

Punjab Technical University, Jalandhar
M. Pharm (Pharmacology)
Scheme of Examination

1st Semester

Sr. No.	Course Code	Subject	Exam Hours	Maximum Marks	
				Int.	Ext.
1	PHM- 511	Systemic Pharmacology	3	20	80
2	PHM- 513	Drug Therapy and Pharmacotherapeutics	3	20	80
3	PHM- 515	Drug Evaluation and Advanced Pharmacological Techniques	3	20	80
4	PHM- 517	Pharmacology Laboratory- I	12	20	80
Total				80	320

2nd Semester

Sr. No.	Course Code	Subject	Exam Hours	Maximum Marks	
				Int.	Ext.
1	PHM - 512	Pharmaceutical Medicine	3	20	80
2	PHM -514	Clinical Evaluation and Molecular Biology	3	20	80
3	PHM- 516	Recent Advances in Pharmacology	3	20	80
4	PHM- 518	Pharmacology Laboratory – II	12	20	80
Total				80	320

3rd & 4th 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
 Presentation of Seminar on thesis
 & Viva Vice

Maximum Marks: 200
 Maximum Marks: 100

Total Marks: 300

PHM-511 SYSTEMIC PHARMACOLOGY**External Marks: 80****4 Hrs/Week****Internal Marks: 20****Total Marks: 100**

1. **Basic Principles of Pharmacology:** Mechanisms of drug action, membrane transporters and drug response, adverse drug reactions, and pharmacogenetics.
2. **Pharmacology of the Autonomic Nervous System:**
 - 2.1. Physiology of autonomic nervous system
 - 2.2. Muscarinic receptor agonists and antagonists
 - 2.3. Anticholinesterase agents
 - 2.4. Agents acting at neuromuscular junction and autonomic ganglia
 - 2.5. Adrenergic agonists and antagonists
 - 2.6. 5-Hydroxytryptamine receptor agonists and antagonists
3. **Pharmacology of Autacoids:**
 - 3.1. Histamine, bradykinin, and their antagonists
 - 3.2. Lipid derived autacoids: Eicosanoids and platelet activating factor
4. **Drugs Acting on the Central Nervous System:**
 - 4.1. Neurotransmission in central nervous system
 - 4.2. General anesthetics
 - 4.3. Local anesthetics
 - 4.4. Hypnotics and sedatives
 - 4.5. Opioid analgesics
 - 4.6. Pharmacology of ethanol
 - 4.7. Drug addiction and drug abuse
5. **Analgesic, Antipyretic, and Anti-inflammatory Agents**
6. **Drugs Affecting Renal and Cardiovascular Function:**
 - 6.1. Diuretics
 - 6.2. Vasopressin and other agents affecting the renal conservation of water
 - 6.3. Renin, angiotensin, and their modulators
 - 6.4. Calcium channel blockers
7. **Pharmacology of Chemotherapeutic and Antimicrobial Agents:**
 - 7.1. General considerations of antimicrobial therapy
 - 7.2. Sulfonamides, trimethoprim, quinolones, other related agents
 - 7.3. Penicillins, cephalosporins, and other beta-lactam antibiotics
 - 7.4. Aminoglycosides
 - 7.5. Protein synthesis inhibitors and miscellaneous antibacterial agents
 - 7.6. Antifungal agents
 - 7.7. Antiviral agents (Non-retroviral)
8. **Antineoplastic Agents**
9. **Immunosuppressants, Tolerogens, and Immunostimulants**
10. **Hormones and Their Antagonists:**
 - 10.1. Pituitary hormones and their hypothalamic releasing factors
 - 10.2. Thyroid and antithyroid drugs
 - 10.3. Estrogens and progestins
 - 10.4. Androgens
 - 10.5. Adrenocortical steroids and their synthetic analogs, inhibitors of synthesis and actions of adrenocortical hormones
 - 10.6. Agents affecting mineral ion homeostasis and bone turnover
11. **Drugs Acting on the Blood and Blood-Forming Organs:**
 - 11.1. Hematopoietic agents: Growth factors, minerals, and vitamins
 - 11.2. Blood coagulation and anticoagulant, thrombolytic, and antiplatelet drugs
12. **Pharmacology of Dermatological Agents**
13. **Ocular Pharmacology**

BOOKS 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.

PHM-513 DRUG THERAPY AND PHARMACOTHERAPEUTICS**External Marks: 80****4 Hrs/Week****Internal Marks: 20****Total Marks: 100**

1. **Basic Principles of Clinical Pharmacology:**
Monitoring of drug therapy, patient compliance, principles of pediatric and geriatric pharmacology, drug therapy in pregnant and lactating mothers.
2. **Drug Therapy of Cardiovascular Disorders:**
Pathophysiology and drug therapy of congestive cardiac failure, hypertension, cardiac arrhythmias, ischemic heart disease, hyperlipidemia, and atherosclerosis.
3. **Drug Therapy of Neurological Disorders:**
Pathophysiology and drug therapy of epilepsy, Parkinson's disease, migraine, and myasthenia gravis.
4. **Drug Therapy of Psychiatric Disorders:**
Pathophysiology and drug therapy of anxiety, schizophrenia, Alzheimer's disease, mood and sleep disorders, and memory.
5. **Drug Therapy of Endocrine Disorders:**
Pathophysiology and drug therapy of diabetes mellitus, contraception, and infertility.
6. **Drug Therapy of Inflammatory Disorders:**
Biology of inflammation, pathophysiology and drug therapy of osteoarthritis, rheumatoid arthritis, and gout.
7. **Drug Therapy of Respiratory Diseases:**
Pathophysiology and drug therapy of asthma.
8. **Drug Therapy of Gastrointestinal Diseases:**
Pathophysiology and drug therapy of peptic ulcers, emesis, irritable bowel syndrome, and inflammatory bowel disease.
9. **Drug Therapy of Metabolic and Sexual Disorders:**
Pathophysiology and drug therapy of obesity and erectile dysfunction
10. **Drug Therapy of Infectious Diseases:**
Pathophysiology and drug therapy of tuberculosis, leprosy, HIV and related opportunistic infections, malaria, amoebiasis, and helminth infections.

BOOKS 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.

PHM-515 DRUG EVALUATION AND ADVANCED PHARMACOLOGICAL TECHNIQUES**External Marks: 80****4 Hrs/Week****Internal Marks: 20****Total Marks: 100**

- 1. 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.
- 2. 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.
- 3. 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.
- 4. Pharmacological Techniques to Evaluate the following Class of Drugs:**
 - 4.1. Antihypertensive agents
 - 4.2. Antianginal agents
 - 4.3. Antiarrhythmic agents and agents used in sudden cardiac death
 - 4.4. Drugs used in cardiac failure and cardiomyopathies
 - 4.5. Drugs used in hyperlipidemia and atherosclerosis
 - 4.6. Anti-infarct agents
 - 4.7. Antiplatelet and thrombolytic agents
 - 4.8. Antiepileptics
 - 4.9. Antiparkinsonian agents
 - 4.10. Antimigraine agents
 - 4.11. Antianxiety agents and drugs used in mood and sleep disorders
 - 4.12. Antipsychotics
 - 4.13. Drugs affecting memory
 - 4.14. Drugs used in Alzheimer's disease
 - 4.15. Local anesthetics
 - 4.16. Skeletal muscle relaxants and neuromuscular blockers
 - 4.17. Antidiabetic agents
 - 4.18. Antifertility agents
 - 4.19. Analgesics and drugs used in arthritis and neuropathic pain
 - 4.20. Anti-inflammatory agents
 - 4.21. Antiasthmatic agents
 - 4.22. Antiulcer agents
 - 4.23. Antiemetics
 - 4.24. Drugs used in inflammatory bowel disease
 - 4.25. Hepatoprotective agents
 - 4.26. Antiobesity agents
 - 4.27. Drugs used in erectile dysfunction
 - 4.28. Antiviral agents
 - 4.29. Antimalarial agents
 - 4.30. Dermatological agents and experiment models in skin pharmacology

BOOKS 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.

PHM-517 PHARMACOLOGY LABORATORY – I

External Marks: 80

16 Hrs/Week

Internal Marks: 20

Total Marks: 100

1. Experiments to study pharmacology of receptors (competitive and non-competitive antagonists) using isolated rectus abdominus muscle of frog, guinea pig ileum, and rat colon preparations.
2. 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.
3. 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
4. Design and statistical analysis of experimental data.

BOOKS 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.

PHM-512 PHARMACEUTICAL MEDICINE**External Marks: 80****4 Hrs/Week****Internal Marks: 20****Total Marks: 100**

1. **Definition and development of scope of pharmaceutical medicine.**
2. **New Drug Development Process:**
Preclinical evaluation: Pharmacological evaluation of acute, subacute, and chronic toxicity studies.
Clinical Evaluation: Justification and purpose, clinical evaluation including phase I, II, III, IV, and IV studies, review of preclinical data, designing and decision, ethical and legal aspects of clinical trials, methods of randomization, size, documentation, monitoring and management of clinical trials. Clinical research in children, women, and elderly patients.
 IND, NDA, and ANDA applications. Concept of drug master files (DMF).
3. **Regulatory Requirements:** United States of America, European Union, Japanese guidelines, and requirements in India. WHO guidelines and WHO certification scheme, Good Manufacturing Practice (GMP). ICH guidelines for data collection and establishing quality, safety, and efficacy of drugs and products. Harmonization of pharmaceutical standards and Common Technical Document (CTD). VICH process of harmonization of veterinary pharmaceuticals. Requirements for biological and biotechnological products. Orphan drugs, and their regulatory requirements.
4. **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.
5. **Clinical Research:** Basic concept of Good Laboratory Practice (GLP) and Good Clinical Practice (GCP). Contract Research Organization (CRO) and relationship of marketing to clinical research.
6. **Pharmacoepidemiology:** Types, methods, and factors affecting drug utilization, applications of pharmacoepidemiology in health care and rational use of drugs.
7. **Pharmacovigilance:** Definition, scope, and epidemiology of adverse events, product recall and withdrawal of drugs with specific examples, and drug related deaths.
8. **Pharmcoeconomics:** Principles, methods, and applications of pharmcoeconomics to pharmacotherapy and managed health care.
9. **Nutraceuticals:** Concept, regulatory requirements, and clinical uses of various nutraceuticals.

BOOKS 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, Elis 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.

PHM-514 CLINICAL EVALUATION AND MOLECULAR BIOLOGY**External Marks: 80****4 Hrs/Week****Internal Marks: 20****Total Marks: 100**

1. **Clinical Evaluation:**
Clinical evaluation of antihypertensive agents, drugs for heart failure, antianginal agents, antiarrhythmic agents, antiepileptics, anxiolytics and hypnotics, antidepressants, antipsychotics, antiparkinsonian agents, drugs used in Alzheimer's disease, and other dementias, analgesics, anti-inflammatory agents, antiulcer agents, diuretics, antidiabetics, and antiviral agents.
2. **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.
8. **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),
4. **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.
5. **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.

BOOKS 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.

PHM-516 RECENT ADVANCES IN PHARMACOLOGY

External Marks: 80

4 Hrs/Week

Internal Marks: 20

Total Marks: 100

1. **Molecular Pharmacology:** Receptor occupancy and cellular signaling systems including G-proteins, cyclic nucleotides, calcium and calcium binding proteins, phospholipases.
 - 1.1. **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
 - 1.2. **Ion Channels and Their Modulators:** Classification and biology of potassium ionic channels, and pharmacology of their modulators
 - 1.3. **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
2. **Neuropeptides:** Biological functions, pharmacological implications, their agonists and antagonists, and therapeutic potentials of the following neuropeptides:
 - 2.1 Neuropeptide Y
 - 2.2 Calcitonin gene-related peptide (CGRP)
 - 2.3 Substance P
 - 2.4 Cholecystokinin
3. **Transporter Proteins:** Classification and biology of ATP binding cassette (ABC) transporter superfamily
 - 3.1 Multidrug resistance (MDR) proteins
 - 3.2 Cystic fibrosis transmembrane regulator (CFTR)
4. **Programmed Cell Death (Apoptosis):** Molecular biology, physiological and pharmacological implications and therapeutic potentials of apoptosis.
5. **Cytokines and Chemokines:** Classification, physiology, pharmacology, pathological, and therapeutic implications of various cytokines and chemokines.
6. **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.
7. **Growth Factors:** Biology and therapeutic potentials of various growth factors. Pharmacology of Erb B receptors, cardiac and vascular remodeling.

8. **Biology of Vascular Endothelium:** Biology of EDRF, EDCF, and EDHF. Pharmacology of endothelins and nitric oxide. Clinical implications of endothelial dysfunction.
9. **Chronobiology and Chiral Pharmacology:** Basic concepts and clinical potentials of chronobiology and chiral configuration.
10. **Nucleic Acid Therapies:** Basic concepts and clinical potentials of gene therapy, oligonucleotide therapy, aptamer therapy, and ribozyme therapy.
11. **Genomics:** Impact of human genome sequence on the discovery of newer pharmacological agents. Basic concept and applications of bioinformatics and proteomics in drug discovery.
12. **Stem Cell Therapeutics:** Biology of stem cells and their potentials in various disorders.
13. **Immunotoxins:** Biology, pharmacology, therapeutic potentials of immunotoxins.
14. **Ethical Issues:** Ethical issues related to stem cells, human cloning, genetic counseling, foeticide, and surrogated parenthood.

BOOKS 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.

PHM-518 PHARMACOLOGY LABORATORY – II

External Marks: 80

16 Hrs/Week

Internal Marks: 20

Total Marks: 100

1. Four-point bioassays of various agonists using rectus abdominus muscle of frog, guinea pig ileum, rat uterus, rat fundus . Calculate log fiducial limits of error.
2. To study the effect of various agonists on isolated guinea pig tracheal chain, isolated phrenic nerve-diaphragm, isolated rat aorta, isolated rabbit atria and gastrocnemius muscle of rabbit.
3. Identification of unknown drug using anesthetized dog by recording mean arterial blood pressure, respiration, gastrointestinal motility, nictitating membrane, and spleen volume.
4. Effect of various agents on rat blood pressure.
5. Effect of various pharmacological agents on heart rate, coronary flow rate, and force of contraction on isolated mammalian heart.
6. Exercises to calculate pharmacokinetic parameters, bioavailability and bioequivalence using serum/plasma and urine excretion data.
7. Study of hepatoprotective agents using various experimental models.
8. Calculation of LD₅₀ and experiments related to toxicity.

BOOKS 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.