PHARM-D FIVE-YEAR COURSE  
SCHEME OF STUDIES FOR ANNUAL SYSTEM

First Professional

(Theory)
Paper 1  Pharmaceutical Chemistry-I (Organic)  100
Paper 2  Pharmaceutical Biochemistry  100
Paper 3  Pharmaceutics-I (Physical Pharmacy)  100
Paper 4  Physiology & Histology  100
Paper 5  Anatomy  50
Paper 6  Pharmaceutical Mathematics & Biostatistics  100

(Practicals)
Paper 7  Pharmaceutical Chemistry-I (organic)  100
Paper 8  Pharmaceutical Biochemistry  100
Paper 9  Pharmaceutics-I (Physical Pharmacy)  100
Paper 10  Physiology & Histology  100

Total Marks: 950

Second Professional

(Theory)
Paper 1  Pharmaceutics-II (Pharmaceutical Preparations)  100
Paper 2  Pharmacology and Therapeutics-I  100
Paper 3  Pharmacognosy-I  100
Paper 4  Pharmaceutical Microbiology  100
Paper 5  Pakistan Studies and Islamiyat (Comp.)  100

(Practicals)
Paper 6  Pharmaceutics-II (Pharmaceutical Preparations)  100
Paper 7  Pharmacology & Therapeutics-I  100
Paper 8  Pharmacognosy-I  100
Paper 9  Pharmaceutical Microbiology  100

Total Marks: 900
### Third Professional

**Theory**
- Paper 1: Pathology, 50 marks
- Paper 2: Pharmacology and Therapeutics-II, 100 marks
- Paper 3: Pharmacognosy-II, 100 marks
- Paper 4: Pharmaceutics-III (Dispensing and Community Pharmacy), 100 marks
- Paper 5: Pharmaceutical Chemistry-II (Instrumentation), 100 marks

**Practicals**
- Paper 6: Pathology, 50 marks
- Paper 7: Pharmacology & Therapeutics-II, 100 marks
- Paper 8: Pharmacognosy-II, 100 marks
- Paper 9: Pharmaceutics-III (Dispensing and Community Pharmacy), 100 marks
- Paper 10: Pharmaceutical Chemistry-II (Instrumentation), 100 marks

Total Marks: **900**

### Fourth Professional

**Theory**
- Paper 1: Pharmaceutics-IV (Hospital Pharmacy), 100 marks
- Paper 2: Pharmaceutics-V (Clinical Pharmacy-I), 100 marks
- Paper 3: Pharmaceutics-VI (Industrial Pharmacy), 100 marks
- Paper 4: Pharmaceutics-VII (Biopharmaceutics), 100 marks
- Paper 5: Pharmaceutics-VIII (Pharmaceutical Quality Management), 100 marks

**Practical**
- Paper 6: Pharmaceutics-V (Clinical Pharmacy-I), 100 marks
- Paper 7: Pharmaceutics-VI (Industrial Pharmacy), 100 marks
- Paper 8: Pharmaceutics-VII (Biopharmaceutics), 100 marks
- Paper 9: Pharmaceutics-VIII (Pharmaceutical Quality Management), 100 marks

Total Marks: **900**
### Final Professional

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<td>Paper 1</td>
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<td>Paper 2</td>
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<td>Paper 3</td>
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<td>Paper 4</td>
<td>Forensic Pharmacy</td>
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<td>Paper 5</td>
<td>Pharmaceutical Management &amp; Marketing</td>
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Total Marks: **900**
DETAILS OF COURSES (ANNUAL SYSTEM)

FIRST PROFESSIONAL

PHARMACEUTICAL CHEMISTRY-I (ORGANIC) WRITTEN

Paper 1  100 Marks

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

1. BASIC CONCEPTS: Conjugation, hyperconjugation, steric effect, inductive effect, mesomeric effect, hydrogen bonding, Theory of resonance. Effect of structure on reactivity of compounds. Tautamerism of carbonyl compounds.

2. NUCLEOPHILIC AND ELECTROPHILIC SUBSTITUTION REACTION IN ALIPHATIC AND AROMATIC SYSTEMS.

3. ORIENTATION IN ELECTROPHILIC SUBSTITUTION REACTIONS ON BENZENE RING.

4. ORGANIC REACTIONS: Baeyer-Villiger oxidation; Diels Alder reaction; Grignard's reaction, Metal hydride reduction and Wolf Krishner reduction, Friedel Craft’s reaction, Perkin reaction, Cannizzaro reaction.


6. CARBANIONS: Condensation reaction (Aldol condensation; Favorskii rearrangement; Witting reaction).

7. STEREOCHEMISTRY: Stereoisomerism, optical isomerism; Molecules with more than one chiral centre. Geometrical isomerism, Resolution of racemic mixture. Conformational analysis.


9. GENERAL METHODS OF PREPARATIONS, PROPERTIES, IDENTIFICATION TEST AND PHARMACEUTICAL APPLICATIONS OF THE FOLLOWING CLASSES AND THEIR ANALOGUES:
Alcohols, Phenols, Ethers, Aldehydes, Ketones, Acids, esters, Amines and Aniline.

10. PREPARATION AND PROPERTIES OF MEDICINALLY IMPORTANT HETEROCYCLIC COMPOUNDS such as: Pyrrol, Furan, Thiophene, Pyridine, Pyrimidine and Pyrazine.

11. PREPARATION AND PROPERTIES OF HETEROCYCLIC COMPOUNDS in which benzo-ring is fused with five and six membered ring containing one heteroatom: Indole, Quinoline and Isoquinoline.

PHARMACEUTICAL CHEMISTRY-I (ORGANIC) PRACTICAL

Paper 7 100 Marks

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.


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

Recommended Books

**PHARMACEUTICAL BIOCHEMISTRY (WRITTEN)**

Paper 2  
100 Marks

1. **GENERAL INTRODUCTION AND BASIC BIOCHEMICAL PRINCIPLES**  
   Role of pharmaceutical Biochemistry in the health Profession.  
   Nature of Biochemical reactions

2. **BASIC CHEMISTRY OF BIOMOLECULES** (Nature, Classification etc.)  
   (a) **Carbohydrates**: Chemistry, Classification, Reactions of Carbohydrates, Optical activity, Biological and pharmaceutical importance of carbohydrates.

   (b) **Lipids**: Chemistry of Fatty acids and Lipids, Classification (Saponifiable and non-saponifiable lipids, Simple, Complex and derived lipids), Reactions of Fatty acids and other Lipids, Essential fatty acids, Biological and pharmaceutical importance of lipids.

   (c) **Proteins and Amino acids**: Chemistry, Classification of proteins and amino acids, Reactions of proteins and amino acids, Organizational levels, Macromolecular nature of proteins, Biological and pharmaceutical importance of proteins and amino acids.

   (d) **Nucleic acids**: Chemistry, Types (DNA, RNA, mRNA, tRNA, rRNA), Purine and Pyrimidine bases, Nucelosides, Nucelotides, Structures of nucleic acids, Biological and pharmaceutical importance of nucleic acids.

   (e) **Vitamins**: Chemistry, Classification (Fat-soluble and water-soluble vitamins), Biological and pharmaceutical importance of vitamins.

   (f) **Hormones**: Chemistry, Classification (Proteinous and non-proteinous hormones, amino acid derivatives, steroids), Biological and pharmaceutical importance of hormones.
(g) **Enzymes:** Chemistry, Classification, Mode of action, Kinetics (Michaelis Menten Equation and some modifications), Inhibition, Activation, Specificity, Allosteric enzymes, Factors affecting the rate of an enzyme-catalyzed reaction, Biological and pharmaceutical importance, Mechanism of action of some important enzymes (Chymotrypsin, Ribonuclease).

3. **METABOLIC FATE OF BIOMOLECULES (Anabolism and Catabolism)**

(a) **Carbohydrates:** Introduction to metabolism, Brief introduction to the digestion and absorption of carbohydrates, Aerobic and anaerobic breakdown of Glucose, Glycolysis, Pentose Phosphate Pathway, Glycogenolysis, Glycogenesis, Gluconeogenesis, Citric acid cycle, Energetics of various metabolic processes.

(b) **Lipids:** Brief introduction to the digestion and absorption of lipids, Oxidation of fatty acids through β-oxidation, Biosynthesis of fatty acids, neutral lipids and cholesterol.

(c) **Proteins and Amino acids:** Brief introduction to the digestion and absorption of proteins and amino acids, Metabolism of essential and non-essential amino acids, Biosynthesis and catabolism of Haemins and porphyrin compounds.

(d) **Bioenergetics:** Principles of bioenergetics. Electron transport chain and oxidative phosphorylation.

4. **REGULATION OF METABOLIC PROCESSES**

(a) **Role of Vitamins:** Physiological role of Fat-soluble (A, D, E and K) and Water-soluble (Thiamin, Riboflavin, Pantothenic acid, Niacin, Pyridoxal phosphate, Biotin, Folic acid, Cyanocobalamin — members of B-complex family — and Ascorbic acid), Coenzymes and their role in the regulation of metabolic processes.

(b) **Receptor mediated regulation (Hormones):** Mechanism of action of hormones, Physiological roles of various hormones, Site of synthesis and target sites of hormones.

(c) **Secondary Messengers:** Role of cAMP, Calcium ions and phosphoinositol in the regulation of metabolic processes.
(d) **Gene Expression:** Replication, Transcription and Translation (Gene expression) Introduction to Biotechnology and Genetic Engineering, Basic principles of Recombinant DNA technology, Pharmaceutical applications, Balance of Catabolic, Anabolic and Amphibolic processes in human metabolism, Acid-Base and Electrolyte Balance in Human body.

**PHARMACEUTICAL BIOCHEMISTRY (PRACTICAL)**

Paper 8 100 Marks

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

2. **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 and Creatinine.

**Recommended Books**

1. PHARMACY ORIENTATION:
Introduction and orientation to the Professional of Pharmacy in relation to Hospital Pharmacy, Retail Pharmacy, Industrial Pharmacy, Forensic Pharmacy, Pharmaceutical education and research etc.

2. HISTORY AND LITERATURE OF PHARMACY:
   (a) A survey of the history of pharmacy through ancient, Greek and Arab periods with special reference to contribution of Muslim scientists to pharmacy and allied sciences.
   (b) An introduction of various official books.

3. PHYSICO-CHEMICAL PRINCIPLES:
   (a) Solutions: Introduction, types, concentration expressions, ideal and real solution, colligative properties, their mathematical derivations and applications in pharmacy, molecular weight determinations, distribution co-efficient and its applications in pharmacy.
   (b) Solubilization: Solubility, factors affecting solubility, surfactants, their properties and types. Micelles, their formulation and types.
   (c) Ionization, pH, pH indicators, pka, buffers, buffer’s equation, Isotonic solutions and their applications in pharmacy.
   (d) Hydrolysis, types and protection of drugs against hydrolysis.
   (e) Micromeritics: Particle size and shapes, distribution of particles methods of determination of particle size and importance of particle size in Pharmacy.

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

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

(d) **Adsorption**: Techniques and processes of adsorption in detail.

5. **RHEOLOGY**:

   (a) Definition and Fundamental concept.

   (b) Properties contributing to Rheological behaviour.

   (c) Graphic presentation of Rheological data.

6. **PHYSICOCHEMICAL PROCESSES**:

   (a) **Precipitation**: Process of precipitation and its applications in Pharmacy.

   (b) **Crystallization**: Types of crystals, Mechanism and methods of crystallization and its applications in Pharmacy.

   (c) **Distillation**: Simple, fractional, steam distillation, vacuum distillation, destructive distillation and their applications in Pharmacy.

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

7. **RATE and ORDER OF REACTIONS**.

8. **KINETIC PRINCIPLES AND STABILITY TESTING: THEORETIC CONSIDERATIONS**: Degradation:

   (a) **Physical Factors**: Influence of pH, temperature, ionic strength, acid-base catalysis, U.V. light.

   (b) **Chemical Factors**: Complex chemical reactions. Oxidation-reduction, hydrolysis
PHARMACEUTICS-I (PHYSICAL PHARMACY) PRACTICAL

Paper 9 100 Marks

**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.

1. Experiments to demonstrate some of physico-chemical processes like simple distillation, steam distillation, crystallization, Dialysis.

2. Determination of Emulsion systems.

3. Determination of particle size.

4. Preparation of Buffer solutions and isotonic solution.

5. Determination of %age composition of solutions by specific gravity method.

6. Partition-coefficient, surface tension, viscosity.

**Recommended Books**

3. *Bentley’s Pharmaceutics*, All India Traveler Book Seller, New Delhi, 1996.
PHYSIOLOGY & HISTOLOGY (WRITTEN)

Paper 4 100 Marks

PHYSIOLOGY
1. **BLOOD:** Composition of blood (RBC, WBC and Platelets), Functions and Genesis of the formed elements, Fate of Red Blood cells, Jaundice, Reaction of Blood, Blood groups, Rh factors, ESR Blood volume, Functions of Spleen, Blood coagulation, Hemophilia. Anaemias-classification.


4. **SKIN:** Structure, Functions of skin, Temperature regulation by Skin.

5. **DIGESTIVE SYSTEM:** Mastication, Deglutation, Digestive juices-saliva, Gastric juice, pancreatic juice. Bile and intestinal juices; their composition, Functions and mechanism of secretion, Movements of the stomach and intestines. Functions of large intestine. Defecation. Functions of liver and gall bladder.


7. **PHYSIOLOGY OF NERVE AND MUSCLE:** Chemical change in Muscle on contraction. Action Potential.

Descending tracts of spinal cord. Basal ganglia, Cerebellum. Autonomic Nervous system. Thalamus. CSF.

9. **SPECIAL SENSE:** Elementary knowledge of structure and function of the special senses.

10. **ENDOCRINOLOGY:** Definition of Hormone, Nature of different types of hormones and Mechanism of action of hormones.

   (a) **Pituitary Hormones:** Growth Hormone, Prolactin, ACTH, TSH, ADH, Oxytocin. Acromegaly, Giantism, PanHypopituitarism.

   (b) **Thyroid Gland:** Thyroxin, Tri-iodothyronin, Format and functions of thyroid hormones. Hyperthyroidism, Myxocdene.

   (c) **Parathyroid Hormone**

   (d) **Pancreatic Hormone:** Insulin, Glucagon, Diabetes mellitis.

   (e) **Adrenal Glands:** Mineralocorticoids, Glucocorticoids, Anabolic Steroids, Adrenalin, Nor-adrenalin, Cushing syndrome, Addison disease.

   (f) **Sex Hormones:** Male Sex Hormone, structure and function. Female Sex Hormone: Structure and function. Male Development of secondary sex characteristics, spermatogenesis. Composition of semen. Development of secondary characters in females. Menstruation, (Ovarian cycle). Oogenesis. (Dysmanorrhea, etc.)

**HISTOLOGY:**

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

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

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

**PHYSIOLOGY & HISTOLOGY (PRACTICAL)**

Paper 10 100 Marks

**NOTE:** - Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Experimental Physiology includes:
1. **BLOOD**: Determination of Haemoglobin (Hb), Determination of ESR, RBC Count, WBC Count, DLC (Differential Leucocyte Count), Bleeding Time, Coagulation Time and Blood groups.

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


4. **EYE**: Visual activity, far vision, near vision and Field of vision (Perimetry).

5. **CENTRAL NERVOUS SYSTEM**: Nerve Muscle Preparation in frog, Effect of Temperature on muscle and Demonstration of spinal reflexes.

**Histology includes:**
1. Demonstration of the Preparation and staining of slides.
3. Organ system — Lung, Kidney, Appendix, Skin, Gall bladder, Stomach, Intestine.

**Recommended Books**

**Physiology**

**Histology**

**ANATOMY (WRITTEN)**

Paper 5  50 Marks

1. **INTRODUCTION: ANATOMICAL TERMINOLOGY.** Definition.
   Cell, tissue, organ system.

2. **STRUCTURE OF CELL:** Cell Membrane. Cytoplasm. Organelles.
   Nucleus. Cell cycle.

3. **TISSUE OF BODY:** Types of tissues with examples
   (a) Epithelial Tissue: General characters, classification.
   (b) Connective Tissue: Structure, types (Connective tissue proper, Cartilage. Bones structure and types of bones and joints).
   (c) Muscle: Structure of — Skeletal muscle, Smooth muscle, Cardiac muscle.

4. **INTEGUMENTARY SYSTEM:**
   (a) Skin — Structure (Epidermis, dermis).
   (b) Glands of Skin, (Sweat, Sebaceous).
   (c) Hair — Structure, function.
   (d) Nail.

5. **CARDIOVASCULAR SYSTEM:**
   (a) Heart — Structure of Heart. Location of Heart. Blood Supply to Heart.
   (b) Blood Vessels — Main blood vessels arising & entering the heart. Types of blood vessels with examples.

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

7. **URINARY SYSTEM:** Name and structure of organs of urinary system and their inter-relationship.
8. **REPRODUCTIVE SYSTEM**: Male and Female reproductive systems. Name, structure and association of the organs.

9. **ENDOCRINE SYSTEM**:
   (a) Pituitary gland — structure and relation to hypothalamus.
   (b) Thyroid gland — structure.
   (c) Adrenal gland — structure.

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

**Recommended Books**

**PHARMACEUTICAL MATHEMATICS AND BIOSTATISTICS**
(WRITTEN)

Paper 6 100 Marks

| Part A | Pharmaceutical Mathematics | (40 marks) |
1. **ALGEBRA:**
   (a) **Sets and Functions:** Elementary concepts of sets. Concept of Functions, Domain and Range of a Function. Different types of Functions. Graphical representation of a function. Some applications of functions.
   (b) **Solution of Linear and Quadratic Equations.** Equations reducible to Quadratic Form. Solution of simultaneous Equations.
   (c) **Arithmetic, Geometric and Harmonic Progressions.** Arithmetic, Geometric and Harmonic Means.
   (d) **Permutations and Combinations**
   (e) **Binomial Theorem:** Simple application.

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

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


5. **INTEGRAL CALCULUS:** Concept of Integration. Rules of Integrations. Integrations of Algebraic and Trigonometric functions by using different techniques.

**Part B  BIOSTATISTICS (60 MARKS)**


2. **ORGANIZING and DISPLAYING DATA:** Variables, Quantitative and Qualitative Variables, Univariate Data, Bivariate Data, Random Variables, Frequency Table, Diagrams, Pictograms, Simple Bar Charts, Multiple Bar Charts, Histograms.

4. **CURVE FITTING:** Fitting a Straight Line. Fitting of Parabolic or High Degree Curve.

5. **PROBABILITY:** Definitions, Probability Rules, Probability Distributions (Binomial & Normal Distributions).


7. **TEST OF HYPOTHESIS AND SIGNIFICANCE:** Statistical Hypothesis. Level of Significance. Test of Significance. Confidence Intervals, Test involving Binomial and Normal Distributions.

8. **STUDENT “t”, “F” and Chi-Square Distributions:** Test of Significance based on “t”, “F” and Chi-Square Distributions.

9. **ANALYSIS OF VARIANCE:** One-way Classification, Two-way Classification, Partitioning of Sum of Squares and Degrees of Freedom, Multiple Compression Tests such as LSD, The analysis of Variance Models.

**Recommended Books**

**Pharmaceutical Mathematics & Biostatistics**


SECOND PROFESSIONAL

PHARMACEUTICS-II (PHARMACEUTICAL PREPARATIONS)

WRITTEN

Paper 1  100 Marks

1. **Introduction:** Dosage form. Ingredients.


5. **Solvents used in Pharmaceutical Preparations.**


7. **Oral Suspensions, Emulsions, Magma and Gels:** Preparations, Examples, and Importance.

8. **TRANSDERMAL DRUG DELIVERY SYSTEMS:** Introduction of Ointments, Creams, Pastes, Poultice, Plasters, Lotions, Liniments, Topical gels, Topical Tinctures, Collodions, Topical solutions, Topical Powders, Percutaneous absorption, Transdermal systems in use.


11. AEROSOLS, INHALATIONS AND SPRAYS: Aerosol: Principle, container and valve assembly, Propellants, filling, testing, packaging, labeling and storage.


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


PHARMACEUTICS-II (PREPARATIONS) PRACTICALS

Paper 6 100 Marks

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. Preparation 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 twenty practical will be conducted)

Recommended Books
PHARMACOLOGY AND THERAPEUTICS-I (WRITTEN)

Paper 2 100 Marks

1. GENERAL PHARMACOLOGY

(a) Introduction: History, Pharmacology and its classification and Drugs and their sources.

(b) Routes of drugs administration: Advantages and disadvantages of Enteral Routes, Advantages and disadvantages of Parenteral Routes and Advantages and disadvantages of Topical Routes.

(c) Pharmacokinetics: Drug solubility and passage of drugs across the body membranes, Plasma concentration of drugs and various factors affecting it (Absorption and factors influencing the rate of absorption (GIT and other routes) of drugs, Distribution and factors influencing the rate of distribution of drugs, Biotransformation and factors influencing the rate of biotransformation of drugs, Excretion, channels of excretion and factors influencing the rate of excretion of drugs), Definition of (Bioavailability & Bioequivalence, Therapeutic Index, Plasma Half Life (t½), Dose-Response Curve, Area Under Curve, Volume of Distribution

(d) Pharmacodynamics: Drug receptors and theories, Mechanisms of drug action, Specificity of drug action and Factors modifying the action & dosage of drugs.

2. DRUGS ACTING ON AUTONOMIC NERVOUS SYSTEM (ANS)

(a) Organization of ANS its subdivisions and innervations.
(b) Neurotransmitters in ANS, their synthesis, release and fate.
(c) Sympathetic agonist drugs: Catecholamines and Non-catecholamines.
(d) Sympathetic antagonist drugs: Adrenergics Nerve Blockers, Adrenoceptor antagonists (Alpha-adrenergic blockers and Beta-adrenergic blockers).
(e) Parasympathetic (Cholinergic) agonists and Anticholinesterase inhibitors.
(f) Parasympathetic antagonists.
(g) Drugs acting on Ganglia (Ganglian stimulants and Ganglion blockers).
(h) Neuromuscular blocking drugs

3. DRUGS ACTING ON GASTROINTESTINAL TRACT:

(a) Emetic.
(b) Anti-emetics.
(c) Purgatives: Bulk forming purgatives, Lubricant purgatives, Irritant purgatives and Saline Purgatives.
(d) Anti-diarrheal Agents.
(e) Treatment of Peptic & Dudenal Ulcers: Antiacids, H2-Receptor Antagonists, Antimuscarinic Agents, Proton Pump Inhibitors, Gastrin Receptor Antagonist and Cytoprotective agents.
(f) Drug treatment of chronic inflammatory diseases of bowel.
(g) Drugs affecting bile flow and Cholelithiasis.

4. AUTACOIDS AND THEIR ANTAGONISTS:
Histamine and Anti-histamines, Serotonin and Serotonin Antagonists and other Autocoids.

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

6. DRUGS ACTING ON CARDIO-VESSCULAR SYSTEM:
(a) Angina pectorus and its drug treatment
(b) Congestive heart failure & its treatment
(c) Anti-arrhythmic drugs
(d) Agents used in Hyperlipidemia
(e) Coagulants and Anti-coagulants
(f) Anti-hypertensives
(g) Diuretics

7. DRUGS ACTING ON GENITOURINARY SYSTEM:
Oxytoxic drugs, Ergot alkaloids and uterine relaxants
8. **ANTI-ANAEMIC DRUGS:**

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

**PHARMACOLOGY & THERAPEUTICS-I (PRACTICALS)**

**Paper 7**

100 Marks

**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. Preparation of standard solution. Ringer solution. Tyrode solution. Kreb solution. Normal saline solution. To demonstrate the effects of sympathomimetic (Adrenaline) & sympatholytic drugs (Propranolol) on Frog’s heart. To demonstrate the effects of parasympathomimetic (Acetylcholine) and parasympatholytic (Atropine) drugs on Frog’s heart. To demonstrate the effects of an unknown drug on Frog’s heart. Routes of Administration of drugs. To demonstrate the effects of vasconstrictor drugs on Frog’s blood vessels. To demonstrate the effects of stimulant drugs on Rabbit’s intestine (Acetyl choline, Barium chloride). To demonstrate the effects of depressant drugs on Rabbit’s intestine (Atropine). To differentiate the effects of an unknown drug on Rabbit’s intestine and identify the (unknown) drug. To study the effects of Adrenaline on Rabbit’s Eyes. To study the effects of Homatropine on Rabbit’s Eyes. To study the effects of Pilocarpine on Rabbit’s Eyes. To study the effects of Local Anaesthetic drug (e.g Cocaine) on Rabbit’s Eyes. To identify the unknown drug & differentiate its effects on Rabbit’s Eyes.

(Note: A minimum of 20 practicals will be conducted)
Recommended Books
10. Prof Dr A Qayum, Fundamentals of Experimental Pharmacology.

PHARMACOGNOSY-I (WRITTEN)

Paper 3 100 Marks


2. THE STUDY OF THE CRUDE DRUGS BELONGING TO VARIOUS FAMILIES OF MEDICINAL IMPORTANCE
   Families                   Crude Drugs
b. Papaveraaceae Papaver somniferum, Sanguinaria, Canadensis.
c. Leguminosae Acacia, Glycyrrhiza, Senna, Cassia, Tamarind.
d. Umbelliferae Fennel, Carum, Coriander, Conium, Asafoetida.
e. Apocynaceae Rauwolfia, Catharanthus.
f. Solanaceae Belladonna, Hycscyamus, Stramonium Capsicum.
g. Scrophulariaceae Digitalis, Verbascum (Mullien).
h. Labiatae Peppermint, Thyme, Spearmint, Salvia, Ocimum.
i. Liliaceae Garlic, Colchicum, Aloe.
j. Zingiberaceae Ginger, Curcuma.

3. **GROWTH REGULATORS:** General account with special reference to Auxins, Gibberellins Abscisic acid, Cytokinins and Ethylene.

4. **ALLERGENS AND ALLERGENIC PREPARATION:** Introduction, case history, skin test, treatment off allergy, inhalant, ingestant, injectant, contactant, infectant and infestant allergens. Mechanism of allergy.

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

6. **POISONOUS PLANTS:** General introduction of poisonous plants with special reference to Pakistan.

7. **PESTICIDES:** Introduction. Methods of controlling pests with special reference to natural methods.

**PHARMACOGNOSY-I (PRACTICALS)**

Paper 8 100 Marks

**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 of the entire and broken parts of the plant drugs (Macro and organoleptic characters). Microscopic examination of powders and sections of plant drugs.
(Note: A minimum of 20 practicals will be conducted)

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 Northern Areas of the country.

**Recommended Books**
PHARMACEUTICAL MICROBIOLOGY (WRITTEN)

Paper 4 100 Marks

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


2. ORGANISMS:
   The Viruses: Introduction, Classification (and detail of at least one species from every group), cultivation, and replication.

3. THE FUNGI/YEAST/MOLDS.

4. THE PROTOZOA.

5. The NORMAL FLORA: Microbiology of air, water and soil (general introduction and normal inhabitants of air, water, and soil).

fermentation process (Penicillins, Cepalosporins, Gentamycin, Erythromycin, Tetracyclines, Rifamycin, Griseofulvin).


8. FACTORY AND HOSPITAL HYGIENE AND GOOD MANUFACTURING PRACTICE:

PHARMACEUTICAL MICROBIOLOGY (PRACTICALS)

Paper 9  
100 Marks

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 microorganisms. Total and viable counts of micro-organisms. Morphological and selective biochemical characterization of some specimen. Staining of Bacteria: Gram method, Acid fast, Giemmasas staining, Capsule staining, Flagella staining and Spore staining. Microbiological analysis of air, water and soil. 
(Note: A minimum of 20 practicals will be conducted)

Recommended Books
3. Lippincot, Microbiology by lipponcott, William & Willkin, USA, 2001

**PAKISTAN STUDIES AND ISLAMIYAT (Comp.) WRITTEN**

**Paper 5**

100 Marks

As per syllabi of B.A/B.Sc. Classes, approved by the respective University.
THIRD PROFESSIONAL

PATHOLOGY (WRITTEN)

Paper 1 50 Marks

1. **SCOPE OF PATHOLOGY & CONCEPT OF DISEASES.**

2. **DEFINITION AND TERMINOLOGY:** Ischemia, Hypoxia, Necrosis, Infarction, Atrophy, Hypertrophy, Hyperplasia, Metaplasia, Aplasia, Anaplasia.

3. **RESPONSE OF BODY TO INJURY AND INFECTION:** Acute inflammation, Chronic inflammation, Immunity, Allergy, Hyper Sensitivity.

4. **SPECIFIC:** Ulcer (Peptic, Doudenal), Hypertension, Leukemia or Blood Cancer (Malignant Carcinoma, Sarcoma & Lymphomas), Diagnosis and treatment of Cancer in general, fate, survival and prognosis with tumours.

PATHOLOGY (Laboratory)

Paper 6 50 Marks

**Study of Pathological Slides of various Pathological Conditions**

**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 diseases, Gastric Analysis, Tests for liver function, Renal function test, Tests for endocrine abnormalities, Biopsies and cytologic techniques.

**Recommended Books**

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

**Paper 2**

**100 Marks**

1. **DRUGS ACTING ON CENTRAL NERVOUS SYSTEM**
   (b) CNS – Stimulants: Cerebral Stimulants, Medullary stimulants, Spinal Cord Stimulants, Anti-depressants, Psychotomimetic or Hallucinogenics, Psychotherapeutic Agents (Anxiolytics and Anti-psychotics), Drug treatment of Epilepsy and Drug treatment of Parkinsonism and other movement disorders.

2. **ANAESTHETICS**
   (a) Anesthesia and its clinical importance.
   (b) General Anaesthesia, Mechanism of action and its application.
   (c) General Anaesthetics
   (d) Local Anaesthetics
   (e) Spinal Anaesthesia and drug used
   (f) Techniques of Local Anaesthesia

3. **CHEMOTHERAPY**
   (a) Classification of drugs.
   (b) Anti-microbials: Sulphonamides, Anti-virals, Anti/protozoals (Treatment of Malaria and Treatment of Amebiasis), Anti-fungals,
Anthelmintics, Anti-neoplastic and Immunosuppressive drugs, Drug treatment of Leprosy and Anti-biotics (Penicillins, Cephalosporins, Aminoglycosides, Tetracyclines, Chloramphenicol, Macrolides, Quinolones and Miscellaneous Anti-biotics).

(c) Anti-hypertensive Drugs.
(d) Steroids and Anti-steroid drugs.

4. HORMONES, ANTAGONISTS AND OTHER AGENTS AFFECTING ENDOCRINE FUNCTION

(a) Endocrine function and dysfunctions.
(b) Drug used for therapy of Diabetes Mellitus: Insulin and Oral Hypoglycemic agents.
(c) Corticosteroids
(d) Thyroid hormone and anti-thyroid drugs

5. TOXICOLOGY

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

Note:
1. Only an introduction will be given of the banned and obsolete drug products.
2. While dealing with Pharmacology stress should be laid to the group actions of related drugs and only important differences should be discussed of the individual drugs placed in same group.
3. Newly introduced drugs should be included in the syllabus while drugs with no clinical and therapeutic values ought to be excluded from syllabus at any time.
4. The prototype drugs in each group from the latest edition of the recommended books.
NOTE:- Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. To study the convulsant effects of strychnine and picrotoxin in frogs and to determine the site of action. To identify the unknown (convulsant) drug and determine its site of action. To study the effects of Adrenaline on Human Eyes. To study the effects of Pilocarpine on Human Eyes. To study the effect of Homatropine on Human Eyes. To identify and observe the effects of unknown drugs on Human Eyes. To study the effects of local anaesthetic drugs on human and the nerve plexus of frog. To identify and differentiate the effects of unknown drug on human and the nerve plexus of frog. To demonstrate the effects of Acetylcholine on the Rectus abdominus muscle of frog and competitive pharmacological antagonism by Neuromuscular blocking agent e.g. Gallamine. To identify the unknown drug by performing pharmacological competitive antagonism on Rectus abdominus muscle of Frog. To study the anticoagulant effects of Heparin and oral anti-coagulants on Rabbits. To identify the unknown anticoagulant drug using Rabbits. To demonstrate the graded Dose-Response curve of Acetylcholine on Rabbit intestine. To identify unknown concentration of Acetycholine from graded Dose-Response curves.
(Note: A minimum of 20 practicals should be conducted)

Recommended Books
PHARMACOGNOSY-II (WRITTEN)

Paper 3 100 Marks

1. SEPARATION AND ISOLATION OF PLANT CONSTITUTIONS:
   An introduction to chromatography and chromatographic techniques e.g. Adsorption Chromatography and Partition Chromatography.

2. CARBOHYDRATES: Introduction of carbohydrate.
   (a) Sucrose and Sucrose containing drugs: Sucrose, Dextrose, Liquid glucose, Fructose, Lactose, Xylose, Caramel, Honey, Starch, Inulin, Dextrine etc.
   (b) Cellulose and Cellulose Derivatives: Purified cotton, Powdered cellulose, Microcrystalline cellulose, Methyl cellulose, Sodium Carboxy-methyl cellulose.
   (c) Gums and Mucilages: Tragacenth, Acacia, Sodium Alginate, Agar, Pectin.

3. GLYCOSIDES: Introduction, classification, chemistry and medicinal uses of:
   (a) Cardioactive glycosides: Digitalis, Strophanthus and white squill.
   (b) Anthroquinone glycosides: Cascara, Aloe, Rhubarb, Cochineal and Senna.
   (c) Saponin glycosides: Glycyrrhiza, Sarsaparilla.
   (d) Cyanophore glycosides: Wild cherry.
   (e) Isothiocyanate glycosides: Black Mustard.
   (f) Lactone glycosides: Cantharide.
   (g) Aldehyde glycosides: Vanilla.
   (h) Miscellaneous glycosides: Gentian, Quassia, Dioscorea.

4. TANNINS: Introduction, classification, properties and chemical identity tests of Tannins and Tannin containing compounds. Detailed study of Hammamelis, Catechu and Nut Galls.
5. **VOLATILE OILS (ESSENTIAL OILS):** Introduction, significance, methods of obtaining volatile oils, chemistry and classification of:
   (a) **Hydrocarbon volatile oils:** Cubeb and Terpentine oil.
   (b) **Alcoholic volatile oils:** Peppermint, Coriander and Cardamom.
   (c) **Aldehydic volatile oils:** Bitter orange peel, sweet orange peel, lemon, cinnamon and bitter almond oil.
   (d) **Ketonic volatile oils:** Camphor, spearmint, caraway, Buchu
   (e) **Phenolic volatile oils:** Clove, Thyme.
   (f) **Phenolic ether volatile oils:** Fennel, Anise, Myristica.
   (g) **Oxide volatile oils:** Eucalyptus, chenopodium.
   (h) **Ester volatile oils:** Rosemary.
   (i) **Miscellaneous volatile oils:** Allium, Anethum.

6. **RESINS AND RESIN COMBINATION:** Introduction, properties and difference between glycoresins, oleoresins, oleo-gum resins and balsams.
   (a) **Resins:** Rosin, Cannabis.
   (b) **Glycoresins:** Podophyllum, Jalap, Ipomoea, Colocynth.
   (c) **Oleoresins:** Terpentine, Capsicum, Ginger.
   (d) **Oleo-gum resins:** Asafoetida, Myrrh.
   (e) **Balsams:** Storax, Peruvian balsam, Tolu balsam, Benzoin.

7. **ALKALOIDS:** Introduction, Properties, Classification, Function of alkaloids in plants, Methods of extraction and identification tests.
   (a) **Pyridine — Piperidine Alkaloids:** Areca nut, Lobelia, Tobacco.
   (b) **Tropane Alkaloids:** Belladonna, Hyoscyamus, Stramonium.
   (c) **Quinoline Alkaloids:** Cinchona.
   (d) **Isoquinoline Alkaloids:** Ipecacuanha, Opium.
   (e) **Indole alkaloids:** Rauwolfia, catharanthus, nux vomica, physostigma, ergot.
   (f) **Imidazole alkaloids:** Pilocarpus.
   (g) **Steroidal alkaloids:** Veratrum.
   (h) **Alkaloidal amines:** Ephedra, colchicum.
   (i) **Purine Bases:** Tea, Coffee.

8. **LIPIDS:** Introduction. Detailed study of:
   (a) **Fixed Oils:** Castor oil, cotton seed oil, olive oil, peanut oil, sunflower oil, corn oil, coconut oil, Almond oil, Linseed oil, Mustard oil, Sesame oil and soybean oil.
   (b) **Fats and Related Compounds:** Theobroma oil and Lanolin.
   (c) **Waxes:** Bees wax, carnauba wax, spermaceti and Jojoba oil.

9. **TUMOUR INHIBITORS FROM PLANT:** Detailed study of various anti-tumour agents isolated from plants.
PHARMACOGNOSY-II (PRACTICALS)

Paper 8  100 Marks

NOTE:- Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Extraction of the active constituents of crude drugs and chemical tests for their identification. Isolation and separation of active constituents of crude drugs by paper and thin layer chromatography.
(Note: A minimum of 20 practicals will be conducted)

Recommended Books

PHARMACEUTICS-III (DISPENSING AND COMMUNITY PHARMACY) WRITTEN

Paper 4  100 Marks (40+60)

PART ‘A’  DISPENSING (40 Marks)

1. Basic Principles of Compounding and Dispensing Including: Weights and Measures, Calculations for compounding and Dispensing, Fundamental operations in Compounding, Containers and closures for Dispensed Products, Prescription-Handling (Parts of Prescription, Filling, Interpretation, Pricing) and Labelling of Dispensed Medication.
2. **Extemporaneous Dispensing of:** Solutions, Suspensions, Emulsions, Creams, Ointments, Pastes and gels, Suppositories and pessaries, Powders and granules and Oral unit dosage form.

3. **Pharmaceutical Incompatibilities:** Types of Incompatibilities, Manifestations, Correction and Prevention with reference to typical examples.

4. **Classical dosage Forms.**

5. **I.V. Admixtures.**

6. **Radio-Pharmacy — Techniques and Applications.**

**PART ‘B’ COMMUNITY PHARMACY** (60 Marks)

1. **DEFINITIONS AND BACKGROUND**

2. **PUBLIC HEALTH AND COMMUNITY PHARMACY:** Epidemiology & its Control, Preventive Health (EPI & CDC), Family Planning and Health Policy & National Drug Policy.

3. **PATIENT ASSESSMENT**

4. **MEDICAL COMPLICATION OF DRUG TAKING:** General and Socio-economic Aspects.

5. **PATIENT PHARMACIST COMMUNICATION.**

6. **PATIENT EDUCATION AND COUNSELLING.**

7. **CONTROL OF DRUG ABUSE AND MISUSE.**

8. **ROLE OF PHARMACIST:** As Public Health Educator in the Community for Drug Monitoring and Drug Information.

**PHARMACEUTICS-III (DISPENSING AND COMMUNITY PHARMACY) PRACTICALS**

**Paper 9**

**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 Labeling.

**Mixtures:** Dispensing of simple mixtures containing soluble substances only, mixtures containing diffusible substances, indiffusible substances and mixtures forming precipitate.

**Powders:** Dispensing of simple powders, compound powders and effervescent powders for external use.

**Incompatibility:** Practical Importance of Incompatibilities

**Ointments And Creams:** Dispensing of iodine and Methyl salicylate ointment. Dispensing of cold cream and vanishing creams.

**Cosmetics:** Lipstick, talcum powder, after shave lotion, shaving cream.

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

**Recommended Books**

2. Hussa’s Dispensing.
5. Martindale's *Extra Pharmacopia*.

**PHARMACEUTICAL CHEMISTRY-II (INSTRUMENTATION) (WRITTEN)**

Paper 5 100 Marks

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

Theory, Instrumentation and Pharmaceutical Applications of the following Spectroscopic Methods:

1. **SPECTROSCOPIC METHODS**
   (a) Atomic Absorption and Emission Spectroscopy
   (b) Molecular fluorescence spectroscopy
   (c) Flame Photometry
   (d) I.R. Spectroscopy
   (e) Mass Spectroscopy
   (f) NMR Spectroscopy
   (g) U.V./Visible Spectroscopy
2. **CHROMATOGRAPHIC METHODS**: Column Chromatography, Thin Layer Chromatography, Gas Liquid Chromatography, HPLC and GC-MS.

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

4. **DIFFERENTIAL SCANNING CALORIMETRY**

**PHARMACEUTICAL CHEMISTRY-II (INSTRUMENTATION)**

(Practical)

Paper 10 100 Marks

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

**Recommended Books**

1. **INTRODUCTION**
   (a) Role of Pharmacist in Hospital
   (b) Minimum standards for pharmacies in Institutions/Hospitals
   (c) Research in Hospital Pharmacy

2. **HOSPITAL AND ITS ORGANIZATION**
   (a) Classification of Hospitals
   (b) Organizational Pattern
   (c) Administration
   (d) Clinical Departments
   (e) Nursing, Dietetic, Pathology, Blood Bank, Radiology and other supportive services etc.
   (f) Role of Pharmacy in Hospital
   (g) Hospital Finances

3. **PHARMACY, ITS ORGANIZATION AND PERSONNEL**
   (a) Pharmacy specialist
   (b) Drug information Centre
   (c) Poison Control Centre and Antidote Bank
   (d) Pharmacy Education
   (e) Determining the need of Professional and other departmental staff
   (f) Professional services rendered

4. **PHARMACY AND THERAPEUTIC COMMITTEE.**

5. **THE HOSPITAL FORMULARY**
   (a) General Principles and guidelines to develop Formulary
   (b) Format
   (c) Preparation of the Formulary & Role of Pharmacist
   (d) Benefits and problems
   (e) Keeping up to date Formulary
   (f) Contraceptives

6. **DISPENSING TO INPATIENTS**
   (a) Methods of Dispensing & SOP’s
   (b) Unit dose dispensing
   (c) Other concepts of dispensing, Satellite Pharmacy etc.

7. **DISPENSING TO AMBULATORY PATIENTS.**
8. DISTRIBUTION OF CONTROL SUBSTANCES.

9. DISPENSING DURING OFF-HOURS.

10. SAFE USE OF MEDICATION IN THE HOSPITAL:
    (a) Medication error
    (b) Evaluation & Precautions of Medication Error
    (c) Role of Pharmacist in Controlling Medication Error

11. MANUFACTURING BULK AND STERILE.

12. THE PHARMACY — CENTRAL STERILE SUPPLY ROOM

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

14. ROLE OF PHARMACISTS IN SMALL HOSPITALS, NURSING
    HOMES ETC.

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

16. NUCLEAR PHARMACY.

17. THE PHYSICAL PLANT AND ITS EQUIPMENT.

18. INVESTIGATIONAL USE OF DRUGS.

19. HEALTH ACCESSORIES.

20. SURGICAL SUPPLIES.

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

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

PHARMACEUTICS-V CLINICAL PHARMACY-I (WRITTEN)

Paper 2 100 Marks

1. GENERAL INTRODUCTION TO CLINICAL PHARMACY:
   Terminologies, Basic Components and Scope.

2. PATIENT PROFILE:
   (a) Patient disease profile
   (b) Taking case History
   (c) Drug Profile of 25 Drugs (Adrenaline, Aminoglycosides, Anti TB Drugs, Antiepileptics, Atropine, Benzodiazepines, Cephalosporins, Chlorpheniramine, Cimetidine, Digoxin, Dobutamine, Dopamine, Fluroquinolone, Frusemide, Lactulose, Macrolides, Metoclopramide, Morphine/Pethedine, Nifedipine, NSAIDS, ORS, Penicillins, Prednisolone, Salbutamol, Vancomycin)

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

4. EMERGENCY TREATMENT.

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

6. ADVERSE DRUG REACTIONS:
   Adverse Drug Reactions and Side Effects: Classification, Excessive pharmacological response, Idiosyncrasy, Secondary pharmacological effects, Allergic drug reactions, General toxicity, Toxicity following drug withdrawal, Detection, reporting & Management of ADR.
7. DRUG INDUCED DISEASES.
8. COMPUTERS IN CLINICAL PHARMACY.

PHARMACEUTICS-V CLINICAL PHARMACY-I (PRACTICAL)

Paper 6 100 Marks

Clerkship in the Clinical Setting. A project related to Clinical Pharmacy Practices will be completed by the students and will be evaluated by the external examiner.

Recommended Books
7. Simon Cook, Clinical Studies Management, a Practical Guide to Success, Sue Horwood Publishing limited, West Sussex UK.
1. MASS TRANSFER.

2. HEAT TRANSFER.

3. DRYING: Theories of drying, Drying of Solids, Classification of dryers, General Methods, Fluidized Bed systems, Pneumatic systems, Spray dryer, Freeze drying.


6. EVAPORATION: General principles of Evaporation, Evaporators and Evaporation under reduced pressure.


8. SAFETY METHODS IN PHARMACEUTICAL INDUSTRY:
   (a) Mechanical, chemical and fire hazards problems.
   (b) Inflammable gases and dusts.

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

10. SUSPENSIONS:
    Formulation of suspensions, Equipment used in preparation and test methods for pharmaceutical suspensions.
11. SEMISOLIDS:
   Equipment used for Ointments, Pastes, Gels and Jellies. Packaging of ointments.

12. STERILE PRODUCTS:
    Sterile area and its Classification, Ophthalmic ointments, Preparation of parenterals (Building, Equipment), Complete Sterility (Aseptic area), air control, (Laminar flow etc.), air locks, Environmental monitoring methods, Sterilization, Filling/Packaging (Plastic and glass containers), Added substances (Preservatives, anti-oxidants, solubilizer, suspending agents, buffers, stabilizers etc.), Inprocess Quality Control of Parenterals (Sterility, leakage, pyrogens, clarity etc.).

13. STANDARDIZATION OF PHARMACEUTICALS:

14. PACKING & PACKAGING:
    Influence of Packaging materials, Stability, Packaging Lines, Packaging Area, Packaging Equipment.

15. EQUIPMENTS USED FOR:
    Patches, Sprays, Implants, Sutures, Plasters and Sachet packing.

16. STUDY TOUR:
    A visit to the pharmaceutical industries will be an integral part of the syllabi.

**PHARMACEUTICS-VI (INDUSTRIAL PHARMACY) (PRACTICAL)**

**Paper 7**

**100 Marks**

**NOTE**: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Manufacture of Tablets by Wet Granulation Method, by Slugging and by Direct Compression. Coating of Tablets (Sugar Coating, Film coating and Enteric Coating). Clarification of liquids by various processes. Size Reduction. Homogenization. Ampoule filling, sealing and sterilization clarity and leakage tests in injectables. Capsule filling by semi automatic machines. Manufacture of sustained action drugs. Tablets Tests like Disintegration. Dissolution. Friability. Hardness and thickness tests. Determination of weight variation in tablets. Density of powder. Particle size analysis. (Note: A minimum of 20 practicals will be conducted)
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 Northern Areas of the country.

**Recommended Books**

**PHARMACEUTICS – VII (BIOPHARMACEUTICS) (WRITTEN)**

Paper 4  
100 Marks

1. **DEFINITIONS AND TERMINOLOGY:**
   Biopharmaceutics, Generic Equivalence, Bioavailability, Bioequivalence, Drug Disposition, Therapeutics, Pharmacokinetics, Biotransformation and Therapeutic Equivalents.

2. **GASTRO-INTESTINAL ABSORPTION AND PHYSICO-CHEMICAL CONSIDERATIONS:**
   Forces which help in transmembrane movements, pH Partition Theory, Lipid Solubility and Factors affecting Bioavailability.

3. **BIOAVAILABILITY STUDIES:**
   Purpose, Relative and Absolute Bioavailability, and Determination of Bioavailability.

4. **FACTORS AFFECTING DISSOLUTION IN RESPECT OF BIOAVAILABILITY:**
   Methods of in-vitro and in-vivo determination of rate of dissolution.

5. **MULTIPLE DOSAGE REGEMIN.**

6. **INTRAVENOUS INFUSIONS.**
7. **BIOPHARMACEUTICAL AND PHARMACOKINETIC ASPECTS IN DEVELOPING A DOSAGE FORM.**

8. **INTRODUCTION TO PHARMACOKINETICS:**
   Determination through plasma drug level studies. Application of pharmacokinetics in clinical situations.

9. **CONCEPT OF COMPARTMENT(S) MODELS:**
   One compartment open model. Two compartment open model. Three compartment open model and Non-compartmental method of analysis.

10. **BIOLOGICAL HALF-LIFE AND VOLUME OF DISTRIBUTION:**
    Concept and Methods of Determination.

11. **DRUG CLEARANCE:**
    Mechanism, determination and relationship of clearance with half-life.

12. **ELIMINATION OF DRUGS:**
    a) **Hepatic Elimination.** Percent of Drug Metabolized, Drug Biotransformation reactions, (Phase-I reactions and phase-II reactions), First pass effect, Hepatic clearance of protein bound drugs and Biliary excretion of drugs.

    b) **Renal Excretion of Drugs:** Renal clearance, Tubular Secretion and Tubular Reabsorption.

    c) **Elimination of Drugs through other organs:** Pulmonary excretion, Salivary excretion, Mammary excretion, Skin excretion and Genital excretion.

13. **PROTEIN BINDING:**
    Determination of plasma protein binding and Clinical significance of drug-protein binding.

14. **APPLICATIONS OF PHARMACOKINETICS AND BIOAVAILABILITY IN CLINICAL SITUATIONS.**

15. **APPLICATIONS OF PHARMACOKIENUTICS IN DISEASE STATES.**
NOTE:- Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Blood Sampling Techniques (In Laboratory Animals like dog, rabbits, mice etc. in human beings), In-vitro dissolution studies, Optional dose determination, Measurement of rate of Bioavailability, Determination of relative and absolute bioavailability. Plasma level-time curve (Determination of Pharmacokinetic parameters). Determination of plasma protein binding. Urinary sampling techniques. In Laboratory animals. In humans. Renal excretion of drugs or drug disposition.

Recommended Books
10. Albert P Li, **Invitro approaches for evaluation of drug efficacy and toxicity**, CRC Press LLC USA, 2004.
PHARMACEUTICS-VIII (PHARMACEUTICAL QUALITY CONTROL)  
(WRITTEN)

Paper 5  100 Marks

1. **SCOPE:**
   
   (a) An understanding of the testing, quality control program and methods adopted in a pharmaceutical industry, dosage form control, process control, testing programme and methods, physical, chemical and biological tests and specifications, statistical quality control.

   (b) General understanding of Total Quality Assurance and measures to adopt Quality Assurance.

2. **QUALITY CONTROL OF SOLID DOSAGE FORMS:**
   
   (a) Physical tests: Hardness, Thickness and Diameter, Friability, Disintegration, Weight Variation.

   (b) Chemical tests: Content uniformity, Assay of active ingredients and dissolution tests of Powders, Granules, Tablets and Capsules.

3. **QUALITY CONTROL OF SYRUPS AND ELIXIRS:**
   
   Viscosity, its determination and application in the Quality Control of Pharmaceuticals, Weight per ml and Assay of active ingredients.

4. **EVALUATION OF SUSTAINED ACTION PRODUCTS (TABLETS & CAPSULES):**
   
   Stability of viability rate during storage and In-vitro & In-vivo evaluation of sustaining action.

5. **QUALITY CONTROL OF SUPPOSITORIES:**
   
   Disintegration test, Uniformity of weight, Assay of active ingredients, Liquefaction time test and Breaking test.

6. **QUALITY CONTROL OF STERILE PRODUCTS (PARENTERALS):**
   
   Leaker’s test, Clarity test, Pyrogen test for Parenteral and other sterile preparations and Assay for active ingredients.

7. **BIOLOGICAL ASSAYS:** Biological methods, Standard preparations and units of activity, Bioassay of antibiotics, Bioassay of insulin injection, Assay of prepared digitalis and Assay of Vitamin D.
8. **ALCOHOL DETERMINATION:** Alholometric methods, Problem during distillation of alcohol, Method for liquids containing less than 30% or more than 30% alcohol and special treatment before distillation.

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

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

11. **GENERAL KNOWLEDGE OF APPENDICES ATTACHED TO B.P., BPC, AND USP.**

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

**PHARMACEUTICS-VIII (PHARMACEUTICAL QUALITY CONTROL) (PRACTICAL)**

Paper 9 100 Marks

**NOTE:** Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Assay of various spirits, tinctures, extracts, syrups and elixirs, Assay of Ointments and suppositories, Assay of tablets and capsules, Test for alkalinity of glass, Determination of alcohol contents in the Pharmaceutical preparations and Pyrogen test. Sterility test, Determination of Ash contents, Determination of Moisture contents, Determination of total solids, Determination of viscosity of syrups, gels, etc., Determination of emulsion types.

(Note: A minimum of 20 practicals will be performed)

**Recommended Books**

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

1. INTRODUCTION TO MEDICINAL CHEMISTRY:
   Chemical constitution and biological activity: (Receptor, Theory, Structure Activity Relationships (SAR) and Drug Metabolism).

2. CLASSIFICATION OF SYNTHETIC DRUGS:
   Drug Design and recent approaches to the synthesis of drugs (a brief concept of methods and reactions of synthesis of various drugs).

3. GENERAL PROPERTIES, CHEMISTRY BIOLOGICAL ACTION, STRUCTURE ACTIVITY RELATIONSHIP AND THERAPEUTIC APPLICATIONS OF THE FOLLOWING:
   (a) Alicyclic Compounds: Cyclopropane, Terpenes, Citral, Pinene, Camphor, Menthol, Carotenes.
   (b) Alkaloids: Atropine, Morphine and related compounds (Codeine, Thebaine), Ergotamine, Reserpine, Ephedrine.
   (c) Vitamins: Water Soluble Vitamins (B1, B2, B6, B12, Folic acid, Nicotinic acid, Biotin, Pantothenic acid and Ascorbic acid) Fat Soluble Vitamins (A, D, E, and K).
   (d) Hormones: Steroidal Hormones (Testosterone, Progesterone, Estrogen, Aldosteron and Cortisol), Proteinous Hormones (Insulin, Glucagon, Oxytocin and Vassopressin).
   (e) Anti-neoplastic Agents: Tamoxifen, Fluorouracil, Mercapturine, Methotrexate and Vinceristine.
   (f) Sedatives and Hypnotics: Benzodiazepines, Barbiturates, Paraldehyde, Glutethimide, Chloral hydrate, and alcohols.
   (g) Anaesthetics: Local anaesthetics (Procaine, Lignocaine, Euaine, Cocaine and Benzocaine), General anaesthetics (Cyclopropane, Halothane, Nitrous oxide, Chloroform, Thiopental Sodium, Ketamine, Methohexital, Thioamylal Sodium, Fantanyl Citrate, Tribromo ethanol).
   (h) Analgesics and Antipyretics: Paracetamol, Salicylic acid analogues, Quinolines derivatives, Pyrazolone and Pyrazolodiones, N-arylanthranilic acids, Aryl and heteroaryl acetic acid derivatives.
(i) **Antiseptics**: Phenols and related compounds, Halogens and Halogen compounds, Aromatic acid and esters, Dyes, Nitrofuran derivatives, Formaldehyde and its derivatives, Mercurochrome and Thiomersal.

(j) **Sulphonamides**: Prontosil, sulphanilamide, Sulphapyridine, sulphadimidine, Sulfamethoxazole, Sulfadiazone and Sulfafurazole.

(k) **Antimalarials**: 4-Aminoquinolines, 8-Aminoquinolines, 9-Amino acridines, Biguanides, Pyrimidine analogues, Mefloquine and Cinchona alkaloids.

(l) **Anthelmintics**: Phenols and related compounds, Piperazine derivatives, Thiabendazole, Mebendazole and Pyrantal.

(m) **Diuretics**: Mercaptomerin, Meralluride, Thiazides, Spironolac-tone, Theophylline, Furosemide, Acetazolamide, Ethacrynic acid and Triameterene.

(n) **Antitubercular Drugs**: Ethambutol, Isonicotinic acid, Hydrazid, Rifampacin, Thioguanine, Pyrazinamide, cycloserine, Ethunamide, Cytarabine, 5-Flourouracil and Dacarbazine.

(o) **Antiviral Drugs**: Acyclovir, Tromantadine Hydrochloride and Ribavirin.

(p) **Immunosuppressant Agents**: Azathioprine and Cyclosporin.

4. **ANTIBIOTICS**:
   Penicillins, Cephalosporins, Streptomycin, Chloramphenicol, Tetracyclines, Kanamycin and Erythromycin.

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

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

**Paper 7**

**100 Marks**

**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-benzoazol-2-one, Aspirin, P-nitrosophenol, 3-nitrophthalic acid, o-

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

**Recommended Books**


**PHARMACEUTICS-IX (CLINICAL PHARMACY-II) (WRITTEN)**

**Paper 2**

**100 Marks**

1. **RATIONAL USE OF DRUGS:** Rational Prescribing, Rational Dispensing, Problems of Irrational Drug Use, Learning about drug use problem, Sampling to study drug use, Indicators of drug use.

2. **INTRODUCTION TO ESSENTIAL DRUGS:** Criteria for selection, Usage and Advantages.

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

4. **DRUG ABUSE & MISUSE.**

5. **PRACTICAL PHARMACOKINETICS:** Therapeutic Drug Monitoring of Digoxin, Theophyline, Gentamycin, Lithium, Phenytoin, Cabamazepine, Phenobarbitone, Primidone, Walparic Acid, Cyclosporins and Vancomycin.

6. **PHARMACOECONOMIC STUDIES.**

7. **PHARMACEUTICAL CARE, ITS SCOPE, MANAGEMENT AND APPLICATION OF CARE PLAN:**
8. ROLE OF CLINICAL PHARMACIST IN COMMUNITY PHARMACY

9. CLINICAL THERAPEUTICS:
   (b) Basic introduction of some clinical situations, their clinical features, etiology, pathophysiology and treatment of causes: Common Cold, Pharyngitis and Tonsillitis, Pneumonia, Tuberculosis, Diarrhea, Malaria, Meningitis, Tetanus, Typhoid Fever, Measles, Rabies, AIDS, Congestive cardiac failure, Conjunctivitis, Anemia, Gout, Asthma, Ulcer, Diabetes mellitus, Hypertension, Hepatitis, Dermatology (Scabies, Fungal diseases).

10. CLINICAL TOXICOLOGY:
    (a) General information. Role of pharmacist in treatment of poisoning and general management of poisoning & over dosage. Role and Status of Poison Control Centre.
    (b) Antidotes and their mechanism of action.

11. SAVE INTRAVENOUS THERAPY & HAZARDS OF INTRAVENOUS THERAPY.

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

PHARMACETICS-IX CLINICAL PHARMACY-II (PRACTICAL)

Paper 8 100 Marks

Clerkship in the Clinical Setting. A project related to Clinical Pharmacy Practices will be completed by the students and will be evaluated by the external examiner.

Recommended Books


**PHARMACEUTICAL TECHNOLOGY (WRITTEN)**

**Paper 3**

1. **PRINCIPLES OF PHARMACEUTICAL FORMULATION AND DOSAGE FORM DESIGN**: Product Formulation, Need for Dosage Form and Preformulation Studies.

2. **FORMULATION DEVELOPMENT**: Pharmaceutical Aerosols, Ophthalmic Preparations, and Parenteral Preparations.


4. **NOVEL DRUG DELIVERY SYSTEMS**:
   a) Introduction to the Drug Carrier: Liposome, Noisome and Biodegradable polymers.
   b) Active & Passive Drug Delivery System.
   c) Other Novel GIT Systems.

5. **MODIFIED DRUG RELEASE DOSAGE FORM**:
   The concept of sustained release, First order release approximation, Multiple dosing, Implementation of designing, Approaches based upon dosage form modification, Product evaluation and testing, Matrices tablets, Control release technology, Micro encapsulation, Method of particle coating and Instrumentation in granule manufacturing.
6. **PHARMACEUTICAL BIOTECHNOLOGY:**
Biotechnological aspects in the product development, Fundamentals of Genetic Engineering and its Application in Medicine, Principle, Synthesis and Application of Monoclonal Antibodies, Introduction to Gene therapy, Immobilized Enzymes and their application in Medicine, General Principle and Methods of Microbial Assay.

**PHARMACEUTICAL TECHNOLOGY (PRACTICAL)**

**Paper 9**

**100 Marks**

**NOTE:** Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the requirements, e.g., Various techniques to develop the formulation, Granulation technology, Study of drug delivery systems, Biotechnological aspect of product development, In-vitro Quality Control of various dosage forms. Microbial assay, Particle size analysis using various methods, Stability studies of Pharmaceuticals, Coating of particles and To prepare, examine and control specifications of packaging materials.

**Recommended Books**


**FORENSIC PHARMACY (WRITTEN)**

**Paper 4**

1. STUDY OF DRUG LAWS:
   (a) The Drugs Act 1976 and rules framed there under.
   (b) Provincial Drug Rules (Respective Drug Rules will be taught in the relevant province).
   (c) Advertisement rules.
   (d) Other related rules and Legal aspects.

2. **THE PHARMACY ACT, 1967.**

3. **THE DANGEROUS DRUGS ACT, 1930.**

4. **THE FACTORY LAW 1934.**

5. **SHOPS AND ESTABLISHMENT ORDINANCE, 1969 WITH RULES.**

6. **THE POISONS ACT, 1919.**

7. **CONTROL OF NARCOTICS SUBSTANCES ACT 1997.**

**Recommended Books**

3. The Poisons Act 1919.
4. The Dangerous Drugs Act 1930.
5. The Factory Law 1934.

**PHARMACEUTICAL MANAGEMENT & MARKETING (WRITTEN)**

**Paper 5**
1. MANAGEMENT:
   a) Nature and Principles of Management
   b) Types and Functions of Managers
   c) Planning: Purpose and types of Planning, Steps in Planning
   d) Organizing
   e) Management Control Systems. Purpose: Steps in the Control
      Process, Forms of Operations control. Requirements for adequate
      control, Critical control points and standards
   f) Motivation
   g) Innovation and creativity
   h) Communication

2. PRODUCTION MANAGEMENT:
   (a) Material Management.

3. MARKETING MANAGEMENT:
   Marketing channels, Promotion and Advertising and Salesmanship.

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

5. PHARMACY LAYOUT DESIGN:
   Objectives of Layout Design, Types of Community Pharmacies
   (Pharmaceutical Centre, Prescription-oriented Pharmacies, Traditional
   Pharmacies and The Super Drug Store), Consumer goods and
   purchases, Classes of Layout designs, Principles and characteristics of
   Layout Design and Traffic Flow analysis.

Recommended Books
1. M Ahmad & N I Bukhari, Pharmaceutical Management and
   Marketing, Tariq Academy, Faslabad-Pakistan, (2002).
2. C Patrick Tharp & Pedro J Lecca, Pharmacy Management for students
   and practitioners, The C V Mosby Company, St. Louis, Toronto, London,
   (1979).
3. Harry A Smith, Principles & Methods of Pharmacy Management, Lea

COMPUTER AND ITS APPLICATION IN PHARMACY (WRITTEN)

Paper 6 50 marks


4. **Data Communication**: Applications of Data Communication, Components of a data communication system, Rate of data Transmission, Computer Networks, Network Topology, Gateway, E-mail/Internet concepts.

**COMPUTER AND ITS APPLICATION IN PHARMACY (PRACTICAL)**

**Paper 10**

**50 marks**

1. Internet and E-mail: Internet and Microsoft Internet Explorer 5, Addresses, Links and Downloading, Searching the Internet, E-mail and Newsgroups, Favorites, security and Customizing Explorer.


3. **Complete Statistical Package like SPSS.**

4. **Languages**: At least two prevailing languages will be taught.

**Recommended Books**


**NOTE:** The candidates are required to work for a minimum of 300 hours in Pharmaceutical Manufacturing unit, Retail/Community Pharmacy/Hospital setting after the final year examination. They must maintain a diary of work signed daily by the Manager.