Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	MPC101T	**Title of the Course**	Modern Pharmaceutical Analytical Techniques	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	4	0	0	4
Pre-Requisite	B Pharm	**Co-requisite**	-				
Course Objectives	1.Chemicals and Excipients 2.The analysis of various drugs in single and combination dosage forms 3.Theoretical and practical skills of the instruments						

Course Outcomes	
CO1	Investigate the pharmaceutical substance by absorption and emission techniques.
CO2	Appraise the pharmaceutical substance by nuclear magnetic spectroscopy techniques.
CO3	Examine the mass spectroscopy involved for the pharmaceutical substances.
CO4	Recognize the principle, instrumentation and applications of chromatographic techniques.
CO5	Sketch the principle, instrumentation and applications of electrophoresis and x ray crystallography.
CO6	Apprehend the fundamentals of potentiometry and thermal techniques.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**UV-Visible spectroscopy, IR spectroscopy, Spectroflourimetry, Flame emission spectroscopy and Atomic absorption spectroscopy**	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	1
2	**NMR spectroscopy**	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	2
3	**Mass Spectroscopy**	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	3
4	**Chromatography**	Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following: a) Thin Layer chromatography b) High Performance Thin Layer Chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Ultra High Performance Liquid chromatography h) Affinity chromatography i) Gel Chromatography	10	4
5	**Electrophoresis and X ray Crystallography**	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	5
6	**Potentiometry and Thermal Techniques**	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	6
Reference Books:				

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, 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.

e-Learning Source:

https://www.classcentral.com/course/swayam-spectroscopic-techniques-for-pharmaceutical-and-biopharmaceutical-industries-14301

https://www.sciencedirect.com/science/article/pii/S1878535213001056

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6258797/

https://www.google.co.in/books/edition/Pharmaceutical_Analysis/Ub8wod1CJ50C?hl=en&gbpv=1&dq=pharmaceutical+analysis+spectral+chromatography&printsec=frontcover

https://www.google.co.in/books/edition/Pharmaceutical_Analysis_E_Book/YExgDAAAQBAJ?hl=en&gbpv=1&dq=pharmaceutical+analysis+spectral+chromatography&printsec=frontcover

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	2	3	2	2	2	3	2	3		3	3	3	-	-	-
CO2	3	3	3	2	3	3	2	3	3	3	3		3	3	3	-	-	-
CO3	3	3	3	2	3	3	2	2	3	2	3		3	3	3	-	-	-
CO4	3	3	3	3	3	2	2	2	3	3	3		3	3	3	-	-	-
CO5	3	3	3	2	3	2	2	2	3	2	3		3	3	3	-	-	-
CO6	3	3	3	2	3	2	2	2	3	2	3		3	3	3	-	-	-

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	MPC 102 T	**Title of the Course**	Advanced Organic Chemistry -1	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**4**	**0**	**0**	**4**
Pre-Requisite	B Pharm	**Co-requisite**	-				
Course Objectives	1.The principles and applications of reterosynthesis 2.The mechanism & applications of various named reactions 3.The concept of disconnection to develop synthetic routes for small target molecule. 4.The various catalysts used in organic reactions 5.The chemistry of heterocyclic compounds						

Course Outcomes	
CO1	Comprehend about the Synthetic applications, basic concept of organic chemistry, method of formation and stability of organic intermediates.
CO2	Knowledge about the mechanism and synthetic applications of name reactions and rearrangements
CO3	Demonstrate the Role of protection in organic synthesis and synthetic reagent with their application
CO4	Explain about the synthetic strategies, Organic name reactions with their respective mechanism and application involved in the synthesis of drugs containing five, six membered and fused heterocyclic's
CO5	Demonstrate the Basic principle, guidelines for dissection of molecules, advantages and strategies of synthesis.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Basic Aspects of Organic Chemistry:**	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) Nucleophilic uni- and bimolecular reactions (SN1 and SN2) b) Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule) c) Rearrangement reaction	12	1
2	**Study of mechanism and synthetic applications of following named Reactions:**	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.	12	2
3	**Synthetic Reagents & Applications:**	Synthetic Reagents & Applications: Aluminiumisopropoxide, N-bromosuccinamide, diazomethane, dicyclohexylcarbodimide, Wilkinson reagent, Witting reagent. Osmium tetroxide, titanium chloride, diazopropane, diethyl azodicarboxylate, Triphenylphosphine, Benzotriazol-1-yloxy) tris (dimethylamino) phosphonium hexafluoro-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	12	3
4	**Heterocyclic Chemistry:**	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, Combes Quinoline 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	12	4
5	**Synthon approach and retrosynthesis applications**	1. Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group interconversion and addition (FGI and FGA) ii. C-X disconnections; C-C disconnections – alcohols and carbonyl compounds; 1,2-, 1,3-,1,4-, 1,5-, 1,6-difunctionalized compounds iii. Strategies for synthesis of three, four, five and six-membered ring	12	5

Reference Books:

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

e-Learning Source:

https://books.google.com/books/about/March_s_Advanced_Organic_Chemistry.html?id=by05kNKm_xYC

https://books.google.com/books?id=LaW-OLJlLGgC&printsec=frontcover&dq=Organic+Chemistry%E2%80%9D+Vol+I+and+II.+I.L.+Finar.+ELBS,+Pearson+Education+Ltd,+Dorling+Kindersley+India)+Pvt.+Ltd.,&hl=en&newbks=1&newbks_redir=1&sa=X&ved=2ahUKEwi-vNyV6v_7AhW6-jgGHffNAWcQ6AF6BAgIEAI

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	0	1	0	1	0	1	2	2	2	2	2	-	-	-
CO2	3	3	1	0	1	0	1	0	1	2	2	2	3	2	-	-	-
CO3	3	3	2	0	2	0	1	0	1	2	2	1	1	2	-	-	-
CO4	3	3	3	0	1	0	2	0	2	3	3	2	2	2	-	-	-
CO5	3	2	2	0	1	0	2	0	2	2	3	1	2	2	-	-	-

1- **1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	MPC 103 T	**Title of the Course**	Advanced Medicinal Chemistry	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**4**	**0**	**0**	**4**
Pre-Requisite	B Pharm	**Co-requisite**	-				
Course Objectives	1.Different stages of drug discovery 2.Role of medicinal chemistry in drug research 3.Different techniques for drug discovery 4.Various strategies to design and develop new drug like molecules for biological targets 5.Peptidomimetics						

Course Outcomes	
CO1	Know the different stages of drug discovery and development, various types of receptors theories of interaction and the role of medicinal chemistry in drug research.
CO2	Comprehend the strategies of drug resistance to combat it, concepts of prodrug design, and types of bio isosteres & their importance in drug therapy.
CO3	Demonstrate the relation of sympathetic, parasympathetic and CNS with chemistry of drugs as adrenergic cholinergic,antipsychotics, anticonvulsants, H1, H2, H3 receptors, antiulcer, anti- neoplastic and anti-viral agents including their SAR, MOA and synthesis.
CO4	Understand the importance of enzymes in biological system & the action of covalently noncovalently enzyme inhibitor.
CO5	Demonstrate the knowledge of peptides, design of peptidomimetics through manipulation of amino acids etc. and correlate the actions of Eicosanoids in biological system and their therapeutic application.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Drug discovery**	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	1
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, 12 Hrs 9 of 27 Faculty of Pharmacy Integral University 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	2
3	**Medicinal chemistry aspects of the following class of**	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	3
4	**Rational Design of Enzyme**	Enzyme kinetics & Principles of Enzyme inhibitors, Enzyme inhibitors in medicine, Enzyme inhibitors in basic research, rational design of	12	4

	Inhibitors	non-covalently and covalently binding enzyme inhibitors		
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 thromboxane	12	5

Reference Books:

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 10 of 27 M Stroud and Janet. F

e-Learning Source:

https://books.google.com/books/about/Burger_s_Medicinal_Chemistry_Drug_Discov.html?id=5TfhzAEACAAJ

https://books.google.co.in/books?id=MhO0AAAAIAAJ&q=Wilson+and+Gisvold%E2%80%99s+Text+book+of+Organic+Medicinal+and+Pharmaceutical+Chemistry,+12+th+Edition,+Lppincott+Williams+%26+Wilkins,+Woltess+Kluwer+(India)+Pvt.Ltd,+New+Delhi&dq=Wilson+and+Gisvold%E2%80%99s+Text+book+of+Organic+Medicinal+and+Pharmaceutical+Chemistry,+12+th+Edition,+Lppincott+Williams+%26+Wilkins,+Woltess+Kluwer+(India)+Pvt.Ltd,+New+Delhi&hl=en&newbks=1&newbks_redir=1&printsec=frontcover&sa=X&ved=2ahUKEwj-2Yj47v_7AhXkSWwGHTvyC1IQ6AF6BAgGEAI

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO11	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	3	1	3	3	3	3	3	-	2	3	2	-	-	-
CO2	3	3	3	1	1	1	3	2	2	2	2	–	2	2	2	–	-	–
CO3	3	2	1	2	3	1	3	2	2	2	2	–	2	2	1	–	-	-
CO4	3	3	2	1	1	1	3	2	2	2	2	-	1	1	2	-	-	-
CO5	3	3	2	1	1	1	3	2	1	3	2	-	3	2	2	-	-	-

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2018-2019							
Course Code	MPC104T	**Title of the Course**	Chemistry of Natural Products	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**4**	**0**	**0**	**4**
Pre-Requisite	B Pharm	**Co-requisite**	-				
Course Objectives	1.Different types of natural compounds and their chemistry and medicinal importance 2. The importance of natural compounds as lead molecules for new drug discovery 3. The concept of rDNA technology tool for new drug discovery 4. General methods of structural elucidation of compounds of natural origin 5. Isolation, purification and characterization of simple chemical constituents from natural source						

Course Outcomes	
CO1	The students get aware about different types of natural compounds as leads for new pharmaceuticals and their chemistry and medicinal importance.
CO2	The students should understand the general methods of structural elucidation of compounds of natural origin.
CO3	The students should understand the Isolation, purification and characterization of simple chemical constituents from natural source.
CO4	The students get aware about the drug discovery by using different tools of recombinant DNA technology.
CO5	The students understand structural characterization of natural compounds using IR, ^{1}HNMR, ^{13}CNMR and MS Spectroscopies.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
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	1
2	**Alkaloids**	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	2
3	**Terpenoids**	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	3
4	**Recombinant DNA technology and drug discovery**	a). Recombinant DNA technology and drug discovery rDNA technology, hybridoma technology, New pharmaceuticals 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 – *Gymnema sylvestre, Salacia reticulate, Pterocarpus marsupiam, Swertia chirata, Trigonella foenum graccum*; Liver dysfunction – *Phyllanthus niruri*; Antitumor – *Curcuma longa* Linn.	12	4
5	**Structural Characterization of natural compounds**	Structural Characterization of natural compounds Structural characterization of natural compounds using IR, ^{1}HNMR, ^{13}CNMR and MS Spectroscopy of specific drugs e.g., Penicillin, Morphine, Camphor, Vit-D, Quercetin and Digitalis glycosides.	12	5

Reference Books:

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 – Scikel Runeckles, 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, Krishan Prakashan.
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, 13th edition.
15. Phytochemical methods of Harborne, Springer, Netherlands.
16. Burger's Medicinal Chemistry.

e-Learning Source:

https://www.sciencedirect.com/science/article/pii/S1319016418300392

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	1	1	1	1	1	1	2	2	3	-	3	1	2	-	-	-
CO2	3	3	1	1	1	1	1	1	1	1	2	-	3	1	2	-	-	-
CO3	3	3	1	1	1	1	1	1	1	2	2	-	3	1	2	-	-	-
CO4	3	3	1	1	1	1	1	2	1	1	2	-	3	1	2	-	-	-
CO5	3	3	1	1	1	1	1	1	1	3	2	-	3	1	2	-	-	-

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2018-2019							
Course Code	MPC 105 P	**Title of the Course**	Pharmaceutical Chemistry Practical - I	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**0**	**0**	**12**	**6**
Pre-Requisite	B.Pharm	**Co-requisite**					
Course Objectives	Demonstrate the knowledge regarding drug synthesis, Interpretation, quantitativeand qualitative analysis, estimation of elements and suggest a rational approach for design of new moieties towards potent molecule with a low incidence of adverse effects.						

Course Outcomes	
CO1	Understand basic facts and concept of molecule synthesis
CO2	Comprehend the new area of research and development in organic chemistry
CO3	Knowledge about the Estimation of elements and functional group in natural organic compounds
CO4	Execute the quantitative & qualitative analysis of drugs.
CO5	Interpret the results of spectral and chromatographical techniques.

Unit No.	Title of the Experiments	Content of Unit	Contact Hrs.	Mapped CO
1	UV Spectrophotometry	Analysis of Pharmacopeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation	10	4
2	UV Spectrophotometry	Simultaneous estimation of multi component containing formulations by UV spectrophotometry	10	4
3	Chromatography	Experiments based on Column chromatography	10	4
4	Chromatography	Experiments based on HPLC	10	4
5	Chromatography	Experiments based on Gas Chromatography	10	4
6	Fluorimetry	Estimation of riboflavin/quinine sulphate by fluorimetry	10	3
7	Flame Photometry	Estimation of sodium/potassium by flame photometry	10	3
8	Reactions of synthetic compounds	Purification of organic solvents, column chromatography	10	4
9	Reactions of synthetic compounds	Claisen-schimidt reaction	10	1
10	Reactions of synthetic compounds	Benzyllic acid rearrangement	10	1
11	Reactions of syntheticcompounds	Beckmann rearrangement.	10	1
12	Reactions of synthetic compounds	Hoffmann rearrangement	10	1
13	Reactions of synthetic compounds	Mannich reaction	10	1
14	Medicinal compound synthesis	Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4 experiments)	10	1
15	Estimation of natural compounds	Estimation of elements and functional groups in organic natural compounds	10	3

16	Isolation of Functional compounds	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	4
17	Degradation reaction	Some typical degradation reactions to be carried on selected plant constituent	10	2

Reference Books:

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.
2. Vogel‘s textbook of quantitative chemical analysis - Jeffery J Bassett, J. Mendham, R. C. Denney, 5 th edition, ELBS, 1991.. 102

e-Learning Source:

https://books.google.co.in/books?id=b5WbqDuL0foC&printsec=frontcover&dq=Vogel%E2%80%98s+textbook+of+quantitative+chemical+analysis&hl=en&newbks=1&newbks_redir=1&sa=X&ved=2ahUKEwiElZaN4f37AhVRRmwGHQ-RBlsQ6AF6BAgIEAI

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	2	1	3	3	3	3	3	3	1	3	–	-	-
CO2	3	3	3	2	2	1	3	3	1	3	3	3	1	3	-	-	–
CO3	2	2	2	1	2	1	2	3	1	2	2	3	2	3	-	–	-
CO4	3	3	3	2	3	2	2	2	3	2	3	2	3	3	-	-	-
CO5	3	3	3	2	3	2	2	2	3	2	3	2	2	3	-	-	-

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	MRM 301 T	**Title of the Course**	Research Methodology & Biostatistics	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	4	0	0	4
Pre-Requisite		**Co-requisite**					
Course Objectives	1. Explain the basic requirements for designing the research project. 2. Demonstrate the types of statistical methods. 3. Explain the CPCSEA guidelines for keeping the laboratory animals. 4. Explain the different ethical principles for conducting the clinical trials. 5. Explain the principles declaration of Helsinki and ICG guidelines						

Course Outcomes	
CO1	After studying this subject, students will learn regarding the strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.
CO2	Students can demonstrate different statistical methods for calculation of data such as t test, ANOVA, wilcoxan rank tests etc.
CO3	Students will learn about history, values in medical ethics, autonomy, beneficence, non–maleficence, double effect, conflicts between autonomy and beneficence/non–maleficence, euthanasia, informed consent, confidentiality etc.
CO4	After studying this subject, students can explain the CPCSEA guidelines for laboratory animal facility.
CO5	After studying this subject, students will know the Declaration of Helsinki: History, introduction, basic principles for all medical research,

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	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.	12	3
2	Biostatistics:	Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests(students “t” test, ANOVA, Correlation coefficient, regression), non–parametric tests (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.	12	3
3	Medical Research:	History, values in medical ethics, autonomy, beneficence, non–maleficence, double effect, conflicts between autonomy and beneficence/non–maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.	12	3
4	CPCSEA guidelines for laboratory animal facility:	CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.	12	2

5	Declaration of Helsinki:	History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.	12	3

Reference Books:

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

2.International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996.

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

4.Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, March 2005, John Wiley and Sons.

e-Learning Source:

https://drive.google.com/drive/folders/1W4b4NRhqBQWMC14vsBNZcdc2LWFFmcrd?usp=share_link

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO 1	2	3	3	3	3	3	3	2	3	3	3	-	3	2	3	-	-	
CO 2	3	3	3	3	3	2	2	3	2	2	2	-	2	3	3	-	-	
CO 3	3	2	2	2	2	2	3	1	3	3	3	-	3	3	3	-	-	
CO 4	3	3	3	3	3	2	2	2	3	2	2	-	3	3	3	-	-	
CO 5	3	2	3	3	1	1	3	1	2	3	3	-	2	2	3	-	-	

1- **Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	MRM 301 T	**Title of the Course**	Research Methodology & Biostatistics	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	4	0	0	4
Pre-Requisite		**Co-requisite**					
Course Objectives	1. Explain the basic requirements for designing the research project. 2. Demonstrate the types of statistical methods. 3. Explain the CPCSEA guidelines for keeping the laboratory animals. 4. Explain the different ethical principles for conducting the clinical trials. 5. Explain the principles declaration of Helsinki and ICG guidelines						

Course Outcomes	
CO1	After studying this subject, students will learn regarding the strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.
CO2	Students can demonstrate different statistical methods for calculation of data such as t test, ANOVA, wilcoxan rank tests etc.
CO3	Students will learn about history, values in medical ethics, autonomy, beneficence, non–maleficence, double effect, conflicts between autonomy and beneficence/non–maleficence, euthanasia, informed consent, confidentiality etc.
CO4	After studying this subject, students can explain the CPCSEA guidelines for laboratory animal facility.
CO5	After studying this subject, students will know the Declaration of Helsinki: History, introduction, basic principles for all medical research,

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	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.	12	3
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3	Medical Research:	History, values in medical ethics, autonomy, beneficence, non–maleficence, double effect, conflicts between autonomy and beneficence/non–maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.	12	3
4	CPCSEA guidelines for laboratory animal facility:	CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.	12	2

5	Declaration of Helsinki:	History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.	12	3

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Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO 1	2	3	3	3	3	3	3	2	3	3	3	-	3	2	3	-	-	
CO 2	3	3	3	3	3	2	2	3	2	2	2	-	2	3	3	-	-	
CO 3	3	2	2	2	2	2	3	1	3	3	3	-	3	3	3	-	-	
CO 4	3	3	3	3	3	2	2	2	3	2	2	-	3	3	3	-	-	
CO 5	3	2	3	3	1	1	3	1	2	3	3	-	2	2	3	-	-	

1- **Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

Name & Sign of Program Coordinator	Sign & Seal of HoD