Department of Pharmaceutical Science and Technology

Maulana Abul Kalam Azad University of Technology,

West Bengal

(Formerly West Bengal University of Technology)

Haringhata-741249,Nadia,West Bengal,India.

Visions

To become a center of excellence and a leading global institutional unit in the field of pharmaceutical education and research by imparting transformative and cognitive education that creates new knowledge and produces environment conscious, highly knowledge-based pharma-professionals, educators and inventors, mastering skills to serve the challenges of pharmaceutical industries, research and health care system in our country, in particular, and worldwide as a whole.

Missions

- To develop an atmosphere to support, encourage and nurture students by providing high-quality education for acquiring knowledge and mastering skills to build them to their fullest potential to become future leaders of pharma-professionals, educators, and inventors.
- To develop students with a strong foundation of knowledge of Pharmaceutical sciences and technologies by additionally imparting cognizance in basic, clinical, and translational sciences with updated technologies
- Fostering a solid collaboration with Pharmaceutical Industry, National and International Institutes of repute and Experienced Industry Veterans
- To equip the students with the skills and mindset to thrive and burgeon globally
- To nurture students to think about the national and global needs related to the pharmaceutical field and to find the solution by rigorous research
- To continuously upgrade facilities, infrastructure, and instrumentations to keep students constantly updated with the current global knowledge.

Program Educational Objectives (PEOs)

1. To furnish extensive and advanced knowledge of pharmaceutical education to conduct quality pharmaceutical research.
2. To develop well educated pharmacy students for effective and sincere contribution to the health care system in the society.
3. To implant the urge for entrepreneurship and leadership quality in the future professional field.

Program Outcomes (POs)

Program Outcome	
PO1	**Pharmacy Knowledge**-Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioural, social, and administrative pharmacy sciences; and manufacturing practices.
PO2	**Planning Abilities-** Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implementplans and organize work to meet deadlines.
PO3	**Problem analysis**- Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.
PO4	**Modern tool usage** - Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.
PO5	**Leadership skills**- Understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfillment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizens or leadership roles when appropriate to facilitate improvement in health and wellbeing.
PO6	**Professional Identity** - Understand, analyze and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).
PO7	**Pharmaceutical Ethics**- Honour personal values and apply ethical

	principles in professional and social contexts. Demonstrate behavior that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.
PO8	**Communication**-Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions.
PO9	**The Pharmacist and society** - Apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.
PO10	**Environment and sustainability** -Understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO11	**Life-long learning**- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Selfassess and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.

Program Specific Outcomes (PSOs)

PSO1:
Acquire the basic knowledge and concepts of Pharmaceutical Science and Technology.
PSO2:
Apply and expand the knowledge of all subjects in the research and development of pharmaceutical formulations.
PSO3:
Apply the knowledge of Pharmaceutical Science in predicting the drug information, disease information, formulation development, safety and efficacy of medicines.

PHARMACOLOGY

Course Code	Course	Credit Hours	Credit Points	Hrs./wk	Marks
Semester I					
MPT 1081	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPT 1082	Advanced Pharmacology-I	4	4	4	100
MPT 1083	Pharmacological and Toxicological Screening Methods-I	4	4	4	100
MPT 1084	Cellular and Molecular Pharmacology	4	4	4	100
MPT 1985	Pharmacology Practical I	12	6	12	200
MPT-1986	Seminar/Assignment	7	4	7	100
TOTAL		**35**	**26**	**35**	**700**
Semester II					
MPT 2081	Advanced Pharmacology II	4	4	4	100
MPT 2082	Pharmacological and Toxicological Screening Methods-II	4	4	4	100
MPT 2083	Principles of Drug Discovery	4	4	4	100
MPT 2084	Experimental Pharmacology practical-II	4	4	4	100
MPT 2985	Pharmacology Practical II	12	6	12	200
MPT-2986	Seminar/Assignment	7	4	7	100
	TOTAL	**35**	**26**	**35**	**700**

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M PHARM – IIIrd Semester

Sr.No.	Course Code	Course	Contact Hours			Credit Points
			L	Project	Full Marks	
3	MPT-391	Discussion /Presentation(Proposal		2	100	2
4	MPT-392	Research Work		28	100	14
	SESSIONAL*					
1.	MPT-384	Research Methodology and Biostatistics*	4		100	4
2	MPT-381	Journal club		1	100	1
	Total		4	31		21

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M.Pharm. IV Semester

Sr.No.	Course Code	Course	Contact Hours			Credit Points
			L		Full Marks	
1	MPT-491	Discussion/Final Presentation		3	100	3
2	MPT-492	Research Work		31	100	16
	SESSIONAL					
3	MPT-481	Journal club		1	100	1
4	MPT-482	Participation in National Level Seminar/Conference/Workshop /Symposium/Training Programs(related to the specialization of the student). Participation in International Level Seminar/Conference/Workshop/Symposium/Training Programs (related to the specialization of the student). Academic Award/research Award from State Level/National Agencies. Academic Award/ research Award from International Agencies. Research/Review Publication in National Journals (Indexed in Scopus/Web of Science). Research/review Publication in International Journals (Indexed in Scopus/Web of Science).				3
	Total			35		23

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Guidelines for Awarding Credit Points for Co-curricular Activities

Name of the Activity	Maximum Credit Points Eligible/Activity
ParticipationinNationalLevelSeminar/Conference/Workshop/ Symposium/TrainingPrograms(relatedtothespecializationof The student)	01
ParticipationininternationalLevelSeminar/Conference/Works hop/Symposium/TrainingPrograms(relatedtothespecializatio nofthestudent)	02
Academic Award/Research Award from State Level/National Agencies	01
Academic Award/Research Award from International Agencies	02
Research/ReviewPublicationinNationalJournals(IndexedinScopus /WebofScience)	01
Research/ReviewPublicationinInternationalJournals(Indexed inScopus/WebofScience)	02

Note: International Conference: Held Outside India

SEMESTER- I st

COURSE NAME: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES
COURSE CODE: MPT-1081

CO	Description: After the completion of the course the students will be able- - -
CO1	To know the various chemicals and reagents used in the analytical process.
CO2	To describe theoretical knowledge of various instruments
CO3	To apply the knowledge of instrumentation with skill and efficacy
CO4	To analyze the various single dosage form with various instruments
CO5	To evaluate the composition of combined dosage forms using different analytical techniques
CO6	To design a project for research and analysis

Course Contents: TOTAL HOURS: 60

1. 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 (Characterestics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications. 10 Hrs

2 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 13C NMR. Applications of NMR spectroscopy. 10 Hrs

3 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. 10 Hrs

4 Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following:

j) Thin Layer chromatography

k) High Performance Thin Layer Chromatography

l) Ion exchange chromatography

m) Column chromatography

n) Gas chromatography

o) High Performance Liquid chromatography

p) Ultra High Performance Liquid chromatography

q) Affinity chromatography

r) Gel Chromatography 10 Hrs

5 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. 10 Hrs

6 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. 10 Hrs

REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, JohnWiley & Sons, 2004.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman,5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBSPublishers, New Delhi, 1997.
5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi,3rd Edition, CBSPublishers, New Delhi, 1997.
7. Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol 11, Marcel. DekkerSeries
8. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd., Delhi.
9. Textbook of Pharmaceutical Analysis, KA.Connors, 3rd Edition, John Wiley & Sons, 1982.

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COURSE NAME: ADVANCED PHARMACOLOGY - I
COURSE CODE: MPT-1082

CO	**Description: After the completion of the course the students will be able- - -**
CO1	To describe the pathophysiology of some diseases
CO2	To explain the pharmacokinetic and pharmacodynamic profile of various drugs
CO3	To describe the mechanism of drug action at the cellular and molecular level
CO4	To determine the adverse effects and contraindications of various drugs
CO5	To apply the knowledge in pharmacotherapy of certain diseases
CO6	To assess the activity of newer drugs of a particular disease

COURSE CONTENT: TOTAL HOURS: 60

1. 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. 12 Hrs

2 Neurotransmission

a. General aspects and steps involved in neurotransmission.

b. Neurohumoral transmission in autonomic nervous system (Detailed study about neurotransmitters - Adrenaline and Acetyl choline).

c. Neurohumoral transmission in central nervous system (Detailed study about neurotransmitters- histamine, serotonin, dopamine, GABA, glutamate and glycine].

d. Non adrenergic non cholinergic transmission (NANC). Co-transmission 12 Hrs

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: Parasympathomimetics and lytics, sympathomimetics and lytics, agents affecting neuromuscularjunction

3 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. 12 Hrs

4 Cardiovascular Pharmacology

Diuretics, antihypertensives, anti ischemics, anti- arrhythmics, drugs for heart failure and hyper- lipidemia. Hematinics, coagulants, anticoagulants, fibrinolytics and antiplatelet drugs. 12Hrs 5 Autocoid Pharmacology

The physiological and pathological role of Histamine, Serotonin, Kinins Prostaglandins Opioid autocoids. Pharmacology of antihistamines, 5HT antagonists. 12 Hrs

REFEERENCES

1. The Pharmacological Basis of Therapeutics, Goodman and Gillman,,s
2. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy by David E Golan, Armen H, Tashjian Jr, Ehrin J,Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers.
3. Basic and Clinical Pharmacology by B.G Katzung
4. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.
5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.
6. Graham Smith. Oxford textbook of Clinical Pharmacology.
7. Avery Drug Treatment
8. Dipiro Pharmacology, Pathophysiological approach.
9. Green Pathophysiology for Pharmacists.
10. Robbins & Cortan Pathologic Basis of Disease, 9th Ed. (Robbins Pathology)
11. A Complete Textbook of Medical Pharmacology by Dr. S.K Srivastava published by APC Avichal Publishing Company
12. KD.Tripathi. Essentials of Medical Pharmacology.
13. Modern Pharmacology with Clinical Applications, Craig Charles R. & Stitzel Robert E., Lippincott Publishers.
14. Clinical Pharmacokinetics & Pharmacodynamics : Concepts and Applications – Malcolm Rowland and Thomas N.Tozer, Wolters Kluwer, Lippincott Williams & Wilkins Publishers.
15. Applied biopharmaceutics and Pharmacokinetics, Pharmacodynamics and Drug metabolism for industrial scientists.
16. Modern Pharmacology, Craig CR. & Stitzel RE, Little Brown & Company.

COURSE NAME: PHARMACOLOGICAL AND TOXICOLOGICAL SCREENING METHODS - I

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COURSE CODE: MPT-1083

CO	Description: After the completion of the course the students will be able- - -
CO1	To judge the value of the regulations and ethical requirements for the use of animals
CO2	To describe about the experimental animals used in the discovery of drugs.
CO3	To apply the knowledge of screening methods in pharmacology (invitro and invivo)
CO4	To apply the knowledge of good laboratory practices during experimentation on animals
CO5	To expand the preclinical data to human data in the drug discovery process
CO6	To evaluate the activity of new molecule for discovery

COURSE CONTENT: TOTAL HOURS: 60

1. Laboratory Animals

Common laboratory animals: Description, handling and applications of different species and strains of animals. Transgenic animals: Production, maintenance and applications Anaesthesia 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 12 Hrs

2 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, Alzheimers and multiple sclerosis. Drugs acting on Autonomic Nervous System. 12 Hrs

3 Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Respiratory Pharmacology: anti-asthmatics, drugs for COPD and anti allergics. Reproductive Pharmacology: Aphrodisiacs and antifertility agents Analgesics, antiinflammatory and antipyretic agents. Gastrointestinal drugs: anti ulcer, anti -

emetic, antidiarrheal and laxatives. 12 Hrs

4 Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Cardiovascular Pharmacology: antihypertensives, antiarrythmics, antianginal, antiatherosclerotic agents and diuretics. Drugs for metabolic disorders like anti-diabetic, antidyslipidemic agents. Anti cancer agents. Hepatoprotective screening methods. 12 Hrs

5 Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Iimmunomodulators, Immunosuppressants and immunostimulants General principles of immunoassay: theoretical basis and optimization of immunoassay, heterogeneous and homogenous 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 12 Hrs

REFERENCES

1. Biological standardization by J.H. Burn D.J. Finney and I.G. Goodwin
2. Screening methods in Pharmacology by Robert Turner. A
3. Evaluation of drugs activities by Laurence and Bachrach
4. Methods in Pharmacology by Arnold Schwartz.
5. Fundamentals of experimental Pharmacology by M.N.Ghosh
6. Pharmacological experiment on intact preparations by Churchill Livingstone
7. Drug discovery and Evaluation by Vogel H.G.
8. Experimental Pharmacology by R.K.Goyal.
9. Preclinical evaluation of new drugs by S.K. Guta
10. Handbook of Experimental Pharmacology, SK.Kulkarni
11. Practical Pharmacology and Clinical Pharmacy, SK.Kulkarni, 3rd Edition.
12. David R.Gross. Animal Models in Cardiovascular Research, 2nd Edition, Kluwer Academic Publishers, London, UK.
13. Screening Methods in Pharmacology, Robert A.Turner.
14. Rodents for Pharmacological Experiments, Dr.Tapan Kumar chatterjee.
15. Practical Manual of Experimental and Clinical Pharmacology by Bikash Medhi (Author), Ajay Prakash (Author)

COURSE NAME: CELLULAR AND MOLECULAR PHARMACOLOGY - I
COURSE CODE: MPT-1084

CO	**Description: After the completion of the course the students will be able- - -**
CO1	To explain the receptors that are involved with the major functions of the body
CO2	To explain the various signaling pathways in the transduction mechanism
CO3	To apply the knowledge of molecular pathways where the drugs act and the use of the biomarkers
CO4	To associate the knowledge of advanced molecular pharmacology in drug discovery
CO5	To design the advanced molecular techniques in drug discovery and pharmacotherapy
CO6	To evaluate the data of molecular methods for better drug discovery and pharmacotherapy

COURSE CONTENT: TOTAL HOURS: 60

1. 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. 12 Hrs

2 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, (IP3), 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. 12 Hrs

3 Principles and applications of genomic and proteomic tools DNA electrophoresis, PCR

(reverse transcription and real time), Gene sequencing, micro array technique, SDS page, ELISA 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. 12 Hrs

4 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 Immunotherapeutics Types of immunotherapeutics, humanisation antibody therapy, Immuno therapeutics in clinical practice 12 Hrs

5 a. Cell culture techniques

Basic equipments 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. Bio-similars 12 Hrs

REFERENCES:

1. The Cell, A Molecular Approach. Geoffrey M Cooper.
2. Pharmacogenomics: The Search for Individualized Therapies. Edited by J. Licinio and M -L. Wong
3. Handbook of Cell Signaling (Second Edition) Edited by Ralph A. et.al
4. Molecular Pharmacology: From DNA to Drug Discovery. John Dickenson et.al
5. Basic Cell Culture protocols by Cheril D.Helgason and Cindy L.Miller
6. Basic Cell Culture (Practical Approach) by J. M. Davis (Editor)
7. Animal Cell Culture: A Practical Approach by John R. Masters (Editor)
8. Current porotocols in molecular biology vol I to VI edited by Frederick M. Ausuvel et al. 219

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COURSE NAME: PHARMACOLOGY PRACTICAL-1
COURSE CODE: MPT-1985

CO	**Description: After the completion of the course student will be able - -**
CO1	To apply the knowledge of pharmaceutical analysis and various methods of screening compounds
CO2	To identify the methods to be adopted while framing a project
CO3	To design a project for newer compounds
CO4	Increase the capability of interpreting data of the experimental results
CO5	To evaluate the results obtained from the research/project
CO6	To discover newer method of detecting the compounds

COURSE CONTENT:

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

Handling 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.
9. Isolation and identification of DNA from various sources (Bacteria, Cauliflower, onion, Goat liver).
10. Isolation of RNA from yeast

11. Estimation of proteins by Braford/Lowry‟s in biological samples.
12. Estimation of RNA/DNA by UV Spectroscopy
13. Gene amplification by PCR.
14. Protein quantification Western Blotting.
15. Enzyme based in-vitro assays (MPO, AChEs, α amylase, α glucosidase).
16. Cell viability assays (MTT/Trypan blue/SRB).
17. DNA fragmentation assay by agarose gel electrophoresis.
18. DNA damage study by Comet assay.
19. Apoptosis determination by fluorescent imaging studies.
20. Pharmacokinetic studies and data analysis of drugs given by different routes of administration using softwares
21. Enzyme inhibition and induction activity
22. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (UV)
23. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (HPLC)

REFERENCES

1. CPCSEA, OECD, ICH, USFDA, Schedule Y, EPA guidelines,
2. Fundamentals of experimental Pharmacology by M.N.Ghosh
3. Handbook of Experimental Pharmacology by S.K. Kulkarni.
4. Drug discovery and Evaluation by Vogel H.G.
5. Spectrometric Identification of Organic compounds - Robert M Silverstein,
6. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman,
7. Vogel„s Text book of quantitative chemical analysis - Jeffery, Basset, Mendham, Denney,
8. Basic Cell Culture protocols by Cheril D. Helgason and Cindy L. Mille
9. Basic Cell Culture (Practical Approach) by J. M. Davis (Editor)
10. Animal Cell Culture: A Practical Approach by John R. Masters (Editor)
11. Practical Manual of Experimental and Clinical Pharmacology by Bikash Medhi(Author), Ajay Prakash (Author) Jaypee brothers‟ medical publishers Pvt. Ltd

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COURSE NAME: SEMINAR/ ASSIGNMENTS
COURSE CODE: MPT-1986

CO	**Description: After the completion of the course the students will be able- - -**
CO1	To develop knowledge on the recent developments in the field of Pharmaceutical Science and Technology
CO2	To understand the necessity of various fields in drug discovery process
CO3	To analyze the advancements of various techniques, methods, research in the field of Pharmaceutical Science and Technology
CO4	To apply the knowledge of the advancements in research
CO5	To employ the recent developments in projects
CO6	Have the ability to outline the projects for the society development

COURSE CONTENT:

Assignments and seminar based of recent developments, various techniques, methods in the field of pharmacology required for research and development.

SEMESTER- IIND

COURSE NAME: ADVANCED PHARMACOLOGY - II
COURSE CODE: MPT-2081

CO	**Description: After the completion of the course the students will be able- - -**
CO1	To describe the pathophysiology of some diseases
CO2	To explain the mechanism of action of drugs at the cellular and molecular level
CO3	To determine the adverse effects and contraindications of various drugs
CO4	To apply the knowledge in pharmacotherapy of certain diseases
CO5	To expand the knowledge in clinical pharmacology regarding certain diseases for different patients
CO6	To identify the various mechanism that are responsible for diseases

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COURSE CONTENT: TOTAL HOURS: 60

1. 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 12 Hrs

2 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. 12 Hrs

3 Chemotherapy

Drugs used in Protozoal Infections, Drugs used in the treatment of Helminthiasis, Chemotherapyof cancer

Immunopharmacology

Cellular and biochemical mediators of inflammation and immune response. Allergic or hypersensitivity reactions. Pharmacotherapy of asthma and COPD. Immunosuppressants and Immunostimulants 12 Hrs

4 GIT Pharmacology

Antiulcer drugs, Prokinetics, antiemetics, anti-diarrheals and drugs for constipation and irritablebowel syndrome.

Chronopharmacology

Biological and circadian rhythms, applications of chronotherapy in various diseases like cardiovascular disease, diabetes, asthma and peptic ulcer 12 Hrs

5 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 12 Hrs

REFERENCES

1. The Pharmacological basis of therapeutics- Goodman and Gill man,,s
2. Principles of Pharmacology. The Pathophysiologic basis of drug therapy by David E Golan et. al.
3. Basic and Clinical Pharmacology by B.G -Katzung
4. Pharmacology by H.P. Rang and M.M. Dale.

5. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.

6. Text book of Therapeutics, drug and disease management by E T. Herfindal and Gourley.

7. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.

8. Handbook of Essential Pharmacokinetics, Pharmacodynamics and Drug Metabolism for Industrial Scientists

9. Robbins & Cortan Pathologic Basis of Disease, 9th Ed. (Robbins Pathology)

10. A Complete Textbook of Medical Pharmacology by Dr. S.K Srivastava published by APC Avichal Publishing Company.

11. KD.Tripathi. Essentials of Medical Pharmacology

12. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy by David E Golan, Armen H, Tashjian Jr, Ehrin J,Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers

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COURSE NAME: PHARMACOLOGICAL AND TOXICOLOGICAL SCREENING METHODS-II
COURSE CODE: MPT-2082

CO	**Description: After the completion of the course the students will be able- - -**
CO1	To explain the different toxicity studies
CO2	To identify the ethical and regulatory guidelines necessary for different toxicity studies
CO3	To demonstrate the knowledge of the toxicity studies in the drug discovery
CO4	To compare the various methods of toxicity study
CO5	To expand the practical knowledge of toxicity study in research and drug discovery process
CO6	To assess the toxic effects of various drugs

COURSE CONTENT: TOTAL HOURS: 60

1. 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 12 Hrs

2 Acute, sub-acute and chronic- oral, dermal and inhalational studies as per OECD guidelines. Acute eye irritation, skin sensitization, dermal irritation & dermal toxicity studies. Test item characterization- importance and methods in regulatory toxicology studies 12 Hrs

3 Reproductive toxicology studies, Male reproductive toxicity studies, female reproductive studies (segment I and segment III), teratogenecity studies (segment II) Genotoxicity studies (Ames Test, in vitro and in vivo Micronucleus and Chromosomal aberrations studies) In vivo carcinogenicity studies 12 Hrs

4 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 . 12 Hrs

5 Toxicokinetics- Toxicokinetic evaluation in preclinical studies, saturation kinetics Importance and applications of toxicokinetic studies. Alternative methods to animal toxicity testing. 12 Hrs

REFERENCES

1. Hand book on GLP, Quality practices for regulated non-clinical research and development (http://www.who.int/tdr/publications/documents/glphandbook. pdf).
2. Schedule Y Guideline: drugs and cosmetics (second amendment) rules, 2005, ministry of health and family welfare (department of health) New Delhi
3. Drugs from discovery to approval by Rick NG.
4. Animal Models in Toxicology, 3rd Edition, Lower and Bryan
5. OECD test guidelines.
6. Principles of toxicology by Karen E. Stine, Thomas M. Brown.
7. 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/guidancecomplianceregulatoryinformation/guidances/ucm073246.pdf)

Department of Pharmaceutical Science and Technology
MaulanaAbulKalam AzadUniversityofTechnology,WestBengal

COURSE NAME: PRINCIPLES OF DRUG DISCOVERY
COURSE CODE: MPT-2083

CO	**Description: After the completion of the course the students will be able- - -**
CO1	To be able to understand and correlate the phases of Drug Discovery
CO2	To be able to understand the basis of finding Potential Targets of a disease and Validation of the same.
CO3	To be able to design models of the therapeutic target proteins.
CO4	To understand the computational method of finding Hits and thereby designing the lead molecule and it's optimization.
CO5	To understand the different types of protein-ligand interactions(Docking) and Thereby quantification and statistical representation of it.
CO6	To understand the basis of designing prodrug .

COURSE CONTENT: TOTAL HOURS: 60

1. 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. 12 Hrs

2 Lead Identification- combinatorial chemistry & high throughput screening, in silico leaddiscovery techniques, Assay development for hit identification.

Protein structure

Levels 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 12 Hrs

3 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, 12 Hrs 4 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, Hansch analysis, Fee Wilson analysis and relationship between them. 12 Hrs

5 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 12 Hrs

REFERENCES

1. MouldySioud. Target Discovery and Validation Reviews and Protocols: Volume 2 Emerging Molecular Targetsand Treatment Options. 2007 Humana Press Inc.
2. Darryl León. Scott MarkelIn. Silico Technologies in Drug Target Identification and Validation. 2006 by Taylor and Francis Group, LLC.
3. Johanna K. DiStefano. Disease Gene Identification. Methods and Protocols. Springer New York Dordrecht Heidelberg London.
4. Hugo Kubiny. QSAR: Hansch Analysis and Related Approaches. Methods and Principles in Medicinal Chemistry. Publisher Wiley-VCH
5. Klaus Gubernator, Hans-Joachim Böhm. Structure-Based Ligand Design. Methods and Principles in Medicinal Chemistry. Publisher Wiley-VCH
6. Abby L . Parrill. M . Rami Reddy. Rational Drug Design. Novel Methodology and Practical Applications. ACS Symposium Series; American Chemical Society: Washington, DC, 1999.
7. J. Rick Turner. New drug development design, methodology and, analysis. John Wiley & Sons, Inc., New Jersey.

Department of Pharmaceutical Science and Technology
MaulanaAbulKalam AzadUniversityofTechnology,WestBengal

COURSE NAME: CLINICAL RESEARCH AND PHARMACOVIGILANCE
COURSE CODE: MPT-2084

CO	**Description: After the completion of the course the students will be able- - -**
CO1	To explain the various regulatory requirements needed for safety assessment study, clinical trials and pharmacovigilance
CO2	To understand the responsibilities of the personnel involved in clinical trials
CO3	To demonstrate different designs that can be used for safety assessment study, clinical trials, pharmacoepidemeology, pharmacoeconomics
CO4	To analyze the various adverse drug reactions
CO5	To compile the adverse drug reactions and communicate to the authorities and patient
CO6	To apply the knowledge in safety assessment, clinical research, pharmacovigilance, pharmacoepidemeology, pharmacoeconomics

COURSE CONTENT: TOTAL HOURS: 60

1. 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 12 Hrs

2 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 12 Hrs

3 Clinical Trial Documentation- Guidelines to the preparation of documents, Preparation of protocol, Investigator Brochure, Case Report Forms, Clinical Study 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. 12 Hrs

4 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 12 Hrs

5 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. 12 Hrs

6 Pharmacoepidemiology, pharmacoeconomics, safety pharmacology 12 Hrs

REFERENCES

1. Central Drugs Standard Control Organization- Good Clinical Practices, Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health;2001.

2. 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.

3. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi.

4. Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, March2005, John Wiley and Sons.

5. Clinical Data Management edited by R K Rondels, S A Varley, C F Webbs. Second Edition,Jan 2000, Wiley Publications.

6. Handbook of clinical Research. Julia Lloyd and Ann Raven Ed. Churchill Livingstone.

7. Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes.

COURSE NAME: PHARMACOLOGY PRACTICAL-2
COURSE CODE: MPT-2985

CO	**Description: After the completion of the course student will be able - -**
CO1	To understand the various methods and guidelines required experimentation on animals
CO2	To apply the knowledge of various guidelines in toxicology and pharmacology
CO3	To interpret the data of the in vitro experimental results
CO4	To gain the ability to evaluate the results obtained from the research/project
CO5	To apply the newer experimental methods for findng the activity of the drugs.
CO6	To outline a project for newer compounds

COURSE CONTENT:

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 suitableisolated tissue preparation.
3. To determine to the strength of unknown sample by matching bioassay by using suitable tissuepreparation.
4. To determine to the strength of unknown sample by interpolation bioassay by using suitabletissue preparation
5. To determine to the strength of unknown sample by bracketing bioassay by using suitabletissue preparation
6. To determine to the strength of unknown sample by multiple point bioassay by using suitabletissue 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.
12. Acute oral toxicity studies as per OECD guidelines.
13. Acute dermal toxicity studies as per OECD guidelines.
14. Repeated dose toxicity studies- Serum biochemical, haematological, urine

analysis,functional observation tests and histological studies.

15. Drug mutagenicity study using mice bone-marrow chromosomal aberration test.

16. Protocol design for clinical trial.(3 Nos.)

17. Design of ADR monitoring protocol.

18. In-silico docking studies. (2 Nos.)

19. In-silico pharmacophore based screening.

20. In-silico QSAR studies.

21. ADR reporting

REFERENCES

1. Fundamentals of experimental Pharmacology-by M.N.Ghosh

2. Hand book of Experimental Pharmacology-S.K.Kulakarni

3. Text book of in-vitro practical Pharmacology by Ian Kitchen

4. Bioassay Techniques for Drug Development by Atta-ur-Rahman, Iqbal choudhary andWilliam Thomsen

5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.

6. Handbook of Essential Pharmacokinetics, Pharmacodynamics and Drug Metabolism forIndustrial Scientists.

COURSE NAME: SEMINAR/ ASSIGNMENTS
COURSE CODE: MPT-2986

CO	**Description: After the completion of the course the students will be able- - -**
CO1	To understand the knowledge of Pharmaceutical Science and Technology
CO2	To discover the recent developments in the field of Pharmaceutical Science and Technology
CO3	To apply the theoretical knowledge in research/project.
CO4	To increase the ability to analyze the results of research and /project
CO5	To gain the competence in designing projects
CO6	To evaluate the necessity of the recent developments in the field of Pharmaceutical Science and Technology

COURSE CONTENT:
Assignments and seminar based of recent developments, various techniques, methods in the field of pharmacology required for research and development.

SEMESTER- IIIrd
COURSE NAME: DISCUSSION/ PRESENTATION
COURSE CODE: MPT-391

CO	**Description: After the completion of the course the students will be able- - -**
CO1	To identify the knowledge of Pharmaceutical science and technology
CO2	To gain idea about the modern areas in Pharmaceutical science and technology
CO3	To apply the knowledge of Pharmaceutical science and technology in research
CO4	To find new techniques and knowledge in Pharmaceutical science and technology
CO5	To expand the knowledge of the newer developments of Pharmaceutical science and technology
CO6	To evaluate the value of subject in pharmaceutical science and research

COURSE NAME: RESEARCH WORK
COURSE CODE: MPT-392

CO	**Description: After the completion of the course the students will be able- - -**
CO1	To understand the knowledge of Pharmaceutical science and technology
CO2	Ability to describe the various concepts, methods of Pharmaceutical science and technology
CO3	To relate the knowledge of Pharmaceutical science and technology in research
CO4	To modify the knowledge of Pharmaceutical science and technology in projects and research
CO5	To outline new projects with the wide knowledge of the subjects
CO6	To ability to assess the various problems related with the research

COURSE NAME: RESEARCH METHODOLOGY AND BIOSTATISTICS
COURSE CODE: MPT-384

CO	Description: After the completion of the course the students will be able- - -
CO1	To understand the guidelines and requirements for preclinical research
CO2	To apply the knowledge of biostatistics analyzing various data
CO3	To design a project following the different components of research
CO4	To interpret the guidelines and requirements for clinical research
CO5	To employ the concept of good clinical practice and good laboratory practice in research
CO6	To apply the knowledge of guidelines in clinical research and preclinical studies

COURSE CONTENT:

1. General Research Methodology: Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls,randomization,crossoverdesign,placebo,blindingtechniques.

2. **Biostatistics:** Definition, application, sample size, importance of sample size, factors influencingsamplesize,dropouts,statisticaltestsofsignificance,typeofsignificancetests,parametrictests(students"t"test,ANOVA,Correlationcoefficient,regression),non-parametrictests(wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.

3. **Medical Research:** History,valuesinmedicalethics,autonomy,beneficence,non-maleficence,doubleeffect,conflictsbetweenautonomyandbeneficence/non-maleficence,euthanasia,informedconsent,confidentiality,criticismsoforthodoxmedicalethics,importanceofcommunication, 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.

4. **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, recordkeeping, SOPs, personnel and training, transport of lab animals.

5. **Declaration of Helsinki:** History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.

Learning Resources:

1. Central Drugs Standard Control Organization- Good Clinical Practices, Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.

2. EthicalGuidelinesforBiomedicalResearchonHumanSubjects2000.IndianCouncilofMedicalResearch, NewDelhi.
3. cpcsea.nic.in
4. Declaration of Helsinki-WMA-The World Medical Association. https://www.wma.net › what-we-do › medical-ethics
5.Research Methodology: Methods and Techniques by C R Kothari.

SEMESTER- IVth

COURSE NAME: DISCUSSION/ PRESENTATION
COURSE CODE: MPT-491

CO	**Description: After the completion of the course the students will be able- - -**
CO1	To analyze a problem in the area of pharmaceutical science and technology
CO2	To outline the project for a novel research to solve a problem
CO3	To apply the concepts of the pharmaceutical science and technology in framing a project
CO4	To apply the practical knowledge of the pharmaceutical science and technology in framing a project
CO5	To assess various parameters of the research work
CO6	To make conclusions of the work and its implication in the society

COURSE NAME: RESEARCH WORK
COURSE CODE: MPT-492

CO	**Description: After the completion of the course the students will be able- - -**
CO1	To identify the problem in the area of pharmaceutical science and technology
CO2	To frame a novel research to solve a problem
CO3	To employ the knowledge of the pharmaceutical science and technology in framing a project
CO4	To apply the practical knowledge of the pharmaceutical science and technology according to international standards and guidelines
CO5	To assess and apply the biostatistics and other concepts in evaluation of data
CO6	To conclude the findings of the research and its implication in the society