



## **School of Basic Sciences**

### **Department of Chemistry**

#### **M.Sc**

### **Pharmaceutical and analytical Chemistry**

#### **Program Specific Outcome**

- PSO1 : Candidate will become the fittest for the pharma industry at all levels namely production, R&D, QC & QA formulation
- PSO2: Placements at global level
- PSO3: Wide research opportunities in all sectors of Pharma industry particularly in drug development and a new drug discovery
- PSO4: Complete knowledge of patents and intellectual property rights
- PSO5: Opportunities in clinical analysis, management of supply chain of a drug from pharma industry to the hand of a noble customer

## Department of Chemistry

### M.Sc

### Pharmaceutical and analytical Chemistry

## Board of Studies Members List

Sl.No.	Name & Address	Designation
1.	Mr. Angalan, Manager, Shasun Pharmaceuticals Ltd., Chennai	External Expert
2.	Mr. Ganesh Babu, Associate Professor & Head Department of Chemistry, RKM Vivekananda College, Mylapore, Chennai 600 004.	External Expert
3.	Sukhanya.V Fourts India Pvt. Ltd., Kelambakkam Road Kandigai, Chennai -600 121	Alumini Member
4.	Dr . V. Mahalingam Professor Department of Chemistry, School of Basic Chemistry Vels University, Pallavaram,Chennai - 600 117	Member
5.	Dr. R. A. Kalaivani, Director HOD, Department of Chemistry, School of Basic Sciences, Vels University, Pallavaram,Chennai - 600 117	Convernor
6.	Dr. A. Perumal Professor Department of Chemistry, School of Basic Chemistry Vels University, Pallavaram,Chennai - 600 117	Member



**M.Sc**

**Pharmaceutical and analytical  
Chemistry**

**Curriculum and Syllabus**

**(Based on Choice based credit system)**

**Effective from the Academic Year**

**2015 – 2016**

**Department of Chemistry**

**School of Basic Sciences**

# M.Sc.

## PHARMACEUTICAL AND ANALYTICAL CHEMISTRY CURRICULUM

Total number of credits: 91

Category	Code	Course	Hours/Week			Credits
			Lecture	Tutorial	Practical	
<b>SEMESTER I</b>						
Core	15MPS001	Medicinal Chemistry	5	0	0	4
Core	15MPS002	Fundamentals of Pharmaceutical Chemistry	5	0	0	4
Core	15MPS003	Advanced Organic Chemistry	4	0	0	4
DSE		Discipline Specific Elective – I	4	0	0	3
DSE		Discipline Specific Elective – II	4	0	0	3
GE		Generic Elective – I	1	0	1	2
Core	15MPS004	Practical I- Organic Synthesis	0	0	6	3
		<b>Total</b>	<b>23</b>	<b>0</b>	<b>7</b>	<b>23</b>
<b>SEMESTER II</b>						
Core	15MPS005	Advanced Pharmaceutical Chemistry	4	0	0	4
Core	15MPS006	QA & QC in Drugs and Pharmaceuticals	4	0	0	4
Core	15MPS007	Analytical Techniques in Chemistry	4	0	0	4
DSE		Discipline Specific Elective – III	4	0	0	3
DSE		Discipline Specific Elective – IV	4	0	0	3
GE		Generic Elective – II	1	0	1	2
GE		Generic Elective – III	2	0	0	2
Core	15MPS008	Practical II: Pharmaceutical and Drug Analysis	0	0	6	3
Core	15MPS009	Internship	0	0	0	2
		<b>Total</b>	<b>23</b>	<b>0</b>	<b>7</b>	<b>27</b>
<b>SEMESTER III</b>						
Core	15MPS010	Pharmaceutical Formulation Technology – I	4	0	0	4
Core	15MPS011	Advanced Chromatographic techniques	4	0	0	4
DSE		Discipline Specific Elective – V	4	0	0	3
DSE		Discipline Specific Elective – VI	4	0	0	3
GE		Generic Elective – IV	2	0	0	2
Core	15MPS012	Practical -III: Medicinal Chemistry	0	0	6	3
Core	15MPS013	Practical –IV: Phyto Chemistry	0	0	6	3
		<b>Total</b>	<b>18</b>	<b>0</b>	<b>12</b>	<b>22</b>
<b>SEMESTER IV</b>						
Core	15MPS014	Pharmaceutical Formulation Technology – II	4	0	0	4
DSE		Discipline Specific Elective – VII	4	0	0	3
Core	15MPS015	Project work		0	22	12
		<b>Total</b>	<b>8</b>	<b>0</b>	<b>22</b>	<b>19</b>
		<b>Over all Total</b>	<b>72</b>	<b>0</b>	<b>48</b>	<b>91</b>

## List of Discipline Specific Elective Courses

<b>S. No.</b>	<b>Sub. Code</b>	<b>-</b>	<b>Title of the Course</b>
1.	15MPS101	-	Fundamentals of Biochemistry
2.	15MPS102	-	Chemical and Instrumental Methods of Drug Analysis
3.	15MPS103	-	Macromolecular Chemistry
4.	15MPS104	-	Organic Chemistry – I
5.	15MPS105	-	Thermodynamics and Chemical Kinetics
6.	15MPS106	-	Synthesis of APIs and Their Manufacture
7.	15MPS107	-	Organic Name Reactions and Synthesis of Reagents
8.	15MPS108	-	Separation Techniques
9.	15MPS109	-	Organic Chemistry- II
10.	15MPS110	-	Analytical Techniques
11.	15MPS111	-	Chemistry of Natural Products
12.	15MPS112	-	Enzyme Technology and Related Entrepreneurial Skills
13.	15MPS113	-	Nuclear and Photochemistry
14.	15MPS114	-	Novel Materials and Green Industrial Catalysis
15.	15MPS115	-	Organic Chemistry- III
16.	15MPS116	-	Strategic Management of Pharma Industry
17.	15MPS117	-	Stereochemistry and Reaction Mechanism Subject
18.	15MPS118	-	Pharmaceutical Chemistry
19.	15MPS119	-	Organic Spectroscopy
20.	15MPS120	-	Inorganic Chemistry

## List of Generic Elective Courses

<b>S.No.</b>	<b>Sub. Code</b>	<b>-</b>	<b>Title of the Paper</b>
1.			Soft Skill - I
2.			Soft Skill - II
3.	15MPS151	-	Green Chemistry
4.	15MPS152	-	Cheminformatics
5.	15MPS153	-	Introduction to Nanoscience and Nanotechnology
6.	15MPS154	-	Food Chemistry and Adulteration

# Syllabus

## Core Courses

L T P C

15MPS001

MEDICINAL CHEMISTRY

5 0 0 4

### Objectives:

To learn about physicochemical properties of drugs, general pathways of drug metabolism, significance of drug metabolism, basic concepts of prodrugs. To learn about medicinal properties of the given drugs.

#### **Unit I Physicochemical properties in relation to biological action 15**

Ionization, Drug distribution and pKa values of specified APIs such as hydrogen bonding, protein binding, chelation, isosterism, stereoisomerism, steric effect, redox potential and surface activity,

#### **Unit II Drug metabolism 15**

General pathways of drug metabolism (different types of reaction in phase-I and phase-II with example), factors affecting drug metabolism,

#### **Unit III Significance of drug metabolism 15**

Significance of drug metabolism in medicinal chemistry. The role of liver in drug metabolism. Preclinical experimental models of drug metabolism.

#### **Unit IV Basic concepts of prodrugs 15**

Basic concepts of prodrugs need for prodrugs, specific prodrugs such as methodology of prodrug design. Applications of prodrugs.

#### **Unit V Medicinal chemistry of the following group of drugs 15**

Antivirals for HIV infection -Indinavir CAS Reg. No. [150378-17-9] synthesis and pharmacology

Antineoplastics- Etoposide CAS Reg. No. [33419-42-0] synthesis and pharmacology.

Diuretics-Indapamide CAS Reg. No. [26807-65-8] and Isosorbide CAS Reg. No. [652-67-5] Synthesis, and pharmacology

Antidiabetics - Liraglutide CAS Reg. No. [204656-20-2](hormone analog) and Gliclazide CAS Reg. No. [21187-98-4] (sulfonylurea) Synthesis and pharmacol.

**Total: 75 hours**

**Outcomes:**

- To understand the importance of different bondings and their relation in biological action
- To know the importance of isosterism, redox potential and surface activity
- To familiarize the factors affecting drug metabolism
- To understand complete knowledge of the role of the lever
- To know pre-clinical experiment models
- To understand pro-drugs and their needs and their application
- To expertise the role of anti virals, antidiabetics, diuretics, antineoplastics
- To learn what is CAS register number and their greater applicability
- To be the master in basic components of medicinal chemistry
- To learn the complete study of synthesis and pharmacology of leading drugs

**Text Book:**

1. Ashutosh Kar. Medicinal Chemistry, New Age International Ltd. Third Edition, 2006.

**Reference Books:**

1. William O. Foye, Principles of medicinal chemistry, Fourth Edition, 1996
2. Graham L. Patrick, An introduction to medicinal chemistry, 4<sup>th</sup> edition, Oxford University press.

**L T P C**

**15MPS002 FUNDAMENTALS OF PHARMACEUTICAL CHEMISTRY 5 0 0 4**

**Objectives:**

To learn about molecular basis of drug action and receptor concept and to know about drug receptor concept. To learn about the drug molecules from lead molecules. To know about the basic concept of enzyme and their catalytic activity.

**Unit I Molecular basis of drug action**

**15**

Receptor: Types of Receptors, Drug- Receptor Interaction including signal transduction mechanism. Basic ligand concept, Agonist, antagonist, partial Agonist, and inverse Agonist. Receptor theories – Occupancy, Rate and Activation theories.





**Text Books:**

1. Purich & Allison, A Comprehensive Guidebook to Enzyme Nomenclature, Reactions, and Methods, The Enzyme Reference, 1st Edition, Allison Academic Press, 2002.
2. Lednicer, Organic Chemistry of Drug Synthesis, Wiley Interscience, 1977.
3. Wilson & Gisvold, Medicinal Chemistry, 10<sup>th</sup> Edition, 1998.

**Reference Books:**

1. William Foye, Medicinal Chemistry, 4<sup>th</sup> Edition, 1995.
2. Burger, Medicinal Chemistry, 5th Edition, 1995.

L T P C

**15MPS003****ADVANCED ORGANIC CHEMISTRY****4 0 0 4****Objectives:**

To learn about simple reactions such as substitution, addition and elimination reactions of organic chemistry. To learn about basics of stereo chemistry, retrosynthetic analysis and heterocyclic chemistry.

**Unit I Substitution and elimination reactions****12**

Mechanism of aliphatic substitution reaction – SN1, SN2, SNi mechanism – Neighboring group participation. Stereo specific and stereo selective synthesis. Concepts of hard, soft acids and bases. Role of crown ethers, PTCs in nucleophilic substitution mechanism. Mechanism of etherification and ester hydrolysis – aromatic electrophilic and nucleophilic substitution.

E1, E2 and E1CB mechanisms. Orientation of a double bond. Hoffmann and Saytzeff rule. Reactivity – the effect of changes in the substrate, base, leaving group and medium on overall reactivity – acyclic & cyclic system.

**Unit II Addition reaction****12**

Electrophilic and nucleophilic addition. Addition of halogens, Hydrogen halide, H<sub>2</sub> and water to carbon-carbon double bonds. Nucleophilic addition to carbonyl group. Carbocation rearrangement. Wagner-Meerwein, Favorski, Baeyer-villiger, Schmidt, Curtius, Claisen, Pinacol-Pinacolone and cope rearrangement.

**Unit III Stereochemistry 12**

Molecular symmetry and chirality, classification of chiral molecules – Chemical resolution-illustration by specific example; principles of symmetry – illustrations of homotopic, enantiotopic and diastereotopic hydrogen and prochiral carbons with suitable examples. R – S notation of simple chiral molecules including substituted biphenyls. Compounds with two asymmetric carbons – illustration of erythro and threo nomenclature. Asymmetric synthesis – Cram's rule. E, Z notation of simple olefins. Determination of absolute configuration. Mechanism and stereochemistry of chemical reaction. Conformational analysis – alkane, cyclohexane and disubstituted cyclohexane.

**Unit IV Retrosynthetic analysis 12**

Synthon, C-C bond formation by various methods, C=C bond formation. Aldol condensation- Benzoin condensation, Umpolung reactions.

**Unit V Heterocyclic chemistry 12**

Synthesis, reactions and structure of Isothiazole, Isooxazole, Quinoline, Isoquinoline, Purines. Azoles – Imidazoles, Oxazoles, Thiazoles and Pyrazoles. Pyrimidines and quinazolines, phenothiazines

**Total: 60 hours**

**Outcomes:**

- To learn about the Substitution and elimination reactions of molecules
- To learn about the electrophilic and nucleophilic addition of halogens.
- To learn about the rearrangement - Wagner-Meerwein, Favorski, Baeyer-villiger, Schmidt, Curtius, Claisen, Pinacol-Pinacolone and cope rearrangement.
- To learn how to work out synthetic strategies for complex organic molecules.
- To learn the principles and terminology used in retrosynthetic analysis
- To understand and to broaden the knowledge about heterosynthetic compounds.
- To learn about the synthesis and reactivity of the heterocyclic compounds.

**Text Books**

1. Raj K. Bansal, Heterocyclic Chemistry, 3<sup>rd</sup> Edition, New Age International Publisher, 1999.
2. P.S. Kalsi, Organic Reactions and their Mechanisms, New Age International Publishers, 2<sup>nd</sup> Edition, 2000.
3. Francies, A Carey and Richard J. Sundberg, Advanced Organic Chemistry, Part – A and Part – B, 4<sup>th</sup> Edition, 2000.

## Reference Books

1. E.H. Eliel, Stereo chemistry of carbon compounds, Tat Mc Graw-Hill Publishing Company Ltd., 1998..
2. I.L. Finar, Organic Chemistry, Vol. – I and Vol. – II, ELBS, 6<sup>th</sup> Edition 2003.

L T P C

**15MPS004**

**PRACTICAL - I: ORGANIC SYNTHESIS**

**0 0 6 3**

### Objectives:

To learn about Good Laboratory Practice(GLP) in chemistry lab.To learn about the synthetic techniques and crystallization techniques of following organic compounds

### Ex. No.            Lists of Experiments

- |          |  |
|----------|--|
| Ex.No.1  | Oxidation of anthracene to anthraquinone - oxidation process   |
| Ex.No.2  | Terephthalic acid from p-xylene - oxidation process  |
| Ex.No.3  | Preparation of benzhydrol from benzophenone - reduction process                                      |
| Ex.No.4  | Preparation of p-bromo acetanilide from acetanilide - bromination process                            |
| Ex.No.5  | Preparation of 1,2,3,4 tetra hydro carbazole from cyclohexanone - Fischer indolization process       |
| Ex.No.6  | Preparation of p-nitro benzoic acid from p-nitro toluene   |
| Ex.No.7  | Preparation of methyl orange from sulphanilic acid - coupling diazotisation process                  |
| Ex.No.8  | Preparation of benzophenoneoxime from benzophenone - molecular rearrangement                         |
| Ex.No.9  | Methyl salicylate from salicylic acid - esterification process                                       |
| Ex.No.10 | Picric acid from phenol - nitration process  |
| Ex.No.11 | O-benzoylbenzoic acid from phthalic anhydride - electrophilic substitution& Friedel-Crafts acylation |
| Ex.No.12 | Benzilic acid from benzoin - elimination addition process  |
| Ex.No.13 | $\beta$ – naphthol from naphthlene-(by sulphonation& hydrolysis)                                     |

**Total: 60 hours**

**Outcomes:**

- To learn the common experimental techniques of synthesis of organic molecules.
- To know the preparation involving molecular rearrangement.
- To learn the preparation involving oxidation, nitration.
- To learn the preparation involving halogenations, reduction, elimination.
- To learn esterification, sulphonation, hydrolysis.
- To learn different recrystallization techniques.
- To learn different drying methods of organic compounds.
- To learn the preparation involving vigorous oxidation.
- To learn the time management, safety, best yield recovery, purity in preparation involving multi stage.
- To understand the various method of organic preparation.

**Text Book:**

1. A.A. Siddiqui, S. Siddiqui, Natural Products Chemistry Practical Manual, CBS Publishers & Distributors, 2008.

**Reference Books:**

1. Gnanprakasam, Ramamurthy, Organic Chemistry Lab Manual, S. Wisvanathan Printers & Publishers Pvt. Ltd, 2010.
2. Vogel, Arthur I. Vogel, Text Book of Practical Organic Chemistry, 5<sup>th</sup> Edition, Pearson Education, Prentice Hall, 1996

**15MPS005                    ADVANCED PHARMACEUTICAL CHEMISTRY                    4 0 0 4**

**Objectives:**

To know about basic concepts of pharmaceutical chemistry. To learn about Introduction, classification, concept and mechanism of action and synthesis of drugs.

**Unit I                    Anti-infective agents                    12**

Introduction, classification, concept and mechanism of action, Structure Activity Relationship(SAR) and synthesis of representative members of the following class of drugs – sulphonamides, non-steroidal anti-inflammatory analgesics, antibiotics, antifungal, anti-mycobacterium agents, Antiviral agents.

Hansch equation, Craig plot, Topliss decision tree approach, Bio-isosterism.

**Unit II                    Chemotherapy                    12**

Chemotherapy of Malaria, AIDS, Cancer, Hepatitis as illustrative.

**Unit III                    CNS Drugs                    12**

Introduction, Classification, Mechanism of Action, SAR and Synthesis of following CNS Drugs. Drugs acting on CNS – Hypnotics & Sedatives, Antianxiety drugs, anti-convulsive drugs, Antidepressant and antipsychotic drugs. Drugs used for neurodegenerative disorders like Dementia, Alzheimer's and Parkinson's disease.

**Unit IV                    CVS and ANS Drugs                    12**

Drugs acting on CVS- Anti-hypertensive, Anti-arrhythmic, Vasopressor, Anti-Anginal agents, cardiac glycosides. Drugs acting on Adrenergic and Cholinergic systems. Drugs acting on kidneys, Analgesics (NSAIDs, Opioids), Anti-Ulcers and coagulant and anti-coagulants.

**Unit V                    QSAR                    12**

Introduction, quantitative models, Hansch-analysis, Free-Wilson models, Non-linear method, mixed method and other QSAR methods. Application of above methods, statistical methods in QSAR.

**Total: 60 hours**

**Outcomes:**

- To understand the concept, structural activity relationship (SAR)
- To understand the concept chemotherapy
- To understand various anti infective agents
- To understand what is CNS drugs, their types, mechanism of action and the importance of their role
- To understand what is CVS and ANS drugs
- To learn quantitative analysis of structure activity relationship (QSAR)
- To understand various QSAR methods and their application
- To understand statistical approach of drug activity of various class of drugs
- To learn importance of craig plot, topless decision tree approach, Bio-isosterism
- To expertise the advanced concepts of pharmaceutical chemistry

**Text Book:**

1. Burger's Medicinal Chemistry & Drug Discovery, Vol.1-5, 5<sup>th</sup> Edition, 1995.

**Reference Books:**

1. Wilson and Gisvold's, Text book of medicinal chemistry, 2006.
2. SurendraNathPandeya, Text book of medicinal chemistry, vol -I & II, 5<sup>th</sup> edition, SG publisher, 2003.





- To learn about the packaging materials and their controls.
- To understand the Microbiological assay

**Text Books:**

1. Liberman&Lachman, Theory & Practice of Industrial Pharmacy, 3<sup>rd</sup> Edition, 1986.
2. Ira R. Berry, A. Robert, Nash Pharmaceutical process validation 2<sup>nd</sup> Edition,

**Reference Books:**

1. WHO, Quality assurance of pharamaceuticals,vol-I & II, Geneva, A.I.T.B.S Publishers india, 2007.
2. Leon Lachman, Herbert A liberman, The theory and practice of industrial pharmacy, special indian edition, 2009.

LT P C

**15MPS007 ANALYTICAL TECHNIQUES IN CHEMISTRY - 4 0 0 4**

**Objectives:**

To learn about the basic concepts and instrumentation of various analytical instruments such as potentiometry, conductometry, biamperometry, nephelometry, fluorimetry, polarimetry, refractometry, radio analytical techniques and thermal methods.

**Unit I Instrumentation-I 12**

Potentiometry, Conductometry, Biamperometry –Theory, Instrumentation and Applications.

**Unit II Instrumentation-II 12**

Nephelometry, Fluorimetry, Polarimetry, Refractometry - Theory, Instrumentation and Applications.

**Unit III Instrumentation – III 12**

Flame Photometry, and Atomic Absorption Spectroscopy - Theory, Instrumentation and Applications.

**Unit IV Instrumentation-IV 12**

Radio analytical Techniques, Isotope dilution analysis, Radioimmunoassay, Radiochromatography and Radio electrophoresis, Activation analysis.

**Unit V Instrumentation-V 12**

Thermal methods - Thermogravimetric and differential thermal analysis, thermometric titrations, differential scanning calorimetry – basic instrumentation and applications.

**Total: 60 hours**

**Outcomes:**

- To learn the various instrumental methods, potentiometry, conductometric, biamperometry
- To learn what is nephelometry, fluorimetry, polarimetry, refractometry
- To understand what is flame photometry and atomic absorption spectroscopy
- To learn what is radio analytical techniques
- To learn the concept, what is thermal methods and their types
- To know the application of flame photometry and atomic absorption spectroscopy
- To know the application of nephelometry, fluorimetry, polarimetry, refractometry
- To understand the application of TGA, DTA, DSC and their titration

**Text Book:**

1. D.A. Skoog and D.M. West, Fundamental of Analytical Chemistry, International Edition, 7<sup>th</sup> Edition, Saunders College Publishing, Philadelphia, Holt, London, 1996.

**Reference Books:**

1. Willard, Merritt, Dean and Settle, Instrumental methods of analysis, 2004.
2. Gurdeep R. Chatwal, Sham K. Anand, Instrumental methods of chemical analysis, Himalaya publishing house, 2007.

**15MPS008 PRACTICAL - II PHARMACEUTICAL AND DRUG ANALYSIS 0 0 6 3****Objectives:**

To learn about the synthetic techniques of active pharmaceutical drugs. To know about the monographs of drugs and to learn about the basic concepts of drug analysis.

**List of Experiments:****Synthesis of active pharmaceutical ingredients**

Ex.No.1	Synthesis of Sulphacetamide
Ex.No.2	Synthesis of Aspirin
Ex.No.3	Synthesis of Methyl Orange
Ex.No.4	Synthesis of 5,5-Diphenylhydantoin
Ex.No.5	Synthesis of Chlorbutol
Ex.No.6	Synthesis of Paracetamol

**IP Monograph of the following drugs**

Ex.No.7	Aspirin
Ex.No.8	Paracetamol
Ex.No.9	Sulphacetamide
Ex.No.10	Chlorbutol

**Drug analysis**

Ex.No.11	Assay of Metronidazole
Ex.No.12	Assay of Calcium Gluconate
Ex.No.13	Assay of Sulphacetamide
Ex.No.14	Assay of Chlorbutol
Ex.No.15	Disintegration Test
Ex.No.16	Hardness Test

**Total: 90 hours****Outcomes:**

- To learn about the synthesis of sulphaacetamides and Aspirin
- To learn about the preparation of methylorange
- To learn about the preparation of 5,5-Diphenylhydantoin
- To learn about the IP monograph of Aspirin and Paraacetamol
- To get the knowledge about the synthesis of Chlorbutol
- And Paraacetamol

- To learn about the drug analysis
- To learn about the disintegration test

**Text Book:**

1. A.A. Siddiqui, S. Siddiqui, Natural Products Chemistry Practical Manual, CBS Publishers & Distributors, 2008.

**Reference Book:**

1. Gnanprakasam, Ramamurthy, Organic Chemistry Lab Manual, S. Wisvanathan Printers & b Publishers Pvt. Ltd, 2010.

L T P C

**15MPS009 INTERNSHIP**

**0 0 0 2**

**Objectives:**

To gain practical experience by working in a well-established research environment.

To demonstrate an ability to work independently and utilize principles of doing research.

**Requirements**

Students wishing to receive credit for internship are required to find, apply for, and be selected for a chemistry or materials related internship position with an organization of their choice. They will then need to seek permission from the Department Chair to register for the appropriate internship course.

The student must complete at least 90 h of work during the semester for each hour of academic credit awarded, and these work hours must be completed during the term (odd or even semester vacation) in which the student is registered for the internship course.

After the student has completed the internship, the student must submit the final evaluation report of the internship experience and 20 minute presentation to department at conclusion of semester. The Department Chair and class instructor will allot the marks for the internship evaluation report.

**Outcomes:**

- To know the various types of industries.
- To learn the procedure of identifying, approaching, applying and getting approval of internship from a leading industry.
- To witness the entire work area of the industry.

- To understand the nature of job involved in the various sector of the industry.
- To adapt with the working people.
- To identify the manufacturing procedures and technical skills involved.
- To understand the complete mechanism of the reactions involved in the manufacturing areas at different sectors.
- To correlate the manufacturing procedures with simple laboratory synthesis.
- To learn the environment aspects, pollution their control involved in the manufacturing unit.
- To prepare a final evaluation report and presentation for the internship carried out for minimum 30 days.

**L T P C**

**15MPS010 PHARMACEUTICAL FORMULATION TECHNOLOGY I 4 0 0 4**

**Objectives:**

To learn about the basic concepts of pharmaceutical formulations. To learn about the physicochemical principles, pharmaceutical operations, profile of pharmaceutical formulations.

**Unit I Introduction to pharmaceutical formulations 15**

Need for formulation; History of formulation; Challenges in early formulations; Drug substance to Drug product with reference to formulating for the patient; Physical and chemical properties of Formulation.

**Unit II Physicochemical Principles 15**

Solutions; pH, EMF and redox potentials ; physicochemical properties evolving into in vivo bioavailability; Absorption, Dissolution, Permeability, Distribution, Metabolism, Excretion; Complexation,; Modifies release dosage forms; profile of common formulations; colloidal systems, Rheology; Drug stability and ICH Guidelines for stability testing.

**Unit III Pharmaceutical operations 15**

Extraction; Drying; Evaporation; Distillation; Filtration/Centrifugation; Size reduction and handling of solids in the powder form; Anti-solvent and reactive crystallization; Melting approaches to particle size; Wet milling and dry milling; packaging.

**Unit IV      Profile of formulations****15**

Tablets, capsules, solution and suspension formulation; Modified release formulation; Parenteral Formulation; Inhaled formulations/aerosols, Topicals.

**Total : 60 hours****Outcomes:**

- To learn about the introduction of pharmaceutical formulation
- To learn about the important properties of physical and chemical properties.
- To understand the pH, EMF and redox potentials
- To learn about the physicochemical properties
- To understand the drug stability and ICH Guidelines for stability testing
- To understand the Extraction methods
- To learn about the Wet milling and dry milling and packaging methods.
- To understand the different types of drug formulation

**Text Book:**

1. S.K.Jain and V.Soni, Bentley's Textbook of Pharmaceutics, An Adaptation-, Elsevier, 2012.

**Reference Book:**

1. C.B.Gupta and S. S. Khanka, Sultan Chand & Sons, Entrepreneurship and Small Business Management- New Delhi, 2012.

**15MPS011 ADVANCED CHROMATOGRAPHIC TECHNIQUES****4 0 0 4****Objectives:**

To learn about the basic concepts of chromatographic techniques. To learn about the basics, instrumentation and application of TLC, HPTLC, GC, HPLC, GPC and IEC techniques.

**Unit I Introduction to chromatography 12**

Adsorption and partition chromatography, definition of terms, techniques and chemical concepts of TLC, HPTLC and Paper chromatography followed by Gas and liquid chromatographic analysis and Sophisticated techniques in chromatography.

**Unit II TLC and HPTLC 12**

TLC - Principles and applications, HPTLC – Theory, principle, instrumentation and application Size exclusion Supercritical fluid chromatography – principle, theory, instrumentation and application. Ion-exchange chromatography, hydrophobic interaction chromatography, affinity chromatography – principle and theory.

Capillary electrophoresis :principle, techniques and application.

**Unit III Gas chromatography 12**

Theory of gas chromatography, principle of gas chromatography, instrumentation and application of gas chromatography.

**Unit IV High performance liquid chromatography 12**

High performance liquid chromatography – principles, theories, stationary phases, Instrumentation for HPLC. Factors affecting resolution, tailing, selectivity, gradient elution, reversed phase chromatography. Preparative HPLC, separation of enantiomers – chiral mobile phases – chiral solid stationary phases – Indirect separation of enantiomers.

Special techniques in HPLC – Micro and capillary HPLC, High speed and super speed HPLC – Hyphenated techniques.

**Unit V            Sophisticated techniques in chromatography****12**

Separation of proteins: Gel filtration, gel electrophoresis – PAGP – (Polyacrylamide gel electrophoresis). Immuno electrophoresis – Methods of purifying proteins – Ion-exchange chromatography, hydrophobic interaction, chromatography, affinity chromatography – Analysis of blood sample – components of blood (serum, plasma, protein-free fraction) – Methods of analysis. **Total : 60 hours**

**Outcomes:**

- To learn about the Adsorption and partition chromatography
- To learn about the techniques and principle, instrumentation, applications of TLC, HPTLC and Paper chromatography.
- To understand the Size exclusion Supercritical fluid chromatography
- To learn about the physicochemical properties
- To understand the principle and theory Ion-exchange chromatography, hydrophobic interaction chromatography and affinity chromatography
- To understand the Capillary electrophoresis
- To learn about the HPLC
- To understand the special techniques in HPLC
- To learn about the theory and applications of gas chromatography
- To understand the Separation and purification of proteins.

**Text Book:**

1. Beckett & Stenlake, Practical Pharmaceutical chemistry, Vol. I and II, 4<sup>th</sup> edition, The Athlone Press, London, 2002.

**Reference Books:**

1. D.C. Garrett, Quantitative Analysis of Drugs, 3<sup>rd</sup> Edition, Springer, 2002.
2. Lloyd R. Snyder, Joseph J. Kirkland & Joseph L. Glajch, Practical HPLC Method Development, 2<sup>nd</sup> Edition, Wiley Interscience, 2001



**15MPS012 PRACTICAL -III: MEDICINAL CHEMISTRY****0 0 6 3****Objectives:**

To learn about the basic concepts of assay of some important drugs. To learn about various analytical techniques used for drug assay and to know about the basic calculations involved in the drug assay.

**Ex. No. List of Experiments**

- Ex.No.1: Assay of Paracetamol
- Ex.No.2: Determination of Isoniazid
- Ex.No.3: Estimation of Aspirin by Colorimetry
- Ex.No.4: Estimation of Caffeine
- Ex.No.5: Estimation of Aspirin by UV-VIS Spectrophotometry
- Ex.No.6: Estimation of Ibuprofen
- Ex.No.7: Thin Layer Chromatography
- Ex.No.8: Determination of water content by Karl Fisher method.
- Ex.No.9: Test for identity of selected drugs.
- Ex.No.10: Determination of strength of strong acid by potentiometry.
- Ex.No.11: Determination of quinine sulphate by fluorimetry.
- Ex.No.12: Conductometric titration of mixture of acids.
- Ex.No.13: Determination of pKa of a weak acid using Henderson equation.

**Total : 90 hours****Outcomes:**

- To learn about the assay of paracetamol
- To learn about estimation of Aspirin by colorimetry
- To learn about Estimation of Aspirin by UV-VIS Spectrophotometry
- To learn about Thin Layer Chromatography
- To learn about Conductometric titration of mixture of acids.

- To learn about potentiometry.
- To learn about Test for identity of selected drugs.

**Text Book:**

1. A.A. Siddiqui, S. Siddiqui, Natural Products Chemistry Practical Manual, CBS Publishers & Distributors, 2008.

**Reference Books:**

1. Gnaprakasam, Ramamurthy, Organic Chemistry Lab Manual, S. Viswanathan Printers & Publishers Pvt. Ltd, 2010.
2. Kenneth A. Connors, Textbook of Pharmaceutical Analysis, 3ed., Wiley, 2010.

**L T P C**

**15MPS013 PRACTICAL - IV: PHYTO CHEMISTRY**

**0 0 6 3**

**Objectives:**

To learn about the separation techniques of various natural products from natural sources. To learn about the experimental techniques and solvent extraction techniques involved in the extraction of the following natural products.

**Ex. No: Lists of Experiments**

- Ex.No.1: Isolation of caffeine from tea leaves
- Ex.No.2: Extraction of piperine from black pepper
- Ex.No.3: Extraction of hesperidin from orange peel
- Ex.No.4: Extraction of pectin from orange peels
- Ex.No.5: Extraction of nicotine picrate from tobacco
- Ex.No.6: Extraction of Curcumin from turmeric
- Ex.No.7: Isolation of lycopene
- Ex.No.8: Extraction beta carotene from plant leaves.
- Ex.No.9: Extraction of flavonoids.
- Ex.No.10: Extraction of naringin

Ex.No.11: Isolation of Ascorbic Acid from lemon

Ex.No. 12: Isolation of Tartaric Acid from grape

**Total: 90hours**

**Outcomes:**

- To learn about Isolation of caffeine from tea leaves
- To learn about Extraction of pectin from orange peels
- To learn about Extraction of nicotine picrate from tobacco
- To learn about Isolation of lycopene
- To learn about Extraction of flavonoids.
- To learn about Isolation of Ascorbic Acid from lemon

**Text Book:**

1. A.A. Siddiqui, S. Siddiqui, Natural Products Chemistry Practical Manual, CBS Publishers & Distributors, 2008.

**Reference Book:**

1. Gnanprakasam, Ramamurthy, Organic Chemistry Lab Manual, S. Wisvanathan Printers &Publishers Pvt. Ltd, 2010.

L T P C

**15MPS014 PHARMACEUTICAL FORMULATION TECHNOLOGY – II 4 0 0 4**

**Objectives:**

To learn about basic principles of Pharmaceutical Formulation Technology. To learn about the standard pharmaceutical practice, role of microbiology in formulations, pilot plant manufacturing and entrepreneurial aspects.

**Unit I Standard pharmaceutical practice**

**12**

Pharmacopoeias; Formularies; Pharmaceutical calculations and prescriptions; Preparations-oral, external, ocular; New drug delivery system; Radio isotopes.



**Text Book:**

1. S.K.Jain and V.Soni, Bentley's Textbook of Pharmaceutics, An Adaptation- Elsevier, 2012.

**Reference Book:**

1. C.B.Gupta and S.S.Khanka, Sultan Chand & Sons, Entrepreneurship and Small Business Management- NewDelhi, 2012.

# Syllabus

## Discipline Specific Elective Course

**L T P C**

**15MPS101      FUNDAMENTALS OF BIOCHEMISTRY      4 0 0 3**

**Objectives:**

To study the metabolism of carbohydrates, amino acids, proteins and lipids. To understand the functions of DNA and RNA - To know about vitamins.

**Unit I            Chemistry And Metabolism Of Carbohydrates            12**

Definition, Classification and biological role of carbohydrates. Monosaccharides Linear and ring structures (Haworth formula) of ribose, glucose, fructose and mannose (structural determination not required) physical and chemical properties of glucose and fructose.

Disaccharides: Ring structures (Haworth formula) – occurrence, physical and chemical properties of maltose, lactose and sucrose. Glycolysis of carbohydrates.

**Unit II            Chemistry And Metabolism Of Amino Acids And Proteins            12**

Amino acids: Various classification, essential amino acids, physical properties (amphoteric nature and isoelectric point) reactions.

Proteins: Classifications (based on shape, composition and solubility), physical properties.

Primary structure – End group analysis (N – terminal analysis – Edman’s method, dansyl chloride method; C – terminal analysis – hydrazinolysis and bio-chemical methods)

Biological functions of proteins, Deamination, transamination reactions, Urea cycle.

**Unit III      Chemistry and Metabolism of Lipids      12**

Definition, classification – simple lipids (fatty acids), compound lipids and derived lipids, Properties: saponification number, Acetyl number.

Cholesterol (structure not needed), biological importance and chemical properties. Bile acids – functions. Biological functions of lipids.

**Unit IV      Nucleic Acids      12**

Purine and pyrimidine bases, nucleosides, nucleotides, polynucleotides, DNA structure – various types, RNA structure – various types. Biological functions of DNA and RNA, Genetic code.

**Unit V Vitamins      12**

Vitamins: Definition, classification – water – soluble vitamins (B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>6</sub>, B<sub>12</sub> and vitamin – C) and fat- soluble vitamins (A, D, E and K) – occurrence, structure, deficiency diseases, biochemical roles and daily requirements.

**Total : 60 hours**

**Outcomes:**

- To learn about the definition, Classification and biological role of carbohydrates
- To learn about the monosaccharides and disaccharides
- To understand the types and properties of Amino acids
- To learn about the types and properties of proteins
- To understand the structure and biological functions of proteins
- To understand the the types and properties of lipids and cholesterol
- To learn about the Purine and pyrimidine bases
- To understand the types and biological functions of DNA and RNA, Genetic code.

- To learn about the different types of vitamins

**Text Book:**

1. J.L. Jain, Sunjay Jain, Nitin Jain, Fundamentals of biochemistry, 6<sup>th</sup> edition, S.Chand and company Ltd, 2005.

**Reference Books:**

1. Charlotte W. Pratt, Kathleen Cornely, Essential Biochemistry, 2<sup>nd</sup> Edition, John Wiley & Sons, 2001.
2. C. B. Powar and G. R Chatwal, Biochemistry-5<sup>th</sup> edition, Himalaya publishing house, 2006

L T P C

4 0 0 3

**15MPS102 CHEMICAL AND INSTRUMENTAL METHODS OF DRUG ANALYSIS**

**Objectives:**

To understand the basic principles, instrumentation and applications in drug analysis using IR, UV-Visible, NMR and Mass spectrometry.

**Unit I UV-visible spectrophotometry 12**

Theory – Beer Lambert’s law – limitations of the law, Design and working of single beam and double beam spectrophotometry. Applications of UV absorption spectrometry in qualitative analysis and quantitative analysis.

**Unit II Thermometry and XRD 12**

Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC). Polymorphism/XRD – analysis.

**Unit III      IR-spectrometry      12**

Theory - Molecular vibration, instrumentation and mechanics of measurement – sample preparation –IR Spectrometry,. FTIR and use in structural elucidation .

**Unit IV      NMR-spectrometry      12**

Theory, spin-spin coupling, chemical shift, magnetic equivalence – spin-spin decoupling – shift reagents instrumentation.Applications of NMR spectrometry in characterization of chemical structure using spectra of simple organic compound as examples.Principles, Instruments and applications of <sup>13</sup>C NMR.

**Unit V      Mass spectrometry      12**

Theory, fragmentation pattern, ionization techniques; electron bombardment, chemical ionization, field desorption, fast atom bombardment. Different analyzers, Interpretation of mass spectra, Determination of molecular weight and molecular formula and applications of mass spectrometry

**Total: 60 hours**

**Outcomes:**

- To learn about the theory and beer Lambert's law
- To learn about the working of single beam, double beam spectrophotometry and pplications of UV absorption spectrometry
- To understand the DTA, DSC and XRD.
- To learn about the theory, instrumentation and application of IR spectroscopy.
- To understand the spin-spin coupling, chemical shift and decoupling
- To understand the the instrumentation and applicaton of NMR spectroscopy.
- To learn about the Principles, instruments and applications of <sup>13</sup>C NMR.
- To understand the Theory, fragmentation pattern, ionization techniques of mass spectroscopy
- To learn about the applications of mass spectrometry.







**Reference Book:**

1. V. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, New Age International, 1986.

**L T P C****15MPS104****ORGANIC CHEMISTRY – I****4 0 0 3****Objectives:**

To learn about the salient features of optical activity and geometrical isomers of organic compounds. To study the mechanism of substitution reactions in aliphatic and aromatic systems.

**Unit I Stereochemistry****12**

Optical activity and chirality. Classification of chiral molecules as asymmetric and dissymmetric. A brief study of dissymmetry of allenes, biphenyls, spiro compounds, trans-cyclooctene and cyclononene and molecules with helical structures. Absolute configuration – R, S notation of biphenyls and allenes. Fischer projection. Inter conversion of Sawhorse, Newman and Fischer projections. Molecules with more than one asymmetric center (restricted to five carbons) E.g. Erythro and threo compounds. Asymmetric synthesis, Cram's rule.

Geometrical isomerism. E, Z nomenclature of olefins, Geometrical and optical isomerism (if shown) of disubstituted cyclopropane, cyclobutane and cyclopentanes. Identification of enantiotopic, homotopic, diastereotopic hydrogens and prochiral carbons in compounds containing up to ten carbons only, stereo specific and stereo selective reactions.

**Unit II Aliphatic nucleophilic substitution reactions****12**

Kinetic and non-kinetic methods of determining organic reaction mechanisms. Hammett and Taft equations- Simple problems.

$SN_1$ ,  $SN_2$  and  $SN_i$  mechanisms – Neighboring group participation – reactivity, Bredt's rule structural and solvent effects- substitution in norbornyl and bridgehead systems – substitution at allylic and vinylic carbons substitution by ambident nucleophiles- substitution at carbon doubly bonded to oxygen and nitrogen-alkylation and acylation of amines, halogen

exchange. Von-Braun reaction, alkylation and acylation of active methylene carbon compounds, hydrolysis of esters, Claisen and Dieckmann condensations.

**Unit III      Aromaticity      12**

Aromaticity of benzenoid, heterocyclic and non-benzenoid compounds, Huckel's rule-Aromatic systems with pi electron numbers other than six-non-aromatic (cyclooctatetraene) and anti-aromatic systems (cyclo butadiene ) –systems with more than 10pi electrons –Annulenes up to C<sub>18</sub> (synthesis of all these compounds is not expected).

**Unit IV      Nucleophilic substitution reactions      12**

Method for the generation of benzyne intermediate and reactions of arylene intermediate-Nucleophilic substitution involving diazonium ions.Aromatic Nucleophilic substitutions of activated halides.Ziegler alkylation.Chichibabinreaction.SandMeyers reagent.

**Unit V      Aromatic electrophilic substitutions      12**

The arenium ion mechanism –Orientation and reactivity (ortho, meta and para directing groups), Hammett equations. Typical reactions –nitration, halogenation, alkylation, acylation and diazonium coupling.Formylation reactions-Gatterman, Gatterman-Koch, Vilsmeier-Hack and Reimer –Tieman reaction. Synthesis of di and tri substituted benzenes (symmetrical tribromo benzene, 2-amino 5-methylphenol, 3-nitro - 4-bromobenzoic acid, 3,4-dibromonitrobenzene, 1,2,3trimethylbenzene) starting from benzene or any monosubstituted benzene. Electrophilic substitution of pyridine and pyridine -N-oxide, Naphthalene &Anthracene .hypso reactions

**Total: 60 hours**

**Outcomes:**

- To learn about the Optical activity and chirality of molecules
- To learn about the Absolute configuration – R, S notation of biphenyls and allenes
- To understand the Fischer projection. Inter conversion of Sawhorse, Newman and Fischer projections.
- To learn about the Asymmetric synthesis, Cram's rule
- To understand the Geometrical isomerism.E, Z nomenclature
- To understand the Kinetic and non-kinetic methods of determining organic reaction mechanisms
- To learn about the SN<sub>1</sub>, SN<sub>2</sub> and SN<sub>i</sub> mechanisms

- To understand the Aromaticity of benzenoid, heterocyclic and non-benzenoid compounds, Huckel's rule-Aromatic systems
- To learn about Method for the generation of benzyne intermediate and reactions.
- To understand the the arenium ion mechanism and Formylation reactions
- To learn about Electrophilic substitution of pyridine and pyridine -N-oxide, Naphthalene & Anthracene .hyppo reactions.

#### **Text Books:**

1. Jerry march, Advanced organic chemistry , 4<sup>th</sup> edition , John Wiley student edition 2004.
2. John Mc Murry, Organic chemistry, 5<sup>th</sup> edition, Asian books Pvt Ltd, 2000.

#### **ReferenceBooks:**

1. F. A. Carey, Richard J. Sundberg, Advanced organic chemistry, 5<sup>th</sup> edition, springer, 2007.
2. P.S. Kalsi, Organic reactions stereochemistry and mechanism, 4<sup>th</sup> edition, New Age International Publishers, 2006.

**L T P C**

**15MPS105 THERMODYNAMICS AND CHEMICAL KINETICS 4 0 0 3**

#### **Objectives:**

To understand the fundamental aspects of classical thermodynamics and chemical potential. To learn the important aspects of statistical thermodynamics and chemical potential. To study the simultaneous reaction, fast reaction, reactional in solution and the effect of temperature on reaction rate.

#### **UnitI Classical thermodynamics**

**12**

Definition - Fugacity : Determination of Fugacity- Variation of Fugacity with temperature and pressure. Fugacity of solids and liquids. Mixture of ideal gases. Maxwell's relationships, spontaneity, equilibria-Temperature, pressure dependence of thermodynamic quantities, Lechatlier principle. The concepts of activity and activity coefficients and determination of activity coefficient.



**Outcomes:**

- To learn about the Fugacity and determination of Fugacity
- To learn about the variation of Fugacity with temperature and pressure
- To understand the Maxwell's relationships
- To learn about the Lechatlier principle
- To understand the Partial molar properties
- To understand the chemical potential.
- To learn about the Concept of thermodynamic probability and distribution of distinguishable and non-distinguishable particles.
- To understand the Maxwell – Boltzmann, Fermi – Dirac and Bohr's Einstein statistics, comparison and applications
- To learn about the Partition function and heat capacity of solids
- To understand the simultaneous reaction and its kinetics
- To learn about the Study of fast reaction and relaxation methods
- To understand the temperature and pressure jump method, stopped flow and flash photolysis methods. CO10 To understand the Collision theory
- To learn about the langmuir and BET absorption isotherms
- To learn the Eyring equation and reactions in solution

**Text Book:**

1. K.L. Kapoor, Physical chemistry, 1st edition, Macmillan Publisher, 2004.

**Reference Books:**

1. K.L. Kapoor, Physical chemistry, 1<sup>st</sup> Edition, Macmillan Publisher, 2004.
2. Kuriacose, Rajaram, Thermodynamics, 3rd edition, ShohanLalNagil Chand & co, 1999.
3. Keith J. Laidler, Chemical Kinetics, 3rd edition, Pearson Education, 2008.
4. M. C Gupta, Statistical thermodynamics, 2nd edition, New Age International Publishers, 2006

**15MPS106 SYNTHESIS OF API AND THEIR MANUFACTURE****4 0 0 3****Objectives:**

To understand the process chemistry, combinatorial chemistry, phase transfer catalysis and asymmetric synthesis and strategy of process research.

**Unit I Process chemistry in pharmaceutical industry – An overview 12**

Introduction, top 200 prescription drugs by worldwide sales ; Top ten drugs in the US market constituting 10% of world wide sales – Premarin, Synthroid, Lipitor, Prilosec, Hydrocortisone, Albuterol, Norvasc, Claritin, Timox and Prozac (\$ one billion). Background of process chemistry – role of process chemistry

**Unit II Strategy of process research & development in pharma industry 12**

Process research and development of Penicillin G CAS Reg. No.[61-33-6] (antibacterial); fosinopril CAS Reg. No.[98048-97-6] (antihypertensive) ; Rabepazole CAS Reg. No.[117976-89-3] (antiulcerative) Time based competition – portfolio management – stages of process research and development.

**Unit III Combinatorial chemistry 12**

Introduction – Drug Optimization – Drug discovery – Solid Phase Technique – parallel synthesis – Mixed Combinatorial Synthesis – Deconvolution – Structure Determination and limitations – Drug design / Drug discovery.

**Unit IV Phase transfer catalysis and asymmetric synthesis 12**

Application of phase transfer catalysts in pharmaceutical industry for drug synthesis – enantioselective synthesis of chiral 2-hydroxycarboxylic acids and esters – asymmetric catalysis – eg. Asymmetric hydrogenation – L-Dopa process ; Sharpless asymmetric epoxidation eg. Synthesis of Fluoxetine enantiomers

**Unit V Polymorphism and process safety in drug synthesis 12**

Polymorphism – solid state – crystallization – recrystallization of drug molecules eg. Isolation techniques and characterization of polymorphs of Venlafaxine hydrochloride [99300-78-4] Clopidogrel bisulphate [135046-48-9] and Lorazepam [846-49-1] (any two) Chemical Process safety – Principles and Practice-guidelines and norms-Green chemistry.

**Total: 60 hours**



**Outcomes:**

- To learn about the Premarin, Synthroid, Lipitor, Prilosec, Hydrocortisone, Albuterol, Norvasc, Claritin, Timox and Prozac
- To learn about the role of process chemistry
- To understand the Process research and development of Penicillin G CAS
- To learn about the Rabeprazole CAS
- To understand the drug optimization and drug discovery
- To understand the solid phase technique, parallel synthesis and mixed combinatorial synthesis
- To learn about the structure determination and limitations of drug
- To understand the application of phase transfer catalysts
- To learn about the asymmetric catalysis and synthesis of fluoxetine enantiomers
- To learn about the Langmuir and BET adsorption, isolation techniques and characterization of polymorphs of drugs.

**Text Book:**

1. R. Hilfiker, Polymorphism in Pharmaceutical industry, Wiley-VCH, 2006.
2. H. G. Brittain, Polymorphism in Pharmaceutical solids II<sup>nd</sup> edition, CRC Press, 1998.

**Reference Book:**

1. C. Starks, C. Liotta, M. Halpern, "Phase-Transfer Catalysis: Fundamentals, Applications and Industrial Perspectives," Chapter 16, Chapman & Hall, New York, 1994.



- To understand the Etard reaction, HVZ reaction, Umpolungsynthesis and Stephen reaction.
- To understand the Barton reaction, Jones oxidation, Oppenauer oxidation
- To learn about the Michael addition
- To understand the Birch reduction, Clemmenson reduction
- to learn about the Meerwin P.V reduction and rosenmund reduction
- To understand the Synthesis and applications of reagents 9-BBN, n-butyl lithium, ceric ammonium nitrate
- To learn about the Synthesis and applications of reagents DDQ, DCC, Grignard reagent, LDA, Gilman reagent, NBS and PCC.

**Text Books:**

1. R.O.C. Norman, Principles of Organic Synthesis by, Chapman and Hall, London 1980.
2. Francis A. Carey and Richard J. Sundberg, Advanced Organic Chemistry-Part B, 3<sup>rd</sup> Edition, 1990.

**Reference Book:**

1. S.M. Mukherji and S.P. Singh, Organic Reaction Mechanism, Macmillan India Ltd. 1990.

L T P C

**15MPS108**

**SEPARATION TECHNIQUES**

**4 0 0 3**

**Objectives:**

To study the salient features of thermal methods and atomic absorption spectroscopy.

To study the general features of chromatography and their Basic principles.

To understand HPLC Ion exchange and gel permeation chromatography.

**UnitI Introduction to chromatography**

**12**

Adsorption and partition chromatography, definition of terms, techniques and chemical concept of column, paper, TLC and HPTLC.



**Text Book:**

1. E. Heftmann, Chromatography-6<sup>th</sup> Edition, Vol-69A, Elsevier Publisher, 2004.

**Reference Book:**

1. Kevin Robards, Charles, P. Jackson, Paul Haddad, Principles and Practice of Modern Chromatographic Methods, Academic Press, Elsevier Publisher, 2015.

**L T P C****15MPS109****ORGANIC CHEMISTRY- II****4 0 0 3****Objectives:**

To learn about the addition reaction involving carbon to carbon and carbon to hetero multiple bonds. To learn about some important oxidation and reduction reactions and elimination reactions.

**Unit I          Addition to carbon - carbon and carbon-hetero multiple bonds          12**

Electrophilic, nucleophilic addition reaction and neighbouring group participation, mechanism - Addition of halogen and nitrosyl chloride to olefins. Hydration of olefins and acetylenes. Hydro boration, Syn & Anti stereochemistry. Hydroxylations, Michael addition, Diels Alder reaction, 1,3-dipolar additions.

**Unit II          Naming reactions          12**

Carbenes and their addition to double bonds-SimmonSmith reaction, Mannich, Stobbe, Darzen, Wittig, Wittig – Horner and Benzoin reactions,  $C \equiv N$  with Grignard reagent. Stereochemical aspects to be studied wherever applicable. Nitrene: methods for generating nitrenes and their reactions.

**Unit III          Elimination reactions          12**

$E_1$ ,  $E_2$  and  $E_1cB$  mechanism-  $E_1$ ,  $E_2$  and  $E_1CB$  Spectrum-orientation of the double bond – Hofmann and Saytzeff rule - competition between elimination and substitution. Typical elimination reactions – dehydration, dehydrohalogenation and dehalogenation. Stereochemistry of  $E_2$  eliminations in cyclohexane systems (Menthyl, Neomenthyl). Mechanism of pyrolytic elimination. Chugaev and Cope eliminations.

**UnitIV      Coupling Reactions      12**

Heck Coupling-Suzki coupling-Tin Coupling-Transition metal catalyzed coupling reactions.

**UnitV      Oxidation and reduction      12**

Mechanisms – study of the following oxidation reactions – oxidation of alcohols-use of DMSO in combination with DCC or acetic anhydride in oxidizing alcohols- oxidation of methylene to carbonyl- oxidation of aryl methanes – allylic oxidation of olefins. Reductions : selectivity in reduction of 4-T- Butyl cyclohexanone using selectrides hydride reductions - LAH, NaBH<sub>4</sub>, DIBAL, Super hydride, Lithium hydride, Sodium hydride – synthetic importance of Clemmenson and Wolff- Kishner reductions- modifications of Wolff-Kishner reduction – Birch reduction, MPV reduction.

**Total : 60 hours**

**Outcomes:**

- To learn about the electrophilic, nucleophilic addition reaction
- To learn about the Hydro boration, Syn& Anti stereochemistry
- To understand the Hydroxylations, Michael addition, Diels Alder reaction, 1,3-dipolar additions.
- To learn about the Carbenes and their addition to double bonds
- To understand the methods for generating nitrenes and their reactions.
- To understand the E<sub>1</sub>, E<sub>2</sub> and E<sub>1</sub>cB mechanism
- To learn about the hofmann and saytzeff rule
- To understand the chugaev and cope eliminations.
- To learn about the heck coupling and suzuki coupling and tin Coupling
- To understand the oxidation of alcohols and reductions.

**Text Books:**

1. R.O.C. Norman, Principles of Organic Synthesis, Chapman and Hall, London 1980.
2. Francis A. Carey and Richard J. Sundberg, Advanced Organic Chemistry-Part B, 3<sup>rd</sup> Edition, 1990.

**Reference Book:**

1. S.M. Mukherji and S.P. Singh, Organic Reaction Mechanism, Macmillan India Ltd. 1990

**L T P C****15MPS110****ANALYTICAL TECHNIQUES****4 0 0 3****Objectives:**

To learn about several methods of analytical techniques. To learn about basic concepts of UV, IR, NMR and mass spectrum and their applications.

**Unit I UV-Visible, IR and Raman spectroscopy 12**

Colourimetric analysis and UV- Visible spectroscopy: Beer Lambert's law, Principles of single and double beam instruments – applications for analysis of inorganic and organic samples. Infrared spectrophotometric analysis – principle and instrumentation and molecular structure determination.

Raman Spectra – principle, basic instrumentation – structural analysis.

**Unit II NMR and mass spectroscopy 12**

Nuclear Magnetic Resonance – Principle, instrumentation, structure determination, NMR of  $^1\text{H}$ ,  $^{13}\text{C}$ ,  $^{31}\text{P}$ ,  $^{19}\text{F}$ .

Electron Spin Resonance – Principle, instrumentation, applications to coordination compounds.

**Unit III Mass spectroscopy 12**

Mass Spectrometry – Principle, basic instrumentation, fragmentation patterns – organic molecular structural determination.

**Unit IV Thermal analysis 12**

Thermo gravimetric and differential thermal analysis, DSC thermometric titrations, differential scanning colourimetry – basic instrumentation and applications.

**Unit V AAS and photoelectron spectroscopy 12**

Atomic absorption spectroscopy: Theory, Atomizers, Flame and Electro thermal. Radiation sources, Instrumentation, spectral and chemical interferences, application.

Photoelectron spectroscopy (UV and X-Ray) –photo electron spectra Koopman's theorem, fine structure in PES, chemical shift and correlation with electronic charges.

**Total : 60 hours**

**Outcomes:**

- To learn about the Colourimetric analysis and UV- Visible spectroscopy
- To learn about the principle, instrumentation, structure determination raman spectra
- To understand the principle, instrumentation, structure determination of nuclear magnetic resonance
- To learn about the Principle, instrumentation, structure determination of electron spin resonance
- To understand the principle, instrumentation, structure determination of Mass Spectrometry
- To understand the Thermo gravimetric and differential thermal analysis
- To learn about the DSC thermometric titrations, differential scanning colourimetry
- To understand the Atomic absorption spectroscopy
- to learn about the Photoelectron spectroscopy
- To understand the chemical shift and correlation with electronic charges.

**Text Books:**

1. Willard Merrit, Dean and Settle, Instrumental methods of analysis, 6<sup>th</sup> Edition, CBS Publisher, 1986.
2. A.I.Vogel, 1976, Textbook of Qualitative Inorganic Analysis, 3<sup>rd</sup> Edition, ELBS.

**Reference Book:**

1. D.A.Skoog and D.M.West, Fundamentals of Analytical Chemistry, 4<sup>th</sup> Edition, oldReinhord& Winston, Publication, 1982.



**Objectives:**

To study the general aspects of alkaloids, steroids, camphor, Acetic acid, carbohydrates and polysaccharides.

**Unit I      Natural pigments      12**

Anthocyanins – general methods of determining structure and synthesis – cyanin and hirsutin chlorides. Flavones and flavanols – general method of determining structure and synthesis – Quercetin – Isoflavones – daidzein.

**Carbohydrates:** Structural aspects of starch and cellulose.

**Unit II      Terpenes      12**

Classification, structural elucidation by chemical degradation and synthesis of pinene, camphor, zingiberene, santonin,  $\beta$ -carotene.

**Steroids:** Structure and synthetic aspects of cholesterol, ergosterol, estrone and progesterone.

**Unit III      Alkaloids      12**

Classification, structural elucidation by chemical degradation and synthesis of papaverine, quinine, morphine and reserpine.

**Unit IV      Antibiotics      12**

Structure and synthesis of chloramphenicol, penicillins and streptomycin.

**Vitamins:** Structure and synthesis of vitamin A, B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>, C, D, E, K and H.

**Unit V      Synthetic methodology      12**

Protection of functional groups (hydroxyl, amino, carboxyl, and carbonyl groups). Illustration of protection and deprotection in synthesis – synthetic analysis and planning – synthesis of target molecules based on disconnection and synthon approach. Control of stereochemistry – synthesis using simple chiral molecules.

**Biosynthesis** – Biosynthetic routes for terpenes, alkaloids, steroids, carbohydrates, proteins and insulin.

**Total : 60 hours**

**Outcomes:**

- To learn about the Anthocyanins
- To learn about the cyanin and hirsutin chlorides
- To understand the flavones and flavanols
- To learn about the Quercetin, Isoflavones and daidzein
- To understand the structural aspects of starch and cellulose

- To understand the classification, structural elucidation by chemical degradation and synthesis of pinene, camphor.
- To learn about the classification, structural elucidation by chemical degradation and synthesis of zingiberene, santonin,  $\beta$ -carotene
- To understand the Structure and synthetic aspects of cholesterol, ergosterol, estrone and progesterone.
- To learn about the synthesis of papaverine, quinine, morphine and reserpine.
- To understand the structure and synthesis of chloramphenicol, penicillins and streptomycin
- To learn about the Structure and synthesis of vitamins
- To learn about the biosynthetic routes for terpenes, alkaloids, steroids, carbohydrates, proteins and insulin.

**Text Books:**

1. I. L. Finar, Organic chemistry, vol.2, 5<sup>th</sup> edition, Pearson Education, 2003.
2. AshutoshKar, Chemistry of natural Products, Vol-I, 1<sup>st</sup> edition, CBS Publisher, 2010.

**Reference Book:**

1. Sujatha V. Bhat, B.A Nagasampagi, S. Meenakshi, Natural Products, Narosa Publishing House, 2009.

**15MPS112 ENZYME TECHNOLOGY AND RELATED ENTREPRENEUREAL SKILLS**

**Objectives:**

To learn biological aspects, metalloenzymes, oxygen carriers, nitrogen fixation, photosynthesis and cytochrome, and bioanalytical aspects.

**Unit I Introduction to biochemistry, function and applications 12**  
Nature and functions of enzyme, Coenzyme/ Cofactor. Classification of enzyme. Assay methods and units. Examples of applications of enzymes in industry, analytical techniques, medicine and Pharmaceuticals.

**Unit II Kinetics and mechanism of enzyme catalysis 12**  
Enzyme catalysis and controlling factors. Kinetics of enzyme catalyzed reactions in solution. Immobilized enzyme reaction kinetics. Effect of mass transfer resistance.

**Unit III Enzyme production on large scale technology 12**  
Isolation and purification of enzymes, protein fractionation methods.

**Unit IV Immobilization technology and development 12**  
Immobilization techniques for enzymes. Characteristics and uses for immobilized enzyme systems

**Unit V Industrial bioreactors utilizing isolated enzymes and biosensors development and applications 12**

Reactor design and analysis for immobilized enzyme reactors. Applications in biosensors. Some modern developments for enzymes in organic synthesis.

**Total: 60 hours**

**Outcomes:**

- To learn about the Nature and functions, classification of enzyme, Coenzyme and Cofactor
- To learn about the applications of enzymes in industry, analytical techniques, medicine and Pharmaceuticals
- To understand the enzyme catalysis and controlling factors
- To learn about the kinetics of enzyme catalyzed reactions in solution

- To understand the immobilized enzyme reaction kinetics
- To understand the effect of mass transfer resistance
- To learn about the Isolation and purification of enzymes
- To understand the protein fractionation methods
- To learn about the immobilization techniques for enzymes.
- To understand the characteristics and uses for immobilized enzyme systems
- To learn about the Reactor design and analysis for immobilized enzyme reactors
- To understand the applications in biosensors and some modern developments for enzymes in organic synthesis.

**Text Book:**

1. J. L Jain, S. Jain , N. Jain, Fundamentals of Biochemistry, 6<sup>th</sup> Edition S.Chand & Company, 2009.

**Reference Books:**

1. A.Wiseman, “Handbook of Enzyme Biotechnology”, Ellis – Horwood, 1983.
2. T. Devasena, Enzymology, 1<sup>st</sup> edition , Oxford University Press, 2010.

**L T P C**

**15MPS113**

**NUCLEAR AND PHOTOCHEMISTRY**

**4 0 0 3**

**Objectives:**

To learn the determination of Radio activity, application of tracers and Inorganic Photochemistry.

**UnitI Nuclear transition and activity 12**

Orbital electron capture: nuclear isomerism, internal conversion, detection and determination of activity by cloud chamber, nuclear emulsion, bubble chamber, G.M., Scintillation and Cherenkov counters.

**Unit II Nuclear reactions 12**

Nuclear fission and fusion reactions as energy sources: direct reactions, photonuclear and thermo nuclear reactions

**Unit III Nuclear reactors 12**

Components of nuclear reactors – the breeder reactor – nuclear reactors in India.

**Unit IV      Activation analyses      12**

Applications of tracer in study of reaction mechanism and in analytical chemistry – neutron activation analysis – isotope dilution analysis –Carbon dating- radio active tracer in the diagnosis and treatment in field of medicine.

**Unit V      Inorganic photochemistry      12**

Photo redox reactions and photo substitution reactions in coordination chemistry - photovoltaic and photo galvanic cells. Photo electro chemistry, Aspects of solar energy conversion.

**Total: 60 hours**

**Outcomes:**

- To learn about the orbital electron capture
- To learn about the determination of activity by cloud chamber, nuclear emulsion, bubble chamber, G.M., Scintillation and Cherenkov counters.
- To understand the nuclear fission and fusion reactions
- To learn about the direct reactions, photonuclear and thermo nuclear reactions
- To understand the Components of nuclear reactors and the breeder reactor
- To understand the Applications of tracer in study of reaction mechanism and in analytical chemistry
- To learn about the neutron activation analysis and isotope dilution analysis
- To understand the Carbon dating, radio active tracer in the diagnosis and treatment in field of medicine.
- to learn about the Photo redox reactions and photo substitution reactions in coordination chemistry
- To understand the photovoltaic and photo galvanic cells and photo electro chemistry

**Text Book:**

1. H.J. Arnikaar, Nuclear Chemistry, Wiley Eastern Co. II Edition, 1987.

**Reference Book:**

1. N.N. Greenwood and Earnshaw, Chemistry of the Elements, Pergamon Press New York, 1984.

**L T P C****4 0 0 3****15MPS114 NOVEL MATERIALS AND GREEN INDUSTRIAL CATALYSIS****Objectives:**

To learn about some important functional materials and nanomaterials. To learn about properties of metallic clusters and characterization techniques of functional and nanomaterials.

**Unit I Introduction to functional and nanomaterials 15**

An overview-, materials, molecular materials, functional materials, nanomaterial's classification /properties and industrial applications.

**Unit II Properties of metallic cluster 15**

Basic concept of metallic clusters - preparation of supported metallic clusters, various method of catalysts preparation and their physical and chemical properties. Tools for Structural Characterization of novel materials-

**Unit III Metal oxides 15**

Metal oxides, Supported metal oxides, Industrial catalysis (Synthesis Gas and Hydrogen).

**Unit IV Catalysts in chemical transformation 15**

Ammonia Synthesis, Methanol and Fischer – Tropsch Synthesis, Hydrocarbon Transformations, Environmental Catalysis

**Total : 60 hours**

**Outcomes:**

- To learn about the nanomaterial's classification, properties and industrial applications.
- To learn about the preparation, properties of supported metallic clusters
- To understand the metal oxides and supported metal oxides
- To learn about the industrial catalysis
- To understand the ammonia Synthesis
- To understand the Methanol and Fischer – Tropsch synthesis
- To learn about the Hydrocarbon Transformations
- To understand the Environmental Catalysis

**Text Book:**

1. Harry R. Allcock, Introduction to Materials Chemistry, Wiley Interscience Publisher, 2000.

**Reference Book:**

1. Bradley D. Fahlman, Materials Chemistry, 2<sup>nd</sup> ed. Springer Publisher, 2011.

**L T P C****15MPS115****ORGANIC CHEMISTRY- III****4 0 0 3****Objectives:**

To study the structure elucidation of organic molecules using NMR, Mass spectroscopy and IR spectroscopy. To know about the general aspects of organic photochemistry. To learn about Heterocycles, terpenoids, steroids and cholesterol.

**Unit I Physical Methods Of Structure Determination****12**

Principle and applications of ultraviolet Woodward Fisher Rule (only application) and infra-red spectroscopy in organic structure determination.

Nuclear magnetic resonance spectroscopy. Proton chemical shift, spin-spin coupling, coupling constants and applications to organic structures  $^{13}\text{C}$  resonance spectroscopy (elementary treatment).

**Unit II      Mass spectroscopy      12**

Mass spectrometry and its applications Optical rotatory dispersion and its applications. Cotton effect, axial haloketone rule and octant rule. Problem solving using spectral data. (for molecules with a maximum number of  $\text{C}_{10}$ )

**Unit III      Organic photochemistry      12**

Photochemical excitation-rate of the excited molecules –Jablonski diagram-study of photochemistry of ketone- photo reduction-photo cyclo addition-Paterno-Buchi reaction-di-pi-methane rearrangement.

**Unit IV      Pericyclic reactions      12**

classification –orbital symmetry-Woodward Hoffman rules-Analysis of electrocyclic, inter conversion of hexatrienes to cyclohexadienes. Cyclo addition and sigmatropic reactions-correlations diagram for butadiene-cyclobutene system. Structure of butylene, a fluxional molecule –Cope and Claisen rearrangements.

**Unit V      Heterocycles, terpenoids and steroids synthesis of the following      12**

Imidazole, oxazole, thiazole, flavones, isoflavones, anthocyanins, pyrimidines (cytosine and uracil only) and purines (adenine, guanine only). Synthesis of parent and simple (alkyl or aryl substituted derivatives are expected). Synthesis of vitamin A1 (Reformatsky and Wittig reaction methods only) Conversion of Cholesterol to progesterone, estrone and testosterone. Elucidation of structure of cholesterol (by chemical degradation)

**Total: 60 hours**

**Outcomes:**

- To learn about the Principle and applications of ultraviolet Woodward Fisher Rule
- To learn about the infra-red spectroscopy in organic structure determination.
- To understand the Nuclear magnetic resonance spectroscopy
- To learn about the  $^{13}\text{C}$  resonance spectroscopy
- To understand the mass spectrometry and its applications
- To understand the Optical rotatory dispersion and its applications



- To learn about the Cotton effect, axial haloketone rule and octant rule
- To understand the Photochemical excitation and Jablonski diagram
- To learn about the Paterno-Buchi reaction-di-pi-methane rearrangement.
- To understand the orbital symmetry-Woodward Hoffman rules
- To learn about the Cyclo addition, sigmatropic reactions, Cope and Claisen rearrangements
- To understand the Imidazole, oxazole, thiazole, flavones, isoflavones, anthocyanins, pyrimidines and purines.

**Text Book:**

1. J.Dyer, Application of absorption spectroscopy of organic compounds, Prentice-Hall of India Pvt.New Delhi, 2001.

**Reference Books:**

1. R.M. Silverstein, G.C. Bassler and Monsil, Spectrometric identification of Organic compounds by John Wiley and Sons, New York, 2005.
2. I.L. Finar, Organic Chemistry, Vol II, 5<sup>th</sup> Edition ELBS Publication, Longman, 1964.

**L T P C**

**15MPS116 STRATEGIC MANAGEMENT OF PHARMA INDUSTRY 4 0 0 3**

**Objectives:**

To know about pharma industry, technology opportunity for innovation, project evaluation, intellectual property protective and business strategy.

**Unit I Introduction and technology evolution**

**12**

Pharma industry-Specifics, Importance and role in health sector; the Global scenario and Positioning of Indian Pharma industry; Specific challenges of the Pharma industry versus the general industrial matrix; Understanding technological change; Need for technology strategy as step towards innovation and competitive advantage; Defining technological innovation and benefits.

Technology S-curves and management; Number of firms in the industry, Process obsolescence and Reverse Engineering; Innovative synthetic routes and atom economy dovetailing aspects of Green chemistry; Technology adoption and diffusion; Forecasting demand and confronting substitution.

**Unit II Opportunity for Innovation**

**12**

Technological, Political and Regulatory changes, Diversification, Demographic changes; Research and Development (R&D); Investment in R&D and return on investment – a profit centre; Linking of Research and Development for leverage; Cost reduction exercises.

**Unit III Project evaluation**

**12**

Managing uncertainty, Analytical hierarchy process, Net Present Value(NPV), Internal Rate of Return(IRR), scenario analysis and decision tree; Portfolio Management, customer-friendly solutions; Product pricing ; Market segmentation and market research.

**Unit IV Intellectual Property Protection**

**12**

Role of IP protection in knowledge era; Patents- process and Product and the patenting process; Lead molecule development and cost; ANDA; Patent litigation; Non-disclosure agreement; Expiry of patents and generic drugs marketing and issues in IP.

**Unit V Business strategy**

**12**

Networking; Joint venturing; Licensing; Contract manufacturing; Outsourcing; Human resource management of technical professionals- R&D personnel, Product Development team, Cross-Functional team, Internal communication, Organization structure-decentralizing R&D, acquisitions.

**Total: 60 hours**

**Outcome:**

- To learn about the pharma industry-specifics
- To learn about the specific challenges of the Pharma industry versus the general industrial matrix.
- To understand the defining technological innovation and benefits.
- To learn about the technology S-curves and management
- To understand the innovative synthetic routes and atom economy dovetailing aspects of green chemistry

To understand the technological, Political and Regulatory changes, Diversification, Demographic changes

To learn about the research and Development (R&D)

- To understand the managing uncertainty, Analytical hierarchy process, Net Present Value(NPV) and Internal Rate of Return(IRR).
- To learn about the friendly solutions, product pricing, market segmentation and market research.
- To understand the Role of IP protection in knowledge era and Patents
- To learn about the Non-disclosure agreement; Expiry of patents and generic drugs marketing and issues in IP.

**Text Book:**

1. Scott Shane, Technology Strategy For Managers And Entrepreneurs, Dorling Kindersley India Pvt. Ltd, 2009.

**Reference Book:**

1. C.B.Gupta and S.S.Khanka, Entrepreneurship and Small Business Management, Sultan Chand & Sons, New Delhi, 2012.

**L T P C**

**4 0 0 3**

**15MPS117 STEREOCHEMISTRY AND REACTION MECHANISM SUBJECT**

**Objectives:**

To understand the stereochemistry of organic compounds and the basic principle and terminology of retrosynthesis. To know about non-conventional techniques in inorganic synthesis.

**UnitI Stereochemistry 12**

- a) General consideration of molecular asymmetry and dissymmetry. b) Configuration – absolute and relative methods of determination





**Unit V          Vitamins****12**

Introduction , water soluble and fat soluble vitamins. Details of vitamin A, C, B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>,

**Total : 60 hours****Outcomes:**

- To learn about the classification of drugs
- To learn about the general and local anesthetics, sedatives and hypnotics
- To understand the Narcotics and analgesics.
- To learn about the Antibiotics
- To understand the structure and synthesis of chloromphenicol, pencillins and streptomycin To understand the Enzymes, co-enzymes
- To learn about the Michaelis-Menten's equation and verification by graphical methods-Eadieplot and Lineweaver-Burk
- To understand the enzyme catalysis, enzyme specificity and enzyme mechanism
- to learn about the enzyme Inhibition- Competitive inhibition, Un-competitive inhibition and Non-competitive inhibition
- To learn about the ionic liquids. miscellaneous catalysis and use of crown ethers
- To understand the water soluble and fat soluble vitamins

**Text Book:**

1. William Foye, Medicinal Chemistry, 4<sup>th</sup> Edition, 1995.

**Reference Books:**

1. Wilson & Gisvold, Medicinal Chemistry, 10<sup>th</sup> Edition, 1998.
2. Burger, Medicinal Chemistry, 5<sup>th</sup> Edition, 1995.

15MPS119

## ORGANIC SPECTROSCOPY

4 0 0 3

**Objectives:**

To understand the salient features of UV, visible, mass, infrared spectroscopy. To understand the salient features of  $^{13}\text{C}$ -NMR and  $^1\text{H}$ -NMR spectroscopy. To learn about the applications of various spectral techniques in characterizing organic compounds.

**Unit I UV-Visible spectroscopy 12**

Introduction – the energy of excitation. The absorption laws, measurement of the spectrum – choice of solvent – selection rules and intensity – Chromospheres – solvent effects – Conjugated dienes, polyenes, ketones and aldehydes.  $\pi - \pi^*$  transitions,  $n - \pi^*$  transition,  $\alpha, \beta$ - unsaturated ketones, acids, esters, nitriles, amides. The benzene ring, the substituted benzene ring – polycyclic aromatic hydrocarbons the effect of steric hindrance to co planarity.

**Unit II Mass spectroscopy 12**

Introduction – Instrumentation – High resolution and low resolution mass spectra – Determination of molecular formula – Molecular peaks rule.  $\text{M}^+$  ion. Natural isotope abundance analysis – fragmentation process – nitrogen rule, metastable ions, metastable peaks, retro Diels – Alder fragmentation – McLafferty rearrangement, loss of odd electron, neutral fragments from molecular ions – Factors which influence fragment abundance – Mass spectra of various functional groups containing compounds to be studied: aromatic, aliphatic hydrocarbons, ketones, acids, esters, amides, ethers, alcohols, amine and nitriles.

**Unit III Infrared spectra 12**

Introduction – Preparation of samples and examination in an infrared spectrometer – The infrared spectrum – the use of the table of characteristic group frequencies – correlation charts. Absorption frequencies of triple bond and cumulative double bonds – the aromatic overtone and combination – Region  $2000 - 1200 \text{ cm}^{-1}$ . Absorption frequencies of the double bond region – Groups absorbing in the finger print region – identification of functional groups.

**Unit IV  $^1\text{H}$ -NMR 12**

The spinning nucleus – The effect of an external magnetic field, precessional motion, precessional frequency, energy transitions.

Theory of NMR – Measurement of chemical shifts – Internal standards – Units used in NMR. Factors influencing chemical shift – electronegativity, shielding and deshielding, Van der Waals deshielding, Anisotropic effects – Correlation data, use of correlation tables. Influence

of restricted rotation. Chemically equivalent and magnetically equivalent protons. Solvents used in NMR – Choice of solvent – solvent shifts – concentration and temperature effects. Integrals – Spin spin splitting – The splitting of NMR signals – Theory of spin-spin splitting. Magnitude of coupling, coupling constants. Proton exchange reactions. Factors influencing geminal coupling – vicinal coupling – Hetero annular coupling, Deuterium exchange. Improving the NMR spectrum – shift reagents. Effect of changing the magnetic field. Nuclear overhauser effect, spin tickling. Problems (Problems involving UV, IR and NMR to be solved)

**Unit V**            <sup>13</sup>C-NMR

**12**

Carbon – 13 NMR: Principle, spin decoupled spectra, single frequency off resonance decoupled (SFORD) spectra, chemical shift values, problems.

**Total : 60 hours**

**Outcomes:**

- To learn about the energy of excitation. The absorption laws, measurement of the spectrum
- To learn about the selection rules and intensity, chromospheres, solvent effects, conjugated dienes, polyenes, ketones and aldehydes
- To understand the  $\pi - \pi^*$  transitions,  $n - \pi^*$  transition,  $\alpha, \beta$ - unsaturated ketones, acids, esters, nitriles, amides.
- To learn about the high resolution and low resolution mass spectra
- To understand the fragmentation process, McLafferty rearrangement.
- To understand the infrared spectrometer
- To learn about the Absorption frequencies of triple bond and cumulative double bonds – the aromatic overtone
- To understand the Groups absorbing in the finger print region, identification of functional groups.
- to learn about the The effect of an external magnetic field, precessional motion, precessional frequency, energy transitions



- To understand the Theory of NMR , measurement of chemical shifts, factors influencing chemical shift, electronegativity, shielding and deshielding, Van der Waals deshielding, Anisotropic effects
- To learn about the factors influencing geminal coupling – vicinal coupling – Hetero annular coupling, Deuterium exchange
- To understand the Nuclear overhauser effect, spin tickling
- To learn about Carbon – 13 NMR spectra

**Text Book:**

1. H.H.Willard, L.L.Meritt, J.A.Dean and F.A.Settle, Instrumental Methods of Analysis, Wadsworth, New York, 7<sup>th</sup> edition, 1986.

**Reference Books:**

1. John R.Dyer, Applications of absorption spectroscopy of Organic Compounds, Prentice Hall, London, 1987.
2. Robert M.Silverstein, Clayton Bassler and Terence C.Morril, Spectrophotometer Identification of Organic Compounds, 6<sup>th</sup> Edition, John Wiley & Sons, New York, 2002.

15MPS120

INORGANIC CHEMISTRY

4 0 0 3

**Objectives:**

To learn about the basic concepts of bonding in metal carbonyls and nitrosyls and other inorganic compounds. To learn about the reactions of organometallic compounds and their magnetic properties.

**Unit I Bonding in inorganic compounds 12**

Alkyls and arene complexes; metalation, bonding in metal carbonyls and nitrosyls, chain and cyclic donors, olefin, acetylene and allyl systems, synthesis, structure and bonding metallocenes.

**Unit II Organometallic reactions 12**

**Catalysis:** Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (oxoprocess), oxidation of olefins to aldehydes and ketones (Wacker process) polymerisation (Zeigler-Natta catalyst); cyclooligomerisation of acetylene using nickel catalyst (Reppes' catalyst)-Synthetic Gasoline-mobile Reaction.

**Unit III Magnetic properties 12**

Spectral and magnetic properties of transition metal complexes-Guoy method, Faraday method. Applications of IR, Raman, NMR, ESR, Massbauer to the study of coordination compounds.

**Unit IV The chemistry of solid state 12**

Structure of solids: Comparison of X-ray, Neutron and Electron diffraction, structure of ZnS, Rutile, Per voskite, Cadmium iodide and Nickel arsenide: Spinel and inverse spinels: defects in solids, non-stoichiometric compounds.

**Unit V Semiconductors 12**

Band theory, semiconductors, superconductors, solid state electrolytes, types of magnetic behaviour, Dia, Para, Ferro, Antiferro and ferri magnetism: Hysterisis, Solid state lasers, inorganic phosphors.

**Total: 60 hours**

**Outcomes:**

- To learn about the alkyls and arene complexes
- To learn about the synthesis, structure and bonding metallocenes.
- To understand Hydrogenation of olefins, hydroformylation of olefins
- To learn about the oxidation of olefins to aldehydes and ketones (Wacker process)  
polymerisation, cyclo oligomerisation of acetylene using nickel catalyst and synthetic  
Gasoline-mobile Reaction
- To understand the Guoy method, Faraday method.
- To understand the applications of IR, Raman, NMR, ESR, Massbauer to the study of  
coordination compounds.
- To learn about the Structure of solids, comparison of X-ray, Neutron and Electron  
diffraction
- To understand the defects in solids and non-stoichiometric compounds
- to learn about the band theory, semiconductors, superconductors, solid state  
electrolytes
- To understand the , types of magnetic behaviour, Dia, Para, Ferro, Antiferro and ferri  
magnetism
- To learn about the Hysterisis, Solid state lasers, inorganic phosphors.

**Text Books:**

1. J.E. Huheey, Inorganic Chemistry – Principles, Structure and Reactivity:  
Harper Collins, New York, IV Edition, 1993.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry- A Comprehensive  
Text, John Wiley and Sons 5<sup>th</sup> Edition, 1998.

### Reference Books:

1. K. F. Purcell and J.C. Kot, Inorganic Chemistry-WB Saunders Co., USA 1977
2. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, Van Nostrand Co., New York,1974
3. D.F. Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, CH Langford, 1990
4. N.N. Greenwood and Earnshaw, Chemistry of the Elements Pergamon, Press New York, 1984.

# Syllabus

## Generic Elective Courses

L T P C

SOFT SKILL -I

1 0 1 2

### Objectives:

The ability to create an open environment for communication  
An understanding of other people communication styles and needs  
To create an environment for open discussion and ongoing dialogue is crucial for communication success.

### Unit I            Reading comprehension and vocabulary            08

Definitions of reading - types of reading - oral reading – silent reading - reading process - classification of reading - nature of reading - Filling in the blanks - Close Exercises - Vocabulary building - Reading and answering question

### UnitII            Listening and answering question            08

Listening process – speaker – hearer - types of listening - transitional listening -critical listening - recreational listening - listening for appreciation - selective listening - intensive listening- extensive listening - listening and sequencing sentences - filling in the blanks – listening and answering questions

<b>Unit III</b>	<b>Group discussion</b>	<b>08</b>
Introduction - Why GD Part of a selection process - Structure of a GD-Strategies in GD - Team work – body language - Debating various points of views - interaction with peers.		
<b>Unit IV</b>	<b>Conversations</b>	<b>08</b>
Introducing oneself and others, narrating events - making telephonic conversation - Giving instruction - Giving instruction- Expressing purposes and functions- obligation and preferences, Accepting offers and Counselling Face to face Conversations		
<b>Unit V</b>	<b>Self – Introduction and role play</b>	<b>08</b>
Introduction self and greetings- asking for information- offerings- requisitions- inviting – vocabulary building- asking for description		

**Total: 40 hours**

**Outcomes:**

- Cloze exercises provide support to build vocabulary.
- Sense of logic develops from sequencing sentences.
- Group discussion infuses team spirit and sense of competition.
- Face to face and telephone conversation builds up self confidence.
- Self introduction and role play facilitate cultivation firmness of mind and empathy.
- Comprehension enhances creative skills.
- Listening regenerates transformation empathatically.
- Implementation of assertive thoughts can be acquired through writing skills.
- Body language enhances personality grooming.
- Reading enhances stylish accent productivity.

**Text Books**

1. Barun K. Mitra, “Personality Development and Soft Skills”. Oxford University Press. New Delhi. 2011.
2. S.P. Sharma, “Personalilty Development”, PustaqMahal. New Delhi. 2010.

**Reference Books**

1. Meenakshi Raman and Sangeetha Sharma, “Technical Communication”, Oxford University Press. New Delhi, 2009.
2. A.S. Hornby: "Oxford Advanced Learner's Dictionary of Current English", Oxford University Press, 2007.



- Comprehension enhances creative skills.
- Listening regenerates transformation empathatically.
- Implementation of assertive thoughts can be acquired through writing skills.
- Body language enhances personality grooming.
- Reading enhances stylish accent productivity.

### **Text Books**

1.Barun K. Mitra, “Personality Development and Soft Skills”. Oxford University Press. New Delhi. 2011.

2.S.P. Sharma, “Personality Development”, PustaqMahal. New Delhi. 2010.

### **Reference Books**

1.Meenakshi Raman and Sangeetha Sharma, “Technical Communication”, Oxford University Press. New Delhi, 2009.

2.A.S. Hornby: "Oxford Advanced Learner's Dictionary of Current English" Oxford University Press, 2007.

**L T P C**

**15MPS151**

**GREEN CHEMISTRY**

**2 0 0 2**

### **Objectives:**

To train the students to use eco-friendly approaches in synthesizing agro-based chemicals viz. insecticides, fungicides, herbicides, bactericides acaricides, weedicides  
To emphasize green chemistry approach in crop protection which help to reduce global warning

**Unit I Introduction 08**

Current status of chemistry and the Environment-Evolution of the Environmental movement: Public awareness - Dilution is the solution to pollution-Pollution prevention

**Unit II Green chemistry 08**

Definition – Principles of Green Chemistry - Why is this new area of Chemistry getting to much attention - Why should chemist pursue the Goals of Green Chemistry - The roots of innovation – Limitations

**Unit III      Green chemistry using bio-catalytic reactions      08**

Introduction - Fermentation and Bio transformations - Production of Bulk and fine chemicals by microbial fermentation- Antibiotics – Vitamins - Bio catalyses synthesis of industrial chemicals by bacterial constructs - Future Trends.

**Unit IV      Greenhouse effect and global warming      08**

Introduction - How the green house effect is produced - Major sources of green house gases - Emissions of CO<sub>2</sub> - Impact of green house effect on global climate - Control and remedial measures of green houseeffect - Global warming a serious threat - Important points

**Unit V      Future trends in green chemistry      08**

Green analytical methods, Redox reagents, Green catalysts; Green nano-synthesis, Green polymer chemistry, Exploring nature, Biomimetic, Proliferation of solvent-less reactions; Non-covalent derivatization, Biomass conversion, emission control.

**Total: 40hours**

**Outcomes:**

- To learn about the environment
- To learn about pollution and prevention methods
- To understand the principle, instrumentation, structure determination of nuclear magnetic resonance
- To learn about the goals of green Chemistry
- To understand the principle, instrumentation, structure determination of Mass Spectrometry
- To understand the The roots of innovation and limitations
- To learn about the Fermentation and Bio transformations
- To understand the Bio catalyses synthesis of industrial chemicals by bacterial constructs and future tends
- To learn about the Major sources of green house gases
- To understand the Control and remedial measures of green houseeffect.
- To learn about the Global warming.





screening/docking of ligands. Protein structure, Drug action & enzymes. Drug action & receptors. Prediction of Binding Modes, Protein–Ligand binding free energies, Fragment-Based Drug Design, ADMET prediction.

**Total: 40hours**

**Outcomes:**

- To learn about the Graph theory and molecular numerology
- To learn about the Markov processes
- To understand the Basic Stereochemistry and properties of Amino acids and Proteins
- To learn about the pKa and pH and ionization of acids and bases
- To understand the History of scientific information communication and chemical literature
- To understand the chemical information sources
- To learn about the experimental sources of biological data
- To understand the visualization of structures using Rasmol or SPDB Viewer or CHIME
- To learn about the Personalised medicine and gene-based diagnostics.
- To understand the structure-based drug design.
- To learn about the Prediction of Binding Modes, Protein–Ligand binding free energies, Fragment-Based Drug Design, ADMET prediction

**Text Books:**

1. P. Shanmughavel, “Principles of Bioinformatics”, Pointer publishers, 2005.
2. Arfken, "Mathematical Methods for Physicists" Academic Press, 1985
- 3.

**Reference Books:**

1. P. Shanmughavel, “Trends in Bioinformatics”, Pointer publishers, 2006.
2. Francis A. Carey and Richard J. Sundberg, “Advanced Organic Chemistry-Part A & B” Third Edition, 1990.

**15MPS153 INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY****Objectives:**

Impart the basic knowledge on nanoscience and technology.

Understand the various process techniques available for the processing of nanostructured materials.

Impart knowledge on the exotic properties of nanostructured materials at their nanoscale lengths.

Acquire the knowledge about the various nanoparticles process methods and their skills.

Study the relative merits of various process techniques.

**Unit I Introduction 08**

Definition of a nano system – Basic concepts of nanoscience and technology - Scientific revolutions of nanotechnology - atomic & molecular size – Time and length at nanoscale - Scope of nanoscience and technology – Commercial Applications of Nanotechnology.

**Unit II Nanostructures and dimensions 08**

Definition of Nanostructure materials - Classification of nanostructures - zero, one, two and three dimensional nanostructures. Size Dependency in Nanostructures -quantum size effects in nanostructures.

**Unit III Nanomaterial synthesis 08**

Synthesis of nanomaterials - top down and bottom up approach -Method of nanomaterials preparation – Physical methods – Inert gas condensation and evaporation, chemical synthesis - sol-gel and chemical reduction – Biological methods – nanoparticles using plant extracts, bacteria, fungi etc.

**Unit IV Nanomaterial properties 08**

Surface properties of nanoparticles - Surface to volume ratio- mechanical - optical, - electronic – magnetic - thermal and chemical properties of nanomaterials. Size dependent properties-size dependent absorption spectra - self-assembly in nanotechnology - Types of SAMs, Methods of self-assembly, Applications of self-assembled monolayers

**Unit V Applications of nanomaterials 08**

Applications of metal nanoparticles in technologically imperative fields like sensors - Nanomaterials for energy storage - Batteries and fuel cells - photovoltaic devices -solar cells - optical memory devices - Quantum nanoelectronic devices -quantum computing.

**Total: 40hours**

**Outcomes:**

- To learn about the basic concepts of nanoscience and technology
- To learn about the Scope of nanoscience and technology and commercial applications of nanotechnology.
- To understand the nanostructure materials and classification of nanostructures
- To learn about the pKa and pH and ionization of acids and bases
- To understand the size dependency in nanostructures and quantum size effects in nanostructures.
- CO6 To understand the synthesis of nanomaterials, top down and bottom up approach
- To learn about the method of nanomaterials preparation
- To understand the Surface properties of nanoparticles
- to learn about the Types of SAMs, Methods of self-assembly, Applications of self-assembled monolayers
- To understand the Applications of metal nanoparticles in technologically imperative fields like sensors and energy storage.

**Text Books:**

1. C. P. Poole and J.F. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2003.
2. M. A. Ratner. and D. Ratner, "Nanotechnology: A Gentle Introduction to the Next Big Idea", Prentice Hall PTR, First Edition, 2002.
3. T. Pradeep, "Nano: The Essential Nanoscience and Nanotechnology", Tata McGraw hill, 2007.

**Reference Books:**

1. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, 2004
2. C. N. R. Rao, A. Muller and A. K. Cheetham, "The Chemistry of nanomaterials: Synthesis, Properties and Applications", Wiley-VCH verlagGmbH& Co.KGA, 2004

**15MPS154                  FOOD CHEMISTRY AND ADULTERATION                  2 0 0 2****Objectives:**

- To understand the basic information of food chemistry and adulteration.
- To appreciate the importance of food additives and pesticide control.
- To provide an information about food preservatives

**UnitI                  Introduction                  08**

Food: source, functions of food – food groups – food guide – basic five food groups, usage of the food guide – food in relation to health – objectives of cooking.

Water: Purification processes – Ion exchangers, reverse osmosis, activated charcoal treatment - Use of chlorination, ozone, and UV light disinfection. Specification of drinking water.

**Unit II                  Constituents of foods                  08**

**Carbohydrates:** Classification, Principles involved in the analysis of carbohydrates – estimation of carbohydrates.

**Proteins:** amino acids – peptides - Analysis of proteins – Separation of amino acids by paper chromatography.

**Minerals and vitamins:** Sources, functions, deficiency of the following minerals (calcium, iron, iodine, fluorine, sodium and potassium (elementary treatment). Vitamins - classification, sources, Vitamins – A, D, E and K, C, B Complex, - B6 & B12.

**UnitIII                  Food additives                  08**

Artificial sweeteners – saccharin, cyclamate, aspartame – food flavours – esters, aldehydes and heterocyclic compounds. Antioxidants. Food colours – changes in cooking. Restricted use. Spurious colours. Emulsifying agents, preservatives – leavening agents. Baking powder – Yeast. Taste enhancers – MSG-vinegar

**Unit IV                  Pesticides control                  08**

Spoilage of foods by insects and pests, loss in food quantity and quality Various pesticides used in agriculture and post-harvest storage, uses of pesticides for food grain application.

**Unit V                  Food adulteration                  08**

Common adulterants in different foods – milk and milk products, vegetable oils, and fats, spices and condiments, cereals, pulses, sweetening agents and beverages. Contamination with toxic chemicals – pesticides and insecticides. .

**Total: 40hours**

**Outcomes:**

- To learn about the source, functions of food
- To learn about the Purification processes of water
- To understand the classification, principles involved in the analysis of carbohydrates and estimation of carbohydrates.

- To learn about the amino acids – peptides - Analysis of proteins and separation of amino acids by paper chromatography
- To understand the Sources, functions, deficiency of the minerals and vitamins
- To understand the artificial sweeteners
- To learn about the Emulsifying agents, preservatives and leavening agents
- To understand the Spoilage of foods by insects and pests, loss in food quantity and quality
- To learn about the harvest storage, uses of pesticides for food grain application.
- To understand the Common adulterants in different foods

**Text Books:**

1. Owen R Fennema, “Food Chemistry”, Marcel Decker Inc., New York. 1996.
2. M. Swaminathan “Text Book on Food chemistry”, Printing and Publishing CO., Ltd. 1993.

**Reference Books:**

1. B. Siva Sankar, “Food Processing and Preservation”, Prentice – Hall of India Pvt. Ltd., New Delhi. 2002.
2. S. Ramakrishnan, K. G. Prasannam, R. Rajan, ”Principles - Text book of medical biochemistry”, Orient Longman Ltd. Third Edition, 2001.

**L T P C**

**15MPS015**

**Project**

**002212**

**Objectives:**

To learn about the concept of project work. To know about designing new experiments and carry out the experiments. To know about the various characterization techniques used to characterize the synthesized compounds. To know about the necessities of literature survey and to learn about writing dissertation of project work.

**NOTE:**

The project work may be carried in pharmaceutical industries / National laboratories/R&D centers/ Academic institutions/ National and International Universities in the field of Pharma or Analytical chemistry with emphasis on the academics or applied fields. In-house project may be carried out.

**Total: 22 hrs**

**Outcomes:**

- To identify the topic with the consideration feasibility.
- To learn the procedure of literature survey of the concerned topic.
- To derive a plan for executing the work in the stipulated time with maximum efficiency and success.
- The intensive exposure to industry as a first time experience.
- Understanding different sectors of an industry and the functionalities of each sector.
- The importance of R&D section and the key role
- Understanding and learning various technical and safety aspects of the concerned topic related work.
- To learn the difference between conventional department laboratory and its nature of work and R & D laboratory of research institute or industry.
- To learn, adapt, and practice the extensive bench work in a research laboratory or industry.
- To prepare a dissertation report with complete follow up of research methodology.