MD PHARMACOLOGY CURRICULUM

AIIMS KALYANI

JANUARY 8, 2024

ACADEMIC SECTION
AIIMS Kalyani

Department of Pharmacology

COURSE NAME: MD in Pharmacology
DURATION OF COURSE: 3 years

Objectives:

Knowledge: The resident should understand the concepts of general principles of pharmacology, pharmacotherapeutics, experimental techniques pertaining to Pharmacology, drug development process, regulatory and ethical concerns related to drug development and usage, biostatistics, and clinical trials.
Teaching: The residents should learn to teach various undergraduate courses like MBBS, BSc in Nursing and allied sciences using various techniques of medical education.
Research: The residents should be able to understand the basic research methodology along with biostatistics at the end of their residency. They should be able to construct the research protocol, construct the consent form and case record form, apply to the ethics committee, conduct the research (basic, clinical, in-vitro or computational), analyze the data, interpret the results, and compile them as a thesis as a part of their curriculum.
The student during the training program should acquire the following competencies:

A. Cognitive domain

1. Describe and apply pharmacological principles to explain the mechanism/s of the effects of drugs used in diagnosis, prevention, and treatment of diseases of all systems of human body.
2. Explain pharmacodynamics and pharmacokinetics of drugs.
3. Describe mechanisms of drug-drug interactions and their clinical importance.
4. Apply and integrate knowledge of pathophysiology of diseases and its modulation by drugs.
5. Acquire knowledge on pharmacogenetics and pharmacogenomics
6. Acquire knowledge on principles of Pharmacoeconomics
7. Acquire knowledge on pharmacoepidemiology, including drug utilization studies.
8. Acquire knowledge and understanding of principles of Good clinical practice (GCP) and Good laboratory practice (GLP) guidelines
9. Acquire knowledge on essential medicines
10. Acquire knowledge on pharmacovigilance
11. Acquire knowledge and apply the principle of biostatistics in the evaluation and interpretation of drug safety and efficacy studies
12. Describe how to evaluate, analyse and monitor preclinical and clinical data in drug discovery
13. Able to integrate principles of immunology in biochemistry.
14. Demonstrate knowledge of basics of research methodology, develop a research protocol, conduct the study, record experimental observations, analyse data using currently available statistical software, interpret results and disseminate these results and to have the potential ability to pursue further specializations and eventually be competent to guide students.
15. Describe the principles of teaching - learning technology towards application and take interactive classroom lectures, modules for problem based learning (PBL), case discussions, small group discussions, seminars, Journal club and research

presentations
16. Demonstrate knowledge about computer assisted learning (CAL) software and ability to use them efficiently to promote learning of pharmacology.
17. Demonstrate knowledge of principles of Instrumentation.
18. Demonstrate knowledge about recent advances and trends in research in the field of pharmacology and clinical pharmacology.
19. Acquire knowledge on generic drugs and generic prescription.
20. Acquire knowledge on rational use of drugs and prescription auditing
21. Aquire knowledge about antimicrobial stewardship programs and strategies for containment of antibiotic resistance
22. Acquire knowledge on animal toxicity studies
23. Acquire knowledge on common poisoning
24. Acquire knowledge on the legal and ethical issues involved in drug development and research.
25. Acquire knowledge in Biostatistics including use of statistical softwares :
    - Estimation Sample size for a clinical trial
    - Scales of measurement, data display, measures of central tendency (mean, median, mode)
    - Dispersion of data (variance, standard deviation)
    - Selection of tests (of significance) and their applicability
    - Correlation and regression analysis
    - Basics of systematic reviews and meta-analysis
26. Acquire knowledge in application of Artificial Intelligence in healthcare:
    - Machine Learning models for diagnostics and predictive analysis
    - Deep learning models

B. Affective domain

1. Effectively explain to patients, the effects and side effects of drugs, including the need for medication adherence.
2. Communicate effectively with pharmacological reasoning with students, peers, staff and faculty, and other members of the health care team on rational use of drugs and improving spontaneous reporting of adverse events.
3. Demonstrate respect in interactions with peers, and other healthcare professionals.
4. Demonstrate ethical behaviour and integrity in one’s work.
5. Demonstrate ability to generate awareness about the use of generic drugs in patients.
6. Acquire skills for self-directed learning to keep up with developments in the field and to continuously build to improve on skills, expertise and perpetual professional development.

C. Psychomotor domain

1. Able to predict efficacy and adverse effects associated with use of drugs, along with causality assessment.
2. Demonstrate skills for prescription writing.
3. Perform major in vivo and in vitro animal experiments.
4. Observe and understand basic principles of working of important advanced techniques, like High Performance Liquid Chromatography (HPLC).
5. Demonstrate standard operating procedures of various methods and techniques used in clinical trials and research.
6. Determine levels of common poisons in blood
7. Demonstrate presentation skills at academic meetings, publications and writing research projects for funding agencies.
8. Be able to analyse and evaluate a research paper

Practical Skills:

1. In vivo and ex vivo experiments, like organ bath, analgesiometer, physiography/ polygraph, convulsiometer, plethysmograph, learning and memory, models for affective disorders.
2. Administration of drugs by various routes (subcutaneous, intravenous, intraperitoneal) in experimental animals
3. Collection of blood samples and oral gavage in experimental animals
4. Preparation and administration of a drug solution in appropriate strength and volume
5. Experiments to show dose response curve of agonists (in the presence or absence of an antagonist) on various biological tissues, like isolated rabbit/rat/ guinea-pig intestine

6. Determination of EC50, ED50, pD2 and pA2 values of drugs
7. Estimate toxic drug levels using chemical and biological tests (alkaloids, glycosides, steroids, barbiturates, salicylates) by commonly used methods)
8. Plan, conduct, analyse and report a clinical trial.
9. Use computational tools for learning and research in pharmacology
10. ADR reporting
11. Provide clinical pharmacology opinions to practising physicians like dose modification, ADR management and suggesting various drug regimens
12. Estimate toxic drug levels using chemical and biological tests (alkaloids, glycosides, steroids, barbiturates, salicylates) by commonly used methods
13. Interpret bioavailability parameters with the help of given pharmacokinetics data

(**Animal Experiments: All animal experiments will be compliant with Govt. of India regulations, notified from time to time. Amphibian/Dog/Cat experiments will be conducted by computer assisted simulation models/ facilities. Other experiments to be performed as permissible by CPCSEA guidelines)**

THEORY :

General pharmacology and allied sciences:

1. Drug-receptor theory
    - Theories like a lock and key principle, two- state theory, three state theory, probabilistic theory
2. Drug targets
    - Proteins like transporters, G proteins, enzyme-linked proteins, enzymes, ion channels and others
    - Carbohydrate as receptors
    - Nucleotide as receptors
    - Other forms of targets
3. Drug delivery systems
    - Various forms of conventional and modern delivery systems like nano-formulation targeted delivery systems

and regional drug delivery systems

4. Pharmacokinetics
    - Basic principles of compartmental kinetics
    - Population kinetics
    - Bioavailability and bioequivalence
5. Pharmacodynamics
    - Molecular mechanisms of drug actions
    - Physiological and pathological principles of drug actions
    - Biochemical principles of drug actions
    - Models of pharmacodynamics and their association with pharmacokinetics
    - Dose-response concepts
    - Agonism and antagonism with isobologram
6. Molecular biological tools relevant to pharmacology and Therapeutic Drug Monitoring
    - High-performance liquid chromatography
    - Mass spectrometry
    - Enzyme-linked immunosorbent assay
    - Spectrophotometry, Flow cytometry
    - Polymerase chain reaction
7. Bioinformatics tools for Pharmacology
    - Drug database like ZINC
    - Protein database like SWISSPROT
    - BLAST
    - Servers for ADME prediction
    - Docking tools
    - Structure-activity prediction
    - CAL tools in pharmacology
8. Modelling in pharmacology
9. Basics of immunology and microbiology relevant to pharmacology
10. Teaching and communication skills

Systemic pharmacology, chemotherapy, and therapeutics:

1. Drugs acting on the autonomic nervous system
2. Drugs acting on the central nervous system
3. Autacoids
4. Renal and cardiovascular system
5. Drugs affecting the gastrointestinal and respiratory system
6. Drugs affecting uterine motility
7. Chemotherapy of microbial (bacterial, fungal and viral) diseases
8. Chemotherapy of parasite infections
9. Antineoplastic agents
10. Immunomodulators
11. Drugs acting on blood and blood-forming organs
12. Hormones, vaccines and miscellaneous agents

Clinical pharmacology and recent advances:

1. Clinical pharmacokinetics
2. Pharmacokinetic-pharmacodynamic correlation and its application in therapeutics
3. Types of clinical Studies
4. Designs of clinical Trials
5. Phase 1 studies
6. Phase 2 studies
7. Phase 3 studies
8. Phase 4 studies
9. Randomization, Blinding and Bias
10. The methodology of Protocol Writing
11. Ethical Considerations in Clinical Studies and Structure of Informed Consent Form
12. PICO concepts and Assessment of a Clinical Trial Publication
13. Types of Literature with Literature Searching and Evidence Pyramid
14. Meta-Analysis
15. Concepts of non-inferiority and equivalence
16. GCP, ethics, GLP and GMP
17. Clinical trials of various organ systems
18. Clinical trials in special populations

19. Pharmacokinetics in special conditions and population
20. Therapeutic drug monitoring
21. Antimicrobial stewardship
22. Simulation of clinical studies
23. Omics in pharmacology
24. Vaccine clinical trials
25. Pharmacoeconomics
26. Pharmacoepidemiology
27. Pharmacovigilance – ADR monitoring and reporting
28. Schedule Y
29. Rational drug prescription
30. Drug formulary
31. Concepts of essential medicines
32. Recent advances in the pharmacotherapy
33. Recent advances in drug development

Experimental pharmacology:

1. Principles of biostatistics
    - Sample size calculation
    - Descriptive statistics
    - Parametric and non-parametric tests, Regression techniques
    - Handling missing data
    - ROC analysis
    - Survival analysis
    - Simulation of clinical studies
2. Principles of animal experimentation and their limitations in drug evaluations
3. Animal handling and animal care
4. Methods of anaesthetizing animals and methods of euthanasia.
5. Restraining and blood collecting methods
6. Principles of bioassay
7. Drug screening methods in the evaluation of -

anti-ulcer, antidepressant, antianginal, antihypertensive, antiarrhythmic, antidiabetic, anti-cataract, antiplatelet, anticancer, anti- inflammatory, antidiarrhoeal, antiepileptic, analgesics, antithyroid, antipyretic, antiglaucoma, antihyperlipidemic, antiasthmatics and cough suppressants, antifungal, antihelminthic, antibacterial, antiviral agents, drugs for heart failure, drugs acting on endocrine system

8. Principles of chromatography, PCR, spectrophotometry and mass spectroscopy
9. Pharmacodynamic assessment of drugs in human beings
10. Computational tools in experimental pharmacology and pre-clinical research
11. Application of Artificial Intelligence and Machine Learning in healthcare:
    - Basics of machine learning models - Logistic Regression, Naïve Bayes, Decision tree, Random Forest, Boosting
    - Basics of Deep learning – neural network
    - Application of the AI techniques in healthcare

PRACTICAL:

1. Determination of various pharmacokinetic parameters using excel for single and multi- compartmental kinetics
2. Determination of binding energy of a drug to its target by molecular docking
3. In-silico prediction of ADME of a compound
4. Determination of concentration of a drug in a biological matrix using different analytical methods
5. Evaluation of pharmacodynamics of drugs acting on the central nervous system in humans using a battery of psychomotor tests
6. Evaluation of pharmacodynamics of drugs acting on the cardiovascular system in humans using the treadmill
7. Evaluation of pharmacodynamics of drugs acting on the respiratory system in humans using spirometry
8. Construction of dose-response curve of acetylcholine using isolated tissue preparations
9. Determination of unknown concentration of acetylcholine or histamine using parallel assay methods like four or three-point bioassay
10. Determination of pA2 of compounds

11. Determination of pharmacodynamic character of various drugs acting on the central nervous system in animals using
    - Elevated plus-maze
    - Photoactometer
    - Rotarod apparatus
12. Determination of pharmacodynamic character of analgesics in animals using analgesiometer
13. Determination of pharmacodynamic character of anti-epileptics using convulsiometer
14. ADR reporting
15. Evaluation of scientific literature
16. Biostatistics
17. Systematic Review and Meta-analysis

TEACHING AND LEARNING METHODS

The minimum teaching schedule for the MD students shall incorporate the participation in the following:

1. **Seminars**- Seminars will be conducted on weekly basis. The presentation should be discussed and finalized with the faculty assigned as the moderator, at least a week prior. The presenter will be assessed by all the faculty and recorded in the logbook.
2. **Journal club** – Which will include critical appraisal of original research or important review article published in peer-reviewed national/international journals. The article should be circulated to all at least a week prior.
3. **Lectures** – Lectures in statistics and research methodology and other clinical pharmacology related topics will be conducted periodically. Students will be given assignments that they have to complete and submit.
4. **Practical** - Pharmacology experiments will be demonstrated and the students have to practice and familiarize themselves with these experiments. The pharmacology experiments and procedures performed by the students should be recorded in the logbook. A practical record should also be maintained.
5. **Modular Teaching** - Participation in Undergraduate Modular Teaching in the subjects of Pharmacology and Therapeutics.

In addition, the student will also participate in

- Interdepartmental meetings between various clinical departments (Medicine, Dermatology, Neurology) and the Department of Pharmacology.
- Bed-side Clinics/Rounds – Routinely conducted for postgraduates in the various clinical departments, in which the student is posted.

Departmental Training schedule & posting of residents:

The topics which have been mentioned above will be covered over a period of 3 years. There will be clinical rotatory posting in various clinical departments over a period of 4 months to understand the pharmacotherapy of various clinical disorders.

ASSESSMENT

Examination on Research Methodology & Biostatistics

- Timing: End of 1st Semester
- Total marks: 50
- Candidate should pass to appear in Final examination
- No marks will be added to final/summative examination

Internal Examinations(A) Theory:

Schedule	Marks
At end of First year	100 (1 Paper)
At end of Second year	100 (1 Paper)
Pre-professional	400 (4 Papers of 100 marks each)
Total	**600**

(B) Practical:

Schedule	Marks
At end of First year	100
At end of Second year	100
Pre-professional	400 (Practical 300 + Viva 100)
Total	**600**

Candidate should secure a minimum of 50 %marks in theory and practical separately, to be eligible to appear for professional examination

Assessment of progress

The student's performance will be recorded by the faculty of the department/laboratory where he/she has worked. The student will also maintain a daily log of his/her activities, and this will be reviewed by the concerned faculty. The progress will be discussed with the student and his/her chief guide every 3 months. The chief guide will periodically monitor the progress of the student and sign on the logbook every quarter. The logbook will be countersigned by the head of the department prior to the final MD examination.

Thesis: Each PG student will carry out a research work under the supervision of a PG guide from the Pharmacology department. PG guide will be allotted within 2 months of joining of PG students. Selection of thesis topic, review of topic in department and its approval by IEC should be completed within first 6 months. Data collection of thesis should be started from 2nd term. The dissertation will be reviewed by all faculty members of the department before submission to the institute. Acceptance of thesis by panel of examiners will be a prerequisite for the candidate to appear in the final examination.

Attend accredited scientific meetings (CME, symposia, and conferences).

A postgraduate student would be required to present **at least one poster presentation, one oral presentation of research paper at a national/state conference**. The student should have **at least one original research article published or accepted for publication** in an indexed journal before appearing for final examination.

Summative assessment:

Total marks: 1000 (including internal marks)

A. Theory papers (400 marks)

There will four theory papers (100 marks each) entitled:

Paper I - General pharmacological principles and allied sciences

Paper-II - Systemic pharmacology, chemotherapy and therapeutics

Paper III - Experimental pharmacology, screening of drugs, bio-statistics and AI in healthcare

Paper IV -Clinical pharmacology and recent advances in Pharmacology

B. Practical examination and viva (400 marks)

The format of the practical examination (400 marks)

Part	Components	Marks allotted
Part A* 200 marks	Longcase (1 no.)	100
	Short cases (2 nos.)	50

	OSCE/OSPE	50
Part B 200 marks	Operative procedure/Pedagogy/Department specific activity	50
	Critical appraisal of a scientific paper	25
	Thesis presentation and evaluation	50
	Viva	75

* Students should pass (secure 50% marks) separately in Part A

Total marking scheme:

	1st Internal Examination	2nd Internal Examination	3rd Internal Examination	Total Internal Marks (Average of Internal exams)	Final Examination	Total Marks
Time frame	End of 2nd semester	End of 4th semester	3 months before final			
Theory	100	100	400	100	400	500
Practical	100	100	400	100	400	500

BOOKS RECOMMENDED

1. Goodman and Gilman's The Pharmacological Basis of Therapeutics
2. Katzung's Basic and Clinical Pharmacology
3. Shargel's Applied Biopharmaceutics & Pharmacokinetics
4. Vogel's Drug Discovery and Evaluation: Pharmacological Assays
5. Wilson's and Walker's Principles and Techniques of Biochemistry and Molecular Biology
6. Friedman's Fundamentals of Clinical Trials
7. Daniel's Biostatistics: A Foundation for Analysis in the Health Sciences
8. Pharmacotherapy: A Pathophysiologic Approach
9. Lu's Basic Toxicology: Fundamentals, Target Organs, and Risk Assessment
10. Drug Discovery and Evaluation: Methods in Clinical Pharmacology
11. Jadad's Randomised Controlled Trials: Questions, Answers and Musings
12. Fundamental of Experimental Pharmacology, M N Ghosh
13. Harrison's Principles of Internal Medicine
14. Guide to Clinical Trial – Bert Spilker
15. Martindale: The Complete Drug Reference

Journals recommended:

1. Annual Reviews of Pharmacology and Toxicology
2. British Journal of Pharmacology
3. British Journal of Clinical Pharmacology
4. Annals of Pharmacotherapy
5. New England Journal of Medicine
6. The Lancet
7. Nature Reviews: Drug Discovery
8. Drugs
9. Journal of American Medical Association
10. Indian Journal of Pharmacology

MODEL QUESTION PAPERS

PAPER 1

GENERAL PHARMACOLOGICAL PRINCIPLES AND ALLIED

SCIENCES Max. Marks:100
Time: 3 hrs
Attempt ALL questions
Illustrate your answer with SUITABLE DIAGRAMS

1. Describe in detail the structure and molecular mechanisms of various types of G protein receptor. Enumerate the various G protein-coupled receptors in the cardiovascular system and describe their pharmacological significance. (8+12)
2. Describe the character of the dose-response curve. Enumerate the various parameters determined from it and its significance. (5+5)
3. Describe the renin-angiotensin system and its pharmacological significance. (10)
4. What is metabolomics? Explain its role in drug development. (10)
5. What is isobologram? Describe its use in determining the drug interactions. (10)
6. Describe the various pharmacokinetic parameters relevant for a drug undergoing two compartmental elimination kinetics when given intravenously. (10)
7. Describe the various online drug databases useful for clinical practice. (10)
8. Role of pharmacoepidemiology in pharmacotherapy. (10)
9. Enumerate the dopamine pathways in the central nervous system and its pharmacological significance. (10)

PAPER 2

SYSTEMIC PHARMACOLOGY, CHEMOTHERAPY AND

THERAPEUTICS Max. Marks:100

Time: 3 hrs

Attempt ALL questions

Illustrate your answer with SUITABLE DIAGRAMS

1. Describe the pharmacotherapeutic management of ST-elevated myocardial infarction. (20)
2. Describe the management of Alzheimer's disease. (10)
3. What is the role of benzodiazepines in clinical practice? (10)
4. Write about the management of hospital-acquired pneumonia. (10)
5. Explain the pharmacotherapeutic management of Helicobacter pylori infection. (10)
6. What are tyrosine kinase inhibitors and their role in the management of various cancers? (10)
7. What is gene therapy? Describe the gene therapy approved for the management of eye disorder. (10)
8. Describe the pharmacotherapeutic management of acne.
9. Pharmacotherapeutic management of the chronic obstructive pulmonary disease. (10)

PAPER 3

EXPERIMENTAL PHARMACOLOGY, SCREENING OF DRUGS AND

STATISTICS MAX. MARKS:100

TIME: 3 HRS ATTEMPT

ALL QUESTIONS

ILLUSTRATE YOUR ANSWER WITH SUITABLE DIAGRAMS

1. Describe the various pharmacodynamic models and the parameters associated with them in explaining the drug action. (20)
2. High throughput screening in drug discovery. (10)
3. Describe the various animal models used in the screening of antihypertensive drugs. (10)
4. What is alpha and beta error and how does it influence the sample size estimation? What are the various parameters which determine the sample size estimation and describe their association with the sample size estimation? (5+5)
5. Describe fragment-based drug discovery. (10)
6. Describe the principles of mass spectrometry. How does it differ from liquid chromatography? What are the advantages and disadvantages associated with mass spectrometry? (4+3+3)
7. Describe the process of simulation of clinical studies and its significance. (10)
8. Explain principal component analysis. (10)
9. Describe toxicokinetic studies in preclinical settings. (10)

PAPER 4

CLINICAL PHARMACOLOGY AND RECENT ADVANCES IN

PHARMACOLOGY MAX. MARKS:100

TIME: 3 HRS ATTEMPT

ALL QUESTIONS

ILLUSTRATE YOUR ANSWER WITH SUITABLE DIAGRAMS

1. Describe the objective, composition, functioning and outcomes of the antimicrobial stewardship program. (20)
2. Describe the causality assessment in adverse drug reaction reporting. (10)
3. Explain the principles of non-inferiority trials. (10)
4. What is the missing data in a clinical trial? What are its types and relevance? What are the ways to handle the missing data in a clinical trial? (3+3+4)
5. What is the role of the principal investigator in clinical trials? (10)
6. Describe the development of biosimilars. (10)
7. What are the recent advances in the treatment of neurodegenerative disorders? (10)
8. What are the recent advances in the drugs acting on coagulation pathway? (10)
9. Describe pharmacoeconomic studies. (10)