Antiparkinsonian and drug used in other neurodegenerativediseases.
  5. Antipsychotics
  6. Opioidanalgesics
  7. Therapeutic gases (Oxygen, Carbon-dioxide, Nitric oxide andHelium.
  8. Cerebral Stimulants, Medullary stimulants, Spinal CordStimulants
  9. Anesthetics: General andlocal

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

#### CHEMOTHERAPY

* Basic principles ofchemotherapy
* 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 tractantiseptics,
* Anti-fungals
* Anti-virals
* Anti-protozoals: anti-malarias, anti-amebiasis, anthelmintics andanti-leishmanials.
* Anti-neoplasticdrugs

1. **IMMUNOPHARMACOLOGY:** Pharmacology of immune-suppressants andstimulants

#### TOXICOLOGY

* 1. Pollution and its types (water, air,food)
  2. Poison and principle of treatment ofpoisoning.
  3. Poisoning (Sign & symptom and treatment): Ethanol, Barbiturates, Digitalis, Salicylates, Strychnine, Narcotics, Nicotine, Paracetamol, Benzodiazepines and Organophosphorouscompounds.
  4. Chelating agents and their role in poisoning:Dimercaprol,Calcium disodium Edetate (Calcium EDTA), Pencillamine andDefroxamine.

#### NOTE:

1. Only an introduction will be given of the banned and obsoletedrug 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 anytime.
4. Theprototypedrugsineachgroupfromthelatesteditionoftherecommendedbooks

**PHARMACOLOGY AND THERAPEUTICS-II (Practical)**

**Paper8 Marks100**

**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 ofaction.
  + To identify the unknown (convulsant) drug and determine its site ofaction.
  + 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 HumanEyes.
  + To identify and observe the effects of unknown drugs on HumanEyes.
  + To studythe 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 ofFrog.
  + To study the anti-coagulant effects of Heparin and oral anti-coagulants onRabbits.
  + To identify the unknown anticoagulant drug usingRabbits.
  + To demonstrate the Graded Dose-Response curve of Acetylcholine onRabbit intestine.
  + To identify unknown concentration of Acetycholinefrom Graded Dose Responsecurves.
  + To demonstrate the general anesthetic effect onrabbits.
  + To demonstrate the effect of sedatives and hypnotics onrabbits.
  + To demonstrate the anti-nociceptive (analgesic) effect onmice.
  + To demonstrate antidepressant effect in rats (forced swimming test, tail suspension test Yohimbin lethalitytest).

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

**PHARMACOGNOSY-II (ADVANCED) (Theory)**

**Paper3 Marks100**

1. **SEPARATION AND ISOLATION OF PLANT CONSTITUENTS:** Introduction and useof

spectroscopic and chromatographic techniques for the identification of natural products. Description and interpretation of ultraviolet, infrared, mass, nuclear magnetic resonance (1H-NMR and 13C-NMR) and other advance techniques to elucidate the structure of natural products.

1. **CARBOHYDRATES AND RELATED COMPOUNDS:** Introduction and classificationof carbohydrates, sugars as adjuvant in drugs, role of impurities in sugarsubstances.
   1. Sucrose and Sucrose containing drugs: Sucrose, Dextrose, Liquid glucose, Fructose, Lactose, Xylose, Caramel, Starch, Inulin, Dextrineetc.
   2. Cellulose and Cellulose Derivatives: Powdered cellulose, microcrystalline cellulose, Methyl cellulose, Sodium Carboxy-methylcellulose.
   3. Gums and Mucilage: Tragacanth, Acacia, Sodium Alginate, Agar,Pectin.
2. **ALKALOIDS:** Introduction, Properties, Classification, Function of alkaloids in plants, Methods of extraction and identificationtests.
   1. Pyridine Piperidine Alkaloids: Areca nut,Lobelia.
   2. Tropane Alkaloids: Belladonna, Hyoscyamus,Stramonium.
   3. Quinoline Alkaloids:Cinchona.
   4. Isoquinoline Alkaloids: Ipecacuanha,Opium.
   5. Indole alkaloids: Rauwolfia, Catharanthus, Nux vomica, Physostigma,Ergot.
   6. Imidazole alkaloids:Pilocarpus.
   7. Steroidal alkaloids:Veratrum.
   8. Alkaloidal amines: Ephedra,Colchicum.
   9. Purine Bases: Tea,Coffee.
3. **GLYCOSIDES:** Introduction, classification, chemistry, extraction, isolation and medicinaluses of:
   1. Cardioactiveglycosides: Digitalis, Strophanthus and whitesquill.
   2. Anthraquinoneglycosides: Cascara, Aloe, Rhubarb, Cochinealand

Senna.

* 1. Saponinglycosides: Glycyrrhiza,Sarsaparilla.
  2. Cyanophoreglycosides: Wildcherry.
  3. Isothiocyanateglycosides: Blackmustard.
  4. Lactoneglycosides: Cantharide.
  5. Aldehydeglycosides: Vanilla.
  6. Miscellaneousglycosides: Gentian, Quassia,Dioscorea.

1. **PLANT STEROIDS:** Introduction, extraction, isolation, nomenclature, sources and uses ofbile acids, plant sterols, steroidal sapogenins, steroid hormones, withanolides andecdysons.
2. **LIPIDS:**Introduction, classification, source, active constituents and pharmacological usesof:
   1. Fixed Oils: Castor oil, Cotton seed oil, olive oil, Peanut oil, Sun flower oil, Corn oil, Coconutoil,Almondoil,Linseedoil,Mustardoil,SesameoilandSoybeanoil.
   2. Fats and Related Compounds: Theobroma oil andLanolin.
   3. Waxes: Bees wax, carnauba wax, spermaceti and Jojobaoil.
3. **VOLATILE OILS (ESSENTIAL OILS):**Introduction, significance, sources, active constituents, methods of obtaining volatile oils, chemistry and classificationof:
   1. Hydrocarbon volatile oils: Cubeb and Turpentineoil.
   2. Alcoholic volatile oils: Peppermint, Coriander andCardamom.
   3. Aldehydic volatile oils: Bitter orange peel, Sweet orange peel, LemonCinnamon and Bitter almondoil
   4. Ketonic volatile oils: Camphor, Spearmint, Caraway,Buchu
   5. Phenolic volatile oils: Clove,Thyme.
   6. Phenolic ether volatile oils: Fennel, Anise,Myristica.
   7. Oxide volatile oils: Eucalyptus,Chenopodium.
   8. Ester volatile oils:Rosemary.
   9. Miscellaneous volatile oils: Allium,Anethum.
4. **RESINS AND OLEORESINS:**Introduction, classification, active constituents and pharmacological uses of jalap, turpentine, asafoetida, benzoin, rosin, cannabis,podophyllum, ipomea, myrrh, andbalsam.
5. **TANNINS:**Introduction, classification, biosynthesis, extraction, identification, occurrence in plants, role in plant life and chemical study of tannins in Kino, Myrobalan, Catechu, Nutgall, Castanea andkrameria.

#### NATURALTOXICANTS:

1. General Introduction to Plant Toxicology: Definition, classification and chemical nature of plant toxins. Plant toxicities in humans andanimals
2. 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).
3. Lower Plant Toxins: Bacterial toxins (Staphylococcus aureus, Clostridium botulinum), Algal toxins (Microcystis aeruginosa, Cyanobecteria, Gonyaulaxcantenella).
4. Mycotoxins: Fungal toxins (Aspergillus spp., Claviceps purpurea), Mushrooms (Amanitaspp.).
5. 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 Abrusprecatorius, Papaver somniferum, Eucalyptus spp., Nicotiana tabaccum, Cannabis sativa, Digitalis purpurea, Datura stramonium etc. poisoning.

#### AN INTRODUCTION TO NUTRACEUTICALS ANDCOSMECEUTICALS:

1. **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 andimmunostimulants.
2. **INTRODUCTION TO CLINICAL PHARMACOGNOSY:**General introduction and historical background of clinical Pharmacognosy. Study of treatment by herbalmedicines.

#### CLINICAL USE OF HERBS & HERBALMEDICINE:

Diabetes: *Gymnemasylvestre, Melia azadirchta, Momordica charantia, Syzygiumjambulana.*

Cardiacdiseases: *Digitalis spp., Convallaria majalis, Urgenia indica,Allium sativum, Punicagranatum.*

Hepatitis: *Berberis vulgaris, Picrorhizakurroa, Lawsoniain.*

Respiratorydiseases: *Ficus religosa, Adhatodavasica.*

Skindiseases: *Aloe vera, Angelica archangelica, Mentha piperita, Citrusspp.,*

*Commiphoramukul.*

CNSdisorders: *Strychnosnux-vomica, Datura stramonium, Cannabissativa,*

*Papaver somniferum, Atropa belladonna.*

Musculo-skeletaldisorders: *Nigella sativa, Phycotis ajowan, Trigonellafoenum-graecum,*

*Zingiber officinale.*

Renaldisorders: *Cucumis melo, Berberis vulgaris, Zea mays, Tribulusterrestris.*

Reproductivedisorders: *Saraca indica, Ruta graveolens, Nigella sativa,Glycyrrhiza*

*glabra, Claviceps purpurea, Myristica fragrance.*

G.I.T.disorders: *Foeniculum vulgare, Ferulafoetida, Cuminum cyminum,Aegle*

*marmelos, Prunus domestica.*

**PHARMACOGNOSY-II (ADVANCED) (Practical)**

**Paper9 Marks100**

**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 layerchromatography.

#### Also include the following experiments;

* Determination of Iodine value; Saponification value and unsaponifiable matter; ester value; Acidvalue.
* 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)**

**Paper4 Marks40+60**

#### PARTA:(DISPENSING): (40MARKS)

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.

1. **EXTEMPORANEOUS DISPENSING:**Solutions, Suspensions, Emulsions, Creams, Ointments, Pastes and gels, Suppositories and pessaries, Powders and granules and Oral unit dosageform.
2. **PHARMACEUTICAL INCOMPATIBILITIES:**Types of Incompatibilities, manifestations, Correction and Prevention with reference to typicalexamples.

#### PART B: (COMMUNITY, SOCIAL &ADMINISTRATIVEPHARMACY): (60MARKS)

1. **DEFINITIONS ANDBACKGROUND:**
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 HealthPolicy.
3. **MEDICAL COMPLICATION OF DRUG TAKING:**General and Socio-economic Aspects.

#### PATIENT EDUCATION ANDCOUNSELLING:

1. **CONTROL OF DRUG ABUSE ANDMISUSE:**
2. **ROLE OF PHARMACIST:**As Public Health Educator in the Community for Drug Monitoring and DrugInformation.
3. **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 pharmacypractice.
4. **PHARMACOECONOMICS:**Pharmacoeconomic modelling andinterpretation.
5. **ALTERNATIVE THERAPIES**: Background, philosophy and use of complementary and alternative therapies including herbal medicines, homoeopathy, acupuncture, acupressure, Bach Flower remedies, aromatherapy andreflexology.
6. **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 Flowanalysis.

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

**(Practical)**

**Paper10 Marks100**

**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)**

**Paper5 Marks100**

The topics will be taught with special reference to their PharmaceuticalApplications.

1. **SPECTROSCOPIC METHODS:**Theory, Instrumentation and Pharmaceutical applications of the following SpectroscopicMethods:
   1. Atomic Absorption and EmissionSpectroscopy
   2. Molecular fluorescencespectroscopy
   3. FlamePhotometry
   4. I.R.Spectroscopy
   5. MassSpectroscopy
   6. NMRSpectroscopy
   7. U.V./VisibleSpectroscopy
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 GravimetricAnalysis.
5. **OCCURENCE, PROPERTIES, PREPARATION AND APPLICATION OF OFFICIAL INORGANIC COMPOUNDS:**Aluminium Hydroxide, Ammonium Chloride,SodiumCarbonate, 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-aqueoustitrationetc.

**PHARMACEUTICAL CHEMISTRY-III (PHARMACEUTICAL ANALYSIS) (Practical)**

**Paper11 Marks100**

**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 beconducted).

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

**Paper6 Marks50**

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-virusesIssues.

#### RESEARCHMETHODOLOGIES:

1. **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.
2. **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 processingsystems,TypesofComputerOperation,BatchProcessingandReal-timeProcessing.
3. **APPLICATION OF COMPUTERS IN HOSPITAL PHARMACY:**Patterns of Computeruse 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.
4. **APPLICATION OF COMPUTER IN COMMUNITY PHARMACY:**Computerizing the Prescription Dispensing process, Use of Computers for Pharmaceutical Care in community pharmacy, Accounting and General Ledgersystem.
5. **APPLICATION OF DRUG INFORMATION RETRIEVAL & STORAGE:**Introduction Advantages of Computerized Literature Retrieval use of ComputerizedRetrieval.
6. **DATA ANALYSIS:** Introduction and implementations of statistical design and test. Students T- test, Chi Square, ANOVA using statistical packages like SPSS, Med Calc, Kineticaetc.

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

**Paper12 Marks50**

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 CustomizingExplorer.
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,Hyperlinking,BookmarksandImageMaps,IntroducingFront-page―components‖, Front-pageandFrames,ManagingyourWeb,Goodsitedesign,Publishingandpublicizing.
3. **DATA PRESENTATION SKILLS**: MS-Word, MS-Excel, MS-Powerpoint.
4. **UNDERSTANDING AND APPLICATION OF STATISTICAL PACKAGES:**SPSS, Kinetica, MedCalc.

## F O U R T H P R O F E S S I O N A L

**PHARMACY PRACTICE-IV (HOSPITAL PHARMACY) (Theory)**

**Paper1 Marks100**

#### INTRODUCTION:

* 1. Role of Pharmacist inHospital
  2. Minimum standards for pharmacies inInstitutions/Hospitals
  3. Research in HospitalPharmacy

#### HOSPITAL AND ITSORGANIZATION:

* 1. Classification ofHospitals
  2. OrganizationalPattern
  3. Administration
  4. ClinicalDepartments
  5. Nursing, Dietetic, Pathology, Blood Bank, Radiology and other supportive servicesetc.
  6. Role of Pharmacy inHospital
  7. HospitalFinances

#### PHARMACY, ITS ORGANIZATION ANDPERSONNEL:

* 1. Pharmacyspecialist
  2. Drug informationCentre
  3. Poison Control Centre and AntidoteBank
  4. PharmacyEducation
  5. Determining the Need of Professional and other departmentalstaff
  6. Professional servicesrendered

#### PHARMACY AND THERAPEUTICCOMMITTEE:

1. **THE HOSPITALFORMULARY:**
   1. General Principles and guidelines to developFormulary
   2. Format
   3. Preparation of theFormulary
   4. Role ofPharmacist
   5. Benefits andproblems
   6. Keeping up to dateFormulary

#### DISPENSING TOIN-PATIENTS:

* 1. Methods of Dispensing &SOP’s
  2. Unit dosedispensing
  3. Other concepts of dispensing, Satellite Pharmacyetc.

#### DISPENSING TO AMBULATORYPATIENTS:

1. **DISTRIBUTION OF CONTROLSUBSTANCES:**
2. **DISPENSING DURINGOFF-HOURS:**
3. **SAFE USE OF MEDICATION IN THE HOSPITAL:**Medication error; Evaluation & PrecautionsofMedicationError;RoleofPharmacistinControllingMedicationError.

#### MANUFACTURING BULK ANDSTERILE:

1. **THE PHARMACY; CENTRAL STERILE SUPPLYROOM:**
2. **ASEPTIC DISPENSING:**TPN, I/V Admixtures, Cytotoxic Dispensing, Semi-sterile Dispensing (Eye drops, Ear drops) andHyperalimentation.

#### ROLE OF PHARMACIST IN SMALL HOSPITALS, NURSING HOMESetc:

1. **PURCHASING, DISTRIBUTION AND CONTROL OF HOSPITAL MEDICINES, MEDICAL & SURGICAL SUPPLIES:**Purchasing, Stocking, Stock Control, Inventory Management, Drug Distribution, Relationship between purchasing, Distribution and Clinical PharmacyServices.

#### NUCLEARPHARMACY:

1. **THE PHYSICAL PLANT AND ITS EQUIPMENT:**
2. **INVESTIGATIONAL USE OFDRUGS:**
3. **HEALTHACCESSORIES:**
4. **SURGICALSUPPLIES:**
5. **INSPECTION OF WARDS WITH REFERENCE TO DRUG STORAGE AND ADMINISTRATION:**
6. **MANAGEMENT OF ACCIDENT & EMERGENCY PHARMACY (A &E):**

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

**Paper2 Marks100**

1. **GENERAL INTRODUCTION TO CLINICALPHARMACY:**
   1. Introduction to clinical pharmacy and related terms, definition, basiccomponents, comparison with other clinical fields, scope ofservices.
   2. Guidelines (General guidelines for Clinical PharmacyPractice)
   3. Patient counselingcompliance
   4. Laboratory Datainterpretation
   5. Electrolytesmanagement
   6. Clinical literatureevaluation
   7. Druginteractions
   8. Medicationerrors

#### DISEASEMANAGEMENT:

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, Heartfailure).
* Unit II: Pulmonary unit (Asthma e.g. acute, chronic, status asthamaticus, childhood asthma, Pneumonia, COPD includes emphysema & chronicbronchitis)
* Unit III: Gastroenterology unit [ulcer, liver cirrhosis, portal hypertension, hepatitis, diarrhea, inflammatory bowel disease(IBD)].

#### PATIENT PROFILE & PATIENTCOUNSELING:

* 1. Patient diseaseprofile
  2. Taking casehistory
  3. 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.
  4. PatientCounseling

1. **CLINICAL TRIALS OF DRUG SUBSTANCES:**Designing of clinical trials, types of trials, Choice of patients, exclusion of patients and monitoring a clinicaltrial.
2. **EMERGENCY TREATMENT:**For example, Cardiopulmonary resuscitation (CPR), ColdBlue.
3. **DRUG INTERACTIONS:**Mechanism, Physiological factors affecting interaction, Types and levelofdruginteractions,Roleofpharmacistinevaluatingdruginteraction&itsmanagement.

#### PHARMACOVIGILANCE:

* 1. Scope, definition and aims ofPharmacovigilance
  2. 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 monitoringsystem.

#### PHARMACOTHERAPYPLAN:

1. **Development, Implementation and Monitoring of Drug TherapyPlans:**
   1. Pharmacist work up of drug therapy(PWDT)
   2. Documentation of PharmacotherapyPlan
      * SOAP note
      * CORE PharmacotherapyPlan
      * PRIME Pharmacotherapyproblems
      * FARMnote
   3. Implementation of Drug TherapyPlan
   4. Monitoring of Pharmacotherapeuticplan
   5. Pharmaceutical care plan as ongoingprocess
   6. Importance of drug therapy plan in today’s pharmacypractice

#### PharmacotherapyDecision-Making:

1. Pursue the role of drug therapy practitioner over that of drug therapyadvisor.
2. Participate in pharmacotherapy decision-makingby:
   1. Identifying opportunities fordecision-making.
   2. Proactively engaging decision-makingopportunities.
   3. Formulating decision rationale that is the result of rigorous inquiry, scientific reasoning, and evidence.
   4. Pursuing the highest levels ofdecision-making.
   5. Seeking independence in making decisions and accepting personal responsibility for the outcomes to patients resulting from one’sdecisions.
   6. Personally enactingdecisions

#### DRUG INDUCEDDISEASES:

1. **UTILIZATION OF CLINICAL DRUG LITERATURE:**Introduction, Drug literature selection, Drug literature evaluation and Drug literaturecommunication.

#### ONLINE PHARMACEUTICAL CARE SERVICES ANDGLOBALIZATION:

1. **PROVISION OF PHARMACEUTICAL CARE IN MULTIPLE ENVIRONMENTS:**Professionalism, physical assessment, body substance precautions and the relationshipsbetween culture, race and gender to pharmaceuticalcare.

**PHARMACY PRACTICE-IV (CLINICAL PHARMACY-I) (Practical)**

**Paper6 Marks100**

#### 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 externalexaminer.
  + Students will also complete a report independently or in a group on a Drug UseEvaluation.
  + 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 andprojects

**PHARMACEUTICS-IV (INDUSTRIAL PHARMACY) (Theory)**

**Paper3 Marks100**

#### MASSTRANSFER.

1. **HEATTRANSFER.**
2. **DRYING:**Theories of drying, Drying of Solids, Classification of dryers, General Methods, Fluidized Bed systems, Pneumatic systems, Spray dryer, Freezedrying.
3. **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 Milletc).
4. **MIXING:**Fundamentals, Mechanisms, Mixing Equipment used in Liquid/Liquid, Liquid/Solid and Solid/Solidmixing.
5. **CLARIFICATION AND FILTRATION:**Theory, Filter Media, Filter aids, Filter selection and Equipment (Leaf filter, Filter press, Meta filters and Rotaryfilters).
6. **EVAPORATION:**General principles of Evaporation, Evaporators and Evaporation under reduced pressure.
7. **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 gelatincapsules).

#### SAFETY METHODS IN PHARMACEUTICALINDUSTRY:

* 1. Mechanical, chemical and fire hazardsproblems.
  2. Inflammable gases anddusts.

1. **EMULSIONS:**Mechanical Equipments, Specific formulation Considerations and Emulsion stability.
2. **SUSPENSIONS:** Formulation of suspensions, Equipment used in preparation and test methods for pharmaceuticalsuspensions.
3. **SEMISOLIDS:**EquipmentusedforOintments,Pastes,GelsandJellies,Packagingofointments.
4. **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, clarityetc.).
5. **PACKING & PACKAGING:** Influence of Packaging materials, Stability, Packaging Lines, Packaging Area, PackagingEquipment.

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)**

**Paper7 Marks100**

**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 DirectCompression.
* Coating of Tablets (Sugar Coating, Film coating and EntericCoating).
* Clarification of liquids by variousprocesses.
* Size Reduction,Homogenization.
* Ampoule filling, sealing and sterilization clarity and leakage tests ininjectables.
* Capsule filling by semi automaticmachines.
* Manufacture of sustained actiondrugs.
* Tablets Tests like Disintegration. Dissolution. Friability. Hardness and thicknesstests.
* Determination of weight variation intablets.
* Density of powder. Particle size analysis (Note: A minimum of 20 practicals will be conducted).

**PHARMACEUTICS-V (BIOPHARMACEUTICS & PHARAMCOKINETICS) (Theory)**

**Paper4 Marks100**

1. **DEFINITIONS AND TERMINOLOGY:**Biopharmaceutics, Generic Equivalence, Therapeutic Equivalents, Bioavailability, Bioequivalence, Drug Disposition, Pharmacokinetics (LADMER: Libration, absorption, distribution, metabolism, elimination andresponse).
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 dosageforms.
3. **BIOLOGICAL HALF LIFE AND VOLUME OF DISTRIBUTION:**Introduction, types, methods of determination andapplication**.**
4. **DRUG CLEARANCE:**Introduction, Mechanism, Models, determination and relationship of clearance withhalf-life.
5. **PHARMACOKINETICS:** Introduction, Linear and Non-linear Pharmacokinetics. Application of pharmacokinetics in clinicalsituations.

#### BIOAVAILABILITY ANDBIOEQUIVALENCE:

* 1. Introduction.
  2. Bioavailability types, parameters, significance and studyprotocol.
  3. Methods of Assessment ofBioavailability
  4. Bioequivalence study designs, components and application, reportformat

#### CONCEPT OF COMPARTMENT(S)MODELS:

1. One compartment openmodel
   1. Intravenous Injection(Bolus)
   2. Intravenousinfusion
2. Multicompartmentmodels
   1. Two compartment openmodel
   2. IV bolus, IV infusion and oraladministration
3. Non-compartmentalModel
   1. Statistical MomentTheory
   2. MRT for various compartmentmodels
   3. Physiological Pharmacokineticmodel

#### MULTIPLE DOSAGEREGIMENS:

* 1. Introduction: principles of superposition
  2. Factors: persistent, accumulation and lossfactors
  3. Repetitive Intravenous injections-One Compartment Open Model
  4. Repetitive Extravascular dosing-One Compartment Openmodel
  5. Multiple Dose Regimen-Two Compartment OpenModel

#### ELIMINATION OFDRUGS:

1. 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 ofdrugs.
2. Renal Excretion of Drugs: Renal clearance, Tubular Secretion and Tubular Re- absorption.
3. Elimination of Drugs through other organs: Pulmonary excretion, salivary excretion, Mammilary excretion, Skin excretion and Genitalexcretion.
4. **PROTEIN BINDING:** Introduction, types, kinetics, determination and clinical significance of drug-proteinbinding.
5. **PHARMACOKINETICS VARIATIONS IN DISEASE STATES:** Determination of pharmacokinetics variations in renal and hepatic diseases, general approaches for dose adjustment in renal disease and hepaticdiseases.

#### PHARMACOKINETICS OF INTRAVENOUSINFUSIONS:

1. **BIOPHARMACEUTICAL ASPECTS IN DEVELOPING A DOSAGE FORM:**Drug considerations, drug product considerations, patient considerations, manufacturing considerations, pharmacodynamic considerations pharmacokineticconsiderations.
2. **IN-VITRO-IN-VIVO CORRELATION (IVIVC):**Introduction, levels and determination of in- vitro/in-vivocorrelation.

**PHARMACEUTICS-V (BIOPHARMACEUTICS & PHARAMCOKINETICS) (Practical)**

**Paper8 Marks100**

**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 drugdisposition.

**PHARMACEUTICS-VI (PHARMACEUTICAL QUALITY MANAGEMENT) (Theory)**

**Paper5 Marks100**

#### 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 andvalidation.

1. **QUALITY CONTROL OF SOLID DOSAGE FORMS** (conventional and modified release dosageforms):
   1. Physical tests: Hardness, Thickness, Diameter, Friability, Disintegration, Weight Variation.
   2. Chemical tests: Content uniformity, Assay of activeIngredient.
2. **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 activeIngredient.
3. **QUALITY CONTROL OF SUPPOSITORIES:** Dissolution test, Uniformity of weight, Assay of active Ingredient, Liquefaction time test and Breakingtest.
4. **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 activeIngredient.
5. **BIOLOGICAL ASSAYS:**Biological methods, Standard preparations and units of activity, Bioassay of antibiotics, Bioassay of insulin injection, Assay of prepared digitalis and Assay of VitaminD.
6. **ALCOHOL DETERMINATION:**Alcoholometric methods, Problem during distillation of alcohol, Method for liquids containing less than 30% or more than 30% alcohol and special treatment beforedistillation.
7. **ALKALOIDAL DRUG ASSAY:**Weighing for assay, Extraction of drugs, Maceration, Percolation,Continuousextraction,PurificationofAlkaloidsanddeterminationofalkaloids.
8. **QUALITY ASSURANCE OF VACCINES:**Introduction, Quality measures for stability of vaccines, potency testing, and post market surveillance ofvaccines.
9. **MISCELLANEOUS DETERMINATIONS AND TESTS:**Determination of weight/ml, Water/Moisture content, Loss on Drying, Evaluation of Ointments, Ash contents and Alkalinity ofGlass.
10. **STANDARDIZATION OF PHARMACEUTICALS:**An understanding of quality assurance system adopted in pharmaceutical industry. Good Manufacturing Practices and Current Good ManufacturingPractices.

#### STATISTICAL INTERPRETATION OF QUALITY CONTROL CHARTS DURING MANUFACTURINGPROCESSES:

**PHARMACEUTICS-VI (PHARMACEUTICAL QUALITY MANAGEMENT) (Practical)**

**Paper9 Marks100**

**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 beperformed).

## FINAL P R O F E S S I O N A L

**PHARMACEUTICAL CHEMISTRY-IV (MEDICINAL CHEMISTRY) (Theory)**

**Paper1 Marks100**

**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,StructureActivityRelationships(SAR)andDrugMetabolism).

Modern concept of rational drug design, pro drug, combinatorial chemistry and computer aided drug design (CADD) and concept of antisense molecules.

#### DRUG TARGETS AND DRUGDESIGNING:

* 1. Introduction and types of drugtargets
  2. Introduction to molecular modeling and computationalchemistry
  3. Structure baseddesigning
  4. Ligand-baseddesigning
  5. Various techniques in drugsynthesis

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

1. Hormones: Steroidal Hormones (Testosterone, Progesterone, Estrogen, Aldosteron and Cortisol), Proteinous Hormones (Insulin, Glucagon, Oxytocin andVassopressin).
2. Anti-neoplasticAgents: Tamoxifen, Fluorouracil, Mercapturine, Methotrexate and Vincristine.
3. Sedatives and Hypnotics: Benzodiazepines, Barbiturates, Paraldehyde, Glutethimide, Chloral hydrate, andalcohols.
4. Anaesthetics: Local anaesthetics (Procaine, Lignocaine, Eucaine, Cocaine and Benzocaine), General anaesthetics (Cyclopropane, Halothane, Nitrous oxide, Chloroform, Thiopental Sodium,Ketamine,Methohexital,ThioamylalSodium,FantanylCitrate,Tribromoethanol).
5. Analgesics and Antipyretics: Paracetamol, Salicylic acid analogues, Quinolines derivatives, Pyrazolone and Pyrazolodiones, N - arylanthranilic acids, Aryl and heteroaryl acetic acid derivatives.
6. Sulphonamides: Prontosil, sulphanilamide, Sulphapyridine, sulphadimidine, Sulfamethoxazole, Sulfadiazine andSulfafurazole.
7. Antimalarials: 4-Aminoquinolines, 8-Aminoquinolines, 9-Amino acridines, Biguanides, Pyrimidine analogues, Mefloquine and Cinchohaalkaloids.
8. Diuretics:Mercaptomerin, Meralluride, Thiazides, Sprironolac-tone, Theophylline, Furosemide, Acetazolamiode, Ethacrynic acid andTriameterene.
9. Antitubercular Drugs: Ethambutol, Isonicotinic acid, Hydrazid, Rifampacin, Thioguanine, Pyrazinamide, cycloserine, Ethunamide, Cytarabine, 5-Flourouracil andDacarbazine.
10. Antiviral Drugs: Acyclovir, Tromantadine Hydrochloride andRibavirin.
11. Immunosuppressant Agents: Azathioprine andCyclosporin.
12. Antibiotics:Penicillins, Cephalosporins, Streptomycin, Chloramphenicol, Tetracyclines, Kanamycin andErythromycin.

**PHARMACEUTICAL CHEMISTRY-IV (MEDICINAL CHEMISTRY) (Practical)**

**Paper6 Marks100**

**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 beconducted).

**PHARMACY PRACTICE-VI (CLINICAL PHARMACY-II) (Theory)**

**Paper2 Marks100**

1. **RATIONAL USE OF DRUGS:**Rational Prescribing, Rational Dispensing, Problems of Irrational DrugUse,Learningaboutdruguseproblem,Samplingtostudydruguse,Indicatorsofdruguse.
2. **INTRODUCTION TO ESSENTIAL DRUGS:**Criteria for selection, Usage and Advantages. Development ofEDL.
3. **DRUG UTILZATION EVALUATION & DRUG UTILIZATIONREVIEW (DUE/DUR):**Development of protocol of use of few very low therapeutic index drug groups like Steroids, Vancomycin andCimetidine.
4. **CLINICAL PHARMACOKINETICS:**Therapeutic Drug Monitoring of Digoxin, Theophyline, Gentamycin, Lithium, Phenytoin, Cabamazepine, Phenobarbitone, Valproic Acid, Cyclosporins andVancomycin.

#### PHARMACEUTICAL CARE, ITS SCOPE, MANAGEMENT AND APPLICATION OF CAREPLAN:

1. **CLINICAL THERAPEUTICS:**General Strategy: Terminology of Disease. Management and Treatment. DrugSelection.

#### CLINICALTOXICOLOGY:

* 1. General information. Role of pharmacist in treatment of poisoning and general managementofpoisoning&overdosage.RoleandStatusofPoisonControlCentre.
  2. Antidotes and their mechanism ofaction.

#### SAFE INTRAVENOUS THERAPY & HAZARDS OF IVTHERAPY

1. **NON-COMPLIANCE:** Definition, introduction and importance, Extent of non-compliance, Methodsofassessment,Reasonsfornon-compliance,Strategiesforimprovingcompliance.

#### DISEASEMANAGEMENT:

* 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-malignantdisorders)
* 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, nephroticsyndrom)
* Unit X: Hematology Unit (Bleeding disorders/coagulopathies/clotting disorders e.g. thrombocytopenia, hemophilia, Vit. K deficiency, Anemia).

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

**Paper7 Marks100**

* ClerkshipintheClinicalSetting.AprojectRelatedtoClinicalPharmacyPracticeswillbe

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 andprojects

**PHARMACEUTICS-VII (PHARMACEUTICAL TECHNOLOGY) (Theory)**

**Paper3 Marks100**

PRINCIPLES OF PHARMACEUTICAL FORMULATION AND DOSAGE FORMDESIGN:

Need for dosage form; Pre-formulation Studies; Product Formulation.

#### 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.

#### POLYMERS USED IN DRUG DELIVERYSYSTEMS:

1. **NOVEL DRUG DELIVERY SYSTEM(DDS):**

Sustained/ Controlled Release Drug Delivery System

* 1. Microencapsulationtechnique
     + Coacervation
     + Solventevaporation
     + Interfacialpolymerization
     + Spraydrying
  2. Developmental aspects of Matrix and ReservoirSystems

#### NOVEL GIT DRUG DELIVERY SYSTEM(DDS):

* Oral OsmoticPumps
* Ion-Exchange ControlledDDS
* pH-Controlled DDS
* Bio/mucoadhesive DDS
* FloatingDDS

#### DRUG CARRIERSYSTEM:

* Liposomes
* Niosomes

#### TARGETED DRUG DELIVERYSYSTEM:

* Active Drug DeliverySystem
* Passive Drug DeliverySystem

#### PHARMACEUTICALBIOTECHNOLOGY:

1. Introduction to Biotechnology: Genetics/Genomics, Proteomics, Biomoleculartarget Identification, Pharmacogenomics, Gene therapy and Nucleic acidtherapeutics.
2. Techniques Used in Pharmaceutical biotechnology: PCR, DNA Sequencing,Affinity ProteinPurification.
3. Fundamentals of Genetic Engineering and its Application inMedicine
4. Pharmaceutical Recombinant therapeutic Proteins, Growth factors,Therapeutic antibodies, High-throughput screening of putative therapeuticcompounds.
5. Biotechnological aspects in the productdevelopment
6. Principle, Synthesis and Application of MonoclonalAntibodies
7. Immobilized Enzymes and their application inMedicine

**PHARMACEUTICS-VII (PHARMACEUTICAL TECHNOLOGY) (Practical)**

**Paper8 Marks100**

**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 theformulation,
* Granulationtechnology,
* Study of drug delivery systems,
* Biotechnological aspect of productdevelopment,
* In-vitro Quality Control of various dosageforms.
* Microbialassay,
* Particle size analysis using variousmethods,
* Stability studies ofPharmaceuticals,
* Coating of particles and toprepare,
* Examine and control specifications of packagingmaterials.

**PHARMACY PRACTICE-VII (FORENSIC PHARMACY) (Theory)**

**Paper4 Marks100**

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 Provinciallevel.
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 carefraud.
3. **PHARMACEUTICAL ETHICS:** Patents and Generics, Ethics in Sale, Ethics in Industry, Ethics inResearch.

#### STUDY OF DRUGLAWS:

* 1. The Drugs Act 1976 and rules framed thereunder.
  2. ProvincialDrugRules(RespectiveDrugRuleswillbetaughtintherelevantprovince).
  3. Advertisementrules.
  4. Other Related rules and Legalaspects.

#### THE PHARMACY ACT1967:

1. **CONTROL OF NARCOTICS SUBSTANCES ACT 1997:**Laws relating to Narcotic drugs and psychotropicsubstances.

#### THE POISONS ACT1919:

1. **THE FACTORIES ACT934:**
2. **SHOPS AND ESTABLISHMENTS ORDINANCE 1969 WITHRULES:**

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

**Paper5 Marks100**

1. **MANAGEMENT &MARKETING:**
   1. Nature and Principles ofManagement:
   2. Types and Functions ofManagers:
   3. Planning: Purpose and types of Planning, Steps inPlanning
   4. Organizing:
   5. Management Control Systems: Purpose, Steps in the Control Process, Forms of operations control. Requirements for adequate control, Critical control points andstandards.
   6. Motivation:
   7. Innovation andCreativity:
   8. Principals ofMarketing:
   9. ProductManagement:
   10. MarketingResearch:
2. **PRODUCTION MANAGEMENT:**Material Management, Planning of production, Batch record maintenance.

#### MARKETINGMANAGEMENT:

* 1. Ethical consideration of PharmaceuticalMarketing
  2. Difference between Pharmaceutical Marketing and ConsumerMarketing
  3. Major stakeholders within pharmaceutical marketenvironment.
  4. Marketing Research (Process andMethodology)
  5. Market Analysis Techniques 3Cs (Customeranalysis, Company analysis, competitors analysis)
  6. Evaluating the marketing performance (audit tools and auditprocess)
  7. Designing sales force structure, sales force size and salesquota
  8. Marketing channels, Promotion and Advertising andSalesmanship.

1. **SALES MANAGEMENT:**Personnel, Buying, Receiving, Pricing, Sales promotion and Customer Services.
2. **BUSINESS DEVELOPMENT MANAGEMENT:**General principles, strategies, short and long term planning andobjectives.
3. **BUSINESS COMMUNICATION:**Importance and benefits of business communication, componentsofcommunication,conceptandproblemsofcommunication,7C’sofcommunications.
4. **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 inmeetings.

**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:

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

Reading/Comprehension:

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

Speaking:

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

#### Communication Skills:

Reading/Comprehension:

1. 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;

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

#### Presentation Skills;

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

#### Reading;

1. Neulib J, Cain KS, Ruffus S, Scharton M. **The Mercury Reader**: A custom publication. 4th Ed. Pearson;2011.
2. White R. **Advanced**: Oxford Supplementary Skills. 3rd Ed. Oxford University Press;1992.
3. 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. 1stEd. 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](http://www.amazon.com/s/ref%3Dntt_athr_dp_sr_2?_encoding=UTF8&sort=relevancerank&search-alias=books&ie=UTF8&field-author=Sandro%20Mecozzi)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. WestES,ToddRW,VanBTJ.**TextBookofBiochemistry**.TheMacMillanCo;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 HallInternational 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. GrantB.**AMethodofAnatomy**.9thEd.BailliereTinalandCoLtd;1975.
3. HamiltonWJ.**ATextbookofAnatomy**.2ndEd.MacmillanandCo;1976.
4. Kuntzman AJ, Tortora GJ. **Anatomy and physiology for the manual therapies**. 1st Ed. John Wiley & Sons;2009.
5. Last RJ. **Anatomy**: Regional and Applied. 11th Ed. Jand A Churchill Ltd; 2001.
6. Martini F, Ober WC, Garrison CW, Welch K, Hutchings RT. **Fundamentals of Anatomy and Physiology**. 5th Ed. Prentice Hall;2001.
7. Moore KL, Dalley AF, Agur AMR. **Clinically Oriented Anatomy**. 6th Ed. Lipponcott Williams and Wilkin;2009.
8. Romanes GJ. **Cunningham’s Manual of Practical Anatomy**. 15th Ed. Oxford University Press;1986.
9. Saladin KS, Miller L. **Anatomy & physiology**: The Unity of Form and Function. 6th Ed. McGraw Hill; 1998.
10. Snell RS. **Clinical Anatomy**. 7th Ed. Boston Little Brown and Company;2003.
11. Standring S. **Gray's anatomy**: **The Anatomical Basis of Clinical Practice**. 40th Ed. Churchill Livingstone;2008.
12. **Tissues of the body by Legros Clerks.**Publisher Oxford at the Clarendon Press, London.
13. Tortora GJ, Derrickson B. **Principles of anatomy and physiology**. 13th Ed. Wiley;2010.

#### Histology

1. Cormack HD. **Essentials of Histology**. 2nd Ed. JB Lippincott Co;1993.
2. HammersenF.**Histology:**Coloratlasofmicroscopicanatomy.3rdEd.Lee&FebijerCo;1985.
3. Hewer EE, Bradbury S. **Textbook of Histology for Medical Students**. 9th Ed. William Heinemann Medical Books Ltd;1973.

## ISLAMIC STUDIES

1. Bhatia HS. **Studies in Islamic Law: Religion and Society.** Deep & Deep Publications New Delhi;1989.
2. Hasan A. **Principles of Islamic Jurisprudence.** Islamic Research Institute, International Islamic University, Islamabad;1993.
3. Hassan HH. **An Introduction to the Study of Islamic Law.** Leaf Publication Islamabad, Pakistan.
4. Muhammad HU. **Emergence of Islam.** IRI,Islamabad.
5. Muhammad HU. **Introduction to Islam.** Maulana Muhammad YousafIslahi.
6. Muhammad HU. **Muslim Conduct ofState.**
7. Waliullah M. **Muslim Jrisprudence and the Quranic Law of Crimes.** Islamic Book Service; 1982.
8. Zia-ul-Haq M. **Introduction to Al-Sharia Al-Islamia.** Allama Iqbal Open University, Islamabad;2001.

## PHARMACEUTICS (DOSAGE FORMS SCIENCE)

1. Allen LV, Popovich NG, Ansel HC. **Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems**. 9th Ed. Lippincott Williams & Wilkins;2010.
2. Armstrong NA, James KC. **Understanding Experimental Design and Interpretation in Pharmaceutics**. 1st Ed. Taylor & Francis Ltd;1990.
3. Aulton ME. **Aulton's Pharmaceutics**: The Design and Manufacture of Medicines. 3rd Ed. Churchill Livingstone;2007.
4. Bentley AO. **Text book of Pharmaceutics**. 8th Ed. Macmillan Publishing Co Inc;1977.
5. Carstensen JT. **Pharmaceutics of Solids and Solid Dosage Forms**. 1st Ed. John Wiley & Sons Inc;1977.
6. Davis H. **Bentley’s Text book of Pharmaceuticals**. 2nd Ed. Tindall and Cox Publishers;1961.
7. Dittert LW. **Sprowl’s American Pharmacy**. 7th Ed. JB Lippincott Co;1990.
8. Finlay WH. **The Mechanics of Inhaled Pharmaceutical Aerosols**: An Introduction. 1st Ed. Academic Pres;2001.
9. Florence AT, Siepmann J. **Moderen Pharmaceutics**: Basic Principles and Systems. 5th Ed. Taylor & Francis;2009.
10. Ghosh T, Jasti B. **Theory and Practice of Contemporary Pharmaceuticals**. 1st Ed. CRC Press; 2005.
11. Kleemann A, Engel J, Kutscher B, Reichert D. **Pharmaceutical Substances**: Synthesis, Patents, Applications of the most relevant APIs. 5th Ed. Thieme;2008.
12. Lewis GA, Mathieu D, Phan RTL. **Pharmaceutical Experimental Design**. 1st Ed. Informa HealthCare;1998.
13. Lund W. **The Pharmaceutical Codex**: Principles and Practice of Pharmaceutics. 12th Ed. The Pharmaceutical Press;1994.
14. Mehta D. **British National Formulary** (BNF). 54th Ed. Pharmaceutical Press;2007.
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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 2012session.
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 thePCP.
4. No omission and changes are allowed in the said curriculum approved by PCP and HEC, by anyinstitution.
5. Doctor of Pharmacy degree holders will be allowed for direct admission in M.S. /M. Phil leading to PhDprogram.