ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYAL SCHOOL OF PHARMACY
(RSP)

Master of Pharmacy (M. Pharm)

SYLLABUS
&
COURSE STRUCTURE

M. Pharm. (Pharmaceutical Chemistry)

PCI Syllabus 2016

M. PHARM. (PHARMACEUTICAL CHEMISTRY)

Programme Structure

Semester-I							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	MPC101T	Modern Pharmaceutical Analytical Techniques	3	1	0	4	4
2	MPC102T	Advanced Organic Chemistry-I	3	1	0	4	4
3	MPC103T	Advanced Medicinal Chemistry	3	1	0	4	4
4	MPC104T	Chemistry of Natural Products	3	1	0	4	4
5	MPC105P	Pharmaceutical Chemistry Practical I	0	0	12	6	12
6	MPC106S	Seminar / Assignment	0	0	7	4	7
		TOTAL	**12**	**4**	**19**	**26**	**35**

Semester-II							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	MPC201T	Advanced Spectral Analysis	3	1	0	4	4
2	MPC202T	Advanced Organic Chemistry-II	3	1	0	4	4
3.	MPC203T	Computer Aided Drug Design	3	1	0	4	4
4.	MPC204T	Pharmaceutical Process Chemistry	3	1	0	4	4
5.	MPC205P	Pharmaceutical Chemistry Practical II	0	0	12	6	12
6.	MPC206S	Seminar / Assignment	0	0	7	4	7
		TOTAL	**12**	**4**	**19**	**26**	**35**

Semester III							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	MRM301T	Research Methodology and Biostatistics	3	1	0	4	4
2	MPC302S	Journal Club	0	0	1	1	1
3	MPC303P	Discussion / Presentation (Proposal Presentation)	0	0	2	2	2
4	MPC304P	Research Work	0	0	28	14	28
		TOTAL	**3**	**1**	**31**	**21**	**35**

Semester IV							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	MPC401S	Journal Club	0	0	1	1	1
2	MPC402P	Research Work	0	0	31	16	31
3	MPC403P	Discussion / Final Presentation	0	0	3	3	3
4	MPC404S	Co-curricular Activities					
		TOTAL	**0**	**0**	**35**	**20**	**35**

Table–1: Semester wise credits distribution

Semester	Credit Points
I	26
II	26
III	21
IV	20
*Co-curricular Activities (a) Participation in National Level Seminar/Conference/Workshop/Symposium/Training Programs (related to the specialization of the student - 01) (b) Research / Review Publication in National Journals (Indexed in Scopus / Web of Science – 01)	Minimum = 02* / Maximum = 07
Total Credit Points	**Minimum = 95** **Maximum = 100**

Scheme of Evaluation

Theory Papers (T):

- **Internal assessment: 25%**
- **End Term Examination:75%**

Practical Papers (P):

- **Internal assessment: 30%**
- **End Term Examination: 70%**

Internal assessment : Continuous mode

The marks allocated for Continuous mode of Internal Assessment shall be awarded as per the scheme given below:

Table–2: Scheme for awarding internal assessment: Continuous mode

Theory	
Criteria	**Maximum Marks**
Attendance (Refer Table–3)	8
Student–Teacher interaction	2
Total	10
Practical	
Attendance (Refer Table–3)	10
Based on Practical Records, Regular viva-voce, etc.	10
Total	20

Table–3: Guidelines for the allotment of marks for attendance

Percentage of Attendance	**Theory**	**Practical**
95-100	8	10
90-94	6	7.5
85-89	4	5
80-84	2	2.5
Less than 80	0	0

Paper I / Subject Name: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MPC 101T)

L-T-P-C – 4-0-0-4 **Credit Units:4** **Scheme of Evaluation:(T)**

Objective: 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.

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

CO1: Understand the operation and applications of modern analytical instruments used in drug analysis, including UV-Visible, IR, Spectrofluorimetry, flame emission, and atomic absorption spectroscopy.

CO2: Understand the principles of NMR and mass spectroscopy and learn to interpret data for identifying organic compounds.

CO3: Understand chromatographic separation processes and apply them to the analysis of pharmaceutical compounds, gaining practical skills in chromatography and electrophoresis techniques.

CO4: Explore X-ray crystallography and immunological assays (RIA, ELISA) for characterizing and quantifying biological compounds. Develop skills in drug analysis using advanced techniques, and learn to interpret NMR, Mass, and IR spectra for identifying and characterizing organic compounds.

Detailed Syllabus:

Module	Topics (if applicable)/Course Content	Hours
I.	**UV-Visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy. **IR spectroscopy:** Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier-Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation. **Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence (Characteristics of drugs that can be analysed by fluorimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **Flame emission spectroscopy and atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and Applications.	15 hrs
II.	**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	15 hrs

	coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR 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.	
III.	**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	15 hrs
IV.	**Electrophoresis:** Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing **X ray Crystallography:** Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction. **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 advantages and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). **TGA:** Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.	15 hrs
TOTAL		**60 hrs**

Text Books:

1. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
2. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
3. Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol 11, Marcel. Dekker Series.
4. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd., Delhi.
5. Textbook of Pharmaceutical Analysis, KA.Connors, 3rd Edition, John Wiley & Sons, 1982.

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. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
4. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.

Teaching Learning Process and Assessment Methods:

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	**CO1:** Students will understand and apply principles of UV-Visible, IR, and Spectrofluorimetry, as well as flame emission and atomic absorption spectroscopy in drug analysis.	Traditional teaching, PPT	Class tests, assignments, MCQs
II.	**CO2:** Students will understand the principles of ionization and mass fragmentation and learn to interpret Mass and NMR spectroscopy data.	Traditional teaching, PPT	Class tests, assignments, MCQs
III.	**CO3:** Students will gain practical skills in chromatography and electrophoresis techniques for the separation and analysis of compounds.	Traditional teaching, PPT	Class tests, assignments, MCQs
IV.	CO4: Students will explore X-ray crystallography methods and immunological assays (RIA, ELISA) for the characterization and quantification of biological compounds.	Traditional teaching, PPT	Class tests, assignments, MCQs

Paper II / Subject Name: ADVANCED ORGANIC CHEMISTRY- I (MPC 102T)

L-T-P-C – 4-0-0-4 **Credit Units:4** **Scheme of Evaluation:(T)**

Objective: 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.

Course Outcome: Upon completion of the course the student will be able to

CO1: Concept on organic chemistry, retrosynthesis and various name reactions and their significances.

CO2: Understand the disconnection concept to develop synthetic routes for target molecules.

CO3: Develop the understanding for different catalysts in organic reactions and importance of different heterocyclic compounds in the synthesis of drugs.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Period
I.	**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. 4. Addition reactions: a) Nucleophilic uni- and bimolecular reactions (SN1 and SN2) b) Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule) c) Rearrangement reaction. 5. 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.	24 hrs
II.	**Synthetic Reagents & Applications:** Aluminium isopropoxide, 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:**	12 hrs

	a) Role of protection in organic synthesis b) Protection for the hydroxyl group, including 1,2- and 1,3-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	
III.	**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 hrs
IV.	**Synthon approach and retrosynthesis applications** i. Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group interconvertion 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 hrs
TOTAL		**60 hours**

Text Books:

1. Advanced Organic chemistry, Reaction, Mechanisms and Structure", J March, John Wiley and Sons, New York.
2. Morrison and Boyd, Organic Chemistry , 7th Edition, 2010

Reference Books:

1. Reactive Intermediates in Organic Chemistry, Tandom and Gowel, Oxford & IBH Publishers.
2. Combinational Chemistry – Synthesis and applications – Stephen R Wilson & Anthony W Czarnik, Wiley Blackwell.
3. "Organic Chemistry" Clayden, Greeves, Warren and Woihers., Oxford University Press 2001

Journals

1. Journal of Chemistry Part A7B
2. The Journal of Organic Chemistry, ACS Publications

Teaching Learning Process and Assessment Methods

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I., II.	**CO1:** Concept on organic chemistry, retrosynthesis and various name reaction.	Classroom lectures though online resources, Educational Software's, digital simulations, concept videos, practical demonstrations, case-based presentations, scientific report discussions (Research articles, research reports etc.)	Seminar, quiz, assignments, journal club, problem-based assignments, report writing, Internal assessments (Sessional exams), continuous evaluation) and End Sem Examinations.
III.	**CO2:** Understand the disconnection concept to develop synthetic routes for target molecules	Classroom lectures though online resources, Educational Software's, digital simulations, concept videos, practical demonstrations, case-based presentations, scientific report discussions (Research articles, research reports etc.)	Seminar, quiz, assignments, journal club, problem-based assignments, report writing, Internal assessments (Sessional exams), continuous evaluation) and End Sem Examinations.
IV.	**CO3:** Develop the understanding for different catalysts in organic reaction and importance of different heterocyclic compounds	Classroom lectures though online resources, Educational Software's, digital simulations, concept videos, practical demonstrations, case-based presentations, scientific report discussions (Research articles, research reports.	Seminar, quiz, assignments, journal club, problem-based assignments, report writing, Internal assessments (Sessional exams), continuous evaluation) and End Sem Examinations.

Paper III / Subject Name: ADVANCED MEDICINAL CHEMISTRY (Theory) (MPC 103T)

L-T-P-C – 4-0-0-4 **Credit Units: 4** **Scheme of Evaluation: (T)**

Objective: 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.

Course Outcome: At completion of this course, it is expected that students will be able to understand.

CO1: Different stages of drug discovery.

CO2: Role of medicinal chemistry in drug research.

CO3: Different techniques for drug discovery.

CO4: Various strategies to design and develop new drug like molecules for biological targets and peptidomimetics.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	**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. **Prodrug design:** Basic concept, Carrier linked prodrugs/Bio precursors, 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.	16 hrs
II.	**Prodrug Design and Analog design:** **Combating drug resistance:** Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance. **Analog Design:** Introduction, Classical & Non classical, Bio isosteric 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. Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of following class of drugs: Anti-hypertensive drugs, Psychoactive drugs, Anticonvulsant drugs.	16 hrs
III.	**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:	12 hrs

	H1 & H2 receptor antagonist, COX1 & COX2 inhibitors, Adrenergic & Cholinergic agents, Antineoplastic and Antiviral agents. **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.	
IV.	**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. **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.	16 hrs
TOTAL		**60 hours**

Text Books:

1. Comprehensive Medicinal Chemistry – Corwin and Hansch.
2. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore.
3. Introduction to Quantitative Drug Design by Y.C. Martin.
4. Principles of Medicinal Chemistry by William Foye, 7th Edition, Lppincott Williams & Wilkins, Woltess Kluwer (India) Pvt. Ltd, New Delhi.
5. Drug Design Volumes by Arienes, Academic Press, Elsevier Publishers, Noida, Uttar Pradesh.
6. Principles of Drug Design by Smith.
7. An Introduction to Medicinal Chemistry, Graham L.Patrick, III Edition, Oxford University Press, USA.
8. Biopharmaceutics and pharmacokinetics, D.M. Brahmankar, Sunil B. Jaiswal II Edition, 2014, Vallabh Prakashan, New Delhi.

Reference Books:

1. Medicinal Chemistry by Burger, Vol I –VI.
2. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, 12th Edition, Lppincott Williams & Wilkins, Woltess Kluwer (India) Pvt. Ltd, New Delhi.
3. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, II Edition, Elsevier Publishers, New Delhi.
4. Peptidomimetics in Organic and Medicinal Chemistry by Antonio Guarna and Andrea Trabocchi, First edition, Wiley publishers.

Teaching Learning Process and Assessment Methods

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	**CO1:** Students will be able to understand the stages of drug discovery, lead discovery; identification, validation, and diversity of drug target.	Traditional chalk and board teaching and power point presentations.	Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session, seminar.
II.	**CO2:** Students will be able to understand how to combat drug resistance, analog design and SAR studies of some important classes of drugs.	Traditional chalk and board teaching, power point presentations.	MCQs, regular discussions, internal assessments, seminar.
III.	**CO2, CO3:** Students will be able to understand the SAR, Mechanism of action and synthesis of new generation molecules of some important classes of drugs.	Traditional teaching and regular discussions and power point presentations.	Test and MCQs, assignments, internal assessments, seminar.
IV.	**CO4:** Students will be able to understand the Rational Design of Enzyme Inhibitors, Peptidomimetics	Class conduction using board and power point presentation.	Test and MCQs, assignments, internal assessments, Seminar.

Paper IV / Subject Name: CHEMISTRY OF NATURAL PRODUCTS (Theory)

(MPC 104T)

L-T-P-C – 4-0-0-4 **Credit Units: 4** **Scheme of Evaluation: (T)**

Objective: 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.

Course Outcome: Upon completion of this course the student should be able to

CO1: Understand the different types of natural compounds and their chemistry and medicinal importance.

CO2: Understand the importance of natural compounds as lead molecules for new drug discovery.

CO3: Understand the concept of rDNA technology tool for new drug discovery.

CO4: Study the general methods of structural elucidation of compounds of natural origin and know the isolation, purification and characterization of simple chemical constituents from natural source.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	**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 macrolide antibiotics (Erythromycin, Azithromycin, Roxithromycin, and Clarithromycin) and β-Lactam antibiotics (Cephalosporins and Carbapenem)	12 hrs
II.	**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**	12 hrs

	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).	
III.	**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 triterpenoids (Squalene, Ginsenoside) carotinoids (β carotene). **b) Vitamins** Chemistry and Physiological significance of Vitamin A, B1, B2, B12, C, E, Folic acid and Niacin. **c) 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.	18 hrs
IV.	a) **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. **b) 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.	18 hrs
TOTAL		**60 hours**

Text 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 W ells, 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. Elements of Biotechnology by P.K. Gupta, Rastogi Publishers.
12. Biotechnology by Purohit and Mathur, Agro-Bios, 13th edition.

Reference Books:

1. Organic Chemistry Vol I and II by I.L. Finar, Pearson education.
2. Pharmaceutical Biotechnology by S.P. Vyas and V.K. Dixit, CBS Publishers.
3. Phytochemical methods of Harborne, Springer, Netherlands.
4. Burger's Medicinal Chemistry.

Teaching Learning Process and Assessment Methods

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	**CO1:** Students will learn the different types of natural products as leads for new pharmaceuticals.	Teaching will be conducted both through black board mode and power point presentation mode.	Oral questions will be asked in the class. Students will be given to prepare power point presentation on the assigned topics related to the class teachings.
II.	**CO2:** Students will understand the importance of natural compounds as lead molecules for new drug discovery.	Teaching will be conducted both through black board mode and power point presentation mode.	Unit assessment by multiple choice questions (MCQs), internal assessments, Question answer sessions.
III.	**CO3:** Understand the concept of rDNA technology tool for new drug discovery.	Traditional teaching and regular discussion and power point presentations.	Regular question answer sessions, and Unit-test for internal assessment
IV.	**CO2, CO4:** Study the general methods of structural elucidation of compounds and know the isolation, purification and characterization of simple chemical constituents from natural source.	Class conduction using board and power point presentation.	Class tests, Quiz, Assignments.

PHARMACEUTICAL CHEMISTRY PRACTICAL I (MPC105P)

12 Hours/Week

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	1. Analysis of Pharmacopoeial 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.	12 hrs/wk
II.	To perform the following reactions of synthetic importance 8. Purification of organic solvents, column chromatography. 9. Claisen-schimidt reaction. 10. Benzyllic acid rearrangement. 11. Beckmann rearrangement. 12. Hoffmann rearrangement. 13. Mannich reaction.	12 hrs/wk
III.	14. Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4 experiments)	12 hrs/wk
IV.	15. Estimation of elements and functional groups in organic natural compounds. 16. 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. 17. Some typical degradation reactions to be carried on selected plant constituents.	12 hrs/wk
TOTAL		**180 hours**

Paper I / Subject Name: ADVANCED SPECTRAL ANALYSIS (MPC 201T)		
L-T-P-C – 4-0-0-4	**Credit Units: 4**	**Scheme of Evaluation: (T)**

Objective: 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.

Course Outcome: At completion of this course, it is expected that students will be able to understand

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

CO2: Interpretation of the Mass spectra of various organic compounds.

CO3: Theoretical and practical skills of the hyphenated instruments.

CO4: Identification of organic compounds.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	**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. **NMR spectroscopy** 1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds.	15 hrs
II.	**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.	15 hrs
III.	**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	15 hrs
IV.	**Thermal methods of analysis** Introduction, principle, instrumentation, and application of DSC, DTA and TGA.	15 hrs

	Raman Spectroscopy Introduction, Principle, Instrumentation and Applications. **Radio immuno assay** Biological standardization, bioassay, ELISA, Radioimmuno assay of digitalis and insulin.	
TOTAL		**60 hours**

Text Books:

1. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
2. Quantitative analysis of pharmaceutical formulations by HPTLC - P D Sethi, CBS Publishers, New Delhi.
3. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
4. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series 87.

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.

Teaching Learning Process and Assessment Methods

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	**CO1, CO4:** Students will be able to understand the different types of spectroscopies such as UV, IR, NMR spectroscopy, and Interpretation of organic compounds.	Traditional chalk and board teaching and power point presentations.	Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session, seminar.
II.	**CO2, CO4:** Students will be able to understand about mass spectrometry and Interpretation of organic compounds.	Traditional chalk and board teaching, power point presentations.	MCQs, regular discussions, internal assessments, seminar.
III.	**CO3:** Students will be able to understand various chromatographic techniques and their principle, instrumentation, and applications.	Traditional teaching and regular discussions and power point presentation	Test and MCQs, assignments, internal assessments, seminar.
IV.	**CO4:** Students will be able to understand thermal methods of analysis, Raman spectroscopy, and Radio immune assays.	Class conduction using board and power point presentation.	Test and MCQs, assignments, internal assessments, seminar.

Paper II / Subject Name: ADVANCED ORGANIC CHEMISTRY–II (MPC 202T)

L-T-P-C – 4-0-0-4 **Credit Units: 4** **Scheme of Evaluation: (T)**

Objective: 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.

Course Outcome: At completion of this course, it is expected that students will be able to understand

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.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	**Green Chemistry** Introduction, principles of green chemistry. **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. **Ultrasound assisted reactions** Types of sonochemical reactions, homogenous, heterogeneous liquid-liquid and liquid-solid reactions, synthetic applications. **Continuous flow reactors** Working principle, advantages, and synthetic applications.	15 hrs
II.	**Chemistry of peptides** • Coupling reactions in peptide synthesis. • 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.	15 hrs

	• Segment and sequential strategies for solution phase peptide synthesis with any two case studies. • Side reactions in peptide synthesis: Deletion peptides, side reactions initiated by proton abstraction, protonation, overactivation and side reactions of individual amino acids.	
III.	**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. **Catalysis** • Types of catalysis, heterogeneous and homogenous catalysis, advantages, and disadvantages. • Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts, catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs. • 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. • Transition-metal and Organo-catalysis in organic synthesis: Metal-catalyzed reactions. • Biocatalysis: Use of enzymes in organic synthesis, immobilized enzymes/cells in organic reaction. • Phase transfer catalysis - theory and applications	18 hrs
IV.	**Stereochemistry & Asymmetric Synthesis** • 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. • Methods of asymmetric synthesis using chiral pool, chiral auxiliaries and catalytic asymmetric synthesis, enantiopure separation and Stereo selective synthesis with examples.	12 hrs
TOTAL		**60 hours**

Text Books:

1. "Organic Chemistry" Vol I and II. I.L. Finar. ELBS, Sixth ed., 1995.
2. Carey, Organic chemistry, 5th edition (Viva Books Pvt. Ltd.)
3. Organic synthesis-the disconnection approach, S. Warren, Wily India
4. Principles of organic synthesis, ROCNorman and JMCoxan, Nelson thorns
5. Organic synthesis- Special techniques VK Ahluwalia and R Aggarwal, Narosa Publishers.
6. Organic reaction mechanisms IV edtn, VK Ahluwalia and RK Parashar, Narosa Publishers.

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,NewYork.
3. "Organic Chemistry" Clayden, Greeves, Warren and Woihers., Oxford University Press 2001.

Teaching Learning Process and Assessment Methods

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	**CO1:** Students will be able to understand about the green chemistry, microwave assisted reactions, ultrasound assisted reactions, Continuous flow reactors.	Traditional chalk and board teaching and power point presentations.	Unit assessment by multiple choice questions (MCQs), internal assessments, regular question answer session, seminar.
II.	**CO2:** Students will be able to understand about Coupling reactions in peptide synthesis, principles of solid phase peptide synthesis, solution phase peptide synthesis.	Traditional chalk and board teaching, power point presentations.	MCQs, regular discussions, internal assessments, seminar.
III.	**CO3:** Students will be able to understand the basic principles of photochemical reactions. photo-oxidation, photo-addition, and photo-fragmentation, types of catalysis, heterogeneous and homogenous catalysis, advantages, and disadvantages.	Traditional teaching and regular discussions and power point presentations.	Test and MCQs, assignments, internal assessments, seminar.
IV.	**CO4:** Students will be able to understand transition-metal and Organo-catalysis in organic synthesis: Metal-catalyzed reactions, biocatalysis, Stereochemistry & Asymmetric Synthesis.	Class conduction using board and power point presentations.	Test and MCQs, assignments, internal assessments, seminar.

Paper III / Subject Name: COMPUTER AIDED DRUG DESIGN (MPC 203T)

L-T-P-C – 4-0-0-4 **Credit Units: 4** **Scheme of Evaluation: (T)**

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

Course Outcome: At completion of this course, it is expected that students will be able to understand.

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 software's to design new drug molecules and the in silico virtual screening protocols.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	**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 hrs
II.	**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 hrs
III.	**Molecular Modeling and Docking** • Molecular and Quantum Mechanics in drug design. • Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation. • Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra-precision docking.	18 hrs

	Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE & BchE). • Prediction and analysis of ADMET properties of new molecules and its importance in drug design.	
IV.	**Molecular Properties and Drug Design** • 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. • Homology modeling and generation of 3D-structure of protein. **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.	18 hrs
TOTAL		**60 hours**

Text Books:

1. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, Elsevier Publishers.
2. Medicinal Chemistry by Burger, Wiley Publishing Co.
3. An Introduction to Medicinal Chemistry –Graham L. Patrick, Oxford University Press.
4. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ippincott Williams & Wilkins.
5. Comprehensive Medicinal Chemistry – Corwin and Hansch, Pergamon Publishers.
6. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore.

Reference Books:

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.

Teaching Learning Process and Assessment Methods

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	**CO1, CO2:** Students will be able to understand Computer Aided Drug Design (CADD) and the role of CADD in drug discovery.	Traditional chalk and board teaching and power point presentations.	Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session, seminar.
II.	**CO1, CO2:** Students will be able to understand QSAR, 2D-QSAR, 3D-QSAR and the different CADD techniques and their applications.	Traditional chalk and board teaching, power point presentations.	MCQs, regular discussions, internal assessments, seminar.
III	**CO3, CO4:** Students will be able to understand the Various strategies to design and develop new drug like molecules.	Traditional teaching and regular discussions and power point presentations.	Test and MCQs, assignments, internal assessments, seminar.
IV	**CO3, CO4:** Students will be able to understand the working with molecular modeling softwares to design new drug Molecules and the *in silico* virtual screening protocols.	Class conduction using board and power point presentation.	Test and MCQs, assignments, internal assessments, Seminar.

Paper IV / Subject Name: PHARMACEUTICAL PROCESS CHEMISTRY (MPC 204T)

L-T-P-C – 4-0-0-4 **Credit Units: 4** **Scheme of Evaluation: (T)**

Objective: 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.

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

CO1: The strategies of scale up process of APIs and intermediates.

CO2: The various unit operations in process chemistry.

CO3: The various reactions in process chemistry.

CO4: The various industrial safety management.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	**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 AP Is. Impurities in API, types and their sources including genotoxic impurities	12 hrs
II.	**Unit operations** • **Extraction:** Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction. • **Filtration:** Theory of filtration, pressure and vacuum filtration, centrifugal filtration. • **Distillation:** azeotropic and steam distillation. • **Evaporation:** Types of evaporators, factors affecting evaporation.	12 hrs

	• **Crystallization:** Crystallization from aqueous, non-aqueous solutions factors affecting crystallization, nucleation. Principle and general methods of P reparation of polymorphs, hydrates, solvates and amorphous APIs.	

III.	**Unit Processes-I**
	• Nitration: Nitrating agents, Aromatic nitration, kinetics and mechanism of aromatic nitration, process equipment for technical nitration, mixed acid for nitration.
	• Halogenation : Kinetics of halogenations, types of halogenations, catalytic halogenations. Case study on industrial halogenation process.
	• 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.
	Unit Processes-II
	• Reduction: Catalytic hydrogenation, Heterogeneous and homogeneous catalyst; Hydrogen transfer reactions, Metal hydrides. Case study on industrial reduction process.
	• Fermentation: Aerobic and anaerobic fermentation.
	Production of
	  • Antibiotics; Penicillin and Streptomycin
	  • Vitamins: B2 and B12
	  • Statins: Lovastatin, Simvastatin
		18 hrs

IV.	**Unit Processes-II**
	• Reaction progress kinetic analysis
	  • Streamlining reaction steps, route selection
	  • Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up.
	
	Industrial Safety
	• MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal Protection Equipment (PPE)
	• Fire hazards, types of fire & fire extinguishers
	• Occupational Health & Safety Assessment Series 1800 (OHSAS-1800) and ISO-14001 (Environmental Management System), Effluents and its management
		18 hrs

TOTAL		**60 hours**

Text Books:

1. Process Chemistry in the Pharmaceutical Industry : Challenges in an Ever-Changing Climate-An Overview; K. Gadamasetti, CRC Press.
2. Medicinal Chemistry by Burger, 6 edition, Volume 1-8.
3. W.L. McCabe, J.C Smith, Peter Harriott. Unit operations of chemical engineering, 7th edition, McGraw Hill
4. Polymorphism in Pharmaceutical Solids. Dekker Series Volume 95 Ed: H G Brittain (1999)
5. Regina M. Murphy: Introduction to Chemical Processes: Principles, Analysis, Synthesis
6. Peter J. Harrington: Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up
7. P. H. Groggins : Unit processes in organic synthesis (MGH)
8. F. A. Henglein : Chemical Technology (Pergamon)
9. M. Gopal : Dryden's Outlines of Chemical Technology, WEP East-West Press
10. Lowenheim & M.K. Moran: Industrial Chemicals
11. S.D. Shukla & G.N. Pandey: A text book of Chemical Technology Vol. II, Vikas Publishing House
12. J.K. Stille: Industrial Organic Chemistry (PH)

Reference Books:

1. Pharmaceutical Manufacturing Encyclopedia, 3 edition, Volume 2.
2. Clausen, Mattson : Principle of Industrial Chemistry, Wiley Publishing Co.
3. Shreve: Chemical Process, Mc Grawhill.
4. B. K. Sharma: Industrial Chemistry, Goel Publishing House
5. ICH Guidelines
6. United States Food and Drug Administration official website www.fda.gov

Teaching Learning Process and Assessment Methods

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	**CO1:** Students will be able to understand about process chemistry, stages of scale up process, case studies of scale up process of APIs and about the impurities in API.	Traditional chalk and board teaching and power point presentations.	Unit assessment by multiple choice questions (MCQ), internal assessments, regular question answer session, seminar.
II.	**CO2:** Students will learn about the various unit operations.	Traditional chalk and board teaching, power point presentations.	MCQs, regular discussions, internal assessments, seminar.
III.	**CO3:** Students will learn about the various unit processes.	Traditional teaching and regular discussions and power point presentation	Test and MCQs, assignments, internal assessments, seminar.
IV.	**CO3, CO4:** Students will learn about the various unit processes and about industrial safety.	Class conduction using board and power point presentation.	Test and MCQs, assignments, internal assessments, seminar.

PHARMACEUTICAL CHEMISTRY PRACTICALS – II (MPC 205P)

12 Hours/Week

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	1. Synthesis of organic compounds by adapting different approaches (3 experiments): a) Oxidation b) Reduction/hydrogenation c) Nitration 2. Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments)	12 hrs/wk
II.	3. Assignments on regulatory requirements in API (2 experiments) 4. Comparison of absorption spectra by UV and Woodward-Fieser rule 5. Interpretation of organic compounds by FT-IR 6. Interpretation of organic compounds by NMR 7. Interpretation of organic compounds by MS	12 hrs/wk
III.	8. Determination of purity by DSC in pharmaceuticals 9. Identification of organic compounds using FT-IR, NMR, CNMR, and Mass spectra To carry out the preparation of following organic compounds 10. Preparation of 4-chlorobenzhydrylpiperazine (an intermediate for cetirizine HCl) 11. Preparation of 4-iodotolene from p-toluidine 12. $NaBH_4$ reduction of vanillin to vanillyl alcohol 13. Preparation of umbelliferone by Pechhman reaction	12 hrs/wk
IV.	14. Preparation of triphenyl imidazole 15. To perform the Microwave irradiated reactions of synthetic importance (Any two) 16. Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using softwares 17. Calculation of ADMET properties of drug molecules and its analysis using softwares Pharmacophore modeling 18. 2D-QSAR based experiments 19. 3D-QSAR based experiments 20. Docking study-based experiment 21. Virtual screening-based experiment	12 hrs/wk
TOTAL		**180 hours**