Effective from Session: 2018-19								
Course Code	**MPC101T**	**Title of the Course**	**MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES**	**SDG Goals**	**L**	**T**	**P**	**C**
Year	`I	**Semester**	I		4	-	-	4
Pre-Requisite	B. Pharm.	**Co-requisite**	Knowledge of chemical structures of Pharmaceutical substances					
Course Objectives	After completion of course student is able to know about 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 immunological assays.

UnitNo.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO	SDG Targets
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. 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, Interferences and Applications.	11	1	4.3,4.4,4.5,4.6,4.7, 4.c, 9.2, 9.4, 9.5, 9.b
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.	11	2	4.3,4.4,4.5,4.6,4.7, 4.c, 9.2, 9.4, 9.5, 9.b
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.	11	3	4.3,4.4,4.5,4.6,4.7, 4.c, 9.2, 9.4, 9.5, 9.b
4	**Chromatography**	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	4	4.3,4.4,4.5,4.6,4.7, 4.c, 9.2, 9.4, 9.5, 9.b
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 diffraction methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.	11	5	4.3,4.4,4.5,4.6,4.7, 4.c, 9.2, 9.4, 9.5, 9.b

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	4.3,4.4,4.5,4.6,4.7, 4.c, 9.2, 9.4, 9.5, 9.b

Reference Books:

Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.

Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.

Instrumental methods of analysis – Willards, 7th edition, CBS publishers.

Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.

Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.

Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.

Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol 11, Marcel. Dekker Series

Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd., Delhi.

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**	**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**

Effective from Session: 2016-17								
Course Code	**MPC102T**	**Title of the Course**	**ADVANCED ORGANIC CHEMISTRY-I**	**SDG Goals**	**L**	**T**	**P**	**C**
Year	`I	**Semester**	I	13 CLIMATE ACTION	4	-	-	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.

UnitNo.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO	SDG Targets
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	13.3

Reference Books:
Advanced Organic chemistry, Reaction, Mechanisms and Structure", J March, John Wiley and Sons, New York.
"Mechanism and Structure in Organic Chemistry", ES Gould, Hold Rinchart and Winston, New York.
"Organic Chemistry" Clayden, Greeves, Warren and Woihers., Oxford University Press 2001.
"Organic Chemistry" Vol I and II. I.L. Finar. ELBS, Pearson Education Lts, Dorling Kindersley 9India) Pvt. Ltd.,
A guide to mechanisms in Organic Chemistry, Peter Skyes (Orient Longman, New Delhi).
Reactive Intermediates in Organic Chemistry, Tandom and Gowel, Oxford & IBH Publishers.
Combinational Chemistry – Synthesis and applications – Stephen R Wilson & Anthony W Czarnik, Wiley – Blackwell
Advanced Organic chemistry, Reaction, Mechanisms and Structure", J March, John Wiley and Sons, New York.
"Mechanism and Structure in Organic Chemistry", ES Gould, Hold Rinchart and Winston, New York.
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

	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	2	1	-	1	-	1	-	1	2	2	2	2	2	-	-	-
CO2	3	3	1	-	1	-	1	-	1	2	2	2	3	2	-	-	-
CO3	3	3	2	-	2	-	1	-	1	2	2	1	1	2	-	-	-
CO4	3	3	3	-	1	-	2	-	2	3	3	2	2	2	-	-	-
CO5	3	2	2	-	1	-	2	-	2	2	3	1	2	2	-	-	-

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

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

Effective from Session: 2018-19								
Course Code	**MPC103T**	**Title of the Course**	**ADVANCED MEDICINAL CHEMISTRY**	**SDG Goals**	**L**	**T**	**P**	**C**
Year	`I	**Semester**	I		4	-	-	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.

UnitNo.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO	SDG Targets
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	3.b
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	3.3, 3.b
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	3.b
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	4	3.b
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	3.b

Reference Books:
Medicinal Chemistry by Burger, Vol I –VI...
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
Comprehensive Medicinal Chemistry – Corwin and Hansch
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**	**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**

Effective from Session: 2018-19								
Course Code	**MPC104T**	**Title of the Course**	**CHEMISTRY OF NATURAL PRODUCTS**	**SDG Goals**	**L**	**T**	**P**	**C**
Year	`I	**Semester**	I		4	-	-	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	Understand different types of natural compounds as leads for new pharmaceuticals and their chemistry and medicinal importance..
CO2	Understand the general methods of structural elucidation of compounds of natural origin.
CO3	Understand chemistry and physiological significance of different vitamins and terpenoids.
CO4	Apply different tools of recombinant DNA technology in drug discovery.
CO5	Apply IR, ^{1}HNMR, ^{13}CNMR and MS Spectroscopy in structural characterization of compounds

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO	SDG Targets
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	3.b
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.b
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	3.b
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	3.b
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	3.b

Reference Books:
Modern Methods of Plant Analysis, Peech and M.V.Tracey, Springer –Verlag, Berlin, Heidelberg.
Phytochemistry Vol. I and II by Miller, Jan Nostrant Rein Hld.
Recent advances in Phytochemistry Vol. I to IV – Scikel Runeckles, Springer Science & Business Media.
Chemistry of natural products Vol I onwards IWPAC.
Natural Product Chemistry Nakanishi Gggolo, University Science Books, California.
Natural Product Chemistry "A laboratory guide" – Rapheal Khan.
The Alkaloid Chemistry and Physiology by RHF Manske, Academic Press.
Introduction to molecular Phytochemistry – CHJ Wells, Chapmannstall.
Organic Chemistry of Natural Products Vol I and II by Gurdeep and Chatwall, Himalaya Publishing House.
Organic Chemistry of Natural Products Vol I and II by O.P. Agarwal, Krishan Prakashan.
Organic Chemistry Vol I and II by I.L. Finar, Pearson education.
Elements of Biotechnology by P.K. Gupta, Rastogi Publishers.
Pharmaceutical Biotechnology by S.P.Vyas and V.K.Dixit, CBS Publishers.
Biotechnology by Purohit and Mathur, Agro-Bios, 13th edition.
Phytochemical methods of Harborne, Springer, Netherlands.
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**	**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**

Effective from Session: 2018-19							
Course Code	**MPC105**	**Title of the Course**	**PHARMACEUTICAL CHEMISTRY PRACTICAL-I**	**L**	**T**	**P**	**C**
Year	`I	**Semester**	I	-	-	12	6
Pre-Requisite	B Pharm	**Co-requisite**	--				
Course Objectives	1. 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 Unit	Content of Unit	Contact Hrs.	Mapped CO
1.	**UV Spectrophotometr y**	Analysis of Pharmacopeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation	10	4
2.	**UV Spectrophotometr y**	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 synthetic compounds**	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

e-Learning Source:

https://books.google.co.in/books?id=b5WbqDuL0foC&printsec=frontcover&dq=Vogel%E2%80%98s+textbook+of+quantitative+chemical+analysi&hl=en&newbks=1&newbks_redir=1&sa=X&ved=2ahUKEwiElZaN4f37 AhVRRmwGHQ-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	-	-	-
CO6	3	3	3	3	2	1	3	3	3	3	3	3	1	3	-	-	-

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

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

Effective from Session: 2018-19								
Course Code	**MPC201T**	**Title of the Course**	**ADVANCED SPECTRAL ANALYSIS**	**SDG Goals**	**L**	**T**	**P**	**C**
Year	`I	**Semester**	II		4	-	-	4
Pre-Requisite	B. Pharm.	**Co-requisite**						
Course Objectives	1. Interpretation of the NMR, Mass and IR spectra of various organic compounds 2. Theoretical and practical skills of the hyphenated instruments 3. Identification of organic compounds							

Course Outcomes	
CO1	Explore the pharmaceutical substance by UV Visible and IR spectroscopy.
CO2	Analyze the essentials of NMR spectroscopy.
CO3	Apprehend the analysis of a pharmaceutical substance by mass spectroscopy.
CO4	Recognize the principle, instrumentation and applications of chromatography.
CO5	Deal with the fundamentals of thermal techniques, Raman spectroscopy and radioimmno assay.

UnitNo.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO	SDG Targets
1	**UV and IR spectroscopy**	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	1	4.3,4.4,4.5,4.6,4.7, 4.c, 9.2, 9.4, 9.5, 9.b
2	**NMR spectroscopy**	NMR spectroscopy: 1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds.	12	2	4.3,4.4,4.5,4.6,4.7, 4.c, 9.2, 9.4, 9.5, 9.b
3	**Mass Spectroscopy**	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	3	4.3,4.4,4.5,4.6,4.7, 4.c, 9.2, 9.4, 9.5, 9.b
4	**Chromatography**	Chromatography: Principle, Instrumentation and Applications of the following : a) GC-MS b) GC-AAS c) LC-MS d) LC-FTIR e) LC-NMR f) CEMS g) High Performance Thin Layer chromatography h) Super critical fluid chromatography i) Ion Chromatography j) I-EC (Ion-Exclusion Chromatography) k) Flash chromatography	12	4	4.3,4.4,4.5,4.6,4.7, 4.c, 9.2, 9.4, 9.5, 9.b
5	**Thermal methods of analysis, Raman Spectroscopy and Radio immuno assay**	a) Thermal methods of analysis: Introduction, principle, instrumentation and application of DSC, DTA and TGA. b) Raman Spectroscopy: Introduction, Principle, Instrumentation and Applications. c) Radio immuno assay: Biological standardization , bioassay, ELISA, Radioimmuno assay of digitalis and insulin.	12	5	4.3,4.4,4.5,4.6,4.7, 4.c, 9.2, 9.4, 9.5, 9.b

Reference Books:

Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.

Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.

Instrumental methods of analysis – Willards, 7th edition, CBS publishers.

Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.

Quantitative analysis of Pharmaceutical formulations by HPTLC - P D Sethi, CBS Publishers, New Delhi.

Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.

Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series

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 /

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	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	2	3	2	2	2	3	2	3	3	2	3	-	-	-
CO2	3	3	3	2	3	2	2	2	3	2	3	3	2	3	-	-	-
CO3	3	3	3	2	3	2	2	2	3	2	3	3	2	3	-	-	-
CO4	3	3	3	2	3	2	2	2	3	2	3	3	2	3	-	-	-
CO5	3	3	3	2	3	2	2	2	3	2	3	3	2	3	-	-	-

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

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

Effective from Session: 2018-19								
Course Code	**MPC202T**	**Title of the Course**	**ADVANCED ORGANIC CHEMISTRY-II**	**SDG Goals**	**L**	**T**	**P**	**C**
Year	`I	**Semester**	II		4	-	-	4
Pre-Requisite	B. Pharm.	**Co-requisite**						
Course Objectives	1.The principles and applications of Green chemistry 2. The concept of peptide chemistry. 3.The various catalysts used in organic reactions 4.The concept of stereochemistry and asymmetric synthesis.							

Course Outcomes	
CO1	Understand the techniques principles and applications of green chemistry
CO2	Comprehend the concept of peptide chemistry and synthetic strategies of peptide synthesis.
CO3	Understand the basic concept of Photochemical reactions & mechanism of pericyclic reactions.
CO4	Comprehend the types of catalyst and role of catalyst in organic synthesis
CO5	Knowledge about the basic concept of stereochemistry and asymmetric synthesis

UnitNo.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO	SDG Targets
1	**Green Chemistry**	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.	12	1	13.3
2	**Chemistry of peptides**	Chemistry of peptides 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 12 Hrs 12 Hrs 18 of 27 Faculty of Pharmacy Integral University reactions initiated by proton abstraction, protonation, overactivation and side reactions of individual amino acids.	12	2	------
3	**Photochemical Reactions**	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	12	3	-----
4	**Catalysis**	Catalysis: 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 application	12	4	-----
5	**Stereochemistry & Asymmetric Synthesis**	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	12	5	------

		examples.			
Reference Books:					
Advanced Organic chemistry, Reaction, mechanisms and structure", J March, John Wiley and sons, New York...					
"Mechanism and structure in organic chemistry", ES Gould, Hold Rinchart and Winston,NewYork					
"Organic Chemistry" Clayden, Greeves, Warren and Woihers., Oxford University Press 2001					
"Organic Chemistry" Vol I and II. I.L. Finar. ELBS, Sixth ed., 1995.					
Carey, Organic chemistry, 5th edition (Viva Books Pvt. Ltd.)					
Organic synthesis-the disconnection approach, S. Warren, Wily India					
e-Learning Source:					
https://books.google.com/books/about/March_s_Advanced_Organic_Chemistry.html?id=by05kNKm_xYC					

	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	2	1	-	1	-	1	-	1	3	2	3	1	2	-	-	-
CO2	3	3	2	-	1	-	1	-	2	2	2	3	1	2	-	-	-
CO3	3	2	2	-	2	-	1	-	1	2	2	3	1	2	-	-	-
CO4	3	3	2	-	1	-	1	-	2	2	1	3	1	2	-	-	-
CO5	3	3	2	-	1	-	1	-	2	2	2	3	1	2	-	-	-

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

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

Effective from Session: 2018-19								
Course Code	**MPC203T**	**Title of the Course**	**COMPUTER AIDED DRUG DESIGN**	**SDG Goals**	**L**	**T**	**P**	**C**
Year	`I	**Semester**	II		4	-	-	4
Pre-Requisite	B. Pharm.	**Co-requisite**						
Course Objectives	1. Role of CADD in drug discovery 2. Different CADD techniques and their applications 3. Various strategies to design and develop new drug like molecules. 4. Working with molecular modeling softwares to design new drug molecules 5. The in silico virtual screening protocols							

Course Outcomes	
CO1	Understand CADD techniques and physicochemical parameters in drug design
CO2	Apply different physicochemical properties and the QSAR analysis techniques in novel drug design.
CO3	Know various strategies to design and develop new drug like molecules by various structure-based drug design methods such as molecular docking.
CO4	Know various strategies to design and develop new drug like molecules by de novo drug design.
CO5	Work with molecular modeling softwares to design new drug molecules (Virtual Screening).

UnitNo.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO	SDG Targets
1	**Introduction to Computer Aided Drug Design (CADD)**	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.	12	1	4.3,4.4,4.5,4.6,4.7, 4.c, 9.4, 9.5, 9.b
2	**Quantitative Structure Activity Relationships: Applications**	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.	12	2	4.3,4.4,4.5,4.6,4.7, 4.c, 9.4, 9.5, 9.b
3	**Molecular Modeling and Docking**	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)	12	3	4.3,4.4,4.5,4.6,4.7, 4.c, 9.4, 9.5, 9.b
4	**Molecular Properties and Drug Design**	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.	12	4	4.3,4.4,4.5,4.6,4.7, 4.c, 9.4, 9.5, 9.b
5	**Pharmacophore Mapping and Virtual Screening**	Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping. In Silico Drug Design and Virtual Screening Techniques Similarity based methods and Pharmacophore based screening, structure based In-silico virtual screening protocols.	12	5	4.3,4.4,4.5,4.6,4.7, 4.c, 9.4, 9.5, 9.b

Reference Books:

Computational and structural approaches to drug discovery, Robert M Stroud and Janet. F Moore, RCS Publishers.

Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor & Francis group..

Drug Design by Ariens Volume 1 to 10, Academic Press, 1975, Elsevier Publishers.

Principles of Drug Design by Smith and Williams, CRC Press, Taylor & Francis

The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, Elsevier Publishers.

Medicinal Chemistry by Burger, Wiley Publishing Co.

An Introduction to Medicinal Chemistry –Graham L. Patrick, Oxford University Press

Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ippincott Williams & Wilkins.

Comprehensive Medicinal Chemistry – Corwin and Hansch, Pergamon Publishers.
Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore
e-Learning Source:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5248982/

	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	1	3	3	2	3	1	1	3	2	3	3	3	1	2	-	-	-
CO2	1	3	2	2	3	1	1	3	2	3	3	3	1	2	-	-	-
CO3	1	3	3	2	3	1	1	3	2	3	3	2	2	3	-	-	-
CO4	1	3	3	2	3	1	1	3	2	3	3	3	1	2	-	-	-
CO5	1	3	3	2	3	1	1	3	2	3	3	2	1	2	-	-	-

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

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

Effective from Session: 2018-19								
Course Code	**MPC204T**	**Title of the Course**	**PHARMACEUTICAL PROCESS CHEMISTRY**	**SDG Goals**	**L**	**T**	**P**	**C**
Year	`I	**Semester**	II		4	-	-	4
Pre-Requisite	B. Pharm.	**Co-requisite**						
Course Objectives	1. The strategies of scale up process of apis and intermediate 2. The various unit operations and various reactions in process chemistry							

Course Outcomes	
CO1	Students can able to understand the synthetic strategy of Process chemistry.
CO2	Students can able to understanding the aromatic nitration and its kinetics.
CO3	Students can understand the production of various drugs via fermentation.
CO4	Students will have information on various unit operations used in pharmaceutical industry.
CO5	Students will be familiar with different safety measures to be taken in various pharmaceutical operations

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO	SDG Targets
1	**Process chemistry**	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	12	1	9.4, 9.5, 9.b
2	**Unit operations**	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.	12	2	-------
3	**Unit Processes - I**	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.	12	3	-------
4	**Unit Processes - II**	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: B_2 and B_{12} 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.	12	4	------
5	**Industrial Safety**	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.	12	5	9.4, 9.5, 9.b

Reference Books:

Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever-changing climate An overview, CRC press.

Medicinal Chemistry by Burger, 6 th edition, Volume 1-8.

Polymorphism in Pharmaceutical Solids .Dekker Series Volume 95 Ed: H G Brittain (1999).
Peter J. Harrington: Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up.
e-Learning Source:
http://www.freebookcentre.net/Chemistry/Medicinal-Chemistry-Books.html
https://eodfnons.typepad.com/blog/2012/02/download-bentley-and-drivers-text-book-of-pharmaceutical-chemistry-ebook.html

	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	2	3	2	2	2	3	2	3	2	2	1	-	-	-
CO2	3	3	3	2	3	3	2	3	3	3	3	2	2	2	-	-	-
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	1	2	2	-	-	-
CO5	3	3	3	2	3	2	2	2	3	2	3	2	3	2	-	-	-

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

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

Effective from Session: 2018-19							
Course Code	**MPC205**	**Title of the Course**	**PHARMACEUTICAL CHEMISTRY PRACTICAL-II**	**L**	**T**	**P**	**C**
Year	`I	**Semester**	II	-	-	12	-
Pre-Requisite	B Pharm	**Co-requisite**	--				
Course Objectives	1. Demonstrate the knowledge of drug synthesis and suggest a rational approach for design of new moieties towards potent molecule with a low incidence of adverse effects.						

Course Outcomes	
CO1	Understand the methods of preparation, chemical reactions including mechanism and reactivity of some medicinal compounds.
CO2	Design and adopt the reaction schemes for the synthesis of diverse medicinal compounds along with their characterizations
CO3	Understand the regulatory requirements for active pharmaceutical ingredients
CO4	Utilization of computational tools
CO5	Execute the qualitative and quantitative analysis of drugs spectral techniques

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1.	**Synthesis of organic compounds by adapting different approaches involving (3 experiments)**	a) Oxidation b) Reduction/hydrogenation c) Nitration	10	2
2.	**Comparative study**	comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments	10	2
3.	**Assignments**	Assignments on regulatory requirements in API (2 experiments	10	3
4.	**Comparison**	Comparison of absorption spectra by UV and Wood ward – Fieser	10	5
5.	**Interpretation**	Interpretation of organic compounds by FT-IR	10	5
6.	**Interpretation**	Interpretation of organic compounds by NMR	10	5
7.	**Interpretation**	Interpretation of organic compounds by MS	10	5
8.	**Determination**	Determination of purity by DSC in pharmaceuticals	10	2
9.	**Identification**	Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra	10	5
10.	**To carry out the preparation of following organic compounds**	Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl).	10	2
11.	**Reduction**	NaBH4 reduction of vanillin to vanillyl alcohol	10	1
12.		Preparation of umbelliferone by Pechhman reaction	10	1
13.		Preparation of triphenyl imidazole	10	1
14.	**Microwave irradiation**	To perform the Microwave irradiated reactions of synthetic importance (Any two)	10	2
15.	**Determination using softwares**	Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using softwares	10	4
16.	**Calculation using software's**	Calculation of ADMET properties of drug molecules and its analysis using software's	10	4
17.	**Pharmacophore modeling**	2D-QSAR based experiments	10	4
18.	**Pharmacophore modeling**	3D-QSAR based experiments	10	4
19.	**Pharmacophore modeling**	Docking study-based experiment	10	4
20.	**Pharmacophore modeling**	Virtual screening-based experiment	10	4

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	2	2	1	1	3	2	2	2	2	3	2	3	-	-	-
CO2	3	3	3	1	2	1	2	2	2	3	3	3	2	3	-	-	-
CO3	3	3	3	2	3	2	2	2	3	2	3	3	2	3	-	-	-
CO4	3	3	3	2	3	2	2	2	3	2	3	3	2	3	-	-	-
CO5	3	3	3	2	3	2	2	2	3	2	3	2	2	3	-	-	-
CO6	3	3	2	2	1	1	3	2	2	2	2	3	2	3	-	-	-

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

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

Effective from Session: 2019-20								
Course Code	**MPC301T**	**Title of the Course**	**RESEARCH METHODOLOGY & BIOSTATISTICS**	**SDG Goals**	**L**	**T**	**P**	**C**
Year	`I	**Semester**	III		4	-	-	4
Pre-Requisite	B. Pharm.	**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	SDG Targets
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:

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

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.

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

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