SavitribaiPhule Pune University

(Formerly University of Pune)

Syllabus for Ph.D. (PET) Entrance Exam : Pharmacy

Research Methodology

1. **Basics of Research:**Definition of research, Applications of research and types of research, Research Methods and Research Methodology and steps involved in a research process.
2. **Literature review:**Importance of literature review, methods and sources of literature review, Review the literature selected, formulating the research problem based on extensive literature survey, developing the hypothesis, preparing the research design, Development of a theoretical and conceptual framework, writing up the synopsis of the proposed Ph.D. program.
3. **Writing a Research Proposal:** Research Grant Funding Agencies, Preparing for application to grant providing agencies (Preamble, problem, objectives, hypothesis to be tested, design of study, measurement procedures, analysis of data, organization of report, Displaying data tables, graphs and charts).
4. **Data collection and Computer applications:**Methods of primary and secondary data collection, selection ofappropriate method of data collection.Advanced Research Tools- Exposure to design expert, Systat, Sigma Plot and Kinetica and other advanced research softwares.
5. **Research ethics, IPR and Scientific Communication:**Ethics – ethical issues, ethical committees (human &animal); Prewriting considerations, Thesis writing, Formats of report writing, Preparing Posters for Scientific Presentation, Preparing and Delivering of oral Presentation. Scholarly publishing – IMRAD concept anddesign of research paper, citation and acknowledgement, plagiarism, reproducibility andaccountability, General considerationof IPR for Patent drafting and submission.

Subject Concerned Syllabus
Pharmacy

Specialization-1: Pharmaceutics

1. **Introduction to pharmacokinetics:** Pharmacokinetics models, physiological models, one compartment open model drug disposition, plasma elimination half life, two compartment open model drug disposition, **Drug Distribution:-** Apparent volume of distribution (one and two compartment models), protein binding of drugs – Implications of drug protein binding in pharmacokinetics and therapy kinetics of drug – protein binding.
2. **Biotransformation of drugs:** Phase I and II biotransformation reactions, factors affecting, **Excretion of drugs –** renal and nonrenal drug excretion – mechanism of renal excretion, **clearance-** renal clearance, hepatic clearance, **kinetics of drug absorption-** one compartment oper model, evaluation of pharmacokinetic parameters.

3. **Dosage form Evaluation-Bioavailability:** Rate and extent of bioavailability, assessing bioavailability, multiple dosing – bioavailability, in vitro bioavailability studies (dissolution), **Bio equivalence –** General principles, criteria for establishing bioequivalence requirement, criteria for waiver of evidence for bioequivalence requirement, methodology, pharmacokinetics parameters – logarithmic transformations.**Multiple dosage regimens –** drugs accumulation, i.v and oral regiment, loading dosing, scheduling, **Diseases-Dose adjustment –** hepatic disease – dose adjustment, renal disease dose adjustment, therapeutics drug monitoring, **Non-compartment model-pharmacokinetics –** statistical movement theory, pharmacokinetics parameters.
4. **Concept & Models for NDDS:** Classification of rate controlled drug delivery system (DDS), rate programmed release, activation modulated & feedback regulated DDS, **Fundamentals of rate controlled drug delivery –** Introduction, mechanistic analysis of controlled release drug delivery, effect of system parameters in controlled drug delivery, evaluation of controlled release drug delivery systems.
5. **Oral drug delivery and delivery systems:** Development of novel drug delivery systems for oral controlled release drug administration, modulation of gastrointestinal transit time, overcome hepatic first pass elimination, **Mucosal drug delivery:** human mucosa, transmucosal systemic delivery of drugs.
6. **Transdermal Drug Delivery systems:** Skin site for transdermal drug administration, recent developments in transdermal drug delivery, fundamentals of skin permeation, technologies for developing transdermal systems, Evaluation of transdermal systems, **Particulate drug carriers –** liposomes and nanoparticles – Concepts, applications, preparation, and evaluation, in vivo barriers to particulate distribution, selected examples of drug delivery.
7. **Target Oriented Drug Delivery Systems:** Rationale for targeted drug delivery, biological processes and events involved in drug targeting, pharmacokinetics and pharmacodynamic considerations, targeted drug delivery systems, targeting in the gastrointestinal tracts and other mucosal surfaces.
8. **Biotechnology:**
   a. Proteins and Nucleic acids and their structure and features, Genetic Engineering, enzymes and vectors in genetic engineering, concepts of cloning, cDNA and genomic libraries, Cloning for production of Biopharmaceuticals, Screening and detection methods for clones. Recombinant DNA products and their applications, Immune System – Innate and acquired immunity, Monoclonal antibodies and immunological techniques.
   b. Basic techniques of mammalian cell culture in vitro; disaggregation of tissue and primary culture, maintenance of cell culture; cell separation, and applications of mammalian cell culture.Different areas and applications of plant tissue culture. Nutritional components of tissue culture media. Totipotency, Transgenic Plants and animals and their applications, Bioinformatics overview and applications.

Specialization-2: Pharmaceutical Chemistry (including Pharm Analysis)

1. **Structural Elucidation:** Structural Elucidation of some important Natural, Synthetic and Semi synthetic drugs by using spectroscopic data. [UV, IR, H^1NMR, C^{13} NMR, Mass].
2. **Reaction Mechanisms:** Generation, Stability, structure and reactivity of free radicals, Carbocations and Carbines. Mechanism of free radical, electrophilic, Nucleophilic (Addition and substitution) reactions, elimination reactions with examinable.

3. Basic Principles and strategies to plan synthetic reactions schemes by using different reagents.
4. **Molecular Boric of Being Action:** Concept of receptors and receptor theories. The role of functional groups in drying receptors, interactions with specific reference to Opioid, thiotaminergic ,Dorpaminergic, Adrenergic, Cholinergic, GABA nergic receptors.
5. Recent advances in the treatment of Diabetes Mellitus, Cardiovascular disease, CNS diseases, Viral, Cancer, Malaria and Tuberculosis.
6. **New drug development and lead approach:** Identification of lead molecule for natural products. Lead optimization for the New drying development with suitable example from CNS, CNS, Chemotherapeutic. Agents.
7. **Drying Resign:** History and development of QSAR, physicochemical parameters. Hansch analysis., free klison analysis.
8. **Molecular modeling:** Molecular mechanics quantum mechanism, docking, advanced concepts of molecular modeling.
9. **Miscellaneous:**
    a. Design and application of prodrugs.
    b. Structure based drug design.
    c. Combinational chemistry: Combinational approached chemical peptide and small molecule librarian.
    d. Assays and Screening combinational libraries introduction to high through puts. Screening (HTS)

10. **Instrumental Methods of Analysis:**
    a. **UV – Visible spectroscopy**: Introduction, Beers law and its limitations, molar extinction coefficient, wood wards Fiesher rules for calculating absorption maximum, instrumentation design and applications.
    b. **IR Spectroscopy:** Basic Principles – Molecular vibrations, vibrational frequency and its influencing factors, sampling techniques, instrumentation and applications of FT – IR.
    c. **NMR Spectroscopy:** Principle, Chemical shifts, shielding and deshielding effects, splitting of signals, computing constants, instrumentations and applications (H&CNMR).
    d. **Mass spectroscopy:** Principle, Ionization Techniques, Fragmentation pattern, Instrumentation and applications.
    e. **GLC and HPLC :** Principles, instrumentation with special emphasis on different column and detectors and applications.
    f. **HPTLC, Ion-exchange Chromatography and Gel filtration:** Principle, instrumentation and applications.
    g. **Potentiometry and Conductometry :**Principle, instrumentation and applications.
    h. **Polarimetry Fluorimetry and Refractometry :**Principle, Instrumentation and applications with suitable examples.

Specialization-3: Pharmacology

1. **Receptor Pharmacology & Mechanisms:** Types of Receptors, theories of receptors, G-protein coupled receptors, NMDA receptors, Kinase linked receptors, ion channels, second messengers, DNA linked receptors, signal transduction mechanism, proliferation and apoptosis.
2. Pharmacogenetics, Drug Interactions – invitro (biopharmaceutical) Pharmacokinetic and Pharmacodynamic interaction, Adverse drug reactions.
3. Neurohumoral transmission in CNS, ANS and somatic various system
   a. Molecular basis, underlying mechanism of action of adrenergic, Cholinergic, Dopaminergie, Serotoninergie and GBA ergic system.
   b. Pharmacological actions and possible physiological role of serotononin, Noradrenalene, Adrenaline. Acetylcholine and Dopamine.
4. **Chemotherapy :**
   a. Molecular and bio chemical mechanisms Pharmacology involved in the activity of various antiviral and anticancer drugs.
   b. Concepts on free radicle mediated injury, TAT inhibitors and its role in HIV.
5. **Cardiovascular Pharmacology :**Cardiotonics, Antiarrhythonics, Antihypertensive, antianginal & anti hyperlipidemic agents.
6. Organisation of screening for the pharmacological activity of new substances with emphasis on the evaluation of antihypertensives, Cardiac, Psychopharmacological, analgesic, anti inflammatory anti diabetic, hepatoprotective, antistress and nootropic agents etc.
7. **Biotransformation of drugs:**
   a. Phase I & II biotransformation reactions
   b. Excretion of drugs: Renal &nonrenal –Mechanisms and factors affecting.
   c. Clearance: Renals& hepatic clearance.
   d. Kinetics of drug absorption – compartment models evaluation of Pharmacokinetic parameters.
8. **Miscellaneous:**
   a. Design & testing of drugs in humans – clinical trials bio equivalence studies.
   b. Advanced concepts of clinical research and compensation in clinical research.
   c. Acute and Chronic toxicity studies in animals models.
   d. Reverse Pharmacology and its applications.
   e. World Health Organization guide lines and other relevant guidelines such as ICMR, OECD etc. for drugs. Current status of regulatory affairs for herbal formulations. Patents and Intellectual property rights.

Specialization-4: Pharmacognosy

1. **Basic Concepts:**General methods and Principles of extraction methods, types of extraction and their merits and demerits for Crude Drugs; Selection and purification of solvents for extraction; screening of the plant extracts for chemicals. General methods of isolation of different classes of phytochemical.
2. **Screening and Evaluation:**Screening of plant extracts / phytochemicals for analgesic, anti-inflammatory, anti-diabetic, diuretic, anti-fertility, anti-epileptic, hepatoprotective, immunomodulatory, anticancer cardiovascular and antimicrobial activity.

3. **Techniques:**Techniques employed in elucidation of bio synthetic pathway. Study of basic metabolic pathways (Shikkinic, Acetatemerolonate pathway 2 calvins cycle) Biogenesis of tropane, quinoline, Imidazole, Isoquinoline and Indole alkaloids; sterols, anthraquinone, saponin glycosides and flavonoids compounds of pharmaceutical significance.
4. **Current Scenario:**Current status of anti-cancer, anti-HIV, anti-diabetic and Immunomodulatory herbal drugs. A review of Bio medicinals of recent discovery. Current status of plants used in alternative systems of medicines.
5. **Analytical Pharamcognosy:**Application of various chromatographic techniques and spectrometry to natural products : TLC, GC, HPLC and HPTLC; Flourimetry and colorimetry. Uses of UV, IR, NMR and mass spectrometry in the structural elucidation of natural products.
6. **Herbal formulations:** Types of herbal formulations preparation of standardized extracts suitable for incorporation into solid dosage form like tablets capsules etc. Recent trends in poly-herbal medicines. Herbal cosmetics and herbal teas. Manufacture, packaging and approach to quality control of herbal formulations. GMP for herbal drug formulations.
7. World Health Organisation guide lines for herbal drugs including standards for pesticide residue / aflatoxins. Current status of regulatory affairs for herbal formulations. Patents and Intellectual property rights.
8. **Plant Tissue Culture:**Current trends in tissue culture and its applications in Pharmaceutical and allied fields. Immobilized cell systems and techniques of immobilization, Biotransformation resulting into pharmaceutically important secondary metabolites, using tissue cultures. Micro propagation, Hairy-root cultures and their applications in Pharmacy.