R21 Curriculum and Syllabus
Master in Pharmaceutical Technology
(M. Pharm- Pharmaceutical Chemistry)

JIS University
Agarpara, Kolkata

SEMESTER-1							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
1		MPC101T	Modern Pharmaceutical Analytical Techniques - Theory	4	0	0	4
2		MPC102T	Advanced Organic Chemistry- I - Theory	4	0	0	4
3		MPC103T	Advanced Medicinal Chemistry-Theory	4	0	0	4
4		MPC104T	Chemistry of Natural Products -Theory	4	0	0	4
PRACTICAL							
5		MPC105P	Pharmaceutical Chemistry Practical I	0	0	12	6
SESSIONAL							
6		MPC106S	Seminar / Assignment	0	7	0	4
MANDATORY COURSE							
7		MSD1861	Seminar and Group Discussion	0	0	0	1
8		MSD1862	Skill X and Other Activities (MOOCs Courses)	0	0	0	1
TOTAL				**16**	**7**	**12**	**26**

SEMESTER-2							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
1		MPC201T	Advanced Spectral Analysis - Theory	4	0	0	4
2		MPC202T	Advanced Organic Chemistry -II - Theory	4	0	0	4
3		MPC203T	Computer Aided Drug Design - Theory	4	0	0	4
4		MPC204T	Pharmaceutical Process Chemistry - Theory	4	0	0	4
PRACTICAL							
5		MPC205P	Pharmaceutical Chemistry Practical II	0	0	12	6
SESSIONAL							
6		MPC206S	Seminar / Assignment	0	0	7	4
MANDATORY CREDIT COURSE							
7	MC	MSD2861	Seminar and Group Discussion	0	0	0	1
8	MC	MSD2862	Skill X and Other activities (MOOCs courses)	0	0	0	1
TOTAL				**16**	**7**	**12**	**26**

SEMESTER-3							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
1		MRM301T	Research Methodology and Biostatistics – Theory*	4	0	0	4
SESSIONAL							
2		MRM302S	Journal Club	0	1	0	1
3		MRM303S	Discussion / Presentation (Proposal Presentation)	0	2	0	2
4		MRM304S	Research Work	0	0	28	14
MANDATORY CREDIT COURSE							
5	MC	MSD3861	Seminar and Group Discussion	0	0	0	1
6	MC	MSD3862	Skill X and Other activities (MOOCs courses)	0	0	0	1
TOTAL				**4**	**3**	**28**	**21**

SEMESTER-4							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
SESSIONAL							
1		MRM401S	Journal Club	0	1	0	1
2		MRM402S	Research Work	0	0	31	16
3		MRM403S	Discussion / Presentation (Final Presentation)	0	3	0	3
MANDATORY CREDIT COURSE							
4	MC	MSD4861	Seminar and Group Discussion	0	0	0	1
5	MC	MSD4862	Skill X and Other activities (MOOCs courses)	0	0	0	1
TOTAL				**0**	**4**	**31**	**20**

Credit Distribution Ratio:

Category	Credit Allocation As Per PCI	Credit Allocation As per University
Semester I	26	28
Semester II	26	28
Semester III	21	23
Semester IV	20	22
Total	98	106
Credit Distribution Details		
Professional Core Courses	48	48
Journal Club	2	2
Discussion and Presentation	5	5
Research Work, Project work and internship in industry or elsewhere	30	30
Mandatory Courses [Seminar, Attending Conference, Scientific Presentations and Other Scholarly Activities, Assignment and Skill X	13	16
Total	98	101

Credit Distribution in details:

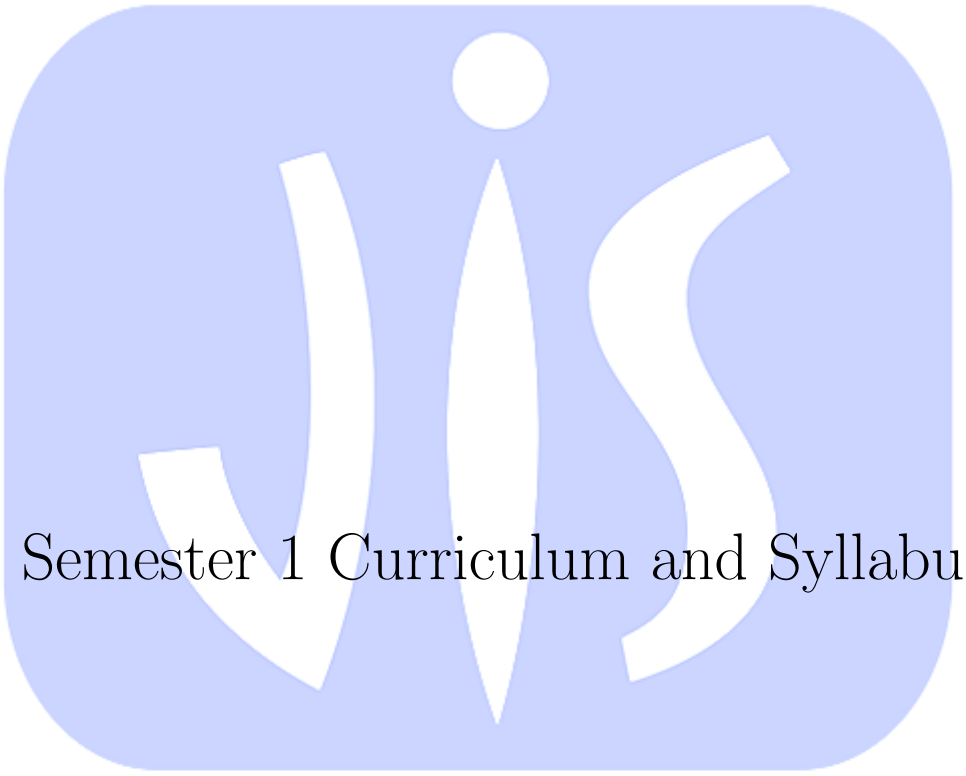
A. Professional Core Courses (PC)							
Sl. No.	**Paper Code**	**Theory and Practical**	**Contact Hours/Week**				**Credit Points**
			L	T	P	Total	
1	MPC101T	ModernPharmaceutical AnalyticalTechniques - Theory	4	0	0	4	4
2	MPC102T	Advanced Organic Chemistry- I -Theory	4	0	0	4	4
3	MPC103T	Advanced Medicinal Chemistry-Theory	4	0	0	4	4
4	MPC104T	Chemistry of Natural Products -Theory	4	0	0	4	4
5	MPC105P	Pharmaceutical Chemistry Practical I	0	0	12	12	6
6	MPC201T	Advanced Spectral Analysis -Theory	4	0	0	4	4
7	MPC202T	Advanced Organic Chemistry -II -Theory	4	0	0	4	4
8	MPC203T	Computer Aided Drug Design -Theory	4	0	0	4	4
9	MPC204T	Pharmaceutical Process Chemistry -Theory	4	0	0	4	4
10	MPC205P	Pharmaceutical Chemistry Practical II	0	0	12	12	6
11	MRM301T	Research Methodology and Biostatistics – Theory	4	0	0	4	4
		Total Credit:0	36	0	24	60	48

B. Journal Club							
Sl. No.	**Paper Code**	**Theory**	**Contact Hours/Week**				**Credit Points**
			L	T	P	Total	
1	MRM302S	Journal Club	0	1	0	1	1
2	MRM402S	Journal Club	0	1	0	1	1
		Total Credit:	0	2	0	2	2

C. Discussion and Presentation							
Sl. No.	**Paper Code**	**Theory**	**Contact Hours/Week**				**Credit Points**
			L	T	P	Total	
1	MRM303S	Discussion / Presentation (Proposal Presentation)	0	2	0	2	2
2	MRM403S	Discussion / Presentation (Final Presentation)	0	3	0	3	3
		Total Credit:	0	5	0	5	5

D. Research Work, Project work and internship in industry or elsewhere (PW)							
Sl. No.	**Paper Code**	**Practical**	**Contact Hours/Week**				**Credit Points**
			L	T	P	Total	
1	MRM304S	Research Work	0	0	28	28	14
2	MRM404S	Research Work	0	0	31	31	16
		Total Credit:	0	0	59	59	30

E. Mandatory Courses [Attending Conference, Scientific Presentations and Other Scholarly Activities and SkillX Seminar] (MC)							
Sl. No.	**Paper Code**	**Theory**	**Contact Hours/Week**				**Credit Points**
			L	T	P	Total	
1	MPC106S	Seminar / Assignment	0	7	0	7	4
2	MPC206S	Seminar / Assignment	0	7	0	7	4
3	MSD2861	Seminar and Group Discussion	0	0	0	0	1
4	MSD2862	Skill X and Other activities (MOOCscourses)	0	0	0	0	1
5	MSD3861	Seminar and Group Discussion	0	0	0	0	1
6	MSD3862	Skill X and Other activities (MOOCscourses)	0	0	0	0	1
7	MSD4861	Seminar and Group Discussion	0	0	0	0	1
8	MSD4862	Skill X and Other activities (MOOCscourses)	0	0	0	0	1
		Total Credit:	0	14	0	14	14



Semester 1 Curriculum and Syllabus

UNIVERSITY

SEMESTER-1							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
1		MPC101T	Modern Pharmaceutical Analytical Techniques - Theory	4	0	0	4
2		MPC102T	Advanced Organic Chemistry- I - Theory	4	0	0	4
3		MPC103T	Advanced Medicinal Chemistry-Theory	4	0	0	4
4		MPC104T	Chemistry of Natural Products -Theory	4	0	0	4
PRACTICAL							
5		MPC105P	Pharmaceutical Chemistry Practical I	0	0	12	6
SESSIONAL							
6		MPC106S	Seminar / Assignment	0	7	0	4
MANDATORY COURSE							
7		MSD1861	Seminar and Group Discussion	0	0	0	1
8		MSD1862	Skill X and Other Activities (MOOCs Courses)	0	0	0	1
TOTAL				**16**	**7**	**12**	**26**

Course Code	MPC101T			
Course Title	Modern Pharmaceutical Analytical Techniques- Theory			
Category				
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	60			
Pre-requisites	None			

Scope:

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

Course Objective:

After completion of course student is able to know about chemicals and excipients

MPC101T.1 The analysis of various drugs in single and combination dosage forms

MPC101T.2 Theoretical and practical skills of the instruments

Course Content:

UNIT I: **[10L]**

a. UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy.

b. IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation.

c. Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence (Characterestics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.

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

UNIT II: **[10L]**

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.

UNIT III: **[10L]**

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.

UNIT IV: **[10L]**

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

UNIT V: **[10L]**

A. Electrophoresis: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following:

a) Paper electrophoresis

b) Gel electrophoresis

c) Capillary electrophoresis

d) Zone electrophoresis

e) Moving boundary electrophoresis

f) Iso electric focusing

B.X ray Crystallography: Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.

UNIT VI: **[10L]**

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.

References:

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

CO-PO Mapping:

CO	Program Outcome										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MPC101T.1	3	-	2	3	1	-	-	2	-	-	3
MPC101T.2	3	2	2	3	2	2	-	1	-	1	2
MPC101T.3	2	3	2	3	1	2	1	1	1	1	2
MPC101T.4	3	3	1	2	2	-	-	2	-	-	-
MPC101T.5	1	3	1	-	2	2	3	3	3	3	1

Course Code	MPC102T			
Course Title	ADVANCED ORGANIC CHEMISTRY - I Theory			
Category				
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	60			
Pre-requisites	None			

Scope:

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

Course Objective:

Upon completion of course, the student shall be to understand

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 Content:

UNIT I: **[12L]**

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 and E2; Hoffman and Saytzeff's rule)

c) Rearrangement reaction

UNIT II: **[12L]**

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 and Suzuki reaction, Ozonolysis and Michael addition reaction

UNIT III: **[12L]**

Synthetic Reagents and 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 and 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

UNIT IV: **[12L]**

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.

UNIT V: **[12L]**

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.

References:

1. "Advanced Organic chemistry, Reaction, Mechanisms and Structure", J March, John Wiley and Sons, New York.

2. "Mechanism and Structure in Organic Chemistry", ES Gould, Hold Rinchart and Winston, New York.

3. "Organic Chemistry" Clayden, Greeves, Warren and Woihers., Oxford University Press 2001.
4. "Organic Chemistry" Vol I and II. I.L. Finar. ELBS, Pearson Education Lts,Dorling Kindersley (India) Pvt. Ltd.
5. A guide to mechanisms in Organic Chemistry, Peter Skyes (Orient Longman, New Delhi).
6. Reactive Intermediates in Organic Chemistry, Tandom and Gowel, Oxford & IBH Publishers.
7. Combinatorial Chemistry – Synthesis and applications – Stephen R Wilson & Anthony W Czarnik, Wiley – Blackwell.
8. Carey, Organic Chemistry, 5th Edition (Viva Books Pvt. Ltd.)
9. Organic Synthesis - The Disconnection Approach, S. Warren, Wily India.
10. Principles of Organic Synthesis, ROC Norman and JM Coxan, Nelson Thorns.
11. Organic Synthesis - Special Techniques. VK Ahluwalia and R Agarwal,Narosa Publishers.
12. Organic Reaction Mechanisms IVth Edtn, VK Ahluwalia and RK Parashar, Narosa Publishers.

CO-PO Mapping:

CO	Program Outcome										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MPC102T.1	-	-	-	-	-	-	-	-	-	-	-
MPC102T.2	-	-	-	-	-	-	-	-	-	-	-
MPC102T.3	-	-	-	-	-	-	-	-	-	-	-
MPC102T.4	-	-	-	-	-	-	-	-	-	-	-
MPC102T.5	-	-	-	-	-	-	-	-	-	-	-
MPC102T.6	-	-	-	-	-	-	-	-	-	-	-

Course Code	MPC103T			
Course Title	ADVANCED MEDICINAL CHEMISTRY - Theory			
Category				
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	60			
Pre-requisites	None			

Scope:

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

Course Objective:

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

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 Content:

UNIT I: **[12L]**

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.

UNIT II: **[12L]**

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 and Non classical, Bioisosteric replacement strategies, rigid analogs,alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance.

UNIT III: **[12L]**

Medicinal chemistry aspects of the following class of drugs:

a) Anti-hypertensive drugs, Psychoactive drugs, Anticonvulsant drugs, H1 and H2 receptor antagonist, COX1 and COX2 inhibitors, Adrenergic and 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.

UNIT IV: **[12L]**

Rational Design of Enzyme Inhibitors:

Enzyme kinetics and Principles of Enzyme inhibitors, Enzyme inhibitors in medicine, Enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors.

UNIT V: **[12L]**

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.

References:

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 and Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi.
3. Comprehensive Medicinal Chemistry – Corwin and Hansch.
4. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore.
5. Introduction to Quantitative Drug Design by Y.C. Martin.
6. Principles of Medicinal Chemistry by William Foye, 7th Edition, Lippincott Williams and Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi.
7. Drug Design Volumes by Arienes, Academic Press, Elsevier Publishers,Noida, Uttar Pradesh..
8. Principles of Drug Design by Smith.
9. The Organic Chemistry of the Drug Design and Drug action by Richard B.Silverman, II Edition, Elsevier Publishers, New Delhi.
10. An Introduction to Medicinal Chemistry, Graham L.Patrick, III Edition, Oxford University Press, USA.

11. Biopharmaceutics and pharmacokinetics, DM.Brahmankar, Sunil B.Jaiswal II Edition, 2014, Vallabh Prakashan, New Delhi.

12. Peptidomimetics in Organic and Medicinal Chemistry by Antonio Guarna and Andrea Trabocchi, First edition, Wiley publishers.

CO-PO Mapping:

CO	Program Outcome										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MPC103T.1	-	-	-	-	-	-	-	-	-	-	-
MPC103T.2	-	-	-	-	-	-	-	-	-	-	-
MPC103T.3	-	-	-	-	-	-	-	-	-	-	-
MPC103T.4	-	-	-	-	-	-	-	-	-	-	-
MPC103T.5	-	-	-	-	-	-	-	-	-	-	-
MPC103T.6	-	-	-	-	-	-	-	-	-	-	-

Course Code	MPC104T			
Course Title	Chemistry of Natural Products - Theory			
Category				
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	60			
Pre-requisites	None			

Scope:

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

Course Objective:

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

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 Content:

UNIT I: **[12L]**

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).

UNIT II: **[12L]**

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).

UNIT III: **[12L]**

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.

UNIT IV: **[12L]**

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.

UNIT V: **[12L]**

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.

References:

1. Modern Methods of Plant Analysis, Peech and M.V.Tracey, Springer – Verlag, Berlin, Heidelberg.
2. Phytochemistry Vol. I and II by Miller, Jan Nostrant Rein Hld.
3. Recent advances in Phytochemistry Vol. I to IV – Scikel Runeckles, Springer Science & Business Media.
4. Chemistry of natural products Vol I onwards IWPAC.
5. Natural Product Chemistry Nakanishi Gggolo, University Science Books, California.
6. Natural Product Chemistry "A laboratory guide" – Rapheal Khan.

7. The Alkaloid Chemistry and Physiology by RHF Manske, Academic Press.
8. Introduction to molecular Phytochemistry – CHJ Wells, Chapmannstall.
9. Organic Chemistry of Natural Products Vol I and II by Gurdeep and Chatwall, Himalaya Publishing House.
10. Organic Chemistry of Natural Products Vol I and II by O.P. Agarwal,Krishan Prakashan.
11. Organic Chemistry Vol I and II by I.L. Finar, Pearson education.
12. Elements of Biotechnology by P.K. Gupta, Rastogi Publishers.
13. Pharmaceutical Biotechnology by S.P.Vyas and V.K.Dixit, CBS Publishers.
14. Biotechnology by Purohit and Mathur, Agro-Bios, 13th edition.
15. Phytochemical methods of Harborne, Springer, Netherlands.
16. Burger's Medicinal Chemistry.

CO-PO Mapping:

CO	Program Outcome										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MPC103T.1	-	-	-	-	-	-	-	-	-	-	-
MPC103T.2	-	-	-	-	-	-	-	-	-	-	-
MPC103T.3	-	-	-	-	-	-	-	-	-	-	-
MPC103T.4	-	-	-	-	-	-	-	-	-	-	-
MPC103T.5	-	-	-	-	-	-	-	-	-	-	-
MPC103T.6	-	-	-	-	-	-	-	-	-	-	-

Course Code	MPC105P			
Course Title	Pharmaceutical Chemistry Practical- I			
Category				
LTP & Credits	L	T	P	Credits
	0	0	12	6
Total Contact Hours	180			
Pre-requisites	None			

Suggestive List of Experiments:

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

To perform the following reactions of synthetic importance

8. Purification of organic solvents, column chromatography **[1 day(s)]**
9. Claisen-schimidt reaction. **[1 day(s)]**
10. Benzyllic acid rearrangement. **[1 day(s)]**
11. Beckmann rearrangement. **[1 day(s)]**
12. Hoffmann rearrangement **[1 day(s)]**
13. Mannich reaction **[1 day(s)]**
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) **[1 day(s)]**
15. Estimation of elements and functional groups in organic natural compounds **[1 day(s)]**
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. **[1 day(s)]**

17. Some typical degradation reactions to be carried on selected plant constituents

[1 day(s)]

⋮

CO-PO Mapping:

	Program Outcome										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MPC105P.1	-	-	-	-	-	-	-	-	-	-	-
MPC105P.2	-	-	-	-	-	-	-	-	-	-	-
MPC105P.3	-	-	-	-	-	-	-	-	-	-	-
MPC105P.4	-	-	-	-	-	-	-	-	-	-	-

Semester 2 Curriculum and Syllabus

SEMESTER-2							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
1		MPC201T	Advanced Spectral Analysis - Theory	4	0	0	4
2		MPC202T	Advanced Organic Chemistry -II - Theory	4	0	0	4
3		MPC203T	Computer Aided Drug Design - Theory	4	0	0	4
4		MPC204T	Pharmaceutical Process Chemistry - Theory	4	0	0	4
PRACTICAL							
5		MPC205P	Pharmaceutical Chemistry Practical II	0	0	12	6
SESSIONAL							
6		MPC206S	Seminar / Assignment	0	0	7	4
MANDATORY CREDIT COURSE							
7	MC	MSD2861	Seminar and Group Discussion	0	0	0	1
8	MC	MSD2862	Skill X and Other activities (MOOCs courses)	0	0	0	1
TOTAL				**16**	**7**	**12**	**26**

Course Code	MPC201T			
Course Title	Advanced Spectral Analysis			
Category				
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	60			
Pre-requisites	None			

Scope:

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

Course Objective:

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

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 Content:

UNIT I: **[12L]**

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.

UNIT II: **[12L]**

NMR spectroscopy:

1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds.

UNIT III: **[12L]**

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.

UNIT IV: **[12L]**

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

UNIT V: **[12L]**

a). Thermalmethods 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.

References:

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

CO-PO Mapping:

CO	Program Outcome										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MPC201T.1	-	-	-	-	-	-	-	-	-	-	-
MPC201T.2	-	-	-	-	-	-	-	-	-	-	-
MPC201T.3	-	-	-	-	-	-	-	-	-	-	-
MPC201T.4	-	-	-	-	-	-	-	-	-	-	-
MPC201T.5	-	-	-	-	-	-	-	-	-	-	-
MPC201T.6	-	-	-	-	-	-	-	-	-	-	-

Course Code	MPC202T			
Course Title	ADVANCED ORGANIC CHEMISTRY - II Theory			
Category				
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	60			
Pre-requisites	None			

Scope:

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

Course Objective:

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

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 Content:

UNIT I: **[12L]**

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.

UNIT II: **[12L]**

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 reactions initiated by proton abstraction, protonation, overactivation and side reactions of individual amino acids

UNIT III: **[12L]**

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

UNIT IV: **[12L]**

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 applications.

UNIT V: **[12L]**

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 examples.

References:

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

CO-PO Mapping:

CO	Program Outcome										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MPC202T.1	-	-	-	-	-	-	-	-	-	-	-
MPC202T.2	-	-	-	-	-	-	-	-	-	-	-
MPC202T.3	-	-	-	-	-	-	-	-	-	-	-
MPC202T.4	-	-	-	-	-	-	-	-	-	-	-
MPC202T.5	-	-	-	-	-	-	-	-	-	-	-
MPC202T.6	-	-	-	-	-	-	-	-	-	-	-

Course Code	MPC203T			
Course Title	Coumputer Aided Drug Design			
Category				
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	60			
Pre-requisites	None			

Scope:

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

Course Objective:

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

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 Content:

UNIT I: **[10L]**

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.

UNIT II: **[12L]**

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.

UNIT III: **[10L]**

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)

UNIT IV: **[12L]**

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.

UNIT V: **[12L]**

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.

References:

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

CO-PO Mapping:

CO	Program Outcome										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MPC203T.1	-	-	-	-	-	-	-	-	-	-	-
MPC203T.2	-	-	-	-	-	-	-	-	-	-	-
MPC203T.3	-	-	-	-	-	-	-	-	-	-	-
MPC203T.4	-	-	-	-	-	-	-	-	-	-	-
MPC203T.5	-	-	-	-	-	-	-	-	-	-	-
MPC203T.6	-	-	-	-	-	-	-	-	-	-	-

Course Code	MPC204T			
Course Title	PHARMACEUTICAL PROCESS CHEMISTRY - Theory			
Category				
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	60			
Pre-requisites	None			

Scope:

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

Course Objective:

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

1. The strategies of scale up process of apis and intermediates.

2. The various unit operations and various reactions in process chemistry.

Course Content:

UNIT I: **[12L]**

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

UNIT II: **[12L]**

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, nonaqueous solutions factors affecting crystallization, nucleation. Principle and general methods of Preparation of polymorphs, hydrates, solvates and amorphous APIs.

UNIT III: **[12L]**

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 H2O2, sodium hypochlorite, Oxygen gas, ozonolysis.

UNIT IV: **[12L]**

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: B2 and B12

iii. Statins: Lovastatin, Simvastatin

c) **Reaction progress kinetic analysis**

i. Streamlining reaction steps, route selection,

ii. Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up.

UNIT V: **[12L]**

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

References:

1. Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever-Changing Climate-An Overview; K. Gadamasetti, CRC Press.
2. Pharmaceutical Manufacturing Encyclopedia, 3rd edition, Volume 2
3. Medicinal Chemistry by Burger, 6th edition, Volume 1-8.
4. W.L. McCabe, J.C Smith, Peter Harriott. Unit operations of chemical engineering, 7th edition, McGraw Hill

5. Polymorphism in Pharmaceutical Solids .Dekker Series Volume 95 Ed: H G Brittain (1999)
6. Regina M. Murphy: Introduction to Chemical Processes: Principles, Analysis, Synthesis
7. Peter J. Harrington: Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up
8. P.H.Groggins: Unit processes in organic synthesis (MGH)
9. F.A.Henglein: Chemical Technology (Pergamon)
10. M.Gopal: Dryden's Outlines of Chemical Technology, WEP East-West Press
11. Clausen,Mattson: Principle of Industrial Chemistry, Wiley Publishing Co.,
12. Lowenheim & M.K. Moran: Industrial Chemicals
13. S.D. Shukla & G.N. Pandey: A text book of Chemical Technology Vol. II, Vikas Publishing House
14. J.K. Stille: Industrial Organic Chemistry (PH)
15. Shreve: Chemical Process, Mc Grawhill.
16. B.K.Sharma: Industrial Chemistry, Goel Publishing House
17. ICH Guidelines
18. United States Food and Drug Administration official website www.fda.gov

CO-PO Mapping:

CO	Program Outcome										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MPC204T.1	-	-	-	-	-	-	-	-	-	-	-
MPC204T.2	-	-	-	-	-	-	-	-	-	-	-
MPC204T.3	-	-	-	-	-	-	-	-	-	-	-
MPC204T.4	-	-	-	-	-	-	-	-	-	-	-
MPC204T.5	-	-	-	-	-	-	-	-	-	-	-
MPC204T.6	-	-	-	-	-	-	-	-	-	-	-

Course Code	MPC205P			
Course Title	Pharmaceutical Chemistry Practicals – II			
Category				
LTP & Credits	L	T	P	Credits
	0	0	12	6
Total Contact Hours	180			
Pre-requisites	None			

Suggestive List of Experiments:

1. Synthesis of organic compounds by adapting different approaches involving (3 experiments)
   a) Oxidation
   b) Reduction/hydrogenation
   c) Nitration **[1 day(s)]**
   ⋮
2. Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments) **[1 day(s)]**
   ⋮
3. Assignments on regulatory requirements in API (2 experiments) **[1 day(s)]**
4. Comparison of absorption spectra by UV and Wood ward – Fieser rule **[1 day(s)]**
   ⋮
5. Interpretation of organic compounds by FT-IR **[1 day(s)]**
   ⋮
6. Interpretation of organic compounds by NMR **[1 day(s)]**
   ⋮
7. Interpretation of organic compounds by MS **[1 day(s)]**
   ⋮
8. Determination of purity by DSC in pharmaceuticals **[1 day(s)]**
   ⋮
9. Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra **[1 day(s)]**
   ⋮
10. To carry out the preparation of following organic compounds **[1 day(s)]**
    ⋮

11. Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl). **[1 day(s)]**

⋮

12. Preparation of 4-iodotolene from p-toluidine **[1 day(s)]**

⋮

13. NaBH4 reduction of vanillin to vanillyl alcohol **[1 day(s)]**

⋮

14. Preparation of umbelliferone by Pechhman reaction **[1 day(s)]**

⋮

15. Preparation of triphenyl imidazole **[1 day(s)]**

⋮

16. To perform the Microwave irradiated reactions of synthetic importance (Any two) **[1 day(s)]**

⋮

17. Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using softwares **[1 day(s)]**

⋮

18. Calculation of ADMET properties of drug molecules and its analysis using softwares **[1 day(s)]**

⋮

Pharmacophore modeling

19. 2D-QSAR based experiments **[1 day(s)]**

⋮

20. 3D-QSAR based experiments **[1 day(s)]**

⋮

21. Docking study based experiment **[1 day(s)]**

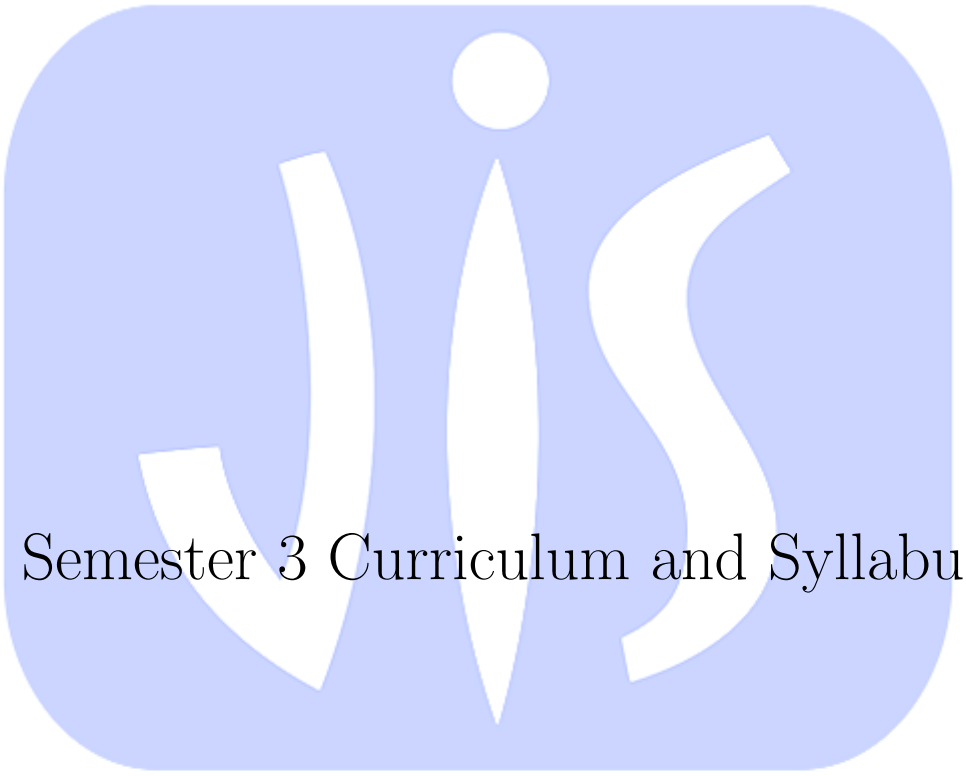
⋮

22. Virtual screening based experiment **[1 day(s)]**

⋮

CO-PO Mapping:

	Program Outcome										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MPC205P.1	-	-	-	-	-	-	-	-	-	-	-
MPC205P.2	-	-	-	-	-	-	-	-	-	-	-
MPC205P.3	-	-	-	-	-	-	-	-	-	-	-
MPC205P.4	-	-	-	-	-	-	-	-	-	-	-



Semester 3 Curriculum and Syllabus

UNIVERSITY

SEMESTER-3							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
1		MRM301T	Research Methodology and Biostatistics – Theory*	4	0	0	4
SESSIONAL							
2		MRM302S	Journal Club	0	1	0	1
3		MRM303S	Discussion / Presentation (Proposal Presentation)	0	2	0	2
4		MRM304S	Research Work	0	0	28	14
MANDATORY CREDIT COURSE							
5	MC	MSD3861	Seminar and Group Discussion	0	0	0	1
6	MC	MSD3862	Skill X and Other activities (MOOCs courses)	0	0	0	1
TOTAL				**4**	**3**	**28**	**21**

Course Code	MRM301T			
Course Title	RESEARCH METHODOLOGY AND BIOSTATISTICS			
Category				
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	60			
Pre-requisites	None			

Scope:

The course describes the basic methodology to carry out the dissertation work..

Course Objective:

After completion of course student is able to know:

1. Evaluate the various statistical techniques to solve statistical problems
2. Evaluate research methodology
3. Analyze statistical techniques in solving the problems
4. Analyze the operation of M.S. Excel and other Microsoft applications
5. Analyze the operation of SPSS and other statistical software

Course Content:

UNIT I: **[12L]**

General Research Methodology:

Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.

UNIT II: **[12L]**

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.

UNIT III: **[12L]**

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.

UNIT IV: **[10L]**

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.

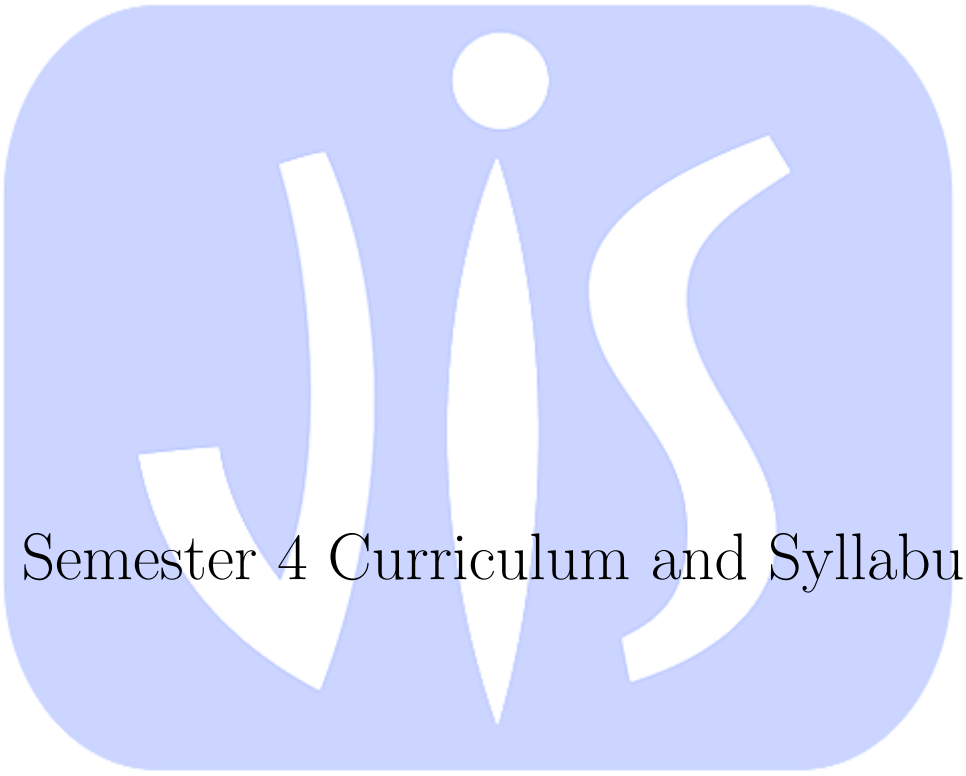
UNIT V: **[10L]**

Declaration of Helsinki:

History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.

CO-PO Mapping:

CO	Program Outcome										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MRM301T.1	1	2	3	-	-	2	-	-	1	-	3
MRM301T.2	-	3	3	-	-	2	-	-	-	-	2
MRM301T.3	-	2	3	3	-	2	-	-	-	-	1
MRM301T.4	-	2	3	3	-	2	-	1	2	-	1
MRM301T.5	-	2	3	3	-	2	-	1	2	-	1



Semester 4 Curriculum and Syllabus

UNIVERSITY

SEMESTER-4							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
SESSIONAL							
1		MRM401S	Journal Club	0	1	0	1
2		MRM402S	Research Work	0	0	31	16
3		MRM403S	Discussion / Presentation (Final Presentation)	0	3	0	3
MANDATORY CREDIT COURSE							
4	MC	MSD4861	Seminar and Group Discussion	0	0	0	1
5	MC	MSD4862	Skill X and Other activities (MOOCs courses)	0	0	0	1
TOTAL				**0**	**4**	**31**	**20**