FOREWORD

The government of the Punjab decided to establish a new medical college and hospital at Multan. On 31st December 1950, at a largely attended public meeting held at Lahnge Khan's Garden adjoining the Civil Hospital Multan. The decision by the Governor of the Punjab Sardar Abdur Rab Nishtar made the announcement of the decision by the government of Punjab to establish a medical college and hospital at Multan. It was named as **Nishtar Medical College and Hospital** to honor Sardar Abdur Rab Nishtar.

Nishtar medical College was upgraded to Nishtar Medical University in May 2017 by ordinance by Governor of the Punjab. That was later on adopted as Act of Parliament on Sep, 2017.

The vision of Nishtar Medical University is to see as a modern, progressive, state of the art Medical institution where educational activities, research and clinical services will develop side by side in an environment of enviable institutional traditions, tolerance and courage to question, centered around a burning passion to ally the pain and sufferings of our people, to produce great scientific minds and to promote a culture of ethical and evidence-based practice.

My aim is to make it a state of the art Medical University, capable of nurturing the undergraduate and post graduate students with quality teaching and training. It should be able to promote the culture of research and ethical orientation. It must inculcate the true sense of education into the students. However, this aim challenges both students and faculty members to rise to their potentials, identify their strengths, and direct to acquire much-needed lifelong learning skills for academic and social pursuits. The ever-expanding faculty of Nishtar Medical University consists of scholars, professors and specialists, who are committed to the highest standards of teaching, training, research, and service delivery. All of us can lead this university into an era of innovation and cutting-edge scientific inquiry with a truly scientific, social and economic impact.

This document precisely briefs the details of newly started **Pharm-D** degree program at **Pharmacy College, Nishtar Medical University, Multan** as prepared by expert committee. I hope this course will be able to meet the need of latest trends in Pharmacy education & research will certainly produce professionally competent and legally qualified Pharmacists, which is the main objective of this program.

Prof. Dr. Rana Altaf Ahmed.
Vice Chancellor,
Nishtar Medical University, Multan

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, up to-date 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 is paramount.
2. Pharmaceutical industry and its quality systems.
3. Academia, research and development.

AIMS:

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

OBJECTIVES:

1. To keep pace with the advancements in the modern sciences.
2. To prepare the students to fulfill the industrial needs and they should be well versed with the basic medical and pharmaceutical sciences in order to prepare a dosage regimen for an individual patient.
3. Community pharmacy practice should be comprehensive.
4. Internship in various disciplines of Pharmacy should be implemented.
5. To update the syllabi of the Pharmacy keeping in view the current proposals, requirements and the Needs of the profession.
6. To help the stakeholders of pharmacy about the implications of WTO and TRIPS agreements. (The Agreement on Trade-Related Aspects of Intellectual Property Rights is an international legal agreement between all the member nations of the World Trade Organization)
7. To cater the local and international pharmacy needs.
8. Credit hours should be harmonized i.e. practical and theory credit hours.
9. To make a health care practitioner who is expert in the use of medicine in all practical fields and are capable of disease state management specially to improve public health at large.
10. To add further in the curriculum clinical oriented areas as per demand of Pharm-D degree.
11. To bring uniformity in the contents of the syllabi in line with International trends/ international universities imparting Pharm-D education.

LEARNING OUTCOMES OF PHARM-D PROGRAM

GENERAL OUTCOMES OF THE PROGRAM:

1. Upon graduation, the graduates should have the capacity, knowledge and capability to undertake career in;

a) Enhance patient safety to safe medication usage in community and health care systems

b) To work in the pharmaceutical industry and its quality system

c) To engage the pharmacy graduates in academics and research i.e. Practice and Academics.

d) To prepare the pharmacy graduates as good human beings in serving the community i.e., ethics, communication skills, writing skills, behavior etc.

SPECIFIC OUTCOMES OF THE PROGRAM:

1. After graduation, the pharmacy graduates will become member of health care team.
2. To make our graduates more skillful, competitive and knowledgeable both practically and Theoretically.
3. The pharmacy graduates will have more practical knowledge rather theoretical.
4. The pharmacy graduates will be able to include new things regarding OTC Pharmacy (Patient Pharmacist interaction).
5. This program will prepare pharmacy graduates for better pharmacy practice in the areas including clinical pharmacy, community pharmacy, hospital pharmacy and industrial pharmacy.
6. To develop graduates capable of catering the needs of national and international health organizations or authorities to help adapt the paradigm shift in the health care system.
7. To produce the graduates to meet the challenges of 21st century of health care problems.

STATUTES & REGULATIONS

STATUTES:

1. The Doctor of Pharmacy (Pharm. D.) shall be a Five Years Degree course.
2. Pharmacy College, Nishtar Medical University, Multan will comprise of following departments with relevant subjects: -

(I) Department of Pharmaceutics

- Pharmaceutics-I (Physical Pharmacy)
- Pharmaceutics-II (Dosage Forms Science)
- Pharmaceutics-III (Pharmaceutical Microbiology & Immunology)
- Pharmaceutics-IV (Industrial Pharmacy)
- Pharmaceutics-V (Biopharmaceutics and Pharmacokinetics)
- Pharmaceutics-VI (Pharmaceutical Quality Management)
- Pharmaceutics-VII (Pharmaceutical Technology)

(II) Department of Pharmacology

- Physiology
- Anatomy & Histology
- Pathology
- Pharmacology and Therapeutics-I (Basic)
- Pharmacology and Therapeutics-II (Advanced)

(III) Department of Pharmaceutical Chemistry

- Pharmaceutical Chemistry-I (Organic Chemistry)
- Pharmaceutical Chemistry-II (Biochemistry)
- Pharmaceutical Chemistry-III (Pharmaceutical Analysis)
- Pharmaceutical Chemistry-IV (Medicinal Chemistry)

(IV) Department of Pharmacognosy

- Pharmacognosy-I (Basic)
- Pharmacognosy-II (Advanced)

(V) Department of Pharmacy Practice

- Pharmacy Practice-I (Pharmaceutical Mathematics and Biostatistics)
- Pharmacy Practice-II (Dispensing, Community, Social & Administrative Pharmacy)
- Pharmacy Practice-III (Computer and its Applications in Pharmacy)
- Pharmacy Practice-IV (Hospital Pharmacy)
- Pharmacy Practice-V (Clinical Pharmacy-I)
- Pharmacy Practice-VI (Clinical Pharmacy-II)

- Pharmacy Practice-VII (Forensic Pharmacy)
- Pharmacy Practice-VIII (Pharmaceutical Management and Marketing)

3. Outline of Tests and marks distribution scheme for all Professional Examination are given in the Appendix "**A"**, in accordance with the HEC and Pharmacy Council of Pakistan (PCP) approved Pharm. D. curriculum (Annual System) adopted by the Nishtar Medical University, Multan.
4. Statutes & Regulations, outline of tests and syllabi and courses of reading can be modified from time to time on approval of the relevant statutory bodies of the Nishtar Medical University & Pharmacy Council of Pakistan.

REGULATIONS:

I. General Regulations

1) Pharm-D. students shall be required to pay fee and such other dues as may be determined by NMU from time to time.
2) Degree of Doctor of Pharmacy (Pharm-D.) shall be awarded to the candidates upon successful completion of the First, Second, Third, Fourth and Final Pharm. D. Professional Examinations as notified by the Nishtar Medical University, Multan.

II. Regulations for Admission

Eligibility/Requirement for Admission to Pharm. D. Program

Any candidate who has passed F.Sc.(Pre-Medical) Examination by securing not less than 60% marks of any of the Boards of Intermediate and Secondary Education in Pakistan or any other examination considered by the Inter Board Committee of Chairmen (IBCC), equivalent to the aforementioned qualification.

III. Regulations for Registration

The Nishtar Medical University Regulation, 2022 for registration of students of Pharm-D shall be applicable.

IV. Regulations for Studies & Examinations

1) The Nishtar Medical University, Conduct of Examinations Regulations 2021 and other existing regulations / policies shall be applicable.

2) Pharm. D. First, Second, Third, Fourth and Final Professional Examination shall be held twice a year (1st Annual and 2nd Annual). Examination calendar shall be recommended by the Board of Studies in Pharmacy and notified by the Controller of Examinations after approval of the Vice Chancellor. Date Sheet for written and practical examinations shall thereafter be prepared and notified by Controller of Examinations.

3) The Examination for the Degree of Doctor of Pharmacy (Pharm.D.) shall consist of five professional examinations, titled First Professional, Second Professional, Third Professional, Fourth Professional and Final Professional Examination. Respective Professional Examinations shall be held at the end of 1st year, 2nd year, 3rd year, 4th year & 5th year.

4) The medium of instruction and examination will be English except for the Pak. Studies and Islamiyat/ Ethics with an option for the candidates to take the examination in Urdu.

5) Pattern of Examination in theory papers shall be MCQs and SEQs with a relative weightage of 40% : 60%. However, examination in the subjects of Pharmaceutical Mathematics & Biostatistics and Pak. Studies & Islamiyat/Ethics may be on extended structured essays pattern or will consist of MCQs and SEQs both.

6) The minimum number of marks required to pass the professional examination for each subject shall be fifty percent (50%) in theory and fifty percent (50%) in the Practical Examination and fifty percent (50%) in the aggregate at one and the same time.

7) A candidate who passes in one or more papers but fails in the annual examination shall, if he/she so desires, provisionally be allowed to join the next higher class till the commencement of supplementary examination. The candidate, however, shall have to pass the failed papers in the supplementary examination failing which the candidate shall be detained in the class in which he/she had failed. Under no circumstances, a candidate shall be promoted to next higher class till he/she cleared all the subjects in the Professional Examination of preceding class.

8) Candidate who secure eighty percent (80%) or above marks in any subject shall be declared to have passed "with distinction" in that subject and no candidate who does not pass in all the subjects of a Professional Examinationas a whole at one and the same time shall be declared to have passed "with distinction" in any subject.

9) A candidate who fails to pass First Professional Examination in Four (04) consecutive chances, availed or unavailed, after becoming eligible for First

   Professional Examination shall cease to become eligible for further educationin Pharmacy.

10) The Professional Examination shall be open to any student who has completed one-year academic courses in the said professional examination and completed 75% of the lectures in Theory and Practical classes separately.

11) Every candidate shall forward to the Controller of Examinations, his/her application for admission to the examination as per schedule before the commencement of the

examination accompanied by the prescribed fee through the Principal/HOD/Chairman of the Pharmacy College, NMU, Multan.

12) Whenever the application or the fee of the candidate is received after the last prescribed date, the candidate shall pay the double fee of the ordinary admission fee, provided that such application shall only be entertained if it isreceived not less than 14 days before the commencement of the examination.

13) A candidate who fails to pass or to present himself for the examination shall not be entitled to a refund of the fee, but the fee shall refundable to the legal heirs of a candidate who dies before the commencement of examination.

14) Result card will be issued by Controller of Examinations to each Candidate after declaration of Official Notification of Result of Pharm.D. Examination.

15) Rules for rechecking, offences and penalties on account of use of unfair means etc. shall be in accordance with the Nishtar Medical University, conduct of Examinations Regulations 2021.

16) A period of five years shall be permitted for re-continuation of pharmacy classes after discontinuation of studies by any student for any reason. However, the validity of the last professional examination taken by the candidate shall be three years. In case of discontinuation of studies for more than three years, the candidate shall be required to retake the last professional examination.

V. Regulations for the Appointment of Examiners in Theory & Practical Examinations

1) The Nishtar Medical University, Conduct of Examinations Regulations 2021 shall be applicable. Appointment of examiners shallbe subject to following guidelines of PCP:

   i.) Paper-setters, Paper Assessors, Internal and External Examiners for all the subjects in Pharm. D should hold basic degree in Pharmacy and have at least three years current experience of teaching the particular subject to Pharm. D classes in a Pharmacy College/Department/ Institute.

   ii.) However, the following exceptions to the above rule are permitted:

   (a) Examiners in subjects of Anatomy & Histology, Physiology, English, Pharmaceutical Mathematics & Biostatistics in 1st Professional Examination, Pakistan Studies & Islamiyat/Ethics (Compulsory) in 2nd Professional Examination and Pathology in 3rd Professional Examination may be non-pharmacy graduates currently involved in teaching of the particular subject to the Pharm. D students.

   (b) Examiners in the subjects of Clinical Pharmacy, Hospital Pharmacy and Industrial Pharmacy in 4th Professional examination may be non-faculty pharmacists with at least 5 years' experience in Clinical /Hospital / Industrial Pharmacy in the appropriate setting.

2) The Vice Chancellor/ Controllers of Examinations shall also appoint one internal and one external examiner for conduct of practical and Viva-Voce examination from the panel approved by the Board of Studies in Pharmacy.
3) No person shall be appointed as an examiner who has relation i.e; father, mother, full and half brother and sister, paternal and maternal uncle, father-in-law, mother-in-law, brother-in-law, sister-in-law, son-in-law, daughter-in-law, wife, son, daughter or husband appearing in the paper to be set or examined by him/her.
4) The award list of the practical examination shall be submitted to the Controller of Examinations by both internal and external examiners, independently.
5) The Controller of examinations shall compile and declare the results on the basis of evaluation record in theory and practical examinations submitted by the examiners strictly in accordance with the Conduct of Examinations Regulations.

APPENDIX -A

- ***SCHEME OF STUDIES OF PHARM-D (ANNUAL SYSTEM)***
- ***OUTLINE OF EXAMINATIONS***
- ***DETAIL OF COURSES OF PHARM-D (ANNUAL SYSTEM)***
- ***MARKS DISTRIBUTION SCHEME (ANNUAL SYSTEM)***
- ***LIST OF RECOMMENDED BOOKS***

PHARM.D. FIVE-YEAR COURSE

SCHEME OF STUDIES FOR ANNUAL SYSTEM

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 andBiostatistics)	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 -VIII (Computer and its Applications inPharmacy)	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 -VIII (Computer and its Applications in Pharmacy)	50
	Total Marks:	**1000**

Fourth Professional

Theory		
Paper 1	Pharmacy Practice-III (Hospital Pharmacy)	100
Paper 2	Pharmacy Practice -IV (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 -IV (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**

Final Professional

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

Grand Total Marks: 4700

Pharm.D. Five-Year Credit Hours Summary

S.No	Pharm-D (5-Year)Program Annual System	Credit. Hours	Marks
1	1st Professional	42	1000
2	2nd Professional	43	1000
3	3rd Professional	39	1000
4	4th Professional	38	900
5	5th Professional (Final)	36	800
Total		**198**	**4700**

Note: Every Prof. will consist of 125-130 Lectures and 20 to 30 Practicals

1 Lecture: 60 Minutes

1Practical: 2 Contact hrs at least

DETAILS OF COURSES (ANNUAL SYSTEM)

FIRST PROFESSIONAL

PHARMACEUTICAL CHEMISTRY-I (ORGANIC) [Theory]

Paper 1 Marks 100

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

1. **BASIC CONCEPTS:** Chemical Bonding and concept of Hybridization, Conjugation, Resonance (Mesomerism), Hyperconjugation, Aromaticity, Inductiveeffect, Electromeric effect, Hydrogen bonding, Steric effect, Effect of structure onreactivity of compounds, Tautomerism of Carbonyl Compounds, Nomenclature ofOrganic Compounds.

2. **STEREOCHEMISTRY/CONFORMATIONAL ANALYSIS:** Stereoisomerism, optical isomerism; Molecules with more than one chiral center Geometrical isomerism, Resolution of racemic mixture, Conformational analysis**.**
3. **GENERAL METHODS OF PREPARATION, PROPERTIES, IDENTIFICATION TEST AND PHARMACEUTICAL APPLICATIONS OF THE FOLLOWING CLASSES AND THEIR ANALOGUES:**

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

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

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

   a. Preparation and properties of medicinally important Heterocyclic Compoundssuch as pyrol, furan, thiophene, pyridine, pyrimidine and pyrazine.

   b. Preparation and properties of hetrocyclic compounds in which benzo-ring is fused with five and six membered ring containing one hetero atom; Indole, Quinoline and Isoquinoline.
7. **REACTION MECHANISM:**

   Organic Reaction Mechanism: Arndt-Eistert reaction, Baeyer-Villiger oxidation, Diels Alder reaction; Grignard's reaction, Metal Hydride reduction and Wolff Kishner reduction, Friedel Craft's reaction, Perkin reaction, Cannizzaro's reaction,Mannich reaction.
8. **REACTIVE INTERMEDIATE AND FREE RADICALS:**
   a. Introduction: Generation, stability and reaction of the following Intermediates;

      Carbocations, Carbanions, Carbenes, Nitrenes, Benzynes,

b. Types of reactions: An Overview.
c. Free radicals: Free radical scavengers and their applications.

9. **CARBONIUM ION REARRANGEMENTS:** Pinacol-Pinacolone, Wagner-Meerwein, Wolff, Hofmann and Beckmann rearrangements.

10. **CARBANIONS REARRANGEMENTS:** Condensation reaction (Aldol condensation, Favorskii rearrangement, Wittig rearrangement).

PHARMACEUTICAL CHEMISTRY-I (ORGANIC) Practical

Paper 7 Marks 100

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

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

PHARMACEUTICAL CHEMISTRY-II (BIOCHEMISTRY) Theory

Paper 2 Marks 100

1. **GENERAL INTRODUCTION AND BASIC BIOCHEMICAL PRINCIPLES:** Role of pharmaceutical biochemistry in the health profession. Nature of biochemical reactions.

2. **BASIC CHEMISTRY OF BIOMOLECULES (Nature, Classification etc.):**
   a) Carbohydrates: Chemistry, Classification, Reactions of Carbohydrates, Optical activity, Biological and pharmaceutical importance of carbohydrates.
   b) Lipids: Chemistry of Fatty acids and Lipids, Classification (Saponifiable and 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 nonproteinous hormones, amino acid derivatives, steroids), Biological and pharmaceutical importance of hormones.

g) Enzymes: Chemistry, Classification, Mode of action, Kinetics (Michaelis Menten Equation and some modifications), Inhibition, Activation, Specificity, Allosteric enzymes, Factors affecting the rate of an enzyme-catalyzed reaction, Biological and pharmaceutical importance, Mechanism of action of some important enzymes (Chymotrypsin, Ribonuclease).

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

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

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

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

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

4. REGULATION OF METABOLIC PROCESSES:

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

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

c. Secondary Messengers: Role of cAMP, Calcium ions and phosphoinositolin the regulation of metabolic processes.

d. Gene Expression: Replication, Transcription and Translation (Gene expression) Introduction to Biotechnology and Genetic Engineering, Basic principles of Recombinant DNA technology, Pharmaceutical applications, Balance of Catabolic, Anabolic and Amphibolic processes in human metabolism, Acid-Base and Electrolyte Balance in Human body.

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

PHARMACEUTICAL CHEMISTRY-II (BIOCHEMISTRY) Practical

Paper 8 Marks 100

1. **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.
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.

PHARMACEUTICS-I (PHYSICAL PHARMACY) Theory

Paper 3 Marks 100

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

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

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

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

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

6. **PHYSICOCHEMICAL PROCESSES:**
   a. Precipitation: Process of precipitation and its applications in Pharmacy.
   b. Crystallization: Types of crystals, Mechanism and methods of crystallization and its applications in Pharmacy.
   c. Distillation: Simple, fractional, steam distillation, vacuum distillation, destructive distillation and their applications in Pharmacy.
   d. Miscellaneous Processes: Efflorescence, deliquescence, lyophillization, elutrition,

exiccation, ignition, sublimation, fusion, calcination, adsorption, decantation, evaporation, vaporization, centrifugation, dessication, levigation and trituration.

7. **EXTRACTION PROCESSES:**
   a. Maceration: Purpose & process.
   b. Percolation: Purpose and Process.
   c. Liquid-Liquid extraction: Purpose and Process.
   d. Large scale extraction: Purpose and Process.
8. **RATE AND ORDER OF REACTIONS:**
9. **KINETIC PRINCIPLES AND STABILITY TESTING: THEORETIC CONSIDERATIONS: (Degradation)**
   a. Physical Factors: Influence of pH, temperature, ionic strength, acid-base catalysis, U.V. light.
   b. Chemical Factors: Complex chemical reactions. Oxidation-reduction reactions, Hydrolysis.

PHARMACEUTICS-I (PHYSICAL PHARMACY) Practical
Paper 9 Marks 100

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

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

PHYSIOLOGY Theory
Paper 4 Marks 100

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

1. **BASIC CELL FUNCTIONS:**
   a. Chemical composition of the body: Atoms, Molecules, Ions, Free Radicals, Polar Molecules, Solutions, Classes of Organic Molecules
   b. Cell structure: Microscopic Observation of Cell, Microscopic, Cell Organelles, Cytoskeleton.
   c. Protein activity and cellular metabolism: Binding Site Characteristics, Regulation of

Binding site Characteristics, Chemical Reactions, Enzymes, Regulation of Enzyme-Mediated Reactions, Multi-enzyme metabolic.

Pathways, ATP, Cellular Energy Transfer, Carbohydrate, Fat, and Protein Metabolism, Essential Nutrients.

d. Genetic information and Protein Synthesis: Genetic Code, Protein Synthesis, Protein, Degradation, Protein Secretion, Replication and Expression of Genetic Information, Cancer, Genetic Engineering.
e. Movement of Molecules across Cell Membranes: Diffusion, Mediated- Transport Systems, Osmosis, Endocytosis and Exocytosis, Epithelial Transport.

2. BIOLOGICAL CONTROL SYSTEM:

a. Homeostatic Mechanisms and Cellular Communication: General Characteristics, Components of Homeostatic Control Systems, Intercellular Chemical Messengers, Processes Related to Homeostasis, Receptors, single Transduction Pathways.
b. Neural Control Mechanisms: Structure and Maintenance of Neurons, Functional Classes of Neurons, Glial Cells, Neural Growth and Regeneration,Basic Principles of Electricity, The resting Membrane Potential, Graded Potentials and Action Potentials, Functional Anatomy of synapses, Activation of the Postsynaptic Cell, Synaptic Effectiveness, Neurotransmitters and Neuro-modulators, Neuro-effector communication, Central Nervous System: Spinal Cord Central Nervous System: Brain, Peripheral Nervous System, Blood Supply, Blood-Brain Barrier phenomenon, and Cerebrospinal fluid.
c. The Sensory Systems: Receptors, Neural Pathways in Sensory System, Association Cortex and Perceptual Processing, Primary Sensory Coding, Somatic Sensation, Visio, Hearing, Vestibular System, Chemical Senses.
d. Principles of Hormonal Control Systems: Hormone Structures and Synthesis, Hormone Transport in the Blood, Hormone Metabolism and Excretion, Mechanisms of Hormone Action, Inputs that control Hormone Secretion, Control Systems Involving the Hypothalamus and Pituitary, candidate Hormones, type of Endocrine Disorders.
e. Muscle: Structure, Molecular Mechanisms of Contraction, Mechanics of Single fiber Contraction, Skeletal Muscle Energy Metabolism, Types of Skeletal Muscle Fibers, Whole Muscle Contraction, Structure, Contraction and its Control.
f. Control of Body Movement: Motor Control Hierarchy, Local control of Motor Neurons, The Brain Motor Centers and the Descending Pathways they Control, Muscle Tone, Maintenance of Upright Posture and Balance, Walking.
g. Consciousness and Behavior: State of consciousness, conscious Experiences, Motivation and Emotion, Altered State of Consciousness, Learning and Memory, Cerebral Dominance and language Conclusion.

3. COORDINATED BODY FUNCTIONS:

a. Circulation: Plasma, the Blood Cell, Pressure, flow and resistance, Anatomy, Heartbeat coordination, Mechanical Events of the Cardiac Cycle, The Cardiac output, Measurement of Cardiac Function, Arteries, Arterioles, Capillaries, veins, The Lymphatic system, Baroreceptor Reflexes, Blood Volume and Long term Regulation of Arterial Pressure, Other Cardiovascular Reflexes and Responses, Hemorrhage and Other Causes of Hypotension, the Upright Posture, Exercise,

Hypertension, Heart Failure, Coronary Artery Disease and Heart Attacks, Formation of Platelet Plug, Blood coagulation: Clot Formation, Anticlotting systems, Anticlotting Drugs.

b. Respiration: Organization of the Respiratory System, Ventilation and Lung Mechanics, Exchange of Gases in Alveoli and tissues, Transport of Oxygen in Blood, Transport of Carbon dioxide in Blood, Transport of Hydrogen ions between Tissues and Lungs, Control of Respiration, Hypoxia, Nonrespiratory Functions of the Lungs.

c. The kidneys and Regulation of Water and Inorganic Ions: Renal Functions, Structure of the Kidneys and Urinary System, Basic Renal Process, The Concept of Renal Clearance Micturition, Total Body Balance of sodium and Water Basic Renal Process for sodium and Water, Renal Sodium Regulation,Renal Water regulation, A Summary Example: the response to Sweating, Thirst and Salt Appetite, Potassium Regulation, Effector Sites for Calcium Homeostasis, Hormonal controls, Metabolic Bone Disease, Source of Hydrogen Ion Gain or Loss, Buffering of Hydrogen Ions in the Body, Integration of Homeostatic Controls, Renal Mechanisms, Classification of Acidosis and Alkalosis, Diuretics, Kidney Disease.

d. The Digestion and Absorption of Food (Overview): Functions of the Gastrointestinal Organs, Structure of the Gastrointestinal Tract Wall, Digestion and Absorption, Regulation of Gastrointestinal Processes, Pathophysiology of the Gastrointestinal Tract.

e. Regulation of Organic Metabolism, Growth, and Energy Balance: Events of the Absorptive and Postabsorptive States, Endocrine and Neural Control of the Absorptive and Postabsorptive States, Fuel Homeostasis in Exercise and Stress Diabetes Mellitus, Hypoglycemia as a Cause of Symptoms, Regulation of Plasma Cholesterol, Bone Growth, Environmental Factors, Influencing Growth, Hormonal Influences on Growth, compensatory Growth, Basic Concepts of Energy Expenditure, Regulation of Total Body Energy Stores, Regulation of Body Temperature.

f. Reproduction: General Principles of Gametogenesis, Anatomy, Spermatogenesis, Transport of Sperm, Hormonal control of Male Reproductive Functions, Anatomy, Ovarian Function, Control of Ovarian Function, Uterine Changes in the Menstrual Cycle, Other Effects of Estrogen and Progesterone, Androgens in Women, Female Sexual Response, Pregnancy, Sex Determination, Sex Differentiation, Puberty, Menopause.

g. Defense Mechanisms of the Body: Cells Mediating Immune Defenses, Nonspecific Immune Defenses, Specific Immune Defenses, Systemic Manifestations of Infection Factors that Alter the Body's Resistance to Infection, Harmful Immune Responses, Absorption, Storage Sites, Excretion, Biotransformation, Functions of Cortisol in Stress, Functions of the Sympathetic Nervous System in Stress, Other Hormones Released During Stress Psychological Stress and Disease.

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

PHYSIOLOGY [Practical]
Paper 10 **Marks 100**

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

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

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

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

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

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

ANATOMY & HISTOLOGY [Theory]
Paper 5 **Marks 50**

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

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

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

3. **TISSUES OF BODY:** Types of tissues with examples;

   a. Epithelial Tissue: General characters, classification.
   b. Connective Tissue: Structure and types of Connective tissue and Cartilage.
   c. Bones: Structure and types of bones and joints.
   d. Muscles: Structure of skeletal muscle, smooth muscle and cardiac muscle.

4. **INTEGUMENTARY SYSTEM:**

   e. Skin Structure: (Epidermis, dermis).
   f. Glands of Skin: (Sweat, Sebaceous).

g. Hair: Structure, function.
h. Nail: Structure, function.

5. **CARDIOVASCULAR SYSTEM:**

i. Heart: Structure of Heart, Location of Heart, Blood Supply to Heart.
j. Blood Vessels: Main blood vessels arising & entering the heart. Types of blood vessels with examples.

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

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

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

9. **ENDOCRINE SYSTEM:**

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

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

(a) Brain; Meninges (Cerebrum cerebral Lobes. Ventricles, Cerebellum Anatomyof Cerebellum, Brain Stem Mid-Brain. Pons. Medulla Oblongata, Diencephalon. Thalamus Hypothalamus and Cranial Nerves).
(b) Spinal Cord Meninges (C.S.F. Internal Structure, Sensory and Motor Pathway, Spinal Reflexes, Peripheral spinal Nerves, Autonomic Nervous System includes Sympathetic N.S. and Parasympathetic Nervous System).

11. **HISTOLOGY (Theory):**

(a) Underlying principles of histological techniques and staining specific tissuesshould 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 andevery type of normal tissue will be covered.

ANATOMY & HISTOLOGY [Practical]
Paper 11 **Marks 50**

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

1. Demonstration of the preparation and staining of slides.
2. Histological examination of slides: Epithelium, Muscle tissue and Connectivetissue.
3. Organ system: Lung, Kidney, Stomach, Appendix, Skin, Intestine and Gall bladder.

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

Part: A (Functional English):

Objectives: Enhance language skills and develop critical thinking.

12. Course Contents:

1. 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.
2. Comprehension: Answers to questions on a given text.
3. 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).
4. Listening: To be improved by showing documentaries/films carefully selected by subject teachers
5. Translation skills: Urdu to English.
6. 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.

13. 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.

14. Course Contents:

Presentation skills:

Essay writing: Descriptive, narrative, discursive, argumentative Academic

writing: How to write a proposal for research paper/term paper, (emphasis

on style, content, language, form, clarity, consistency).

Technical Report writing: Progress report writing:

NOTE: Extensive reading is required for vocabulary building.

SECOND PROFESSIONAL

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

1. PHARMACEUTICAL CALCULATIONS: Some Fundamentals of Measurements and Calculations. The Metric System. The Common Systems. Conversions. Calculation of Doses. Percentage calculations, Reducing and Enlarging Formulas. Weights and Volumes of Liquids. HLB Values. Industrial Calculations. Calculations involving parenteral admixtures. Some calculations involving Hydrogen-ion concentration. Calculations involving isotonic, electrolyte and buffer solutions.

2. INTRODUCTION: Dosage form, Ingredient, Product formulation.

3. GALENICAL PREPARATIONS: Infusions, Decoctions, Extracts, Fluid extracts, Tinctures, Aromatic waters.

4. SOLVENTS USED IN PHARMACEUTICAL PREPARATIONS:

5. ORAL SOLUTIONS, SYRUPS, ELIXIRS AND SPIRITS: Solutions: Preparation, dry mixtures for solution, oral rehydrate solutions, oral colonic lavage solution. Syrup: components and preparation of syrups. Elixirs: Preparation of elixirs, Medicated and non-Medicated elixirs. Spirits: Preparation of Spirits.

6. ORAL SUSPENSIONS, EMULSIONS, MAGMA AND GELS: Preparations, examples and importance.

7. TOPICAL AND TRANSDERMAL DRUG DELIVERY SYSTEMS: Introduction of Ointments, Creams, Pastes, Poultice, Plasters, Lotions, Liniments, Topical gels, Topical Tinctures, Collodions, Topical solutions, Topical powders, Percutaneous absorption, Transdermal systems in use.

8. OPHTHALMIC, NASAL AND OTIC PREPARATIONS: Ophthalmic solutions, suspensions, ointment, inserts, contact lens solutions. Nasal decongestant solutions, Decongestant inhalers. Ear preparations: Anti-infective, anti- inflammatory and analgesic.

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

10. AEROSOLS, INHALATIONS AND SPRAYS: Aerosol: Principle, container and valve assembly, propellants, filling, testing, packaging, labelling and storage. Inhalations: Principle, container and valve assembly, propellants, filling, testing, packaging, labelling and storage. Sprays: Principle, container and valve assembly, propellants, filling, testing, packaging, labelling and storage.

11. POWDERS, CAPSULES, TABLET DOSAGE FORMS: Preparation of Powders,mixing of powders, uses and packaging of powders, granules, effervescent granulated salts. Hard gelatin capsules: Capsule sizes, preparation of filled hard gelatin capsules. Soft gelatin capsules: Preparation and its application. Tablets, their types, characteristics and methods of preparation.

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

13.A BRIEF INTRODUCTION TO ORAL HYGIENE PRODUCTS:

PHARMACEUTICS-II (DOSAGE FORMS SCIENCE) Practical
Paper 7 Marks 100

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

- Prepartion of simple syrup, Orange syrup, Ferrous sulphate syrup, Cod Liver oil Emulsion, Liquid paraffin Emulsion, Throat paint (Mandle's paint), Boroglycerine glycerite, Tannic acid glycerin, Spirit ammonia aromatic, Spirit of Ethyl Nitrite.
- Preparation of Methyl salicylate ointment, Sulphur ointment, Calamine lotion, Iodine tincture, Preparations of oral hygiene products, Poultice of Kaolin,
- Effervescent granules, Distilled Water for injections (A minimum of 20 practicals will be conducted).

PHARMACOLOGY AND THERAPEUTICS-I [Theory]
Paper 2 Marks 100

1. GENERAL PHARMACOLOGY:

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

2. **DRUGS ACTING ON AUTONOMIC NERVOUS SYSTEM (ANS):**
   a. Organization of ANS its subdivisions and innervations.
   b. Neurotransmitters in ANS, their synthesis, release and fate.
   c. Sympathetic agonist drugs: Catecholamines and Non-catecholamines.
   d. Sympathetic antagonist drugs: Adrenergic receptor Blockers and neuronblockers.
   e. Parasympathetic (Cholinergic) agonists and Anticholinestrase inhibitors. Parasympathetic antagonists.
   f. Ganglion stimulants and Ganglion blockers
   g. Neuromuscular Blockers

3. **DRUGS ACTING ON GASTROINTESTINAL TRACT:**
   a. Emetic and anti-emetics.
   b. Purgatives.
   c. Anti-diarrheal agents.
   d. Treatment of Peptic ulcer: Antacids, H2-Receptor antagonists, antimuscarinic agents, proton pump inhibitors, prostaglandin agonists, gastrin receptor antagonist and cytoprotective agents.
   e. Drug treatment of chronic inflammatory bowel diseases.
   f. Drugs affecting bile flow and Cholelithiasis.

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

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

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

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

8. **ANTI-ANAEMIC DRUGS:**

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

NOTE:

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

PHARMACOLOGY AND THERAPEUTICS-I [Practical]

Paper 8 **Marks 100**

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

- Introduction to instruments: such as Organ Bath, Kymograph, Oscilographpolygraph Patch Clamp Technique and Power Lab.
- Preparation of standard solution: Ringer solution. Tyrode solution. Kreb solution.Normal saline solution.
- To demonstrate the effects of sympathomimetic (Adrenaline) &sympatholyticdrugs (Propranolol) on Frog's heart.
- To demonstrate the effects of parasympathomimetic (Acetylcholine) andparasympatholytic (Atropine) drugs on Frog's heart.
- To demonstrate the effects of an unknown drug on Frog's heart. Routes ofAdministration 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 (Acetylcholine, 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 identifythe (unknown) drug.
- To study the effects of Adrenaline on Rabbit's Eyes.
- To study the effects of Homatropine on Rabbit's Eyes.
- To study the effects of Pilocarpine on Rabbit's Eyes.
- To study the effects of Local Anaesthetic drug (e.g Cocaine) on Rabbit's Eyes.
- To identify the unknown drug & differentiate its effects on Rabbit's Eyes.
- To demonstrate emetic effects of various drugs in pigeons.

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

PHARMACOGNOSY-I Theory
Paper 3 Marks 100

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

2. **Crude Drugs:** Crude drugs, commerce, preparation, chemical and therapeutic classifications of crude drugs (official and un-official drugs). Methods of Cultivation, Drying, Storage, Preservation and Packing.

3. **The study of the crude drugs belonging to various families of medicinal importance**

S. No.	Families	Crude Drugs
a.	Ranunculaceae	Aconitum, Larkspur, Pulsatilla, Hydrastis
b.	Papaveraceae	Papaver somniferum, Sanguinaria, Canadensis
c.	Leguminosae	Acacia, Glycyrrhiza, Senna, Cassia, Tamarind
d.	Umbelliferae	Fennel, Carum, Coriander, Conium, Asafoetida
e.	Apocynaceae	Rauwolfia, Catharanthus
f.	Asclepiadaceae	Gymnema sylvestre, Calotropis gigantean
g.	Compositae	Artemisia, Silybum marianum, Echinaceae, Arctium lappa
h.	Solanaceae	Belladonna, Hyoscyamus, Stramonium, Capsicum
i.	Scrophulariaceae	Digitalis, Verbascum (Mullien).
j.	Labiatae	Peppermint, Thyme, Spearmint, Salvia, Ocimum
k.	Liliaceae	Garlic, Colchicum, Aloe
l.	Zingiberaceae	Ginger, Curcuma

4. **Evaluation and Adulteration of Crude Drugs:** Evaluation of crude drugs i.e. Organoleptic, Microscopic, Physical, Chemical and Biological. Deterioration and Adulteration of crude drugs. Types of adulteration, inferiority, spoilage, admixture, sophistication and substitution of crude drugs.

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

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

7. **Surgical Dressings:** Classification of fibers as vegetable, animals and syntheticfibers.

Evaluation of fibers in surgical dressings, BPC standards for dressings and sutures. Discussion on cotton, wool, cellulose, rayon, catgut and nylon

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

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

10. **Poisonous Plants including Allergens and Allergenic Preparations:** General introduction, case history, skin test, treatment of allergy, inhalant, ingestant, injectant, contactant, infectant and infestant allergens. Mechanism of allergy.

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

PHARMACOGNOSY-I — Practical
Paper 9 Marks 100

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

NOTE: A Study Tour will be an integral part of the syllabus and will be arranged at the end of the session for collection of medicinal plants from the country.

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

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

1. **GENERAL MICROBIOLOGY:** Historical introduction, Scope of microbiology with special reference to Pharmaceutical Sciences. Nomenclature and classification of Micro-organisms.

2. **MICRO-ORGANISMS:**

   a. The Bacteria: General and cellular Morphology, structure and function. Classification of Bacteria. Growth curve, growth factors and growth characteristics. Nutrition requirements and nutrition factors affecting growth. Culture Media, Bacterial cultures and staining Methods.
   b. The Viruses: Introduction, Classification (and detail of at least one species from every group), cultivation and replication.

c. The Fungi/Yeast/Molds:
d. The Protozoa:

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

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

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

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

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

PHARMACEUTICS-III (PHARM. MICROBIOLOGY & IMMUNOLOGY) [Practical]
Paper 10 Marks 100

NOTE: Practical of the subject shall be designed from time to time on the basis ofthe 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 andselective Media and culturing of micro-organisms. Total and viable counts of
micro-organism. Morphological and selective biochemical characterization of somespecimen. Staining of Bacteria: Gram method, Acid fast, Giemasas staining, Capsule staining, Flagella staining and Spore staining. Microbiological analysis of air, water and soil (Note: A minimum of 20 practicals will be conducted).

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

Part: A Pakistan Studies: 40 marks

1. Introduction/Objectives:

- Develop vision of historical perspective, government, politics, contemporaryPakistan,

ideological background of Pakistan.

- Study the process of governance, national development, issues arising in themodern age and posing challenges to Pakistan.

2. HISTORICAL PERSPECTIVE:

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

3. GOVERNMENT AND POLITICS IN PAKISTAN:

Political and constitutional phases:

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

4. CONTEMPORARY PAKISTAN:

a. Economic institutions and issues
b. Society and social structure
c. Ethnicity
d. Foreign policy of Pakistan and challenges
e. Futuristic outlook of Pakistan

Part: B **Islamic Studies:** **60 marks**

Course Objectives: This course is aimed at:

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

1. Introduction to Quranic Studies:

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

2. Study of Selected Text of Holly Quran:

1.Verses of Surah Al-Baqra Related to Faith (Verse No. 284-286)
2.Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No. 1-18)

3.Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No.1-11)
4.Verses of Surah al-Furqan Related to Social Ethics (Verse No. 63-77)
5.Verses of Surah Al-Inam Related to Ihkam (Verse No. 152-154)

3.Study of Selected Text of Holly Quran:

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

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

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

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

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

6.**Introduction to Sunnah:**

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

7.Selected Study from Text of Hadith:

8. Introduction to Islamic Law & Jurisprudence:

a. Basic Concepts of Islamic Law & Jurisprudence
b. History & Importance of Islamic Law & Jurisprudence
c. Sources of Islamic Law & Jurisprudence
d. Nature of Differences in Islamic Law
e. Islam and Sectarianism

9.Islamic Culture & Civilization:

f. Basic Concepts of Islamic Culture & Civilization
g. Historical Development of Islamic Culture & Civilization
h. Characteristics of Islamic Culture & Civilization
i. Islamic Culture & Civilization and Contemporary Issues

10.Islam & Science:

j. Basic Concepts of Islam & Science
k. Contributions of Muslims in the Development of Science
l. Quran & Science

11. Islamic Economic System:

m. Basic Concepts of Islamic Economic System
n. Means of Distribution of wealth in Islamic Economics
o. Islamic Concept of Riba
p. Islamic Ways of Trade & Commerce

12. Political System of Islam:

q. Basic Concepts of Islamic Political System
r. Islamic Concept of Sovereignty
s. Basic Institutions of Govt. in Islam

13. Islamic History:

t. Period of Khlaft-e-Rashida
u. Period of Umayyads
v. Period of Abbasids

14. Social System of Islam:

w. Basic Concepts of Social System of Islam
x. Elements of Family
y. Ethical Values of Islam.

PHARMACY PRACTICE-I (MATHEMATICS AND BIOSTATISTICS) [Theory]
Paper 6 Marks 100

Part A: (Pharmaceutical Mathematics) (40 Marks)

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

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

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

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

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

Part B: (BIOSTATISTICS) **(60 Marks)**

1. **DESCRIPTION OF STATISTICS:** Descriptive Statistics: What is Statistics? Importance of Statistics. What is Biostatistics? Application of Statistics in Biological and Pharmaceutical Sciences. How samples are selected?

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

3. **SUMMARIZING DATA and VARIATION:** The Mean, The Median, The Mode, The Mean Deviation, The Variance and Standard Deviation, Coefficient of Variation.

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

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

6. **SIMPLE REGRESSION AND CORRELATION:** Introduction. Simple Linear Regression Model. Correlation co-efficient.

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

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

10. **STATISTICAL PACKAGE:** An understanding of data analysis by using different statistical tests using various statistical software's like SPSS, Minitab, Statistica etc.

THIRD PROFESSIONAL

PATHOLOGY	**[Theory]**
Paper 1	**Marks 50**

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 and Chronic inflammation, Immunity, Allergy, Hyper Sensitivity.

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

PATHOLOGY	**[Practical]**
Paper 7	**Marks 50**

1. **Study of Pathological Slides of various Pathological Conditions:** Acute inflammation, Chronic inflammation, Chronic specific inflammation, Different typesof Degeneration, Thrombosis, Embolism, Infarction, Necrosis, Gangrene, Hyperplasia, Metaplasia, Pigmentation, Calcification, CVC, Papilloma, Adenoma, Chondroma, Fibroma, Leomyoma, Neofibroma, Squamous Cell Carcinoma, Basal Cell Carcinoma, Transitional Cell Carcinoma, Adenocarcinoma, Fibrocarcinoma, Rhadomyo sarcoma, Leomyo sarcoma, Lymphosarcoma, Liposarcoma, Reticular Cell Sarcoma, Hodgkins disease, Breast Carcinoma, Osteogenic Sarcoma,Osteoclastoma, Hapatitis, Diabetes.

2. **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.

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

PHARMACOLOGY AND THERAPEUTICS-II — Theory
Paper 2 — **Marks 100**

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

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

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

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

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

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

4. The prototype drugs in each group from the latest edition of the recommended books.

PARMACOLOGY AND THERAPEUTICS-II [Practical]
Paper 8 **Marks 100**

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

- To study the convulsant effects of strychnine and picrotoxin in frogs and todetermine 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 muscleof frog and competitive pharmacological antagonism by Neuromuscular blocking agent e.g. Gallamine.
- To identify the unknown drug by performing pharmacological competitive antagonism on Rectus abdominus muscle of Frog.
- To study the anti-coagulant effects of Heparin and oral anti-coagulants on Rabbits.
- To identify the unknown anticoagulant drug using Rabbits.
- To demonstrate the Graded Dose-Response curve of Acetylcholine onRabbit intestine.
- To identify unknown concentration of Acetycholine from Graded DoseResponse curves.
- To demonstrate the general anesthetic effect on rabbits.
- To demonstrate the effect of sedatives and hypnotics on rabbits.
- To demonstrate the anti-nociceptive (analgesic) effect on mice.
- To demonstrate antidepressant effect in rats (forced swimming test, tailsuspension test Yohimbine lethality test).

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

PARMACOGNOSY-II (ADVANCED) [Theory]
Paper 3 **Marks 100**

1. **SEPARATION AND ISOLATION OF PLANT CONSTITUENTS:** Introduction and use of spectroscopic and chromatographic techniques for the identification of natural products. Description and interpretation of ultraviolet, infrared, mass, nuclear magnetic resonance (^{1}H-NMR and ^{13}C-NMR) and other advance techniques to elucidate the structure of natural products.

2. **CARBOHYDRATES AND RELATED COMPOUNDS:** Introduction and classification of carbohydrates, sugars as adjuvant in drugs, role of impurities insugar substances.

   (a) Sucrose and Sucrose containing drugs: Sucrose, Dextrose, Liquid glucose, Fructose, Lactose, Xylose, Caramel, Starch, Inulin, Dextrine etc.
   (b) Cellulose and Cellulose Derivatives: Powdered cellulose, microcrystalline cellulose, Methyl cellulose, Sodium Carboxy-methyl cellulose.
   (c) Gums and Mucilage: Tragacanth, Acacia, Sodium Alginate, Agar, Pectin.

3. **ALKALOIDS:** Introduction, Properties, Classification, Function of alkaloids inplants, Methods of extraction and identification tests.
   (a) Pyridine Piperidine Alkaloids: Areca nut, Lobelia.
   (b) Tropane Alkaloids: Belladonna, Hyoscyamus, Stramonium.
   (c) Quinoline Alkaloids: Cinchona.
   (d) Isoquinoline Alkaloids: Ipecacuanha, Opium.
   (e) Indole alkaloids: Rauwolfia, Catharanthus, Nux vomica, Physostigma, Ergot.
   (f) Imidazole alkaloids: Pilocarpus.
   (g) Steroidal alkaloids: Veratrum.
   (h) Alkaloidal amines: Ephedra, Colchicum.
   (i) Purine Bases: Tea, Coffee.

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

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

6. **LIPIDS:** Introduction, classification, source, active constituents and pharmacological uses of:

   (a) Fixed Oils: Castor oil, Cotton seed oil, olive oil, Peanut oil, Sun flower oil, Corn oil, Coconut oil, Almond oil, Linseed oil, Mustard oil, Sesame oil and Soybean oil.
   (b) Fats and Related Compounds: Theobroma oil and Lanolin.
   (c) Waxes: Bees wax, carnauba wax, spermaceti and Jojoba oil.

7. **VOLATILE OILS (ESSENTIAL OILS):** Introduction, significance, sources, active constituents, methods of obtaining volatile oils, chemistry and classification of:
   (a) Hydrocarbon volatile oils: Cubeb and Turpentine oil.

(b) Alcoholic volatile oils: Peppermint, Coriander and Cardamom.
(c) Aldehydic volatile oils: Bitter orange peel, Sweet orange peel, Lemon, Cinnamon and Bitter almond oil
(d) Ketonic volatile oils: Camphor, Spearmint, Caraway, Buchu
(e) Phenolic volatile oils: Clove, Thyme.
(f) Phenolic ether volatile oils: Fennel, Anise, Myristica.
(g) Oxide volatile oils: Eucalyptus, Chenopodium.
(h) Ester volatile oils: Rosemary.
(i) Miscellaneous volatile oils: Allium, Anethum.

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

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

10. NATURAL TOXICANTS:

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

11. AN INTRODUCTION TO NUTRACEUTICALS AND COSMECEUTICALS:

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

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

14. CLINICAL USE OF HERBS & HERBAL MEDICINE:

Diabetes:Gymnema sylvestre, Melia azadirchta, Momordica charantia, Syzygium jambulana.

Cardiac diseases:Digitalis spp., Convallaria majalis, Urgenia indica, Allium sativum,

Punica granatum.

Hepatitis:Berberis vulgaris, Picrorhiza kurroa, Lawsonia in.

Respiratory diseases:Ficus religosa, Adhatoda vasica.

Skin diseases:Aloe vera, Angelica archangelica, Mentha piperita, Citrus spp., Commiphora mukul.

CNS disorders:Strychnos nux-vomica, Datura stramonium, Cannabis sativa, Papaver somniferum, Atropa belladonna.

Musculo-skeletal disorders: Nigella sativa, Phycotis ajowan, Trigonella foenum-graecum, Zingiber officinale.

Renal disorders: Cucumis melo, Berberis vulgaris, Zea mays, Tribulus terrestris. Reproductive disorders:Saraca indica, Ruta graveolens, Nigella sativa, Glycyrrhiza glabra, Claviceps purpurea, Myristica fragrance.

G.I.T. disorders: Foeniculum vulgare, Ferula foetida, Cuminum cyminum, Aegle marmelos, Prunus domestica.

PARMACOGNOSY-II (ADVANCED) [Practical]

Paper 9 **Marks 100**

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

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

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

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

Theory

Paper 4 **Marks 40+60**

Part A: Dispensing: (40 Marks)

1. **BASIC PRINCIPLES OF COMPOUNDING AND DISPENSING INCLUDING:** Fundamental operations in Compounding, Containers and closures for Dispensed Products, Prescription-Handling (Parts of Prescription, Filling, Interpretation, Pricing) and Labelling of Dispensed Medication.
2. **EXTEMPORANEOUS DISPENSING:** Solutions, Suspensions, Emulsions, Creams,

Ointments, Pastes and gels, Suppositories and pessaries, Powdersand granules and Oral unit dosage form.

3. **PHARMACEUTICAL INCOMPATIBILITIES:** Types of Incompatibilities, manifestations, Correction and Prevention with reference to typical examples.

Part B: Community, Social & Administrative Pharmacy: (60 Marks)

1. **DEFINITIONS AND BACKGROUND:**

2. **PUBLIC HEALTH AND COMMUNITY PHARMACY:**Epidemiology & its Control, Epidemiological methodology with a focus on specific disease states, Pharmacoepidemiology (including Drug Utilization Review). Preventive Health (EPI & CDC), Family Planning and Health Policy.

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

4. **PATIENT EDUCATION AND COUNSELLING:**

5. **CONTROL OF DRUG ABUSE AND MISUSE:**

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

7. **HEALTH SYSTEM RESEARCH:** Knowledge skills of research methods, epidemiologic study design, experimental study design, Pre- and post-marketing surveys, Application of various statistical procedures in Pharmacy and Medical Research, causality assessment as well as the sensitivity and specificity tests in pharmacy practice.

8. **PHARMACOECONOMICS:** Pharmacoeconomic modelling and interpretation.

9. **ALTERNATIVE THERAPIES**: Background, philosophy and use of complementary and alternative therapies including herbal medicines, homoeopathy, acupuncture, acupressure, Bach Flower remedies, aromatherapy and reflexology.

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

PARMACY PRACTICE-II

(DISPENSING, COMMUNITY, SOCIAL & ADMNISTRATIVE PHARMACY **[Practical]**
Paper 10 **Marks 100**

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

Mixtures: Dispensing of simple mixtures containing soluble substances only, mixtures containing diffusible substances, in-diffusible substances and mixtures forming precipitate.
Powders: Dispensing of simple powders, compound powders and effervescentpowders 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,

PARMACEUTICAL CHEMISTRY-III (PHARMACEUTICAL ANALYSIS) [Theory]
Paper 5 **Marks 100**

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

1. **SPECTROSCOPIC METHODS:** Theory, Instrumentation and Pharmaceutical applications of the following Spectroscopic Methods:
   a. Atomic Absorption and Emission Spectroscopy
   b. Molecular fluorescence spectroscopy
   c. Flame Photometry
   d. I.R. Spectroscopy
   e. Mass Spectroscopy
   f. NMR Spectroscopy
   g. U.V./Visible Spectroscopy
2. **CHROMATOGRAPHIC METHODS:** Column Chromatography, Thin Layer Chromatography, Gas Liquid Chromatography, HPLC, LCMS, GCMS, Capillary Electrophoresis.
3. **ELECTRO CHEMICAL METHODS:** Potentiometry, Polarography and Radiochemical Techniques.
4. **THERMAL ANALYSIS:** Differential Scanning Calorimetry, Differential Thermal Analysis, Thermo Gravimetric Analysis.
5. **OCCURENCE, PROPERTIES, PREPARATION AND APPLICATION OF OFFICIAL INORGANIC COMPOUNDS:** Aluminium Hydroxide, Ammonium Chloride, Sodium Carbonate, Magnesium Carbonate, Lithium Carbonate, Sodium Nitrite, Calcium Gluconate, Antimony Gluconate, Ferrous Fumarate, Ferrous Sulfate and Silver Nitrate.
6. **TITRIMETRIC ANALYSIS:**

Acid-base titration, Oxidation-reduction titration, Argentometric titration,Complexometric titration, Non-aqueous titration etc.

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

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the requirements e.g. Determination of the Purity and Composition of the unknown drugs by using at least each of the above techniques. (Note: A minimum of 20 practicals will be conducted).

PARMACY PRACTICE-VIII (COMPUTER AND ITS APPLICATION IN PHARMACY) [Theory]
Paper 6 **Marks 50**

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

2. **RESEARCH METHODOLOGIES:**

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

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

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

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

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

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

PARMACY PRACTICE-VIII (COMPUTER AND ITS APPLICATION IN PHARMACY) [Practical]
Paper 12 **Marks 50**

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

2. **WEB PAGE DEVELOPMENT**: Introduction to Front-page, Creating a First Web site, Basic Formatting Techniques, Manipulating Tables within Front- page, Front-page, Picture and MultiMedia, Hyper linking, Bookmarks and Image Maps, Introducing Front-page "components", Front-page and Frames, Managing your Web, Good site design, Publishing and publicizing.

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

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

FOURTH PROFESSIONAL

PARMACY PRACTICE-III (HOSPITAL PHARMACY) Theory
Paper 1 Marks 100

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

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

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

4. **PHARMACY AND THERAPEUTIC COMMITTEE:**

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

6. **DISPENSING TO IN-PATIENTS:**
   (a) Methods of Dispensing & SOP's
   (b) Unit dose dispensing
   (c) Other concepts of dispensing, Satellite Pharmacy etc.

7. **DISPENSING TO AMBULATORY PATIENTS:**

8. **DISTRIBUTION OF CONTROL SUBSTANCES:**
9. **DISPENSING DURING OFF-HOURS:**

10. **SAFE USE OF MEDICATION IN THE HOSPITAL:** Medication error; Evaluation & Precautions of Medication Error; Role of Pharmacist in ControllingMedication Error.

11. **MANUFACTURING BULK AND STERILE:**

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

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

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

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

16. **NUCLEAR PHARMACY:**

17. **THE PHYSICAL PLANT AND ITS EQUIPMENT:**

18. **INVESTIGATIONAL USE OF DRUGS:**

19. **HEALTH ACCESSORIES:**

20. **SURGICAL SUPPLIES:**

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

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

PARMACY PRACTICE-IV (CLINICAL PHARMACY-I) Theory

Paper 2 Marks 100

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

2. DISEASE MANAGEMENT:

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

3. MODULES:

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

4. PATIENT PROFILE & PATIENT COUNSELING:

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

5. CLINICAL TRIALS OF DRUG SUBSTANCES:

Designing of clinical trials, types of trials, Choice of patients, exclusion of patients and monitoring a clinical trial.

6. EMERGENCY TREATMENT:

For example, Cardiopulmonary resuscitation (CPR), Cold Blue.

7. DRUG INTERACTIONS:

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

8. PHARMACOVIGILANCE:

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

9. PHARMACOTHERAPY PLAN:

1. Development, Implementation and Monitoring of Drug Therapy Plans:

a. Pharmacist work up of drug therapy (PWDT)
b. Documentation of Pharmacotherapy Plan
   - SOAP note
   - CORE Pharmacotherapy Plan

- PRIME Pharmacotherapy problems
- FARM note

c. Implementation of Drug Therapy Plan
d. Monitoring of Pharmacotherapeutic plan
e. Pharmaceutical care plan as ongoing process
f. Importance of drug therapy plan in today's pharmacy practice

2. Pharmacotherapy Decision-Making:

a. Pursue the role of drug therapy practitioner over that of drug therapy advisor.
b. Participate in pharmacotherapy decision-making by:
   i. Identifying opportunities for decision-making.
   ii. Proactively engaging decision-making opportunities.
   iii. Formulating decision rationale that is the result of rigorous inquiry, scientific reasoning, and evidence.
   iv. Pursuing the highest levels of decision-making.
   v. Seeking independence in making decisions and accepting personal responsibility for the outcomes to patients resulting from one's decisions.
   vi. Personally enacting decisions

10. DRUG INDUCED DISEASES:

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

12. ONLINE PHARMACEUTICAL CARE SERVICES AND GLOBALIZATION:

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

PARMACY PRACTICE-IV (CLINICAL PHARMACY-I) [Practical]
Paper 6 **Marks 100**

1. PHARMACY PRACTICE-IV (CLINICAL PHARMACY-I) (PRACTICAL)

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

PARMACEUTICS-IV (INDUSTRIAL PHARMACY) Theory
Paper 3 **Marks 100**

1. **MASS TRANSFER:**

2. **HEAT TRANSFER:**

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

4. **COMMINUTION (SIZE REDUCTION):** Reasons for size reduction, Factors affecting size reduction, size analysis, Sieving, Energy Mills (Ball Mill, Endrumer, Edge Rumer, Disintegrant, Colloid Mill, Hammer Mill, Cutter Mill andFluid Energy Mill etc).

5. **MIXING:** Fundamentals, Mechanisms, Mixing Equipment used in Liquid/Liquid, Liquid/Solid and Solid/Solid mixing.

6. **CLARIFICATION AND FILTRATION:** Theory, Filter Media, Filter aids, Filter selection and Equipment (Leaf filter, Filter press, Meta filters and Rotary filters).

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

8. **COMPRESSION AND COMPACTION:** The solid-air Interface, Angle of Repose, Flow rates, Mass volume relationship, Density, Heckel Plots, Consolidation, Granulation, Friability, Compression (dry method, wet method, slugging), Physics of Tabletting, tabletting machines and other equipment required, problems involved in tabletting, tablet coating, **Capsulation**: (Hard and Soft gelatin capsules).

9. **SAFETY METHODS IN PHARMACEUTICAL INDUSTRY:**
   (a) Mechanical, chemical and fire hazards problems.
   (b) Inflammable gases and dusts.
10. **EMULSIONS:** Mechanical Equipments, Specific formulation Considerations and Emulsion stability.

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

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

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

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

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

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

PARMACEUTICS-IV (INDUSTRIAL PHARMACY) [Practical]
Paper 7 **Marks 100**

NOTE: Practical of the subject shall be designed from time to time on the basis ofthe 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 thicknesstests.
- Determination of weight variation in tablets.
- Density of powder. Particle size analysis

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

PARMACEUTICS-V (BIOPHARMACEUTICS &PHARAMCOKINETICS) [THEORY]
Paper 4 **Marks 100**

1. **DEFINITIONS AND TERMINOLOGY:** Biopharmaceutics, Generic Equivalence, Therapeutic Equivalents, Bioavailability, Bioequivalence, Drug Disposition, Pharmacokinetics (LADMER: Libration, absorption, distribution, metabolism, elimination and response).

2. **GASTRO-INTESTINAL ABSORPTION:**Forces which help in transmembrane movements, Anatomical and physiological factors influencing absorption of drugs. Physicochemical properties of drugs affecting absorption. Absorption ofdifferent oral dosage forms.

3. **BIOLOGICAL HALF LIFE AND VOLUME OF DISTRIBUTION:** Introduction, types, methods of determination and application**.**

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

5. **PHARMACOKINETICS:** Introduction, Linear and Non-linear Pharmacokinetics. Application of pharmacokinetics in clinical situations.

6. **BIOAVAILABILITY AND BIOEQUIVALENCE:**
   a. Introduction.
   b. Bioavailability types, parameters, significance and study protocol.
   c. Methods of Assessment of Bioavailability
   d. Bioequivalence study designs, components and application, report format

7. **CONCEPT OF COMPARTMENT(S) MODELS:**
   I. One compartment open model
      a. Intravenous Injection (Bolus)
      b. Intravenous infusion
   II. Multicompartment models
      a. Two compartment open model
      b. IV bolus, IV infusion and oral administration
   III. Non-compartmental Model
      a. Statistical Moment Theory
      b. MRT for various compartment models
      c. Physiological Pharmacokinetic model

8. **MULTIPLE DOSAGE REGIMENS:**
   a. Introduction: principles of superposition
   b. Factors: persistent, accumulation and loss factors
   c. Repetitive Intravenous injections-One Compartment Open Model
   d. Repetitive Extravascular dosing-One Compartment Open model
   e. Multiple Dose Regimen-Two Compartment Open Model

9. **ELIMINATION OF DRUGS:**
   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.

NOTE: Practical of the subject shall be designed from time to time on the basisof the above mentioned theoretical topics and availability of the facilities, e.g.
Blood Sampling Techniques (In Laboratory Animals like dog, rabbits, mice etc. inhuman 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.

   b. Renal Excretion of Drugs: Renal clearance, Tubular Secretion and Tubular Re-absorption.
   c. Elimination of Drugs through other organs: Pulmonary excretion, salivaryexcretion, Mammilary excretion, Skin excretion and Genital excretion.

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

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

adjustment in renal disease and hepatic diseases.

12. **PHARMACOKINETICS OF INTRAVENOUS INFUSIONS:**

13. **BIOPHARMACEUTICAL ASPECTS IN DEVELOPING A DOSAGE FORM:** Drug considerations, drug product considerations, patient considerations, manufacturing considerations, pharmacodynamic considerations pharmacokinetic considerations.
14. **IN-VITRO-IN-VIVO CORRELATION (IVIVC):** Introduction, levels and determination of in-vitro/in-vivo correlation.

PARMACEUTICS-V (BIOPHARMACEUTICS &PHARAMCOKINETICS)

Practical
Paper 8 **Marks 100**

PARMACEUTICS-VI (PHARMACEUTICAL QUALITY MANAGEMENT)

Theory
Paper 5 **Marks 100**

INTRODUCTION:

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

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

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 active Ingredient.

3. **QUALITY CONTROL OF SUPPOSITORIES:** Dissolution test, Uniformity of weight, Assay of active Ingredient, Liquefaction time test and Breaking test.

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 active Ingredient.

5. **BIOLOGICAL ASSAYS:** Biological methods, Standard preparations and unitsof activity, Bioassay of antibiotics, Bioassay of insulin injection, Assay of prepared digitalis and Assay of Vitamin D.

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 before distillation.

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

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

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

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

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

PARMACEUTICS-VI (PHARMACEUTICAL QUALITY MANAGEMENT) [Practical]
Paper 9 **Marks 100**

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities e.g. Assay of various spirits, tinctures, extracts, syrups and elixirs, Assay of Ointments and suppositories, Assay of tablets and capsules, Test for alkalinity of glass, Determination of alcohol contents in the Pharmaceutical preparations and Pyrogen test. Sterility test, Determination of Ash contents, Determination of Moisture contents, Determination of total solids, Determination of viscosity of syrups, gels etc. Determination of emulsion types (Note: A minimum of 20 practicals will be performed).

FINAL PROFESSIONAL

PARMACEUTICAL CHEMISTRY-IV (MEDICINAL CHEMISTRY) [Theory]
Paper 1 Marks 100

1. **INTRODUCTION TO MEDICINAL CHEMISTRY:** Chemical constitution and biological activity: (Receptor, Theory, Structure Activity Relationships (SAR) and Drug Metabolism). Modern concept of rational drug design, pro drug, combinatorial chemistry and computer aided drug design (CADD) and conceptof antisense molecules.

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

2. **DRUG TARGETS AND DRUG DESIGNING:**
   a) Introduction and types of drug targets
   b) Introduction to molecular modeling and computational chemistry
   c) Structure based designing
   d) Ligand-based designing
   e) Various techniques in drug synthesis

3. **GENERAL PROPERTIES, CHEMISTRY, BIOLOGICAL ACTION, STRUCTRE ACTIVITY RELATIONSHIP AND THERAPEUTIC APPLICATIONS OF THE FOLLWING:**

(a) Hormones: Steroidal Hormones (Testosterone, Progesterone, Estrogen, Aldosteron and Cortisol), Proteinous Hormones (Insulin, Glucagon, Oxytocin and Vassopressin).
(b) Anti-neoplasticAgents: Tamoxifen, Fluorouracil, Mercapturine, Methotrexate and Vincristine.
(c) Sedatives and Hypnotics: Benzodiazepines, Barbiturates, Paraldehyde, Glutethimide, Chloral hydrate, and alcohols.
(d) Anaesthetics: Local anaesthetics (Procaine, Lignocaine, Eucaine, Cocaine and Benzocaine), General anaesthetics (Cyclopropane, Halothane, Nitrous oxide, Chloroform, Thiopental Sodium, Ketamine, Methohexital, Thioamylal Sodium, Fantanyl Citrate, Tribromo ethanol).
(e) Analgesics and Antipyretics: Paracetamol, Salicylic acid analogues, Quinolines derivatives, Pyrazolone and Pyrazolodiones, N - arylanthranilic acids, Aryl and heteroaryl acetic acid derivatives.
(f) Sulphonamides: Prontosil, sulphanilamide, Sulphapyridine, sulphadimidine, Sulfamethoxazole, Sulfadiazine and Sulfafurazole.
(g) Antimalarials: 4-Aminoquinolines, 8-Aminoquinolines, 9-Amino acridines, Biguanides, Pyrimidine analogues, Mefloquine and Cinchoha alkaloids.
(h) Diuretics: Mercaptomerin, Meralluride, Thiazides, Sprironolac-tone, Theophylline, Furosemide, Acetazolamiode, Ethacrynic acid and Triameterene.
(i) Antitubercular Drugs: Ethambutol, Isonicotinic acid, Hydrazid, Rifampacin, Thioguanine, Pyrazinamide, cycloserine, Ethunamide, Cytarabine, 5- Flourouracil and Dacarbazine.
(j) Antiviral Drugs: Acyclovir, Tromantadine Hydrochloride and Ribavirin.
(k) Immunosuppressant Agents: Azathioprine and Cyclosporin.

(l) Antibiotics:Penicillins, Cephalosporins, Streptomycin, Chloramphenicol, Tetracyclines, Kanamycin and Erythromycin.

PARMACEUTICAL CHEMISTRY-IV (MEDICINAL CHEMISTRY) [Practical]
Paper 6 **Marks 100**

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities e.g.Estimation of functional groups; Carboxylic, Hydroxy, Amino and Nitro groups; Determination of Molecular weights of Organic Compounds.
Synthesis of Paracetamol, Salicylic Acid, Methyl salicylate, Azobenzene, Benzoic Acid, 5-Hydroxy-1, 3-benzoxazol-2-one, Aspirin, P-nitrosophenol, 3- nitrophthalic acid, Chloro-benzoic acid. Assay of the Drugs like Sulpha drugs,Aspirin, Paracetamol, Benzyl Penicillin. Inorganic Preparations **(Note:** A minimum of 20 practicals will be conducted).

PARMACY PRACTICE-VI (CLINICAL PHARMACY-II) [Theory]
Paper 2 **Marks 100**

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

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

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

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

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

6. **CLINICAL THERAPEUTICS:**

   General Strategy: Terminology of Disease. Management and Treatment. DrugSelection.

7. **CLINICAL TOXICOLOGY:**

   (a) General information. Role of pharmacist in treatment of poisoning and general management of poisoning & over dosage. Role and Status of Poison Control Centre.

   (b) Antidotes and their mechanism of action.

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

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

10. **DISEASE MANAGEMENT:**

- Unit V: Central nervous system unit (Stroke, Epilepsy, Psychosis)
- Unit VI: Infectious diseases (Meningitis, tuberculosis, dermatological infections, Rabies, Urinary tract infection, Malaria fever, Typhoid fever, Fungal infections of skin, AIDS, Dengue fever, Common Cold, Pharyngitis & Tonsillitis, Conjunctivitis)
- Unit VII: Endocrinology Unit (Diabetes Mellitus, Hyper/Hypo-thyroidism,pituitary gland non-malignant disorders)
- Unit VIII: Oncology Unit (Types of tumors, Brief introduction to oncologicaldiseases e.g. prostate cancer, breast cancer, lungs cancer)
- Unit IX: Nephrology Unit (Renal failure, nephrotic syndrome)
- Unit X: Hematology Unit (Bleeding disorders/coagulopathies/clotting disorders e.g. thrombocytopenia, hemophilia, Vit. K deficiency, Anemia).

PARMACY PRACTICE-VI (CLINICAL PHARMACY-II) Practical

Paper 7 Marks 100

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

PARMACEUTICS-VII (PHARMACEUTICAL TECHNOLOGY) [Theory]

Paper 3 Marks 100

1. **PRINCIPLES OF PHARMACEUTICAL FORMULATION AND DOSAGE FORM DESIGN:**

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

2. **ADVANCED GRANULATION TECHNOLOGY (DESIGN & PRACTICE):** Spray Drying Granulation Technology; Roller Compaction Technology; Extrusion/Spheronization as a Granulation Technique; Single-Pot Processing **Granulation Technology:** Rapid Release Granulation Technique; Particle Coating by Centrifugation Granulation Technology.

3. **POLYMERS USED IN DRUG DELIVERY SYSTEMS:**

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

a. Sustained/ Controlled Release Drug Delivery System

- Microencapsulation technique
- Coacervation
- Solvent evaporation
- Interfacial polymerization
- Spray drying
- Developmental aspects of Matrix and Reservoir Systems

5. NOVEL GIT DRUG DELIVERY SYSTEM (DDS):

- Oral Osmotic Pumps
- Ion-Exchange Controlled DDS
- pH-Controlled DDS
- Bio/mucoadhesive DDS
- Floating DDS

6. DRUG CARRIER SYSTEM:

- Liposomes
- Niosomes

7. TARGETED DRUG DELIVERY SYSTEM:

- Active Drug Delivery System
- Passive Drug Delivery System

8. PHARMACEUTICAL BIOTECHNOLOGY:

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

PARMACEUTICS-VII (PHARMACEUTICAL TECHNOLOGY) [Practical]
Paper 8 Marks 100

NOTE: Practical of the subject shall be designed from time to time on the basis ofthe 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.

PARMACY PRACTICE-VII (FORENSIC PHARMACY)	**Theory**
Paper 4	**Marks 100**

1. **GENERAL INTRODUCTION:** Forensic Pharmacy & Forensic Pharmacist, History of Drug Legislation and Pharmacy Profession in Pakistan, National Health Policy, National Drug Policy, Essential Drugs, Prescription handling at Retail level and Record keeping, Drug Control Administration at Federal and Provincial level.

2. **ROLE OF FORENSIC PHARMACIST:** Forensic drug Measurement, Post- mortem redistribution (PMR), Medication errors, prescription forgery, product tampering, Insurance fraud, Use of drugs or alcohol in car accidents or violent actions, Legal and illegal pharmaceutical evidence in criminal investigations, use of abused drugs in the workplace, professional malpractice, quackery and healthcare fraud.

3. **PHARMACEUTICAL ETHICS:** Patents and Generics, Ethics in Sale, Ethics in Industry, Ethics in Research.
4. **STUDY OF DRUG LAWS:**

   a. The Drugs Act 1976 and rules framed there under.
   b. Provincial Drug Rules (Respective Drug Rules will be taught in the relevantprovince).
   c. Advertisement rules.
   d. Other Related rules and Legal aspects.

5. **THE PHARMACY ACT 1967:**
6. **CONTROL OF NARCOTICS SUBSTANCES ACT 1997:** Laws relating to Narcotic drugs and psychotropic substances.
7. **THE POISONS ACT 1919:**
8. **THE FACTORIES ACT 934:**
9. **SHOPS AND ESTABLISHMENTS ORDINANCE 1969 WITH RULES:**

PARMACEUTICS-VIII (PHARMACEUTICAL MANAGEMENT & MARKETING)	**[Theory]**
Paper 5	**Marks 100**

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

f. Motivation:
g. Innovation and Creativity:
h. Principals of Marketing:
i. Product Management:
j. Marketing Research:

2. **PRODUCTION MANAGEMENT:** Material Management, Planning of production, Batch record maintenance.
3. **MARKETING MANAGEMENT:**
   a. Ethical consideration of Pharmaceutical Marketing
   b. Difference between Pharmaceutical Marketing and Consumer Marketing
   c. Major stakeholders within pharmaceutical market environment.
   d. Marketing Research (Process and Methodology)
   e. Market Analysis Techniques 3Cs (Customer analysis, Company analysis, competitors analysis)
   f. Evaluating the marketing performance (audit tools and audit process)
   g. Designing sales force structure, sales force size and sales quota
   h. Marketing channels, Promotion and Advertising and Salesmanship.
4. **SALES MANAGEMENT:**Personnel, Buying, Receiving, Pricing, Sales promotion and Customer Services.
5. **BUSINESS DEVELOPMENT MANAGEMENT:** General principles, strategies,short and long term planning and objectives.
6. **BUSINESS COMMUNICATION:** Importance and benefits of business communication, components of communication, concept and problems of communication, 7C's of communications.
7. **STRATEGIES FOR SUCCESSFUL BUSINESS AND GLOBAL MEETINGS:** Background information on groups, purpose and kinds ofmeetings, solving problems in meetings, leadership responsibilities in meetings, participant's responsibilities in meetings.

NOTE: Upon completion of recognized Pharm.D. degree, a pharmacy graduate is required to undergo residency-based training for a period of 1 year in any area; at general or private Hospital, pharmaceutical industry, community pharmacy, 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.

Marks Distribution Scheme

Doctor of Pharmacy (Pharm.D)

First Professional Examination (Written Papers)

Paper No	Name of Paper	Theory Paper						Marks for Theory Paper
		SEQs			MCQs			
1	**Pharmaceutical Chemistry-I (Organic)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
2	**Pharmaceutical Chemistry-II (Biochemistry)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
3	**Pharmaceutics-1 (Physical Pharmacy)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
4	**Physiology**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
5	**Anatomy & Histology**	30 Marks	5SEQs	6 Marks Each	20 Marks	20MCQs	1 mark each	**50**
			2 hrs.			30mins		
6	**English**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		

First Professional Pharm.D
Practical Examinations

Paper No.	Name of Paper	Practical Paper		Marks for practical paper
		Division of Marks		
7	**Pharmaceutical Chemistry-I (Organic)**	1. Method /Procedure Writing	20	**100**
		2. Preparation/ Performance	30	
		3. Calculation/ Result	10	
		4. Viva Voce	30	
		5. Practical Copy	10	
8	**Pharmaceutical Chemistry-II (Biochemistry)**	1. Method /Procedure Writing	20	**100**
		2. Preparation/ Performance	30	
		3. Calculation/ Result	10	
		4. Viva Voce	30	
		5. Practical Copy	10	
9	**Pharmaceutics -I (Physical Pharmacy)**	1. Method /Procedure Writing	20	**100**
		2. Preparation/ Performance	30	
		3. Calculation/ Result	10	
		4. Viva Voce	30	
		5. Practical Copy	10	
10	**Physiology**	1. Method /Procedure Writing	20	**100**
		2. Preparation/ Performance	30	
		3. Identification of Slides	10	
		4. Viva Voce	30	
		5. Practical Copy	10	
11	**Anatomy& Histology**	1. Identification of Slides	10	**50**
		2. Identification of Bones	20	
		3. Draw & Label Diagram of Bone	5	
		4. Viva Voce	10	
		5. Practical Copy	5	

Total Marks =1000

Doctor of Pharmacy (Pharm-D)
Second Professional Examination
(Written Papers)

Paper No	Name of Paper	Theory Paper						Marks for Theory Paper
		SEQs			MCQs			
1	**Pharmaceutics-II (Dosage Forms Science)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
2	**Pharmacology and Therapeutics-I**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
3	**Pharmacognosy-I (Basic)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
4	**Pharmaceutics-III (Pharmaceutical Microbiology & Immunology)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
5	**Islamic Studies (Compulsory)**	60 Marks	5 Questions	20 Marks Each	60 + 40			**100**
			Attempt any 3 Questions					
			2hrs					
	Pakistan Studies (Compulsory)	40 Marks	4 Questions	14+13+13				
			Attempt any 3 Questions					
			1hr					
6	**Pharmaceutical Mathematics (Paper A)**	60 Marks	5 Questions	20 Marks Each	(Paper A) 60 + (Paper B) 40			**100**
			Attempt any 3 Questions					
			2hrs					
	Biostatics (Paper B)	40 Marks	4 Questions	14+13+13				
			Attempt Any three					
			1 hr					

Second Professional Pharm.D
Practical Examinations

Paper #	Name of Paper		Practical Paper Division of Marks		Marks for practical paper
6	**Pharmaceutics-II (Dosage Forms Science)**		1. Method /Procedure Writing	20	**100**
			2. Preparation/ Performance	30	
			3. Calculation/ Result	10	
			4. Viva Voce	30	
			5. Practical Copy	10	
7	**Pharmacology and Therapeutics-I**		1. Method /Procedure Writing	20	**100**
			2. Preparation/ Performance	30	
			3. Calculation/ Result	10	
			4. Viva Voce	30	
			5. Practical Copy	10	
8	**Pharmacognosy-I (Basic)**		1. Method /Procedure Writing	20	**100**
			2. Preparation/ Performance	30	
			3. Calculation/ Result	10	
			4. Viva Voce	30	
			5. Practical Copy	10	
9	**Pharmaceutics-III (Pharmaceutical Microbiology & Immunology) (Two Days)**	**1st Day Performance of the Practical**	1. Method /Procedure Writing of Two Practical	15	**100**
			2. Identification of Slides	10	
			3. Preparation/ Performance	25	
			4. Viva Voce	30	
			5. Practical Copy	10	
		2nd Day	6. Observation/ Calculation/ Result	10	

Total Marks **=1000**

Doctor of Pharmacy (Pharm-D)

Third Professional Examination

(Written Papers)

Paper No	Name of Paper	Theory Paper						Marks for Theory Paper
		SEQs			MCQs			
1	**Pathology**	30 Marks	5SEQs	6 Marks Each	20 Marks	20MCQs	1 mark each	**50**
			2 hrs			30mins		
2	**Pharmacology and Therapeutics-II**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
3	**Pharmacognosy-II (Advanced)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
4	**Pharmacy Practice-II (Dispensing, Community, Social & Administrative Pharmacy)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
5	**Pharmaceutical Chemistry-III (Pharmaceutical Analysis)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
6	**Pharmacy Practice - VIII (Computer and its Applications in Pharmacy)**	30 Marks	5SEQs	6 Marks Each	20 Marks	20MCQs	1 mark each	**50**
			2 hrs			30mins		

Third Professional Pharm-D
Practical Examinations

Paper #	Name of Paper	Practical Paper Division of Marks		Marks for practical paper
7	**Pathology**	1. Method /Procedure Writing	10	**50**
		2. Preparation/ Performance	20	
		3. Calculation/ Result	5	
		4. Viva Voce	10	
		5. Practical Copy	5	
8	**Pharmacology and Therapeutics-II**	1. Method /Procedure Writing	20	**100**
		2. Preparation/ Performance	30	
		3. Calculation/ Result	10	
		4. Viva Voce	30	
		5. Practical Copy	10	
9	**Pharmacognosy-II (Advanced)**	1. Method /Procedure Writing	20	**100**
		2. Preparation/ Performance	30	
		3. Calculation/ Result	10	
		4. Viva Voce	30	
		5. Practical Copy	10	
10	**Pharmacy Practice-II (Dispensing, Community, Social & Administrative Pharmacy)**	1. Method /Procedure Writing of TwoPractical	20	**100**
		2. Preparation/ Performance	30	
		3. Viva Voce	10	
		4. Practical Copy	30	
		5. Observation/ Calculation/ Result	10	
11	**Pharmaceutical Chemistry-III (Pharmaceutical Analysis)**	1. Method /Procedure Writing of TwoPractical	20	**100**
		2. Preparation/ Performance	30	
		3. Viva Voce	10	
		4. Practical Copy	30	
		5. Observation/ Calculation/ Result	10	
12	**Pharmacy Practice -VIII (Computer and its Applications in Pharmacy)**	1. Method /Procedure Writing of TwoPractical	10	**50**
		2. Preparation/ Performance	20	
		3. Viva Voce	10	
		4. Practical Copy	10	

***Total Marks* = 1000**

Doctor of Pharmacy (Pharm-D)

Fourth Professional Examination

(Written Papers)

Paper No	Name of Paper	Theory Paper						Marks for Theory Paper
		SEQs			MCQs			
1	**Pharmacy Practice-III (Hospital Pharmacy)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs			40mins		
2	**Pharmacy Practice - IV (Clinical Pharmacy-I)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
3	**Pharmaceutics-IV (Industrial Pharmacy)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
4	**Pharmaceutics-V (Biopharamceutics and Pharmacokinetics)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
5	**Pharmaceutics-VI (Pharmaceutical Quality Management)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		

Fourth Professional Pharm-D
Practical Examinations

Paper #	Name of Paper	Practical Paper Division of Marks		Marks for practical paper
7	**Pharmacy Practice -IV (Clinical Pharmacy-I)**	1. Method /Procedure Writing	20	**100**
		2. Preparation/ Performance	30	
		3. Calculation/ Result	10	
		4. Viva Voce	30	
		5. Practical Copy	10	
8	**Pharmaceutics-IV (Industrial Pharmacy)**	1. Method /Procedure Writing	20	**100**
		2. Preparation/ Performance	30	
		3. Calculation/ Result	10	
		4. Viva Voce	30	
		5. Practical Copy	10	
9	**Pharmaceutics-V (Biopharamceutics and Pharmacokinetics)**	1. Method /Procedure Writing	20	**100**
		2. Preparation/ Performance	30	
		3. Calculation/ Result	10	
		4. Viva Voce	30	
		5. Practical Copy	10	
10	**Pharmaceutics-VI (Pharmaceutical Quality Management)**	1. Method /Procedure Writing of TwoPractical	20	**100**
		2. Preparation/ Performance	30	
		3. Viva Voce	10	
		4. Practical Copy	30	
		5. Observation/ Calculation/ Result	10	

***Total Marks* = 900**

Doctor of Pharmacy (Pharm-D)

Final Professional Examination

(Written Papers)

Paper No	Name of Paper	Theory Paper						Marks for Theory Paper
		SEQs			**MCQs**			
1	**Pharmaceutical Chemistry-IV (Medicinal Chemistry)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs			40mins		
2	**Pharmacy Practice - V (Advanced Clinical Pharmacy-II)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
3	**Pharmaceutics-VII (Pharmaceutical Technology)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
4	**Pharmacy Practice - VI (Forensic Pharmacy)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		
5	**Pharmacy Practice-VII (Pharmaceutical Management and Marketing)**	60 Marks	10SEQs	6 Marks Each	40 Marks	40MCQs	1 mark each	**100**
			2 hrs20mins			40mins		

Final Professional
Pharm- D
Practical Examinations

Paper #	Name of Paper	Practical Paper		Marks for practical paper
		Division of Marks		
7	**Pharmaceutical Chemistry-IV (Medicinal Chemistry)**	1. Method /Procedure Writing	20	**100**
		2. Preparation/ Performance	30	
		3. Calculation/ Result	10	
		4. Viva Voce	30	
		5. Practical Copy	10	
8	**Pharmacy Practice -V (Advanced Clinical Pharmacy-II)**	1. Method /Procedure Writing	20	**100**
		2. Preparation/ Performance	30	
		3. Calculation/ Result	10	
		4. Viva Voce	30	
		5. Practical Copy	10	
9	**Pharmaceutics-VII (Pharmaceutical Technology)**	1. Method /Procedure Writing	20	**100**
		2. Preparation/ Performance	30	
		3. Calculation/ Result	10	
		4. Viva Voce	30	
		5. Practical Copy	10	

***Total Marks* = 800**

LIST OF RECOMMENDED BOOKS
ENGLISH

Functional English:

Grammar:

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

Writing:

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

Reading/Comprehension:

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

Speaking:

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

Communication Skills:

6. **Reading/Comprehension:**

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

Technical Writing and Presentation Skills:

8. **Essay Writing and Academic Writing;**

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

10. **Presentation Skills;**

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

12. **Reading;**

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

PHYSICAL PHARMACY

1. Allen LV, Popovich NG. **Ansel's pharmaceutical dosage forms and drug delivery systems**. 8th Ed. Lippincott Williams & Wilkins New York; 2005.
2. Attwood D, Flocence AT. Surfactant Systems: Their Chemistry, Pharmacy and Biology. 1st Ed. London: Chapman and Hall Ltd; 1982.
3. Aulton ME. **Aulton's pharmaceutics: the design and manufacture ofmedicines**. Churchill Livingstone; 2007.
4. Britain MD. **British national formulary**. 54th Ed. British Medical Association; 2001.
5. Carstensen JT. **Pharmaceutics of solids and solid dosage forms**. 1st Ed. Wiley;1977.
6. Connors KA, Mecozzi S. **Thermodynamics of pharmaceutical systems**: An introduction to Theory and Applications. 2nd Ed. Wiley & Sons; 2010.
7. Cooper JW, Gunn C, Carter SJ. **Cooper and Gunn's Tutorial Pharmacy**. 6th Ed. New Delhi: CBS Publishers & Distributors; 2004.
8. Davis H. **Bentley's Text Book of Pharmaceutics**. 2nd Ed. Tindall and Cox Publishers; 1961.
9. Finlay WH. **The mechanics of Inhaled pharmaceutical aerosols**: Anintroduction. 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. FinarIL. **Organic Chemistry**. 6thEd. 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, TatchellAR, 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. ChaterjeeMN. **Medical Biochemistry**. 7th Ed. Jaypee Brothers Medical Publishers; 2007.
5. Conn EE, Stumpf PK. **Outlines of Biochemistry**. 5th Ed. John Willey & Sons;1999.
6. Lehninger AL. **Principles of Biochemistry**. 4th Ed. CBS Publisher; 2004.
7. Murray R, Rodwell V, Bender D, Kathleen M, Botham P, Weil A et al. **Harper's Illustrated Biochemistry**. 28th Ed. Print-Hall; 2009.
8. West ES, Todd RW, Van BTJ. **Text Book of Biochemistry**. The MacMillan Co;1996.

PHYSIOLOGY

1. Chatterjee CC. **Human Physiology**. 9th Ed. Medical Allied Agency; 1994.
2. Cyril A, Neil E, JoelsN. **Samson Wright's Applied Physiology**.13thEd.OxfordUniversity Press; 1992.
3. Guyton AC. **Text Books of Medical Physiology**. 9th Ed. W B SaundersCompany; 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. 6thEd. 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. WestPublishing 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. McGrawHill; 2010.
12. William F, Ganong WF. **Review of Medical physiology.** 22nd Ed. Prentice HallInternational Inc; 2005.

ANATOMY & HISTOLOGY

Anatomy

1. Drake RL, VoglWA, Mitchell AWM. **Gray's Anatomy**: Descriptive and Applied.2nd Ed. Churchil Living Stone; 2009.
2. Grant B. **A Method of Anatomy**. 9th Ed. Bailliere Tinal and Co Ltd; 1975.
3. Hamilton WJ. **A Textbook of Anatomy**. 2nd Ed. Macmillan and Co; 1976.
4. Kuntzman AJ, Tortora GJ. **Anatomy and physiology for the manualtherapies**. 1st Ed. John Wiley & Sons; 2009.
5. Last RJ. **Anatomy**: Regional and Applied. 11th Ed. J and A Churchill Ltd; 2001.
6. Martini F, Ober WC, Garrison CW, Welch K, Hutchings RT. **Fundamentals ofAnatomy 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**. 15thEd.OxfordUniversity Press; 1986.
9. SaladinKS, 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. Hammersen F. **Histology:** Color atlas of microscopic anatomy. 3rd Ed. Lee & Febijer Co; 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 & DeepPublications 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 PublicationIslamabad, Pakistan.
4. Muhammad HU. **Emergence of Islam.** IRI, Islamabad.
5. Muhammad HU. **Introduction to Islam.** Maulana Muhammad Yousaf Islahi.
6. Muhammad HU. **Muslim Conduct of State.**
7. Waliullah M. **Muslim Jrisprudence and the Quranic Law of Crimes.** IslamicBook Service; 1982.
8. Zia-ul-Haq M. **Introduction to Al-Sharia Al-Islamia.** AllamaIqbal OpenUniversity, Islamabad; 2001.

PHARMACEUTICS (DOSAGE FORM 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.
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6. DavisH. **Bentley's Text book of Pharmaceuticals**. 2nd Ed. Tindall and Cox Publishers; 1961.
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11. Kleemann A, Engel J, Kutscher B, Reichert D. **Pharmaceutical Substances**: Synthesis, Patents, Applications of the most relevant APIs. 5th Ed. Thieme; 2008.
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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.
15. Rowe RC. **Handbook of Pharmaceutical Excipients**. 6th Ed. Pharmaceutical Press; 2009.
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18. Zinc G. **Remington: The Science and Practice of Pharmacy**.21stEd. Philadelphia College of Pharmacy and Science; 2005.

PHARMACEUTICS (PHARM. MICROBIOLOGY &IMMUNOLOGY)

1. Brooks G, Carroll KC, Butel J, Morse S, Mietzner T. **Jawetz, Melnick & Adelberg's Medical Microbiology and Immunology**. 24th Ed. Churchill Livingstone; 2010.
2. Collins CH, Lynes PM, Grange JM, Falkinham JO. Collins & Lyne's **Microbiological Methods**. 8th Ed. Vutterworth Heineman; 2004.
3. Fraise A, Lambert PA, Maillard JY. **Russell, Hugo & Ayliffe's Principles and Practice of Disinfection, Preservation & Sterilization**. 4th Ed. Wiley Blackwell; 2004.
4. Harvey RA, Champe PC,Fisher BD. **Microbiology:**Lippincott's IllustratedReviews Series. 4th Ed. William & Willkins; 2004.
5. Hugo WB, Russell AD. **Pharmaceutical Microbiology**. 7th Ed. Black WellScience Ltd; 1998.
6. Hugo WB, Denyer SP, Hodges NA, Gorman SP. **Hugo and Russell's pharmaceutical microbiology**. 7th Ed. Wiley Blackwell; 2004.
7. McKane L, Kandel J. **Microbiology**: Essentials and Application. 2nd Ed. McGrawHill Inc; 1995.
8. Pelczar MJ. Microbiology. 7th Ed. McGraw Hill Inc; 2007.
9. Pommerville JC. **Alcamo's Funtamentals of Microbiology**. 9th Ed. John Bartlett Publishers; 2010.
10. Singleton P, Sainsbury D. **Dictionary of Microbiology and Molecular Biology.** 3rd Ed. John Willey & Sons; 2006.
11. Willey J, Sherwood L,Woolverton C. **Prescott's Microbiology**. 8th Ed. C Brown Publishers; 2010.

PHARMACOLOGY & THERAPEUTICS

1. Brunton L, Lazo J, Parker K. **Goodman & Gilman's Pharmacological Basis of Therapeutics**. 11th Ed. McGraw Hill Book Company; 2005.
2. Chang HM, But PPH, YaoSC, Wang LL, Yeung SCS. **Pharmacology and applications of Chinese Materia Medica**. 3rd Ed. World Scientific Pub Co Inc; 2000.
3. Ebadi M. **Pharmacology**. 3rd Ed. Little Brown & Company; 1996.
4. Harvey RA, Champe PC. **Lippincott's Illustrated Reviews: Pharmacology**. 4th Ed. Lippincott William & Wilkins; 2008.
5. Humphrey P. **Rang & Dale's Pharmacology**. 6th Ed. Churchil Livingstone; 2007.
6. Katzung BG, Masters SB, Trevor AJ. **Basic & Clinical Pharmacology**. 11th Ed. McGraw Hill; 2009.
7. Koda KMA, Young LY, Kradjan WA, Guglielmo BJ, Alldredge BK, Corelli RL. **Applied therapeutics**: the clinical use of drugs. 9th Ed. Lippincott Williams & Wilkins; 2008.
8. Laurence DR.**Clinical Pharmacology**. 8th Ed. ELBS Publishers; 1998.
9. Ritter JM, Levis LD. **A Text Book of Clinical Pharmacology**. 5thEd.OxfordUniversity Press; 2008.
10. Satorkar RS, Bhandarkar SD. **Pharmacology and Pharmacotherapeutics**. 19th Ed. Bomby: Popular Prakashan; 1998.
11. Tripathi JD. **Essentials of Medical Pharmacology**. 6th Ed. Jaypee Brothers;2008.
12. Wecker L, Crespo L, Dunaway G, Faingold C, Watts S. **Brody's Human Pharmacology**. 5th Ed. Mosby Inc; 2009.

PHARMACOGNOSY

1. Anonymous. **Monographs of Unani Medicine.** Hamdard Foundation Pakistan;2003.
2. Baker BM, Bender DA. **Vitamins in Medicine**. 12th Ed. Academic Press; 1982.
3. Brain KR, Turner TD. **The Practical Evaluation of Phytopharmaceuticals**. 1st Ed. Scientechnica Publishers; 1975.
4. Braun L, Cohen M. **Herbs and Natural Supplements**: An Evidence Based Guide.3rd Ed. London: Elsevier Mosby; 2010.
5. Chauhan P. **Ayurvedic Pharmacognosy**. 1st Ed. Sonali Publications; 2007.
6. Cutler SJ, Cutler HG. **Biologically Active Natural Products**: Pharmaceuticals. 1st Ed. CRC Press Publisher; 1999.
7. Dewick PM. **Medicinal Natural Products**: A Biosynthetic Approach. 1st Ed. John Wiley & Sons; 1997.
8. Evans WC, Trease GE, Evans D. **Trease and Evan's Pharmacognosy**. 16th Ed.Elsevier Health Sciences Publisher; 2009.
9. Forhne D, Pfander HJ. **Poisonous Plants**: A Hand Book for Doctors, Pharmacists, Toxicologists, Biologists and Veterinarians. 2nd Ed. Timber Press; 2005.
10. Harborne JB, Baxter H. **The Hand Book of Natural Flavonoids**. 2nd Ed. John Willey & Son; 1999.

11. Jackson BP. **Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices**. 2nd Ed. CBS Publishers; 2005.
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13. Lesley Braun and Marc Cohen. **Herbs and Natural Supplements**: An evidenceBased guide. 3rd Ed. London: Elsevier Mosby; 2010.
14. Lockwood B. **Nutraceuticals**: A Guide for Healthcare Professionals. 2nd Ed. Pharmaceutical Press; 2007.
15. Mannito P. **Biosynthesis of Natural Products.** John Wiley & Sons; 1981.
16. Manske RHF. **Alkaloids:** Chemistry and Physiology. Academic Press; 1970.
17. Partab Chauhan. **Ayurvedic Pharmacognosy**. 1st Ed. Sonali Publications; 2007.
18. Ross IA. **Medicinal Plants of the World**. 2nd Ed. Humana Press; 2003.
19. Smith AB. **Poisonous Plants of All Countries**. 2nd Ed. Periodical Expert Book; 1988.
20. Smith AB. **Poisonous Plants of all Countries**: With the Active, Chemical Principles Which They Contain; and the Toxic Symptoms Produced by Each Group. 4th Ed. General Books LLC; 2010.
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22. Wichtl M. **Herbal Drugs and Phytopharmaceuticals**. 3rd Ed. Medpharm Publishers; 2004.

PHARMACY PRACTICE (PHARMACEUTICAL MATHEMATICS)

1. Bali N, Gupta P, Gandhi C. **A Textbook of Pharmaceutical Mathematics**. 2nd Ed. Laxmi Publications; 2008.
2. Edvards CH, Penney DE. **Calculus and Analytic Geometry**. 5th Ed. PrenticeHall Inc; 1999.
3. Hoel PG, PortSC, Stone CJ. **Introduction to Statistical Theory**. 1st Ed. BrooksCole; 1972.

PAKISTAN STUDIES

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