M.Sc Chemistry

Academic Year 2018-2019 – Odd Semester

Programme Outcomes of M.Sc.

- ➢ Acquire interdisciplinary knowledge and the skill of designing and conducting experiments independently in collaboration and interpreting scientific data.
- ➢ Communicate effectively, analyze critically and learn to adapt to the socio technological changes.
- □ Face competitive examinations that offer challenging and rewarding careers in science and education.
- □ Identify, formulate and critically analyze various scientific problems and design/develop solutions by applying the knowledge to different domains.

Programme Specific Outcome

PSO No.	*Upon completion of M.Sc Chemistry, students will be able to:*
PSO-1	Understand the principles, instrumentation and applications of organic, inorganic and physical chemistry
PSO-2	Develop critical thinking, technical skills and innovative ideas to work effectively in the various fields of chemistry
PSO-3	Apply the basic concepts to predict the structure of chemical compounds
PSO-4	Design, synthesis, separate and characterize chemical compounds
PSO-5	Apply chemistry in medicine, biology and industry
PSO-6	Evaluate problems to identify the structure of compounds
PSO-7	Utilize the concept of photochemical phenomena to different fields of chemistry

Semester : III
Name of the Course : Organic Chemistry III
Subject Code : PG1731

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
6	5	90	100

Course Outcome

CO No.	*Upon completion of this course, the students will be able to*:	**PO /PSO Addressed**	**Cognitive Level**
CO-1	Understand the principle and applications of UV, IR, NMR and Mass spectroscopy.	PSO-1	U
CO-2	Predict the structure of organic compounds using spectroscopic techniques.	PSO-4	C
CO-3	Predict the splitting pattern of organic compounds using NMR spectroscopy	PSO-4	C
CO-4	Predict the mass to charge ratio of organic compounds using mass spectroscopy	PSO-4	C
CO-5	Elucidate the structure of heterocyclic compounds.	PSO-2	An
CO-6	Discuss the use of reagents in organic synthesis.	PSO-1	U

Teaching Plan

Credit: 4 ***Total Hours: 90 (Incl. Seminar & Test)**

Unit	**Module**	**Topics**	**Lecture Hours**	**Learning Outcome**	**Pedagogy**	**Assessment/Evaluation**
I	**UV- Visible spectroscopy and IR spectroscopy**					
	1	UV-Visible spectroscopy: Basic principles of electronic transition. Absorption spectra of conjugated dienes,α,β-unsaturated carbonyl compounds and aromatic compounds.	3	Understand the principle of UV spectroscopy	Lecture	Evaluation through class test and group discussion Formative assessment I

	2	Woodward-Fieser rule and Fieser-Khun rule. Effect of solvent polarity on λ_{max}. Applications of UV-Visible spectroscopy.	3	Predict λ_{max} usingWoodward-Fieser rule and Fieser-Khun rule.	Lecture and Group discussion	
	3	IR spectroscopy: Principle, instrumentation and sampling techniques, Hooke's law, types of stretching and bending vibrations.	3	Know the principle and instrumentation of IR spectroscopy	Lecture with videos	
	4	Factors influencing the vibrational frequency. Vibrational frequencies of alkane, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenol, amines, acids, esters and amides.	3	Predict the functional groups	Lecture	
	5	Overtones and combination bands. Fermi resonance. Applications of IR spectroscopy.	3	Explain the applications of IR spectroscopy	Lecture	
II	**NMR Spectroscopy**					
	1	^{1}H NMR Spectroscopy: Instrumentation, principle of NMR spectroscopy, Chemical shift and factors affecting chemical shift.	3	Understand the principle and applications of NMR spectroscopy	Lecture with videos	Evaluation through class test and group discussion Formative assessment II
	2	Spin-spin splitting. Types of coupling - germinal, vicinal, long range and through space coupling. Coupling constant - AB, AB_2 and A_2B_3.	3	Predict the splitting pattern of organic compounds using NMR spectroscopy	Lecture	
	3	Simplification of complex spectra - chemical exchange, double resonance and NMR shift reagents.	3	Describe the simplification of complex spectra	Lecture	
	4	^{13}C NMR Spectroscopy: Principle, chemical shift, factors affecting chemical shift, broad band decoupling and OFF - resonance decoupling.	3	Explain the factors affecting chemical shift in ^{13}C NMR Spectroscopy	Lecture	

	5	2D-NMR - COSY-HOMCOR, HETCOR and DEPT Technique.	3	Interpret COSY-HOMCOR and HETCOR	Lecture	
	6	Comparison of ^{13}C NMR and ^{1}H NMR.	2	Compare of ^{13}C NMR and ^{1}H NMR.	Lecture and group discussion	
III	**Mass Spectroscopy**					
	1	Basic principle, instrumentation and production of ions - EI, CI and FAB. Molecular ion peak, base peak, meta stable peak and isotopic peaks.	3	Understand the basic concepts of mass spectroscopy	Lecture with videos	Evaluation through class test and group discussion Formative assessment III
	2	Nitrogen rule. McLafferty rearrangement. Retro Diels Alder reaction.	2	State and explain nitrogen rule and fragmentation reactions	Lecture	
	3	Fragmentation pattern of simple organic compounds - alkenes, halogens, alkylbenzene, benzene, aliphatic and aromatic alcohols, acids, ketones and aldehydes.	4	Predict the fragmentation pattern of organic compounds	Lecture and group discussion	
	4	Application of mass spectroscopy. Problems related to structural determination using UV, IR, ^{1}HNMR and Mass spectroscopy.	5	Deduce the structure of organic compounds	Lecture	
	5	Circular birefringence (CB), Circular dichroism (CD), Cotton effect, ORD, Kronig-Kramers relation, applications of axial haloketone rule and octant rule.	4	Understand the applications of axial haloketone rule and octant rule.	Lecture	
IV	**Heterocyclic Compounds**					
	1	Synthesis, reactions and structure of indole, carbazole, oxazole, imidazole.	2	Understand the synthesis and reactions of some heterocyclic compounds	Lecture	Evaluation through class test and group discussion Formative assessment II
	2	Synthesis, reactions and structure of thiazole, pyrones, coumarins, chromone.	3	Explain the synthesis and reactions of some heterocyclic compounds	Lecture	

	3	Structural elucidation of flavones, isoflavone.	2	Elucidate the structure of flavones and isoflavones	Lecture	
	4	Anthocyanins, caffeine, theobromine and theopylline.	3	Elucidate the structure of heterocyclic compounds	Lecture	
V	**Reagents in organic synthesis**					
	1	Oxidation reactions involving SeO_2, DDQ, DCC, 1,3-dithiane, NBS, m-CPBA and Aluminiumisopropoxide.	3	Understand the oxidation reactions of some reagents	Lecture	Evaluation through class test and group discussion Formative assessment I
	2	Reduction involving complex metal hydrides - $LiAlH_4$, $NaBH_4$, DIBAL, Gilman's reagent.	3	Explain the applications of metal hydrides	Lecture	
	3	Tri-n-butyl tin hydride, 9-BBN, Wilkinson's catalyst, Vaska's catalyst and Baker yeast.	4	Describe the properties and applications some catalyst	Lecture	
	4	Phase transfer catalysts, crown ether, LDA, Me_3SiI, Fetizon's reagent.	3	Explain the applications of organic reagents	Lecture	
	5	Lemieux-Von Rudloff reagent and Lemieux-Johnson reagent.	3	Know the applications of Lemieux-Von Rudloff reagent and Lemieux-Johnson reagent	Lecture	

Course Instructor: Y. ChristabelShaji HOD: G. Leema Rose

Semester : III

Name of the Course : Physical Chemistry III

Subject Code : PG1732

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
6	4	90	100

Course Outcome

CO No.	*Upon completion of this course, the students will be able to*:	**PO /PSO Addressed**	**Cognitive Level**
CO-1	Construct character table for different point groups	PSO-4	C
CO-2	Apply group theory to normal mode analysis and hybridization	PSO-3	Ap
CO-3	Predict types of electronic transitions in ethylene and formaldehyde	PSO-4	C

CO-4	Infer the characteristics of rotational spectra of diatomic and polyatomic molecules	PSO-1	U
CO-5	Predict the nature of molecules using microwave and photoelectron spectroscopy	PSO-4	C
CO-6	Determine the molecular mass of polymers and kinetics of polymerization	PSO-2	An
CO- 7	Explain the experimental techniques related to radiation chemistry	PSO-1	U
CO- 8	Apply radiation chemistry in biology and industry	PSO-5	Ap

Teaching Plan

Credit: 4 ***Total Hours: 90 (Incl. Seminar & Test)**

Unit	Module	Topics	Lecture Hours	Learning Outcome	Pedagogy	Assessment/Evaluation
I	**Group Theory - I**					
	1	Molecular symmetry elements and symmetry operations, molecular symmetry and point groups.	4	Understand symmetry elements and symmetry operations	Lecture	Evaluation through class test Formative assessment I
	2	Group multiplication tables, abelian, non-abelian, cyclic and sub groups, conjugacy relation and classes.	3	Explain the terms in group theory	Lecture	
	3	Representation of symmetry operations by matrices - representation for the C_{2v}, C_{3v}, C_{2h}.	4	Represent symmetry operations	Lecture	
	4	Reducible and irreducible representations, the great orthogonality theorem and its consequences without proof.	3	Apply orthogonality theorem for the construction of character table	Lecture	
	5	Construction of the character tables C_{2v}, C_{3v} and C_{4v}.	2	Construct character table for different point groups	Lecture	
II	**Group Theory - II**					
	1	Standard reduction formula, Symmetry of normal modes of vibration in H_2O, NH_3, and CO_2. Application of group theory to normal mode analysis of H_2O and NH_3.	4	Apply group theory to normal mode analysis of H_2O and NH_3	Lecture	Evaluation through class test and group discussion Formative assessment II
	2	Symmetry properties of integrals and symmetry based selection rule for vibrational spectra. Identification of IR and	4	Identify IR and Raman active vibrations	Lecture	

		Raman active fundamentals, symmetry of molecular orbitals.				
	3	Symmetry based selection rule for electronic transition, prediction of electronic transitions in ethylene and formaldehyde.	4	Predict the electronic transitions in ethylene and formaldehyde	Lecture	
	4	Group theory applied to determine π- electron energy in ethylene. HMO theory - HMO calculations.	3	Apply group theory and HMO theoryto determine π- electron energy	Lecture	
	5	Delocalization energy in trans-1,3-butadiene and benzene. Group theory applied to determine hybridization scheme in CH_4 and BF_3.	2	Determine the hybridization of CH_4 and BF_3		
III	**Molecular Spectroscopy - I**					
	1	Microwave spectroscopy: Rotation of molecules, rotational spectra of diatomic molecules.	5	Explain microwave spectroscopy	Lecture	Evaluation through class test and group discussion Formative assessment III
	2	Intensity of spectral lines, effects of isotopic substitution, non-rigid rotator. Rotational spectra of polyatomic molecules.	3	Infer the characteristics of rotational spectra of polyatomic molecules.	Lecture	
	3	Chemical analysis by microwave spectroscopy.	2	Analyse compounds microwave spectroscopy	Lecture	
	4	Photoelectron spectroscopy: Principle, photoelectric effect, Ionization process. Applications of photoelectron spectroscopy to simple molecules.	3	Applyphotoelectron spectroscopy to simple molecules	Lecture	
	5	PES to O_2 molecule, N_2 molecule, CO molecule, NaN_3, Ethyl trifluoro acetate.	3	Apply PES to O_2, N_2, CO, NaN_3 and Ethyltrifluoro acetate	Lecture	
IV	**Polymer Chemistry**					

	1	General introduction. Determination of molecular mass - osmometry, viscosity, diffusion, light scattering, and sedimentation methods.	4	Determine the molecular mass of polymers by various methods	Lecture	Evaluation through class test and group discussion Formative assessment II
	2	Visco-elasticity, Rubber elasticity. Kinetics and mechanism of linear stepwise polymerization.	3	Explain the kinetics and mechanism of polymerization	Lecture	
	3	Addition, free radical, cationic and anionic polymerization. Kinetics of co-polymerization.	2	Describe the kinetics of polymerization and co-polymerization	Lecture	
	4	Polymerization in homogeneous and heterogeneous systems.	3	Differentiate Polymerization in homogeneous and heterogeneous systems	Lecture	
	5	Conducting Polymers.Factors affecting the conductivity of conducting polymers. Dopping of conducting polymers.	2	Explain conducting polymers	Lecture	
		Polymers processing - compression moulding, injection moulding, transfer moulding and extrusion moulding. Casting extrusion of fibres, spinning.	2	Understand the processing of polymers	Lecture	
V	**Radiation Chemistry**					
	1	Radioactivity, rate of radioactive disintegration. Sources of high energy radiation. Comparison of radiation chemistry with photochemistry, interaction of high energy radiation with matter. .	4	Compare radiation chemistry with photochemistry	Lecture	Evaluation through class test, group discussion and quiz Formative assessment I
	2	Nature of radiations from radioactive elements. Detection and measurement of radioactivity - Geiger-Muller counter.	2	Detect and measure radioactivity	Lecture	

	3	Wilson Cloud Chamber. G-value, Curie, radiolysis of water, hydrated electron. Radiolysis of some aqueous solutions - Fricke Dosimeter solution.	4	Explain the radiolysis of some aqueous solutions	Lecture	
	4	Fricke Dosimeter solution and redox reactions using energy transfer from irradiated alkali halides. Radiation dosimetry - Rad, Gray, dose rate and Rontgen. Chemical dosimeters.	3	Understand radiation dosimetry and chemical dosimeters	Lecture with videos	
	5	Fricke and Ceric sulphate dosimeters. Applications of radiation chemistry in biology and industry.	2	Apply radiation chemistry in biology and industry	Lecture	

Course Instructor: S. LizyRoselet HOD: G. Leema Rose

Semester : III

Name of the Course : Advanced Topics in Chemistry

Subject Code : PG1733

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
6	4	90	100

Course Outcomes

CO No.	*Upon completion of this course, the students will be able to*:	**PO /PSO Addressed**	**Cognitive Level**
CO-1	Understand the principles of nanotechnology and the properties of nanomaterials	PSO-1	U
CO-2	Synthesize nanoparticles and apply nanotechnology in medical field	PSO-4 and PSO-5	C + Ap
CO-3	Design chemical reactions using green solvents	PSO-4	C
CO-4	Synthesize chemical compounds using solvent free, microwave and sonication assisted techniques	PSO-4	C
CO-5	Apply supramolecular chemistry in organic chemistry and photochemisty	PSO-3	Ap
CO-6	Explain the synthesis and therapeutic action of drugs	PSO-1	U
CO-7	Express the importance and applications of thermodynamics in biology	PSO-1	U

Teaching Plan

Credit: 4 ***Total Hours: 90 (Incl. Seminar & Test)**

Unit	Module	Topics	Lecture Hours	Learning Outcome	Pedagogy	Assessment/Evaluation
I	**Nanochemistry**					
	1	General principles of nanotechnology Nanoparticles - definition, size relationship and nanoparticles of metals Nanoparticles - semiconductors and oxides.	3	Understand the properties of nanoparticles	Lecture	Evaluation through class test and group discussion Formative assessment I
	2	Synthesis of nanosized compounds - Reduction methods Synthesis of nanosized compounds - Solgel method Optical and electrical properties of nanoparticles.	3	Synthesis various nanoparticles	Lecture and Seminar	
	3	Introduction, synthesis and purification of Fullerenes, Carbonnanotubes - preparation by Arc method Carbonnanotubes - preparation by chemical vapour deposition method.	2	Synthesis carbon nanotubes and fullerenes	Lecture and Seminar	
	4	Gold and silver nanoshells and its applications.	2	Understand the applications of gold and silver nanoshells	Lecture with videos	
	5	Nanosensors - introduction and nanoscale organization for sensors Nanosensos - characterization and optical properties.	2	Explain nanosensors and its properties	Lecture and Seminar	
		Nanomedicines - introduction and approach to developing nanomedicines Protocol for nanodrug administration Diagnostic and therapeutic applications.	3	Know about the therapeutic applications of nanoparticles		
II	**Green Chemistry**					
	1	Definition, necessity for green chemistry, Green chemistry and sustainable development. Basic principles and applications of green chemistry.	2	Understand the principle and applications of green chemistry	Lecture and seminar	Evaluation through class test and group discussion Formative

	2	Atom economy vs. yield in assessing greenness of organic reactions. Prevention of waste/byproducts and Prevention or minimization of hazardous products.	2	Explain the applications of green chemistry	Seminar and group discussion	assessment II
	3	Designing safer chemicals through Sommelet-Hauser and Cope reactions Designing safer chemicals through Wolff, Witting and Bamberger reactions.	2	Design and synthesise compounds using green methods	Lecture	
	4	Energy requirement for synthesis. CFC alternatives – Example for green chemistry in organic synthesis. Selection of appropriate solvent and starting material, use of protecting group and catalyst.	3	Understand the role of solvent, protecting groups and catalyst in green synthesis	Lecture and seminar	
	5	Solvent free reactions, reactions at ambient temperature. Microwave assisted reactions.	2	Synthesise compounds using solvent free and microwave assisted reactions	Lecture and seminar	
	6	Sonication assisted reactions - Reformatsky and Ullmann coupling Sonication assisted reactions – Wurtz and Bouveault reactions	2	Apply sonication method for synthesis	Lecture and seminar	
		Reactions in ionic solvents Reactions in super critical fluids and Tandem reactions.	2	Explain the reactions in ionic solvents	Lecture and seminar	
III	**Supramolecular Chemistry**					
	1	History and nature of supramolecular interactions Host - guest systems Cation and anion binding host.	3	Understand the host-guest relation in supramolecular chemistry	Lecture with videos	Evaluation through class test and group discussion Formative assessment I
	2	Crown ethers - synthesis and properties Crown ethers - Applications Lariat ethers.	3	Explain the applications of crown ethers	Lecture with ppt and videos	

	3	Podants - properties 3-dimensional podants Cryptands - synthesis, properties and applications. Spherands - synthesis, structure and uses.	4	Describe the properties and applications of podants, cryptands and spherands	Lecture and group discussion	
	4	Supramolecular chemistry of fullerenes Supramolecular photochemistry.	2	Explain supramolecular photochemistry	Lecture and seminar	
	5	Molecular devices - non- linear optical switches Molecular devices - electrophoto switching Molecular devices - Liquid crystal display.	3	Understand the types and applications of molecular devices	Lecture with videos	
IV	**Medicinal Chemistry**					
	1	Anti-neoplastic agents - classification and synthesis Assay of cyclophoshamide Assay of chlorambucil.	3	Identify anti-neoplastic agents	Lecture	Evaluation through class test Formative assessment III
	2	Antimalarial drugs - Classification and synthesis Assay of chloroquine Assay of primaquine.	3	List out the classification and the assay of antimalarial drugs	Seminar	
	3	Diuretics - Classification, synthesis Assay of Frusemide Assay of benzthiazide.	3	Explain the classification and the assay of diuretics	Seminar	
	4	Anti-inflammatory drugs - synthesis and therapeutic action of phenylbutazone Synthesis and therapeutic action of Ibuprofen.	2	Understand the therapeutic action of anti-inflammatory drugs	Lecture	
	5	Antipyretics Non-narcotic analgesics.	2	Know about antipyretics and analgesics	Seminar	
	6	Synthesis and therapeutic action of paracetamol Synthesis and therapeutic action of aspirin.	2	Describe the synthesis and therapeutic action of paracetamol and aspirin		

V	**Biophysical Chemistry**					
	1	Thermodynamics in biology - limitations of equilibrium thermodynamics Irreversible thermodynamics - Postulates and methodologies. Onsagar reciprocal theory Irreversible thermodynamics and biological systems.	4	Explain thermodynamics in biological systems	Lecture	Evaluation through class test Formative assessment II
	2	Energy flux biochemical standard state ATP ATP Currency of energy - Oxidative phosphorylation.	4	Understand energy flux and oxidative phosphorylation	Lecture and seminar	
	3	Role of Singlet Oxygen in biology Reactions in biomolecules-membrate potential Reactions in biomolecules-ion pumps.	3	Describe the reactions in biomolecules	Lecture	
	4	Photoacoustic effect Photoacoustic effect - Applications in biology.	2	Apply photoacoustic effect in biology	Lecture with ppt	
	5	Biophysical applications of Moss-bauer effect NMR imaging - Applications of spin labeling in membrane research.	2	Explain the biophysical application of Moss-bauer effect NMR imaging	Lecture with videos	

Course Instructor: A.K. Shermila HOD: G. Leema Rose