DEPARTMENT OF PHARMACY
GURU GHASIDAS VISHWAVIDYALAYA (A CENTRAL UNIVERSITY), BILASPUR (C.G.)

M. Pharm. (Pharmaceutics)

Course of study for M. Pharm. (Pharmaceutics)

Course Code	Course	Credit Hours	Credit Points	Hrs./w k	Marks
Semester I					
MPH101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPH102T	Drug Delivery System	4	4	4	100
MPH103T	Modern Pharmaceutics	4	4	4	100
MPH104T	Regulatory Affair	4	4	4	100
MPH105P	Pharmaceutics Practical I	12	6	12	150
MPH106P	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650
Semester II					
MPH 201T	Molecular Pharmaceutics (Nano Tech and Targeted DDS)	4	4	4	100
MPH 202T	Advanced Biopharmaceutics& Pharmacokinetics	4	4	4	100
MPH 203T	Computer Aided Drug Delivery System	4	4	4	100
MPH204T	Cosmetic and Cosmeceuticals	4	4	4	100
MPH 205P	Pharmaceutics Practical II	12	6	12	150
MPH 206P	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650

Schemes for internal assessments and end semester examinations
(Pharmaceutics- MPH)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
Semester I								
MPH101T	Modern Pharmaceutical Analytical Techniques	10	15	1 Hr	25	75	3 Hrs	100
MPH102T	Drug Delivery System	10	15	1 Hr	25	75	3 Hrs	100
MPH103T	Modern Pharmaceutics	10	15	1 Hr	25	75	3 Hrs	100
MPH104T	Regulatory Affair	10	15	1 Hr	25	75	3 Hrs	100
MPH105P	Pharmaceutics Practical I	20	30	6 Hrs	50	100	6 Hrs	150
MPH106P	Seminar/Assignment	-	-	-	-	-	-	100
							Total	650
Semester II								
MPH201T	Molecular Pharmaceutics (Nano Tech and Targeted DDS)	10	15	1 Hr	25	75	3 Hrs	100
MPH202T	Advanced Biopharmaceutics& Pharmacokinetics	10	15	1 Hr	25	75	3 Hrs	100
MPH203T	Computer Aided Drug Delivery System	10	15	1 Hr	25	75	3 Hrs	100
MPH204T	Cosmetic and Cosmeceuticals	10	15	1 Hr	25	75	3 Hrs	100
MPH205P	Pharmaceutics Practical I	20	30	6 Hrs	50	100	6 Hrs	150
MPH206P	Seminar/Assignment	-	-	-	-	-	-	100
							Total	650

Course of study for M. Pharm. III Semester (Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
MRM 302P	Journal club	1	1
MRM 303P	Discussion / Presentation (Proposal Presentation)	2	2
MRM 304P	Research Work	28	14
	Total	35	21

**Non University Examination*

Course of study for M. Pharm. IV Semester (Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
MRM 401P	Journal club	1	1
MRM 402P	Research Work	31	16
MRM 403P	Discussion / Final Presentation	3	3
	Total	35	20

Semester wise credits distribution

Semester	Credit Points
I	26
II	26
III	21
IV	20
Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)	Minimum=02 Maximum=07*
Total Credit Points	Minimum=95 Maximum=100*

**Credit Points for Co-curricular Activities*

Schemes for internal assessments and end semester examinations (Semester III & IV)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
Semester III								
MRM301T	Research Methodology and Biostatistics*	10	15	1 Hr	25	75	3 Hrs	100
MRM 302P	Journal club	-	-	-	25	-	-	25
MRM 303P	Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
MRM 304P	Research work*	-	-	-	-	350	1 hr	350
							Total	525
Semester IV								
MRM401P	Journal club	-	-	-	25	-	-	25
MRM402P	Discussion / Presentation (Proposal Presentation)	-	-	-	75	-	-	75
MRM403P	Research work and Colloquium	-	-	-	-	400	1 hr	400
							Total	500

*Non University Examination

M. Pharm. (Pharmaceutics)

Programme Outcomes

PO1: Fundamentals on advanced analytical instrumental techniques: UV-Visible, IR, Spectroflourimetry, Flame emission and Atomic absorption spectroscopy, NMR spectroscopy, Mass Spectroscopy, Chromatography, Electrophoresis and Immunological assays methods.

PO2: Advances and development of novel and targeted drug delivery systems: Sustained Release and Controlled Release, Rate Controlled Drug Delivery Systems, Gastro-Retentive Drug Delivery Systems, Occular Drug Delivery Systems, Occular Drug Delivery Systems, Protein and Peptide Delivery, Vaccine delivery systems.Targeted Drug Delivery Systems, Targeting Methods, Micro Capsules / Micro Spheres, Pulmonary Drug Delivery Systems, Nucleic acid based therapeutic delivery system

PO3: Advanced knowledge and skills of pharmaceutical industries: Preformulation Concepts, Optimization techniques in Pharmaceutical Formulation, Validation, cGMP& Industrial Management, Compression and compaction, Study of consolidation parameters.

PO4: Regulatory filings and different phases of clinical trials: Documentation in Pharmaceutical industry, Regulatory requirement for product approval, CMC, post approval regulatory affairs, Non clinical drug development, Clinical trials.

PO5:Knowledge about Research Methodology & Biostatistics: review of literature, strategies to eliminate errors/bias, values in medical ethics, CPCSEA guidelines for laboratory animal facility, Declaration of Helsinki.

PO6: Basic and principles of biopharmaceutics and pharmacokinetics: Drug Absorption from the Gastrointestinal Tract, Biopharmaceutic considerations in drug product design and In Vitro Drug Product Performance, Pharmacokinetics, Drug Product Performance, In Vivo: Bioavailability and Bioequivalence, Application of Pharmacokinetics.

PO7: Computer applications in pharmaceutical drug research and development: Computers in Pharmaceutical Research and Development, Computational Modeling of Drug Disposition, Computer-aided formulation development, Computer-aided biopharmaceutical characterization, Artificial Intelligence (AI), Robotics and Computational fluid dynamics.

PO8: Fundamental of cosmetic and cosmeceutical products: Regulatory on cosmetics, Biological aspects of cosmetics, Formulation Building blocks, Design of cosmeceutical products, Herbal Cosmetics.

Programme Specific Outcomes:

PSO1: Advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc, to impart knowledge on the area of advances in novel drug delivery systems, to impart advanced knowledge and skills required to learn various aspects and concepts at pharmaceutical industries.

PSO2: Impart advanced knowledge and skills required to learn the concept of generic drug and their development, various regulatory filings in different countries, different phases of clinical trials and submitting regulatory documents, to impart knowledge on the area of advances in novel drug delivery systems, to impart knowledge and skills necessary for dose calculations, dose adjustments and to apply biopharmaceutics theories in practical problem solving. Basic theoretical discussions of the principles of biopharmaceutics and pharmacokinetics are provided to help the students' to clarify the concepts.

PSO3: Impart knowledge and skills necessary for computer Applications in pharmaceutical research and development who want to understand the application of computers across the entire drug research and development process. Basic theoretical discussions of the principles of more integrated and coherent use of computerized information (informatics) in the drug development process are provided to help the students to clarify the concepts and to impart knowledge and skills necessary for the fundamental need for cosmetic and cosmeceutical products.

First Semester

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MPH 101T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPH101T	3	1	-	4 hours	25	75	100	4

Scope

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives

After completion of course student is able to know, Chemicals and Excipients

- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

Theory (60 hrs)

1.	a. UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy. Choice of solvents and solvent effect and Applications of UV- Visible spectroscopy. b. 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. c. Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. d. Flame emission spectroscopy and Atomic absorption spectroscopy:Principle,Instrumentation Interference andApplications.	11 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. Applicationsof NMR spectroscopy.	11 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	11 Hrs
4	Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography	11 Hrs
5	a. Electrophoresis: Principle, Instrumentation, Working	11

	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 b. X ray Crystallography: Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, Xray powder technique, Types of crystals and applications of X-ray diffraction.	Hrs
6	Immunological assays :RIA (Radio immuno assay), ELISA, Bioluminescence assays.	5Hrs

REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & 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, CBS Publishers, 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, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series

Course Outcomes

After completion of course student is able to know

CO1. The identification, characterization, and quantification of drugs using a variety of sophisticated analytical instrumental techniques including instruments such as mass spectrometers, IR, HPLC, GC, etc.

CO2. The analysis of various drugs in single and combination dosage forms.

CO3. Theoretical and practical skills of the instruments.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1			2		1	3	1	
CO2	3	2						1	3	1	
CO3	3								3	1	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

DRUG DELIVERY SYSTEM (MPH102T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPH102T	3	1	-	4 hours	25	75	100	4

Scope

This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

Objectives

Upon completion of the course, student shall be able to understand

The various approaches for development of novel drug delivery systems.

The criteria for selection of drugs and polymers for the development of delivering system

The formulation and evaluation of Novel drug delivery systems.

Theory (60 hrs)

1.	Sustained Release (SR) and Controlled Release (CR) formulations:Introduction & basic concepts, advantages/ disadvantages, factors influencing, Physicochemical & biological approaches for SR/CR formulation, Mechanism of Drug Delivery from SR/CR formulation. Polymers: introduction, definition, classification, properties and application Dosage Forms for Personalized Medicine: Introduction, Definition, Pharmacogenetics, Categories of Patients for Personalized Medicines: Customized drug delivery systems, Bioelectronic Medicines, 3D printing of pharmaceuticals, Telepharmacy.	10 Hrs
2	Rate Controlled Drug Delivery Systems: Principles & Fundamentals, Types, Activation; Modulated Drug Delivery Systems; Mechanically activated, pH activated, Enzyme activated, and Osmotic activated Drug Delivery Systems Feedback regulated Drug Delivery Systems; Principles & Fundamentals.	10 Hrs
3	Gastro-Retentive Drug Delivery Systems: Principle, concepts advantages and disadvantages, Modulation of GI transit time approaches to extend GI transit. Buccal Drug Delivery Systems: Principle of muco adhesion, advantages and disadvantages, Mechanism of drug permeation, Methods of formulation and its evaluations.	10 Hrs
4	Occular Drug Delivery Systems: Barriers of drug permeation, Methods to overcome barriers.	06 Hrs
5	Transdermal Drug Delivery Systems:Structure of skin and barriers, Penetration enhancers, Transdermal Drug Delivery Systems, Formulation and evaluation.	10 Hrs
6	Protein and Peptide Delivery:Barriers for protein delivery. Formulation and Evaluation of delivery systems of proteins and other macromolecules.	08 Hrs
7	Vaccine deliverysystems: Vaccines, uptake of antigens, single shot vaccines, mucosal and transdermal delivery of vaccines.	06 Hrs

REFERENCES

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
3. Encyclopedia of controlled delivery, Editor- Edith Mathiowitz, Published by WileyInterscience Publication, John Wiley and Sons, Inc, New York! Chichester/Weinheim
4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
5. S.P.Vyas and R.K.Khar, Controlled Drug Delivery - concepts and advances, VallabhPrakashan, New Delhi, First edition 2002

JOURNALS

1. Indian Journal of Pharmaceutical Sciences (IPA)
2. Indian drugs (IDMA)
3. Journal of controlled release (Elsevier Sciences) desirable
4. Drug Development and Industrial Pharmacy (Marcel & Decker) desirable

Course Outcomes

After completion of course student is able to understand-

CO1. Approaches for development of novel drug delivery systems (NDDS).
CO2. Selection criteria of drugs and polymers for the development of delivering system.
CO3. The various formulations of NDDS and their evaluation.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	1	3	1		1				1	1	
CO2	1	3							1	1	
CO3		3	1	1	1					1	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

MODERN PHARMACEUTICS (MPH103T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPH103T	3	1	-	4 hours	25	75	100	4

Scope

Course designed to impart advanced knowledge and skills required to learn various aspects and concepts at pharmaceutical industries

Objectives

Upon completion of the course, student shall be able to understand

- The elements of preformulation studies.
- The Active Pharmaceutical Ingredients and Generic drug Product development
- Industrial Management and GMP Considerations.
- Optimization Techniques & Pilot Plant Scale Up Techniques
- Stability Testing, sterilization process & packaging of dosage forms.

Theory (60 hrs)

1.	a. Preformation Concepts – Drug Excipient interactions - different methods, kinetics of stability, Stability testing. Theories of dispersion and pharmaceutical Dispersion (Emulsion and Suspension, SMEDDS) preparation and stability Large and small volume parental – physiological and formulation consideration, Manufacturing and evaluation. b. Optimization techniques in Pharmaceutical Formulation: Concept and parameters of optimization, Optimization techniques in pharmaceutical formulation and processing. Statistical design, Response surface method, Contour designs, Factorial designs and application in formulation	10 Hrs
2	Validation:Introduction to Pharmaceutical Validation, Scope & merits of Validation, Validation and calibration of Master plan, ICH & WHO guidelines for calibration and validation of equipments, Validation of specific dosage form, Types of	10 Hrs

	validation. Government regulation, Manufacturing Process Model, URS, DQ, IQ, OQ & P.Q. of facilities.	
3	cGMP& Industrial Management: Objectives and policies of current good manufacturing practices, layout of buildings, services, equipments and their maintenance Production management: Production organization, , materials management, handling and transportation, inventory management and control, production and planning control, Sales forecasting, budget and cost control, industrial and personal relationship. Concept of Total Quality Management.	10 Hrs
4	Compression and compaction: Physics of tablet compression, consolidation, effect of friction, distribution of forces, compaction profiles. Solubility.	10 Hrs
5	Study of consolidation parameters; Diffusion parameters, Dissolution parameters and Pharmacokinetic parameters, HeckelHrs plots, Similarity factors – f2 and f1, Higuchi and Peppas plot, Linearity Concept of significance, Standard deviation , Chi square test, students T-test , ANOVA test.	10 Hrs

REFERENCES

1. Theory and Practice of Industrial Pharmacy ByLachmann and Libermann
2. Pharmaceutical dosage forms: Tablets Vol. 1-3 by Leon Lachmann.
3. Pharmaceutical Dosage forms: Disperse systems, Vol, 1-2; By Leon Lachmann.
4. Pharmaceutical Dosage forms: Parenteral medications Vol. 1-2; By Leon Lachmann.
5. Modern Pharmaceutics; By Gillbert and S. Banker.
6. Remington's Pharmaceutical Sciences.
7. Advances in Pharmaceutical Sciences Vol. 1-5; By H.S. Bean & A.H. Beckett.
8. Physical Pharmacy; By Alfred martin
9. Bentley's Textbook of Pharmaceutics – by Rawlins.
10. Good manufacturing practices for Pharmaceuticals: A plan for total quality control, Second edition; By Sidney H. Willig.
11. Quality Assurance Guide; By Organization of Pharmaceutical producers of India.
12. Drug formulation manual; By D.P.S. Kohli and D.H.Shah. Eastern publishers, New Delhi.
13. How to practice GMPs; By P.P.Sharma. Vandhana Publications, Agra.
14. Pharmaceutical Process Validation; By Fra. R. Berry and Robert A. Nash.
15. Pharmaceutical Preformulations; By J.J. Wells.
16. Applied production and operations management; By Evans, Anderson, Sweeney and Williams.
17. Encyclopaedia of Pharmaceutical technology, Vol I – III.

Course Outcomes

After completion of course student shall be able to understand-

CO1. Various elements of pre-formulation studies.

CO2. The active pharmaceutical ingredients (API) and generic drug Product development.

CO3. To learn about Industrial management and GMP considerations. Also learn the optimizationtechniques & pilot plant scale up techniques

CO4. Fundamentals of stability testing, sterilization process & packaging of dosage forms.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1			3						1	1	
CO2			3						1	1	
CO3			3	1						1	
CO4			3								

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

REGULATORY AFFAIRS (MPH 104T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPH104T	3	1	-	4 hours	25	75	100	4

Scope

Course designed to impart advanced knowledge and skills required to learn the concept of generic drug and their development, various regulatory filings in different countries, different phases of clinical trials and submitting regulatory documents: filing process of IND, NDA and ANDA

- To know the approval process of
- To know the chemistry, manufacturing controls and their regulatory importance
- To learn the documentation requirements for
- To learn the importance and

Objectives:

Upon completion of the course, it is expected that the students will be able to understand

- The Concepts of innovator and generic drugs, drug development process
- The Regulatory guidance's and guidelines for filing and approval process
- reparation of Dossiers and their submission to regulatory agencies in different countries
- Post approval regulatory requirements for actives and drug products
- Submission of global documents in CTD/ eCTD formats
- Clinical trials requirements for approvals for conducting clinical trials
- Pharmacovigilence and process of monitoring in clinical trials.

Theory (60 hrs)

1.	a. Documentation in Pharmaceutical industry: Master formula record, DMF (Drug Master File), distribution records. Generic drugs product development Introduction, Hatch-Waxman act and amendments, CFR (CODE OF FEDERAL REGULATION) ,drug product performance, in-vitro, ANDA regulatory approval process, NDA approval process, BE and drug product assessment, in –vivo, scale up process approval changes, post marketing surveillance, outsourcing BA and BE to CRO. b. Regulatory requirement for product approval: API, biologics, novel therapies obtaining NDA, ANDA for generic drugs ways and means of US registration for foreign drugs	12 Hrs
2	CMC, post approval regulatory affairs. Regulation for combination products and	12

	medical devices. CTD and ECTD format, industry and FDA liaison. ICH - Guidelines of ICH-Q, S E, M. Regulatory requirements of EU, MHRA, TGA and ROW countries.	Hrs
3	Non clinical drug development: Global submission of IND, NDA, ANDA. Investigation of medicinal products dossier, dossier (IMPD) and investigator brochure (IB).	12 Hrs
4	Clinical trials: Developing clinical trial protocols. Institutional review board/ independent ethics committee Formulation and working procedures informed Consent process and procedures. HIPAA-new,requirement to clinical study process, pharmacovigilance safety monitoring in clinical trials.	

REFERENCES

1. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and IsaderKaufer, Marcel Dekker series, Vol.143
2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P.Martin, Drugs and the Pharmaceutical Sciences,Vol.185, Informa Health care Publishers.
3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD,5th edition, Drugs and the Pharmaceutical Sciences, Vol.190.
4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley &Sons.Inc.
5. FDA regulatory affairs: a guide for prescription drugs, medical devices, and biologics/edited By Douglas J. Pisano, David Mantus.
6. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A.Rozovsky and Rodney K. Adams
7. www.ich.org/
8. www.fda.gov/
9. europa.eu/index_en.htm
10. https://www.tga.gov.au/tga-basics

Course Outcomes

After completion of course student shall be able to understand-

CO1. To know the concepts of innovator and generic drugs, drug development process and the Regulatory guidance's and guidelines for filing and approval process.

CO2. Preparation of dossiers and their submission to regulatory agencies in different countries and post approval regulatory requirements for actives and drug products.

CO3. Submission of global documents in CTD/ eCTD formats.

CO4. Clinical trials requirements for approvals for conducting clinical trials and Pharmacovigilance and process of monitoring in clinical trials.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1			1	3					1	1	
CO2				3					1	1	
CO3				3						1	
CO4				3							

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

PHARMACEUTICS PRACTICALS – I (MPH 105P)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPH10P	-	-	12	12 hours	50	100	150	6

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. To perform $I_{n\text{-}vitro}$ dissolution profile of CR/ SR marketed formulation
8. Formulation and evaluation of sustained release matrix tablets
9. Formulation and evaluation osmotically controlled DDS
10. Preparation and evaluation of Floating DDS- hydro dynamically balanced DDS
11. Formulation and evaluation of Muco adhesive tablets.
12. Formulation and evaluation of trans dermal patches.
13. To carry out preformulation studies of tablets.
14. To study the effect of compressional force on tablets disintegration time.
15. To study Micromeritic properties of powders and granulation.
16. To study the effect of particle size on dissolution of a tablet.
17. To study the effect of binders on dissolution of a tablet.
18. To plot Heckal plot, Higuchi and peppas plot and determine similarity factors.

Course Outcomes

After completion of course student shall be able to understand-
The student will try to learn-

CO1. Analysis of compounds and their formulations by UV-Vis spectrophotometer, Column chromatography, HPLC, Gas chromatography.

CO2. Preparation and evaluation of Floating DDS-hydro dynamically balanced DDS

CO3. Preformulation studies of different type of tablets and estimations of different type of drugs using different methods.

CO4. Handling of animals.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3								2	1	
CO2					3				2	1	
CO3			3							1	
CO4							3				

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

MOLECULAR PHARMACEUTICS (NANO TECHNOLOGY & TARGETED DDS) (NTDS) (MPH 201T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPH 201T	3	1	-	4 hours	25	75	100	4

Scope

This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

Objectives

Upon completion of the course student shall be able to understand

- The various approaches for development of novel drug delivery systems.
- The criteria for selection of drugs and polymers for the development of NTDS
- The formulation and evaluation of novel drug delivery systems.

Theory (60 hrs) 60 Hrs

1.	Targeted Drug Delivery Systems: Concepts, Events and biological process involved in drug targeting. Tumor targeting and Brain specific delivery.	12 Hrs
2	Targeting Methods: introduction preparation and evaluation. Nano Particles & Liposomes: Types, preparation and evaluation.	12 Hrs
3	Micro Capsules / Micro Spheres: Types, preparation and evaluation, Monoclonal Antibodies ; preparation and application, preparation and application of Niosomes, Aquasomes, Phytosomes, Electrosomes.	12 Hrs
4	Pulmonary Drug Delivery Systems: Aerosols, propellents, Containers Types, preparation and evaluation, Intra Nasal Route Delivery systems; Types, preparation and evaluation.	12 Hrs
5	Nucleic acid based therapeutic delivery system: Gene therapy, introduction (ex-vivo & in-vivo gene therapy). Potential target diseases for gene therapy (inherited disorder and cancer). Gene expression systems (viral and nonviral gene transfer). Liposomal gene delivery systems. Biodistribution and Pharmacokinetics. knowledge of therapeutic antisense molecules and aptamers as drugs of future.	12 Hrs

REFERENCES

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. S.P. Vyas and R.K. Khar, Controlled Drug Delivery - concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.
3. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).

Course Outcomes

After completion of course student shall be able to understand-

CO1. The various approachesfor development of NDDS.

CO2. The criteria for selection of drugs and polymers for the development of NTDS.

CO3. The formulation and evaluation of NDDS.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1		3		2						1	
CO2		3		2						1	
CO3	1	3		2						1	
CO4		3		2					1		

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

ADVANCED BIOPHARMACEUTICS & PHARMACOKINETICS (MPH 202T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPH202T	3	1	-	4 hours	25	75	100	4

Scope

This course is designed to impart knowledge and skills necessary for dose calculations, dose adjustments and to apply biopharmaceutics theories in practical problem solving. Basic theoretical discussions of the principles of biopharmaceutics and pharmacokinetics are provided to help the students' to clarify the concepts.

Objectives

Upon completion of this course, it is expected that students will be able understand,

- The basic concepts in biopharmaceutics and pharmacokinetics.
- The use raw data and derive the pharmacokinetic models and parameters the best describe the process of drug absorption, distribution, metabolism and elimination.
- The critical evaluation of biopharmaceutic studies involving drug product equivalency.
- The design and evaluation of dosage regimens of the drugs using pharmacokinetic and biopharmaceutic parameters.
- The potential clinical pharmacokinetic problems and application of basics of pharmacokinetic

Theory (60 hrs)

1. Drug Absorption fromtheGastrointestinaTract: Gastrointestinal tract, Mechanism of drug absorption, Factors affecting drug absorption, pH–partition theory of drug absorption. Formuulation and physicochemical factors: Dissolution rate, Dissolution process, Noyes–Whitney equation and drug dissolution, Factors affecting the dissolution rate. Gastrointestinal absorption: role of the dosage form: Solution (elixir, syrup and solution) as a dosage form ,Suspension as a dosage form, Capsule as a dosage form, Tablet as a dosage form, Dissolution methods ,Formulation and processing factors, Correlation of in vivo data with in vitro dissolution data.Transport model: Permeability-Solubility-Charge State and the pH Partition Hypothesis, Properties of the Gastrointestinal Tract (GIT), pH Microclimate Intracellular pH Environment, Tight-Junction Complex. — 12 Hrs
2. Biopharmaceutic considerations in drug product design — 12

	and In Vitro Drug Product Performance: Introduction, biopharmaceutic factors affecting drug bioavailability, rate-limiting steps in drug absorption, physicochemical nature of the drug formulation factors affecting drug product performance, in vitro: dissolution and drug release testing, compendial methods of dissolution, alternative methods of dissolution testing, meeting dissolution requirements, problems of variable control in dissolution testing performance of drug products. In vitro–in vivo correlation, dissolution profile comparisons, drug product stability, considerations in the design of a drug product.	Hrs
3	Pharmacokinetics: Basic considerations, pharmacokinetic models, compartment modeling: one compartment model- IV bolus, IV infusion, extra-vascular. Multi compartment model two compartment - model in brief, non-linear pharmacokinetics: cause of non-linearity, Michaelis – Menten equation, estimation of k_{max} and v_{max}. Drug interactions: introduction, the effect of protein-binding interactions, the effect of tissue-binding interactions, cytochrome p450-based drug interactions, drug interactions linked to transporters.	12 Hrs
4	Drug Product Performance, In Vivo: Bioavailability and Bioequivalence: drug product performance, purpose of bioavailability studies, relative and absolute availability. methods for assessing bioavailability, bioequivalence studies, design and evaluation of bioequivalence studies, study designs, crossover study designs, evaluation of the data, bioequivalence example, study submission and drug review process. Biopharmaceutics classification system, methods. Permeability: In-vitro, in-situ and In-vivo methods .generic biologics (biosimilar drug products),clinical significance of bioequivalence studies, special concerns in bioavailability and bioequivalence studies, generic substitution.	12 Hrs
5	Applicationof Pharmacokinetics:Modified-ReleaseDrug Products, Targeted Drug Delivery Systems and Biotechnological products. Introduction to Pharmacokinetics and pharmacodynamic, drug interactions. Pharmacokinetics and pharmacodynamics of biotechnology drugs. Introduction, Proteins and peptides, Monoclonal antibodies, Oligonucleotides, Vaccines (immunotherapy), Gene therapies.	12 Hrs

REFERENCES

1. Biopharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi, 4th edition,Philadelphia, Lea and Febiger, 1991
2. Biopharmaceutics and Pharmacokinetics, A. Treatise, D. M. Brahmankar and Sunil B. Jaiswal., VallabPrakashan, Pitampura, Delhi
3. Applied Biopharmaceutics and Pharmacokinetics by Shargel. Land YuABC, 2nd edition, Connecticut Appleton Century Crofts, 1985
4. Textbook of Biopharmaceutics and Pharmacokinetics, Dr. Shobha Rani R. Hiremath,Prism Book
5. Pharmacokinetics by Milo Gibaldi and D. Perrier, 2nd edition, Marcel Dekker Inc.,New York, 1982
6. Current Concepts in Pharmaceutical Sciences: Biopharmaceutics, Swarbrick. J, LeaandFebiger, Philadelphia, 1970

7. Clinical Pharmacokinetics, Concepts and Applications 3rd edition by MalcolmRowland and Thom~ N. Tozer, Lea and Febiger, Philadelphia, 1995
8. Dissolution, Bioavailability and Bioequivalence, Abdou. H.M, Mack Publishing Company, Pennsylvania 1989
9. Biopharmaceutics and Clinical Pharmacokinetics, An Introduction, 4th edition,revised and expande by Robert. E. Notari, Marcel Dekker Inc, New York and Basel,1987.
10. Biopharmaceutics and Relevant Pharmacokinetics by John. G Wagner and M.Pemarowski, 1st edition, Drug Intelligence Publications, Hamilton, Illinois, 1971.
11. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James. G.Boylan, Marcel Dekker Inc, New York, 1996.
12. Basic Pharmacokinetics,1stedition,Sunil S JambhekarandPhilip J Breen,pharmaceutical press, RPS Publishing, 2009.
13. Absorption and Drug Development- Solubility, Permeability, and Charge State, Alex Avdeef, John Wiley & Sons, Inc, 2003.

Course Outcomes

After completion of course student shall be able to understand-

CO1. The basic concepts in biopharmaceutics and pharmacokinetics.

CO2. The use raw data and derive the pharmacokinetic models and parameters the best describe the process of drug ADME.

CO3. Evaluation of biopharmaceutic studies involving drug product equivalency.

CO4. Design and evaluation of dosage regimens of the drugs using pharmacokinetic and biopharmaceutic parameters.

CO5. The potential clinical pharmacokinetic problems and application of basics of pharmacokinetic

Course Outcomes and their mapping with Programme Outcomes:

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1						3				1	
CO2						3				1	
CO3	1					3				1	1
CO4						3			1		1
CO5						3					

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

COMPUTER AIDED DRUG DEVELOPMENT (MPH 203T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPH203T	3	1	-	4 hours	25	75	100	4

Scope

This course is designed to impart knowledge and skills necessary for computer Applications in pharmaceutical research and development who want to understand the application of computers across the entire drug research and development process. Basic theoretical discussions of the principles of more integrated and coherent use of computerized information (informatics) in the

drug development process are provided to help the students to clarify the concepts.

Objectives

Upon completion of this course it is expected that students will be able to understand,

- History of Computers in Pharmaceutical Research and Development
- Computational Modeling of Drug Disposition
- Computers in Preclinical Development
- Optimization Techniques in Pharmaceutical Formulation
- Computers in Market Analysis
- Computers in Clinical Development
- Artificial Intelligence (AI) and Robotics
- Computational fluid dynamics(CFD)

Theory (60 hrs)

1.	a. Computers in Pharmaceutical Research and Development: A General Overview: History of Computers in Pharmaceutical Research and Development. Statistical modeling in Pharmaceutical research and development: Descriptive versus Mechanistic Modeling, Statistical Parameters, Estimation, Confidence Regions, Nonlinearity at the Optimum, Sensitivity Analysis, Optimal Design, Population Modeling. b. Quality-by-Design In Pharmaceutical Development: Introduction, ICH Q8 guideline, Regulatory and industry views on QbD, Scientifically based QbD - examples of application.	12 Hrs
2	Computational Modeling of Drug Disposition: Introduction, Modeling Techniques: Drug Absorption, Solubility, Intestinal Permeation, Drug Distribution, Drug Excretion, Active Transport; P-gp, BCRP, Nucleoside Transporters, hPEPT1, ASBT, OCT, OATP, BBB-Choline Transporter.	12 Hrs
3	Computer-aided formulation development::Concept of optimization, Optimization parameters, Factorial design, Optimization technology & Screening design. Computers in Pharmaceutical Formulation: Development of pharmaceutical emulsions, microemulsion drug carriers Legal Protection of Innovative Uses of Computers in R&D, The Ethics of Computing in Pharmaceutical Research, Computers in Market analysis	12 Hrs
4	a. Computer-aided biopharmaceutical characterization: Gastrointestinal absorption simulation. Introduction, Theoretical background, Model construction, Parameter sensitivity analysis, Virtual trial, Fed vs. fasted state, In vitro dissolution and in vitro- in vivo correlation, Biowaiver considerations b. Computer Simulations in Pharmacokinetics and Pharmacodynamics: Introduction, Computer Simulation: Whole Organism, Isolated Tissues, Organs, Cell, Proteins and Genes. c. Computers in Clinical Development: Clinical Data Collection and Management, Regulation of Computer Systems	12 Hrs
5	Artificial Intelligence (AI), Robotics and Computational fluid dynamics:General overview, Pharmaceutical Automation, Pharmaceutical applications, Advantages and Disadvantages. Current Challenges and Future Directions.	12 Hrs

REFERENCES

1. Computer Applications in Pharmaceutical Research and Development, Sean Ekins, 2006, John Wiley & Sons.
2. Computer-Aided Applications in Pharmaceutical Technology, 1st Edition, JelenaDjuris, Woodhead Publishing
3. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James. G.Boylan, Marcel Dekker Inc, New York, 1996.

Course Outcomes

After completion of course student shall be able to understand-

CO1. History of computers in pharmaceutical research and development.

CO2. Computational modeling of drug disposition.

CO3. Computers in Preclinical Development, Market Analysis and Clinical Development.

CO4. To learn the optimization techniques in pharmaceutical formulation and computational fluid dynamics (CFD).

CO5. Artificial intelligence (AI) and robotics

Course Outcomes and their mapping with Programme Outcomes:

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1							3				2
CO2							3				2
CO3			1				3				2
CO4		1					3				2
CO5							3				2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

COSMETICS AND COSMECEUTICALS (MPH 204T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPH204T	3	1	-	4 hours	25	75	100	4

Scope

This course is designed to impart knowledge and skills necessary for the fundamental need for cosmetic and cosmeceutical products.

Objectives

Upon completion of the course, the students shall be able to understand

- Key ingredients used in cosmetics and cosmeceuticals.
- Key building blocks for various formulations.
- Current technologies in the market
- Various key ingredients and basic science to develop cosmetics and cosmeceuticals
- Scientific knowledge to develop cosmetics and cosmeceuticals with desired Safety, stability, and efficacy.

Theory (60 hrs)

1. Cosmetics – Regulatory: Definition of cosmetic products as per Indian regulation. Indian regulatory requirements for labeling of cosmetics Regulatory provisions 12 Hrs

relating to import of cosmetics., Misbranded and spurious cosmetics. Regulatory provisions relating to manufacture of cosmetics – Conditions for obtaining license, prohibition of manufacture and sale of certain cosmetics, loan license, offences and penalties.

2 Cosmetics - Biological aspects: Structure of skin relating to problems like dry skin, acne, pigmentation, prickly heat, wrinkles and body odor. Structure of hair and hair growth cycle. Common problems associated with oral cavity. Cleansing and care needs for face, eye lids, lips, hands, feet, nail, scalp, neck, body and under-arm. — 12 Hrs

3 Formulation Building blocks: Building blocks for different product formulations of cosmetics/cosmeceuticals. Surfactants – Classification and application. Emollients, rheological additives: classification and application. Antimicrobial used as preservatives, their merits and demerits. Factors affecting microbial preservative efficacy. Building blocks for formulation of a moisturizing cream, vanishing cream, cold cream, shampoo and toothpaste. Soaps and syndetbars.
Perfumes; Classification of perfumes. Perfume ingredients listed as allergens in EU regulation
Controversial ingredients: Parabens, formaldehyde liberators, dioxane. — 12 Hrs

4 Design of cosmeceutical products: Sun protection, sunscreens classification and regulatory aspects. Addressing dry skin, acne, sun-protection, pigmentation, prickly heat, wrinkles, body odor., dandruff, dental cavities, bleeding gums, mouth odor and sensitive teeth through cosmeceutical formulations. — 12 Hrs

5 Herbal Cosmetics: Herbal ingredients used in Hair care, skin care and oral care. Review of guidelines for herbal cosmetics by private bodies like cosmos with respect to preservatives, emollients, foaming agents, emulsifiers and rheology modifiers. Challenges in formulating herbal cosmetics. — 12 Hrs

REFERENCES

1. Harry's Cosmeticology. 8th edition.
2. Poucher'sperfumecosmeticsandSoaps,10thedition.
3. Cosmetics - Formulation, Manufacture and quality control, PP.Sharma,4th edition
4. Handbook of cosmetic science and Technology A.O.Barel, M.Paye and
5. H.I. Maibach. 3rd edition
6. Cosmetic and Toiletries recent suppliers catalogue.
7. CTFA directory.

Course Outcomes

After completion of course student shall be able to understand-

CO1. Key ingredients used in cosmetics and cosmeceuticals and key building blocks for various formulations.

CO2. To know the current technologies in the market and various key ingredients and basic science to develop cosmetics and cosmeceuticals

CO3. Scientific knowledge to develop cosmetics and cosmeceuticals with desired Safety, stability, and efficacy.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1			1					3			
CO2			1					3			1
CO3								3			

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

PHARMACEUTICS PRACTICALS – II (MPH 205P)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPH205P	-	-	12	12 hours	50	100	150	6

1. To study the effect of temperature change, non-solvent addition, incompatible polymer addition in microcapsules preparation
2. Preparation and evaluation of Alginate beads
3. Formulation and evaluation of gelatin /albumin microspheres
4. Formulation and evaluation of liposomes/niosomes
5. Formulation and evaluation of spherules
6. Improvement of dissolution characteristics of slightly soluble drug by Solid dispersion technique.
7. Comparison of dissolution of two different marketed products /brands
8. Protein binding studies of a highly protein bound drug & poorly protein bound drug
9. Bioavailability studies of Paracetamol in animals.
10. Pharmacokinetic and IVIVC data analysis by Winnoline R software
11. In vitro cell studies for permeability and metabolism
12. DoE Using Design Expert® Software
13. Formulation data analysis Using Design Expert® Software
14. Quality-by-Design in Pharmaceutical Development
15. Computer Simulations in Pharmacokinetics and Pharmacodynamics
16. Computational Modeling of Drug Disposition
17. To develop Clinical Data Collection manual
18. To carry out Sensitivity Analysis, and Population Modeling.
19. Development and evaluation of Creams
20. Development and evaluation of Shampoo and Toothpaste base
21. To incorporate herbal and chemical actives to develop products
22. To address Dry skin, acne, blemish, Wrinkles, bleeding gums and dandruff

Course Outcomes

After completion of course student shall be able to understand-

CO1. To study the effect of temperature change, non-solvent addition, incompatible polymer addition in microcapsules preparation.

CO2. Preparation and evaluation of Alginate beads.Formulation and evaluation of gelatin/albumin microspheres, liposomes/niosomes and spherules.Improvement of dissolution characteristics of slightly soluble drug by Solid dispersion technique.

CO3. Protein binding studies of a highly protein bound drug & poorly protein bound drug.

CO4. DoE Using Design Expert® Software and formulation data analysis Using Design Expert® Software.Computer Simulations in Pharmacokinetics and Pharmacodynamics.

CO5. Development and evaluation of Creams, Shampoo and Toothpaste base.To address Dry skin, acne, blemish, Wrinkles, bleeding gums and dandruff.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1					3						
CO2		3								1	1
CO3						3					
CO4							3				2
CO5								3			

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

RESEARCH METHODOLOGY & BIOSTATISTICS (MRM 301T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MRM 301T	3	1	-	4 hours	25	75	100	4

UNIT – I

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.

UNIT – II

Biostatistics: Definition, application, sample size, importance of sample size,factors influencing sample size, dropouts, statistical tests of significance, typeof significance tests, parametric tests(students "t" test, ANOVA, Correlationcoefficient, regression), non-parametric tests (wilcoxan rank tests, analysis ofvariance, correlation, chi square test), null hypothesis, P values, degree offreedom, interpretation of P values.

UNIT – III

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy andbeneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, controlresolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personalhygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medicalresearch, and additional principles for medical research combined withmedical care.

Course Outcomes

The student will try to learn-

CO1. Student will gain knowledge of general research methodology, review of literature, biostatistics.

CO2. They will know about values of medical ethics.

CO3. CPCSEA guidelines for laboratory animal facility.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	1						2	2			
CO2	1			1		1	2	3		1	
CO3	1			1		1	2	3			1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

DEPARTMENT OF PHARMACY
GURU GHASIDAS VISHWAVIDYALAYA (A CENTRAL UNIVERSITY), BILASPUR (C.G.)

M. Pharm. (Pharmaceutical Chemistry)

Course of study for M. Pharm. (Pharmaceutical Chemistry)

Course Code	Course	Credit Hours	Credit Points	Hrs./w k	Marks
Semester I					
MPC101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPC102T	Advanced Organic Chemistry – I	4	4	4	100
MPC103T	Advanced Medicinal chemistry	4	4	4	100
MPC104T	Chemistry of Natural Product	4	4	4	100
MPC105P	Pharmaceutical Chemistry Practical I	12	6	12	150
-	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650
Semester II					
MPC201T	Advanced Spectral Analysis	4	4	4	100
MPC202T	Advanced Organic Chemistry –II	4	4	4	100
MPC203T	Computer Aided Drug Design	4	4	4	100
MPC204T	Pharmaceutical Process Chemistry	4	4	4	100
MPC205P	Pharmaceutical Chemistry Practical II	12	6	12	150
-	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650

Schemes for internal assessments and end semester examinations
(Pharmaceutical Chemistry-MPC)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
Semester I								
MPC101T	Modern Pharmaceutical Analytical Techniques	10	15	1 Hr	25	75	3 Hrs	100
MPC102T	Advanced Organic Chemistry – I	10	15	1 Hr	25	75	3 Hrs	100
MPC103T	Advanced Medicinal chemistry	10	15	1 Hr	25	75	3 Hrs	100
MPC104T	Chemistry of Natural Product	10	15	1 Hr	25	75	3 Hrs	100
MPC105P	Pharmaceutical Chemistry Practical I	20	30	6 Hrs	50	100	6 Hrs	150
MPC106P	Seminar/Assignment	-	-	-	-	-	-	100
Total								650
Semester II								
MPC201T	Advanced Spectral Analysis	10	15	1 Hr	25	75	3 Hrs	100
MPC202T	Advanced Organic Chemistry –II	10	15	1 Hr	25	75	3 Hrs	100
MPC203T	Computer Aided Drug Design	10	15	1 Hr	25	75	3 Hrs	100
MPC204T	Pharmaceutical Process Chemistry	10	15	1 Hr	25	75	3 Hrs	100
MPC205P	Pharmaceutical Chemistry Practical II	20	30	6 Hrs	50	100	6 Hrs	150
MPC206P	Seminar/Assignment	-	-	-	-	-	-	100
Total								650

Course of study for M. Pharm. III Semester (Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
MRM 302P	Journal club	1	1
MRM 303P	Discussion / Presentation (Proposal Presentation)	2	2
MRM 304P	Research Work	28	14
	Total	35	21

**Non University Examination*

Course of study for M. Pharm. IV Semester (Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
MRM 401P	Journal club	1	1
MRM 402P	Research Work	31	16
MRM 403P	Discussion / Final Presentation	3	3
	Total	35	20

Semester wise credits distribution

Semester	Credit Points
I	26
II	26
III	21
IV	20
Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)	Minimum=02 Maximum=07*
Total Credit Points	Minimum=95 Maximum=100*

**Credit Points for Co-curricular Activities*

Schemes for internal assessments and end semester examinations (Semester III & IV)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
Semester III								
MRM 301T	Research Methodology and Biostatistics*	10	15	1 Hr	25	75	3 Hrs	100
MRM 302P	Journal club	-	-	-	25	-	-	25
MRM 303P	Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
MRM 304P	Research work*	-	-	-	-	350	1 hr	350
Total								525
Semester IV								
MRM 401P	Journal club	-	-	-	25	-	-	25
MRM 402P	Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
MRM 403P	Research work and Colloquium	-	-	-	-	400	1 hr	400
Total								475

*Non University Examination

M. Pharm. (Pharmaceutical Chemistry)

Programme Outcomes

Postgraduate students will be able to learn:

PO1: Fundamentals on advanced analytical instrumental techniques: UV-Visible, IR, Spectro-flourimetry, Flame emission and Atomic absorption spectroscopy, NMR spectroscopy, Mass Spectroscopy, Chromatography, Electrophoresis and Immunological assays methods.

PO2: Knowledge about advances in organic chemistry: retrosynthesis, Organic intermediates, Nucleophilic reaction, electrophilic reactions, green chemistry, Peptide Chemistry, stereochemistry and asymmetric synthesis.

PO3: Study of mechanism and synthetic applications OF compounds: Ugi reaction,Brook rearrangement, Ullmann coupling reactions, Ozonolysis and Michael addition reaction, Synthetic Reagents & Applications, Wilkinson reagent, Witting reagent. Osmium tetroxide, Benzotriazol-1-yloxy) tris (dimethylamino) phosphoniumhexafluoro-phosphate (BOP).

PO4: Advances in the field of medicinal chemistry: drug discovery, lead discovery; identification, validation of drug targets, Receptors, artificial enzymes, Prodrug Design and Analog design, Stereochemistry and Drug action, Rational Design of Enzyme Inhibitors, Peptidomimetics.

PO5: Advanced knowledge and skills of pharmaceutical industries: Stages of scale up process,Impurities in API, Unit operation Extraction, Distillation , Filteration, evaporation, crystallization, Unit process Nitration, Halogenation, oxidation , Reduction,Fermentation, Industrial safety,OHSAS 1800, ISO 14001.

PO6: Advanced knowledge about chemistry of medicinal compounds from natural origin: Drugs Affecting the Central Nervous System, Anticancer Drugs, Cardiovascular Drugs Neuromuscular Blocking Drugs, Anti-malarial drugs, Alkaloids, flavonoids, steroids, terpenoids, vitamins, Structural Characterization of natural compounds.

PO7: Advanced knowledge about computer assisted drug design: CADD in drug discovery, Quantitative Structure Activity Relationships, Molecular Modeling and Docking, Pharmacophore Mapping and Virtual Screening, In Silico Drug Design and Virtual Screening Techniques.

PO8: Knowledge about Research Methodology & Biostatistics: review of literature, strategies to eliminate errors/bias, values in medical ethics, CPCSEA guidelines for laboratory animal facility, Declaration of Helsinki.

First Semester

MODERN PHARMACEUTICAL ANALYTICAL TECHENIQUES (MPC 101T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPC101T	3	1	-	4 hours	25	75	100	4

Scope

This subject deals with various advanced analyticalinstrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives

After completion of course student is able to know, Chemicals and Excipients

- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

Theory (60 hrs)

1.	a. 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. b. 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. c. Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence (Characteristics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. d. 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: a) Thin Layer chromatography b) High Performance Thin Layer Chromatography c) Ion exchange chromatography	10 Hrs

	d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Ultra High-Performance Liquid chromatography h) Affinity chromatography i) Gel Chromatography	
5	a. 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 b. 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	a.Potentiometry: Principle, working, Ion selective Electrodes and Application of potentiometry. b. 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, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5 th 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, CBS Publishers, 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, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol 11, Marcel. Dekker Series
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.

Course Outcomes

After completion of course student is able to know-

CO1. The identification, characterisation, and quantification of drugs using a variety of sophisticated analytical instrumental techniques including instruments such as mass spectrometers, IR, HPLC, GC, etc are the topics covered in this course.

CO2. The analysis of different drugs in both single and multiple dose versions
CO3. Theoretical and practical instrument knowledge.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3							
CO2	3							
CO3	3							

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

ADVANCED ORGANIC CHEMISTRY – I (MPC 102T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPC102T	3	1	-	4 hours	25	75	100	4

Scope
The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

Objectives
Upon completion of course, the student shall be to understand

- The principles and applications of retrosynthesis
- The mechanism & applications of various named reactions
- The concept of disconnection to develop synthetic routes for small target molecule.
- The various catalysts used in organic reactions.
- The chemistry of heterocyclic compounds

Theory (60 hrs)

1 Basic Aspects of Organic Chemistry: 12 Hrs

1. Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications.
2. Types of reaction mechanisms and methods of determining them,
3. Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations.

Addition reactions

a) Nucleophilicuni- and bimolecular reactions (SN1 and SN2)
b) Elimination reactions (E1 & E2; Hoffman &Saytzeff's rule)
c) Rearrangement reaction

2 Study of mechanism and synthetic applications of following named Reactions: 12 Hrs

Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner-Miller Reaction, Sandmeyer Reaction, Mitsunobu reaction, Mannich reaction, Vilsmeyer-Haack Reaction, Sharpless asymmetric epoxidation, Baeyer-Villiger oxidation, Shapiro & Suzuki reaction, Ozonolysis and Michael addition reaction

3 Synthetic Reagents & Applications: 12 Hrs

Aluminiumisopropoxide, N-bromosuccinamide, diazomethane, dicyclohexylcarbodimide, Wilkinson reagent, Witting reagent. Osmium tetroxide, titanium chloride, diazopropane, diethyl azodicarboxylate, Triphenylphosphine, Benzotriazol-1-yloxy) tris (dimethylamino) phosphoniumhexafluoro-phosphate (BOP).

Protecting groups

a. Role of protection in organic synthesis
b. Protection for the hydroxyl group, including 1,2-and1,3-diols: ethers, esters, carbonates, cyclic acetals & ketals
c. Protection for the Carbonyl Group: Acetals and Ketals
d. Protection for the Carboxyl Group: amides and hydrazides, esters
e. Protection for the Amino Group and Amino acids: carbamates and amides

4 Heterocyclic Chemistry: 12 Hrs

Organic Name reactions with their respective mechanism and application involved in synthesis of drugs containing five, six membered and fused hetrocyclics such as Debus-Radziszewski imidazole synthesis, Knorr Pyrazole Synthesis Pinner Pyrimidine Synthesis, CombesQuinoline Synthesis, Bernthsen Acridine Synthesis, Smiles rearrangement and Traube purine synthesis.

Synthesis of few representative drugs containing these hetrocyclic nucleus such as Ketoconazole, Metronidazole, Miconazole, celecoxib, antipyrin, Metamizole sodium, Terconazole, Alprazolam, Triamterene, Sulfamerazine, Trimethoprim, Hydroxychloroquine, Quinine, Chloroquine, Quinacrine, Amsacrine, Prochlorpherazine, Promazine, Chlorpromazine,Theophylline , Mercaptopurine and Thioguanine.

5 Synthon approach and retrosynthesis applications 12 Hrs

I. Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group interconvertion and addition (FGI and FGA)
I. C-X disconnections; C-C disconnections – alcohols and carbonyl compounds; 1,2-, 1,3-,1,4-, 1,5-, 1,6-difunctionalized compounds
I. Strategies for synthesis of three, four, five and six-membered ring.

REFERENCES

1. “Advanced Organic chemistry, Reaction, Mechanisms and Structure”, J March, John Wiley and Sons, New York.
2. “Mechanism and Structure in Organic Chemistry”, ES Gould, Hold Rinchart and Winston, New York.
3. “Organic Chemistry” Clayden, Greeves, Warren and Woihers., Oxford University Press 2001.
4. “Organic Chemistry” Vol I and II. I.L. Finar. ELBS, Pearson Education Lts, Dorling Kindersley 9India) Pvt. Ltd.,.

5. A guide to mechanisms in Organic Chemistry, Peter Skyes (Orient Longman, New Delhi).
6. Reactive Intermediates in Organic Chemistry, Tandom and Gowel, Oxford & IBH Publishers.
7. Combinational Chemistry – Synthesis and applications – Stephen R Wilson & Anthony W Czarnik, Wiley – Blackwell.
8. Carey, Organic Chemistry, 5 th Edition (Viva Books Pvt. Ltd.)
9. Organic Synthesis - The Disconnection Approach, S. Warren, Wily India
10. Principles of Organic Synthesis, ROC Norman and JM Coxan, Nelson Thorns.
11. Organic Synthesis - Special Techniques. VK Ahluwalia and R Agarwal, Narosa Publishers.
12. Organic Reaction Mechanisms IV thEdtn, VK Ahluwalia and RK Parashar, Narosa Publishers

Course outcomes

After completion of course student is able to know-

CO1. The goal of the study is to give students in-depth knowledge of recent developments in organic chemistry, various methods of organic synthesis, and how these methods can be used to process chemistry and drug discovery.

CO2. Study the fundamentals and uses of retrosynthesis. Study various named reactions mechanisms and applications. Knowledge of different catalysts that are employed in organic processes and understanding chemistry of heterocyclic compounds.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		3	2	1	1			
CO2		3	2	1	1			

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

ADVANCED MEDICINAL CHEMISTRY (MPC 103T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPC103T	3	1	-	4 hours	25	75	100	4

Scope

The subject is designed to impart knowledge about recent advances in the field of medicinal chemistry at the molecular level including different techniques for the rational drug design.

Objectives

At completion of this course it is expected that students will be able to understand

- Different stages of drug discovery
- Role of medicinal chemistry in drug research
- Different techniques for drug discovery
- Various strategies to design and develop new drug like molecules for biological targets

- Peptidomimetics

Theory (60 hrs)

1.	Drug discovery: Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets. Biological drug targets: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonists vs antagonists, artificial enzymes.	12 Hrs
2	Prodrug Design and Analog design: a) Prodrug design: Basic concept, Carrier linked prodrugs/ Bioprecursors, Prodrugs of functional group, 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. b) Combating drug resistance: Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance. c) Analog Design: Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance.	12 Hrs
3	a) Medicinal chemistry aspects of the following class of drugs Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of following class of drugs: a) Anti-hypertensive drugs, Psychoactive drugs, Anticonvulsant drugs, H1 & H2 receptor antagonist, COX1 & COX2 inhibitors, Adrenergic & Cholinergic agents, Antineoplastic and Antiviral agents. b) Stereochemistry and Drug action: Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination.	12 Hrs
4	Rational Design of Enzyme Inhibitors Enzyme kinetics & Principles of Enzyme inhibitors, Enzyme inhibitors in medicine, Enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors.	12 Hrs
5	Peptidomimetics Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally. Chemistry of prostaglandins, leukotrienes and thromboxones.	12 Hrs

REFERENCES

1. Medicinal Chemistry by Burger, Vol I –VI.
2. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, 12 th Edition, Lppincott Williams & Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi.
3. Comprehensive Medicinal Chemistry – Corwin and Hansch.
4. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore 80
5. Introduction to Quantitative Drug Design by Y.C. Martin.
6. Principles of Medicinal Chemistry by William Foye, 7th Edition, Ippincott Williams & Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi.
7. Drug Design Volumes by Arienes, Academic Press, Elsevier Publishers, Noida, Uttar Pradesh.
8. Principles of Drug Design by Smith.
9. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, II Edition, Elsevier Publishers, New Delhi.
10. An Introduction to Medicinal Chemistry, Graham L.Patrick, III Edition, Oxford University Press, USA.
11. Biopharmaceutics and pharmacokinetics, DM.Brahmankar, Sunil B. Jaiswal II Edition, 2014, VallabhPrakashan, New Delhi.
12. Peptidomimetics in Organic and Medicinal Chemistry by Antonio Guarna and Andrea Trabocchi, First edition, Wiley publishers.

Course outcomes

After completion of course student is able to know-

CO1. The course is intended to teach students about recent developments in medicinal chemistry at the molecular level, including various methods for rational drug design.

CO2. Study different phases of drug discovery, medicinal chemistry's role in drug research, different methods for design and developing novel drug-like compounds for biological targets.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		3	2	1	1			
CO2		3	2	1	1			

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

CHEMISTRY OF NATURAL PRODUCTS (MPC 104T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPC104T	3	1	-	4 hours	25	75	100	4

Scope

The subject is designed to provide detail knowledge about chemistry of medicinal compounds from natural origin and general methods of structural elucidation of such compounds. It also emphasizes on isolation, purification and characterization of medicinal compounds from natural origin.

Objectives

At completion of this course it is expected that students will be able to understand-

- Different types of natural compounds and their chemistry and medicinal importance
- The importance of natural compounds as lead molecules for new drug discovery
- The concept of rDNA technology tool for new drug discovery
- General methods of structural elucidation of compounds of natural origin
- Isolation, purification and characterization of simple chemical constituents from natural source

Theory (60 hrs)

1.	Study of Natural products as leads for new pharmaceuticals for the following class of drugs a) Drugs Affecting the Central Nervous System: Morphine Alkaloids b) Anticancer Drugs: Paclitaxel and Docetaxel, Etoposide, and Teniposide c) Cardiovascular Drugs: Lovastatin, Teprotide and Dicoumarol d) Neuromuscular Blocking Drugs: Curare alkaloids e) Anti-malarial drugs and Analogues f) Chemistry of macrolid antibiotics (Erythromycin, Azithromycin, Roxithromycin, and Clarithromycin) and β - Lactam antibiotics (Cephalosporins and Carbapenem)	12 hrs
2	a) Alkaloids General introduction, classification, isolation, purification, molecular modification and biological activity of alkaloids, general methods of structural determination of alkaloids, structural elucidation and stereochemistry of ephedrine, morphine, ergot, emetine and reserpine. b) Flavonoids Introduction, isolation and purification of flavonoids, General methods of structural determination of flavonoids; Structural elucidation of quercetin. c) Steroids General introduction, chemistry of sterols, sapogenin and cardiac glycosides. Stereochemistry and nomenclature of steroids, chemistry of contraceptive agents male & female sex hormones (Testosterone, Estradiol, Progesterone), adrenocorticoids (Cortisone), contraceptive agents and steroids (Vit – D).	12 hrs
3	a) Terpenoids Classification, isolation, isoprene rule and general methods of structural elucidation of Terpenoids; Structural elucidation of drugs belonging to mono (citral, menthol, camphor), di(retinol, Phytol, taxol) and tri terpenoids (Squalene,Ginsenoside) carotinoids (β carotene). b) Vitamins Chemistry and Physiological significance of Vitamin A, B1, B2, B12, C, E, Folic acid and Niacin.	12 hrs
4	a) Recombinant DNA technology and drug discovery rDNA technology, hybridoma technology, New pharmaceuticals	12 hrs

	derived from biotechnology; Oligonucleotide therapy. Gene therapy: Introduction, Clinical application and recent advances in gene therapy, principles of RNA & DNA estimation b) Active constituent of certain crude drugs used in Indigenous system Diabetic therapy – Gymnemasylvestre, Salacia reticulate, Pterocarpusmarsupiam, Swertiachirata, Trigonellafoenumgraccum; Liver dysfunction – Phyllanthusniruri; Antitumor – Curcuma longa Linn.	
5	Structural Characterization of natural compounds Structural characterization of natural compounds using IR, 1HNMR, 13CNMR and MS Spectroscopy of specific drugs e.g., Penicillin, Morphine, Camphor, Vit-D, Quercetin and Digitalis glycosides.	12 hrs

REFERENCES

1. Modern Methods of Plant Analysis, Peech and M.V.Tracey, Springer – Verlag, Berlin, Heidelberg.
2. Phytochemistry Vol. I and II by Miller, Jan Nostrant Rein Hld.
3. Recent advances in Phytochemistry Vol. I to IV – ScikelRuneckles, Springer Science & Business Media.
4. Chemistry of natural products Vol I onwards IWPAC.
5. Natural Product Chemistry Nakanishi Gggolo, University Science Books, California.
6. Natural Product Chemistry "A laboratory guide" – Rapheal Khan.
7. The Alkaloid Chemistry and Physiology by RHF Manske, Academic Press.
8. Introduction to molecular Phytochemistry – CHJ Wells, Chapmannstall.
9. Organic Chemistry of Natural Products Vol I and II by Gurdeep and Chatwall, Himalaya Publishing House.
10. Organic Chemistry of Natural Products Vol I and II by O.P. Agarwal, KrishanPrakashan.
11. Organic Chemistry Vol I and II by I.L. Finar, Pearson education.
12. Elements of Biotechnology by P.K. Gupta, Rastogi Publishers.
13. Pharmaceutical Biotechnology by S.P.Vyas and V.K.Dixit, CBS Publishers.
14. Biotechnology by Purohit and Mathur, Agro-Bios, 13 th edition.
15. Phytochemical methods of Harborne, Springer, Netherlands.
16. Burger's Medicinal Chemistry.

Course outcomes

After completion of course student is able to know-

CO1. In-depth knowledge of Different types of natural compounds and their chemistry and medicinal importance.

CO2. To learn about the importance of natural compounds as lead molecules for new drug discovery.

CO3. The idea of using rDNA technology as a tool for finding novel drugs.

CO4. General methods of structural elucidation of compounds of natural origin.

CO5. Isolation, purification and characterization of simple chemical constituents from natural source

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		1		2		3		
CO2						3	2	
CO3						3		
CO4	2					3		
CO5						3		

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

PHARMACEUTICAL CHEMISTRY PRACTICAL – I (MPC 105P)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPC105P	-	-	12	12 Hrs.	50	100	150	6

1. Analysis of Pharmacopeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on Column chromatography
4. Experiments based on HPLC
5. Experiments based on Gas Chromatography
6. Estimation of riboflavin/quinine sulphate by fluorimetry
7. Estimation of sodium/potassium by flame photometry

To perform the following reactions of synthetic importance

1. Purification of organic solvents, column chromatography
2. Claisen-schimidt reaction.
3. Benzyllic acid rearrangement.
4. Beckmann rearrangement.
5. Hoffmann rearrangement
6. Mannich reaction
7. Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4 experiments)
8. Estimation of elements and functional groups in organic natural compounds
9. Isolation, characterization like melting point, mixed melting point, molecular weight determination, functional group analysis, co-chromatographic technique for identification of isolated compounds and interpretation of UV and IR data.
10. Some typical degradation reactions to be carried on selected plant constituents

Course outcomes

After completion of course student is able to know-

CO1. Analysis of Pharmacopeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation.

CO2. Experiments based on Column chromatography, HPLC, Gas chromatography.

CO3. To perform reactions of synthetic importance

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3							
CO2	3							
CO3		3						

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Second Semester

ADVANCED SPECTRAL ANALYSIS (MPC 201T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPC201T	3	1	-	4 hours	25	75	100	4

Scope

This subject deals with various hyphenated analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are LC-MS, GC-MS, ATR-IR, DSC etc.

Objectives

At completion of this course it is expected that students will be able to understand-

- Interpretation of the NMR, Mass and IR spectra of various organic compounds
- Theoretical and practical skills of the hyphenated instruments
- Identification of organic compounds

Theory (60 hrs)

1.	UV and IR spectroscopy: Wood ward – Fieser rule for 1,3- butadienes, cyclic dienes and α, β-carbonyl compounds and interpretation compounds of enones. ATR-IR, IR Interpretation of organic compounds.	12 Hrs
2	NMR spectroscopy: 1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds.	12 Hrs
3	Mass Spectroscopy Mass fragmentation and its rules, Fragmentation of important functional groups like alcohols, amines, carbonyl groups and alkanes, Meta stable ions, Mc Lafferty rearrangement, Ring rule, Isotopic peaks, Interpretation of organic compounds.	12 Hrs
4	Chromatography: Principle, Instrumentation and Applications of the following: a) GC-MS b) GC-AAS c) LC-MS d) LC-FTIR e) LC-NMR f) CE-MS g) High Performance Thin Layer chromatography h) Super critical fluid chromatography i) Ion Chromatography j) I-EC (Ion-Exclusion Chromatography) k) Flash chromatograph	12 Hrs

5	1. Thermalmethods of analysis Introduction, principle, instrumentation and application of DSC, DTA and TGA. 2. Raman Spectroscopy Introduction, Principle, Instrumentation and Applications. 3. Radio immuno assay Biological standardization , bioassay, ELISA, Radioimmuno assay of digitalis and insulin.	12 Hrs

RFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5 th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7 th edition, CBS publishers.
4. Organic Spectroscopy - William Kemp, 3 rd edition, ELBS, 1991.
5. Quantitative analysis of pharmaceutical formulations by HPTLC - P D Sethi, CBS Publishers, New Delhi.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3 rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker

Course outcomes

After completion of course student is able to know-

CO1. Interpretation of the NMR, Mass and IR spectra of various organic compounds.

CO2. Theoretical and practical skills of the hyphenated instruments.

CO3. Identification of organic compounds.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1		1				
CO2	3			1				
CO3	3	1		1				

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

ADVANCED ORGANIC CHEMISTRY – II (MPC 202T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPC202T	3	1	-	4 hours	25	75	100	4

Scope

The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

Objectives

Upon completion of course, the student shall able to understand

- The principles and applications of Green chemistry
- The concept of peptide chemistry.
- The various catalysts used in organic reactions
- The concept of stereochemistry and asymmetric synthesis.

Theory (60 hrs)

1. Green Chemistry: 12 Hrs
   a. Introduction, principles of green chemistry
   b. Microwave assisted reactions: Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles synthesis
   c. Ultrasound assisted reactions: Types of sonochemical reactions, homogenous, heterogeneous liquid-liquid and liquid-solid reactions, synthetic applications
   d. Continuous flow reactors: Working principle, advantages and synthetic applications

2 Chemistry of peptides 12 Hrs
   a. Coupling reactions in peptide synthesis
   b. Principles of solid phase peptide synthesis, t-BOC and FMOC protocols, various solid supports and linkers: Activation procedures, peptide bond formation, deprotection and cleavage from resin, low and high HF cleavage protocols, formation of free peptides and peptide amides, purification and case studies, site-specific chemical modifications of peptides
   c. Segment and sequential strategies for solution phase peptide synthesis with any two case studies
   d. Side reactions in peptide synthesis: Deletion peptides, side reactions initiated by proton abstraction, protonation, over- activation and side reactions of individual amino acids.

3 Photochemical Reactions 12 Hrs

Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation.

Pericyclic reactions

Mechanism, Types of pericyclic reactions such as cyclo addition, electrocyclic reaction and sigmatrophic rearrangement reactions with examples.

4 Catalysis: 12 Hrs
   a. Types of catalysis, heterogeneous and homogenous catalysis, advantages and disadvantages
   b. Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts, catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs.
   c. Homogenous catalysis, hydrogenation, hydroformylation, hydrocyanation, Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts, some examples of homogenous catalysis used in synthesis of drugs

d. Transition-metal and Organo-catalysis in organic synthesis: Metal-catalyzed reactions
e. Biocatalysis: Use of enzymes in organic synthesis, immobilized enzymes/cells in organic reaction.
f. Phase transfer catalysis - theory and applications

5 Stereochemistry & Asymmetric Synthesis 12 Hrs

a. Basic concepts in stereochemistry – optical activity, specific rotation, racemates and resolution of racemates, the Cahn, Ingold, Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centres, axes of symmetry, Fischers D and L notation, cis-trans isomerism, E and Z notation.
b. Methods of asymmetric synthesis using chiral pool, chiral auxiliaries and catalytic asymmetric synthesis, enantiopure separation and Stereo selective synthesis with examples.

REFERENCES

1. "Advanced Organic chemistry, Reaction, mechanisms and structure", J March, John Wiley and sons, New York.
2. "Mechanism and structure in organic chemistry", ES Gould, Hold Rinchart and Winston,NewYork.
3. "Organic Chemistry" Clayden, Greeves, Warren and Woihers., Oxford University Press 2001.
4. "Organic Chemistry" Vol I and II. I.L. Finar. ELBS, Sixth ed., 1995.
5. Carey, Organic chemistry, 5th edition (Viva Books Pvt. Ltd.)
6. Organic synthesis-the disconnection approach, S. Warren, Wily India
7. Principles of organic synthesis, ROCNorman and JMCoxan, Nelson thorns
8. Organic synthesis- Special techniques VK Ahluwalia and R Aggarwal, Narosa Publishers.
9. Organic reaction mechanisms IV edtn, VK Ahluwalia and RK Parashar, Narosa Publishers.

Course outcomes

After completion of course student is able to know-

CO1. The principles and applications of Green chemistry
CO2. The concept of peptide chemistry.
CO3. The various catalysts used in organic reactions.
CO4. The concept of stereochemistry and asymmetric synthesis.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		3						
CO2		3						
CO3		3	2		1			
CO4		3	1					

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

COMPUTER AIDED DRUG DESIGN (MPC 203T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPC203T	3	1	-	4 hours	25	75	100	4

Scope

The subject is designed to impart knowledge on the current state of the art techniques involved in computer assisted drug design.

Objectives

At completion of this course it is expected that students will be able to understand

- Role of CADD in drug discovery
- Different CADD techniques and their applications
- Various strategies to design and develop new drug like molecules.
- Working with molecular modelingsoftwares to design new drug molecules
- The in silico virtual screening protocols

Theory (60 hrs)

1. Introduction to Computer Aided Drug Design (CADD) — 12 Hrs

History, different techniques and applications.

Quantitative Structure Activity Relationships: Basics

History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pi-substituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters.

2 Quantitative Structure Activity Relationships: Applications — 12 Hrs

Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations.

3D-QSAR approaches and contour map analysis.

Statistical methods used in QSAR analysis and importance of statistical parameters.

3 Molecular Modeling and Docking — 12 Hrs

a) Molecular and Quantum Mechanics in drug design.
b) Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation
c) Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE&BchE)

4 Molecular Properties and Drug Design — 12 Hrs

a) Prediction and analysis of ADMET properties of new molecules and its importance in drug design.
b) De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design.
c) Homology modeling and generation of 3D-structure of protein.

5 Pharmacophore Mapping and Virtual Screening — 12

Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophoremodeling; Conformational search used in pharmacophore mapping. Hrs

In Silico Drug Design and Virtual Screening Techniques
Similarity based methods and Pharmacophore base screening, structure based In-silico virtual screening protocols.

REFERENCES

1. Computational and structural approaches to drug discovery, Robert M Stroud and Janet. F Moore, RCS Publishers.
2. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor & Francis group..
3. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975, Elsevier Publishers.
4. Principles of Drug Design by Smith and Williams, CRC Press, Taylor & Francis.
5. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, Elsevier Publishers.
6. Medicinal Chemistry by Burger, Wiley Publishing Co.
7. An Introduction to Medicinal Chemistry –Graham L. Patrick, Oxford University Press.
8. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Iippincott Williams & Wilkins.
9. Comprehensive Medicinal Chemistry – Corwin and Hansch, Pergamon Publishers.
10. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore.

Course outcomes

After completion of course student is able to know-

CO1. Role of CADD in drug discovery.
CO2. Different CADD techniques and their applications.
CO3. Various strategies to design and develop new drug like molecules.
CO4. Working with molecular modeling softwares to design new drug molecules.
CO5. The in silico virtual screening protocols.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1				1			3	
CO2				2			3	
CO3				2			3	
CO4				1			3	
CO5				1			3	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

PHARMACEUTICAL PROCESS CHEMISTRY (MPC 204T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits

MPC204T	3	1	-	4 hours	25	75	100	4

Scope

Process chemistry is often described as scale up reactions, taking them from small quantities created in the research lab to the larger quantities that are needed for further testing and then to even larger quantities required for commercial production. The goal of a process chemist is to develop synthetic routes that are safe, cost-effective, environmentally friendly, and efficient. The subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure for the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.

Objectives

At completion of this course it is expected that students will be able to understand

- The strategies of scale up process of API's and intermediates.
- The various unit operations and various reactions in process chemistry.

Theory (60 hrs)

1. Process chemistry — 12 Hrs
   Introduction, Synthetic strategy
   Stages of scale up process: Bench, pilot and large scale process.
   In-process control and validation of large scale process.
   Case studies of some scale up process of APIs.
   Impurities in API, types and their sources including genotoxic impurities

2 Unit operations — 12 Hrs
   a) Extraction: Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction.
   b) Filtration: Theory of filtration, pressure and vacuum filtration, centrifugal filtration,
   c) Distillation: azeotropic and steam distillation
   d) Evaporation: Types of evaporators, factors affecting evaporation.
   e) Crystallization: Crystallization from aqueous, non-aqueous solutions factors affecting crystallization, nucleation. Principle and general methods of Preparation of polymorphs, hydrates, solvates and amorphous APIs.

3 Unit Processes - I — 12 Hrs
   a) Nitration: Nitrating agents, Aromatic nitration, kinetics and mechanism of aromatic nitration, process equipment for technical nitration, mixed acid for nitration,
   b) Halogenation: Kinetics of halogenations, types of halogenations, catalytic halogenations. Case study on industrial halogenation process.
   c) Oxidation: Introduction, types of oxidative reactions, Liquid phase oxidation with oxidizing agents. Nonmetallic Oxidizing agents such as H_2O_2, sodium hypochlorite, Oxygen gas, ozonolysis.

4 Unit Processes - II — 12 Hrs
   a) Reduction: Catalytic hydrogenation, Heterogeneous

and homogeneous catalyst; Hydrogen transfer reactions, Metal hydrides. Case study on industrial reduction process.

b) Fermentation: Aerobic and anaerobic fermentation. Production of
   i. Antibiotics; Penicillin and Streptomycin,
   ii. Vitamins: B2 and B12
   iii. Statins: Lovastatin, Simvastatin

c) Reaction progress kinetic analysis
   i. Streamlining reaction steps, route selection,
   ii. Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up.

5 Industrial Safety 12 Hrs

a) MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal Protection Equipment (PPE)

b) Fire hazards, types of fire & fire extinguishers

c) Occupational Health & Safety Assessment Series 1800 (OHSAS-1800) and ISO-14001(Environmental Management System), Effluents and its management

REFERENCES

1. Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever-Changing Climate-An Overview; K. Gadamasetti, CRC Press.
2. Pharmaceutical Manufacturing Encyclopedia, 3 rd edition, Volume 2.
3. Medicinal Chemistry by Burger, 6 th edition, Volume 1-8.
4. W.L. McCabe, J.C Smith, Peter Harriott. Unit operations of chemical engineering, 7th edition, McGraw Hill
5. Polymorphism in Pharmaceutical Solids .Dekker Series Volume 95 Ed: H G Brittain (1999)
6. Regina M. Murphy: Introduction to Chemical Processes: Principles, Analysis, Synthesis
7. Peter J. Harrington: Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up
8. P.H.Groggins: Unit processes in organic synthesis (MGH)
9. F.A.Henglein: Chemical Technology (Pergamon)
10. M.Gopal: Dryden's Outlines of Chemical Technology, WEP East-West Press
11. Clausen,Mattson: Principle of Industrial Chemistry, Wiley Publishing Co.,
12. Lowenheim& M.K. Moran: Industrial Chemicals
13. S.D. Shukla & G.N. Pandey: A text book of Chemical Technology Vol. II, Vikas Publishing House
14. J.K. Stille: Industrial Organic Chemistry (PH)
15. Shreve: Chemical Process, McGrawhill.
16. B.K.Sharma: Industrial Chemistry, Goel Publishing House
17. ICH Guidelines
18. United States Food and Drug Administration official website www.fda.gov

Course outcomes

After completion of course student is able to know-

CO1. To study the techniques for scaling up the production of intermediates and APIs.
CO2. Process chemistry's various unit operations and reactions.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		1	1		3	1		
CO2		1	1		3			

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

PHARMACEUTICAL CHEMISTRY PRACTICALS – II (MPC 205P)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPC205P	-	-	12	12 hours	50	100	150	6

1. Synthesis of organic compounds by adapting different approaches involving (3 experiments)
   a) Oxidation
   b) Reduction/hydrogenation
   c) Nitration
2. Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments)
3. Assignments on regulatory requirements in API (2 experiments)
4. Comparison of absorption spectra by UV and Wood ward – Fieser rule
5. Interpretation of organic compounds by FT-IR
6. Interpretation of organic compounds by NMR
7. Interpretation of organic compounds by MS
8. Determination of purity by DSC in pharmaceuticals
9. Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra
10. To carry out the preparation of following organic compounds
11. Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl).
12. Preparation of 4-iodotolene from p-toluidine.
13. $NaBH_4$ reduction of vanillin to vanillyl alcohol
14. Preparation of umbelliferone by Pechhman reaction
15. Preparation of triphenyl imidazole
16. To perform the Microwave irradiated reactions of synthetic importance (Any two)
17. Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using softwares
18. Calculation of ADMET properties of drug molecules and its analysis using softwares
    Pharmacophoremodeling
19. 2D-QSAR based experiments
20. 3D-QSAR based experiments
21. Docking study based experiment

22. Virtual screening based experimentSynthesis of organiccompounds by adapting different approaches involving (3 experiments)
    a) Oxidation
    b) Reduction/hydrogenation
    c) Nitration
23. Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments)
24. Assignments on regulatory requirements in API (2 experiments)
25. Comparison of absorption spectra by UV and Wood ward – Fieser rule
26. Interpretation of organic compounds by FT-IR
27. Interpretation of organic compounds by NMR
28. Interpretation of organic compounds by MS
29. Determination of purity by DSC in pharmaceuticals
30. Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra
31. To carry out the preparation of following organic compounds
32. Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl).
33. Preparation of 4-iodotolene from p-toluidine.
34. $NaBH_4$ reduction of vanillin to vanillyl alcohol
35. Preparation of umbelliferone by Pechhman reaction
36. Preparation of triphenyl imidazole
37. To perform the Microwave irradiated reactions of synthetic importance (Any two)
38. Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using softwares
39. Calculation of ADMET properties of drug molecules and its analysis using softwares
    Pharmacophoremodeling
40. 2D-QSAR based experiments
41. 3D-QSAR based experiments
42. Docking study based experiment

Virtual screening based experiment

Course outcomes

After completion of course student is able to know-

CO1. Synthesis of organic compounds by adopting nitration, oxidation, reduction.

CO2. Interpretation of organic compounds by FT-IR, NMR, MS.

CO3. To perform 2D-QSAR based experiments,3D-QSAR based experiments,dockingstudy-based experiment,Virtual screening-based experiment.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		3						
CO2	3							
CO3							3	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Third Semester

RESEARCH METHODOLOGY & BIOSTATISTICS (MRM 301T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPM301T	3	1	-	4 hours	25	75	100	4

UNIT – I

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.

UNIT – II

Biostatistics: Definition, application, sample size, importance of sample size,factors influencing sample size, dropouts, statistical tests of significance, typeof significance tests, parametric tests(students "t" test, ANOVA, Correlationcoefficient, regression), non-parametric tests (wilcoxan rank tests, analysis ofvariance, correlation, chi square test), null hypothesis, P values, degree offreedom, interpretation of P values.

UNIT – III

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy andbeneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, controlresolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personalhygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medicalresearch, and additional principles for medical research combined withmedical care.

Course outcomes

After completion of course student is able to know-

CO1. General research methodology, review of literature, biostatistics.

CO2. They will know about values of medical ethics.

CO3. CPCSEA guidelines for laboratory animal facility

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1							3
CO2	1							3
CO3	1							3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

DEPARTMENT OF PHARMACY
GURU GHASIDAS VISHWAVIDYALAYA (A CENTRAL UNIVERSITY), BILASPUR (C.G.)

M. Pharm. (Pharmacology)

Course of study for M. Pharm. (Pharmacology)

Course Code	Course	Credit Hours	Credit Points	Hrs./w k	Marks
Semester I					
MPL 101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPL 102T	Advanced Pharmacology-I	4	4	4	100
MPL 103T	Pharmacological and Toxicological Screening Methods-I	4	4	4	100
MPL 104T	Cellular and Molecular Pharmacology	4	4	4	100
MPL 105P	Pharmacology Practical I	12	6	12	150
MPL 106P	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650
Semester II					
MPL 201T	Advanced Pharmacology II	4	4	4	100
MPL 202T	Pharmacological and Toxicological Screening Methods-II	4	4	4	100
MPL 203T	Principles of Drug Discovery	4	4	4	100
MPL 204T	Clinical Research and Pharmacovigilance	4	4	4	100
MPL 205P	Pharmacology Practical II	12	6	12	150
MPL 206P	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650

Schemes for internal assessments and end semester examinations (Pharmacology-MPL)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
Semester I								
MPL 101T	Modern Pharmaceutical Analytical Techniques	10	15	1 Hr	25	75	3 Hrs	100
MPL 102T	Advanced Pharmacology-I	10	15	1 Hr	25	75	3 Hrs	100
MPL 103T	Pharmacological and Toxicological Screening Methods-I	10	15	1 Hr	25	75	3 Hrs	100
MPL 104T	Cellular and Molecular Pharmacology	10	15	1 Hr	25	75	3 Hrs	100
MPL 105P	Pharmacology Practical I	20	30	6 Hrs	50	100	6 Hrs	150
MPL 106P	Seminar/Assignment	-	-	-	-	-	-	100
							Total	650
Semester II								
MPL 201T	Advanced Pharmacology II	10	15	1 Hr	25	75	3 Hrs	100
MPL 202T	Pharmacological and Toxicological Screening Methods-II	10	15	1 Hr	25	75	3 Hrs	100
MPL 203T	Principles of Drug Discovery	10	15	1 Hr	25	75	3 Hrs	100
MPL 204T	Clinical Research and Pharmacovigilance	10	15	1 Hr	25	75	3 Hrs	100
MPL 205P	Pharmacology Practical II	20	30	6 Hrs	50	100	6 Hrs	150
MPL 206P	Seminar/Assignment	-	-	-	-	-	-	100
							Total	650

Course of study for M. Pharm. III Semester (Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
MRM 302P	Journal club	1	1
MRM 303P	Discussion / Presentation (Proposal Presentation)	2	2
MRM 304P	Research Work	28	14
	Total	35	21

**Non University Examination*

Course of study for M. Pharm. IV Semester (Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
MRM 401P	Journal club	1	1
MRM 402P	Discussion / Final Presentation	3	3
MRM 403P	Research Work	31	16
	Total	35	20

Semester wise credits distribution

Semester	Credit Points
I	26
II	26
III	21
IV	20
Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)	Minimum=02 Maximum=07*
Total Credit Points	Minimum=95 Maximum=100*

**Credit Points for Co-curricular Activities*

Schemes for internal assessments and end semester examinations (Semester III & IV)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
Semester III								
MRM301T	Research Methodology and Biostatistics*	10	15	1 Hr	25	75	3 Hrs	100
MRM 302P	Journal club	-	-	-	25	-	-	25
MRM 303P	Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
MRM 304P	Research work*	-	-	-	-	350	1 hr	350
							Total	525
Semester IV								
MRM401P	Journal club	-	-	-	25	-	-	25
MRM402P	Discussion / Presentation (Proposal Presentation)	-	-	-	75	-	-	75
MRM403P	Research work and Colloquium	-	-	-	-	400	1 hr	400
							Total	500

*Non University Examination

M. Pharm. (Pharmacology)

Programme Outcomes

Postgraduate's students will be able to

PO1: Fundamentals on advanced analytical instrumental techniques: UV-Visible, IR, Spectroflourimetry, Flame emission and Atomic absorption spectroscopy, NMR spectroscopy, Mass Spectroscopy, Chromatography, Electrophoresis and Immunological assays methods.

PO2: Advanced knowledge in field of pharmacology: Pharmacokinetics, Pharmacodynamics, Neurotransmission, Systemic Pharmacology, pathophysiology of diseases, Parasympathomimetics and lytics, sympathomimetics and lytics, Central nervous system, cardiovascular and autocoids Pharmacology.

PO3: knowledge on preclinical evaluation of drugs and recent experimental techniques in the drug discovery: Common laboratory animals, Anaesthesia and euthanasia of experimental animals, Bioassay, Preclinical screening of new substances for the pharmacological activity, Preclinical screening of new substances, immunoassay.

PO4: Fundamental knowledge on the structure and functions of cellular components: Cell biology, cell cycle and its regulation, Cell death, Cell signaling, genomic and proteomic tools , intracellular signaling pathways, Recombinant DNA technology and gene therapy, Pharmacogenomics.

PO5: Knowledge of recent advances in the drugs used for the treatment of various diseases: Endocrine Pharmacology, Chemotherapy, Immunopharmacology, GIT Pharmacology, Chronopharmacology, Free radicals Pharmacology.

PO6: Imparts knowledge on the preclinical safety and toxicological evaluation of drug: OECD, ICH, EPA and Schedule Y, Reproductive toxicology studies, Genotoxicity studies, In vivo carcinogenicity studies, Toxicokinetics.

PO7: Knowledge of drug discovery, clinical research and pharmacovigilance: lead identification and lead Optimization, Economics of drug discovery, Rational Drug Design, Molecular docking, 3D-QSAR approaches like COMFA and COMSIA, Good ClinicalPractice (ICH-GCP) guidelines,Pharmacoepidemiology, pharmacoeconomics.

PO8: Knowledge about Research Methodology & Biostatistics: review of literature, strategies to eliminate errors/bias, values in medical ethics, CPCSEA guidelines for laboratory animal facility, Declaration of Helsinki.

First Semester

MODERN PHARMACEUTICAL ANALYTICAL TECHENIQUES (MPL101T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPL101T	3	1	-	4 hours	25	75	100	4

Scope

This subject deals with various advanced analyticalinstrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives

After completion of course student is able to know,

- Chemicals and Excipients
- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

Theory (60 Hrs)

1.	e. UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy. Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy. f. 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. g. Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. h. Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation Interference and Applications. i.	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	10 Hrs

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

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 diffraction 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.	10Hrs

REFERENCES

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

Course Outcomes

After completion of course student is able to know

CO1. The identification, characterization, and quantification of drugs using a variety of sophisticated analytical instrumental techniques including instruments such as mass spectrometers, IR, HPLC, GC, etc.

CO2. The analysis of various drugs in single and combination dosage forms.

CO3. Theoretical and practical skills of the instruments.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	1	1	1	1	1	1
CO2	3	1	2	1	1	1	1	1
CO3	3	1	1	1	1	1	1	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

ADVANCED PHARMACOLOGY - I (MPL 102T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPL 102T	4	-	-	4 hours	25	75	100	4

Scope

The subject is designed to strengthen the basic knowledge in the field of pharmacology and to impart recent advances in the drugs used for the treatment of various diseases. In addition, this subject helps the students to understand the concepts of drug action and mechanisms involved

Objectives

Upon completion of the course, student shall be able to :

- Discuss the pathophysiology and pharmacotherapy of certain diseases
- Explain the mechanism of drug actions at cellular and molecular level
- Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases

Theory(60 Hrs)

1. General Pharmacology — 12 Hrs
   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
2. Neurotransmission — 12 Hrs
   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 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 neuromuscular junction	
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, antiischemics, anti- arrhythmics, drugs for heart failure and hyperlipidemia. Hematinics, coagulants , anticoagulants, fibrinolytics and anti- platelet drugs	12 Hrs
5	Autocoid Pharmacology The physiological and pathological role of Histamine, Serotonin, Kinins Prostaglandins Opioid autocoids. Pharmacology of antihistamines, 5HT antagonists.	12 Hrs

REFERENCES

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, TashjianJr, EhrinJ,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, 9 th 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 Outcomes

The student will try to learn-

CO1. Cellular and molecular basis of drug action.

CO2. Negative effects, contraindications, and clinical applications of medications used to treat diseases.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	1	3	3	1	2	3	1
CO2	1	2	3	3	2	1	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

PHARMACOLOGICAL AND TOXICOLOGICAL SCREENING METHODS – I (MPL 103T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPL 103T	4	-	-	4 hours	25	75	100	4

Scope

This subject is designed to impart the knowledge on preclinical evaluation of drugs and recent experimental techniques in the drug discovery and development. The subject content helps the student to understand the maintenance of laboratory animals as per the guidelines, basic knowledge of various in-vitro and in-vivo preclinical evaluation processes

Objectives

Upon completion of the course, student shall be able to

- Appraise the regulations and ethical requirement for the usage of experimental animals.
- Describe the various animals used in the drug discovery process and good laboratory practices in maintenance and handling of experimental animals
- Describe the various newer screening methods involved in the drug discovery process
- Appreciate and correlate the preclinical data to humans

Theory (60 Hrs)

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, antiepileptics 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, anti-diarrheal 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.
8. Preclinical evaluation of new drugs by S.K. Guta
9. Handbook of Experimental Pharmacology, SK.Kulkarni
10. Practical Pharmacology and Clinical Pharmacy, SK.Kulkarni, 3rd Edition.
11. David R.Gross. Animal Models in Cardiovascular Research, 2nd Edition, Kluwer Academic Publishers, London, UK.
12. Screening Methods in Pharmacology, Robert A.Turner.
13. Rodents for Pharmacological Experiments, Dr.Tapan Kumar chatterjee.
14. Practical Manual of Experimental and Clinical Pharmacology by Bikash
15. Medhi (Author), Ajay Prakash (Author)

Course Outcomes

The student will try to learn-

CO1. Laws and moral standards governing the use of experimental animals.

CO2. Different types of animals employed in the drug development process and best techniques for maintaining and handling experimental animals in the lab.

CO3. Many modern screening techniques used in the drug discovery process.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	1	3	1	2	3	1	1
CO2	1	2	3	2	3	1	1	3
CO3	1	3	3	3	3	1	3	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

CELLULAR AND MOLECULAR PHARMACOLOGY (MPL 104T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPL 104T	4	-	-	4 hours	25	75	100	4

Scope

The subject imparts a fundamental knowledge on the structure and functions of cellular components and help to understand the interaction of these components with drugs. This information will further help the student to apply the knowledge in drug discovery process.

Objectives

Upon completion of the course, it is expected that the students shall be able to

- Explain the receptor signal transduction processes.
- Explain the molecular pathways affected by drugs.

- Appreciate the applicability of molecular pharmacology and biomarkers in drug discovery process.
- Demonstrate molecular biology techniques as applicable for pharmacology

Theory (60 Hrs)

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, Immunotherapeutics in clinical practice	
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. Biosimilars

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 CherilD.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.Ausuvelet la.

Course Outcomes

The student will try to learn-

CO1. The steps involved in receptor signal transduction.

CO2. Molecular pharmacology and biomarkers used in the drug discovery process.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	3	3	3	2	1	2	1
CO2	2	3	3	3	2	2	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

PHARMACOLOGICAL PRACTICAL - I (MPL 105P)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPL 105P	-	-	12	12 hours	50	100	150	6

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

Course Outcomes

The student will try to learn-

CO1. Analysis of Pharmacopoeial compounds and their formulations by UV-Vis spectrophotometer, RNA & DNA estimation.
CO2. Experiments based on Column chromatography, HPLC, Gas chromatography.
CO3. Handling of laboratory animals.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	1	3	2	2	3	1
CO2	3	2	1	1	1	1	3	1
CO3	1	2	3	2	1	3	1	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Second Semester

ADVANCED PHARMACOLOGY - II (MPL 201T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPL 201T	4	-	-	4 hours	25	75	100	4

Scope

The subject is designed to strengthen the basic knowledge in the field of pharmacology and to impart recent advances in the drugs used for the treatment of various diseases. In addition, the subject helps the student to understand the concepts of drug action and mechanism involved

Objectives

Upon completion of the course the student shall be able to:

- Explain the mechanism of drug actions at cellular and molecular level
- Discuss the Pathophysiology and pharmacotherapy of certain diseases
- Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases

Theory (60 Hrs)

1. Endocrine Pharmacology — 12 Hrs
   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
2. Chemotherapy — 12 Hrs
   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.
3. Chemotherapy — 12 Hrs
   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	
4	GIT Pharmacology Antiulcer drugs, Prokinetics, antiemetics, anti-diarrheals 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	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, 9 th 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, TashjianJr, EhrinJ,Armstrong, April W. Armstrong , Wolter, Kluwer-Lippincott Williams & Publishers

Course Outcomes

The student will try to learn-

CO1. Pathophysiology and pharmacotherapy of certain diseases.

CO2. Adverse effects, contraindications and clinical uses of drugs used in treatment of diseases.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	3	2	3	3	2	2	1
CO2	1	3	2	2	3	3	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

PHARMACOLOGICAL AND TOXICOLOGICAL SCREENINGMETHODS-II (MPL 202T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPL 202T	4	-	-	4 hours	25	75	100	4

Scope

This subject imparts knowledge on the preclinical safety and toxicological evaluation of drug & new chemical entity. This knowledge will make the student competent in regulatory toxicological evaluation.

Objectives

Upon completion of the course, the student shall be able to,

- Explain the various types of toxicity studies.
- Appreciate the importance of ethical and regulatory requirements for toxicity studies.
- Demonstrate the practical skills required to conduct the preclinical toxicity studies.

Theory (60 Hrs)

60 Hrs

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	12 Hrs
3	Reproductive toxicology studies, Male reproductive toxicity	12

	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	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/glp-handbook.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)

Course Outcomes

The student will try to learn-

CO1. Preclinical safety and toxicity assessment of drugs and novel chemical entities.

CO2. Regulatory toxicological evaluations.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	2	3	2	1	3	1	2
CO2	2	2	3	2	1	3	1	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

PRINCIPLES OF DRUG DISCOVERY (MPL 203T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPL 203T	4	-	-	4 hours	25	75	100	4

Scope

The subject imparts basic knowledge of drug discovery process. This information will make the student competent in drug discovery process

Objectives

Upon completion of this course it is expected that students will be able to

- Explain the various stages of drug discovery.
- Appreciate the importance of the role of genomics, proteomics and bioinformatics in drug discovery
- Explain various targets for drug discovery.
- Explain various lead seeking method and lead optimization
- Appreciate the importance of the role of computer aided drug design in drug discovery

Theory (60 Hrs)

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 lead discovery 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	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

Course Outcomes

The student will try to learn-

CO1. The basics of the drug discovery process.

CO2. Competency in the drug discovery process using this information.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	2	1	2	3	2
CO2	3	1	3	1	1	2	3	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

CLINICAL RESEARCH AND PHARMACOVIGILANCE (MPL 204T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPL 204T	4	-	-	4 hours	25	75	100	4

Scope

This subject will provide a value addition and current requirement for the students in clinical research and pharmacovigilance. It will teach the students on conceptualizing, designing, conducting, managing and reporting of clinical trials.

This subject also focuses on global scenario of Pharmacovigilance in different methods that can be used to generate safety data. It will teach the students in developing drug safety data in Pre-clinical, Clinical phases of Drug development and post market surveillance.

Objectives

Upon completion of the course, the students shall be able to,

- Explain the regulatory requirements for conducting clinical trial
- Demonstrate the types of clinical trial designs
- Explain the responsibilities of key players involved in clinical trials
- Execute safety monitoring, reporting and close-out activities
- Explain the principles of Pharmacovigilance
- Detect new adverse drug reactions and their assessment
- Perform the adverse drug reaction reporting systems and communication in Pharmacovigilance

Theory (60 Hrs)

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 Non-proprietary 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. 229
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, March 2005, 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 Outcomes

The student will try to learn-

CO1. Current necessity in the fields of clinical research and pharmacovigilance.

CO2. Conceptualising, designing, carrying out, managing, and reporting clinical studies.

CO3. Pharmacovigilance environment and various safety data generation techniques.

CO4. Developing drug safety data during the pre-clinical, clinical, and post-market surveillance phases of drug development.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	2	3	1	1	2	2	1
CO2	1	2	1	1	1	2	1	1
CO3	2	1	2	1	2	2	3	1
CO4	1	1	3	1	2	3	1	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

PHARMACOLOGICAL PRACTICAL – II (MPL 205P)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPL 205P	-	-	12	12 hours	50	100	150	6

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.
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, Iqbalchoudhary and William Thomsen
5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.
6. Handbook of Essential Pharmacokinetics, Pharmacodynamics and Drug Metabolism for Industrial Scientists.

Course Outcomes

The student will try to learn-

CO1. To determine to the strength of unknown sample by interpolation, bracketing, bioassay, and multiple pointbioassay by using suitable tissue preparation.
CO2. Toxicity studies as per OECD guidelines.
CO3. *In-silico* QSAR studies.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	2	3	1	1	2	1	2
CO2	1	2	2	1	2	3	1	2
CO3	1	2	1	1	1	1	3	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Third Semester

RESEARCH METHODOLOGY & BIOSTATISTICS (MRM 301T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MRM 301T	4	-	-	4 hours	25	75	100	4

UNIT – I
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.

UNIT – II
Biostatistics: Definition, application, sample size, importance of sample size,factors influencing sample size, dropouts, statistical tests of significance, typeof significance tests, parametric tests(students "t" test, ANOVA, Correlationcoefficient, regression), non-parametric tests (wilcoxan rank tests, analysis ofvariance, correlation, chi square test), null hypothesis, P values, degree offreedom, interpretation of P values.

UNIT – III
Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy andbeneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, controlresolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

UNIT – IV
CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personalhygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medicalresearch, and additional principles for medical research combined withmedical care.

Course Outcomes

The student will try to learn-

CO1. General research methodology, review of literature, biostatistics.

CO2. Values of medical ethics.

CO3. CPCSEA guidelines for laboratory animal facility.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	1	3	1	1	3	2	3
CO2	1	1	3	1	1	3	2	3
CO3	1	1	3	1	1	3	1	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

DEPARTMENT OF PHARMACY
GURU GHASIDAS VISHWAVIDYALAYA (A CENTRAL UNIVERSITY), BILASPUR (C.G.)

M. Pharm. (Pharmacognosy)

Course of study for M. Pharm. (Pharmacognosy)

Course Code	Course	Credit Hours	Credit Points	Hrs./w k	Marks
Semester I					
MPG101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPG102T	Advanced Pharmacognosy-I	4	4	4	100
MPG103T	Phytochemistry	4	4	4	100
MPG104T	Industrial Pharmacognostical Technology	4	4	4	100
MPG105P	Pharmacognosy Practical I	12	6	12	150
MPG106P	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650
Semester II					
MPG201T	Medicinal Plant biotechnology	4	4	4	100
MPG102T	Advanced Pharmacognosy-II	4	4	4	100
MPG203T	Indian system of medicine	4	4	4	100
MPG204T	Herbal cosmetics	4	4	4	100
MPG205P	Pharmacognosy Practical II	12	6	12	150
MPG206P	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650

Schemes for internal assessments and end semester examinations
(Pharmacognosy- MPH)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
Semester I								
MPG101T	Modern Pharmaceutical Analytical Techniques	10	15	1 Hr	25	75	3 Hrs	100
MPG102T	Advanced Pharmacognosy-I	10	15	1 Hr	25	75	3 Hrs	100
MPG103T	Phytochemistry	10	15	1 Hr	25	75	3 Hrs	100
MPG104T	Industrial Pharmacognostical Technology	10	15	1 Hr	25	75	3 Hrs	100
MPG105P	Pharmacognosy Practical I	20	30	6 Hrs	50	100	6 Hrs	150
MPG106P	Seminar/Assignment	-	-	-	-	-	-	100
							Total	650
Semester II								
MPG201T	Medicinal Plant biotechnology	10	15	1 Hr	25	75	3 Hrs	100
MPG102T	Advanced Pharmacognosy-II	10	15	1 Hr	25	75	3 Hrs	100
MPG203T	Indian system of medicine	10	15	1 Hr	25	75	3 Hrs	100
MPG204T	Herbal cosmetics	10	15	1 Hr	25	75	3 Hrs	100
MPG205P	Pharmacognosy Practical II	20	30	6 Hrs	50	100	6 Hrs	150
MPG206P	Seminar/Assignment	-	-	-	-	-	-	100
							Total	650

Course of study for M. Pharm. III Semester (Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
MRM 302P	Journal club	1	1
MRM 303P	Discussion / Presentation (Proposal Presentation)	2	2
MRM 304P	Research Work	28	14
	Total	35	21

**Non University Examination*

Course of study for M. Pharm. IV Semester (Common for All Specializations)

Course Code	Course	Credit Hours	Credit Points
MRM 401P	Journal club	1	1
MRM 402P	Research Work	31	16
MRM 403P	Discussion / Final Presentation	3	3
	Total	35	20

Semester wise credits distribution

Semester	Credit Points
I	26
II	26
III	21
IV	20
Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)	Minimum=02 Maximum=07*
Total Credit Points	Minimum=95 Maximum=100*

**Credit Points for Co-curricular Activities*

Schemes for internal assessments and end semester examinations (Semester III & IV)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
Semester III								
MRM301T	Research Methodology and Biostatistics*	10	15	1 Hr	25	75	3 Hrs	100
MRM 302P	Journal club	-	-	-	25	-	-	25
MRM 303P	Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
MRM 304P	Research work*	-	-	-	-	350	1 hr	350
Total								525
Semester IV								
MRM401P	Journal club	-	-	-	25	-	-	25
MRM402P	Discussion / Presentation (Proposal Presentation)	-	-	-	75	-	-	75
MRM403P	Research work and Colloquium	-	-	-	-	400	1 hr	400
Total								500

*Non University Examination

M. Pharm. (Pharmacognosy)

Programme Outcomes

Postgraduate's students will be able to learn:

PO1: Fundamentals on advanced analytical instrumental techniques: UV-Visible, IR, Spectroflourimetry, Flame emission and atomic absorption spectroscopy, NMR spectroscopy, Mass Spectroscopy, Chromatography, Electrophoresis and Immunological assays methods.

PO2: Advances in the field of cultivation and isolation of drugs of natural origin: Plant drug cultivation, Marine natural products, Recent advances in research in marine drugs, Nutraceuticals, Phytopharmaceuticals, Pharmacovigilance of drugs of natural origin, Validation , screening technique and procedures for detection of the herbal and natural drugs.

PO3: Advanced knowledge of natural product drug discovery: Biosynthetic pathways and Radio tracing techniques, alkaloids, glycosides, steroids, coumarin, terpenoids, Extraction and Phytochemical studies, Separation ofphytoconstituents by latest CCCET, SCFE techniques, HPTLC and LCMS/GCMS applications in the characterization of herbal extracts, Structure elucidation of compounds by spectroscopic techniques like UV, IR, MS, NMR (1H, 13C).

PO4: Understanding Industrial and commercial potential of drugs of natural origin: Infrastructure of herbal drug industry involved in production of standardized extracts, Global marketing management, Concepts of TQM, GMP, GLP, ISO-9000, Monographs of herbal drugs, Ayurvedic, Siddha and Unani, American herbal and British herbal pharmacopoeia, Indian and international patent laws.

PO5: Advanced knowledge of Biotechnology and its application: Introduction to Plant biotechnology, Different tissue culture techniques, Immobilisation techniques, Biotransformation and Transgenesis, Fermentation technology,

PO6: Study of preparation and standardization of herbal/natural cosmetics: Herbal/natural cosmetics, Classification &Economic aspects, Physiology and chemistry of skin and pigmentation, hairs, scalp, lips and nail, possible interactions between chemicals and herbs, Tonic, Bleaches, Dentifrices and Mouth washes &Toothpastes, Analysis of Cosmetics, Quality control and toxicity studies as per Drug and Cosmetics Act.

PO7: Knowledge of Indian systems of medicine: Ayurveda, Siddha, Unani and Homoeopathy systems of medicine, Ayurvedic Pharmacopoeia, Naturopathy, Yoga and

Aromatherapy practices, Schedule T, AYUSH, ISM, CCRAS, CCRS, CCRH, CCRU, Shelf life and Stability studies of ISM formulations.

PO8: Knowledge about Research Methodology & Biostatistics: review of literature, strategies to eliminate errors/bias, values in medical ethics, CPCSEA guidelines for laboratory animal facility, Declaration of Helsinki.

First Semester

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MPG 101T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG101T	3	1	-	4 hours	25	75	100	4

Scope

This subject deals with various advanced analyticalinstrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives

After completion of course student is able to know,

- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

Theory (60 hrs)

1. UV-Visible spectroscopy: Introduction, Theory, Laws, InstrumentationassociatedwithUV-Visiblespectroscopy. Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy. — 11 Hrs

   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.

   Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation andApplications of fluorescence spectrophotometer.

   Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.

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. Applicationsof NMR spectroscopy. — 11 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 — 11 Hrs

4. Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: — 11 Hrs
   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

5. Electrophoresis: Principle, Instrumentation, Workingconditions, factors affecting separation and applications of thefollowing: — 11 Hrs
   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 diffraction methods, Bragg's law, Rotating crystal technique, Xray powder technique, Types of crystals and applications of X-ray diffraction.

6 Potentiometry: Principle, working, Ion selective Electrodes andApplication of potentiometry. 5Hrs

Thermal Techniques: Principle, thermal transitions andInstrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (samplepreparation, experimental conditions, calibration, heating andcooling 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 anddisadvantages, pharmaceutical applications

REFERENCES

17. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
18. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
19. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
20. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
21. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
22. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
23. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series
24. Spectroscopy of Organic Compounds, 2 ndedn., P.S/Kalsi, Wiley estern Ltd., Delhi.

Course Outcome

After completion of course student is able to know-

CO1.The identification, characterisation, and quantification of drugs using a variety of sophisticated analytical instrumental techniques including instruments such as mass spectrometers, IR, HPLC, GC, etc are the topics covered in this course.

CO2. The analysis of different drugs in both single- and multiple-dose versions.

CO3. Theoretical and practical instrument knowledge.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3		2					
CO2	3		1					
CO3	3		2					

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

ADVANCED PHARMACOGNOSY – I (MPG 102T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 102T	3	1	-	4 hours	25	75	100	4

SCOPE

To learn and understand the advances in the field of cultivation and isolation ofdrugs of natural origin, various phytopharmaceuticals, nutraceuticals and theirmedicinal use and health benefits.

OBJECTIVES

Upon completion of the course, the student shall be able to know the,

- advances in the cultivation and production of drugs
- variousphyto-pharmaceuticals and their source, its utilization andmedicinal value.
- various nutraceuticals/herbs and their health benefits
- Drugs of marine origin
- Pharmacovigilance of drugs of natural origin

Theory (60 hrs)

1. Plant drug cultivation: General introduction to the importance ofPharmacognosy in herbal drug industry, Indian Council ofAgricultural Research, Current Good Agricultural Practices, Current Good Cultivation Practices, Current Good CollectionPractices, Conservation of medicinal plants- Ex-situ and In- situ conservation of medicinal plants — 12 Hrs

2. Marine natural products: General methods of isolation andpurification, Study of Marine toxins, Recent advances in researchin marine drugs, Problems faced in research on marine drugssuch as taxonomical identification, chemical screening and theirsolution. — 12 Hrs

3. Nutraceuticals: Current trends and future scope, Inorganicmineral supplements, Vitamin supplements, Digestive enzymes, Dietary fibres, Cereals and grains, Health drinks of natural origin, Antioxidants, Polyunsaturated fatty acids, Herbs as functionalfoods, Formulation and standardization of neutraceuticals, Regulatory aspects, FSSAI guidelines, Sources, name of markercompounds and their chemical nature, medicinal uses and healthbenefits of following
   i) Spirulina ii) Soya bean iii) Ginseng iv) Garlic v) Broccoli vi)Green and Herbal Tea vii) Flax seeds viii) Black cohosh ix)Turmeric. — 12 Hrs

4. Phytopharmaceuticals: Occurrence, isolation and characteristicfeatures (Chemical nature, uses in pharmacy, medicinal andhealth benefits) of following. — 12 Hrs
   a) Carotenoids – i) α and β - Carotene ii) Xanthophyll (Lutein)
   b) Limonoids – i) d-Limonene ii) α – Terpineol
   c) Saponins – i) Shatavarins
   d) Flavonoids – i) Resveratrol ii) Rutin iii) Hesperidin iv) Naringin v) Quercetin
   e) Phenolic acids- Ellagic acid
   f) Vitamins
   g) Tocotrienols and Tocopherols
   h) Andrographolide, Glycolipids, Gugulipids, Withanolides, Vascine, Taxol
   i) Miscellaneous

5. Pharmacovigilance of drugs of natural origin: WHO andAYUSH guidelines for safety monitoring of natural medicine, Spontaneous reporting schemes for biodrug adverse reactions,bio drug-drug and bio drug-food interactions with suitableexamples. — 12 Hrs

REFERENCES (Latest Editions of)

1. Pharmacognosy - G. E. Trease and W.C. Evans. Saunders Edinburgh, New York.
2. Pharmacognosy-Tyler, Brady, Robbers
3. Modem Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I&II
4. Text Book of Pharmacognosy by T.E. Wallis
5. Marine Natural Products-Vol.I to IV.
6. Natural products: A lab guide by Raphael Ikan , Academic Press 1991.

7. Glimpses of Indian Ethano Pharmacology, P. Pushpangadam. Ulf Nyman.V.George Tropical Botanic Garden & Research Institute, 1995.
8. Medicinal natural products (a biosynthetic approach), Paul M. Dewick,John Wiley & Sons Ltd., England, 1998.
9. Chemistry of Marine Natural Products- Paul J. Schewer 1973.
10. Herbal Drug Industry by RD. Choudhary, Eastern Publisher, New Delhi, 1996.
11. Cultivation of Medicinal Plants by C.K. Atal & B.M. Kapoor.
12. Cultivation and Utilization of Aromatic Plants, C.K. Atal & B.M. Kapoor
13. Cultivation of medicinal and aromatic crops, AA Farooqui and B.S. Sreeramu. University Press, 2001.
14. Natural Products from Plants, 1st edition, by Peter B. Kaufman, CRCPress, New York, 1998
15. Recent Advances in Phytochemistry- Vol. 1&4: ScikelRuneckles- AppletonCentury crofts.
16. Text book of Pharmacognosy, C.K.Kokate, Purohit, Ghokhale, NiraliPrakasshan, 1996.
17. Pharmacognosy and Pharmacobiotechnology, Ashutoshkar, New AgePublications, New Delhi.

Course Outcome

After completion of course student is able to know

CO1. To study about the developments in the production and purification of natural medicines.

CO2. To study phytopharmaceuticals, nutraceuticals and the medical applications and health advantages of each.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		3					1	
CO2		3				1	1	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

PHYTOCHEMISTRY (MPG 103T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 103T	3	1	-	4 hours	25	75	100	4

Scope

Students shall be equipped with the knowledge of natural product drug discovery and will be able to isolate, identify and extract and the phyto- constituents

Objectives

Upon completion of the course, student shall be able to know the,

- different classes of phytoconstituents, their biosynthetic pathways, their properties, extraction and general process of natural product drugdiscovery
- phytochemical fingerprinting and structure elucidation ofphytoconstituents.

Theory (60 hrs)

1. Biosynthetic pathways and Radio tracing techniques: Constituents & their Biosynthesis, Isolation, Characterization andpurification with a special reference to their importance in herbalindustries of following phyto-pharmaceuticals containing drugs: 12 Hrs

a) Alkaloids: Ephedrine, Quinine, Strychynine, Piperine, Berberine, Taxol, Vincaalkoloids.
b) Glycosides: Digitoxin, Glycyrrhizin, Sennosides, Bacosides, Quercitin.
c) Steroids: Hecogenin, guggulosterone and withanolides
d) Coumarin: Umbelliferone.
e) Terpenoids: Cucurbitacin

2	Drug discovery and development: History of herbs as source ofdrugs and drug discovery, the lead structure selection process, structure development, product discovery process and drugregistration, Selection and optimization of lead compounds withsuitable examples from the following source : artemesin, andrographolides. Clinical studies emphasising on phases ofclinical trials, protocol design for lead molecules.	12 Hrs
3	Extraction and Phytochemical studies: Recent advances inextractions with emphasis on selection of method and choice ofsolvent for extraction, successive and exhaustive extraction andother methods of extraction commonly used like microwave assisted extraction, Methods of fractionation. Separation ofphytoconstituents by latest CCCET, SCFE techniques including preparative HPLC and Flash column chromatography	12 Hrs
4	Phytochemical finger printing: HPTLC and LCMS/GCMSapplications in the characterization of herbal extracts. Structureelucidation of phytoconstituents.	12 Hrs
5	Structure elucidation of the following compounds by spectroscopictechniques like UV, IR, MS, NMR (1H, 13C) a. Carvone, Citral, Menthol b. Luteolin, Kaempferol c. Nicotine, Caffeine iv) Glycyrrhizin.	12 Hrs

REFERENCES (Latest Editions of)

1. Organic chemistry by I.L. FinarVol.II
2. Pharmacognosy by Trease and Evans, ELBS.
3. Pharmacognosy by Tylor and Brady.
4. Text book of Pharmacognosy by Wallis.
5. Clark's isolation and Identification of drugs by A.C. Mottal.
6. Plant Drug Analysis by Wagner &Bladt.
7. Wilson and Gisvolds text book of Organic Medicinnal and Pharmaceutical Chemistry by Deorge. R.F.
8. The Chemistry of Natural Products, Edited by R.H. Thomson, SpringerInternational Edn. 1994.
9. Natural Products Chemistry Practical Manual by Anees A Siddiqui andSeemiSiddiqui
10. Organic Chemistry of Natural Products, Vol. 1&2. Gurdeep R Chatwal.
11. Chemistry of Natural Products- Vol. 1 onwards IWPAC.
12. Modem Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I&II
13. Medicinal Natural products – a biosynthetic approach, Dewick PM, JohnWiley & Sons, Toronto, 1998.
14. Chemistry of Natural Products, Bhat SV, Nagasampagi BA, Meenakshi S, Narosa Publishing House, New Delhi.
15. Pharmacognosy & Phytochemistry of Medicinal Plants, 2 nd edition, Bruneton J, Interceptt Ltd., New

Course outcome

After completion of course student is able to know

CO1. The ability to isolate, recognise, and extract phytoconstituents.

CO2. Understanding of natural product drug discovery.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	1	3					

CO2		1	3					

Weightage: 1-Sightly; 2-Moderately; 3-Strongl

INDUSTRIAL PHARMACOGNOSTICAL TECHNOLOGY (MPG 104T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 104T	3	1	-	4 hours	25	75	100	4

Scope

To understand the Industrial and commercial potential of drugs of natural origin,integrate traditional Indian systems of medicine with modern medicine and alsoto know regulatory and quality policy for the trade of herbals and drugs ofnatural origin

Objectives

By the end of the course the student shall be able to know,

- the requirements for setting up the herbal/natural drug industry.
- the guidelines for quality of herbal/natural medicines and regulatoryissues.
- the patenting/IPR of herbals/natural drugs and trade of raw andfinished

Theory (60 hrs)

1.	Herbal drug industry: Infrastructure of herbal drug industryinvolved in production of standardized extracts and variousdosage forms. Current challenges in upgrading andmodernization of herbal formulations. EntrepreneurshipDevelopment, Project selection, project report, technicalknowledge, Capital venture, plant design, layout and construction. Pilot plant scale –up techniques, case studies of herbal extracts. Formulation and production management of herbals.	12 Hrs
2	Regulatory requirements for setting herbal drug industry: Global marketing management. Indian and international patentlaw as applicable herbal drugs and natural products. Export - Import (EXIM) policy, TRIPS. Quality assurance in herbal/natural drug products. Concepts of TQM, GMP, GLP, ISO-9000	12 Hrs
3	Monographs of herbal drugs: General parameters ofmonographs of herbal drugs and comparative study in IP, USP, Ayurvedic Pharmacopoeia, Siddha and Unani Pharmacopoeia, American herbal pharmacopoeia, British herbal pharmacopoeia, WHO guidelines in quality assessment of herbal drugs.	12 Hrs
4	Testing of natural products and drugs: Herbal medicines -clinical laboratory testing. Stability testing of natural products, protocols.	
5	Patents: Indian and international patent laws, proposedamendments as applicable to herbal/natural products andprocess. Geographical indication, Copyright, Patentable subjectmaters, novelty, non obviousness, utility, enablement and bestmode, procedure for Indian patent filing, patent processing, grantof patents, rights of patents, cases of patents, opposition andrevocation of patents, patent search and literature, Controllers ofpatents	12 Hrs

REFERENCES (Latest Editions of)

1. Herbal drug industry by R.D. Choudhary (1996), Eastern Publisher, NewDelhi.
2. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine by Pulok K Mukharjee (2003), Ist Edition, Business horizons RobertVerpoorte, New Delhi.
3. Quality control of herbal drugs by Pulok K Mukarjee (2002), BusinessHorizons Pharmaceutical Publisher, New Delhi.
4. PDR for Herbal Medicines (2000), Medicinal Economic Company, NewJersey.
5. Indian Herbal Pharmacopoeia (2002), IDMA, Mumbai.

6. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (1996), NiraliPrakashan, New Delhi.
7. Text book of Pharmacognosy and Phytochemistry by Vinod D. RangarI(2002), Part I & II, Career Publication, Nasik, India.
8. Plant drug analysis by H.Wagner and S.Bladt, Springer, Berlin.
9. Standardization of Botanicals. Testing and extraction methods of medicinalherbs by V. Rajpal (2004), Vol.I, Eastern Publisher, New Delhi.
10. Phytochemical Dictionary. Handbook of Bioactive Compounds from Plantsby J.B.Harborne, (1999), IInd Edition, Taylor and Francis Ltd, UK.
11. Herbal Medicine. Expanded Commission E Monographs by M.Blumenthal, (2004), IST Edition,
12. Drug Formulation Manual by D.P.S.Kohli and D.H.Shah (1998), EasternPublisher, New Delhi.

Course outcome

After completion of course student is able to know

CO1. Knowing the regulatory and quality policy for the trade of herbals and medications of natural origin is important for understanding the industrial and commercial potential of drugs of natural origin.

CO2. Integrating traditional Indian medical practises with modern medicine.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1				3		1		
CO2				3			1	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

PHARMACOGNOSY PRACTICAL – I (MPG 105P)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG I05P	-	-	12	12 hours	50	100	150	6

1. Analysis of Pharmacopoeial compounds of natural origin and their formulations by UV Vis spectrophotometer
2. Analysis of recorded spectra of simple phytoconstituents
3. Experiments based on Gas Chromatography
4. Estimation of sodium/potassium by flame photometry
5. Development of fingerprint of selected medicinal plant extracts commonly used in herbal drug industry viz. Ashwagandha, Tulsi, Bael, Amla, Ginger, Aloe, Vidang, Senna, Lawsonia by TLC/HPTLC method.
6. Methods of extraction
7. Phytochemical screening
8. Demonstration of HPLC- estimation of glycerrhizin
9. Monograph analysis of clove oil
10. Monograph analysis of castor oil. 11. Identification of bioactive constituents from plant extracts
11. Formulation of different dosage forms and their standardisation.

Course outcome

After completion of course student is able to know

CO1. Analysis of Pharmacopeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation.

CO2. Experiments based on Column chromatography, HPLC, Gas chromatography.

CO3. Identification of bioactive constituents from plant extracts

CO4. Formulation of different dosage forms and their standardisation.

Course Outcomes and their mapping with Programme Outcomes

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3							
CO2	3							
CO3		2						
CO4							2	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Second Semester

MEDICINAL PLANT BIOTECHNOLOGY (MPG 201T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 201T	3	1	-	4 hours	25	75	100	4

Scope

To explore the knowledge of Biotechnology and its application in theimprovement of quality of medicinal plants

Objectives

Upon completion of the course, the student shall be able to,

- Know the process like genetic engineering in medicinal plants forhigher yield of Phytopharmaceuticals.
- Use the biotechnological techniques for obtaining and improving thequality of natural products/medicinal plants

Theory (60 hrs)

1.	Introduction to Plant biotechnology: Historical perspectives, prospects for development of plant biotechnology as a source ofmedicinal agents. Applications in pharmacy and allied fields. Genetic and molecular biology as applied to pharmacognosy, study of DNA, RNA and protein replication, genetic code, regulation of gene expression, structure and complicity ofgenome, cell signaling, DNA recombinant technology.	12 Hrs
2	Different tissue culture techniques: Organogenesis andembryogenesis, synthetic seed and monoclonal variation, Protoplast fusion, Hairy root multiple shoot cultures and theirapplications. Micro propagation of medicinal and aromatic plants. Sterilization methods involved in tissue culture, gene transfer inplants and their applications.	15 Hrs
3	Immobilisation techniques & Secondary Metabolite Production: Immobilization techniques of plant cell and itsapplication on secondary metabolite Production. Cloning of plantcell: Different methods of cloning and its applications. Advantagesand disadvantages of plant cell cloning. Secondary metabolism intissue cultures with emphasis on production of medicinal agents. Precursors and elicitors on production of secondary metabolites.	15 Hrs
4	Biotransformation and Transgenesis: Biotransformation, bioreactors for pilot and large scale cultures of plant cells andretention of biosynthetic potential in cell culture. Transgenicplants,	13 Hrs

	methods used in gene identification, localization andsequencing of genes. Application of PCR in plant genomeanalysis.	
5	Fermentation technology: Application of Fermentationtechnology, Production of ergot alkaloids, single cell proteins, enzymes of pharmaceutical interest.	05 Hrs

REFERENCES (Latest Editions of)

1. Plant tissue culture, Bhagwani, vol 5, Elsevier Publishers.
2. Plant cell and Tissue Culture (Lab. Manual), JRMM. Yeoman.
3. Elements in biotechnology by PK. Gupta, Rastogi Publications, New Delhi.
4. An introduction to plant tissue culture by MK. Razdan, Science Publishers.
5. Experiments in plant tissue culture by John HD and Lorin WR., Cambridge University Press.
6. Pharmaceutical biotechnology by SP. Vyas and VK. Dixit, CBS Publishers.
7. Plant cell and tissue culture by Jeffrey W. Pollard and John M Walker, Humana press.
8. Plant tissue culture by Dixon, Oxford Press, Washington DC, 1985
9. Plant tissue culture by Street.
10. Pharmacognosy by G. E. Trease and WC. Evans, Elsevier.
11. BiotechnologybyPurohitandMathur,Agro-Bio,3rd revised edition.
12. Biotechnological applications to tissue culture by Shargool, Peter D, Shargoal, CKC Press.
13. Pharmacognosy by Varo E. Tyler, Lynn R. Brady and James E. Robberrt, That Tjen, NGO.
14. Plant Biotechnology, CiddiVeerasham.

Course outcomes

After completion of course student shall be able to-

CO1. The process like genetic engineering in medicinal plants for higher yield of Phytopharmaceuticals.

CO2. Use of the biotechnological techniques for obtaining and improving the quality of natural products/medicinal plants

Course Outcomes and their mapping with Programme Outcomes

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1					3			
CO2					3			

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

ADVANCED PHARMACOGNOSY – II (MPG 202T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 202T	3	1	-	4 hours	25	75	100	4

Scope

To know and understand the Adulteration and Deterioration that occurs inherbal/natural drugs and methods of detection of the same. Study of herbalremedies and their validations, including methods of screening

Objectives

Upon completion of the course, the student shall be able to know the,

- validation of herbal remedies
- methods of detection of adulteration and evaluation techniques for theherbal drugs
- methods of screening of herbals for various biological properties

Theory (60 hrs)

1.	Herbal remedies – Toxicity and Regulations: Herbals vsConventional drugs, Efficacy of Herbal medicine products, Validation of herbal therapies, Pharmacodynamic andPharmacokinetic issues	12 Hrs
2	Adulteration and Deterioration: Introduction, Types ofAdulteration/ Substitution of Herbal drugs, Causes and Measuresof Adulteration, Sampling Procedures, Determination of ForeignMatter, DNA Finger printing techniques in identification of drugs ofnatural origin, detection of heavy metals, pesticide residues, phytotoxin, microbial contamination in herbs and theirformulations.	12 Hrs
3	Ethnobotany and Ethnopharmacology: Ethnobotany in herbaldrug evaluation, Impact of Ethnobotany in traditional medicine, New development in herbals, Bio-prospecting tools for drugdiscovery, Role of Ethnopharmacology in drug evaluation, Reverse Pharmacology.	12 Hrs
4	Analytical Profiles of herbal drugs: Andrographispaniculata, Boswelliaserata, Coleus forskholii, Curcuma longa, Embelicaofficinalis, Psoraleacorylifolia.	12 Hrs
5	Biological screening of herbal drugs: Introduction and Need forPhyto-Pharmacological Screening, New Strategies for evaluatingNatural Products, In vitro evaluation techniques for Antioxidants, Antimicrobial and Anticancer drugs. In vivo evaluation techniquesfor Anti-inflammatory, Antiulcer, Anticancer, Wound healing, Antidiabetic, Hepatoprotective, Cardio protective, Diuretics andAntifertility, Toxicity studies as per OECD	12 Hrs

REFERENCES (Latest Editions of)

1. Glimpses of Indian Ethano Pharmacology by P. Pushpangadam. Ulf Nyman. V.George Tropical Botanic Garden & Research Institute.
2. Natural products: A lab guide by Raphael Ikan, Academic Press.
3. Pharmacognosy - G. E. Trease and W.C. Evans. WB. Saunders Edinburgh, New York.
4. Pharmacognosy-Tyler, Brady, Robbers, Lee &Fetiger.
5. Modem Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I & II, Springer Publishers.
6. Herbal Drug Industry by RD. Choudhary, Eastern Publishers, New Delhi.
7. Text book of Pharmacognosy by C.K.Kokate, Purohit, Ghokhale, NiraliPrakashan.
8. Text Book of Pharmacognosy by T.E. Wallis, J & A Churchill Ltd., London.
9. Quality control of herbal drugs by Pulok K Mukherjee, Business Horizons Pharmaceutical Publishers, New Delhi.
10. Indian Herbal Pharmacopoeia, IDMA, Mumbai.
11. Text book of Pharmacognosy and Phytochemistry by Vinod D. RangarI, Part I & II, Career Publication, Nasik, India.
12. Plant drug analysis by H.Wagner and S.Bladt, 2nd edition, Springer, Berlin.
13. Standardization of Botanicals. Testing and extraction methods of medicinal herbs by V. Rajpal (2004), Vol.I, Eastern PublisherS, New Delhi.
14. Herbal Medicine. Expanded Commission E Monographs, M.Blumenthal.

Course outcome

After completion of course student shall be able to-

CO1. To be aware of the adulteration, degradation, and procedures for detection of the same in herbal and natural drugs.

CO2. Study of herbal medicines and how they are validated, including screening techniques.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	3				2	1	
CO2	1	3	1			2	1	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

INDIAN SYSTEMS OF MEDICINE (MPG 203T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG203T	3	1	-	4 hours	25	75	100	4

Scope

To make the students understand thoroughly the principles, preparations of medicines of various Indian systems of medicine like Ayurveda, Siddha, Homeopathy and Unani. Also focusing on clinical research of traditional medicines, quality assurance and challenges in monitoring the safety of herbal medicines.

Objectives

After completion of the course, student is able to

- To understand the basic principles of various Indian systems of medicine
- To know the clinical research of traditional medicines, Current Good Manufacturing Practice of Indian systems of medicine and their formulations.

Theory (60 hrs)

1.	Fundamental concepts of Ayurveda, Siddha, Unani andHomoeopathy systems of medicine Different dosage forms of the ISM. Ayurveda: Ayurvedic Pharmacopoeia, Analysis of formulationsand bio crude drugs with references to: Identity, purity and quality. Siddha: Gunapadam (Siddha Pharmacology), rawdrugs/Dhatu/Jeevam in Siddha system of medicine, Purificationprocess (Suddhi).	12 Hrs
2	Naturopathy, Yoga and Aromatherapy practices a) Naturopathy - Introduction, basic principles and treatmentmodalities. b) Yoga - Introduction and Streams of Yoga. Asanas, Pranayama, Meditations and Relaxation techniques. c) Aromatherapy – Introduction, aroma oils for common problems, carrier oils.	12 Hrs
3	Formulation development of various systems of medicine Salient features of the techniques of preparation of some of theimportant class of Formulations as per Ayurveda, Siddha, Homeopathy and Unani Pharmacopoeia and texts. Standardization, Shelf life and Stability studies of ISM formulations	12 Hrs
4	Schedule T – Good Manufacturing Practice of Indian systems ofmedicine	12

	Components of GMP (Schedule – T) and its objectives,Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records. Quality assurance in ISM formulation industry - GAP, GMP andGLP. Preparation of documents for new drug application andexport registration. Challenges in monitoring the safety of herbal medicines:Regulation, quality assurance and control, National/RegionalPharmacopoeias.	Hrs
5	TKDL, Geographical indication Bill, Government bills in AYUSH,ISM, CCRAS, CCRS, CCRH, CCRU	12 Hrs

REFERENCES (Latest Editions of)

1. Ayurvedic Pharmacopoeia, The Controller of Publications, Civil Lines, Govt. of India, New Delhi.
2. Hand Book on Ayurvedic Medicines, H. Panda, National Institute ofIndustrial Research, New Delhi.
3. Ayurvedic System of Medicine, KavirajNagendranathSengupata, SriSatguru Publications, New Delhi.
4. Ayurvedic Pharmacopoeia. Formulary of Ayurvedic Medicines, IMCOPS, Chennai.
5. Homeopathic Pharmacopoeia. Formulary of Homeopathic Medicines,IMCOPS, Chennai.
6. Homeopathic Pharmacy : An introduction & Hand book, Steven B. Kayne,Churchill Livingstone, New York.
7. Indian Herbal Pharmacopoeia, IDMA, Mumbai.
8. British Herbal Pharmacopoeia, bRITISH Herbal Medicine Association, UK.
9. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine, Pulok K Mukharjee, Business Horizons, New Delhi.
10. Indian System of Medicine and Homeopathy in India, Planning andEvaluation Cell, Govt. of India, New Delhi.
11. Essential of Food and Nutrition, Swaminathan, Bappco, Bangalore.
12. Clinical Dietitics and Nutrition, F.P. Antia, Oxford University Press, Delhi.
13. Yoga - The Science of Holistic Living by V.K.Yoga, Vivekananda YogaPrakashna Publishing, Bangalore.

Course outcome

After completion of course student shall be able to-

CO1. To ensure that the students fully comprehend the principles of the various Indian medicine, including Ayurveda, Siddha, Homeopathy, and Unani.

CO2. Clinical studies of conventional medicines, quality control, and difficulties in ensuring the safety of herbal medicines.

Course Outcomes and their mapping with Programme Outcomes

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1						2	3	
CO2	1			1		2	3	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

HERBAL COSMETICS (MPG 204T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 204T	3	1	-	4 hours	25	75	100	4

Scope

This subject deals with the study of preparation and standardization ofherbal/natural cosmetics. This subject gives emphasis to various national andinternational standards prescribed regarding herbal cosmeceuticals.

Objectives

After completion of the course, the students shall be able to

- understand the basic principles of various herbal/natural cosmeticpreparations
- current Good Manufacturing Practices of herbal/natural cosmetics asper the regulatory authorities

Theory (60 hrs)

1.	Introduction: Herbal/natural cosmetics, Classification &Economic aspects. Regulatory Provisions relation to manufacture of cosmetics: -License, GMP, offences & Penalties, Import & Export ofHerbal/natural cosmetics, Industries involved in the production ofHerbal/natural cosmetics.	12 Hrs
2	Commonly used herbal cosmetics, raw materials, preservatives, surfactants, humectants, oils, colors, and some functional herbs, preformulation studies, compatibility studies, possible interactionsbetween chemicals and herbs, design of herbal cosmeticformulation.	12 Hrs
3	Herbal Cosmetics : Physiology and chemistry of skin andpigmentation, hairs, scalp, lips and nail, Cleansing cream, Lotions, Face powders, Face packs, Lipsticks, Bath products, soaps and baby product, Preparation andstandardisation of the following : Tonic, Bleaches, Dentifrices and Mouth washes & Tooth Pastes, Cosmetics for Nails.	12 Hrs
4	Cosmeceuticals of herbal and natural origin: Hair growthformulations, Shampoos, Conditioners, Colorants & hair oils, Fairness formulations, vanishing & foundation creams, anti-sunburn preparations, moisturizing creams, deodorants.	12 Hrs
5	Analysis of Cosmetics, Toxicity screening and test methods:Quality control and toxicity studies as per Drug and CosmeticsAct.	12 Hrs

REFERENCES (Latest Editions of)

1. Panda H. Herbal Cosmetics (Hand book), Asia Pacific Business Press Inc, New Delhi.
2. Thomson EG. Modern Cosmetics, Universal Publishing Corporation, Mumbai.
3. P.P.Sharma. Cosmetics - Formulation, Manufacturing & Quality Control, Vandana Publications, New Delhi.
4. Supriya K B. Handbook of Aromatic Plants, Pointer Publishers, Jaipur
5. Skaria P. Aromatic Plants (Horticulture Science Series), New India. Publishing Agency, New Delhi.
6. KathiKeville and Mindy Green. Aromatheraphy (A Complete Guide to the Healing Art), Sri Satguru Publications, New Delhi.
7. Chattopadhyay PK. Herbal Cosmetics & Ayurvedic Medicines (EOU), National Institute of Industrial Research, Delhi.
8. Balsam MS & Edward Sagarin. Cosmetics Science and Technology, Wiley Interscience, New York.

Course outcomes

After completion of course student shall be able to-

CO1. The manufacture and standardisation of herbal/natural cosmetics.

CO2. National and international standards for herbal cosmeceuticals.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8

CO1	**1**			**1**		**3**		
CO2	**1**			**2**		**3**		

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

HERBAL COSMETICS PRACTICALS (MPG 205P)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 205P	-	-	12	12 hours	50	100	150	6

1. Isolation of nucleic acid from cauliflower heads
2. Isolation of RNA from yeast
3. Quantitative estimation of DNA
4. Immobilization technique
5. Establishment of callus culture
6. Establishment of suspension culture
7. Estimation of aldehyde contents of volatile oils
8. Estimation of total phenolic content in herbal raw materials
9. Estimation of total alkaloid content in herbal raw materials
10. Estimation of total flavonoid content in herbal raw materials
11. Preparation and standardization of various simple dosage forms from Ayurvedic, Siddha, Homoeopathy and Unani formulary
12. Preparation of certain Aromatherapy formulations
13. Preparation of herbal cosmetic formulation such as lip balm, lipstick, facial cream, herbal hair and nail care products
14. Evaluation of herbal tablets and capsules
15. Preparation of sunscreen, UV protection cream, skin care formulations.
16. Formulation & standardization of herbal cough syrup.

Course outcome

After completion of course student is able to know

CO1. Preparation and standardization of various simple dosage forms fromAyurvedic, Siddha, Homoeopathy and Unani formulary

CO2. Estimation of total phenolic content, alkaloid content, flavonoid content in herbal raw materials

CO3. Preparation of herbal cosmetic formulation such as lip balm, lipstick, facialcream, herbal hair and nail care products

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1				**3**				
CO2		**3**						
CO3						**3**		

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Third Semester

RESEARCH METHODOLOGY & BIOSTATISTICS- (MRM 301T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MRM 301T	3	1	-	4 hours	25	75	100	4

UNIT – I

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.

UNIT – II

Biostatistics: Definition, application, sample size, importance of sample size,factors influencing sample size, dropouts, statistical tests of significance, typeof significance tests, parametric tests(students "t" test, ANOVA, Correlationcoefficient, regression), non-parametric tests (wilcoxan rank tests, analysis ofvariance, correlation, chi square test), null hypothesis, P values, degree offreedom, interpretation of P values.

UNIT – III

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy andbeneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, controlresolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personalhygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medicalresearch, and additional principles for medical research combined withmedical care.

Course outcomes

After completion of course student shall be able to-

CO1. Student will gain knowledge of general research methodology, review of literature, biostatics.

CO2. They will know about values of medicalethics.

CO3. CPCSEA guidelines for laboratory animal facility.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1							3
CO2	1							3
CO3	1							3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly