



# VELS

INSTITUTE OF SCIENCE, TECHNOLOGY  
& ADVANCED STUDIES (VISTAS)



(DEEMED TO BE UNIVERSITY Estd. u/s 3 OF THE UGC ACT, 1956)

**NAAC ACCREDITED**

PALLAVARAM - CHENNAI - INDIA

## 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



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PALLAVARAM - CHENNAI - INDIA

**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.AshutoshKar. 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.

**Unit II                  Receptor concept    15**

Receptor complex and Allosteric modulation, Second and Third messenger system, Receptor dynamics, Molecular biology of receptors, Receptor Models, Receptor Binding assays, Autoradiography. (Above concepts with special reference to opioid, histaminergic, adrenergic and GABA-ergic receptors)

**Unit III                  New drugs from lead molecules    15**

Lead molecule choice and modification for API, Bioisosteric replacement, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereoisomers and geometric isomers, fragments of lead molecule.

**Unit IV                  Enzymes    15**

Enzymes structure – primary, secondary, tertiary and quaternary. Enzyme kinetics, Enzyme inhibitors, irreversible and reversible inhibitions, Kcat inhibitors. Transition – State analogues.

**Unit V                  Enzyme inhibitor – drugs    15**

Enzyme Inhibitors as drugs like cytochrome P450 inhibitors, Aromatase, lipoxxygenases. Protein and peptide drugs – insulin, somatostatin, Relaxin, DNase interferon, interleukin, Growth stimulating factors and urokinase enzymes.

**Total: 75 hours**

**Outcomes:**

- To understand agonist, anti agonist, partial agonist and inverse agonist
- To gain the knowledge of various receptor theories
- To understand the role of receptors and auto radiography
- To learn various receptors like GABA and familiar adriginic receptors.
- To learn lead molecules choice and API modification.
- To learn the complete structure of enzymes.
- To know the importance of enzyme inhibitor as drugs.
- To understand growth stimulation factors.
- To know the complete fundamentals of pharmaceutical chemistry.
- To learn lead molecules, their choice, API modification, structural changes.

**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

<b>Ex. No.</b>	<b>Lists of Experiments</b>
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 naphthalene-(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 methods of organic preparation.

**Text Book:**

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

**Reference Books:**

1. Gnanaprakasam, 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

**L T P C**

**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.

Introduction, quantitative models, Hantsch-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.

<b>15MPS006</b>	<b>QUALITY ASSURANCE AND QUALITY CONTROL IN DRUGS AND PHARMACEUTICALS</b>	<b>L T P C</b> <b>4 0 0 4</b>
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**Objectives:**

To learn about the concept and philosophy of quality assurance and quality control in drugs. To learn about the regulatory aspects of pharmaceuticals. To learn about quality control of packaging materials and microbiological assay.

**Unit I Concept and philosophy 12**

TQM, GLP, GMP, Quality audit, SOP, ICH, ISO-9000.

**Unit II Regulatory aspects of pharmaceuticals**

Validation of Personnel, Equipment and cleaning methods, In-process quality control on various dosage forms, (Sterile and non-sterile).

**Unit III Quality control of finished products 12**

Factor affecting stability of formulations, shelf-life prediction.

**Unit IV Quality control of packaging materials 12**

Types of plastics, primary and secondary packaging materials, glass, closures, cartons, blister and their control.

**Unit V Microbiological assay 12**

Microbiological assay- antibiotics and vitamins.

**Total: 60 hours**

**Outcomes:**

- To learn about the importance of TQM, GLP and GMP



- To learn about the importance of Quality audit, SOP, ICH and ISO-9000
- To understand the validation of Personnel, Equipment and cleaning methods.
- To learn about the In-process quality control on various dosage forms.
- To understand the quality control of finished products.
- To understand the Types of plastics
- 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.

L T P C

### 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.

**L T P C**

**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

**L T P C****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 pK<sub>a</sub> 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**



- To learn about the Antibiotics; Blood products and plasma substitutes
- To understand the Pilot plant techniques
- To understand the Analytical method transfer to quality assurance
- To learn about the mixing/blending, drug uniformity, excipient uniformity
- To understand the Wet granulation, binder addition, drying and milling, dry blending and compression
- To learn about the Coating techniques and contract manufacture
- To understand the Concept and function of entrepreneurship

**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.

# Syllabus

## Discipline Specific Elective Course

	<b>L T P C</b>
<b>15MPS101</b>	<b>4 0 0 3</b>
<b>FUNDAMENTALS OF BIOCHEMISTRY</b>	

**Objectives:**

To study the metabolism of carbohydrates, aminoacids, 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 plications 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  $^{13}\text{C}$  NMR.
- To understand the Theory, fragmentation pattern, ionization techniques of mass spectroscopy
- To learn about the applications of mass spectrometry.

**Text Book:**

1. Y.R.Sharma, Elementary Organic Absorption Spectroscopy, S.Chand & Co., 2<sup>nd</sup> edition New Delhi. 1996.

**Reference Books:**

1. A.H.Beckett and J.B.stenlake, Practical Pharmaceutical Chemistry, Part-I and II, the Athlone Press, London, 4<sup>th</sup> Edition, CBS Publisher, Delhi, 1998.
2. 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.
3. John R.Dyer, Applications of absorption spectroscopy of Organic Compounds, PrenticeHall, London, 1987.
4. Robert M.Silverstein, ClaydonBassler and Terence C.Morril, Spectrophotometric Identification of Organic Compounds, 6<sup>th</sup> Edition, John Wiley & Sons, New York, 2002.

**L T P C**

**15MPS103**

**MACROMOLECULAR CHEMISTRY**

**4 0 0 3**

**Objectives:**

To study the types of polymerization, polymerization techniques, crystallinity in polymers, applications of polymer, polymer degradation and additives for polymers.

**UnitI**

**Basic concepts of polymers**

**12**

Basic concepts of polymers. Monomer, Repeat unit, degree of polymerization. Classification of polymers, Stereochemistry of polymer, nomenclature of stereo regular polymers.

**Unit II Polymerization technique 12**

Chain polymerization, free radical polymerization, ionic polymerization and coordination polymerization; Ziegler Natta catalyst. Step polymerization, ring opening polymerization.

Co-polymerization, random, block and graft co polymers- preparation.

Polymerisation techniques; bulk, solution, suspension and emulsion polymerization.

**Unit III Properties of polymers 12**

Measurement of molecular weight and size; number average and weight average molecular weights.

Glass transition temperature, concepts of glass transition temperature and associated properties, glassy solids and glass transition, factors influencing glass transition temperature (T<sub>g</sub>).

Crystallinity in polymers; Polymer crystallization, structural and other factors affecting crystallisability, effect of crystallinity on the properties of polymers.

**Unit IV Synthetic resins 12**

Synthetic resins and plastics; Manufacture and applications of polyethylene, PVC, Teflon, poly styrene, polymethylmethacrylate, polyurethane, phenol – formaldehyde resins, urea-formaldehyde resins and epoxy polymers.

**Unit V Polymer degradation and additives 12**

Polymer degradation: Types of degradation- thermal, mechanical, photo, hydrolytic and oxidative degradations.

Additives for polymers: Fillers, plasticizers, thermal stabilizers, photo stabilizers, anti-oxidants and colourants.

**Total: 60 hours**

**Outcomes:**

- To learn about the Basic concepts of polymers, monomer, degree of polymerization
- To learn about the Classification of polymers, Stereochemistry of polymer, nomenclature of stereo regular polymers
- To understand the types of polymerisation .
- To learn about the Polymerisation techniques

- To understand the Measurement of molecular weight and size
- To understand the the Glass transition temperature
- To learn about the Crystallinity in polymers.
- To understand the manufacture and applications of Synthetic resins and plastics

**Text Book:**

1. Fred W. Billmeyer, Text Book of Polymer Science, 3<sup>rd</sup> Edition, John Wiley & Sons, 2000.

**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, diaestereotopic 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.

$S_N1$ ,  $S_N2$  and  $S_Ni$  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  $C_{18}$  (synthesis of all these compounds is not expected).

**Unit IV Nucleophilic substitution reactions 12**

Method for the generation of benzyne intermediate and reactions of aryl intermediate-Nucleophilic substitution involving diazonium ions.Aromatic Nucleophilic substitutions of activated halides.Ziegler alkylation.Chichibabin reaction.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 –Tiemann reaction. Synthesis of di and tri substituted benzenes (symmetrical tribromo benzene, 2-amino 5-methylphenol, 3-nitro - 4-bromobenzoic acid, 3,4-dibromonitrobenzene, 1,2,3-trimethylbenzene) starting from benzene or any monosubstituted benzene. Electrophilic substitution of pyridine and pyridine -N-oxide, Naphthalene & Anthracene .hypos 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  $SN_1$ ,  $SN_2$  and  $SN_i$  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 arenium ion mechanism and Formylation reactions
- To learn about Electrophilic substitution of pyridine and pyridine -N-oxide, Naphthalene & Anthracene .hypro 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.

**Unit I                      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.

**Unit II                      Chemical potential                      12**

Partial molar properties -Partial molar free energy –Partial molar volume and partial molar heat content –their significance and determination of these quantities. Equilibrium in heterogeneous system. Variation of chemical potential with temperature and pressure. Alternative definition of chemical potential.

**Unit III                      Statistical thermodynamics                      12**

Concept of thermodynamic probability – distribution of distinguishable and non-distinguishable particles.

Maxwell – Boltzmann, Fermi – Dirac and Bohr's Einstein statistics- Comparison and applications – modes of contribution to energy- Partition function – evaluation of translational, vibrational and rotational, nuclear and electronic partition functions for mono, di atomic and poly atomic ideal gases-thermodynamic functions in terms of partition functions to heat capacities of ideal gases – Law of equipartition energy- heat capacity of solids (Einstein and Debye models).

**Unit IV                      Chemical kinetics-I                      12**

Simultaneous reaction- A detail study of reversible reaction-First order opposed first order, first order opposed second order reactions-. Kinetics of complex/composite reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions, general treatment of chain reactions – chain length - Rice Herzfeld mechanism – explosion limits.

Study of fast reaction – relaxation methods – temperature and pressure jump method – stopped flow and flash photolysis methods.

**Unit V                      Chemical kinetics-II                      12**

Effect of temperature on reaction rate – Collision theory of reaction rates- Molecular beams – Collision cross sections- Effectiveness of collisions-Probability factor – Potential energy surfaces. Langmuir and BET absorption isotherms – study of kinetics of surface reaction – catalysis by metals semiconductor oxides – Mechanism of heterogeneous catalytic reaction – Absorption coefficient and its significance. Partition functions and activated complex. Eyring equation Estimation of free energy, enthalpy and entropy of activation and their significances.

Reactions in solutions – Effect of pressure, dielectric constant and ionic strength on reactions in solutions – Kinetic isotope effects – Linear free energy relationships – Hammett and Taft equations – Acid base catalysis – Mechanism of acid base catalyzed reactions – Bronsted catalysis law.

**Total: 60 hours**

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**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

**L T P C****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) ; Rabeprazole 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] Clopidogrelbisulphate [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 absorption i 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.



Examples of reduction reactions: Birch reduction, Clemmenson reduction, Meerwin P.V reduction, rosenmund reduction,

**Unit V          Synthesis of useful reagents          12**

Synthesis and applications of the following reagents: 9-BBN, n-butyl lithium, ceric ammonium nitrate(CAN), DDQ, DCC, Grignard reagent, LDA, Gilman reagent, NBS and PCC.

**Total: 60 hours**

**Outcomes:**

- To learn about the aldol condensation
- To learn about the Claisen ester condensations.
- To understand the Cannizzaro reaction, Dieckmann cyclisation
- To learn about the Reformatsky reaction, Dakin reaction.
- To understand the Etard reaction, HVZ reaction, Umpolung synthesis 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.

**UnitII GLC 12**

Gas-Liquid Chromatography, Principles, Retention Volumes, Instrumentation, Carrier Gas, Columns, Stationary Phase, Detectors, Thermal Conductivity, Flame Ionization, Electron Capture, Application of G.L.C.

**Unit III HPLC 12**

High Performance Liquid chromatography: Scope, Column efficiency, Instrumentation, Pumping Systems, Columns, Column packing, Detectors, Applications.

**UnitIV IEC 12**

Basic principle of ion exchange chromatography (IEC), instrumentation and application of Ion-Exchange chromatography (IEC).

**Unit V GPC 12**

Basic principle, instrumentation and application of Gel Permeation chromatography (GPC). Standard deviation and correlation coefficient.

**Total: 60 hours**

**Outcomes:**

- To learn about the Adsorption and partition chromatography
- To learn about the techniques and chemical concept of column, paper, TLC and HPTLC.
- To understand the principle, theory and applications of gas-liquid chromatography
- To learn about the principle, theory and applications of High Performance Liquid chromatography
- To understand the principle, theory and applications of ion exchange chromatography (IEC)
- To understand the principle, instrumentation of Gel Permeation chromatography
- To learn about the applications of of Gel Permeation chromatography
- To understand the Standard deviation and correlation coefficient.

**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.

**Unit IV      Coupling Reactions      12**

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

**Unit V      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,  $NaBH_4$ , 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 <sup>1</sup>H, <sup>13</sup>C, <sup>31</sup>P, <sup>19</sup>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 calorimetry – 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 calorimetry
- 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.

**15MPS111                      CHEMISTRY OF NATURAL PRODUCTS                      L T P C  
4 0 0 3**

**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. Ashutosh Kar, 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.

**L T P C****4 0 0 3****15MPS112 ENZYME TECHNOLOGY AND RELATED ENTREPRENEUREAL SKILLS****Objectives:**

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

- |  |  |           |
|--|--|-----------|
| <b>Unit I</b>  | <b>Introduction to biochemistry, function and applications</b> | <b>12</b> |
| 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. |  |           |
| <b>Unit II</b>   | <b>Kinetics and mechanism of enzyme catalysis</b>              | <b>12</b> |
| Enzyme catalysis and controlling factors. Kinetics of enzyme catalyzed reactions in solution. Immobilized enzyme reaction kinetics. Effect of mass transfer resistance.                                      |  |           |
| <b>Unit III</b>  | <b>Enzyme production on large scale technology</b>             | <b>12</b> |
| Isolation and purification of enzymes, protein fractionation methods.  |  |           |



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.

**Unit I 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. Arnikar, 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.







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.

**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.

<b>Unit I</b>	<b>Stereochemistry</b>	<b>12</b>
	a) General consideration of molecular asymmetry and dissymmetry. b) Configuration – absolute and relative methods of determination c) Chemical transformation ii) asymmetric synthesis; Chiral auxiliaries, chiral reagents and catalysts, Enantiomeric excess iii) Quasiracemates d) Atropisomerism of biphenyls.	
<b>Unit II</b>	<b>Conformational analysis</b>	<b>12</b>
	Conformation – conformational analysis based on physical properties and chemical reactivity, shape of six membered ring, conformation and reactivity in cyclo hexanes and decalins.	
<b>Unit III</b>	<b>Rearrangements- I</b>	<b>12</b>
	Sommelet – Hauser, Favorski, Fries and benzilic acid rearrangements. Hoffmann – Loffler- Freytag reaction, Barton reaction and Shapiro reaction.	
<b>Unit IV</b>	<b>Rearrangements- II</b>	<b>12</b>
	A detailed study with suitable examples of the mechanism of the following rearrangements: Pinacol-pinacolone(Barton and Shapiro)-Wagner-Meerwein, Demjanov, dienone – phenol, Favorski , Baeyer – Villiger , Wolf, Stevens (in cyclic systems) and Von Richter rearrangements.	
<b>UNIT V</b>	<b>Non-conventional techniques</b>	<b>12</b>
	Non-conventional Techniques in organic synthesis-Green chemistry-Microwave assisted reaction-Un Catalyzed reaction. Reaction in ionic organic liquids-Solid state melts reaction.	

**Total: 60 hours**

**Outcomes:**



Antibiotics – structure and synthesis; Chloromphenicol, pencillins and streptomycin.

**Unit III      Enzyme concept      12**

Enzymes, co-enzymes, theory. Michaelis-Menten's equation and verification by graphical methods-Eadieplot and Lineweaver-Burk plot. Enzyme catalysis, Enzyme specificity, Enzyme mechanism. Enzyme Inhibition- Competitive inhibition, Un-competitive inhibition and Non-competitive inhibition.

**Unit IV      Phase transfer catalysis      12**

Phase transfer catalysis, ionic liquids. Miscellaneous catalysis. Use of crown ethers.

**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.

**L T P C****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 <sup>13</sup>C-NMR and <sup>1</sup>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 coplanarity.

**Unit II Mass spectroscopy****12**

Introduction – Instrumentation – High resolution and low resolution mass spectra – Determination of molecular formula – Molecular peaks rule.  $M^+$  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**





- 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 Walls 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.

L T P C

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: Spinels 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

	<b>L T P C</b>
<b>SOFT SKILL -I</b>	<b>1 0 1 2</b>

**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.

<b>Unit I</b>	<b>Reading comprehension and vocabulary</b>	<b>08</b>
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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

**Unit II 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

**Unit III Group discussion 08**

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.

**Unit IV Conversations 08**

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

**Unit V Self – Introduction and role play 08**

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.



**Total: 40hours**

**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.

**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 Tends.

**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.

#### **Text Books:**

1. M. Lancaster, "Green Chemistry: an Introductory Text", RSC, 2002.
2. Sheldon, Arends, Hanefeld, "Green Chemistry and Catalysis", Wiley, New York, 2007.

#### **Reference Books:**

1. Anastas& Warner, Green Chemistry : Theory & Practice ,Oxford University Press,New York, 1998
2. S. E. Park, J. S. Chang, S. H. Jhung, "The Role of Catalyst for Green Chemistry", Chemworld, Vol. 44 (8), 38, 2004.

**L T P C**

**15MPS152**

**CHEMINFORMATIC**

**2 0 0 2**

#### **Objectives:**

Students completing this paper should be able to understand concepts of molecular chemistry that are basic to cheminformatics.

This course will train the students to use QSAR, docking etc.

#### **Unit I Mathematics process**

**08**

Graph theory and molecular numerology; Logic, sets and functions; Algorithms, integers and matrices; Mathematical reasoning, induction and recursion; Counting; graphs, trees and sets, basic probability and statistics; Markov processes

#### **Unit II Basics of stereochemistry**

**08**

Basic Stereochemistry, Amino acids and Proteins and Properties; pKa, pH and ionization of acids and bases; Protein structure - Primary structure, Secondary structure - helix & sheet; Tertiary structure; Quaternary structure; covalent and non-covalent forces that maintain structures.

**Unit III Cheminformatics 08**

History of scientific information communication-chemical literature-chemical information-chemical information search-chemical information sources-chemical name and formula searching-analytical chemistry-chemical history-biography-directories and industry sources

**Unit IV Biological databases 08**

Introduction; Experimental sources of biological data; Publicly available databases; Gene expression monitoring; Genomics and Proteomics; Metabolomics; Visualisation of sequence data; Visualization of structures using Rasmol or SPDB Viewer or CHIME; Genetic basis of disease; Personalised medicine and gene-based diagnostics.

**Unit V Drug Design 08**

Introduction to drugs, structure-based drug design. QSAR and 3D-QSAR Methods. Pharmacophore Design, Ligand-Based Design and *De Novo* Drug Design Virtual 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.

**L T P C****2 0 0 2****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.



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

L T P C

**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

#### **Unit I            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.

#### **Unit III            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.