

Syllabus for PET examination – PhD (Pharmaceutical sciences)

Subject Specific

Unit I: Pharmaceutics

- Basics of Pharmacokinetics: Processes involved in transportation of drug across cell membrane. Absorption, distribution, protein binding, metabolism, and excretion of drugs and factors affecting these processes. Pharmacokinetic parameters, their evaluation and applications, elimination and absorption rate constants, half-life, clearance: renal, hepatic and organ clearance, volume of distribution etc., Pharmacokinetics models and physiological models, noncompartmental analysis, concept of nonlinear pharmacokinetics, application of pharmacokinetics in clinics, therapeutic drug monitoring and dose adjustments in renal and hepatic diseases.
- In vitro and in vivo product performance: BCS classification, dissolution: factors, models and apparatus, bioavailability and bioequivalence principles, study designs and regulatory considerations, permeation models and IVIVC.
- Controlled and sustained drug delivery systems: General principles, fundamentals of rate-controlled drug delivery, classification of systems, role of polymers and evaluation parameters.
- Formulation and evaluation of novel drug delivery systems: Conceptual overview of barriers, polymer selection, formulation approaches and evaluation for oral, transmucosal, gastro-retentive, ocular, transdermal and parenteral systems.
- Targeted drug delivery systems: Rationale, biological processes in targeting, pharmacokinetic and pharmacodynamic considerations, examples of particulate carriers, liposomes and nanoparticles – concepts and evaluation.
- Biotechnology: Proteins and nucleic acids basics, genetic engineering concepts, recombinant products and applications, immune system overview, monoclonal antibodies, and high-level overview of mammalian/plant cell culture concepts and their applications.

Unit II: Pharmaceutical chemistry

- Basic concepts of Reaction Mechanisms and stereochemistry
- Recent advances in the treatment of Metabolic disorders, Cardiovascular diseases, CNS diseases, chemotherapeutic agents for treatment of Cancer, Malaria, Viral and Tuberculosis infections.

- New drug development and lead approach: Identification of lead molecule, Lead optimization for the new drug development, Pharmacophore mapping
- Rational Drug Design (Ligand Based): QSAR, physicochemical parameters. Hansch analysis, Free Wilson analysis.
- Molecular modelling: Molecular mechanics, quantum mechanics, docking, advanced concepts of molecular modelling.
- Design and application of prodrugs.
- Combinatorial chemistry for peptide and small molecule library.
- Instrumental Methods of Analysis:
- UV - Visible spectroscopy: Introduction, Beers law, Wood Wards Fiesher rules for calculating absorption maximum, instrumentation and applications.
- IR Spectroscopy: Basic Principles- Molecular vibrations, vibrational frequency and its influencing factors, sampling techniques, instrumentation and applications of FT - IR.
- NMR Spectroscopy: Principle, Chemical shifts, Spin - spin splitting, coupling constants, instrumentations and applications (^1H -NMR, ^{13}C -NMR).
- Mass spectroscopy: Principle, Ionization Techniques, Fragmentation pattern, Instrumentation and applications.
- Chromatographic separation-HPLC and GC: Principles, instrumentation with special emphasis on stationary phases, columns, detectors and applications.
- Hyphenated techniques-LC-MS, LC-MS/MS, GC-MS
- Structural Elucidation: Structural Elucidation of some important drugs by using spectroscopic data. [UV, IR, ^1H NMR, ^{13}C NMR, Mass].

Unit III: Pharmacology

- Basic Principles in Drug Therapy: Site and mechanisms of drug action, receptor families and regulation, drug-receptor interactions, cellular transduction mechanisms, adverse drug reactions, medication safety and adherence considerations.
- Pharmacovigilance and Clinical Trials: Study designs, conduct, safety monitoring frameworks and ethical considerations.
- Chemotherapy: Principles of chemotherapy and representative antimicrobial and anticancer approaches.
- Systems Pharmacology: Highlights of cardiovascular, endocrine and CNS pharmacology —mechanisms and representative therapeutic approaches.
- Organization of screening: Principles for preclinical pharmacological evaluation including in vitro and in vivo techniques, endpoints and alternatives to animal experimentation.
- Principles and applications of molecular biology techniques: PCR, RT-PCR, blotting and immunoassays — principles, interpretation and applications.
- Recent advances in therapeutics: Selected emerging topics.

Unit IV: Pharmacognosy

- Fundamentals of Pharmacognosy and Phytochemical Extraction: Principles and methodologies for extraction of crude drugs; comparative evaluation of conventional and modern techniques with selection criteria, Preliminary phytochemical screening of plant extracts, General strategies for isolation and purification of major classes of phytoconstituents, Quality considerations in crude drug processing and extract development
- Herbal Drug Technology: Classification and types of herbal formulations, rationale for polyherbal formulations, herbal cosmetics overview, and high-level manufacturing, packaging and GMP concepts.
- Classes of Nutraceuticals: Phytochemicals (polyphenols, flavonoids, carotenoids, alkaloids, terpenoids), Nutrient-based nutraceuticals (vitamins, minerals, fatty acids, amino acids), Probiotics, prebiotics and synbiotics, Functional foods and fortified foods, Marine, microbial and algal nutraceuticals, Dietary fibers and bioactive peptides.
- Quality control of herbal drugs : Application of chromatographic techniques in natural product analysis: Thin Layer Chromatography (TLC), High Performance Thin Layer Chromatography (HPTLC), High Performance Liquid Chromatography (HPLC), Gas Chromatography (GC), UV–Visible spectroscopy, Infrared (IR) spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy, Mass spectrometry, Preparation and standardization of herbal extracts suitable for solid dosage forms (tablets, capsules, etc.), Different methods of evaluation of crude drugs and Quality control parameters for herbal products
- Regulatory Affairs and Intellectual Property in Herbal Drugs: World Health Organization (WHO) guidelines for herbal medicines, Standards for pesticide residues, Limits for aflatoxins and contaminants, National and international regulatory frameworks governing herbal formulations, Current regulatory status of herbal products in India, Patents and Intellectual Property Rights (IPR) related to herbal drugs, Documentation, compliance, and ethical considerations in herbal research.
- Plant Biotechnology: Plant tissue culture techniques and their pharmaceutical applications, Micropropagation and clonal multiplication of medicinal plants, biotransformation processes for production of pharmaceutically important metabolites, Emerging trends in plant biotechnology for drug discovery and large-scale production
- Current Developments: Selected examples of herbal research in anticancer, antidiabetic, immunomodulatory domains and emerging translational trends.