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 : I
Name of the Course : Organic Chemistry I
Subject Code : PG1711

No. of hours per week	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*:**	**PSO Addressed**	**Cognitive Level**
CO-1	Correlate the impact of displacement of electrons with the physico-chemical properties of organic compounds	PSO-2	An
CO-2	Identify the nature and stability of organic compounds	PSO-1	U
CO-3	Recognize the concept of chirality and stereoisomerism	PSO-1	R
CO-4	Ilustrateasymmetric synthesis using Cram's rule and prelog'srule	PSO-3	Ap
CO-5	Predict the effects of conformation in cyclic and acyclic systems.	PSO-4	C
CO-6	Infer the mechanism of electrophilic addition reaction	PSO-3	Ap

CO-7	Describe the kinetic and thermodynamic aspects of organic reactions	PSO-1	U
CO-8	Interpret the reaction mechanisms using linear free energy relationship	PSO-3	Ap

Teaching plan

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

Unit	Module	Topics	Lecture Hours	Learning Outcome	Pedagogy	Assessment/Evaluation
I	**Electron Displacement and Reactive Intermediates**					
	1	Inductive effect, Mesomeric effect, types and impact on the physico-chemical characteristics of molecules and dissociation constants of acids and bases.	4	Correlate the impact of electron displacement of organic compounds	Lecture	Evaluation through class test and group discussion Formative assessment I
	2	Tautomerism, Comparision of mesomerism and tautomerism, Hyperconjugation, Steric effects in molecules and their impact.	3	Compare electronic effect and steric effect	Lecture and Seminar	
	3	Preparation and stability of carbocations, carbanions and free radicals.	3	Know the preparation and stability of reactive intermediates	Lecture and Seminar	
	4	Preparation structure stability and reactions of carbenes and nitrenes.	3	Understand the reactions of carbenes and nitrenes	Lecture	
	5	Electron Donor Acceptor complexes - types, nature and applications.	2	Explain applications of EDA complexes	Lecture	
II	**Stereochemistry**					
	1	Concept of chirality. Newman, Sawhorse and Fischer projections and their conversion.	3	Convert Newman, Sawhorse and Fischer projections	Lecture	Evaluation through class test and group discussion Formative assessment II
	2	Enantiotopic, diastereotopichydrogens and prochiralcentres. Axial and planar chirality - ansa compounds and cyclophanes.	3	Differentiate axial and planar chirality	Lecture	

	3	Stereochemistry of compounds containing two dissimilar asymmetric carbons. Optical activity of biphenyls, allenes and spiranes. Optical isomerism of nitrogen and sulphur compounds.	4	Learn the optical activity of biphenyls, allenes and spiranes.	Lecture and group discussion	
	4	Stereospecific and stereoselective synthesis. Asymmetric synthesis. Cram's rule - open chain, cyclic and dipolar model. Prelog's rule.	5	Ilustrate asymmetric synthesis using Cram's rule and prelog'srule	Lecture	
III	**Conformational Analysis**					
	1	Conformation: Definition, Differences between configuration and conformation, Conformation of simple acyclic systems.	2	Differentiate configuration and conformation	Lecture	Evaluation through class test and group discussion Formative assessment III
	2	Effects of conformation on reactivity of acyclic system - electrophilic addition, nucleophilic addition, cis- and trans- addition, E_2 elimination and cis-elimination.	3	Know the effect of conformation in acyclic system	Lecture	
	3	Conformation of cyclic systems up to 6 membered rings, Conformational analysis of mono and di-substituted cyclohexanes.	3	Sketch the conformation of cyclic systems.	Lecture and group discussion	
	4	Effects of conformation on reactivity of cyclic systems involving saponification, esterification, S_N^1 andS_N^2 reactions.	3	Evaluate the effect of conformation in cyclic system	Lecture	
	5	Conformation equilibrium. Curtin-Hammet principle. Conformation of decalin, perhydrophenanthrene and perhydroanthracene.	4	Know Curtin – Hammet principle	Lecture	
IV	**Addition to multiple bonds**					

	1	Mechanism and stereochemical factors in reactions like addition of hydrogen halides, hypohalous acids.	4	Infer the mechanism of electrophilic addition reaction.	Lecture	Evaluation through class test and group discussion Formative assessment II
	2	Hydroboration, hydroxylation and epoxidation.	3	Know the mechanism of hydroboration, hydroxylation and epoxidation	Lecture and group discussion	
	3	Mechanism and applications of Michael addition, Diels' Alder reaction, Knoevenagal reaction.	2	Infer the mechanism and applications of addition reactions	Lecture	
	4	Mechanism and applications of Mannich reaction, Stork-enamine reaction, Grignard reaction.	4	Understand the mechanism of Mannich reaction, Stork-enamine reaction, Grignard reaction	Lecture	
	5	Mechanism and applications of Darzen's reaction, Reformatsky reaction and Wittig reaction.	2	Know the mechanisms of Darzen's , Reformatsky and Wittig reactions	Lecture	
V	**Organic Reaction Mechanism and Methods**					
	1	Reaction mechanism: Energy diagram of simple organic reactions, transition state and intermediate.	4	Predict the energy diagram of simple organic reactions.	Lecture	Evaluation through class test, group discussion and quiz Formative assessment I
	2	Kinetic and Thermodynamic requirements of reactions. Baldwin rules for ring closure	4	Describe the kinetic and thermodynamic aspects of organic reactions.	Lecture	
	3	Primary and secondary isotope effect. Testing and Trapping of intermediates, isotopic labeling, cross–over experiment and stereo chemical evidence.	3	Identify the evidence of reactive intermediates	Lecture with videos	
	4	Linear Free Energy Relationship: Hammett equation,physical significance of σ and ρ, applications and limitations.Taft equation.	4	Interpret the reaction mechanisms using linear free energy relationship	Lecture and Group Discussion	

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

Semester : **I**

Name of the Course : **Inorganic Chemistry I**

Subject Code : **PG1712**

No. of hours per week	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*:	PSO Addressed	Cognitive Level
CO-1	Understand the general characteristics and aqueous chemistry of transition elements.	PSO-1	U
CO-2	Explain various substitution reactions in coordination complexes and its applications.	PSO-2	U
CO-3	List out the importance of organometallic compounds.	PSO-1	R
CO-4	Determine the stability of transition metal complexes.	PSO-2	An
CO-5	Recognize the bonding in metallocenes.	PSO-1	U
CO-6	Recall the properties and theories related to solids.	PSO-1	U
CO-7	Synthesize organometallic compounds,Inorganic chains, Rings, Cages and Clusters and discuss its structures.	PSO-4	C

Teaching Plan

Credit: 5 ***Total Hours: 90 (Incl. Seminar & Test)**

Unit	Module	Topics	Lecture Hours	Learning Outcome	Pedagogy	Assessment/Evaluation
I	**Chemistry of transition elements**					
	1	Second and third series: Zirconium and Hafnium- Occurrence, isolation and oxidation states. Aqueous Chemistry - Zr^{4+} and Hf^{4+}- halides.	3	Gain knowledge about second and third transition series	Lecture	Evaluation through class test Formative assessment I
	2	ZrO_2 and mixed oxides, Zr clusters. Niobium and Tantalum - Occurrence, isolation, oxidation states, oxygen compounds, fluorides – pentafluoride.	4	Compare Niobium and Tantalum	Lecture	
	3	Rhenium- Occurrence, isolation and oxidation states. Rhenium heptafluoride- $ReCl_5$, $ReCl_4$ and Re III chlorides.	3	Learnaboutthe halides of Rhenium	Lecture	

	4	General characteristics of Ruthenium and Osmium: Nitrogen - Ligand complexes of Ru. Creutz- Taube and related complexes - Rh and Ir- Wilkinson's catalyst.	3	Understand the general characteristics of Ruthenium and Osmium	Lecture	
	5	Pt complexes in the treatment of cancer. Preparation and properties of UF_4, $UO_2(NO_3)_2.9H_2O$, ThO_2, $Th(NO_3)_2$, $PtCl_4$, H_2PtCl_6 and Cis-$PtCl_2(NH_3)_2$.	2	Get knowledge about the Pt complexes in the treatment of cancer	Lecture	
II	**Co-ordination Chemistry**					
	1	Stability constant, Determination of stability constant by Jobs and spactro photometric methods. Magnetic and spectral properties of complexes $[Ti(H_2O)_6]^{3+}$and $[Cu(H_2O)_6]^{2+}$.	4	Determine the stability of complexes by different methods	Lecture	Evaluation through class test and group discussion Formative assessment II
	2	Chelate compounds. Nephelauxetic effect. Substitution in octahedral complexes.	4	Understand the effect of substitution in complexes	Lecture	
	3	Acid hydrolysis. Base hydrolysis. Electron transfer reactions.	4	Compare acid and basic hydrolysis.	Lecture and group discussion	
	4	Outer sphere and inner sphere mechanism. Applications of electron transfer reactions in synthesis of coordination complexes.	3	Apply electron transfer reactions in coordination complexes	Lecture and group discussion	
	5	Mechanism of ascorbic acid oxidation by free and chelate Cu(II) Complexes.	2	Acquaint the mechanism of ascorbic acid oxidation	Lecture	
III	**Organometallic Chemistry**					
	1	Introduction, EAN and its correlation to stability. Synthesis and structures of metal carbonyls.	5	Synthesise metal carbonyl complexes	Lecture	Evaluation through class test and group discussion Formative assessment III
	2	Carbonylate anions. Carbonyl hydride complexes and metal nitrosyls. Isolobal analogy. IR study of metal carbonyls.	3	Learn about metal carbonyls and nitrosyls	Lecture and seminar	

	3	Synthesis, properties and structural features of metal complexes with carbine and alkene.	2	Synthesisemetal complexes of carbene and alkene	Lecture and group discussion	
	4	Synthesis, properties and structural features of alkyne and arene.	3	Synthesisemetal complexes of alkyne and arene	Lecture	
	5	Hapticity. Metallocenes - Synthesis, properties and bonding in ferrocene. Covalent versus ionic bonding in beryllocene	5	Recognise the bonding in metallocenes	Lecture	
IV	**Solid State**					
	1	Electronic structure of solids - Free electron and band theory type of solids.	4	Comparefree electron and band theory	Lecture	Evaluation through class test and group discussion Formative assessment II
	2	Conductors, insulators, intrinsic and extrinsic semiconductors.	3	Differentiate conductors, insulators and semiconductors	Lecture and group discussion	
	3	Optical and electrical properties of semiconductors-photovoltaic effect, Hall effect. Metal-metal and metal-semiconductor junction. Superconductivity.	2	Infer the optical and electrical properties of semiconductors	Lecture	
	4	High temperature super conductors, properties and applications. BCS theory, Cooper electrons, Meissener effect and levitation.	4	Explain high temperature super conductivity and its applications	Lecture	
	5	Crystal defects in solids - line and plane defects. Colourcentres. Solid electrolytes and their applications.	2	Determine the crystal defect in solids	Lecture	
V	**Inorganic chains, Rings, Cages and Clusters**					
	1	Silicates: classification-soluble and insoluble, based on $(SiO_4)^{4-}$ linkage -ortho, pyro, cyclic, chain, sheet, three-dimensional silicates - Intercalation chemistry of silica and graphite.	4	List out the type of silicates	Lecture	Evaluation through class test, group discussion and quiz Formative assessment I

	2	Polyacids-structure of isopoly and heteropoly anions, Polythiazyl- preparation and properties - Borazines- preparation, similarity with benzene and applications.		Correlateborazine with benzene		
	3	Phosphazenes- preparation and structure- craig and Paddock, Dewar's model - Preparation of carboranes.	4	Explain the structure of phospazenes and carboranes	Lecture	
	4	Diborane- preparation, structure and chemical properties, preparation and structure of tetraborane, structures of pentaborane-9, pentaborane-11, hexaborane-10 and decaborane-14.	3	Identify the structure of boranes	Lecture with videos	
	5	Metal clusters: Carbonyl type - structure of four, five and six atom clusters - Anionic and hydrido clusters, Non carbonyl type - Octahedral and triangular clusters.	2	Knowledge about metal clusters	Lecture	

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

Semester : I
Name of the Course : Physical Chemistry I
Subject Code : PG1713

No. of hours per week	Credit	Total no. of hours	Marks
6	4	90	100

Course Outcome

CO No.	Expected Learning Outcomes *Upon completion of this course, the students will be able to*:	PSO Addressed	Cognitive Level
CO-1	Gain knowledge about thermodynamics.	PSO-1	U
CO-2	Sketch the phase diagrams of three component systems.	PSO-3	Ap
CO-3	Deduce various relations of statistical thermodynamics.	PSO-2	An
CO-4	Determine the kinetics of chemical reactions.	PSO-1	U

CO-5	State quantum mechanical postulates and defines operators, Eigen values and Eigen functions.	PSO-1	R
CO-6	Apply Schrodinger wave equation for particle in 1, 3 D box and simple harmonic oscillator.	PSO-3	Ap
CO-7	Determine the surface area of films and liquids.	PSO-3	Ap
CO-8	Differentiate the types of adsorption in various phases.	PSO-2	An

Teaching Plan

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

Unit	Module	Topics	Lecture Hours	Learning Outcome	Pedagogy	Assessment/Evaluation
I	**Thermodynamics and phase rule**					
	1	Thermodynamics: Partial molar properties - Significance and determination by intercept and density methods. Partial molar free energy - Gibb's-Duhem equation.	4	Gain knowledge about thermodynamics.	Lecture	Evaluation through class test Formative assessment I
	2	Definitions for chemical potential, partial molar volume and partial molar heat content. Variation of chemical potential with temperature and pressure. Choice of standard states - components in gases and solution.	3	Deduce various relations of thermodynamic quantity.	Lecture and Seminar	
	3	Determination of activity and activity coefficients for non-electrolytes. Phase rule: Definitions of phase and components, three liquid components forming one, two or three pairs of partially miscible liquids.	4	General idea about phase diagrams of three component systems	Lecture and Seminar	
	4	Two solids and water systems involving (i) no chemical combination (ii) forming of a double salts.	3	Sketch the phase diagrams of various component systems	Lecture	
	5	Decomposed and not decomposed by water (iii) formation of a hydrate - dehydrated and not dehydrated by second salt.	2	Understand the types, nature and component systems	Lecture	
II	**Statistical thermodynamics**					

	1	Aim, permutation and combinations. Thermodynamic probability and entropy. Ensemble - canonical and micro canonical and grand canonical.	4	Deduce various relations of statistical thermodynamics	Lecture	Evaluation through class test and group discussion Formative assessment II
	2	Maxwell-Boltzmann statistics, Bose-Einstein statistics and Fermi-Dirac statistics. Population inversion.	4	Derive MB, BE and FD statistics	Lecture	
	3	Negative Kelvin temperature. Comparison of MB, BE and FD. Derivation of distribution laws.	4	Compare MB, BE and FD statistics	Lecture and group discussion	
	4	Partition function - translation, rotational, vibrational and electronic partition function. Thermodynamic functions in terms of partition function-internal energy and entropy.	3	Explain thermodynamic and partition functions	Lecture and group discussion	
	5	Relationships between partition function and work, pressure, enthalpy, Gibbs free energy and internal energy. Sacker-Tetrode equation.	2	Relate thermodynamic and partition functions		
III	**Chemical kinetics - I**					
	1	Arrhenius equation. Simple collision theory. ARRT theory - statistical and thermodynamic treatment.	5	Determine the kinetics of chemical reactions	Lecture	Evaluation through class test and group discussion Formative assessment III
	2	Ionic reactions - primary and secondary salt effects. Derivation and significance of volume of activation.	3	Explain ionic reactions and volume of activation	Lecture and seminar	
	3	Kinetic isotopic effect. Kinetics of unimolecular reaction - Lindemann, Hinshelwood and Rice-Ramsperger-Kassel Marcus.	2	Determine the kinetics of unimolecular reactions	Lecture and group discussion	

	4	Fast reactions - general features - flow techniques.	3	Determine the kinetics of the reaction by flow techniques	Lecture	
	5	Relaxation theory and relaxation techniques (T-jump and p jump) - crossed molecular beam technique.	5	Determine the kinetics of the reaction	Lecture	
IV	**Quantum mechanics - I**					
	1	Quantum mechanical operators: Addition, subtraction and multiplication of operators, position operator.	4	Know aboutquantum mechanical operators	Lecture	Evaluation through class test and group discussion Formative assessment II
	2	Linear operators, linear momentum operator, angular momentum operator, kinetic energy operator and Hamiltonian operator.	3	Explain hamiltonian operator.	Lecture and group discussion	
	3	Hermitian operator-commutation relationship among Lx, Ly, Lz and L^2 operators. Wave functions, Eigen functions and Eigen values.	2	Differentiate eigen functions and eigen values	Lecture	
	4	Orthogonality and normalization. Schrodinger time independent wave equation, De-Broglie equation, Heisenberg's uncertanity principle, postulates of quantum mechanics, setting up of Schrodinger equation.	4	Explain the postulates of quantum mechanics	Lecture	
	5	Solution and interpretation with regard of particle in 1 D box, particles in a 3D box, simple harmonic oscillator.	2	Interpret particles in 1 D and 3D box	Lecture	
V	**Surface chemistry**					

	1	Electrical aspects of surface chemistry, electrical double layer, Zeta potential. BET and Gibbs adsorption isotherms - Derivation and application.	4	Deriveadsorption isotherms	Lecture	Evaluation through class test, group discussion and quiz Formative assessment I
	2	Determination of surface area (BET equation) surface films and liquids. Membrane equilibria and dialysis.	3	Determine the surface area of films and liquids	Lecture	
	3	Surface active reagents: Classification of surface agents - micellization, hydrophilic interactions.	4	Classify surface active reagents	Lecture	
	4	Critical micellar concentration - factors affecting the CMC of surfaces. Adsorption on semiconductor surfaces.	3	Differentiate the types of adsorption in various phases	Lecture with videos	
	5	Transition state theory of surface reactions - rates of chemisorptions - Hertz-Knudson equation.	2	Interpret and derive various theories	Lecture	

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

Semester : I

Name of the Course : Instrumental Methods of Analysis

Subject Code : PG1714

No. of hours per week	Credit	Total no. of hours	Marks
6	4	90	100

Course Outcome

CO No.	Expected Learning Outcomes *Upon completion of this course, the students will be able to*:	PSO Addressed	Cognitive Level
CO-1	Apply the chromatographic techniques to chemical compounds	PSO-3	Ap
CO-2	Understand the principles and applications of ion-exchange chromatography, HPLC and GC	PSO-1	U

CO-3	Analyze the concentration, purity and thermal stability of compounds using different instrumental techniques	PSO-2	An
CO-4	Detect electroactive substances using electrogravimetric, coulometry, polarography and amperometric techniques	PSO-2	An
CO-5	Employ colourimetric, spectrophotometric, fluorometry and flame photometry techniques to photoactive compounds	PSO-3	Ap
CO-6	Gain knowledge about the principles, instrumentation and applications of nephelometry and turbidimetric titrations	PSO-1	U
CO-7	Explain the principles and instrumentation of various spectroscopic techniques	PSO-1	U

Teaching Plan

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

Unit	Module	Topics	Lecture Hours	Learning Outcome	Pedagogy	Assessment/Evaluation
I	**Chromatography I**					
	1	Introduction and Classification of Chromatography, Plate and rate theories.	2	Understand the theories of chromatography	Lecture	Evaluation through class test Formative assessment I
	2	Paper chromatography - Principle and experimental techniques - ascending and descending paper chromatography - radical paper chromatography. Paper chromatography – applications.	4	Know about the applications of paper chromatography	Lecture and Seminar	
	3	Thin layer chromatography - Experimental techniques Thin layer chromatography – Applications.	2	Determine the purity of compounds using TLC	Lecture and Seminar	
	4	Column chromatography - Principle and Experimental techniques Column chromatography – Applications.	2	Apply column chromatographic techniques to compounds	Lecture and Seminar	
II	**Chromatography II**					

	1	Ion exchange chromatography - Principle and types- Experimental techniques. Cation exchange chromatography Anion exchange chromatography.	4	Distinguish cation and anion exchange chromatography	Lecture	Evaluation through class test and group discussion Formative assessment II
	2	Ion exchange chromatography – Applications. Separation of zinc and magnesium, separation of chloride and bromide.	2	Separate metals and ions using ion exchange chromatography	Seminar and group discussion	
	3	High performance liquid chromatography – Principle, experimental techniques and applications.	2	Understand the principle and applications of HPLC	Lecture and group discussion	
	4	Gas chromatography – Principle, experimental techniques and applications.	2	Understand the principle and applications of gas chromatography	Lecture	
III	**Thermo Analytical and Electroanalytical Methods**					
	1	Thermo Gravimetric Analysis - Principle Automatic thermogravimetric analysis and its applications Factors affecting TGA. Applications Thermometric titrations.	5	Analyze the purity and thermal stability of compounds	Lecture	Evaluation through class test and group discussion Formative assessment III
	2	Differential Thermal Analysis DTA - Applications Simultaneous DTA and TGA curves.	3	Relate TGA andDTA	Lecture and seminar	
	3	Electrogravimetric analysis - theory and instrumentation Electrogravimetric analysis – Applications.	2	Understand the applications of electrogravimetric analysis	Lecture and group discussion	

	4	Coulometry Coulometric titrations and applications. Potentiostaticcoulometry and its applications.	3	Detect electroactive substance using coulometry	Lecture and seminar	
	5	Polarography - Principle and Ilkovic equation Polarography - Experimental assembly of dropping mercury electrode Polarographic curves Polarography - applications to qualitative and quantitative analysis Concept of pulse polarography.	5	Determine the diffusion current using polarography	Lecture	
	6	Amperometric titrations - principle Amperometric titrations – Applications.	2	Demonstrate amperometric titrations	Lecture and seminar	
IV	**Colorimetric and Spectrophotometric Analysis**					
	1	Colorimetry - Principle Instrumentation for visual colorimetry Photoelectriccolorimetry - Single-beam photoelectric colorimeter Double-beam photoelectric colorimeter.	4	Understand the principle and instrumentation of colorimetry	Lecture with ppt and videos	Evaluation through class test and group discussion Formative assessment II
	2	Spectrophotometry - Instrumentation. Fluorometry - principle, instrumentation Fluorometry– Applications.	3	Identify photoactive and fluorescent materials	Lecture and group discussion	
	3	Flame photometry - principle, instrumentation and applications.	2	Determine the concentration of certain metal ions	Lecture	
	4	Nephelometry - theory and instrumentation Nephelometry - Applications Turbidimetry - theory and instrumentation Turbidimetry– Applications.	4	Differentiate nephelometry and turbidity	Lecture with ppt and videos	

	5	Turbidimetric titrations Applications of Turbidimetric titrations.	2	Determine solubility distribution using turbidimetrictitations	Seminar	
V	**Spectroscopy**					
	1	Spectroscopy - Introduction UV Spectroscopy - Principle and its basic concepts UV Spectroscopy - Instrumentation UV Spectroscopy – Applications.	4	Understand the principle of UV Spectroscopy	Lecture with ppt and videos	Evaluation through class test, group discussion and quiz Formative assessment I
	2	IR Spectroscopy - Principle and its basic concepts IR Spectroscopy - Instrumentation IR Spectroscopy – Applications.	3	Understand IR Spectroscopy	Lecture with videos	
	3	Raman Spectroscopy - Principle and its basic concept Raman Spectroscopy - Instrumentation Raman Spectroscopy - Applications Comparative study of Raman spectra and IR spectra.	4	Correlate IR and Raman spectroscopy	Lecture with videos	
	4	^{1}H NMR spectroscopy - Basic concepts ^{1}H NMR spectroscopy - Instrumentation ^{1}H NMR spectroscopy – Applications.	3	Explain the principle and instrumentation of ^{1}H NMR spectroscopy	Lecture with videos	
	5	Mass spectroscopy - Instrumentation Mass spectroscopy - Applications	2	Explain the principle and instrumentation of mass spectroscopy	Lecture with videos	

	6	Mossbauer Spectroscopy - Instrumentation Mossbauer Spectroscopy – Applications.	2	Understand the principle and instrumentation of Mossbauer spectroscopy	Lecture and Seminar	
	7	AAS - Instrumentation AAS - Applications.	2	Understand the principle and instrumentation of AAS	Lecture and Seminar	

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

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