PhD Entrance Syllabus – Pharmaceutics

Unit 1: Preformulation Studies and Drug-Excipient Compatibility

- Preformulation studies involving physical, chemical, and pharmaceutical characteristics of drug substances.
- Study of formulation additives including diluents, binders, disintegrants, lubricants, preservatives, etc.
- Understanding drug-excipient interactions and incompatibilities.

Unit 2: Design and Technology of Dosage Forms

- Technology and equipment used for development of solid, liquid, semisolid, sterile dosage forms, and aerosols.
- Formulation and evaluation of tablets, tablet coating, capsules, solutions, suspensions, creams, ointments, and suppositories.

Unit 3: Stability Studies and Polymer Applications

- Stability testing protocols, kinetics of drug degradation, shelf-life prediction, and stability-indicating assays.
- Classification and pharmaceutical applications of polymers including biodegradable polymers.
- Mechanisms of biodegradation and physicochemical characterization of polymers.

Unit 4: Advanced Packaging Technology

- Concepts and materials used in pharmaceutical packaging, including glass, plastics, metals, and polymers.
- Testing of containers, closures, and package systems; packaging of specialized dosage forms.
- Legal, regulatory, and stability aspects of packaging systems.

Unit 5: Fundamentals of Biopharmaceutics and Pharmacokinetics

- Pharmacokinetic models (one- and two-compartment), ADME parameters, and dosage regimen calculations.
- Kinetics of multiple dosing, sustained-release formulations, and blood level maintenance.

Unit 6: Bioavailability and Bioequivalence Evaluation

- Concepts, significance, and influencing factors of bioavailability and bioequivalence.
- In vitro–in vivo correlation, study design, and regulatory/statistical considerations.

Unit 7: Controlled and Novel Drug Delivery Systems

- Principles, design, and evaluation of controlled drug delivery systems and prodrug approaches.
- Microencapsulation techniques and evaluation of drug release kinetics.
- Formulation and assessment of transdermal drug delivery systems and osmotic pumps.

Unit 8: Targeted and Nanocarrier Drug Delivery

- Concepts and strategies for drug targeting and site-specific delivery.
- Design and use of liposomes, niosomes, dendrimers, pharmacosomes, nanoparticles, and resealed erythrocytes.

Unit 9: Regulatory Guidelines and Quality Assurance

- GMP, CGMP, GLP, WHO, USFDA, and ISO guidelines for pharmaceutical manufacturing.
- Quality control measures, ICH guidelines, in-process quality testing, and SOP documentation.

Unit 10: Product Development, Scale-Up, and Clinical Evaluation

- Pilot plant and scale-up techniques, technology transfer processes.
- Product development, troubleshooting, validation of manufacturing processes and equipment.
- Clinical trial phases, toxicological studies, and environmental compliance (sewage and pollution control).

PhD Entrance Syllabus – Pharmacology

Unit 1: Fundamentals of Clinical Pharmacology

- Scope and organization of clinical pharmacology
- Cellular transduction mechanisms
- Pharmacokinetics & pharmacogenetics
- Adverse drug reactions & drug interactions
- Pediatric, geriatric pharmacology
- Drug use in pregnancy and lactation
- Patient compliance and therapeutic monitoring

Unit 2: Autonomic Nervous System

- Neurotransmission in ANS and somatic systems
- Muscarinic & adrenergic receptors (agonists/antagonists)
- Anticholinesterase agents
- Neuromuscular junction pharmacology
- Serotonin receptors and ocular pharmacology

Unit 3: Central Nervous System

- CNS neurotransmission principles
- General & local anesthetics
- Hypnotics, sedatives, and alcohol
- Psychiatric disorders: antipsychotics, antidepressants
- Antiepileptics, migraine therapy
- Neurodegenerative disease treatment
- Opioids, drug addiction, and abuse

Unit 4: Autacoids and Inflammation

- Histamine, bradykinin, eicosanoids
- NSAIDs, analgesics, gout medications
- Asthma pharmacotherapy

Unit 5: Cardiovascular and Renal System

- Diuretics and antihypertensives
- Heart failure and ischemia therapy
- Antiarrhythmics, lipid-lowering drugs
- Hematopoietic agents, anticoagulants, antiplatelets

Unit 6: Gastrointestinal and Endocrine System

- Peptic ulcer, diarrhoea, constipation therapy
- GI motility, emesis, bile acids
- Hormonal therapies: thyroid, insulin, sex hormones
- Corticosteroids, calcium metabolism drugs
- Vasopressin and water balance

Unit 7: Chemotherapy and Immunopharmacology

- Antibacterials: sulphonamides, quinolones, β-lactams, etc.
- Antiprotozoals, anthelmintics
- Antitubercular, antifungal, antiviral agents
- Anticancer chemotherapy
- Immunosuppressants and immunostimulants
- Newer chemotherapeutic drugs

Unit 8: Recent Advances in Pharmacology

- Receptor dynamics, G-proteins, cyclic nucleotides
- Apoptosis, TNF, nitric oxide
- Ion channels, neurosteroids, cannabinoids
- Angiotensin modulators, melatonin, antioxidants
- Gene therapy and peptide modulators

Unit 9: Pharmacological Methods

- Drug screening and evaluation techniques
- Behavioral pharmacology, CNS drug evaluation
- Cardiovascular and antiulcer drug models

- Use of in vitro and transgenic models
- Cancer and antifertility drug testing
- Antioxidant assay methods

Unit 10: Toxicology and Regulatory Guidelines

- Principles of drug toxicity
- Preclinical safety evaluation
- Regulatory and ethical requirements for animal experimentation
- GLP and laboratory animal care standards

PhD Entrance Syllabus – Pharmaceutical Chemistry

Unit 1: Fundamentals of Drug Design

- Physicochemical properties and their relation to drug action
- Metabolic transformations and metabolic antagonism
- Stereochemistry in drug-receptor interactions
- Isosterism and bioisosterism in structural variations
- Role of conformational analysis in drug development

Unit 2: Principles and Strategies of Drug Design

- Concepts of drug design: Analogue synthesis vs rational design
- Discovery of lead compounds and pharmacophoric identification
- Role and design of prodrugs and soft drugs
- QSAR (Quantitative Structure-Activity Relationship)
- Introduction to molecular modeling

Unit 3: Organic Name Reactions in Drug Synthesis

- Claisen-Schmidt, Perkins, Friedel-Crafts, Aldol condensations
- Mannich reaction (e.g. Tolmetin, Atropine)
- Beckmann and Wagner-Meerwein rearrangements
- Wittig reaction
- Oppenaur oxidation and MPV reduction

Unit 4: Alkaloids

- Classification, isolation, purification
- Structure determination techniques
- Constitution and chemistry of morphine, reserpine, and quinine

Unit 5: Steroids and Related Natural Products

- Stereochemistry and nomenclature
- Structure elucidation of cholesterol, diosgenin
- Chemistry of cardiac glycosides

Unit 6: Peptides, Proteins, and Nucleic Acids

- Synthesis of amino acids and peptides
- End-group analysis
- Structural insights into insulin, vasopressin, oxytocin
- DNA & RNA structural features

Unit 7: Antibiotics

- Classification of antibiotics
- Chemistry and structure of penicillins, tetracyclines
- Polypeptide antibiotics

Unit 8: Other Natural Product Classes

- Flavonoids: Rutin and quercetin
- Triterpenoids: General structure and chemical features
- Coumarins: Isolation and structural elucidation of xanthotoxin and psoralene

Unit 9: Medicinal Chemistry – Major Drug Classes I

- Cardiovascular drugs: Antihypertensives, antiarrhythmics, antianginals, antihyperlipidemics
- Psychopharmacological agents: Antipsychotics, antidepressants, anxiolytics
- Structure-activity relationships (SAR) of key classes

Unit 10: Medicinal Chemistry – Major Drug Classes II

- Chemotherapeutics: Antivirals (incl. AIDS), anticancer agents
- Immunomodulators
- Radioprotective agents
- Analgesics & anti-inflammatory drugs: Prostaglandins, NSAIDs, steroids
- Diuretics

PhD Entrance Syllabus – Pharmacognosy & Phytochemistry

Unit 1: Introduction to Pharmacognosy

- General introduction to pharmacognosy and its importance in herbal drug industry
- Classification with special reference to chemotaxonomy
- Pharmacognostical evaluation and their importance in raw material standardization

Unit 2: Genetics in Pharmacognosy

- Mendel's laws of heredity and their application to pharmacognosy
- Chemical races, selections, hybridization, polyploidy, mutation
- Plant growth hormones – application and effect on plant growth and constituents

Unit 3: Comparative Phytochemistry

- Relationship between phytochemistry and taxonomy
- Comparative phytochemistry of alkaloids, flavonoids and C-glycosides

Unit 4: Plant Tissue Culture

- Techniques for initiation and maintenance of cultures
- Immobilized cell techniques, Biotransformation studies
- Production of active constituents using suspension, static and hairy root cultures
- Bioreactors and applications of tissue culture

Unit 5: Recent Advances in Pharmacognosy

- Drugs of plant origin with anticancer, antidiabetic, anti-inflammatory, hepatoprotective, adaptogenic and immunomodulating properties

- Skin irritants and sensitizing agents from plants and marine sources
- Plant-based sweeteners

Unit 6: Phytochemistry and Isolation Techniques

- Phytochemical & biological screening methods
- Isolation, purification and characterization of phytoconstituents
- Examples: Alkaloids (Morphine, Quinine), Glycosides (Sennosides, Glycyrrhizine, etc.)

Unit 7: Biogenesis and Pathways

- Investigation and methods of biogenetic pathways
- Biogenetic routes for Alkylamine, Pyridine, Piperidine, Tropane, Quinoline, Isoquinoline, Diterpene, Indole, Cardiac glycosides, Coumarins, Flavones

Unit 8: Herbal Drugs and Cosmetics

- Study and formulation of herbal drugs used in therapeutics and cosmetics

Unit 9: Cultivation & Agrotechnology

- Herbarium preparation, histological techniques, microphotography
- Quantitative microscopy and pollen grain analysis
- Cultivation methods and economic importance of medicinal plants like Glycyrrhiza, Ipecac, Mentha, Poppy, Psyllium, Senna, etc.

Unit 10: Standardization and Instrumental Techniques

- Chromatographic methods: column, paper, TLC, HPTLC, GLC, HPLC, DCCC
- Spectroscopy methods: UV, IR, NMR, 1HNMR, 13CNMR, Mass spectrometry
- Standardization and quality control of plant products

PhD Entrance Syllabus – Pharmacy Practice

Unit 1: Clinical Pharmacy Fundamentals

- Definition, development and scope of clinical pharmacy
- Clinical pharmacokinetics and pharmacodynamics
- Clinical evaluation of new drugs and phases of clinical trials
- Clinical laboratory tests and imaging pharmaceuticals
- Drugs in special patient groups (pregnancy, neonates, elderly)
- Genetics in drug response
- Drug therapy monitoring and patient data analysis

Unit 2: Toxicology and Emergency Management

- Occupational and environmental toxicology
- Heavy metal intoxication and chelators
- Insecticide poisoning and OTC toxicity
- Organ-specific toxicities (dermatological, ocular, cardiac, etc.)
- Emergency treatment of poisoning
- Poison information centre management

Unit 3: Cardiovascular and Respiratory Pharmacotherapy

- Hypertension, CHF, IHD, arrhythmias, hyperlipidaemias
- Asthma, COPD, drug-induced pulmonary diseases

Unit 4: Renal and Endocrine Pharmacotherapy

- Renal failure, dialysis, drug dosing in renal dysfunction
- Diabetes, thyroid disorders, oral contraceptives, HRT, osteoporosis

Unit 5: Nervous System and Psychiatric Disorders

- Epilepsy, Parkinson's disease, Alzheimer's, stroke, neuralgias
- Schizophrenia, depression, anxiety, sleep disorders

Unit 6: Gastrointestinal, Immunological and Rheumatic Disorders

- Ulcers, IBD, hepatitis, liver dysfunction, diarrhoea, constipation
- Pathophysiology of inflammation, repair and immunology
- Rheumatoid arthritis, gout, juvenile rheumatoid arthritis

Unit 7: Infectious and Neoplastic Diseases

- Bacterial, viral, protozoal, fungal, and HIV infections
- Chemotherapy of lung, breast, prostate, cervical cancers
- Hematological malignancies

Unit 8: Nutrition, Pain, Ophthalmology, Dermatology

- Pain pathways, analgesics, NSAIDs, opiates
- Malnutrition, enteral and parenteral nutrition
- Glaucoma and eye infections
- Skin and STD: psoriasis, acne, eczema, syphilis, gonorrhoea

Unit 9: Community Pharmacy Practice

- Concept, roles and responsibilities of community pharmacy
- Patient counselling, OTC sales, services to clinics
- Management: finance, infrastructure, legal compliance
- Code of ethics and polypharmacy

Unit 10: Hospital Pharmacy and Pharmaco-economics

- Hospital pharmacy organization and drug policy

- Drug distribution, manufacturing (sterile/non-sterile), quality control
- Radio pharmaceuticals and clinical trial support
- Pharmacoepidemiology, pharmacoeconomics, public health policy
- Prescription writing, communication skills, ADRs, drug interactions

PhD Entrance Syllabus – Pharmaceutical Biotechnology

Unit 1: Microbial and Cellular Biology

- Classification and characteristics of prokaryotic and eukaryotic cells
- Structural and reproductive features of bacteria, fungi, actinomycetes, and viruses
- Techniques for cultivation and isolation of pure microbial cultures
- Microbial screening: primary and secondary screening approaches
- Strain improvement strategies
- Pyrogens and endotoxins: origin, chemical nature, properties, and official detection tests

Unit 2: Molecular Biology and Genetic Engineering

- Structure, types, and composition of DNA and RNA
- Central dogma: mechanisms of replication, transcription, and translation
- Regulation of gene expression; RNA splicing, editing, and amplification
- Mutagenesis and DNA repair systems
- Recombinant DNA technology: cloning vectors, gene libraries, plasmid mapping, PCR
- Gene expression in E. coli and yeast; site-directed mutagenesis
- Biotechnological products: interferons, insulin, erythropoietin, hepatitis-B vaccine

Unit 3: Cell Biology, Signal Transduction, and Apoptosis

- Ultrastructure and function of cellular organelles and cytoskeleton

- Mechanisms of cell movement and signaling pathways (GPCRs, kinases, ion channels, nuclear receptors)
- ON/OFF signal regulation; cellular development, proliferation, and stress responses
- Cell cycle regulation and mechanisms of apoptosis
- Role of oncogenes, tumor suppressors, and characteristics of tumor cells
- Fertilization biology, stem cell types, in vitro fertilization (IVF), and embryonic germ cells

Unit 4: Immunotechnology and Vaccine Development

- Anatomy and functions of primary and secondary lymphoid organs
- Immune responses: humoral vs. cell-mediated immunity
- Structure and function of antigens and antibodies
- MHC complex, antigen presentation, and activation of T and B lymphocytes
- Cytokines, complement pathways, and hypersensitivity reactions (Type I–IV)
- Autoimmune disorders and immunodeficiencies
- Development of conventional, DNA-based, recombinant, and peptide vaccines
- Stem cell applications in immunology

Unit 5: Hybridoma and Monoclonal Antibody Technology

- Hybridoma development: cell fusion, selection, and screening techniques
- Monoclonal antibody production and purification
- Diagnostic and therapeutic applications of monoclonal antibodies
- Immunodiagnostic methods: ELISA, RIA, Western blot, immunofluorescence

Unit 6: Fermentation Technology and Bioreactor Design

- Fundamentals and kinetics of microbial fermentation

- Bioreactor types and designs: stirred tank (CSTR), airlift, tower, bubble column, hollow fiber
- Impeller design and agitation mechanisms
- Bioprocess monitoring and control: DO, CO_2, pH, foam, temperature
- Automation and computerized systems in fermentation operations

Unit 7: Downstream Processing and Enzyme Immobilization

- Recovery and purification: filtration, extraction, chromatography, crystallization
- Cell disruption methods and enzymatic assays
- Enzyme and whole-cell immobilization techniques
- Immobilized reactor designs and enzyme engineering approaches

Unit 8: Industrial Biotechnology and Biotransformations

- Microbial production of:
- Alcohols (ethanol, glycerol)
- Organic acids (citric acid, lactic acid)
- Antibiotics (penicillin, streptomycin, griseofulvin)
- Vitamins (B12, riboflavin, vitamin C)
- Amino acids (lysine, glutamic acid), nucleotides (cAMP, cGMP)
- Chiral drug synthesis via biotransformations
- Single-cell protein, probiotics, and postbiotics
- Regulatory aspects of biopharmaceutical production

Unit 9: Protein Engineering and Therapeutic Proteomics

- Strategies for protein isolation, purification, stabilization, and formulation
- Rational design and directed evolution in protein engineering
- Therapeutic enzyme production: amylase, trypsin, glucose isomerase

- Proteomics tools: 2D-GE, isotope labeling, protein tagging
- Peptidomimetics and synthetic therapeutic peptides

Unit 10: Bioinformatics and Computer-Aided Drug Design

- Biological databases: nucleotide, protein, and structural data