# M. Pharm. (Pharmacology)

## I – SEMESTER

### Theory

<table>
<thead>
<tr>
<th>Course</th>
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<td>I. Advanced Pharmacology – I</td>
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<td>II. Advanced Pharmacology – II</td>
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<tr>
<td>III. Advances in Preclinical Evaluation – I</td>
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<td>IV. Pharmacokinetics, Pharmacodynamics &amp; Drug Metabolism (PPDM)</td>
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### Practicals

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## II – SEMESTER

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<td>II. Advances in Preclinical Evaluation – II</td>
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<tr>
<td>III. Clinical Research @ (common for Pharmacy practice specialization)</td>
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<td>IV. Molecular and Biochemical Pharmacology Basis of Drug Discovery &amp; Development</td>
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## III – SEMESTER

Comprehensive Viva-voce
Seminar on Dissertation Topic (Project Work)

## IV – SEMESTER

Final Seminar of Dissertation (Results)
Dissertation
I - SEMESTER

M.PHARM. (PHARMACOLOGY)

PAPER I : ADVANCED PHARMACOLOGY – I
(Theory) 3 Hrs per week

1. Drugs acting at synaptic and neuro effecto junctional sites.
   A. Autonomic & somatic nervous systems.
   B. Muscarinic receptor agonists & antagonists.
   C. Anticholinesterases
   D. Agents acting at NMJ and autonomic ganglia
   E. Sympathomimetic drugs. Catecholamine and adrenergic antagonists.

2. Drugs acting on the Central Nervous System.
   A. Neurotransmission and CNS.
   B. Drugs used in the treatment of
      1. Anxiety & Psychosis
      2. Depression & Mania
      3. Epilepsy
      4. Migraine
      5. CNS degenerative disorders
      6. Parkinson’s Disease
      7. Pain

3. Drugs affecting renal and cardiovascular function
   A. Diuretics
   B. Renin & Angiotensin
   C. Drugs used in the treatment of
      1. Myocardial Ischemia
      2. Hypertension
      3. CHF
      4. Hyperlipidemia

4. Drugs acting on the blood & blood forming organs
   A. Growth factors
   B. Anticoagulants, thrombolytics & antiplatelet drugs.
PAPER II : ADVANCED PHARMACOLOGY – II
(Theory) 3 Hrs per week

1. Autacoids; Drug therapy of Inflammation
   A. Histamine, Bradykinin & their antagonists
   B. Eicasonoids & PAF
   C. Anti-inflammatory, analgesic & antipyretic agents
   D. Antiasthmatic agents.

2. Drugs affecting gastro intestinal function.
   A. Agents for control of acidity and antiulcer drugs
   B. Emetics & anti emetics

3. Chemotherapy of
   A. Malaria
   B. Microbial infections.
      (i) Fluroquinolones
      (ii) Cephalosporins and other newer agents
      (iii) Antifungal and antiviral drugs including Anti HIV drugs.
   C. Neoplastic diseases

4. Oral hypoglycemic agents , Thyroid and anti-thyroid agents.

5. Estrogens, Progestins and Androgens.
PAPER III : ADVANCES IN PRECLINICAL EVALUATION -I
(Theory) 3 Hrs per week

1. Care, handling and breeding techniques of laboratory animals. Regulations for laboratory animal care and ethical requirement. Knowledge of the CPCSEA proforma for performing experiments on animals.

2. Organization of preclinical screening programme (Blind screening)


4. Preclinical and clinical models employed in the screening of new drugs belonging to following categories.
   I. Drugs acting on Autonomic nervous system: Sympathomimetics, Parasympathomimetics, Anticholinesterases, anticholinergics, adrenolytics.
   Muscle relaxants (peripheral)
   II. Cardiovascular Pharmacology: Cardiac glycosides, antiarythmics, antihypertensives, antiatherosclerotics.
   III. Screening of free radical scavenging activity
   IV. Immunopharmacology: Specific (Cell and humoral mediated) and non-specific methods.
   V. Drugs for metabolic disorders: Anti-diabetic agents, Hepatoprotective agents, Anti-hyperlipidemic agents

5. Principles of Toxicological evaluations, ED 50, LD50 and TD values, acute, sub-acute and chronic toxicity studies.

6. Introduction to biostatistics, parametric and non parametric tests.
Paper IV: Pharmacokinetics, Pharmacodynamics & Drug Metabolism (PPDM)
(Theory) 3 Hrs per week

1. DRUG ABSORPTION
Factors affecting drug absorption.
Gastro intestinal, percutaneous and rectal absorpton
Absorption kinetics, Wagner Nelson & Loo Riegelman methods
BCS classification – significance

2. DRUG DISTRIBUTION
b. Kinetics of protein binding, use of different plots (Scatchard plots etc.,) in characterizing binding kinetics
c. Tissue binding.
d. Transfer of drugs through biological barriers, their therapeutic implication in drug action with emphasis on drug transporters.

3. EXCRETION OF DRUGS
a. Routes of excretion of drugs. Extensive study of contribution of each route with specific examples
b. The role of kidney and factors influencing excretion

4. BIOAVAILABILITY AND BIOEQUIVALENCE OF DRUG PRODUCTS
Factors affecting bioavailability & importance of bioequivalence studies.
Conduct of BE studies – Different approaches
US FDA, EMEA & DCGI guidance on BE studies in fasted, fed conditions
BE study waivers

5. METABOLISM OF DRUGS
a. Phase-I and Phase-II metabolic reactions, microsomal and non-microsomal biotransformation reactions.
b. Drug metabolism in liver, kidney, intestine and other extra-hepatic sites.
c. Drug metabolism in placenta, fetus, new born and aged.

6. FACTORS INFLUENCING DRUG METABOLISM
a. Stereochemical, physicochemical and biological factors.
b. Physiological and environmental factors, species, strain, sex, and age differences.
c. Pathological states.
d. Genetic factors – Introduction to the role of genetics in drug metabolism, Polymorphism in drug oxidation and other metabolic reactions.

7. CLINICAL PHARMACOKINETICS
   i. Revision of basic concepts
   ii. Dose – response in man
iii. Influence of renal and hepatic disease on pharmacokinetics
iv. Therapeutic drug monitoring
v. Population pharmacokinetics

8. PHARMACODYNAMICS & PK/PD modeling
a. Drug receptor interaction dynamics – Application of stoichometry principles
b. Understanding of pharmacokinetics - pharmacodynamic relationships
c. Different pharmacodynamic models: Linear, Emax, Biophase distribution & Indirect response models.

PRACTICALS

Paper I: Advanced Pharmacology Practicals based on theory paper.

Paper II: Pharmacokinetics, Pharmacodynamics & Drug Metabolism practicals based on theory paper.
II - SEMISTER

PAPER I : CLINICAL PHARMACOLOGY & TOXICOLOGY
(Theory) 3 Hrs per week

PART 1. Clinical Pharmacology (70% weightage)

1. Adverse Drug Reactions, Drug Interactions and ADR monitoring. Mechanisms of ADR.

2. Pathophysiology and drug therapy of the following disorders.

   Schizophrenia, anxiety, depression, epilepsy, Parkinson’s, Alzheimer’s diseases, migraine hypertension, angina pectoris, arrhythmias, atherosclerosis, myocardial infarction, TB, leprosy, leukemia, solid tumors, lymphomas, psoriasis, respiratory, urinary, g.i. tract infections, endocarditis, fungal and HIV infection, rheumatoid arthritis, glaucoma, menstrual disorders, menopause.

3. Drug therapy in special populations
   A. Geriatrics
   B. Pediatrics - neonate, infants & adolescents
   C. Pregnancy & Lactation

4. Pharmacogenomics: Interracial and individual variability in drug metabolism and drug action.

PART 2. Principles of Toxicology (30% weightage)

a. Physicochemical, Biochemical and genetic basis of toxicity, principles of toxicokinetics, mutagenesis and carcinogenesis.
b. Guidelines and regulatory agencies – CPCSEA, OECD, FDA, ICH, FHSA, EPA, EEC, WHO etc.,
c. Behavioural, Inhalation, cellular and sub-cellular toxicity hypersensitivity and immune response, range finding tests.
d. Acute, sub-acute and chronic toxicity studies according to guidelines.
e. Application of toxicology in clinical medicine.

2. Preclinical evaluation of following categories of drugs.
   i. CNS Pharmacology: Sedatives, hypnotics, anxiolytics, antidepressants, Muscle relaxants (Central), CNS stimulations, anticonvulsants, antipsychotics, Noortrops, antiparkinsonian agents,
   ii. Analgesics, antipyretics, anti-inflammatory agents and local anesthetics.
   iii. Gastrointestinal drugs: Antulcer agents, laxatives
   iv. Respiratory pharmacology: Bronchodilators, antitussives,
   v. Histamine antagonists
   vi. Reproductive pharmacology: Antifertility agents
   vii. Anticancer agents

3. Cell culture technology:
   Animal cell culture – General requirements for establishing the animal cell culture, media, conditions and methods for cell cultures. Applications in Pharmacy.

4. Alternatives to animal screening procedures, Cell-line, patch clamp technique, In-vitro models, molecular biology techniques.

5. Concept of transgenic animals, knockout animals, nude animals, receptor binding assays, principles of immunoassay, patch clamp techniques.
Paper – III: CLINICAL RESEARCH
(Theory 3hrs per week)

1. Introduction to Clinical Research
   2
   • Definitions and terminology used in clinical trials
   • Historical development in clinical research practice
   • Drug development process

2. Research Design Methods
   2.1. Planning and execution of clinical trials
   2.2. Various Phases of clinical trials
   2.3. Randomization techniques (Simple randomization, restricted randomization, blocking method and stratification)
   2.4. Types of research designs based on Controlling Method (Experimental, Quasi experimental, and Observational methods) Time Sequences (Prospective and Retrospective), Sampling methods (Cohort study, case Control study and cross sectional study)
   2.5. Health outcome measures (Clinical & Physiological, Humanistic and Economic)

3. Bioavailability and Bioequivalence studies

4. Ethics and Guidelines in Biomedical Research
   7
   • Ethical Issues in Biomedical Research – Principles of ethics in biomedical research
   • Ethical committee [institutional review board], its constitution and functions
   • Good clinical practice [ICH GCP guidelines, CDSCO regulations, MPA, European, Japan, Health Canada and MHRA guidelines, schedule Y and USFDA in the conduct of clinical trials]

5 Clinical research
   20
   • Establishing and functioning of Contract Research Organisation (CRO)
   • Roles and responsibilities of clinical trial personnel
   • Trial initiation, volunteer recruitment, trial supplies and site management
   • Designing of clinical trial documents
   • Monitoring and auditing of clinical trials
• Trial report generation
  1
• Site closure

6. Data Management

6.1. Medical Writing and Ethics of publication
6.2. Clinical data management (Data entry, data interpretation, data monitoring and auditing)

Reference books (Latest editions)
  2. Designing Clinical Research. Edtd by Stephen B Hulley, Steven R Cummings

ASSIGNMENTS FOR CLINICAL RESEARCH

  1. Design of Protocol for different types of studies
  2. Correspondence procedures for constitution of IRB
  3. Designing of informed consent process
  4. Designing of CRF
  5. Clinical data monitoring
This course primarily focuses on study of the following from molecular and biochemical perspective. The purpose is to enable the student to understand the trends in modern drug discovery.

**General Principles:**

1. A general treatment of the approaches to drug design: including the methods of variation, study of the use of biochemical and physiological information involving new drugs.
2. Drug Receptor theory:
   - Concept of receptors, theories of drug receptor interaction, forces involved in drug receptor interaction. Receptor polymorphism and dimerization and its importance in drug design.
   - A detailed study of Ion channel modulators, Tyrosine kinase and G-Protein coupled receptor, Cyclic nucleotides

**Drug Design:**

1. Physiochemical properties in relation to biological action and drug design.
   - a. Complex of events between drug administration and drug action.
   - b. Solubility & partition coefficient.
   - c. Rational drug design.
   - d. Selected physiochemical properties like isosterism, steric behaviour, ionization, hydrogen bonding, chelation, oxidation- reduction potential, surface actions.

2. Guidelines for drug and analog drug design:
   - a. Basic considerations of drug design, de- novo drug design, lead seeking methods, rational drug design.
   - b. Structural factors in drug design.
   - c. Prodrug concepts.

4. The quantitative analysis of structure activity relationships
   b. QSAR parameters related to chemical structure, correlative methods and
      analysis of results.

5. Molecular & Biochemical pharmacology Basis:
   b. Introduction to cell structure and function.
   c. Cell signaling, organization of signal transduction pathway and biosensors. A detailed
      study on:
         TNF, Apoptosis
         Neurosteroids and Cannabinoids
         Nitric oxide
         ANF, Anti oxidants : Melatonin
         Neuropeptide, Substance P
         Angiotensin II modulators
         Novel peptide based drugs
   d. Protein structure prediction and molecular modeling.

PRACTICALS

Paper I : Clinical Pharmacology & Toxicology
Paper II : Advances in Preclinical Evaluation
REFERENCES

ADVANCED PHARMACOLOGY – I & II

2. Katzung BG, Basic and Clinical Pharmacology, Lange Medical Publication, California
8. Review articles from published journals.

Advances in Preclinical Evaluation – I & II

5. S K Gupta, Drug Screening Methods, Jaypee brothers, New Delhi.
8. M.C. Prabhakar, Experimental Pharmacology, Orient Longman, Chennai
13. Indian Pharmacopoeia and other pharmacopoeias
14. The UFAW handbook on the care and management of laboratory animals by UFAW.
16. Review articles from published journals.

Pharmacokinetics, Pharmacodynamics & Drug Metabolism (PPDM)
1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi
4. Hand Book of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.
7. Clinical Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and
10. Biopharmaceutics and Clinical Pharmacokinetics - An introduction , by Rebot F
14. Review articles from published journals

Clinical Pharmacology & Toxicology
7. Derelanko and Holinger , CRC Hand book of toxicology
9. Hayes, Principles and Methods of toxicology
14. Review articles from published journals.

**Molecular and Biochemical Pharmacology Basis of Drug Discovery & Development**

1. A guide to chemical basis of drug design by Alfred Rurger (John Willey & Sons)
2. Introduction to the principles of drug design by John Smith and Hawel Williams (Wright PSG).
9. Current protocols in Molecular biology by Frederick m Ausubel.
10. Human molecular genetics by tomstracham & Andrew P Read.
12. The Cell – A molecular approach by Geoffrey M Cooper.
16. Review articles from published journals.
CLINICAL RESEARCH


7. Goodman & Gilman’s The Pharmacological basis of Therapeutics Ed. J.G.


11. Designing Clinical Research. Edtd by Stephen B Hulley, Steven R Cummings


13. Review articles from published journals