CENTRAL UNIVERSITY OF PUNJAB
BATHINDA

Master of Pharmacy (Pharmacology)

MH-MPL-F

Batch-2025

Department of Pharmacology

Graduate attributes

M. Pharmacology graduates on completion of their study will demonstrate professional attitudes and behavior. They will acquire competencies in the acquisition of knowledge, teaching and training. They acquire a solid foundation of pharmacology principles and research experience in a lab setting. A graduate in M. Pharmacology can describe and apply pharmacological principles to explain the mechanisms of the effects of drugs used in diagnosis, prevention and treatment of diseases of all systems of human body and describe mechanisms of drug-drug interactions and their clinical importance. They can apply and integrate knowledge of pathophysiology of diseases and its modulation by drugs. They will acquire knowledge and understanding of principles of Good clinical practice (GCP) and Good laboratory practice (GLP) guidelines. They can describe how to evaluate, analyse and monitor preclinical and clinical data in drug discovery. They can demonstrate knowledge of basics of research methodology, develop a research protocol, conduct the study, record experimental observations, analyze data using currently available statistical software, interpret results and disseminate these results and have the potential ability to pursue further specializations and eventually be competent to guide students. Students who are graduated from the course can pursue higher studies and found employment in research positions either in academia or research industry. Other destinations include positions as consultants, medical writers, patent attorney, regulatory affair officers and product manager.

Course structure for M. Pharm. (Pharmacology)

Course Code	Name of the course	Credit hours	Credit points	Hrs/ wk	Marks
SEMESTER I					
MPL 101T	Modern Pharmaceutical Analytical techniques	4	4	4	100
MPL102T	Advanced Pharmacology- I	4	4	4	100
MPL103T	Pharmacological and Toxicological Screening Methods-1	4	4	4	100
MPL104T	Cellular and Molecular Pharmacology	4	4	4	100
MPL105P	Pharmacological Practical I (Analytical Instruments Handling, Handling of Laboratory Animals & Bio-Chemical analysis)	12	6	12	150
MPL106S	Seminar/Assignment	7	4	7	100
	Total	**35**	**26**	**35**	**650**
SEMESTER II					
MPL 201T	Advanced Pharmacology- II	4	4	4	100
MPL202T	Pharmacological and Toxicological Screening Methods- II	4	4	4	100
MPL203T	Principles of Drug Discovery	4	4	4	100
MPL204T	Clinical Research and Pharmacovigilance	4	4	4	100
MPL205P	Pharmacological Practical II (General Pharmacology,Toxicology & *In silico* studies)	12	6	12	150
MPL206S	Seminar/Assignment	7	4	7	100
XXX	Inter-Disciplinary Course	2	2	2	100
	Total	**37**	**28**	**37**	**750**
IDC/MOOC					
IDC Courses	**(Offer by Dept. of Pharmacology for other students)**				
IDC-506	Drug Abuse: Problem, Management and Prevention	**2**	**2**	**2**	**100**
IDC-521	Rational use of Medicines	**2**	**2**	**2**	**100**
MOOC offered from approved Platform		**2**	**2**	**2**	**100**
SEMESTER III					
MRM 301T	Research Methodology & Biostatistics	4	4	4	100
MPL302T	Journal club	1	1	1	25
MPL303T	Discussion/Presentation (Proposal Presentation)	2	2	-	50
MPL600	Research Work	28	14	-	350
	Total	**35**	**21**	**5**	**525**
SEMESTER IV					
MPL401T	Journal club	1	1	1	25
MPL402T	Discussion and Final Presentation	3	3	-	75
MPL601	Research Work	31	16	-	400

	Total	**35**	**20**	**-**	**500**
[#]To be evaluated by external expert					

Evaluation Criteria for Theory Courses

A. Continuous Assessment: [25 Marks]
   i. Surprise Test (minimum three) - Based on Objective Type Tests (10 Marks)
   ii. Term paper/Surprise interview/Clinical Case studies/Think pair share (10 Marks)
   iii. Assignment(s) (Classroom or Home assignments)/open book Test (5 Marks)

B. Mid Semester Test: Subjective Type Test [25Marks]

C. End-Term Exam (Final): Subjective (70%) + Objective 30% [50 Marks]

- The objective type will include one-word answers, fill-in the blank, sentence completion, true/false, MCQs', matching.
- The subjective type will include very short answer (1-2 lines), short answer (one paragraph), essay type with restricted response, and essay type with extended response.

Evaluation Criteria for Practical Courses

Item	Synopsis	Experiment	Practical Notebook and day to day evaluation	Viva voce
Marks	20	50	50	30

Evaluation Criteria for Research Work (3rd&4th Semester)

Thesis Proposal (Third Semester)			Thesis (Fourth Semester)		
	Marks	**Evaluation**		**Marks**	**Evaluation**
Supervisor	200	Thesis proposal and presentation	Supervisor	200	Continuous assessment (regularity in work, mid-term evaluation), Thesis report, presentation, final viva-voce
HoD and senior-most faculty of the department	150	Thesis proposal and presentation	External expert, HoD and senior-most faculty of the department	200	Thesis report (100), presentation (50), final viva- voce (50)

Semester I

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

Course Code: MPL101T
Total Hours: 60hrs

Course Learning Outcomes
After completion of the course, the students will be able to:
CLO 1: Understand the fundamental principles and instrumentation of UV-Visible, IR, fluorescence, flame emission, and atomic absorption spectroscopy.
CLO 2: Apply spectroscopic techniques for qualitative and quantitative analysis of pharmaceutical compounds.
CLO 3: Explain the theory, instrumentation, and factors affecting NMR spectral data.
CLO 4: Interpret NMR spectra for the structural elucidation of pharmaceutical molecules.
CLO 5: Understand the principle, instrumentation, and ionization techniques in mass spectrometry.
CLO 6: Analyze and interpret mass spectra for compound identification and fragmentation patterns.
CLO 7: Describe the principles, instrumentation, and parameters affecting various chromatographic techniques.
CLO 8: Utilize chromatographic methods for the separation and analysis of pharmaceutical substances.
CLO 9: Explain the principles, instrumentation, and applications of electrophoresis and X-ray crystallography in pharmaceutical analysis..
CLO 10: Understand the principles and pharmaceutical applications of potentiometry, thermal techniques, and quality by design (QbD) as per regulatory guidelines.

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/10hr	UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference Derivative spectroscopy. IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier – Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation. Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence (Characteristics of drugs that can be analyzed by flourimetry), Quenchers, Instrumentation and Applications of fluores**c**ence spectrophotometer. Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.	**CLO 1** **CLO 2**
Unit-2/10hr	NMR spectroscopy: Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and ^{13}C NMR. Applications of NMR spectroscopy.	**CLO 3** **CLO 4**

Unit-3/10hr	Mass Spectroscopy: Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy..	**CLO 5** **CLO 6**
Unit-4/10hr	Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following: a. Thin Layer chromatography b. High Performance Thin Layer Chromatography c. Ion exchange chromatography d. Column chromatography e. Gas chromatography f. High Performance Liquid chromatography g. Ultra-High-Performance Liquid chromatography h. Affinity chromatography i. Gel chromatography	**CLO 7** **CLO 8**
Unit-5/10hr	Electrophoresis: Principle, Instrumentation, working conditions, factors affecting separation and applications of the following: (a) Paper electrophoresis (b) Gel electrophoresis (c) Capillary electrophoresis (d) Zone electrophoresis (e) Moving boundary electrophoresis (f) Iso-electric focusing X ray Crystallography: Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.	**CLO 9**
Unit-6/10hr	Potentiometry: Principle, working, Ion selective Electrodes and Application of potentiometry. Thermal Techniques: Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. Differential Thermal Analysis (DTA): Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). TGA: Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications. Pharmaceutical Quality by design, qualitative and quantitative analysis of drugs and pharmaceuticals including impurity profiling in Active Pharmaceutical Ingredients (APIs) as per regulatory requirements, ICH guidelines for analysis of drugs and pharmaceuticals.	**CLO 10**

REFERENCES

1. Principles of Instrumental Analysis – Doglas A Skoog, F. James Holler, Timothy A. Nieman, 7th edition, Cengage, 2018.
2. Spectrometric Identification of Organic compounds – Robert M Silverstein, 8thedition, John Wiley & Sons, 2014.

3. Instrumental methods of analysis – Willards, 7 th edition, CBS publisher, 2018
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 2007.
5. Organic Spectroscopy – William Kemp, 3rd edition, ELBS, 2019.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation – P D Sethi, 3rd edition, CBS Publishers, New Delhi, 2008.
7. Pharmaceutical Analysis – Modern Methods – Part B – J W Munson, Vol 11, Marcel, Dekker Series 1984 (Reprint 2012)
8. Spectroscopy of Organic Compounds, 8th Edition, P. S. Kalsi, New Age International Private Limited, 2020.
9. Textbook of Pharmaceutical Analysis, KA. Connors, 3rd Edition, John Wiley & Sons, 2007.
10. Introduction to spectroscopy. 5th Edition, Pavia DL, Lampman GM, Kriz GS, Vyvyan JA.; Cengage Learning India Private Limited, 2015
11. Pharmaceutical quality by design: a practical approach. Schlindwein WS, Gibson M, editors. John Wiley &Sons; 2018.
12. HPLC in the Pharmaceutical Industry, (Volume 47) (Drugs and the Pharmaceutical Sciences Series) – Edited by Godwin W. Fong, Stanley K. Lam, CRC press, 2010
13. Handbook of Pharmaceutical Analysis (Volume 117) (Drugs and the Pharmaceutical Sciences Series) Edited by Lena Ohannesian, Anthony J. Streeter, Marcel Dekker Inc. 2008

VANCED PHARMACOLOGY – 1

Course Code: MPL 102T
Total Hours: 60hrs

Course Learning Outcomes
After completion of the course, the students will be able to:
CLO 1: Explain the principles of pharmacokinetics including absorption, distribution, metabolism, and elimination.
CLO 2: Understand drug-receptor interactions and their role in pharmacodynamics.
CLO 3: Describe neurotransmission in the ANS and CNS, including major neurotransmitters.
CLO 4: Explain the pharmacology of autonomic drugs and co-transmission mechanisms.
CLO 5: Understand the pharmacology of CNS-acting drugs including anesthetics and psychotropic agents.
CLO 6: Explain drug actions in neurodegenerative and seizure disorders.
CLO 7: Describe the pharmacology of cardiovascular drugs including diuretics and antihypertensives.
CLO 8: Explain drug mechanisms in coagulation and lipid management.
CLO 9: Understand the role of autacoids in physiology and pathology.
CLO 10: Understand the mechanism and uses of antihistamines and serotonin antagonists.

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/12hr	General Pharmacology a. Pharmacokinetics: The dynamics of drug absorption, distribution, biotransformation and elimination. Concepts of linear and non-linear compartment models. Significance of Protein binding. b. Pharmacodynamics: Mechanism of drug action and the relationship between drug concentration and effect. Receptors, structural and functional families of receptors, quantitation of drug receptors interaction and elicited effects.	**CLO 1** **CLO 2**

Unit-2/12hr	Neurotransmission General aspects and steps involved in neurotransmission. Neurohumoral transmission in autonomic nervous system (Detailed study about neurotransmitters – Adrenaline and Acetylcholine). Neurohumoral transmission in central nervous system (Detailed study about neurotransmitters – histamine, serotonin, dopamine, GABA, glutamate and glycine). Non adrenergic non cholinergic transmission (NAN). Co- transmission Systemic Pharmacology A detailed study on pathophysiology of diseases, mechanism of action, pharmacology and toxicology of existing as well as novel drugs used in the following systems Autonomic Pharmacology Parasympatho-mimetics and -lytics, sympatho-mimetics and -lytics, agents affecting neuromuscular junction	**CLO 3** **CLO 4**
Unit-3/12hr	Central nervous system Pharmacology General and local anesthetics Sedatives and hypnotics, drugs used to treat anxiety. Depression, psychosis, mania, epilepsy, neurodegenerative diseases. Narcotic and non-narcotic analgesics.	**CLO 5** **CLO 6**
Unit-4/12hr	Cardiovascular Pharmacology Diuretics, anti-hypertensives, anti-ischemics, anti-arrhythmics, drugs for heart failure and hyperlipidemia. Hematinics, coagulants, anticoagulants, fibrinolytics and anti-platelet drugs	**CLO 7** **CLO 8**
Unit-5/12hr	Autacoid Pharmacology: The physiological and pathological role of Histamine, Serotonin, Kinins Prostaglandins Opioid autacoids. Pharmacology of antihistamines, SHT antagonists.	**CLO 9** **CLO 10**

REFERENCES

1. Basic and Clinical Pharmacology by B. G Katzung, 14th edition, McGraw-Hill, 2018.
2. Handbook of Drug Metabolism, Third Edition (Drugs and the Pharmaceutical Sciences)3rd Edition, Paul G Pearson, Larry C. Wienkers, CRC Press, 2021
3. The Pharmacological Basis of Therapeutics, Goodman and Gillman's 13th edition by Laurence Brunton, Bjorn Knollman and Randa Hilal-Dandan, McGraw-Hill Education, 2017.
4. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy,4th edition by David E Golan, Armen H, Tashjian Jr, Ehrin J, Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers, 2016.
5. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott, New York: ADIS Health Science Press, 1983.
6. Applied bioharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu. 7th edition, McGraw-Hill Education, 2016
7. Graham Smith. Oxford textbook of Clinical Pharmacology, 3rd edition, Oxford University Press, 2008.
8. Avery Drug Treatment by Trevor M. Speight and Nicholas H.G. Holford, 4th edition, Wiley India Pvt Ltd, 2012.
9. Dipiro Pharmacology: A pathophysiological approach. 10th edition, McGraw-Hill Education, 2017.
10. Pathology and Therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice 3rd Revised edition Russell J. Greene & Norman D. Harris Pharmaceutical Press, 2008
11. Robbins & Cortan Pathologic Basis of Disease, 10 th Ed. (Robbins Pathology), Elsevier, 2020
12. A Complete Textbook of Medical Pharmacology 2nd edition by Dr. S. K. Srivastava published by APC Avichal Publishing Company, 2017.
13. K.D. Tripathi, Essentials of Medical Pharmacology, 8th edition, Jaypee Brothers Medical Pub, 2018.
14. Modern Pharmacology with Clinical Applications, 6th edition, Craig Charles R. & Stitzel Robet E., Wolters Kluwer India Pvt. Ltd 2012.
15. Rowland and Tozer's Clinical Pharmacokinetics and Pharmacodynamics: Concepts and Applications

Hardcover, 5 th edition,Wolters Kluwer, Lippincott Williams & Wilkins Publishers, 2019.
16. Applied Biopharmaceutics and Pharmacokinetics, Pharmacodynamics and Drug metabolism for industrial scientists, 7th edition, 2016.
17. Gene Therapy: Treating Disease by Repairing Genes (The New biology Series)– Joseph Panno, Viva books private limited, 2017
18. Oxford Handbook of Clinical Pharmacy 3rd Edition Philip Wiffen, Marc Mitchell, Melanie Snelling, Nicola Stoner, Oxford university press, 2017
19. New Drug Approval Process: 190 (Drugs and the Pharmaceutical Sciences) Richard A. Guarino (Ed.), 5th Edition, CRC Press, 2009
20. Animal and Translational Models for CNS Drug Discovery (3 volumes Set)- Edited by Robert A. Mcarthur, Franco Borsini, Academic press, 2008
21. Drug-drug interactions, (Volume 179)(Drugs and the Pharmaceutical Sciences Series) Edited by A. David Rodrigues, 2nd Edition, Informa Healthcare, 2008
22. The chemical basis of Drug Action (Volume 2) (Foundations of Molecular Pharmacology Series) – J.B. Stenlake, The Anthlone Press, 2009
23. Drug Facts Comparisons 2015 – Facts & comparisons, 2014

PHARMACOLOGICAL AND TOXICOLOGICAL SCREENING METHODS-1 (MPL 103T)

Course Code: MPL 103T
Total Hours: 60hrs

Course Learning Outcomes
After completion of the course, the students will be able to:
CLO 1: Understand the handling, breeding, and ethical use of laboratory and transgenic animals.
CLO 2: Explain the principles and methods of bioassay and good laboratory practices.
CLO 3: Describe in vivo and in vitro methods for CNS and ANS drug screening.
CLO 4: Understand models for neurodegenerative and psychiatric disorders.
CLO 5: Understand preclinical models to evaluate drugs acting on the respiratory, reproductive, and gastrointestinal systems.
CLO 6: Understand screening techniques for cardiovascular, metabolic, hepatic, and anti-cancer agents.
CLO 7: Understand immunoassay principles and methods for immunomodulatory drugs.
CLO 8: Recognize limitations of animal studies and explore alternative models and data extrapolation methods.

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/12hr	Laboratory Animals Common laboratory animals: Description, handling and applications of different species and strains of animals. Transgenic animals: Production, maintenance and applications Anesthesia and euthanasia of experimental animals. Maintenance and breeding of laboratory animals. CPCSEA guidelines to conduct experiments on animals. Good laboratory practice. Bioassay-Principle, scope and limitations and methods	**CLO 1** **CLO 2**

Unit-2/12hr	Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. General principles of preclinical screening. CNS Pharmacology behavioral and muscle co-ordination, CNS stimulants and depressants, anxiolytics, anti-psychotics, anti-epileptics and nootropics. Drugs for neurodegenerative diseases like Parkinsonism, Alzheimer's and multiple sclerosis, Drugs acting on Autonomic Nervous System.	**CLO 3** **CLO 4**
Unit-3/12hr	Preclinical screening of new substances for the pharmacological activity using in vivo. In-vitro, and other possible animal alternative models. Respiratory Pharmacology: ani-asthmatics, drugs for COPD and anti-allergic. Reproductive Pharmacology: Aphrodisiacs and anti-fertility agents Analgesics, anti-inflammatory and antipyretic agents. Gastrointestinal drugs: anti-ulcer, anti-emetic, anti-diarrheal and laxatives.	**CLO 5**
Unit-4/12hr	Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Cardiovascular Pharmacology: anti-hypertensives, anti-arrythmics, anti-anginal, anti- atherosclerotic agents and diuretics. Drugs for metabolic disorders like anti-diabetic, anti-dyslipidemic agents. Anti-cancer agents. Hepatoprotective screening methods.	**CLO 6**
Unit-5/12hr	Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models, Immunomodulators, lmmunosuppressants and immunostimulants. General principles of immunoassay: theoretical basis and optimization of immunoassay, heterogeneous and homogeneous immunoassay systems. Immunoassay methods evaluation protocol outline, objectives and preparation. Immunoassay for digoxin and insulin; Limitations of animal experimentation and alternate animal experiments; Extrapolation of in vitro data to preclinical and preclinical to humans	**CLO 6** **CLO 7**

REFERENCES

1. Biological standardization by J.H. Burn, D.J. Finney and I.G. Goodwin, 2011.
2. Fundamentals of experimental Pharmacology by M.N. Ghosh, 2019.
3. Practical Manual of Experimental and Clinical Pharmacology 2nd edition by Bikash Medhi and Ajay Prakash, 2017.
4. Drug discovery and Evaluation: Pharmacological Assay by Vogel H.G. 2015.
5. Screening methods in Pharmacology by Robert Tuner A, 2013.
6. Evaluation of Drug Activities: Pharmacometrics by Laurence and Bachrach, Academic Press 2013.
7. Methods in Pharmacology by Arnold Schwartz 2013
8. Drug screening methods by SK Gupta, 2016.
9. Handbook of Experimental pharmacology, S.K. Kulkarni, 2016.
10. Practical Pharmacology and Clinical Pharmacy, S.K. Kulkarni, 3rd Edition. 2008.
11. Animal Models in Cardiovascular Research, by David R. Gross, 3rdEdition, 2009.
12. Screening Methods in Pharmacology, Robert A. Turner. 2013.
13. Viva Voce in Experimental Pharmacology by Jaggi A.S., Bali, A., and Singh, N. 2015
14. Rodents for Pharmacological Experiments, Dr. Tapan Kumar Chatterjee. 2018 (reprint)
15. G Protein-Coupled Receptor Screening Assays by Duarte Miguel F. Prazeres (Editor), Sofia Aires M. Martins (Editor), 2015

CELLULAR AND MOLECULAR PHARMACOLOGY

Course Code: MPL 104T
Total Hours: 60hrs

Course Learning Outcomes
CLO 1: Understand cell structure, genome organization, and gene regulation.
CLO 2: Understand cell cycle control and mechanisms of cell death.
CLO 3: Understand intercellular and intracellular signaling mechanisms.
CLO 4: Learn receptor types and secondary messenger pathways.
CLO 5: Apply genomic and proteomic techniques in research.
CLO 6: Understand gene therapy principles and recent advancements.
CLO 7: Analyze the impact of genetic variation on drug response.
CLO 8: Understand clinical applications of immunotherapeutics.
CLO 9: Learn basic cell culture techniques and viability assays.
CLO 10: Understand the principles and significance of biosimilars.

Unit/hr	Course Content	Course Learning Outcomes

Unit-1/12hr	Cell biology Structure and functions of cell and its organelles Genome organization. Gene expression and its regulation, importance of siRNA and micro RNA, gene mapping and gene sequencing, Cell cycles and its regulation. Cell death — events, regulators, intrinsic and extrinsic pathways of apoptosis. Necrosis and autophagy.	**CLO 1** **CLO 2**
Unit-2/12hr	Cell signaling Intercellular and intracellular signaling pathways. Classification of receptor family and molecular structure ligand gated ion channels; G- protein coupled receptors, tyrosine kinase receptors and nuclear receptors. Secondary messengers: cyclic AMP, cyclic GMP, calcium ion, inositol 1,4,5-trisphosphate, (IP_3), NO, and diacylglycerol. Detailed study of following intracellular signaling pathways: cyclic AMP signaling pathway, mitogen-activated protein kinase (MAPK) signaling, Janus kinase (JAK) signal transducer and activator of transcription (STAT) signaling pathway.	**CLO 3** **CLO 4**
Unit-3/12hr	Principles and applications of genomic and proteomic tools DNA electrophoresis, PCR (reverse transcription and real time), Gene sequencing, micro array technique, SDS page, ELlSA and western blotting, Recombinant DNA technology and gene therapy Basic principles of recombinant DNA technology-Restriction enzymes, various types of vectors. Applications of recombinant DNA technology. Gene therapy— Various types of gene transfer techniques, clinical applications and recent advances in gene therapy.	**CLO 5** **CLO 6**
Unit-4/12hr	Pharmacogenomics Gene mapping and cloning of disease gene, Genetic variation and its role in health, pharmacology Polymorphisms affecting drug metabolism, Genetic variation in drug transporters, Genetic variation in G protein coupled receptors, Applications of proteomics science: Genomics, proteomics, metabolomics, functionomics, nutrigenomics. Immunotherapeutic: Types of immunotherapeutic, humanization antibody therapy, Immunotherapeutic in clinical practice	**CLO 7** **CLO 8**
Unit-5/12hr	a. Cell culture techniques Basic equipment used in cell culture lab. Cell culture media, various types of cell culture, general procedure for cell cultures; isolation of cells, subculture, cryopreservation, characterization of cells and their application. Principles and applications of cell viability assays, glucose uptake assay, Calcium influx assays, Principles and applications of flow cytometry b. Biosimilars	**CLO 9** **CLO 10**

REFERENCES:

1. The Cell, A Molecular Approach. 8th edition, Geoffrey M Cooper. 2019.
2. Pharmacogenomics: The Search for individualized Therapies. Edited by J. Licinio and M L. Wong, 2009.
3. Cellular and Molecular Pharmacology by Jaggi AS, Virdi K J, Bali A, Singh N, 2020
4. Handbook of Cell Signaling (Second Edition) Edited by Ralph A. Bradshaw and Edward A. Dennis, 2009
5. Molecular Pharmacology: From DNA to Drug Discovery. John Dickenson et.al, 2012.
6. Basic Cell Culture protocols, 4th edition by Cheril D. Helgason and Cindy L.Miller, 2013.
7. Basic Cell Culture (Practical Approach) 2nd revised edition by M. Davis (Editor), 2001.

8. Animal Cell Culture by Mohamed Al-Rubeai, 2016.
9. Current protocols in molecular biology vol l to VI edited by Frederick M. Ausuvelet la. 1988.

PHARMACOLOGICAL PRACTICAL-I

Course Code: MPL 105P

Course Learning Outcomes
After completion of the course, the students will be able to:
CLO 1: Demonstrate the ability to operate and apply various analytical instruments for qualitative and quantitative analysis of drugs and formulations.
CLO 2: Learn essential techniques in experimental pharmacology including drug administration, behavioral evaluation, and efficacy testing using laboratory animals.
CLO 3: Apply biochemical and molecular biology techniques to analyze biomolecules, assess enzyme activity, and evaluate cellular responses in experimental models.

S. No	Experiments	Course Learning Outcomes
1	A. **ANALYTICAL INTRUMENTS HANDLING** 1. Analysis of pharmacopoeial compounds and their formulations by UV Vis spectrophotometer 2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry 3. Experiments based on HPLC 4. Experiments based on Gas Chromatography 5. Estimation of riboflavin/quinine sulphate by fluorimetry 6. Estimation of sodium/potassium by flame photometry 7. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (UV) 8. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (HPLC)	**CLO 1**
2	B. **HADNLING OF LABORATORY ANIMALS** 1. Various routes of drug administration. 2. Techniques of blood sampling, anesthesia and euthanasia of experimental animals. 3. Functional observation battery tests (modified Irwin test) 4. Evaluation of CNS stimulant, depressant, anxiogenics and anxiolytic, anticonvulsant activity. 5. Evaluation of analgesic, anti-inflammatory, local anesthetic, mydriatic and miotic activity. 6. Evaluation of diuretic activity. 7. Evaluation of antiulcer activity by pylorus ligation method 8. Oral glucose tolerance test.	**CLO 2**
3	C. **BIO-CHEMICAL ANALYSIS** 1. Isolation and identification of DNA from various sources (Bacteria, Cauliflower, onion, Goat liver). 2. Isolation of RNA from yeast	**CLO 3**

	3. Estimation of proteins by Braford/Lowry's in biological samples. 4. Estimation of RNA/DNA by UV Spectroscopy 5. Gene amplification by PCR. 6. Protein quantification Western Blotting. 7. Enzyme based in-vitro assays (MPO, AChEs, α amylase, α glucosidase). 8. Cell viability assays (MTT/Trypan blue/SRB). 9. DNA fragmentation assay by agarose gel electrophoresis. 10. DNA damage study by Comet assay. 11. Apoptosis determination by fluorescent imaging studies. 12. Pharmacokinetic studies and data analysis of drugs given by different routes of administration using software 13. Enzyme inhibition and induction activity	

REFERENCES:

1. CPCSEA, OECD, ICH, USFDA, Schedule Y, EPA guidelines
2. Fundamentals of experimental Pharmacology by M.N.Ghosh, 2011.
3. Handbook of Experimental Pharmacology by S.K. Kulkarni.2016.
4. Drug discovery and Evaluation by Vogel H.G.2011.
5. Spectrometric Identification of Organic compounds 8th edition - Robert M Silverstein. 2017.
6. Principles of Instrumental Analysis 7th edition- Doglas et al., 2018.
7. Vogel's Text book of quantitative chemical analysis 6th edition by Mendham et al, 2009
8. Basic Cell Culture protocols by Cheril D. Helgason and Cindy L.Mille, Springer, 2013.
9. Animal Cell Culture: A Practical Approach 3rd revised edition by John R. Masters (Editor) 2005
10. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics – by Carl A Burtis; David E Bruns; Barbara G Sawyer; Norbert W Tietz, 8th Edition, Elsevier, 2019
11. Practical Manual of Experimental and Clinical Pharmacology 2nd edition by Bikash Medhi (Author), Ajay Prakash (Author) Jaypee brothers' medical publishers Pvt. Ltd, 2017.

Course Title: Seminar/Assignment

Course Code: MPL 106S

Course Learning Outcomes
After completion of the course, the students will be able to:

CLO 1: Perform literature review on a given topic
CLO 2: Prepare a report on a given topic
CLO 3: Prepare a power point presentation on a given topic

Evaluation criteria:
Literature survey/background information
Organization of content
Physical presentation
Questions and answers
Report evaluation

Semester II

ADVANCED PHARMACOLOGY – II

Course Code: MPL 201T
Total Hours: 60hrs

Course Learning Outcomes
CL0 1: Understand hormonal mechanisms and pharmacological interventions in endocrine disorders.
CL0 2: Explain the molecular actions and resistance mechanisms of antimicrobial agents.
CL0 3: Describe pharmacotherapy for parasitic, cancerous, and immune-related conditions.
CL0 4: Understand drug actions in GIT disorders and the concept of chronopharmacology.
CL0 5: Recognize the role of free radicals in disease and explore advances in pharmacological treatments.

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/12hr	**Endocrine Pharmacology** Molecular and cellular mechanism of action of hormones such as growth hormone, prolactin, thyroid, insulin and sex hormones Anti-thyroid drugs, Oral hypoglycemic agents, Oral contraceptives, Corticosteroids. Drugs affecting calcium regulation	**CLO 1**
Unit-2/12hr	**Chemotherapy** Cellular and molecular mechanism of actions and resistance of antimicrobial agents such as ß-lactams, aminoglycosides, quinolones, Macrolide antibiotics. Antifungal, antiviral, and anti-TB drugs.	**CLO 2**
Unit-3/12hr	**Chemotherapy** Drugs used in Protozoal Infections Drugs used in the treatment of Helminthiasis Chemotherapy of cancer **Immunopharmacology** Cellular and biochemical mediators of inflammation and immune response. Allergic or hypersensitivity reactions. Pharmacotherapy of asthma and COPD. Immunosuppressants and Immunostimulants	**CLO 3**
Unit-4/12hr	**GIT Pharmacology** Antiulcer drugs, Prokinetics, anti-emetics, anti-diarrheal and drugs for constipation and irritable bowel syndrome. **Chronopharmacology** Biological and circadian rhythms, applications of chronotherapy in various diseases like cardiovascular disease, diabetes, asthma and peptic ulcer	**CLO 4**
Unit-5/12hr	**Free radicals Pharmacology** Generation of free radicals, role of free radicals in etiopathology of various diseases such as diabetes, neurodegenerative diseases and cancer. Protective activity of certain important antioxidant Recent Advances in Treatment: Alzheimer's disease, Parkinson's disease, Cancer, Diabetes mellitus	**CLO 5**

REFERENCES

1. The Pharmacological basis of therapeutics 13th edition - Goodman and Gilman's, 2017.
2. Principles of Pharmacology. The Pathophysiologic basis of drug therapy 4th edition by David E Golan et al. 2016.
3. Basic and Clinical Pharmacology 15th edition by B.G –Katzung, 2020.
4. Pharmacology 9th edition by H.P. Rang and M.M. Dale. Elsevier, 2018.
5. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.1983.
6. Text book of Therapeutics, drug and disease management 8th edition by E T. Herfindal and Gourley. 2011.
7. Applied biopharmaceutics and Pharmacokinetics 7th edition by Leon Shargel and Andrew B.C.Yu.2015.
8. Handbook of Essential Pharmacokinetics, Pharmacodynamics and Drug Metabolism for Industrial Scientists. 7th edition, 2016.
9. Robbins & Cortan Pathologic Basis of Disease, 10th Ed. (Robbins Pathology) 2020
10. A Complete Textbook of Medical Pharmacology 2nd edition by Dr. S.K Srivastava published by APC Avichal Publishing Company. 2017.
11. K.D.Tripathi. Essentials of Medical Pharmacology, 8th edition, 2018.
12. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy 4th edition, by David E Golan, Armen H, Tashjian Jr, Ehrin J,Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams &Wilkins Publishers, 2018.

PHARMACOLOGICAL AND TOXICOLOGICAL SCREENING METHODS-II (MPL 202T)

Course Code: MPL 202T
Total Hours: 60hrs

Course Learning Outcomes
After completion of the course, the students will be able to:
CLO 1: Understand basic toxicology types and regulatory guidelines including OECD and GLP principles.
CLO 2: Understand acute, subacute, chronic toxicity models and test item characterization per OECD.
CLO 3: Learn protocols for reproductive, genotoxic, and carcinogenic toxicity evaluations.
CLO 4: Understand IND-enabling and safety pharmacology studies with emphasis on key organ systems.
CLO 5: Describe nanotoxicology concepts, toxicokinetics, and alternative methods to animal testing.

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/12hr	Basic definition and types of toxicology (general, mechanistic, regulatory and descriptive) Regulatory guidelines for conducting toxicity studies OECD, ICH, EPA and Schedule Y OECD principles of Good laboratory practice (GLP) History, concept and its importance in drug development	**CLO 1**
Unit-2/12hr	Acute, sub-acute and chronic- oral, dermal and inhalational studies as per OECD guidelines.	**CLO 2**

	Acute eye irritation, skin sensitization, dermal irritation & dermal toxicity studies. Test item characterization-importance and methods in regulatory toxicology	
Unit-3/12hr	Reproductive toxicology studies, Male reproductive toxicity studies, female reproductive studies (segment I and segment III), teratogenicity studies (segment II) Genotoxicity studies (Ames Test, in vitro and in vivo Micronucleus and chromosomal aberrations studies) In vivo carcinogenicity studies	**CLO 3**
Unit-4/12hr	IND enabling studies (IND studies)- Definition of IND, importance of IND, industry perspective, list of studies needed for IND submission. Safety pharmacology studies- origin, concepts and importance of safety pharmacology. Tier1- CVS, CNS and respiratory safety pharmacology, HERG assay. Tier2- GI, renal and other studies	**CLO 4**
Unit-5/12hr	Engineered nanomaterials, drug delivery, nanotoxicology and regulatory requirements, Toxicokinetics- Toxicokinetic evaluation in preclinical studies, saturation kinetics Importance and applications of toxicokinetic studies. Alternative methods to animal toxicity testing.	**CLO 5**

REFERENCES

1. Drugs from discovery to approval 3rd edition by Rick NG. Wiley Blackwell, 2015.
2. Studies on Experimental Toxicology and Pharmacology (Oxidative Stress in Applied Research and Clinical Practice)by Stephen M. Roberts, James P. Kehrer, et al., 2016 Hand book on GLP, Quality practices for regulated non-clinical research and development 2nd edition, (http://www.who.int/tdr/publications/documents/glp-handbook.pdf).WHO, 2008.
3. Schedule Y Guideline: drugs and cosmetics (second amendment) rules, 2005, ministry of health and family welfare (department of health) New Delhi
4. Animal Models in Toxicology, 3rd Edition, Lower and Bryan
5. OECD test guidelines
6. https://link.springer.com/protocol/10.1007/978-1-60327-405-0_25 (AMES Test-OECD 471)
7. Principles of toxicology 3rd edition by Karen E. Stine, Thomas M. Brown. 2015.
8. Guidance for Industry M3(R2) Nonclinical Safety Studies for the Conduct of Human Clinical Trials and Marketing Authorization for Pharmaceuticals (http://www.fda.gov/downloads/drugs/guidancecompliancеregulatoryinformation/guidances/ucm07 3246.pdf)
9. Nanoparticle Technology for Drug Delivery (Volume 159) (Drugs and the Pharmaceutical Sciences Series) –Edited by Ram B. Gupta, Uday B. Komepella, 2nd Edition, Taylor &Frabcis Group, 2006
10. Clinical Trials. A Practical Approach by Jorgen Seldrup, Stuart J. Pocock, 1985
11. Lippincott Illustrated Reviews: Pharmacology (Lippincotts Illustrated Reviews Pharmacology)by Karen Whalen , 2018

PRINCIPLES OF DRUG DISCOVERY

Course Code: MPL 203T
Total Hours: 60hrs

Course Learning Outcomes
After completion of the course, the students will be able to:
CLO 1: Understand the stages of modern drug discovery including target identification, validation, and the role of

genomics, proteomics, and transgenic models.
CLO 2: Explain lead identification techniques and computational methods for protein structure prediction.
CLO 3: Describe traditional and rational drug design approaches, including virtual screening and pharmacophore-based techniques.
CLO 4: Understand molecular docking strategies and fundamentals of QSAR analysis and methodologies.
CLO 5: Apply statistical methods in QSAR and explain the principles and rationale of prodrug design.

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/12hr	An Overview of modern drug discovery process: Target identification, target validation, lead identification and lead optimization. Economics of drug discovery. Target Discovery and validation-role of Genomics, proteomics and bioinformatics. Role of Nucleic acid microarrays, protein microarrays, antisense technologies, siRNAs, antisense oligonucleotides, Zinc finger proteins. Role of transgenic animals in target validation	**CLO 1**
Unit-2/12hr	Lead identification- combination chemistry & High throughput screening, in silico lead discovery techniques, Assay development of hit identification. Protein structure Level of protein structure, Domains, Motifs, and folds in protein structure. Computational prediction of protein structure: threading and homology modeling methods. Application of NMR and X-ray crystallography in protein structure prediction	**CLO 2**
Unit-3/12hr	Rational Drug Design Traditional vs rational drug design, Methods followed in traditional drug design, high Throughput screening, concepts of rational drug design, Rational Drug design Methods: Structure and Pharmacophore based Approaches. Virtual Screening techniques: Drug likeness screening, concept of pharmacophore mapping and pharmacophore-based screening	**CLO 3**
Unit-4/12hr	Molecular docking: Rigid docking, flexible docking, manual docking; Docking based screening. De novo drug design. Quantitative analysis of structure Activity Relationship History and Development of QSAR, SAR versus QSAR, Physicochemical parameters, Hanschanalysis, fee Wilson analysis and relationship between them.	**CLO 4**
Unit-5/12hr	QSAR Statistical methods- regression analysis, partial least square analysis (PLS) and other multivariate statistical methods. 3D-QSAR approaches like COMFA and COMSIA Prodrug design-Basic concept, prodrugs to improve patient acceptability, drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design	**CLO 5**

REFRENCES

1. Disease Gene Identification. Methods and Protocols.2nd edition by Johanna K. Di., 2018
2. Target Discovery and Validation Reviews and Protocols: Volume 2 Emerging Molecular Targetsand Treatment Options by Mouldy Sioud, 2007.
3. InSilico Technologies in Drug Target Identification and Validation by Darryl León. Scott Markel, 2006

4. QSAR: Hansch Analysis and Related Approaches. Methods and Principles in Medicinal Chemistry. by Hugo Kubiny, 1993.
5. Structure-Based Ligand Design. Methods and Principles in Medicinal Chemistry, Klaus Gubernator, Hans-Joachim Böhm by Publisher Wiley-VCH. 1998.
6. Rational Drug Design. Novel Methodology and Practical Applications. by Abby L . Parrill. M .Rami Reddy, 1999.
7. J. Rick Turner. New drug development design, methodology and, analysis. John Wiley & Sons, Inc., New Jersey, 2007.
8. Advances in QSAR Modeling: Applications in Pharmaceutical, Chemical, Food, Agricultural and Environmental Sciences (Challenges and Advances in Computational Chemistry and Physics)by Kunal Roy, 2017.
9. Computational Approaches for the Prediction of pKa Values (QSAR in Environmental and Health Sciences)by George C. Shields and Paul G. Seybold, 2017

CLINICAL RESEARCH AND PHARMACOVIGILANCE (MPL204T)

Course Code: MPL 204T
Total Hours: 60hrs

Course Learning Outcomes
After completion of the course, the students will be able to:
CLO 1: Understand regulatory perspectives, ethical principles, and informed consent processes by ICH-GCP, Schedule Y, and ICMR guidelines.
CLO 2: Explain various clinical trial designs and delineate the roles and responsibilities of clinical trial stakeholders.
CLO 3: Demonstrate knowledge of clinical trial documentation, safety monitoring, and assessment of adverse drug reactions (ADRs).
CLO 4: Describe the fundamentals, history, and structure of pharmacovigilance systems including national and international programs.
CLO 5: Apply ADR reporting methods and utilize pharmacovigilance tools and software for monitoring drug safety.
CLO 6: Interpret concepts of pharmacoepidemiology, pharmacoeconomics, and ICH-guided safety pharmacology practices.

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/10hr	Regulatory Perspectives of Clinical Trials: Origin and Principles of International Conference on Harmonization - Good Clinical Practice (ICH-GCP) guidelines Ethical Committee: Institutional Review Board, Ethical Guidelines for Biomedical Research and Human Participant Schedule Y, ICMR Informed Consent Process: Structure and content of an Informed Consent Process Ethical principles governing informed consent process.	CLO 1
Unit-2/10hr	Clinical Trials: Types and Design Experimental Study- RCT and Non RCT Observation Study: Cohort, Case Control, Cross sectional Clinical Trial Study Team Roles and responsibilities of Clinical Trial Personnel: Investigator, Study Coordinator, Sponsor, Contract Research Organization and its management	CLO 2
Unit-3/10hr	Clinical Trial Documentation- Guidelines to the preparation of documents, Preparation of protocol, Investigator Brochure, Case Report Forms, Clinical Study	CLO 3

	Report Clinical Trial Monitoring-Safety Monitoring in CT Adverse Drug Reactions: Definition and types. Detection and reporting methods. Severity and seriousness assessment. Predictability and preventability assessment, Management of adverse drug reactions; Terminologies of ADR.	
Unit-4/10hr	Basic aspects, terminologies and establishment of pharmacovigilance History and progress of pharmacovigilance, Significance of safety monitoring, Pharmacovigilance in India and international aspects, WHO international drug monitoring programme, WHO and Regulatory terminologies of ADR, evaluation of medication safety, establishing pharmacovigilance centres in Hospitals, Industry and National programmes related to pharmacovigilance. Roles and responsibilities in Pharmacovigilance	CLO 4
Unit-5/10hr	Methods, ADR reporting and tools used in Pharmacovigilance International classification of diseases, International Nonproprietary names for drugs, Passive and Active surveillance, Comparative observational studies, Targeted clinical investigations and Vaccine safety surveillance. Spontaneous reporting system and Reporting to regulatory authorities, Guidelines for ADRs reporting. Argus, Aris G Pharmacovigilance, VigiFlow, Statistical methods for evaluating medication safety data.	CLO 5
Unit-6/10hr	Pharmacoepidemiology, Pharmacoeconomics, safety pharmacology (ICH Guideline)	CLO 6

REFERENCES

1. Ethical Guidelines for Biomedical Research on Human Subjects 2017. Indian Council of Medical Research, New Delhi
2. Central Drugs Standard Control Organization- Good Clinical Practices, Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.
3. International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996.
4. Clinical Data Management edited by R K Rondels, S A Varley, C F Webbs. Second Edition, March 2013, Wiley Publications.
5. Handbook of clinical Research. 2nd edition Julia Lloyd and Ann Raven Ed. Churchill Livingstone. 1994.
6. Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes. 2001.
7. Clinical Trials. A Practical Approach by Jorgen Seldrup, Stuart J. Pocock, 1985
8. Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, 2nd edition, John Wiley and Sons.2010.
9. Principles of Research Methodology: A Guide for Clinical Investigators by Phyllis G. Supino and Jeffrey S. Borer, 2012
10. Principles of Pharmacogenetics and Pharmacogenomics by Russ B. Altman, David Flockhart, et al., 2012

PHARMACOLOGICAL PRACTICAL II
(MPL 205P)

A. GENERAL PHARMACOLOGY

1. To record the DRC of agonist using suitable isolated tissues preparation.
2. To study the effects of antagonist/potentiating agents on DRC of agonist using suitable isolated tissue preparation.
3. To determine to the strength of unknown sample by matching bioassay by using suitable tissue preparation.
4. To determine to the strength of unknown sample by interpolation bioassay by using suitable tissue preparation
5. To determine to the strength of unknown sample by bracketing bioassay by using suitable tissue preparation
6. To determine to the strength of unknown sample by multiple point bioassay by using suitable tissue preparation.

7. Estimation of PA2 values of various antagonists using suitable isolated tissue preparations.
8. To study the effects of various drugs on isolated heart preparations
9. Recording of rat BP, heart rate and ECG.
10. Recording of rat ECG
11. Drug absorption studies by averted rat ileum preparation.

B. TOXICOLOGY

1. Acute oral toxicity studies as per OECD guidelines.
2. Acute dermal toxicity studies as per OECD guidelines.
3. Repeated dose toxicity studies- Serum biochemical, hematological, urine analysis, functional observation tests and histological studies.
4. Drug mutagenicity study using mice bone-marrow chromosomal aberration test.
5. Protocol design for clinical trial. (3 Nos.)
6. Design of ADR monitoring protocol and reporting.

C. *IN SILICO* STUDIES

1. In silico physico chemical prediction
2. ADME prediction tools and software
3. In-silico docking studies. (2 Nos.)
4. In-silico pharmacophore-based screening.
5. In-silico QSAR studies.

REFERENCES

1. Fundamentals of experimental Pharmacology-by M.N.Ghosh 2016.
2. Hand book of Experimental Pharmacology-S.K. Kulakarni. 2016.
3. Applied biopharmaceutics and Pharmacokinetics 8th edition by Leon Shargel and Andrew B.C.Yu.2022.
4. Text book of in-vitro practical Pharmacology by Ian Kitchen. 1984.
5. Bioassay Techniques for Drug Development by Atta-ur-Rahman, Iqbal Choudhary and William Thomsen. 2017
6. Handbook of Essential Pharmacokinetics, Pharmacodynamics and Drug Metabolism for Indu2s2trial Scientists. 7th edition, 2016.
7. Computational Toxicology: Risk Assessment for chemicals (Wiley Series on technologies for the pharmaceutical industry) Edited by Sean Ekins, John Wiley & Sons, 2018

Course Title: Seminar/Assignment

Paper Code: MPL206S

L	T	P	Credits	Marks
0	0	0	4	100

Learning outcome: Students who successfully complete this course will be able to

Perform literature review on a given topic
Prepare a report on a given topic
Prepare a power point presentation on a given topic

Evaluation criteria:

Literature survey/background information
Organization of content
Physical presentation
Questions and answers
Report evaluation

Semester III

Course Title: Research Methodology & Biostatistics

L	T	P	Credits
4	0	0	4

Paper Code: MRM301T

Course Learning Outcomes:

After completing this course, the learner will be able to:

CLO1: Establish a Relevant Research problem
CLO2: Understand and interpret commonly reported statistical measures and analysis of different types of data using statistical software
CLO3: Understand **c**ore values and essential principles of Medical Ethics
CLO4: Understand and promote the care and breeding of animals for biomedical and behavioral research
CLO5: Understand the Influence of the Declaration of Helsinki on Ethical Medical Research Practices

Units/Hours	Content	Mapping with course learning outcome
Unit 1/12 Hours	**General Research Methodology:** Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.	**CLO1, CLO2**
Unit 2/12 Hours	**Biostatistics:** Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests(students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.	**CLO2**
Unit 3/12	**Medical Research:** History, values in medical ethics, autonomy, beneficence,	**CLO3**

Hours	nonmaleficence, double effect, conflicts between autonomy and beneficence/nonmaleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.	
Unit 4/12 Hours	**CPCSEA guidelines for laboratory animal facility:** Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.	**CLO4**
Unit 5/12 Hours	**Declaration of Helsinki :** History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care	**CLO5**

REFERNCES:

1. Research Methodology and Statistical Techniques by Gupta S, 2010.
2. Research Methodology: Methods and Techniques by Kothari, C. R. 2019
3. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches by Creswell D and Creswell J W, 2019
4. Research Methodology: A Theoretical Approach by D. Napolean and B. Balaji Sathya Narayanan, 2014
5. World Trade Organization [website: www.wto.org].
6. Research Methodology in Behavioural Sciencesby Mangal S.K, 2013
7. Biostatistics: The Bare Essentials by Norman, G. and Streiner, D, 2008
8. Biometry: The Principles and Practices of Statistics in Biological Research by Sokal, R.R. and Rohlf, F.J. , 1994.
9. Pharmaceutical statistics: practical and clinical applications. By CRC Press Bolton, S, & Bon, C. 2009.
10. Biomedical Research from Ideation to Publication by Jagadeesh G., Murthy S., Gupta YK, Prakash A, 2010

e Title: Journal Club Paper Code:

MPL302T

Course Title: Discussion/ Presentation (Proposal Presentation)

Paper Code: MPL303T

Course Title: Research Work

Paper Code: MPL600

Learning outcome: Students who successfullycomplete this course will be able to

- Design a research problem and prepare synopsis
- Plan and execute experiments in the laboratory
- Interpret and analyze the results

Evaluation criteria:

- Literature survey/background information
- Organization of content
- Physical presentation
- Questions and answers
- Report evaluation

Semester IV

Course Title: Journal Club Paper

Code: MPL401T

Course Title: Discussion/ Presentation Paper
Code: MPL402T

Course Title: Research Work: MPL601

Learning outcome: Students who successfully complete this course will be able to

- Design a research problem and prepare synopsis
- Plan and execute experiments in the laboratory
- Interpret and analyze the results

Evaluation criteria:

- Literature survey/background information
- Organization of content
- Physical presentation
- Questions and answers
- Thesis evaluation
- Viva-voce

The following are some of the modes of classroom transaction	**The following tools can be used in different transactional modes:** **Software tools**
• Lecture • Demonstration • Lecture Cum demonstration • Project • Seminar • Group discussion • Focus group discussion	• Tracker • Chem Draw • Schrodinger • Maestro/Autodock, etc. • Endnote/reference

Inter disciplinary course-I

Drug Abuse: Problem, Management and Prevention

Scope: This course will help the students to acquire the basic knowledge of drug abuse to reduce the

burden of mortality and morbidity through the detection, prevention and treatment.

L	T	P	Credits
2	0	0	2

Course Code: IDC-506

Total Hours: 30hrs

Course Learning Outcomes
After completion of this course, the students will be able to learn:

CLO 1: Types of abuse drugs and their effects

CLO 2: Drug trafficking and strategies for prevention of drug abuse

CLO 3: Knowledge of the etiology of drug abuse, addiction, prevention, and treatment

Unit/hr	Course Content	
Unit-1/15hr	**Introduction to Drug Abuse:** Concept and Overview, Drug Dependence, Drug Addiction, Physical and Psychological Dependence, Drug Tolerance and withdrawal symptoms, Signs and symptoms of Drug Abuse, Causes and Consequences of Drug Abuse. **Types of Abused Drugs and their Effects:** 1) Stimulants: Amphetamines– Benzedrine, Dexedrine, Cocaine. 2) Depressants: Alcohol, Barbiturates, Barbiturates. 3) Narcotics: Heroin, Morphine. 4) Hallucinogens: Cannabis, Marijuana, LSD. 5) Steroids **Organized crime and Drug trafficking, Drug Cartel, Drug Mafia, Drug Crime Indian statistics and world data**	**CLO 1** **CLO 2**
Unit-2/15hr	**Management and Prevention of Drug Abuse:** Management of Drug Abuse, Prevention of Drug Abuse, Role of Family, Society, School, Media in preventing substance abuse, Narcotic Drugs and Psychotropic Substances Act, 1985,De-addictionCenters	**CLO 3**

Suggested Readings:

1. Drug Abuse Concepts, Prevention and Cessation by Sussman S and Ames S, 2008.
2. Drugs and Crime in Lifestyle Perspective: The Drug Crime Connection by Inciardi JA, 1981
3. Drug Epidemic Among Indian Youth by Kapoor T, 1985
4. Alcohalism by Kessel, Neil and Walton H, 1982
5. Drug abuse: Prevention and Management. Gurmehar Publication by Bedi O, Arora S, Krishan P, 2019
6. Addiction: A Reference Encyclopedia by Padwa H Cunningham J, 2010
7. Encyclopedia of Drugs, Alcohol & Addictive Behavior by Korsmeyer, P Kranzler HR, 2008
8. Drugs, Crime, and Justice: Contemporary Perspectives by Gaines L and Kremling J, 2013

Inter disciplinary course-II
Rational use of Medicines

Scope: This course will help the students to acquire the knowledge of essential medicines concept and rational use of medicine to reduce the burden of mortality and morbidity

L	T	P	Credits
2	0	0	2

Course Code:

IDC-521

Total Hours:

30hrs

Course Learning Outcomes
After completion of this course, the students will be able to learn:
CLO 1: Rational and irrational medicines use
CLO 2: Factors underlying irrational use of medicine **CLO 3:** Adverse effects of irrational medicines use **CLO 4**: Infectious diseases and their prevention

Unit/hr	Course Content	Course Learning Outcomes

Unit-1/20hr	**Introduction to Rational use of drugs:** Introduction and Definition of rational use of drugs, Introduction to essential drugs, Over the counter drugs (OTC), Role of physician, Pharmacist and Patient in rational use of drugs, Misuse of OTC and prescription of drugs **Antibiotic Resistance and Rational use of antibiotics:** Bacteria, Antibiotic resistance, Factors of antibiotic resistance, Mechanism of antibiotic resistance, Prevention of antibiotic resistance, rational antibiotic use	**CLO 1** **CLO 2** **CLO 3**
Unit-2/10hr	**Communicable diseases:** Definition, Types, Sign and Symptoms, Causes and Prevention of Food or water-borne diseases, Respiratory-borne diseases, Vector-borne diseases, Zoonotic diseases. Role of Pharmacist and Patient in prevention of communicable diseases.	**CLO 4**

Suggested Readings:

1. Improving Use of Medicines and Medical Tests in Primary Care by Weekes LM, 2020.
2. Rationale of Drug of Choice: A Comparative Analysis by Nirmala P, Chidambaram N 2017.
3. The tutorial manual for rational drug-use training by Dong YY, 2012.
4. Antibiotic Drug Resistance by Capelo□Martínez JL and Igrejas G, 2019
5. No-Nonsense Guide to Antibiotics:Dangers, Benefits & Proper Use by Dolan Moira, Croft A, Hartmann DL, 2017.
6. The rational use of antibiotics in bacterial infection. Symposium infections: Current Paediatrics by McLellan NJ, Gray J, 2001
7. Rational use of antibiotics. Internist by Walger P, 2016.
8. Antibiotic Essentials by Cheston BC, Burke AC, 2019.