

PUNJAB TECHNICAL UNIVERSITY, JALANDHAR
M. Pharm. (PHARMACOLOGY)
Scheme and Syllabus

FIRST SEMESTER

| S.No. | Subject Code | Subject Title | Teaching Load Allocation | | | Marks Distribution | | | Exam. (hr) | Credit |
|-------|--------------|---|--------------------------|----|----|--------------------|-----|-------|------------|--------|
| | | | L | T | P | Int | Ext | Total | | |
| 01 | PHCOL 131 | Systemic Pharmacology | 4 | 1 | - | 20 | 80 | 100 | 3 | 5 |
| 02 | PHCOL 133 | Drug Therapy and Pharmacotherapeutics | 4 | 1 | - | 20 | 80 | 100 | 3 | 5 |
| 03 | PHCOL 135 | Drug Evaluation and Advanced Pharmacological Techniques | 4 | 1 | - | 20 | 80 | 100 | 3 | 5 |
| 04 | PHCOL 137 | Pharmacology Laboratory- I | - | | 16 | 20 | 80 | 100 | 8 | 5 |
| | | Total (31) | 12 | 03 | 16 | 80 | 320 | 400 | | 20 |

SECOND SEMESTER

| S.No. | Subject Code | Subject Title | Teaching Load Allocation | | | Marks Distribution | | | Exam. (hr) | Credit |
|-------|--------------|---|--------------------------|----|----|--------------------|-----|-------|------------|--------|
| | | | L | T | P | Int | Ext | Total | | |
| 01 | PHCOL 132 | Pharmaceutical Medicine | 4 | 1 | - | 20 | 80 | 100 | 3 | 5 |
| 02 | PHCOL 134 | Clinical Evaluation and Molecular Biology | 4 | 1 | - | 20 | 80 | 100 | 3 | 5 |
| 03 | PHCOL 136 | Recent Advances in Pharmacology | 4 | 1 | - | 20 | 80 | 100 | 3 | 5 |
| 04 | PHCOL 138 | Pharmacology Laboratory – II | - | | 16 | 20 | 80 | 100 | 8 | 5 |
| | | Total (31) | 12 | 03 | 16 | 80 | 320 | 400 | | 20 |

THIRD AND FOURTH SEMESTER

Research Work for one year

The thesis shall be presented by the candidate at the end of record academic year. The thesis shall be evaluated as under :

Evaluation of written thesis : MM 200

Presentation of seminar on thesis : MM 100

and viva-voce

Total : 300 marks

[Note : Credit System : 1 credit = 20 marks, L- Lecture – Tutorial , P – Practical]

M. PHARM.PHARMACOLOGY- SEMESTER-I

| S.No. | Subject Code | Subject Title | Teaching Load Allocation | | | Marks Distribution | | | Credit |
|-------|--------------|-----------------------|--------------------------|---|---|--------------------|-----|-------|--------|
| | | | L | T | P | Int | Ext | Total | |
| 01 | PHCOL 131 | Systemic Pharmacology | 4 | 1 | - | 20 | 80 | 100 | 5 |

Module 01

Basic Principles of Pharmacology :

Mechanisms of drug action, membrane transporters and drug response, adverse drug reactions.

Pharmacology of the Autonomic Nervous System :

- Physiology of autonomic nervous system
- Muscarinic receptor agonists and antagonists
- Anticholinesterase agents
- Agents acting at neuromuscular junction and autonomic ganglia
- Adrenergic agonists and antagonists
- 5-Hydroxytryptamine receptor agonists and antagonists

Module 02

Pharmacology of Autacoids :

- Histamine, bradykinin, and their antagonists
- Lipid derived autacoids: Eicosanoids and platelet activating factor

Drugs Acting on the Central Nervous System :

- Neurotransmission in central nervous system
- General anesthetics
- Local anesthetics
- Hypnotics and sedatives
- Opioid analgesics
- Pharmacology of ethanol
- Drug addiction and drug abuse

Module 03

Analgesic, Antipyretic, and Anti-inflammatory Agents

Drugs Affecting Renal and Cardiovascular Function :

- Diuretics
- Vasopressin and other agents affecting the renal conservation of water
- Renin, angiotensin, and their modulators
- Calcium channel blockers

Module 04

Pharmacology of Chemotherapeutic and Antimicrobial Agents :

- General considerations of antimicrobial therapy
- Sulfonamides, trimethoprim, quinolones, other related agents
- Penicillins, cephalosporins, and other beta-lactam antibiotics
- Aminoglycosides
- Protein synthesis inhibitors and miscellaneous antibacterial agents

- Antifungal agents
- Antiviral agents (Non-retroviral)

Antineoplastic Agents

Module 05

Hormones and Their Antagonists :

- Pituitary hormones and their hypothalamic releasing factors
- Thyroid and antithyroid drugs
- Estrogens and progestins
- Androgens
- Adrenocortical steroids and their synthetic analogs, inhibitors of synthesis and actions of adrenocortical hormones
- Agents affecting mineral ion homeostasis and bone turnover

Module 06

Drugs Acting on the Blood and Blood-Forming Organs:

- Hematopoietic agents: Growth factors, minerals, and vitamins
- Blood coagulation and anticoagulant, thrombolytic, and antiplatelet drugs

Pharmacology of Dermatological Agents

Ocular Pharmacology

Immunosuppressants, Tolerogens, and Immunostimulants

Reading Material Recommended

1. Goodman and Gilman's The Pharmacological Basis of Therapeutics, 11th ed. Joel G. Hardman, Lee E. Limbird, Alfred G. Gilman (eds.). International Edition, The McGraw Hill Companies, Inc., 2006.
2. H. P. Rang and M. M. Dale, "Pharmacology" 5th Ed. Churchill Livingstone.
3. B. G. Katzung, "Basic and Clinical Pharmacology" 9th Ed. McGraw-Hill Medical.

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| 02 | PHCOL 133 | Drug Therapy and Pharmacotherapeutics | 4 | 1 | - | 20 | 80 | 100 | 5 |

Module 01

Basic Principles of Clinical Pharmacology :

therapy, patient compliance, principles of pediatric and geriatric pharmacology, drug therapy in pregnant and lactating mothers. Monitoring of drug

Module 02

Drug Therapy of Cardiovascular Disorders :

drug therapy of congestive cardiac failure, hypertension, cardiac arrhythmias, ischemic heart disease, hyperlipidemia, and atherosclerosis.

Pathophysiology and

Module 03

Drug Therapy of Neurological Disorders :

drug therapy of epilepsy, Parkinson's disease, migraine, and myasthenia gravis.

Pathophysiology and

Drug Therapy of Psychiatric Disorders :

Pathophysiology and drug therapy of anxiety, schizophrenia, Alzheimer's disease, mood and sleep disorders.

Module 04

Drug Therapy of Endocrine Disorders :

Pathophysiology and drug therapy of diabetes mellitus, contraception, and infertility.

Drug Therapy of Inflammatory Disorders :

inflammation, pathophysiology and drug therapy of osteoarthritis, rheumatoid arthritis, and gout.

Biology of

Module 05

Drug Therapy of Respiratory Diseases :

drug therapy of asthma.

Pathophysiology and

Drug Therapy of Gastrointestinal Diseases :

Pathophysiology and drug therapy of peptic ulcers, emesis, irritable bowel syndrome, and inflammatory bowel disease.

Drug Therapy of Metabolic and Sexual Disorders :

Pathophysiology and drug therapy of obesity and erectile dysfunction

Module 06

Drug Therapy of Infectious Diseases :

Pathophysiology and drug therapy of tuberculosis, leprosy, HIV and related opportunistic infections, malaria, amoebiasis, and helminth infections.

Reading Material Recommended

1. J.T. Dipiro, R.L. Talbert, , G.C. Yee, G.R. Matzke, B.G. Wells, L. Michael Posey (eds.), Pharmacotherapy : A Pathophysiologic Approach, 6th ed., The McGraw Hill Companies, Inc., 2005.
2. E.T. Herfindal and D.R Gourley, Text Book of Therapeutics: Drug and Disease Management,7th ed., Lippincott Williams & Wilkins, USA, 2000.

3. T.M. Speight and NHG Holford (ed.), *Avery's Drug Treatment: Principals and Practice of Clinical Pharmacology and Therapeutics*, 4th ed., ADIS Press, Sydney, Australia, 1997.
4. Dennis L. Kasper, Eugene Braunwald, Anthony S. Fauci, Stephen L. Hauser, Dan L. Longo, J. Larry Jameson, and Kurt J. Isselbacher, (Eds.), *Harrison's Principles of Internal Medicine*, 16th ed., The McGraw Hill Companies, Inc., 2004.

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| 03 | PHCOL 135 | Drug Evaluation and Advanced Pharmacological Techniques | 4 | 1 | - | 20 | 80 | 100 | 5 |

Module 01

Principles of Experimental Pharmacology :

Common laboratory animals in pharmacological research, limitations of animal tests, alternatives to animal use, anesthetics used in laboratory animals, some standard techniques used in laboratory animals, euthanasia of experimental animals. Regulations for the care and use of laboratory animals.

Module 02

Drug Discovery :

Strategies and approaches employed in drug discovery. Basic concept of combinatorial chemistry, high throughput screening, cell lines, and their application in drug discovery. Transgenic animal models in the development of new drugs.

Receptor-Radioligand Binding Assays

General principles and techniques of radioligand binding assays. Specific assay design for adrenoceptors, dopamine receptors, histamine receptors, GABA and benzodiazepine receptors.

Pharmacological Techniques to Evaluate the following Class of Drugs:

Module 03

- Antihypertensive agents
- Antianginal agents
- Antiarrhythmic agents and agents used in sudden cardiac death
- Drugs used in cardiac failure and cardiomyopathies
- Drugs used in hyperlipidemia and atherosclerosis
- Anti-infarct agents
- Antiplatelet and thrombolytic agents

Module 04

- Antiepileptics
- Antiparkinsonian agents
- Antimigraine agents
- Antianxiety agents and drugs used in mood and sleep disorders
- Antipsychotics
- Drugs used in Alzheimer's disease
- Local anesthetics

Module 05

- Skeletal muscle relaxants and neuromuscular blockers
- Antidiabetic agents
- Antifertility agents

- Analgesics and drugs used in arthritis and neuropathic pain
- Anti-inflammatory agents

Module 06

- Antiasthmatic agents
- Antiulcer agents
- Antiemetics
- Hepatoprotective agents
- Antiobesity agents
- Drugs used in erectile dysfunction
- Dermatological agents and experiment models in skin pharmacology

Reading Material Recommended

1. H.G. Vogel (ed), Drug Discovery and Evaluation-Pharmacological Assays, 2nd edition, Springer Verlag, Berlin, Germany, 2002.
2. M.N. Ghosh, Fundamentals of Experimental Pharmacology, 2nd edition, Scientific Book Agency, Calcutta, India, 1984.
3. D.R. Laurence and A.L. Bacharach (eds), Evaluation of Drug Activities: Pharmacometrics, Vol. 1 and 2, Academic Press, London, U.K., 1964.
4. David R. Gross, Animal Models in Cardiovascular Research, 2nd edition, Kluwer Academic Publishers, London, U.K., 1994.

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| 04 | PHCOL 137 | Pharmacology Laboratory- I | - | | 16 | 20 | 80 | 100 | 5 |

1. Experiments to study pharmacology of receptors (competitive and non-competitive antagonists). Experiments to calculate pA_2 and pA_{10} using isolated rectus abdominus muscle of rat, vas deferens, muscle of rat, rat colon, and rat fundus preparations.
2. Experiments in intact animals to evaluate local anesthetics, mydriatics, miotics, analgesics, anti-inflammatory agents, hypnotics, antianxiety agents, antiepileptic agents, antidepressants, antipsychotics, antiparkinsonian agents, nootropics, and antiulcer agents
3. Design and statistical analysis of experimental data using student t-test, One way ANOVA etc.

Reading Material Recommended

1. M.N. Ghosh, Fundamentals of Experimental Pharmacology, 2nd & 3rd edition, Scientific Book Agency, Calcutta, India, 1984, 2005.
2. Staff of the Department of Pharmacology, University of Edinburgh (ed.). Pharmacological experiments on isolated preparations. 2nd edition. Edinburgh and London: E and S Livingstone; 1970.
3. H.G. Vogel (ed), Drug Discovery and Evaluation-Pharmacological Assays, Springer Verlag, Berlin, Germany, 2002.
4. W.W. Daniel, Biostatistics: A Foundation for Analysis in the Health Sciences, 7th ed., John Wiley & Sons, Inc., India, 2000.
5. S.P. Gupta, Statistical Methods, 31st ed., Sultan Chand & Sons, India, 2003.

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| 01 | PHCOL 132 | Pharmaceutical Medicine | 4 | 1 | - | 20 | 80 | 100 | 5 |

Module 01

New Drug Development Process: Stages of drug discovery, pre-clinical and safety evaluation, acute, sub-acute, chronic studies, in-vivo and in-vitro studies (behavioral, biochemical, neurochemical models) and special studies including carcinogenicity, mutagenicity, teratogenicity..

Module 02 -03

Clinical trials: Design (placebo, multicentre clinical trials, randomization, blinding) and different phases of clinical trials (1 to 4), principles of controlled clinical trials, protocol designing, patient informed consent, patient enrolment, inclusion and exclusion criteria, withdrawals and dropout, run in period. Clinical trial team, monitoring of clinical trial, report preparation, deviations in clinical trials. Clinical data management. Contract Research Organization (CRO) and relationship of marketing to clinical research. Clinical research in children, women, and elderly patients. IND, NDA, and ANDA applications

Module 04

Regulatory Requirements : Good clinical practice, Good Laboratory practice, ICH guidelines, Regulation on manufacture of drugs in India, Drug regulatory controls and authorities. Preparation and submission of marketing application of India, US and Europe. WHO guidelines Harmonization of pharmaceutical standards and Common Technical Document (CTD).

Module 05

Intellectual property

Concepts and fundamentals regarding intellectual property (IP), intellectual property protection (IPP) and intellectual property rights (IPR); mechanism for protection of intellectual property - patents, copyright, trademarks; brief introduction of WTO, WIPO, GATT, GATS, TRIPs and TRIMS.

Module 06

Pharmacoepidemiology: Types, methods, and factors affecting drug utilization, applications of pharmacoepidemiology in health care. Rational use of drugs, essential drug list.

Pharmacovigilance: Definition, scope, and epidemiology of adverse events, product recall and withdrawal of drugs with specific examples.

Pharmacoeconomics: Principles, methods, and applications of pharmacoeconomics to pharmacotherapy and managed health care.

Nutraceuticals: Concept, regulatory requirements, and clinical uses of various nutraceuticals.

Reading Material Recommended

1. A.J. Fletcher, L.D. Edwards, A.W. Fox, P. Stonier (eds.), Principles and Practice of Pharmaceutical Medicine, John Wiley & Sons, Ltd., U.K., 2002.
2. J.P. Griffin and J. O'Grady (eds.), The Text Book of Pharmaceutical Medicine, 5th ed., Blackwell Publishing Ltd., India, 2006.
3. P.I. Good, A Managers Guide to Design and Conduct of Clinical trials, Wiley-Liss, Hobokem, U.S.A., 2002.

4. A.C. Cartwright and B.R. Matthews (eds.), *International Pharmaceutical Product Registration*, Ellis Horwood, New York, U.S.A., 1994.
5. J.T. Dipiro, R.L. Talbert, , G.C. Yee, G.R. Matzke, B.G. Wells, L. Michael Posey (eds.), *Pharmacotherapy : A Pathophysiologic Approach*, 6th ed., The McGraw Hill Companies, Inc., 2005.

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| 02 | PHCOL 134 | Clinical Evaluation and Molecular Biology | 4 | 1 | - | 20 | 80 | 100 | 5 |

Module 01

- Clinical Evaluation:** Clinical evaluation of antihypertensive agents, antianginal agents, antiepileptics, antidepressants, antipsychotics, antiparkinsonian agents, drugs used in Alzheimer's disease, antiulcer agents, antidiabetics.
- Clinical Pharmacokinetics:** Determination and clinical relevance of various pharmacokinetic parameters. Concept and measurement of bioavailability, bioequivalence, renal and hepatic clearances. Calculation of loading and maintenance doses and dose adjustment in renal and hepatic impairments.

Module 02

- Recombinant DNA Technology:** DNA structure and functions, restriction endonucleases, plasmid cloning, methods of creating and screening gene library, cloning DNA sequences that encode eukaryotic proteins, vectors for cloning large pieces of DNA, genetic transformation, and selection of prokaryotes.

Module 03

- Molecular Diagnostics:** DNA diagnostic systems, hybridization probes, diagnosis of malaria, fluorescent in situ hybridization procedure, molecular diagnosis of genetic diseases – PCR/OLA procedures, ligase chain reaction (LCR).

Introduction and application of molecular pharmacological techniques: Elisa, Western Blotting, SDS-Page and electrophoresis, flow cytometry.

Module 04

- Monoclonal Antibodies:** Scope and limitation of monoclonal antibodies, formation and selection of hybrid cells, identification of specific antibody producing hybrid cell lines. Applications of monoclonal antibodies in clinical, treatment, and biomedical research. Monoclonal antibodies as therapeutic agents, preventing rejection of transplanted organs, treatment of bacterial blood infections. Chemically linked monoclonal antibodies, human monoclonal antibodies, and hybrid human-mouse monoclonal antibodies.

Module 05

- Biopharmaceuticals:** Basic principles of development of protein pharmaceuticals with special reference to human insulin, human interferons, human growth hormone, erythropoietin, variants of t-PA, immunoadhesions, and chimeric proteins.

Module 06

- Gene and stem cell Therapies:** Basic concepts and clinical potentials of gene therapy and stem cell therapy, Impact of human genome sequence on the discovery of newer pharmacological agents. Ethical issues related to stem cells and human cloning.
- Applications of cell lines.

Reading Material Recommended

1. P.I. Good, A Managers Guide to Design and Conduct of Clinical trials, Wiley-Liss, Hoboken, U.S.A., 2002.
2. B.R. Glick and J.J. Paternak, Molecular Biotechnology: Principles and Applications of DNA Recombinant Technology. ASM Press, Washington, U.S.A., 1994.

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| | | | L | T | P | Int | Ext | Total | |
| 03 | PHCOL 136 | Recent Advances in Pharmacology | 4 | 1 | - | 20 | 80 | 100 | 5 |

Module 01

Molecular Pharmacology :

Receptor occupancy and cellular signaling systems including G proteins, cyclic nucleotides, calcium and calcium binding proteins, phospholipases.

Pharmacology of receptors :

Classification, cellular signaling systems, and pharmacology of agonists and antagonists of the following receptor types:

- (a) Excitatory Amino Acid receptors
- (b) Purinoreceptors
- (c) GABA and Benzodiazepine receptors
- (d) Neurosteroid receptors
- (e) Cannabinoid receptors
- (f) Melatonin receptors

Ion Channels and Their Modulators :

Classification and biology of potassium ionic channels, and pharmacology of their Modulators

Module 02

Novel Target Sites :

Physiological functions, pharmacological implications, and therapeutic potential of the following target sites:

- (a) Rho kinase (ROCK)
- (b) Phosphoinositide 3-kinase (PI3K)
- (c) Akt (Protein kinase B)
- (d) Caspases
- (e) Poly (ADP-ribose) polymerase (PARP)
- (f) Peroxisome proliferator activator receptors (PPAR)- α and γ
- (g) AMP activated protein kinases
- (h) Protein kinases
- (i) Phosphodiesterases

Module 03

Neuropeptides :

Biological functions, pharmacological implications, their agonists and antagonists, and therapeutic potentials of the following neuropeptides:

- Neuropeptide Y
- Calcitonin gene-related peptide (CGRP)
- Substance P
- Cholecystokinin

Module 04

Transporter Proteins :

Classification and biology of ATP binding cassette (ABC) transporter super family.

Multidrug resistance (MDR) proteins

Cystic fibrosis transmembrane regulator (CFTR)

Programmed Cell Death (Apoptosis) :

Molecular biology, physiological and pharmacological implications and therapeutic potentials of apoptosis.

Module 05

Cytokines and Chemokines :

Classification, physiology, pharmacology, pathological, and therapeutic implications of various cytokines and chemokines.

Cell Adhesion Molecules and Matrix Proteins :

Biology of cell adhesion molecules and matrix proteins, their role in various disease processes, and potential target sites to develop newer agents. Glycoprotein IIb/IIIa receptor antagonists and anti-integrin therapy.

Module 06

Growth Factors :

Biology and therapeutic potentials of various growth factors. Pharmacology of Erb B receptors, cardiac and vascular remodeling.

Biology of Vascular Endothelium :

Biology of EDRF, EDCF, and EDHF. Pharmacology of endothelins and nitric oxide. Clinical implications of endothelial dysfunction.

Chronobiology and Chiral Pharmacology :

Basic concepts and clinical potentials of chronobiology and chiral configuration.

Reading Material Recommended

1. Annual Review of Pharmacology and Toxicology
2. Annual Review of Medicine
3. Trends in Pharmacological Sciences
4. Advances in Pharmacology
5. Trends in Biotechnology
6. Advances in Drug Therapy
7. Drug Discovery Today.

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| | | | L | T | P | Int | Ext | Total | |
| 04 | PHCOL 138 | Pharmacology Laboratory – II | - | | 16 | 20 | 80 | 100 | 5 |

1. Bioassay designs using various in-vitro preparations.
2. Effect of various pharmacological agents on heart rate, coronary flow rate, and force of contraction on isolated mammalian heart.
3. Exercises to calculate pharmacokinetic parameters, bioavailability and bioequivalence using serum/plasma and urine excretion data.
4. Calculation of LD₅₀, therapeutic index and experiments related to toxicity.
5. Study and analysis of clinical problems including case history and drug therapy, pharmacovigilance studies, exercises on effective pharmacist-patient communication.
6. Computer aided learning in experimental pharmacology.
7. Biochemical estimations: Blood glucose, cholesterol, protein, antioxidant parameters, liver and renal function tests.

Reading Material Recommended

1. M.N. Ghosh, Fundamentals of Experimental Pharmacology, 2nd & 3rd edition, Scientific Book Agency, Calcutta, India, 1984, 2005.
2. Edinburg University Pharmacology Staff (ed.) Pharmacological Experiments on Isolated Preparations, Livingstone, U.K.
3. H.G. Vogel (ed), Drug Discovery and Evaluation-Pharmacological Assays, Springer Verlag, Berlin, Germany, 2002.