7. **ALCOHOL DETERMINATION:** Alcoholometric methods, Problem during distillation of alcohol, Method for liquids containing less than 30% or more than 30% alcohol and special treatment before distillation.

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

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

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

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

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

PHARMACEUTICS-VI (PHARMACEUTICAL QUALITY MANAGEMENT) (Practical)

Paper 9 **Marks 100**

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

FINAL PROFESSIONAL

PHARMACEUTICAL CHEMISTRY-IV (MEDICINAL CHEMISTRY) (Theory)

Paper 1 **Marks 100**

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

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

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

2. DRUG TARGETS AND DRUG DESIGNING:

a) Introduction and types of drug targets

b) Introduction to molecular modeling and computational chemistry

c) Structure based designing

d) Ligand-based designing

e) Various techniques in drug synthesis

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

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

PHARMACEUTICAL CHEMISTRY-IV (MEDICINAL CHEMISTRY) (Practical)

Paper 6 **Marks 100**

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

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

Paper 2 **Marks 100**

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

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

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

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

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

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

7. **CLINICAL TOXICOLOGY:**

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

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

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

10. DISEASE MANAGEMENT:

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

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

Paper 7 **Marks 100**

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

- Student are required to take/present verbal presentation, communication, written and problem-solving skills, critical analysis of data and provision of care through a weekly conference and projects

PHARMACEUTICS-VII (PHARMACEUTICAL TECHNOLOGY) (Theory)

Paper 3 **Marks 100**

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

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

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

4. **NOVEL DRUG DELIVERY SYSTEM (DDS):**
   Sustained/ Controlled Release Drug Delivery System
   i. Microencapsulation technique
      - Coacervation
      - Solvent evaporation
      - Interfacial polymerization
      - Spray drying
   ii. Developmental aspects of Matrix and Reservoir Systems

5. NOVEL GIT DRUG DELIVERY SYSTEM (DDS):

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

6. DRUG CARRIER SYSTEM:

- Liposomes
- Niosomes

7. TARGETED DRUG DELIVERY SYSTEM:

- Active Drug Delivery System
- Passive Drug Delivery System

8. PHARMACEUTICAL BIOTECHNOLOGY:

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

PHARMACEUTICS-VII (PHARMACEUTICAL TECHNOLOGY) (Practical)

Paper 8 **Marks 100**

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

- Various techniques to develop the formulation,
- Granulation technology,
- Study of drug delivery systems,
- Biotechnological aspect of product development,
- In-vitro Quality Control of various dosage forms.
- Microbial assay,
- Particle size analysis using various methods,
- Stability studies of Pharmaceuticals,
- Coating of particles and to prepare,
- Examine and control specifications of packaging materials.

PHARMACY PRACTICE-VII (FORENSIC PHARMACY) (Theory)

Paper 4 **Marks 100**

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

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

3. **PHARMACEUTICAL ETHICS:** Patents and Generics, Ethics in Sale, Ethics in Industry, Ethics in Research.

4. **STUDY OF DRUG LAWS:**

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

5. **THE PHARMACY ACT 1967:**

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

7. **THE POISONS ACT 1919:**

8. **THE FACTORIES ACT 934:**

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

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

Paper 5 **Marks 100**

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

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

2. **PRODUCTION MANAGEMENT:** Material Management, Planning of production, Batch record maintenance.

3. **MARKETING MANAGEMENT:**
   a. Ethical consideration of Pharmaceutical Marketing
   b. Difference between Pharmaceutical Marketing and Consumer Marketing
   c. Major stakeholders within pharmaceutical market environment.
   d. Marketing Research (Process and Methodology)
   e. Market Analysis Techniques 3Cs (Customer analysis, Company analysis, competitors analysis)
   f. Evaluating the marketing performance (audit tools and audit process)
   g. Designing sales force structure, sales force size and sales quota
   h. Marketing channels, Promotion and Advertising and Salesmanship.

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

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

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

7. **STRATEGIES FOR SUCCESSFUL BUSINESS AND GLOBAL MEETINGS:** Background information on groups, purpose and kinds of meetings, solving problems in meetings, leadership responsibilities in meetings, participant's responsibilities in meetings.

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