

# **HOLY CROSS COLLEGE (Autonomous) NAGERCOIL.**

**(Affiliated to Manonmaniam Sundaranar University, Tirunelveli.  
Nationally Re-Accredited with A<sup>+</sup> grade by NAAC (CGPA 3.35))  
Kanyakumari District, Tamil Nadu, India.**



## **DEPARTMENT OF CHEMISTRY**

### **Teaching Plan**

**Semester I to VI (UG)**

**2020 - 2023**

**Semester - I**  
**Major Core I: GENERAL CHEMISTRY - I**  
**Course Code: CC2011**

Hours Per week	Credits	Total Hours	Marks
4	4	60	100

**Objectives**

- To gain basic knowledge on classification nomenclature of organic compounds
- To understand the quantum theory and wave mechanical concept
- To understand the chemistry of s - block elements and the principles of volumetric analysis

**Course Outcome**

COs	<i>Upon completion of this course, students will be able to</i>	PSO Addressed	Cognitive Level
CO - 1	understand the structure and naming of various organic compounds	PSO-1	U
CO - 2	interpret various electronic effects and chemical bonding	PSO-3	An
CO - 3	analyse the periodic properties of elements	PSO-2	An
CO - 4	apply wave mechanical concept in other fields	PSO-6	A
CO - 5	predict the properties of elements and the principle behind volumetric analysis	PSO-6	An

**Total Number of Contact hours: 60 (Including lectures, assignments and tests)**

Unit	Module	Topics	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Classification and Nomenclature</b>					
	1	Classification of organic compounds - based on the nature of carbon skeleton and functional groups - classification of C and H atoms of organic compounds (primary/secondary/tertiary)	2	Classify organic compounds	Lecture and power point presentation	Evaluation through Multiple choice questions, short test, quiz, slip test and group discussion
	2	IUPAC system of nomenclature of common organic compounds (upto C-10) - alkanes, alkenes and alkynes. Naming of cycloalkanes, bicycloalkanes with and without bridges and aromatic compounds	4	Know about the IUPAC nomenclature of organic compounds	Lecture and power point presentation	Formative assessment I

	3	Naming of organic compounds with one functional group - halogen compounds, alcohols, phenol, aldehydes, ketones, carboxylic acids and its derivatives, cyano compounds, amines, nitro compounds	3	Learn to name organic compounds with one functional group	Lecture and seminar	
	4	Naming of compounds with two functional groups - naming of compounds with more than one carbon chain. Naming of heterocyclic compounds containing one and two hetero atoms present in five/six membered rings	3	Know to name organic compounds	Lecture with power point presentation	
<b>II</b>	<b>Bonding in Organic Molecules</b>					
	1	Hybridization and geometry - bond angle, bond length, bond strength of C-H and C-C bonds - Van der Waal's interactions, Inter & Intra molecular forces and their effects on physical properties	3	Classify the elements based on the force of attraction and properties.	Question answer session	Evaluation through Multiple choice questions, short test, quiz and slip test
	2	Electronic effects - inductive effect, resonance effect - drawing of resonance structures - conditions for resonance - stability of resonance structures	3	Know about various types of electronic effects	Lecture	Formative assessment I
	3	Hyper conjugation, electromeric effect, steric effect - steric overcrowding - steric inhibition of resonance - steric relief (with examples)	3	Distinguish various effects	Lecture with power point presentation and Group discussion	
	4	Dissociation of bonds - homolysis and heterolysis - radicals, carbocations, carbanions - electrophiles and nucleophiles - Influence of electronic effects - dipole moment - relative strengths of acids and bases - stability of olefins - stability of radicals, carbocations and carbanions	3	Know about electrophiles, nucleophiles and stability of different ions	Lecture with power point presentation	

<b>III Periodic Properties</b>						
	1	Atomic orbitals - Quantum numbers- Principal, Azimuthal, Magnetic and Spin quantum numbers and their significance	2	Know about various quantum numbers and filling up of atomic orbitals	Seminar and power point presentation	Evaluation through Multiple choice questions, short test, quiz and class test  Formative assessment II
	2	Principles governing the occupancy of electrons in various quantum levels- Pauli's exclusion principle - Hund's rule- Aufbau Principle, (n+1) rule	2	Learn about different principles governing the occupancy of electrons	Lecture and Problem solving	
	3	Stability of half-filled and completely filled orbitals- inert pair effect. Variation of metallic characters - Factors affecting the periodic properties	2	Remember the factors affecting the periodic properties	Lecture and Problem solving	
	4	Anomalies and variations in atomic radius, ionic radius, electronic configuration	2	Calculate the atomic radius and ionic radius	Problem solving	
	5	Variation of electron affinity and electro negativity, ionization energy, metallic character of elements along the group and periods	2	Distinguish various periodic properties	Illustration, Seminar and Power point presentation	
	6	Influence of various characters on stability, colour, coordination number, geometry, physical and chemical properties	2	Calculate coordination number	Power point presentation	
<b>IV Atomic Structure</b>						
	1	Planck's quantum theory - Photoelectric effect, Compton effect	2	Understand the Plank's quantum theory	Power point presentation and videos	Evaluation through Multiple choice questions, short test, quiz and class test
	2	Bohr's model of hydrogen atom	2	Know Bohr's model of hydrogen atom	Lecture	
	3	Wave particle duality, de Broglie equation, Heisenberg uncertainty principle	2	Learn to derive de Broglie equation	Lecture	

	4	Eigen function and Eigen value - Postulates of Quantum mechanics	2	Differentiate Eigen function and Eigen value	Problem solving	Formative assessment II
	5	Schrodinger's time independent wave equation (no derivation), wave functions and its physical properties -Normalization and Orthogonal function	4	Understand the importance of Schrodinger's wave equation	Lecture	
<b>V</b>	<b>i) s - block elements</b>					
	<b>ii) Principles of Volumetric Analysis</b>					
	1	Position of hydrogen in the periodic table, General characteristics of s - block elements. Compounds of s-block metals - oxides, hydroxides, peroxides, superoxide's-preparation and properties - oxo salts - carbonates - bicarbonates - nitrates - halides and polyhalides	3	Recognize the various metals, oxides and hydroxides	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz and class test  Formative assessment I
	2	Extraction of Be and Mg - physical and chemical properties - Uses	2	Understand the extraction process	Lecture with videos	
	3	Complexes of s-block metals - complexes with crown ethers - biological importance sodium and potassium - Organometallic compounds of Li and Be	1	Explicate the biological importance of sodium and potassium	Seminar	
	4	General principles of volumetric Analysis, Types of titrations. Requirements for titrimetric analysis. Concentration systems	1	Know about the principles of volumetric analysis	Power point presentation, seminar	
	5	Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions. Limitation of volumetric analysis, endpoint and equivalence point	2	Understand the criteria of preparation of standard solutions	Demonstration	
	6	Neutralisation-titration curve, theory of indicators, choice of indicators. Use of phenolphthalein and methyl orange	1	Acquire knowledge about the use of indicators.	Demonstration	

	7	Complexometric titrations: Stability of complexes, titration involving EDTA. Metal ion indicators and characteristics. Problems based on titrimetric analysis	2	Analyse the stability of complexes	Problem solving	
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Course Instructor: Dr. R. Gladis Latha

HOD: Dr. G. Leema Rose

**Semester I**  
**Allied Chemistry - Botany and Zoology Major**  
**Chemistry for Life Sciences**  
**Course Code: CA2011**

Hours Per week	Credits	Total Hours	Marks
4	3	60	100

**Objectives:**

- To acquire knowledge on atomic structure and bonding
- To understand the importance of photochemistry and catalysis
- To apply the principles of chromatography techniques

**Course Outcome**

COs	<i>Upon completion of this course, the students will be able to:</i>	PSO Addressed	Cognitive Level
CO-1	remember the structure and bonding in atoms and molecules	PSO-1	R
CO-2	analyse the types of bonding and the ways of expressing concentration in molecules	PSO-2	An
CO-2	understand the concepts of biophysical analysis, catalysis and buffer action	PSO-1	U
CO-3	apply the concepts of photochemistry and chromatography to various chemical processes.	PSO-6	A

**Total Number of Contact hours: 60 (Including lectures, assignments and tests)**

Unit	Module	Topics	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Atomic Structure</b>					
	1	Dual nature of electron, de-Broglie equation	2	Acquire knowledge on Dual nature of electron and de-Broglie equation	Lecture, power point presentation and videos	Evaluation through Multiple choice questions, short test, quiz
	2	Davisson and Germer experiment	1	Understand Davisson and Germer experiment	Lecture and power point presentation	
	3	Heisenberg's uncertainty principle and its significance	1	Understand Heisenberg's uncertainty principle and its significance	Lecture, power point presentation and discussion	Formative assessment I

	4	Compton effect - Schrodinger's wave equation and its significance, eigen values and eigen functions, quantum numbers and their significance	3	Distinguish eigen values and eigen functions	Lecture and power point presentation	
	5	Atomic orbitals - significance, shapes, difference between orbit and orbital	1	Differentiate between orbit and orbital	Lecture, power point presentation and illustration	
	6	Rules for filling up of orbitals - Pauli's exclusion principle, Aufbau principle and Hund's rule	2	Know about different principles governing the filling up of orbitals	Lecture and power point presentation	
	7	Electronic configuration of elements up to 20	2	Gain knowledge on the filling up of atomic orbitals	Lecture and power point presentation	
<b>II</b>	<b>Chemical bonding</b>					
	1	Ionic bond, formation of ionic bond, general characteristics of ionic compounds	1	Know about ionic bond and its characteristics	Lecture and power point presentation	Evaluation through Multiple choice questions, short test, quiz
	2	Lattice energy, Born-Haber cycle and its applications	2	Understand lattice energy	Lecture and power point presentation	
	3	Covalent bond - formation of covalent bond with examples characteristics of covalent compounds	2	Gain Knowledge about Covalent bond	Lecture and power point presentation	Formative assessment I
	4	Ionic character in covalent compounds, Fajan's rule	1	Acquire knowledge about Ionic character and Fajan's rule	Lecture and power point presentation	
	5	Coordinate bond - formation of coordinate bond with examples.	2	Understand Coordinate bond formation	Lecture and Power point presentation	
	6	Metallic bond -band theory, conductors, insulators and semiconductors.	2	Explicate the difference between conductors, insulators, semiconductors	Lecture with power point presentation	



	7	Hydrogen bonding - types - inter and intramolecular and effect of hydrogen bonding.	2	Understand Hydrogen bonding and its effect	Lecture with power point presentation	
<b>III</b>	<b>Photochemistry</b>					
	1	Importance of photochemistry, difference between thermal and photochemical reactions. Laws of photochemistry - Beer-Lambert's Law, Grother's- Drapers law and Stark-Einstein's law	3	Differentiate between thermal and photochemical reactions	Lecture and power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Quantum efficiency, Electronic excitations - singlet and triplet states, Jablonski diagram, internal conversion - intersystem crossing - fluorescence, phosphorescence. Difference between fluorescence and phosphorescence	3	Understand various electronic excitations	Lecture and power point presentation	
	3	Types of photochemical reactions based on quantum efficiency ( $\phi = 1$ , $\phi < 1$ and $\phi > 1$ ) - primary and secondary process of photochemical reactions	2	Differentiate primary and secondary process of photochemical reactions	Lecture and power point presentation	
	4	Photochemical rate law - kinetics of photochemical combination of H <sub>2</sub> and Cl <sub>2</sub> and decomposition of HI	2	Acquire knowledge about kinetics of photochemical combination of H <sub>2</sub> and Cl <sub>2</sub> - decomposition of HI	Lecture with power point presentation	
	5	Photosensitization, photosensitizers, chemiluminescence and bioluminescence	2	Differentiate chemiluminescence and bioluminescence.	Lecture with power point presentation	

<b>IV Biophysical Analysis and Catalysis</b>						
	1	Osmosis, osmotic pressure and isotonic solutions	1	Understand Osmosis, osmotic pressure, isotonic solutions	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz
	2	Determination of molar mass by osmotic pressure measurement	2	Acquire knowledge on molar mass by osmotic pressure measurement	Lecture with power point presentation	
	3	Reverse osmosis	1	Understand reverse osmosis	Lecture and power point presentation	Formative assessment II
	4	Adsorption - types, factors influencing adsorption and applications of adsorption	2	Acquire knowledge on adsorption, types, factors influencing adsorption and its applications	Lecture and power point presentation	
	5	Catalysis - types, theories, intermediate compound formation theory and adsorption theory	3	Understand catalysis, types and theories	Lecture and power point presentation	
	6	Enzyme catalysis - Michaelis-Menten equation and theory	3	Understand Enzyme catalysis, Michaelis, Menten equation	Lecture and power point presentation	
<b>V Analytical Chemistry</b>						
	1	Methods of expressing concentration - normality, molarity, molality, mole fraction, ppm and ppb	2	Understand methods of expressing concentration of solution	Lecture and power point presentation	Evaluation through Multiple choice questions, short test, quiz
	2	Ionic product of water - pH and pOH	1	Acquire knowledge about Ionic product of water, pH and pOH	Lecture and power point presentation	Formative assessment I
	3	Strength of acids and bases - $K_a$ and $K_b$ , $pK_a$ and $pK_b$	2	Understand strength of acids and bases	Lecture and power point presentation	
	4	Buffer solutions - examples and theory of buffer action	1	Know about buffer solutions and theory of buffer action	Lecture and power point presentation	

5	Chromatography - classification, Column chromatography - principle, experimental techniques, factors affecting column efficiency and its applications	2	Understand chromatography and column chromatography	Lecture with videos
6	TLC - principle, experimental techniques, advantages, limitations and applications	1	Know about TLC	Lecture with videos
7	GC – principle, experimental techniques and applications	2	Acquire knowledge about GC	Lecture with videos
8	HPLC - principle and experimental technique	1	Understand HPLC	Lecture with videos

Course Instructor: Dr. S. Ajith Sinthuja

HOD: Dr. G. Leema Rose

**Semester - I**  
**Part IV: NME**  
**Applied Chemistry - I**  
**Course Code: CNM201**

Hours Per week	Credits	Total Hours	Marks
2	2	30	100

**Objectives:**

- To know the preparation and importance of agrochemicals
- To acquire knowledge about soaps and sugar
- To understand the chemicals used in day to day articles

**Course Outcome**

CO	<i>Upon completion of this course, the students will be able to:</i>	PSO Addressed	Cognitive Level
CO-1	remember the importance of soaps and detergents	PSO-2	R
CO-2	analyse the characteristics and advantages of agrochemicals	PSO-2	An
CO-2	understand the process of manufacture of sugar and paper	PSO-4	U
CO-3	apply the chemical reactions to synthesize day to day articles	PSO-4	A

**Total Number of Contact hours: 30 (Including lectures, assignments and tests)**

Unit	Section	Topics	Hours	Learning outcome	Pedagogy	Assessment / Evaluation
<b>I</b>	<b>Fertilizers</b>					
	1	Plant nutrients - macronutrients - micronutrients -need for fertilizers - characteristics of a good fertilizer -role of N, P and K in plant growth	2	Know the role of nutrients and fertilizers in plants	Lecture and power point presentation	Evaluation through Multiple choice questions, short test, quiz
	2	Classification of fertilizers - natural fertilizers - artificial fertilizers - manufacture and uses of artificial fertilizers -urea - calcium cyanamide	2	Classify fertilizers and understand the method of manufacturing	Lecture and discussion	Formative assessment I

	3	Calcium ammonium nitrate - superphosphate of lime- triple superphosphate - potassium chloride. Biofertilizers and their advantages	2	Remember the methods of manufacture of fertilizers	Explanation using equations	
<b>II</b>	<b>Pesticides</b>					
	1	Pesticides- classification based on the use and chemical composition. Insecticides- structure and uses of lead arsenate - calcium arsenate - methoxychlor - baygon - malathion- D.D.T. - BHC	2	Classify and know the structure and uses of pesticides	Lecture	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Fungicides - preparation and uses of limesulphur - bordeaux mixture - sodium sulphate - thallium sulphate	2	Remember the uses and methods of preparation of fungicides	Lecture and group discussion	
	3	Weedicides - structure and uses of butachlor - eptam - DNOC. Rodenticides - preparation and uses of zinc phosphide - aluminium phosphide - warfarin	2	Analyse the characteristics and advantages of weedicides and rodenticides	Lecture and power point presentation	
<b>III</b>	<b>Soaps and detergents</b>					
	1	Soaps -classification -hard soap - soft soap - raw materials -manufacture of toilet soap - transparent soap - liquid soap - medicated soap - herbal soap - cleansing action of soap	3	Acquire knowledge about soaps	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II

	2	Detergents - classification - examples- advantages of detergents over soaps -detergent action -detergent chemicals-additives - excipients - colors - flavours - environmental hazards	3	Remember the importance of detergents	Lecture and group discussion	
<b>IV</b>	<b>Sugar and Paper industry</b>					
	1	Sugar -manufacture - double sulphitation process - refining and grading of sugar-sugar substitute - saccharin - synthesis and uses - manufacture of ethanol from molasses.	2	Understand the process of manufacture and uses of sugar and sugar substitute	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Paper - manufacture - production of wood pulp by sulphate process - processing - blending - beating - refining and calendaring -	2	Understand the process of manufacture of paper	Lecture and discussion	
	3	Types of paper - printing paper – newsprint paper - writing paper - wrapping paper - bond paper - art paper - blotting paper - tissue paper - parchment paper - cardboard.	2	Remember the types of paper	Peer group teaching	
<b>V</b>	<b>Chemicals in day-to-day life</b>					
	1	Ingredients and preparation of tooth powder - tooth paste - writing inks - gum paste - boot polish - talcum powder	3	Apply chemical principles to prepare articles of day - to-day life.	Lecture with power point presentation	Evaluation through Multiple choice questions, short test,

	2	Ingredients and preparation of sealing wax - agar agar - chalk crayons -liquid blues - camphor tablets - agar battis - phenoyl- moth balls.	3	Apply chemical principles to prepare articles of day - to-day life	Peer group teaching	quiz Formative assessment I
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Course Instructor: Ms. L. Deva Vijila

HOD: Dr. G. Leema Rose

**Semester – II**  
**Major Core – II: GENERAL CHEMISTRY - II**  
**Course Code: CC2021**

Hours Per week	Credits	Total Hours	Marks
4	4	60	100

**Objectives**

1. To learn the preparation, properties and importance of aliphatic hydrocarbons and alicyclic compounds.
2. To understand the principles and theories of chemical bonding metallurgical processes.
3. To study the gas laws , physical properties of liquids and the classification of liquid crystals

**Course Outcome**

COs	<i>Upon completion of this course, students will be able to</i>	PSO Addressed	Cognitive Level
CO - 1	understand the preparation, properties of organic compounds	PSO-1	U
CO - 2	apply the theories in the preparation of compounds	PSO-6	A
CO - 3	prepare and evaluate compounds based on their application and structure	PSO-4	E
CO - 4	predict the properties of elements and the principles of volumetric analysis	PSO-6	Y
CO - 5	analyse the properties of matter	PSO-2	Y
CO - 6	learn the basics of metallurgy and the theories about gases	PSO-1	U

**Total Number of Contact hours: 60 (Including lectures, assignments and tests)**

Unit	Module	Topic	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
I	<b>Aliphatic Compounds</b>					
	1	Alkanes - preparation, physical properties, reactions, reactions with radical mechanism for substitution reaction	3	Understand the preparation and properties of alkanes	Lecture and discussion	Evaluation through Multiple choice questions, short test, quiz and class test
	2	Alkenes: Preparation from alcohol, haloalkane, dihaloalkanes and alkynes - reactions of alkenes	3	Know about alkenes and the reactions	Lecture and discussion	



	3	Hydroboration, hydroxylation, ozonolysis and epoxidation - peroxide effect - allylic substitution, oxidation by $\text{KMnO}_4$ and polymerization	2	Gain knowledge about the reactions of alkenes	Lecture	Formative assessment I
	4	Synthesis of - Dibenzyl, cis and trans 2-butene, propanal and 1-methyl cyclohexanol	2	Prepare various compounds from alkenes	Lecture	
	5	Alkynes: preparation, reactions - addition of hydrogen, halogen, hydrogen halide, water, $\text{HCN}$ , $\text{CH}_3\text{COOH}$ - dimerisation and cyclisation - acidity of terminal alkynes	2	Understand the preparation and properties of alkynes	Question answer session and lecture	
<b>II</b>	<b>Alicyclic Compounds</b>					
	1	Cycloalkanes: Preparation - reactions -cycloaddition, dehalogenation, pyrolysis of calcium salt of dicarboxylic acid	3	Know about preparation and reactions of cycloalkanes	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Wurtz reaction -stability of cycloalkanes - Baeyer's strain theory. Cycloalkenes: Preparation and reactions	3	Know the stability of cycloalkanes	Lecture with illustration	
	3	Preparation of conjugate dienes - reactions - 1,2 and 1,4 addition and Diels-Alder reaction, Synthesis of trans 2-chloro cyclopentanol	3	Understand clearly about the reactions and synthesis of compounds	Lecture, Discussion	
	4	Synthesis trans-2 methylcyclopentanol, cis and trans 1,2cyclohexanediol, cyclohexene, 2,3-butanedione and adipic acid	2	Study the synthesis of compounds	Lecture, Discussion	

III <b>Chemical bonding</b>						
	1	Ionic bond - Properties of ionic compounds, factors favoring the ionic bond formation - ionization potential - electron affinity - electronegativity - Lattice energy - Born-Haber Cycle - Polarizing power and Polarizability	3	Understand clearly about ionic bond and lattice energy	Lecture with illustration	Evaluation through Multiple choice questions, short test, quiz
	2	Transition from ionic to covalent character and vice versa - Fajan's rules - Covalent bond - Properties of covalent compounds - structure and bonding of homo and heteronuclear molecules	3	Learn covalent bonding	Lecture with illustration	Formative assessment II
	3	Hydrogen bonding - types, effect on properties - Hybridisation - $sp^3, sp^2, sp, dsp^2, d^2sp^3, d^3sp^3$ - Examples - $BeCl_2, BF_3, SiCl_4, PCl_5, SF_6, IF_7, H_2O, NH_3, XeF_6$	3	Analyze the effects of hydrogen bonding and types of hybridization	Lecture	
	4	VSEPR Theory – Postulates – MO Theory – Bonding and anti-bonding orbitals – Applications of MO theory $H_2, He, N_2, O_2, HF$ and CO molecules – Comparison of VB and MO theories	3	Know about VSEPR and MO theories	Lecture with power point presentation and illustration	
IV <b>Metallurgy</b>						
	1	Occurrence of metals – basic metallurgical operations and metallurgy process – General methods involved in extraction of metals	2	Know about various metallurgical processes	Lecture	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Concentration of ores – froth floatation, magnetic separation, calcination, roasting, smelting, flux, aluminothermic process	1	Understand about different concentration methods	Lecture and discussion	
	3	Extraction processes – Chemical reduction – electrolytic reduction – metal displacement	2	Acquire knowledge about extraction processes	Lecture	

	4	Refining methods - distillation - fractional crystallization - electrolysis. Zone refining van Arkel de Boer methods	1	Know about various refining methods	Lecture and discussion	
	5	Electrolytic refining - ion exchange method - extraction - chemical properties and uses of Ti, W, Mo, V, and Ni	4	Study the extraction and properties of different metals	Lecture with power point presentation	
<b>V</b>	<b>Gas and Liquid state</b>					
	1	Ideal gas: Kinetic theory of gases - Postulates and derivation of kinetic gas equation, derivation of gas laws-Maxwell's distribution of molecular velocities	3	Know about the theory of gases and derivation of gas equation	Lecture and discussion	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Types of molecular velocities - collision diameter - collision frequency - mean free path	2	Know about molecular velocities	Lecture	
	3	Degrees of freedom - translational, rotational and vibrational - Principle of equipartition of energy - Behaviour of real gas - Vander Waals equation of state - derivation	3	Understand the different degrees of freedom and behaviour of real gases	Lecture with Illustration	
	4	Liquid state: Physical properties - Trouton's rule - surface tension - Effect of temperature on surface tension - viscosity - effect of pressure and temperature - refraction - refractive index - specific and molar refraction	2	Learn about liquid state	Lecture and discussion	
	5	Liquid crystals: Vapour pressure temperature diagram – thermography – classification of thermotropic liquid crystals – nematic, smetic and cholesteric liquid crystals with examples.	2	Know about different types of liquid crystals.	Lecture and discussion	

Course Instructor: Ms. L. Deva Vijila

HOD: Dr. G. Leema Rose

**Allied Chemistry - Botany and Zoology Major**  
**Chemistry of Biomolecules**  
**Course Code: CA2021**

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	3	60	100

**Objectives:**

1. To acquire knowledge about the chemistry of biomolecules
2. To understand the structure and functions of biomolecules

**Course Outcome**

COs	Upon completion of this course, students will be able to	PSO Addressed	Cognitive Level
CO-1	remember the classification of biomolecules	PSO-1	R
CO-2	understand the structure, function and metabolism of biomolecules	PSO-1	U
CO-3	apply the chemistry of biomolecules in industry and medicine	PSO-6	A
CO-4	analyse and identify biomolecules	PSO-2	Y

**Total Number of Contact hours: 60 (Including lectures, assignments and tests)**

Unit	Module	Topics	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Carbohydrates</b>					
	1	Introduction - sources of carbohydrates in the diet - classification and functions	2	Understand the sources, classification and functions of carbohydrates in the diet	Lecture with illustration	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Glucose and fructose - reactions - interconversions and mutarotation	1	Gather knowledge on the reaction interconversions and mutarotation of glucose and fructose	Lecture and discussion	
	3	Tests for carbohydrates - Molisch's, Benedict and Fehlings tests	1	Know the tests for carbohydrates	Lecture with power point presentation	
	4	Digestion - absorption - metabolism of carbohydrates	3	Understand the metabolism of carbohydrates.	Lecture and discussion	
	5	Regulation of blood sugar - diabetes mellitus	1	Study the regulation of blood sugar	Lecture and discussion	

	6	Properties and uses of sucrose, starch and cellulose	2	Know the properties and uses of sucrose, starch and cellulose.	Lecture with power point discussion	
	7	Differences between starch and cellulose	2	Differentiate between starch and cellulose	Lecture with power point discussion	
<b>II</b>	<b>Amino Acids and Proteins</b>					
	1	Amino acids - classification - isolation from proteins - Zwitter ion formation and isoelectric point	2	Understand the classification of amino acids	Lecture and discussion	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Synthesis of glycine, alanine and phenyl alanine	2	Study the synthesis of amino acids	Lecture and discussion	
	3	Peptides - peptide bond - synthesis of dipeptides	2	Know the synthesis of peptides	Lecture with power point discussion	
	4	Proteins - classification based on structure and functions	2	Study the classification of proteins	Lecture with power point discussion	
	5	Primary, secondary, tertiary and quaternary structure of proteins	2	Acquire knowledge on structure of proteins.	Lecture and discussion	
	6	Denaturation of proteins - Tests for proteins - Ninhydrin and biuret tests	2	Understand denaturation of proteins	Lecture with power point discussion	
<b>III</b>	<b>Nucleic Acids and Enzymes</b>					
	1	Nucleic acids - nucleosides and nucleotides. Structure of DNA - denaturation and renaturation of DNA - replication of DNA	3	Know the structure of DNA	Lecture and discussion	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Hydrogen bonding in DNA. Stabilizing forces in protein and DNA -Vander waal's forces, dipole-dipole and dipole-induced dipole interactions	2	Study the bonding in DNA molecules	Lecture with power point discussion	
	3	Structure of RNA - Types of RNA. Difference between DNA and RNA	2	Acquire knowledge on structure of RNA	Lecture with power point discussion	

	4	Enzymes - classification and characteristics - Mechanism of enzyme action -factors influencing enzyme activity	2	Understand the classification of enzymes	Lecture and discussion	
	5	Cofactors and coenzymes. Enzyme inhibitors - reversible and non-reversible inhibitors	2	Know the importance of cofactors and coenzymes	Lecture with power point discussion	
	6	Industrial and medical application of enzymes	1	Study the application of enzymes	Lecture and discussion	
<b>IV</b>	<b>Lipids, Oils and Fats</b>					
	1	Lipids - classification - properties - biological functions	1	Classify lipids and its properties	Lecture with power point discussion	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Biological functions of phospholipids and glycolipids	2	Understand the functions of phospholipids and glycolipids	Lecture and power point discussion	
	3	Oils and fats - definition - characteristics and uses	1	Describe the characteristics and uses of oils and fats	Lecture and discussion	
	4	Common fatty acids in oils and fats - extraction and refining of oils	2	Understand the process of extraction and refining of oils	Lecture with power point discussion	
	5	Estimation of fats and oils - acid value, saponification value and Iodine value	3	Determine the saponification and iodine value of fats and oils	Lecture and discussion	
	6	Distinction between animal and vegetable fats. Hydrogenation and Rancidity	3	Differentiate animal and vegetable fats	Lecture with power point presentation	
<b>V</b>	<b>Vitamins and Hormones</b>					
	1	Vitamins -introduction - classification - Sources - biological function	3	Understand the classification and biological functions of vitamins	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Deficiency diseases of Vitamin A, B, C, D, E and K	2	Recognize the diseases caused by vitamin deficiency	Lecture with power point presentation	
	3	Hormones introduction and classification	2	Classify hormones	Lecture with power point presentation	

	4	Structure and functions of thyroxin, adrenaline, bile acids, progesterone, testosterone and oestrone	3	Explain the structure and functions of hormones	Lecture	
	5	Effect of hormone activity on biological functions.	2	Understand the effect of hormone on biological functions	Lecture	

Course Instructor: Dr. M. Anitha Malbi

HOD: Dr. G. Leema Rose

**Semester - II**  
**Part IV: NME**  
**Applied Chemistry - II**  
**Course Code: CNM202**

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
2	2	30	100

**Objectives:**

1. To acquire knowledge on petroleum and petroleum products
2. To know about the preparation of cosmetics and perfumes
3. To understand the manufacture of matches and characteristics of paints and pigments

**Course Outcome**

COs	<i>Upon completion of this course, the students will be able to:</i>	PSO Addressed	Cognitive Level
CO-1	remember the refining of petroleum and manufacture of petroleum products	PSO-4	R
CO-2	analyse the therapeutic uses of pharmaceuticals	PSO-7	Y
CO-3	understand the process of manufacture of cosmetics and perfumes	PSO-8	U
CO-4	analyse the characteristics of matches, explosives, paints and pigments	PSO-2	Y

**Total contact hours: 30 (Including lectures, assignments and tests)**

Unit	Module	Topics	Hours	Learning outcome	Pedagogy	Assessment / Evaluation
<b>I</b>	<b>Petroleum</b>					
	1	Petroleum - refining of petroleum - fractional distillation - cracking - thermal and catalytic cracking - advantages of catalytic cracking - octane rating - anti knock agents - cetane rating	3	Know the process of refining of petroleum and the importance of cracking	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz
	2	Petrochemicals - direct and indirect petrochemicals - methods involved in manufacture of petrochemicals - alkylation - pyrolysis	3	Understand the methods involved in the manufacture of petrochemicals	Lecture and discussion	Formative assessment I



<b>II</b>	<b>Pharmaceuticals</b>					
	1	Preparation and therapeutic uses of the following: Antiseptics - alum - zinc oxide - boric acid. Mouth wash - hydrogen peroxide. Antacid - aluminium hydroxide. Analgesics - aspirin - paracetamol. Haematinics - ferrous fumarate - ferrous gluconate. Laxatives - epsom salt - milk of magnesia	6	Acquire knowledge about the therapeutic uses of pharmaceuticals	Lecture	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
<b>III</b>	<b>Cosmetics and Perfumes</b>					
	1	Preparation and uses - shampoo - hair dye - face cream - sun screen lotion - nail polish - nail polish removers - lipsticks	3	Acquire knowledge about cosmetics	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz
	2	Perfumes - ingredients - isolation of essential oils - preparation of odorous substances - vanillin - diphenyl oxide	3	Remember the preparation of perfumes	Lecture and discussion	Formative assessment II
<b>IV</b>	<b>Matches and Explosives</b>					
	1	Safety matches - classification - composition - manufacture of safety matches. Pyrotechny - composition of fireworks	3	Understand the process of manufacture and uses of safety matches and fire works	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz
	2	Explosives - characteristics - classification - low explosives - gun powder - smokeless powder - primary explosives - preparation and uses of lead azide - mercury fulminate - high explosives - picric acid - dynamite	3	Gain knowledge about the classification of explosives	Lecture and discussion	Formative assessment II

V	Paints and Pigments					
	1	Paints - general characteristics - constituents - pigment - vehicle - thinners - driers - plasticizers - fillers - anti-skinning agents - mechanism of film formation - paint removers - constituents.	3	Gain knowledge about the characteristics and constituents of paints.	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz
	2	Pigments - manufacture of white lead - lithopone - titanium dioxide - ultra marine blue - red lead - chrome yellow- Prussian blue.	3	Know the methods of manufacturing pigments.	Peer group teaching	Formative assessment I

Course Instructor: Dr. S. Ajith Sinthuja

HOD: Dr. G. Leema Rose

**Semester – III**  
**Major Core – III : GENERAL CHEMISTRY - III**  
**Course Code: CC2031**

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

**Objectives**

- To gain knowledge on aromaticity, aromatic compounds and electrophilic substitution reactions.
- To understand the characteristics of (Group 13 and 14) Group 14 and 15)
- To gain knowledge on different colloids and photochemical processes

**Course Outcome**

COs	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive Level
CO - 1	gain knowledge on aromatic compounds	PSO -1	U
CO - 2	synthesize aromatic compounds	PSO -4	Ap
CO - 3	remember the characteristics of group 13 and 14 elements	PSO -2	U
CO - 4	predict the chemistry of nitrogen and oxygen family	PSO -2	E
CO - 5	to understand the different colloidal systems	PSO -1	Ap
CO - 6	explain the various photochemical processes	PSO -1	U

**Total Contact hours: 60 (Including lectures, assignments and tests)**

Unit	Module	Topic	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
I	<b>Aromatic Compounds</b>					
	1	Aromaticity - definition - Huckel's rule - consequence of aromaticity-structure of benzene - stability, carbon-carbon bond lengths in benzene ring - resonance energy	3	Understand about aromaticity, stability of benzene and resonance energy	Lecture and discussion	Evaluation through Multiple choice questions, short test, quiz
	2	Aromatic electrophilic substitution - general pattern of the mechanism involving $\sigma$ and $\pi$ complexes, mechanism of nitration, halogenation, sulphonation	3	Know about Aromatic electrophilic substitution reactions	Lecture and discussion	Formative assessment I

	3	Mercuration, formylation and Friedel-Crafts reaction - Energy profile diagrams. Activating and deactivating substituents - orientation in mono substituted benzenes	2	Gain knowledge about activating and deactivating substituents	Lecture	
	4	Reactions of aromatic side chain - halogenation and oxidation - methods of formation and Chemical reactions of alkylbenzenes	2	Know about reactions of aromatic compounds	Lecture	
	5	Biphenyl, naphthalene and anthracene - synthesis of 3-nitrotoluene, 4-bromonitro benzene, 4-bromoacetophenone, 3-(4-nitrophenyl)prop-1-ene, 3-nitrostyrene	2	Understand about the synthesis of benzene compounds	Question answer session and lecture	
<b>II</b>	<b>p-block elements – Boron and Carbon family (Group 13 and 14)</b>					
	1	General characteristics of elements of Group 13 - extraction of boron physical and chemical properties of boron	3	Know about characteristic, extraction and properties of boron	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Compounds of boron - borax, boric acid, diborane, boron nitride-extraction of Al -physical and chemical properties - uses	3	Know the compounds of boron along with uses	Lecture and illustration	
	3	Compounds of aluminium -Al <sub>2</sub> O <sub>3</sub> , AlCl <sub>3</sub> , alums - alloys of Aluminium. General characteristics of elements of Group 14 - allotropic forms of carbon - structure of graphite, diamond and fullerene	3	Understand clearly about the Allotropic forms of carbon	Lecture and discussion	
	4	Chemistry of charcoal-chemistry of oxides of carbon-preparation of silicon - physical and chemical properties of Si - uses -oxides of silicon - structures of silicates - chemistry of silicones	2	Study about chemistry of silicones	Lecture and discussion	

	5	Manufacture of glass - types of glasses - ceramics - extraction of lead - physical and chemical properties - uses - lead pigments	2	Understand about the extraction, properties and uses of lead	Question answer session and lecture	
III	<b>p-block elements – Nitrogen and Oxygen family (group 15 and 16)</b>					
	1	General characteristics of elements of group 15 - Preparation of nitrogen - physical and chemical properties of nitrogen – uses	2	Know about Characteristic, extraction, properties and uses of nitrogen	Lecture and illustration	Evaluation through Multiple choice questions, short test, quiz
	2	Chemistry of nitrogen - hydrazine, hydroxylamine, hydrazoic acid, nitric acid - nitrogen cycle. Preparation, physical and chemical properties and uses of phosphorus	3	Learn about chemistry of nitrogen compounds	Lecture and illustration	Formative assessment II
	3	Chemistry of $\text{PH}_3$ , $\text{PCl}_3$ , $\text{PCl}_5$ , $\text{POCl}_3$ , $\text{P}_2\text{O}_5$ and oxyacids of phosphorous - phosphate fertilizers - super phosphate of lime-triple super phosphate	1	Analyse the effects of phosphate fertilizers and super phosphate	Lecture	
	4	Oxides of nitrogen and Phosphorous - oxoacids of nitrogen and phosphorus. Anomalous behavior of oxygen - allotropy of oxygen and phosphorous	3	Know about allotropy of oxygen and its anomalous behaviour	Lecture with power point Illustration	
	5	Structure of ozone, oxides - peroxides, suboxides, basic oxides, amphoteric oxides, acidic oxides, neutral oxides - oxides of sulphur - oxoacids of sulphur - sulfuryl compounds - extraction - uses - selenium and tellurium	3	Understand about oxides and oxoacids of sulphur	Question answer session and lecture	

IV	Colloids					
	1	Definition -classifications - lyophobic and lyophilic colloids - differences. True solutions, colloidal solutions and suspension - definition and characteristics	3	Know about true, colloidal solutions and suspensions	Lecture	Evaluation through Multiple choice questions, short test, quiz
	2	Preparation of colloidal solutions - dispersion methods and condensation methods- purification of colloidal solutions- optical properties-Tyndall effect	3	Understand about different methods of colloidal solutions	Lecture and discussion	Formative assessment II
	3	Kinetic properties - Brownian motion- electrical properties- Helmholtz and diffuse double layers - electro kinetic or zeta potential - electrophoresis - applications -coagulation	3	Acquire knowledge about kinetic and electric properties	Lecture	
	4	Methods- Hardy Schultz law -Hofmeister series - protective colloids - protective action - gold number -applications	2	Know about methods of colloids	Lecture and discussion	
	5	Emulsions - classification, preparation, Gels - preparation - properties - thixotropy -syneresis- imbibitions - application of colloids	1	Study about emulsions, gels and applications of colloids.	Lecture with power point presentation	
V	<b>Photo Chemistry</b>					
	1	Introduction-comparison of thermal and photochemical reactions Laws of photochemistry - Beer-Lamberts law- Grothus-Drapper law - Stark-Einstein law of photochemical equivalence	3	Know about the Laws of photochemistry	Lecture and discussion	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I

2	Quantum efficiency - determination of quantum efficiency - chemical actinometry -consequence of light absorption - Jablonski diagram	3	Gather knowledge regarding quantum efficiency and Jablonski diagram	Lecture
3	Radiative and non-radiative transitions- primary and secondary processes- fluorescence- phosphorescence – photochemical reactions	1	Understand about primary and secondary processes	Lecture and Illustration
4	Photochemical rate law- kinetics of photochemical combination of H <sub>2</sub> and Cl <sub>2</sub> , H <sub>2</sub> and Br <sub>2</sub> and decomposition of HI – energy transfer in photochemical reactions	2	Learn about kinetics of photochemical reactions.	Lecture and Discussion
5	Photosensitization - photosynthesis in plants – chemiluminescence - thermoluminescence- bioluminescence. Lasers- principle-types- applications.	2	Know about different types of lasers	Lecture with power point presentation

Course Instructor: Dr. G. Leema Rose

HOD: Dr. G. Leema Rose

**Semester - III**  
**Major Elective I a– Pharmaceutical Chemistry**  
**Course Code: CC2032**

Hours / Week	Credits	Total hours	Marks
4	3	60	100

**Objectives:**

- To understand the classification, sources, design and action of common drugs.
- To impart knowledge on various diseases and treatment.

**Course Outcome**

CO	<i>Upon completion of this course, the students will be able to:</i>	PSO addressed	Cognitive level
CO-1	to understand the characteristics, classification and sources of drugs	PSO-1	U
CO-2	interpret the chemical structure and pharmacological activities of drugs	PSO-3	E
CO-3	compare the action of various drugs	PSO-2	An
CO-4	design common drugs and interpret their therapeutic uses	PSO-5	Ap
CO-5	identify common diseases, their causes and treatment	PSO-2	An

**Total Contact hours: 60 (Including lectures, assignments and tests)**

Unit	Module	Topics	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Classification and sources of drugs</b>					
	1	Important terminologies used in pharmaceutical chemistry - pharmacy - pharmacology - pharmacodynamics - pharmacokinetics- pharmacophore-metabolites- antimetabolites-actionmycetes- chemotherapy-pharmacopoeia- pharmacognosy- pharmacotherapeutics	3	Gain knowledge about the various terminologies used in pharmaceutical chemistry	Lecture	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Classification of drugs -drugs acting on central and peripheral nervous system- chemotherapeutic drugs - pharmacodynamic agents	2	Understand the action of drugs and classify them	Lecture	



	3	Drugs for metabolic diseases and endocrine function. Nature and sources of drugs - various sources of drugs	2	Know the sources, nature, functions of drugs	Lecture with power point presentation	
	4	Drug development -pre-clinical and clinical trials	3	Understand the various steps involved in drug development	Lecture	
	5	Patenting and legal issues - chemical and process development	2	Gain knowledge about the importance of patenting	Lecture with power point presentation	
<b>II</b>	<b>Drug Design and chemicals in medicine</b>					
	1	Introduction- physical and chemical properties of drugs	3	Recall the physical and chemical properties of drugs	Question answer session	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Designing of drugs procedures followed lead component methods of lead discovery lead modification	3	Understand the steps involved in designing of drugs	Lecture	
	3	Prodrugs types-applications drawbacks soft drug advantages. Physical and chemical factors of drug design	2	Explain about prodrugs	Lecture with group discussion	
	4.	Chemical structure and pharmacological activities of drugs	2	Draw the structure of various drugs	Group discussion	
	5.	Preparation, properties and uses of alum-aluminium hydroxide gel -phosphoric acid -arsenous anhydride-ferrous fumarate – ferric ammonium citrate - mercury with chalk (Grew powder)	2	Understand the methods of preparing drugs and recall their properties and uses	Lecture method	
<b>III</b>	<b>Drug Action and Metabolism of drugs</b>					
	1	General principles - assay of drugs - biological assay	2	Get idea about general principles and assay of drugs	Seminar	Evaluation through Multiple choice questions,

	2	Absorption - drug distribution - drug metabolism	2	Predict the mechanism of drug absorption	Lecture and power point presentation	short test, quiz Formative assessment II
	3	Biological role of salts of sodium, potassium, calcium, zinc and iodine. Agonist and antagonist. Receptor forces - types - theories	3	Recognize the role of salts in drugs	Lecture	
	4	Mechanism of drug action - actions at extra cellular site - actions at cellular site. Mechanism of different types of drug action	2	Write the mechanisms of drug action	Lecture	
	5	Time response relationships - dose response relationship - biotransformation of drugs. Metabolism of drugs - oxidation -reduction -hydrolysis - conjugation	3	Know the metabolism of drugs	Lecture	
<b>IV</b>	<b>Common Drugs</b>					
	1	Antibacterial drugs -preparation and therapeutic uses of sulpha drugs - sulphanilamide - sulphadiazine - sulphathiazole- sulphafurazole -prontosil. Mechanism of action of sulpha drugs	3	Know about antibacterial drugs	Lecture and Seminar	Evaluation through Multiple choice questions, short test, quiz Formative assessment II
	2	Antibiotics - classification based on chemical structure and biological action - structure and therapeutic uses of chloramphenicol - Penicillin - Streptomycin - Tetracyclin - Erythromycin	3	Know the importance of antibiotics	Lecture and group discussion with power point	
	3	Antiseptics and Disinfectant- distinction between antiseptics and disinfectants. Disinfectant- definition - examples - phenol -preparation and uses -chloroxylenol- structure - properties and uses. Antiseptics- Chloramine T - preparation and uses -crystal violet -structure and uses	3	Differentiate and know the importance of antiseptics and disinfectants.	Lecture	

	5	Antipyretics - definition - examples - aspirin -methyl salicylate -paracetamol, phenacetin - preparation and therapeutic uses	3	Understand the importance of antipyretics	Lecture	
<b>V</b>	<b>Common diseases and treatment</b>					
	1	Insect borne diseases - malaria and filariasis. Airborne diseases - diphtheria-influenza and TB. Waterborne diseases - cholera and typhoid	2	Know about insects borne diseases	Lecture and discussion	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Blood pressure - definition- factors affecting blood pressure- systolic pressure - diastolic pressure - pulse pressure - blood pressure levels. Hyper tension- types - control antihypertensive agents. Hypotension - measurement	3	Understand the reasons and methods of treating blood pressure	Lecture with power point presentation	
	3	Anaemia - symptoms and causes - types - antianaemic drugs - types	3	Realize the causes and symptoms of anaemia	Lecture and group discussion	
	4	Cardio-vascular drugs cardiac-glycosides- cardiovascular action - antiarrhythmic drugs- functions -therapeutic uses	2	Gain knowledge about cardio - vascular drugs	Lecture with power point presentation	
	5	Vasodilators or vasopressor - definition- examples - antianginal drugs -example. Cancer -causes -antineoplastic agents-cis-platin-vinblastine and mustine	2	Explain the importance of vasodilators and antineoplastic drugs	Lecture	

Course Instructor: Ms. L. Deva Vijila

HOD: Dr. G. Leema Rose

**Allied Chemistry for Physics Major**  
**Semester III**  
**Inorganic and Physical Chemistry**  
**Course Code: CA2031**

Hours / week	Credits	Total hours	Marks
4	4	60	100

**Objectives**

1. To acquire knowledge on atomic structure and bonding
2. To know about metallurgy and the structure of solids
3. To understand the principles of nuclear reactions

**Course Outcome**

CO	<i>Upon completion of this course, the students will be able to:</i>	PSO addressed	Cognitive level
CO-1	remember the structure and bonding in atoms and molecules	PSO-1	R
CO-2	know about different types of bonding	PSO-2	Y
CO-2	understand the metallurgical processes and the methods of purification of metals	PSO-6	A
CO-3	understand the concepts of solid state chemistry and nuclear chemistry	PSO-1	U

**Total Number of Contact hours: 60 (Including lectures, assignments and tests)**

Unit	Module	Topics	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Atomic Structure</b>					
	1	Dual nature of electron - de-Broglie equation	2	Acquire knowledge on Dual nature of electron and de-Broglie equation	Lecture and power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Davisson and Germer experiment	1	Learn Davisson and Germer experiment	Lecture and power point presentation	
	3	Heisenberg's uncertainty principle and its significance.	1	Understand Heisenberg's uncertainty principle and its significance	Lecture and power point presentation	
	4	Compton effect - Schrodinger's wave equation and its significance	1	Understand Schrodinger's wave equation	Lecture and power point presentation	
	5	eigen values and eigen functions	1	Distinguish eigen values and eigen functions	Lecture and power point presentation	

	6	quantum numbers and their significance	2	Understand the various quantum numbers	Lecture and power point presentation	
	7	Atomic orbitals - shapes - significance - difference between orbit and orbital	1	Differentiate between orbit and orbital	Lecture and power point presentation	
	8	Rules for filling up of orbitals - Pauli's exclusion principle - Aufbau principle - Hund's rule	2	Know about different principle Governing the filling up of orbitals	Lecture and power point presentation	
	9	Electronic configuration of elements	1	Know about the filling up of atomic orbital	Lecture and power point presentation	
<b>II</b>	<b>Chemical bonding</b>					
	1	Ionic bond, formation of ionic bond, general characteristics of ionic compounds	1	Know about ionic bond and its characteristics	Lecture and power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Lattice energy, Born-Haber cycle and its applications	1	Understand Lattice energy	Lecture and power point presentation	
	3	Covalent bond, formation of covalent bond with examples, general characteristics of covalent compounds	1	Gain knowledge about covalent bond	Lecture and power point presentation	
	4	Ionic character in covalent compounds, M.O. theory	1	Acquire knowledge about Ionic character	Lecture and power point presentation	
	5	Fajan's rule. percentage of ionic character and bond moment	1	Understand Fajan's rule	Lecture and power point presentation	
	6	bonding, antibonding and non-bonding molecular orbitals	1	Explicate the difference between bonding, antibonding and non-bonding molecular orbitals	Lecture and power point presentation	
	7	M.O diagram of H <sub>2</sub> , N <sub>2</sub> , O <sub>2</sub> and F <sub>2</sub> , bond order	2	Draw the M.O diagram of H <sub>2</sub> , N <sub>2</sub> , O <sub>2</sub> and F <sub>2</sub>	Lecture and power point presentation	
	8	Coordinate bond - formation of coordinate bond with examples	1	Understand Coordinate bond formation	Lecture and power point presentation	

	9	Metallic bond, band theory, conductors, insulators and semiconductors	1	Explicate the difference between conductors, insulators and semiconductors	Lecture and power point presentation	
	10	Hydrogen bonding types - inter and intramolecular, effect of hydrogen bonding	2	Understand Hydrogen bonding and its effect	Lecture and power point presentation	
<b>III</b>	<b>Metallurgy and Alloys</b>					
	1	Difference between minerals and ores, metallurgical processes, gravity separation and magnetic separation	3	Differentiate minerals and ores	Lecture and power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Froth floatation process, roasting, calcination, smelting	1	Understand various ore dressing methods	Lecture and power point presentation	
	3	purification of metals, electrolytic refining and zone refining	1	Understand various purification methods	Lecture and power point presentation	
	4	Van - Arkel de-Boer process, Kroll's process. Extraction and uses of Ti ,V, W and Mo	2	Understand the extraction of metals	Lecture and discussion	
	5	Purpose of making alloys, types of alloys - ferrous alloys and non-ferrous alloys and preparation of alloys	2	Gain knowledge on alloys.	Lecture and power point presentation	
	6	Heat treatment of alloys, composition and uses of bronze and german silver	1	Understand the types of alloys.	Lecture and discussion	
	7	Nichrome, monel metal, stainless steel, gun metal and bell metal	2	Gain knowledge on types of metals.	Lecture and discussion	
<b>IV</b>	<b>Solid State Chemistry</b>					
	1	Amorphous and crystalline solids, difference between amorphous and crystalline solids	2	Differentiate amorphous and crystalline solids	Lecture and power point presentation	Evaluation through Multiple choice questions, short test,

	2	Isotropy and anisotropy, elements of symmetry, plane of symmetry, axis of symmetry, centre of symmetry and law of rational indices	2	Understand various symmetry elements	Lecture and power point presentation	quiz  Formative assessment II
	3	Miller indices and elements of symmetry of a cubic crystal	1	Gain knowledge on miller indices	Lecture and power point presentation	
	4	Point groups and seven basic crystal system, Bravais lattice	2	Understand basic crystal system.	Lecture and power point presentation	
	5	Bragg's equation-derivation, determination of crystal structure by powder method	3	Gain knowledge on determination of crystal structure	Lecture and power point presentation	
	6	Structure of crystals - diamond, graphite and fullerene. Imperfections in a crystal - Point defect, Schottky defect, Frenkel defect, metal excess defect, metal deficiency defect	2	Understand the structure of graphite and diamond	Lecture and power point presentation	
<b>V</b>	<b>Nuclear Chemistry</b>					
	1	Nuclear forces, nuclear size, atomic mass unit, N/P ratio, packing fraction, mass defect and binding energy	2	Understand packing fraction and binding energy	Lecture and power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Radioactivity - $\alpha$ , $\beta$ , $\gamma$ radiations and properties, Soddy's group displacement law	1	Knowledge on $\alpha$ , $\beta$ and $\gamma$ radiations	Lecture and power point presentation	
	3	Natural radioactivity - detection and measurement of radioactivity by Geiger-Muller method	2	Know the detection and measurement of radioactivity	Lecture and power point presentation	
	4	Rate of radioactive disintegration, decay constant, half-life period and average life period	1	Gain knowledge on decay constant and half life	Lecture and power point presentation	

5	Nuclear reactions - nuclear fission, principle of atom bomb, nuclear reactor, radioactive hazards and disposal of radioactive waste from nuclear reactors	2	Understand the types of nuclear reactions and nuclear hazards	Lecture and power point presentation	
6	Nuclear fusion - principle of hydrogen bomb and stellar energy	1	Understand hydrogen bomb	Lecture and power point presentation	
7	Principle and working of cyclotron. Applications of radio activity	2	Gain knowledge on cyclotron	Lecture and power point presentation	
8	Radioactive tracers in agriculture, medicine and industry. Radiocarbon dating	1	Gain knowledge on various applications of radioactivity	Lecture and power point presentation	

Course Instructor: Dr. M. Anitha Malbi

HOD: Dr. G. Leema Rose



**Semester - IV**  
**Core IV: General Chemistry IV**  
**Course Code: CC2041**

Hours / week	Credits	Total hours	Marks
4	4	60	100

**Objectives**

- To study the preparation and chemical reactions of alkyl and aryl halides, alcohols, phenols, ethers and epoxides with mechanism
- To know the chemistry of halogens and noble gases.
- To understand the basics of first and second law of thermodynamics and related relationship.

**Course outcome**

COs	<i>Upon completion of this course, the students will be able to:</i>	PSO addressed	Cognitive level
CO - 1	know the mechanism of important name reactions	PSO - 1	U
CO - 2	apply the reaction mechanisms in the synthesis of components used in industrial and medicinal fields	PSO - 2	An
CO - 3	evaluate the characteristics of halogens and noble gases	PSO - 3	E
CO - 4	classify the non-aqueous solvents and know the theories of acids and bases	PSO - 3	E
CO - 5	list out the applications of first and second law of thermodynamics	PSO - 3	R

**Total Contact hours: 60 (Including lectures, assignments and tests)**

Unit	Module	Topic	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
I	<b>Haloalkanes and Haloarenes</b>					
	1	Classification of alkyl halides, methods of formation from alcohols, alkanes, alkenes. Allylic/ benzylic bromination and chlorination	2	Understand the preparation and properties of alkyl halides	Lecture and discussion	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Hundiecker reaction, Finkelstein reaction and Swart's reaction	2	Know about the mechanisms of the reactions	Lecture and discussion	

	3	Nucleophilic substitution reactions and its mechanisms. $S_N2$ and $S_N1$ reactions with energy profile diagrams and its difference	2	Gain knowledge about the nucleophilic substitution reactions	Lecture	
	4	Dehydrohalogenation with mechanism, Hoffmann and Saytzeff's rules, Reaction with metals, Wurtz reaction and formation of Grignard reagent	2	Understand the mechanisms of named reactions and formation of Grignard reagent	Lecture	
	5	Methods of formation of aryl halides - nucleophilic substitution reactions of aryl halides - addition-elimination and the elimination-addition mechanisms	2	Understand the preparation and properties of alkynes	Question answer session and lecture	
	6	Electrophilic substitution - Ullmann reaction and Wurtz-Fittig reaction. Relative reactivities of alkyl, allyl, vinyl and aryl halides	1	Study the synthesis of compounds	Lecture and discussion	
	7	Synthesis and uses of DDT and BHC	1	Know the synthesis and uses of some compounds	Lecture and discussion	
<b>II</b>	<b>Alcohols, Phenols and Ethers</b>					
	1	Preparation of alcohols through reduction, hydroboration, hydration, oxymercuration and Grignard reaction	2	Know about preparation and reactions of alcohols	Lecture with illustration	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I

	2	Reactions of alcohol with metals, esterification with mechanism, oxidation, dehydration, conversion to alkyl halides	2	Understand the reactions of alcohol with metals	Lecture with illustration	
	3	Preparation of Phenols its acidity and relative acid strength of substituted phenols	2	Understand clearly about the reactions and synthesis of compounds	Lecture and discussion	
	4	Reactions of phenols - esterification, oxidation, Kolbe's, Reimer-Tiemann, Gattermann, electrophilic substitution reactions	2	Study the reactions of phenols	Lecture and discussion	
	5	Dihydric and trihydric phenols- preparation and properties	2	Know about the preparation and properties of dihydric and trihydric phenols	Lecture and illustration	
	6	Preparation of ethers, reactions with epoxide. Synthesis of aspirin, 3 and 4-nitro phenol and t-butylmethyl ether	2	Learn the preparation of ethers and its reactions with epoxide	Lecture and discussion	
<b>III</b>	<b>Halogen family and Noble gases</b>					
	1.	General characteristics of halogen with reference of electro negativity, electron affinity, oxidation states, and oxidizing power	2	Understand clearly about the general characteristics of halogen	Lecture with illustration	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2.	Peculiarities of fluorine its hydrides and oxides oxo acids of halogens	2	Learn about peculiarities of fluorine compounds	Lecture with illustration	

	3.	Interhalogen compounds, polyhalide ions, pseudohalogens, preparation, properties and structure of interhalogen compounds	2	Analyse the properties and structure of interhalogen compounds	Lecture	
	4.	Inert gases , position in the periodic table , isolation from atmosphere , General characteristics, Structure and shape of xenon compounds $\text{XeF}_2$ , $\text{XeF}_4$ , $\text{XeF}_6$ , $\text{XeOF}_2$ , $\text{XeOF}_4$ its uses of noble gases	2	Know the characteristics, structure and shape of Inert gases	Lecture with power point presentation	
	5.	Protic & Aprotic solvents, non-aqueous solvents, Classification of solvents, General properties of ionizing solvents-chemical reactions. Liquid ammonia and liquid $\text{SO}_2$ as solvents	2	Learn about protic & aprotic solvents its classification and general properties	Lecture and discussion	
	6.	Acid Base Chemistry, Theories of acids and bases, Arrhenius, Bronsted, Lowry theory proton donor - acceptor system. HSAB principle and Usanovich concept	2	Know the various theories of acids and bases	Lecture and discussion	
<b>IV</b>	<b>First Law of Thermodynamics and Hess's law</b>					
	1.	Chemical thermodynamics, importance of thermodynamics, basic terms- system, boundary and surroundings. Types of systems - open, closed and isolated	2	Know the importance of thermodynamics	Lecture	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II

2.	Types of processes - isothermal, adiabatic, isobaric and isochoric, reversible and irreversible process. Difference between reversible and irreversible process. First law of thermodynamics- mathematical form	2	Understand the different types of processes	Lecture and discussion
3.	Heat capacity of a system, heat capacity at constant volume ( $C_v$ ) and heat capacity at constant pressure ( $C_p$ ), relationship between $C_p$ and $C_v$ . Calculations of $w$ , $q$ , $dE$ and $dH$ for the reversible expansion of ideal gases under isothermal and adiabatic conditions	2	Acquire knowledge heat capacity of a system	Lecture
4.	Joule- Thomson effect, derivation of Joule- Thomson coefficient for ideal gases and real gases, inversion temperatures	2	Derive Joule- Thomson coefficient	Lecture and discussion
5.	Hess's law and its applications. Variation of enthalpy change of reaction with temperature (Kirchoff's equation)	2	Understand the variation of enthalpy	Lecture
6.	Second law of thermodynamics, Need for second law, statements of Second law, Carnot theorem, Carnot cycle, Efficiency of heat engine	2	Study the need for second law of thermodynamics	Lecture and power point presentation

V Thermodynamics – II						
1.	Third law of thermodynamics, concept of entropy, State function, entropy change in isothermal expansion of ideal gas, entropy change in reversible and irreversible process	2	Know about the Third law of thermodynamics and the concept of entropy	Lecture, Discussion	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I	
2.	Entropy change accompanying by change of phase, calculation of entropy change of an ideal gas with changes in pressure, volume and temperature, Entropy of mixing	2	Gather knowledge on entropy change accompanying change of phase	Lecture		
3.	Physical significance of entropy. Gibbs free energy , Work function, Variation of free energy change with temperature and pressure , Criteria for spontaneity , Gibbs Helmholtz equation	2	Understand the physical significance of entropy	Lecture, Illustration		
4	Partial molar properties, Clapeyron Clausius equation and its applications. Van't Hoff reaction isotherm and its significance	2	Learn Clapeyron Clausius equation, Van't Hoff reaction and its applications.	Lecture, Discussion		
5	Van't Hoff isochore and significance. Fugacity, concept , determination of fugacity of real gases	2	Gain knowledge on Van't Hoff isochore and fugacity	Lecture		

	6	Variation of fugacity with temperature and pressure. Physical significance of fugacity. Activity, activity coefficient Nernst Heat theorem and its applications. Zeroth law of thermodynamics	2	Understand the variation of fugacity with temperature and pressure	Lecture, Discussion	
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Course Instructor: Sr. K. Francy

HOD: Dr. G. Leema Rose

**Semester – IV**  
**Elective II a - Green Chemistry**  
**Course Code: CC2042**

Hours / week	Credits	Total hours	Marks
4	3	60	100

**Objectives**

1. To know the principles of green chemistry.
2. To study the important techniques and green synthesis of compounds.
3. To study the concept of atom economy in chemical synthesis.

**Course outcome**

COs	<i>Upon completion of this course, the students will be able to:</i>	PSO addressed	Cognitive level
CO - 1	know the principles of green chemistry	PSO - 1	R
CO - 2	design green synthesis	PSO - 5	C
CO - 3	interpret green method for organic synthesis	PSO - 3	E
CO - 4	synthesize various compounds by microwave and ultrasound assisted methods	PSO - 4	C
CO - 5	analyze the important techniques and directions in practicing green chemistry	PSO - 2	An
CO - 6	identify the importance of Green chemistry in day to day life	PSO - 8	Ap

**Total Contact hours: 60 (Including lectures, assignments and tests)**

Unit	Module	Topics	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Introduction to green chemistry</b>					
	1	Definition, need for green chemistry and scope of green chemistry	2	Know the need for green chemistry	Lecture with power point presentation and group discussion	Evaluation through Multiple choice questions, short test, quiz
	2	Concept of atom economy, yield, mass intensity and atom economy. Calculation of atom economy, mass intensity, mass productivity and carbon efficiency	4	Calculate the atom economy, mass intensity, mass productivity and carbon efficiency	Seminar	Formative assessment I
	3	Different types of reactions and atom economy, addition, substitution, elimination and rearrangements	2	Differentiate the types of reactions	Illustration and seminar	



	4	Concept of selectivity, enantioselectivity and chemoselectivity	2	Understand the concept of selectivity	Lecture with power point presentation	
	5	Regioselectivity and diastereoselectivity	2	Know the different types of selectivity	Lecture and group discussion	
<b>II</b>	<b>Green solvent</b>					
	1	Super critical fluids, Introduction, extraction of super critical fluids, solvents of super critical fluid, advantages and applications Carbon dioxide as a super critical fluid	4	Learn the extraction and advantages of super critical fluids	Question answer session	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Features of technique for using super critical carbon dioxide, advantages and application. Chemical reaction in supercritical water and Near, Critical Water (NCW), Region	4	Understand the features of technique for using super critical carbon dioxide	Lecture	
	3	Extraction natural products, dry cleaning, supercritical polymerization, hydrogenation and hydroformylation. Ionic liquid as green solvent: Introduction, synthesis of ionic liquids, acidic ionic liquid and neutral ionic liquids, applications in organic synthesis	4	Know the process of extraction of natural products and applications	Lecture with power point presentation and group discussion	
<b>III</b>	<b>Green catalyst</b>					
	1	Catalysis over view, acid catalyst, basic catalyst, oxidation catalyst, polymer supported catalyst, photosensitized super acid catalyst and Tetra Amido Macrocylic Ligand (TAML) catalyst	3	Understand the different types of catalyst	Seminar	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II

	2	Biocatalyst, microbial oxidation, microbial reduction, enzyme catalyzed hydrolytic process, per fluorinated catalyst and modified biocatalyst	4	Know the action of Biocatalyst	Assignment	
	3	Development of mesoporous supports by liquid crystal templating, neutral templating methods, heterogeneous catalyst, solid supported catalyst	5	Compare the Development of mesoporous supports by various methods	Lecture with power point presentation and group discussion	
<b>IV</b>	<b>Green synthesis</b>					
	1	Green synthesis of the following compounds, Adipic acid, Catechol, Benzoyl bromide, Acetaldehyde, Citral, Ibruprofen and Paracetamol	3	Synthesize different compounds by Green synthesis method	Illustration and seminar	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Microwave assisted reactions in water, Hoffmann Elimination, Hydrolysis of benzyl chloride and methyl benzoate, oxidation of toluene and alcohols	3	Learn the different microwave assisted reactions in water	Lecture and group discussion	
	3	Microwave assisted reactions in organic solvents, Esterification, Fries rearrangement, Claisen Rearrangement, Diels - Alder Reaction and Decarboxylation	3	Understand the different microwave assisted reactions in organic solvents	Lecture with power point presentation	
	4	Ultra sound assisted reactions, Esterification, Saponification, alkylation, oxidation, reduction, coupling reactions and Cannizaro reactions	3	Learn the different ultra sound assisted reactions	Lecture and illustration	
<b>V</b>	<b>Green reactions involving basic principle of green chemistry</b>					
	1	Twelve principles of green chemistry - choice of starting materials - biomimetic, multifunctional reagents materials reagents.	4	Know the twelve principles of green chemistry	Lecture, Quiz	Evaluation through Multiple choice questions, short test, quiz  Formative

	2	Combinatorial green chemistry, Green Chemistry in sustainable developments	4	Understand the importance of Green Chemistry in sustainable developments	Lecture with power point presentation	assessment I
	3	Importance of Green chemistry in day to day life, versatile bleaching agents and analgesic drugs	4	Learn the Importance of Green chemistry in day to day life	Lecture and group discussion	

Course Instructor: Dr. S. Ajith Sinthuja

HOD: Dr. G. Leema Rose

**Allied Chemistry for Physics Major**  
**Semester IV**  
**Physical Chemistry**  
**Course Code: CA2032**

Hours / week	Credits	Total hours	Marks
4	4	60	100

**Objectives**

1. To understand the basic concepts of thermodynamics and nano chemistry
2. To enable them to apply concepts related to chemistry in their careers
3. To know the basic principles of kinetics and photochemistry

**Course Outcome**

COs	<i>Upon completion of this course, the students will be able to:</i>	PSO addressed	Cognitive level
CO-1	remember the theories and the factors influencing rate of reaction	PSO-1	R
CO-2	understand the laws and theories that govern photochemistry	PSO-1	U
CO-3	apply the principles of physical properties for structural determination	PSO-6	A
CO-4	understand the different laws of thermodynamics	PSO-1	U
CO-5	analyse the importance of nano chemistry in various fields	PSO-2	Y

**Total Contact hours: 60 (Including lectures, assignments and tests)**

Unit	Module	Topics	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Thermodynamics</b>					
	1	Thermodynamics - importance - basic terms - system, boundary and surroundings - types of systems - open - closed - isolated - homogeneous and heterogeneous	2	Know about the basics in thermodynamics	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz
	2	Types of processes - isothermal, adiabatic, isobaric, isochoric, reversible and irreversible process- difference between reversible and irreversible process - state and path functions	2	Differentiate the different processes	Lecture with power point presentation	Formative assessment I

	3	First law of thermodynamics - different statements - mathematical derivation - heat capacity of a system - heat capacity at constant volume ( $C_v$ ) - heat capacity at constant pressure ( $C_p$ ) - thermodynamic relationship between $C_p$ and $C_v$	2	Derive the expressions for heat capacities	Lecture and power point presentation	
	4	Variation of enthalpy of a reaction with temperature - Kirchoff's equation, Joule Thomson effect	2	Learn about Joule Thomson effect	Lecture and seminar	
	5	Expression for Joule Thomson coefficient for an ideal gas and vanderwaal's gas - derivation - inversion temperature - significance	2	Know to derive expression for Joule Thomson coefficient for an ideal gas and vanderwaal's gas	Lecture with power point presentation	
	6	Second law of thermodynamics - need for second law of thermodynamics - different statements - Carnot's cycle	2	Learn Carnot's cycle	Lecture with power point presentation	
<b>II</b>	<b>Chemical kinetics</b>					
	1	Rate of reaction - expression of rate - factors influencing rate of reaction - order and molecularity of a reaction - definition and examples	3	Know about reaction rate and factors influencing rate of reaction	Question answer session	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Difference between order and molecularity - zero, first and second order reactions - examples derivation of rate constant and half-life period	3	Differentiate order and molecularity	Lecture	
	3	Methods of determining order of reaction - use of differential - integral - half-life method and Ostwald's methods	3	Learn about different methods of determining order of reaction	Lecture with power point presentation and group discussion	

	4	Arrhenius theory -concept of activation energy - effect of catalyst - calculation of energy of activation. Theories of reaction rates - collision theory of bimolecular gaseous reactions - activated complex theory	3	Know about activation energy	Lecture with power point presentation	
<b>III</b>	<b>Physical properties and structure determination</b>					
	1	Dipole moment - definition and expression for dipole moment - applications - molecular geometry - cis-trans isomerism and disubstituted benzene derivatives	2	Know about dipole moment and isomerism	Seminar and power point presentation	Evaluation through Multiple choice questions, short test, quiz
	2	Dia, para and ferro magnetism - magnetic susceptibility and magnetic moment - measurement using Guoy balance - application of magnetic properties	2	Learn about dia , para and ferro magnetism	Lecture and power point presentation	Formative assessment II
	3	Thermogravimetric analysis - principles - applications. Chromatography - classification	2	Know about thermogravimetric analysis	Lecture and power point presentation	
	4	Column chromatography - principle - experimental techniques - factors affecting column efficiency and applications	2	Gather knowledge regarding column chromatography	Power point presentation with videos	
	5	TLC principle - experimental techniques - advantages - limitations - applications. GC - principle - experimental techniques - applications	2	Distinguish between TLC and GC	Illustration, seminar and power point presentation	
	6	HPLC - principle and experimental techniques	2	Know about the principles of HPLC	Lecture and power point presentation	

IV	<b>Photochemistry</b>					
	1	Importance of photochemistry - difference between thermal and photochemical reactions - laws of photo chemistry - Beer-Lambert's Law - Grother's - Drapers law - Stark-Einstein's law	3	Understand about photo chemical laws.	Power point presentation with videos	Evaluation through Multiple choice questions, short test, quiz
	2	Quantum efficiency - electronic excitations - singlet and triplet states - Jablonski diagram - internal conversion - intersystem crossing	3	Know about electronic excitations	Lecture	Formative assessment II
	3	Fluorescence - phosphorescence - difference between fluorescence and phosphorescence	2	Differentiate between fluorescence and phosphorescence	Lecture	
	4	Types of photo chemical reactions based on quantum efficiency ( $\phi = 1, \phi < 1$ and $\phi > 1$ ) - primary and secondary process of photo chemical reaction - photo chemical rate law	2	Learn the types of photo chemical reactions	Lecture and power point presentation	
	5	Kinetics of photo chemical reactions - combination of H <sub>2</sub> and Cl <sub>2</sub> - decomposition of HI- photosensitization - photosensitizers - Chemiluminescence – bioluminescence. Lasers - principle - uses	2	Understand the kinetics of photo chemical reactions	Lecture and power point presentation	
V	<b>Chemistry of Nanomaterials</b>					
	1	Nanotechnology - introduction, fundamental principles - nano particles - size - nano particles of metals - semiconductors and oxides	3	Understand the fundamental principles of nanochemistry	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz

	2	Synthesis of nano sized compounds - reduction methods by sodium citrate and borohydride - Sol-gel method and chemical vapour deposition method - properties - optical and electrical	3	Gather knowledge regarding synthesis of nano particles	Lecture with videos	Formative assessment I
	3	Sol-gel method and chemical vapour deposition method - properties - optical and electrical	2	Learn about synthesis of nano particles	Seminar	
	4	Nano clusters - carbon nano tubes - single walled nano tubes and multi-walled nanotubes	2	Know about nano clusters and carbon nano tubes	Power point presentation and seminar	
	5	Properties of carbon nanotubes - applications - Application of nano chemistry in various fields	2	Understand the applications of nano chemistry	Lecture with videos	

Course Instructor: Dr. S. Ajith Sinthuja

HOD: Dr. G. Leema Rose



**Semester - V**  
**Major Core V: ORGANIC CHEMISTRY- I**  
**Course Code: CC2051**

Hours Per week	Credits	Total hours	Marks
5	5	75	100

**Objectives:**

- To understand symmetry elements, stereo isomerism and conformational analysis of organic compounds.
- To know the methods of synthesis and the reactions of carbonyl, nitrogen containing and heterocyclic compounds.

**Course Outcome**

COs	Upon completion of course students will be able to	PSO Addressed	Cognitive Level
CO - 1	understand the concept of optical activity, stereoisomerism and stereo isomers.	PSO-1	U
CO - 2	remember the preparation and synthesis of carbonyl, Nitrogen containing and heterocyclic compounds.	PSO-4	R
CO - 3	apply the synthetic methods to synthesize new compounds	PSO-4	A
CO - 4	analyze the synthetic importance of different organic compounds	PSO-2	An
CO - 5	create alternate routes to prepare new compounds.	PSO-5	C

**Total Hours: 75 (Including lectures, assignments and tests)**

Unit	Module	Topic	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Stereochemistry</b>					
	1	Optical activity-elements of symmetry, optical activity of compounds containing asymmetric carbon atoms - lactic and tartaric acids. Chirality-achiral carbon molecules - (+), (-) and D, L notations	2	Understand the concept of optical activity	Lecture with models	Evaluation through quiz, slip test, group discussion and problem solving
	2	Projection formulae - Newmann, Fischer, Flying wedge, Sawhorse and projection formulae notation for optical isomers, Cahn - Ingold and Prelog rules, R-S notation	3	Predict the projection formulae and R-S notation of optical isomers	Lecture and group discussion	

	3	Enantiomers and diastereomers, racemic and mesoforms. Racemisation-resolution of racemic mixtures. Walden inversion and asymmetric synthesis	2	Categorize optical isomers and define the racemization and asymmetric synthesis	Lecture	Formative assessment I
	4	Optical activity of compounds without asymmetric carbon atoms-biphenyl, allenes and spiranes	2	Illustrate the optical activity of biphenyls, allenes and spiranes	Lecture with power point presentation	
	5	Geometrical isomerism: Maleic and fumaric acid-aldoximes and ketoximes. Methods of distinguishing geometrical isomers, determination of configuration of ketoximes -Beckmann rearrangement, E-Z notation	3	Differentiate geometrical isomers and determine its E-Z notation	Lecture with power point presentation	
	6	Conformational analysis: Introduction of terms-configuration and conformation, dihedral angle, torsional strain, conformational analysis of ethane, n- butane, 1,2-dichloro ethane and cyclohexane	3	Describe the conformational analysis of simple organic compounds	Lecture with models	
<b>II</b>	<b>Carbonyl Compounds - I (Aldehydes and Ketones)</b>					
	1	Synthesis of aldehydes from acid chlorides, Stephen's reduction - Gattermann - Koch and Etard reactions	2	Synthesize aldehydes from the given reactions	Lecture	Evaluation through quiz, slip test and group discussion
	2	Synthesis of ketones from nitriles, dialkylcadmium, alkyl lithium and lithium dialkylcuprate and Friedel-Crafts and Hoesch reactions	3	Synthesize ketones from the given reagents and reactions	Lecture	
	3	Mechanism of nucleophilic additions to carbonyl group - addition of HCN, alcohols, thiols, sodium bisulfite, Grignard reagents - condensation with ammonia and its derivatives	2	Illustrate the mechanism of nucleophilic additions to carbonyl group	Lecture	Formative assessment I

	4	Aldol, Perkin, Benzoin and Knoevenagel condensations, Wittig reaction, Mannich reaction, Reformatsky reaction and Cannizzaro reaction	4	Explain the reactions of carbonyl compounds	Lecture	
	5	Oxidation by Tollen's reagent, $\text{KMnO}_4$ , hypohalite, $\text{SeO}_2$ and peracids. Reduction by $\text{H}_2/\text{Ni}$ , $\text{H}_2\text{-Pd-C}$ , $\text{NaBH}_4$ , $\text{LiAlH}_4$ , MPV, Clemmenson and Wolff-Kishner reductions, $\alpha$ , $\beta$ unsaturated aldehydes and ketones - preparation and reactions	4	Understand the oxidation and reduction reactions of carbonyl compounds	Lecture	
<b>III</b>	<b>Carbonyl Compounds – II (Carboxylic acids and their derivatives)</b>					
	1	Preparation of carboxylic acids, acidity of carboxylic acids, effects of substituents on acid strength, acidity of aliphatic and aromatic acids	3	Analyze the preparation and properties of carboxylic acids	Lecture with videos	Evaluation through class test, quiz and group discussion
	2	Reactions of carboxylic acids - Hell-Volhard-Zelinsky reaction, Synthesis of acidchlorides, esters and amides, Reduction of carboxylic acids, methods and mechanism of decarboxylation	3	Know the reactions of carboxylic acids	Lecture	Formative assessment II
	3	Methods of preparation and chemical reactions of halo acids - Hydroxy acids - malic, tartaric and citric acids - unsaturated monocarboxylic acids - dicarboxylic acids	3	Explain the preparation and properties of carboxylic acids	Lecture	
	4	Preparation and reactivity of carboxylic acid derivatives - acid chlorides, esters, amides and anhydrides - Mechanisms of esterification and hydrolysis - acid catalysed reactions	3	Describe the preparation and reactivity of carboxylic acid derivatives	Lecture	
	5	Relative stability of acyl derivatives interconversion of acid derivatives by nucleophilic acyl substitution	3	Understand the relative stability and interconversion of acid derivatives	Lecture with power point presentation	

<b>IV Nitrogen Containing Compounds</b>						
	1	Preparation of nitroalkanes and nitroarenes - Chemical reactions of nitroalkanes and nitroarenes - reduction in acidic, neutral and alkaline media	3	Compare the preparation and reactions of nitroalkanes and nitroarenes	Lecture	Evaluation through class test, quiz and group discussion  Formative assessment II
	2	Methods of preparation of alkyl and aryl amines - Ritter reaction, Hofmann ammonolysis - Hofmann degradation - Schmidt, Curtius reaction - Leuckart reaction - Ullmann reaction - Gabriel phthalimide reaction and Hofmann reaction	4	Illustrate the methods of preparation of alkyl and aryl amines	Lecture	
	3	Separation of a mixture of primary, secondary and tertiary amines - Hinsberg's and Hofmann's method	3	Understand the separation of primary, secondary and tertiary amines	Lecture with videos	
	4	Basicity of amines - basicity of aliphatic and aromatic amines - reactions of amines	2	Explain the basicity and reactions of aliphatic and aromatic amines	Lecture	
	5	Aryl diazonium salts – benzene diazonium chloride -preparation, reactions and synthetic transformations	3	Describe the synthetic transformations of aryl diazonium salts	Lecture	
<b>V Heterocyclic Compounds</b>						
	1	Aromatic characteristics of pyrrole, furan, thiophene and pyridine	2	Understand the aromaticity of heterocyclic compounds	Lecture	Evaluation through class test, quiz and group discussion
	2	Comparison of the basicity of pyridine, piperidine and pyrrole	2	Compare the basicity of heterocyclic compounds	Lecture with power point presentation	
	3	Methods of synthesis and chemical reactions with special emphasis on the mechanism of electrophilic substitution and mechanism of nucleophilic substitution reaction in pyridine derivatives	3	Analyze the mechanism of substitution reactions of pyridine derivatives	Lecture	Formative assessment I

	4	Preparation and reactions of indole, quinoline and isoquinoline - Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis	4	Explain the synthesis and reactions of indole, quinoline and isoquinoline	Lecture	
	5	Reactions and mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline	4	Describe the electrophilic substitution reactions of indole, quinoline and isoquinoline	Lecture and group discussion	

Course Instructor: Sr. K. Francy

HOD: Dr. M. Anitha Malbi

**Semester - V**  
**Major Core VI: INORGANIC CHEMISTRY- I**  
**Course code: CC2052**

Hours per week	Credits	Total hours	Marks
5	5	75	100

**Objectives**

- To understand the chemistry of transition, inner transition elements and organometallic compounds
- To know the nomenclature and isomerism in co-ordination compounds
- To learn the principles of analytical chemistry

**Course Outcome**

COs	<i>Upon completion of course students will be able to</i>	PSO Addressed	Cognitive Level
CO - 1	acquire knowledge on transition and inner transition elements	PSO – 1	U
CO - 2	name the co-ordination compounds	PSO – 5	R
CO – 3	analyse the nature of bonding in co-ordination and organometallic compounds	PSO – 2	An
CO – 4	predict the geometry and colour and spin of co-ordination compounds	PSO – 4	E
CO – 5	minimize the errors in chemical analysis	PSO – 2	A

**Total Contact hours: 75 (Including lectures, assignments and tests)**

Unit	Module	Topics	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>d and f-block Elements</b>					
	1	General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties and ability to form complexes	3	Know about the group trends	Lecture and power point presentation	Evaluation through short test, assignment quiz  Formative assessment I
	2	Difference between the first, second and third transition series. Extraction, properties and uses of Ti, V, Mo and W. Toxicity of Cd and Hg - oxides, mixed oxides, halides, and oxohalides of transition metals	3	Differentiate between different transition series	Lecture and power point presentation	

	3	Synthesis, reactivity and uses of vanadates, chromates, dichromate, molybdates, tungstates, tungsten bronzes, manganate, permanganate, ferrocyanide, ferricyanide, platinum(IV)chloride, chloroplatinic acid and purple of Cassius	3	Know about different salts	Illustration and lecture	
	4	Interstitial compounds - nitrides, carbides, hydrides, borides of Ti, V, Cr, W and their industrial uses	2	Learn about interstitial compounds	Lecture and seminar	
	5	Electronic configuration, oxidation states, colour, spectral and magnetic properties. Causes and consequences of lanthanide contraction - uses of lanthanides	2	Know about lanthanide contraction	Lecture with power point presentation	
	6	Comparison between lanthanides and actinides. Extraction, properties and uses of thorium and uranium, compounds of uranium-zinc uranyl acetate and uranium hexa fluoride	2	Able to compare between lanthanides and actinides.	Lecture and power point presentation	

## II Co-ordination Chemistry - I

	1	Double salts and co-ordination compounds-differences - types of ligands. Nomenclature, and isomerism- structural isomerism - ionization, hydrate, co-ordination, linkage and co-ordination position isomerism	4	Know about the nomenclature and isomerism	Question answer session	Evaluation through Multiple choice questions, short test, quiz
	2	Stereoisomerism - geometrical isomerism in tetrahedral and octahedral complexes - optical isomerism in octahedral complexes. Theories of co-ordination compounds	4	Differentiate octahedral and tetrahedral complexes	Lecture	Formative assessment I
	3	Werner's theory- postulates - verification of Werner's theory - cobalt ammine complexes. EAN rule - calculation of EAN in metal complexes and carbonyls. Pauling's theory (VBT) - postulates	4	Learn about different theories	Lecture with power point presentation and group discussion	
	4	Application of VBT to square planar and tetrahedral complexes, inner and outer complexes - merits and demerits of VBT	3	Know about inner and outer complexes	Lecture with power point presentation	

<b>III Co-ordination Chemistry – II</b>						
	1	Shapes of d-orbitals. Crystal field theory - Crystal field splitting of tetrahedral, square planar and octahedral complexes. Factors affecting crystal field stabilisation energy CFSE crystal field splitting energy values and stability of complexes	5	Know about Crystal field theory and factors affecting CFSE	Seminar and power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Weak and strong field ligands - spectrochemical series. Distortion from perfect symmetry - Jahn-Teller theorem and its effect	3	Learn about weak and strong field ligands	Lecture and problem solving	
	3	Molecular Orbital Theory (MOT) MO diagrams of $ML_6$ type complexes. Stability of metal complexes	3	Know about MO diagrams different complexes	Lecture and problem solving	
	4	Relation between stability constant and dissociation constant - factors affecting the stability of metal complexes from thermodynamic data	2	Gather knowledge regarding stability constant and dissociation	Problem solving	
	5	Irving William series - stabilization of unstable oxidation state. Substitution reactions of square planar complexes - trans effect	2	Learn about square planar complexes	Illustration, seminar and power point presentation	
<b>IV Analytical Chemistry</b>						
	1	Types of errors- determinate and indeterminate errors - minimization of errors. Precision and accuracy- ways of expressing precision	2	Understand about different types of errors	Power point presentation with videos	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Standard deviation- mean deviation - relative mean deviation and coefficient of variance	3	Know about standard deviation and mean deviation	Lecture	
	3	Accuracy - absolute error- relative error- confidence limit- Rejection of a doubtful value - Q Test and related problems	3	Differentiate between absolute error and relative error	Lecture	
	4	Principles and requirements of gravimetric analysis- mechanism of precipitation - digestion, filtration, washing, drying and ignition	3	Learn the steps in gravimetric analysis	Lecture and power point presentation	



	5	Factors affecting solubility of precipitate - co-precipitation and post precipitation - prevention and difference between co-precipitation and post precipitation, precipitation from homogenous solution	3	Understand the principles of co-precipitation and post precipitation	Lecture with power point presentation	
<b>V</b>	<b>Organometallic Chemistry</b>					
	1	Introduction - structure and application of metal carbonyls - mono and poly nuclear carbonyls of Ni, Fe, Cr, Co and Mn - synthesis and structure -nitrosyl compounds	3	Understand the structure and application of metal carbonyls	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Classification, preparation and properties -structure of nitrosyl chloride and sodium nitroprusside.	3	Gather knowledge regarding the properties of compounds	Lecture with videos	
	3	Nomenclature of organometallic compounds, 16- and 18- electron rule. Structure and bonding in transition metal carbonyls- polynuclear carbonyls.	3	Learn about the nomenclature of organometallic compounds	Seminar	
	4	Bridging and terminal carbonyls, transition metal alkyls, carbenes, and carbynes, and metallocenes. Photochemistry of organometallic compounds.	3	Know about carbonyls	Power point presentation and seminar	
	5	Wilkinson's catalyst and alkene hydrogenation, hydroformylation, Monsanto acetic acid process, Ziegler – Natta catalyst and polymerization of olefins.	3	Understand about different catalysts and reactions	Demonstration	

Course Instructor: Dr. R. Gladis Latha

HOD: Dr. M. Anitha Malbi

## Semester - V

### Major Core VII: PHYSICAL CHEMISTRY

Course code: CC2053

Hours per week	Credits	Total hours	Marks
6	5	90	100

#### Objectives:

- To know the concepts of conductance, strong and weak electrolytes
- To understand the working of electro chemical cells, EMF measurement and their applications
- To learn the basic principles and applications of spectroscopy

#### Course Outcome

COs	Upon completion of course students will be able to	PSO Addressed	Cognitive Level
CO - 1	understand the basic principles of electrochemistry	PSO - 1	U
CO - 2	apply EMF measurements in different fields of chemistry	PSO - 2	A
CO - 3	analyze the working of electrical appliances in day to day life	PSO - 5	An
CO - 4	remember the principle and applications of the different spectral techniques	PSO - 7	R
CO - 5	interpret the IR, NMR and ESR spectra of simple molecules	PSO - 3	E

#### Total Hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Electrochemistry – I</b>					
	1	Conductance, specific conductance, equivalent conductance and molar conductance, factors affecting conductance of a solution	3	Understand the factors affecting conductance of a solution	Lecture	Evaluation through Multiple choice questions, short test, quiz
	2	Strong and weak electrolytes, variation of equivalent conductance with dilution. Debye-Huckel theory of strong electrolytes, Debye-Huckel-Onsagar equation	3	Know the differences between strong and weak electrolytes	Lecture and group discussion	Formative assessment I

	3	Kohlrausch's law and its applications. Applications of conductance measurements, Determination of $\lambda_{\infty}$ of weak acid and weak base, degree of dissociation of weak electrolytes, solubility and solubility products of sparingly soluble salts and conductometric titrations	2	Understand the applications of conductance measurements	Lecture	
	4	Transport number, determination of transport number by Hittorff's method and moving boundary method	3	Determine the transport number	Lecture with power point presentation	
	5	Hydrolysis, hydrolysis constant, degree of hydrolysis of salts of weak acids and strong bases, weak bases and strong acids	4	Illustrate the hydrolysis of salts	Lecture with power point	
	6	Determination of degree of hydrolysis, conduction and distribution methods	3	Describe the degree of hydrolysis	Lecture	
<b>II</b>	<b>Electrochemistry – II</b>					
	1	Electrochemical cells, reversible and irreversible cells, EMF of cells, determination, cell representation	3	Determine EMF of cells	Lecture	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Single electrode potential, types of electrodes, metal-metal ion electrodes, amalgam electrodes, gas electrodes, metal - insoluble metal salt electrodes and oxidation - reduction electrodes, standard hydrogen electrode (SHE) and calomel electrode	3	Know the types of electrodes	Lecture	
	3	Nernst equation for electrode potential, Nernst equation for emf of cells, standard electrode potential determination	3	Derive Nernst equation	Lecture with tutorials	

	4	Electro chemical series, thermodynamics of galvanic cells, $\Delta G$ , $\Delta H$ , $\Delta S$ and equilibrium constant (K). Concentration cells with transference and without transference, liquid junction potential and its elimination	3	Explain the thermodynamics of galvanic cells	Lecture	
	5	Applications of EMF measurements, determination of transport number, valency of an ion, pH of a solution using hydrogen, quinhydrone and glass electrode	3	Know the applications of EMF measurements	Lecture with tutorials	
	6	Potentiometric titrations, acid-base, oxidation-reduction and precipitation titrations. Decomposition potential and overvoltage	3	Illustrate the principle of potentiometric titrations	Lecture with power point presentation	
<b>III</b>	<b>Applied Electro Chemistry</b>					
	1	Application of electrochemical principle in inorganic chemistry, manufacture of NaOH and $H_2O_2$ . Organic electro chemistry	3	Know the applications of electrochemical principle in inorganic chemistry	Lecture with videos	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Electro chemical oxidation, Kolbe's synthesis, electro reduction of carbonyl compounds, adiponitrile synthesis	3	Understand the electro chemical reactions	Lecture	
	3	Electroplating, principle, electro plating of copper, nickel and cadmium, types of coating, protection of pipelines, protection of ships in sea	4	Explain the principle of electroplating	Lecture	
	4	Power sources, primary cells, Leclanche cell, principle, selection of anode and cathode, alkaline $MnO_2$ cells	3	Describe the principle and working of power sources	Lecture	
	5	Secondary cells, characteristics, lead storage, lithium and nickel-cadmium battery	3	Understand the characteristics of secondary cells	Lecture with power point presentation	

	6	Fuel cells, principle, hydrogen - oxygen fuel cells and alkaline fuel cells	2	Acquire knowledge on the principle and working of fuel cells	Lecture with power point	
<b>IV</b>	<b>Spectroscopy –I</b>					
	1	Electromagnetic radiation, electromagnetic spectrum, general spectroscopic methods, Born-Oppenheimer approximation, types of molecular spectra	3	Understand the characteristics of electromagnetic radiation	Lecture	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Microwave spectra, principle, intensity, selection rule and applications determination of bond distances in diatomic molecules	4	Illustrate the principle of microwave spectra	Lecture	
	3	Infra-Red spectra , principle of harmonic oscillator, unharmonicity, selection rules, intensity, modes of vibrations and types, force constant, determination	3	Understand the principle of harmonic oscillator	Lecture with videos	
	4	Applications of IR, important functional groups and elucidation of structure, hydrogen bonding, Fermi resonance, overtones and combination bands	4	Explain the applications of IR spectroscopy	Lecture	
	5	Electronic spectra, selection rules, Frank Condon Principle, types of transitions, applications.	4	Describe the applications of electronic spectra	Lecture	
<b>V</b>	<b>Spectroscopy –II</b>					
	1	NMR, introduction, conditions, principle, type, origin, Larmor procession, signals, chemical shift, screening constant, spin-spin coupling	3	Understand the principle of NMR spectroscopy	Lecture	Evaluation through Multiple choice questions, short test, quiz

	2	Applications of NMR- elucidation of molecular structure, hydrogen bonding, tautomerism, study of water of crystallization in solids and Nuclear magnetic resonance imaging	4	Know the applications of NMR	Lecture with power point presentation	Formative assessment I
	3	ESR spectroscopy, principle, hyperfine structure, application of ESR to hydrogen and methyl radicals	4	Analyze the ESR spectrum of hydrogen and methyl radicals	Lecture	
	4	Raman Spectra, introduction, Rayleigh scattering, quantum theory, Raman effect, Raman scattering	4	Explain Rayleigh scattering , quantum theory and Raman effect	Lecture	
	5	Conditions for Raman spectra, selection rule, mutual exclusion principle, Raman spectra of CO <sub>2</sub> and HCN - differences between Raman and IR spectra	3	Know the conditions of Raman spectra		

Course Instructor: Dr. S. Ajith Sinthuja

HOD: Dr. M. Anitha Malbi

**Semester - V**  
**Elective III: BIO CHEMISTRY**  
**Course code: CC2054**

Hours per week	Credits	Total hours	Marks
4	3	60	100

**Objectives:**

- To understand the biological action of carbohydrates
- To know the functions of lipids, amino acids, proteins and nucleic acids

**Course Outcome**

COs	Upon completion of course students will be able to	PSO Addressed	Cognitive Level
CO - 1	understand the function and metabolism of biomolecules	PSO - 1	U
CO - 2	recall the importance of biomolecules	PSO - 2	R
CO - 3	compare DNA and RNA	PSO - 5	An
CO - 4	elucidate the structure of different biomolecules	PSO - 2	A
CO - 5	illustrate the industrial and medical applications of enzymes	PSO - 8	U

**Total Hours: 60 (Including lectures, assignments and tests)**

Unit	Module	Topic	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Carbohydrate</b>					
	1	Carbohydrates -definition and classification. Glycosides physiological significance. Amino sugars - importance	3	Understand the classification and importance of carbohydrates	Lecture	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Chemistry of poly saccharides - starch, glycogen, cellulose, inuline, hemi-celluloses, chitin, pectin and lignin	3	Know the structure and functions of polysaccharides	Lecture and group discussion	
	3	Glycosaminoglycans - hyaluronic acid, chondroitin sulphate, keratin sulphate, heparin and dermatan sulphate	3	Explain the structure and functions of glycosamino glycans	Lecture with power point presentation	
	4	Blood group substances. Carbohydrate metabolism - Embden - Meyerhof pathway- TCA cycle	3	Illustrate carbohydrate metabolism	Lecture with power point presentation	

<b>II</b>		<b>Lipids</b>				
	1	Lipids - definition and classification. Types of fatty acids - saturated, unsaturated, unusual and essential fatty acids	2	Classify lipids and fatty acids	Lecture	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Triacylglycerols - chemistry. Characterization - saponification number, iodine number, acid number, RM value and acetyl value	4	Determine the characteristics of lipids	Lecture	
	3	Chemistry and functions of phospholipids - lecithin and cephalin. Sphingolipids - sphingomyelin.	3	Understand the functions of phospholipids, sphingolipids and sphingomyelin	Lecture with tutorials	
	4	Glycolipids - cerebroside, ganglioside Cholesterol - spot tests and structure. Biochemical functions of cholesterol	3	Explain the structure and functions of glycolipids and cholesterol	Lecture	
<b>III</b>		<b>Amino acids and Proteins</b>				
	1	Amino acids and proteins - structure, classification and biochemical importance - one method each to identify 'C' terminal and N terminal amino acids	3	Know the classification, structure and the importance of amino acids and proteins	Lecture with videos	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Secondary, tertiary and quaternary structures	3	Analyze the structures of proteins	Lecture	
	3	Abbreviated names - structure and importance of simple peptide - glutathione, carnosine, anserine, vasopressin and oxytocin	3	Explain the structure and the importance of peptides	Lecture	
	4	Peptide antibiotics - Geramicidin, bacitracin and actinomycin. Transamination - deamination - urea cycle	3	Describe the properties of peptide antibiotics and urea cycle	Lecture	



<b>IV Nucleic Acids</b>						
	1	Components of nucleic acid - organic nitrogeneous bases - Purines - pyrimidines - sugars - deoxyribose - ribose	3	Describe the components of nucleic acid	Lecture with power point presentation	Evaluation through Multiple choice questions, short test, quiz  Formative assessment II
	2	Nucelosides - ribonucleoside- deoxyribonucleoside. Nucleotides- ribonucleotide- deoxyribonucleotide- cyclic nucleotides	3	Differentiate nucleosides and nucleotides	Lecture	
	3	DNA - Structure and functions - RNA - types (m-RNA, t-RNA and r-RNA). Nucleases- Endonucleases - DNase - RNase- Exonucleases	3	Compare the structure and functions of DNA, RNA and nucleases	Lecture with videos	
	4	Cyclic nucleotides - functions of cyclic AMP - and cyclic GMP - Nucleoproteins - nucleohistones - nucleoprotamines	3	Explain cyclic nucleotides, nucleoproteins, nucleohistones and nucleoprotamine	Lecture	
<b>V Enzymes</b>						
	1	Enzymes - characteristics - classification, enzyme specificity. Factors affecting enzyme reaction	4	Understand the classification and characteristics of enzymes	Lecture	Evaluation through Multiple choice questions, short test, quiz  Formative assessment I
	2	Michaelis-Menten equation - derivation - inhibition of enzyme action - competitive, non - competitive and uncompetitive coenzymes	4	Explain Michaelis-Menten equation and inhibition of enzymes	Lecture with power point presentation	
	3	Mechanism of NAD <sup>+</sup> and PLP. Immobilisation of enzymes - industrial and medical application of enzymes	4	Mechanism and applications of enzymes	Lecture	

Course Instructor: Dr. Sheeba Daniel

HOD: Dr. M. Anitha Malbi

**Semester - VI**  
**Major Core VIII: ORGANIC CHEMISTRY - II**  
**Course Code: CC2061**

Hours per week	Credits	Total hours	Marks
6	5	90	100

**Objectives:**

- To know the synthesis and structure of carbohydrates, alkaloids, terpenoids and dyes
- To understand the rearrangements, synthetic strategies and terminologies involved in organic synthesis and the role of reagents in organic synthesis.
- To study the basic principles of UV, IR and NMR spectroscopy and instrumentation.

**Course Outcome**

COs	<i>Upon completion of course students will be able to</i>	PSO Addressed	Cognitive Level
CO - 1	understand the synthetic methodology, reagents and rearrangements in organic chemistry	PSO-1	U
CO - 2	elucidate the structure of carbohydrates, alkaloids and terpenoids	PSO-6	C
CO - 3	synthesize dyes and compounds of synthetic importance	PSO-4	A
CO - 4	analyse the strategies and terminologies involved in organic synthesis leading to new products	PSO-5	An
CO - 5	apply the spectral techniques in structural determination	PSO-6	A

**Total Hours: 90 (Including lectures, assignments and tests)**

Unit	Module	Topic	Hours	Learning Outcome	Pedagogy	Assessment/Evaluation
<b>I</b>	<b>Carbohydrates</b>					
	1	Carbohydrates: Definition - classification with suitable examples - classification of sugars as reducing and non-reducing sugars - stereochemistry of carbohydrates: D- and L-configurations - erythro and threodiastereomers - anomers and epimers with suitable examples	3	Classify carbohydrates and its stereochemistry	Lecture with videos	Evaluation through quiz, slip test, group discussion  Formative assessment I

	2	Monosaccharides: Classification of monosaccharides with suitable examples – glucose - properties of glucose - epimerisation of glucose - anomers of glucose and mutarotation - fructose and its properties	3	Analyze the classification and properties of monosaccharides	Lecture	
	3	Conversion of aldose to ketose and ketose to aldose - formation of osazone and glycosides - Fischer open structure and evidences for open structure - Haworth projection cyclic structures - pyranose and furanose and evidences for cyclic structures of glucose and fructose	3	Understand the conversion and structure of glucose and fructose	Lecture	
	4	Stepping up - Kiliani-Fischer synthesis and stepping down - Ruff degradation of monosaccharides	3	Recognize the degradation of monosaccharides	Lecture	
	5	Disaccharides: $\alpha$ - and $\beta$ - glucosidic linkages with suitable examples - 1,4' and 1,5' linkages with suitable examples - Structure and properties of sucrose	3	Identify the linkages in disaccharides and explain the structure and properties of sucrose	Lecture	
	6	Polysaccharides: Cellulose and starch - reactions and structure	3	Compare cellulose and starch	Lecture with power point presentation	
<b>II</b>	<b>Synthetic methodology and reagents</b>					
	1	Synthetic terminology - Disconnection, synthon, synthetic equivalent (SE), functional group interconversion (FGI), target molecule (TM)	3	Understand the synthetic terminologies of retrosynthesis	Lecture	Evaluation through quiz, slip test and group discussion
	2	Retro synthetic analysis - Linear, convergent and combinatorial syntheses	3	Compare linear, convergent and combinatorial syntheses	Lecture	Formative assessment I

	3	Retrosynthesis of 4-methyl acetophenone, methylcyclohex-3-enecarboxylate, phenylethylbromide, 2-methylcyclopentene and 2-allyl phenol	4	Illustrate the retrosynthesis of the given organic compounds	Lecture	
	4	Role of following reagents in organic synthesis: DIBAL, NBS, DCC, trimethylsilyl chloride and methyl lithium - List of nucleophilic reagents and electrophilic reagents	4	Analyze the role of the given reagents in organic synthesis	Lecture and group discussion	
	5	Malonic ester and acetoacetic ester in the synthesis of monocarboxylic acids - dicarboxylic acids - $\alpha,\beta$ -unsaturated carboxylic acids and heterocyclic compounds	4	Explain the role of malonic ester and acetoacetic ester in organic synthesis	Lecture	
<b>III</b>	<b>Natural Products and Dyes</b>					
	1	Alkaloids: Definition - classification with suitable examples for each class - properties - structural determination - Hoffman exhaustive methylation	3	Understand the classification, properties and structure of alkaloids	Lecture	Evaluation through class test, quiz and group discussion
	2	Sources, isolation, physiological activities and structural elucidation of conine, piperine and nicotine.	4	Elucidate the structure of conine, piperine and nicotine	Lecture	Formative assessment II
	3	Terpenoids: Definition, classification, isoprene and special isoprene rule	2	Explain terpenoids, isoprene and special isoprene rule	Lecture	
	4	Sources, isolation, structural elucidation and uses of citral, geraniol and limonene	3	Elucidate the structure of citral, geraniol and limonene	Lecture	

	5	Dyes: Theory of color and constitution - chromophore, auxochrome, classification according to application and structure.	3	Categorize dyes based on their application and structure	Lecture with videos	
	6	Preparation and uses of methyl orange, congo red, malachite green, phenolphthalein, fluorescein, indigotin and alizarin.	3	Describe the preparation and uses of the given dyes	Lecture with power point presentation	
<b>IV</b>	<b>Rearrangements</b>					
	1	Rearrangement to electron-deficient carbon - 1,2 shift - Wagner-Meerwein rearrangement, pinacol-pinacolone rearrangement, dienone-phenol rearrangement; Wolff rearrangement, benzil-benzilic acid rearrangement	5	Understand the mechanism of nucleophilic rearrangement	Lecture	Evaluation through class test, quiz and group discussion
	2	Rearrangements from oxygen to ring carbon - Fries rearrangement, Claisen rearrangement and benzidine rearrangement.	3	Explain the mechanism of rearrangement reactions	Lecture	Formative assessment II
	3	Rearrangement to electron-deficient nitrogen - Beckmann rearrangement, Schmidt rearrangement, Hofmann rearrangement, Lossen rearrangement and Curtius rearrangement.	5	Apply the mechanism of nucleophilic rearrangement	Lecture	
	4	Rearrangement to electron-deficient oxygen: Baeyer-Villiger oxidation, Dakin reaction, cumenehydroper-oxide-phenol rearrangement	5	Analyze the mechanism of nucleophilic rearrangement	Lecture	

V	Spectroscopy					
	1	UV Spectroscopy: Electromagnetic spectrum - Types of electronic transitions - $\lambda_{\max}$ , chromophores and auxochromes. Bathochromic and hypsochromic shifts. Intensity of absorption - hyper chromic and hypo chromic shifts	3	Understand the concepts of UV spectroscopy	Lecture with videos	Evaluation through class test, quiz, group discussion and problem solving
	2	Application of Woodward-Fieser rules for calculation of $\lambda_{\max}$ for $\alpha$ , $\beta$ unsaturated aldehydes, ketones, carboxylic acids and esters. Conjugated dienes - acyclic, homoannular and heteroannular, extended conjugated systems-aldehydes, ketones and dienes	4	Predict the $\lambda_{\max}$ value of the given compounds using Woodward-Fieser rule	Lecture and problem solving	Formative assessment I
	3	IR Spectroscopy: Molecular vibrations and origin of IR spectra, IR absorptions- fingerprint region and its significance. H-bonding-inter and intramolecular hydrogen bonding	3	Explain the concept of IR spectroscopy	Lecture with videos	Evaluation through class test, quiz and group discussion
	4	Application in functional group analysis. IR spectrum of alkane, alkene, alkyne, alkyl halide, alcohols and carbonyl compounds	2	Interpret the IR spectrum of the given compounds	Lecture with power point presentation	Formative assessment II
	5	NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it. Significance of number of peaks and peak area. Spin-spin coupling and coupling constant	3	Describe the principle and concept of NMR Spectroscopy	Lecture with videos	

	6	Interpretation of NMR spectra of simple compounds- ethyl alcohol, benzene, methyl chloride, benzaldehyde and mesitylene	3	Interpret the NMR spectrum of simple organic compounds	Lecture with power point presentation	
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Course Instructor: Dr. Sr. Francy

HOD: Dr. M. Anitha Malbi

**Semester - VI**  
**Major Core IX: INORGANIC CHEMISTRY II**  
**Course Code: CC2062**

Hours per week	Number of Credit	Total Hours	Marks
5	5	75	100

**Objectives**

- To understand the concepts and applications of nuclear reactions.
- To know the characteristics of solids and its applications.
- To gain knowledge about the development and uses of bioinorganic compounds.

**Course Outcome**

COs	Upon completion of course students will be able to	PSO Addressed	Cognitive Level
CO - 1	understand the types of nuclear reactions and their applications	PSO - 1	U
CO - 2	know about natural and artificial radioactivity	PSO - 2	R
CO - 3	classify crystal systems and their structures	PSO - 1	An
CO - 4	predict the role of bioinorganic compounds in biological systems	PSO - 2	E
CO - 5	use the solid materials for specific purposes	PSO - 6	A

**Total Contact hours: 75 (Including lectures, assignments and tests)**

Unit	Module	Topics	Hours	Learning Outcome	Pedagogy	Assessment/Evaluation
<b>I</b>	<b>Nuclear Chemistry I</b>					
	1	Introduction - composition of nucleus and nuclear forces - nuclear stability - mass defect - binding energy - packing fraction	3	Know about the basics in nuclear chemistry	Lecture and power point presentation	Evaluation through class test, quiz and group discussion
	2	N/P ratio - magic numbers - nuclear models - liquid drop - Shell and collective model	3	Learn about magic numbers	Lecture and power point presentation	
	3	Isotopes - detection and separation - deviation of atomic weights from whole numbers - isobars, isotones and isomers	3	Differentiate between isotopes, isobars and isotones	Illustration and lecture	Formative assessment I
	4	Radioactive decay and equilibrium - nuclear isomerism - internal conversion	3	Learn about Joule Thomson effect	Lecture and seminar	



	5	Nuclear Q-value - threshold energy - cross sections, types of reactions - fission and fusion - modes of radioactive decay	3	Know to derive Calculate Q value and threshold energy	Lecture and power point presentation	
<b>II</b>	<b>Nuclear Chemistry II</b>					
	1	Natural and induced radioactivity - radioactive decay - half-life period - radioactive displacement law - radioactive series - Radioactive techniques - Geiger Muller and ionization counters	4	Know about radioactivity	Question answer session	Evaluation through class test, quiz and group discussion
	2	Natural radioactivity - Detection and measurement of radioactivity - radioactive series including neptunium series - group displacement law - Rate of disintegration and half-life period - Average life period	4	Differentiate between various radioactive series	Lecture	Formative assessment I
	3	Artificial radioactivity - induced radioactivity - transmutation of elements- hazards of radiations - nuclear energy - nuclear reactors - fission products and fission yields - spallation - photonuclear and thermo nuclear reactions - energy source of the sun and stars - carbon dating - rock dating	4	Learn about different nuclear reactions	Lecture with power point presentation and group discussion	
	4	Radioactive waste disposal - applications of nuclear science in agriculture, biology and medicine - Atomic power projects in India	3	Know about the disposal of radioactive wastes	Lecture and power point presentation	

<b>III Solid State Chemistry</b>						
	1	Amorphous and crystalline solids - Laws of crystallography Elements of symmetry Weiss and Miller indices Crystal systems and Bravais lattices - derivation of Bragg's equation	3	Know about the laws of crystallography	Seminar and power point presentation	Evaluation through class test, quiz and group discussion
	2	Ionic bonding lattice energy Born equation and its derivation, radius ratio rules structures of some ionic crystals Structure of solids comparison of X-ray and Neutron diffraction	3	Learn about ionic bonding	Lecture and power point presentation	Formative assessment II
	3	Crystal structure of NaCl powder method - Electrical, Magnetic and optical properties of solids band theory semiconductors superconductors. Solid state electrolytes	3	Know about the structure of crystals	Lecture and problem solving	
	4	Types of magnetic behavior, dia, para, ferro, antiferro and ferrimagnetism Hysteresis Solid state lasers inorganic phosphors ferrites	3	Gather knowledge regarding types of magnetic behavior	Problem solving	
	5	Crystal defects- Schottky defect Frenkel defect - metal excess defect - metal deficiency defect f centres	3	Distinguish between various defects	Illustration, Seminar and power point presentation	
<b>IV Bioinorganic Chemistry</b>						
	1	Metal ions in biology- role of sodium - potassium- calcium - magnesium - copper - molybdenum and their vital role in the active site	4	Understand about the role of different metal ions.	Power point presentation with videos	Evaluation through class test, quiz and group discussion

	2	Metallo proteins - types and functions - metalloenzymes - structure and characteristic features of Vitamin B <sub>12</sub>	4	Know about proteins and vitamins	Lecture	Formative assessment II
	3	Biological functions of haemoglobin and myoglobin, - sodium / potassium pump- cytochromes and ferredoxins	3	Differentiate between haemoglobin and myoglobin	Lecture	
	4	Metal complexes of copper and platinum as therapeutic agents - Biological nitrogen fixation, Photosynthesis: Photosystem-I	4	Learn the types different therapeutic agents	Lecture and power point presentation	
<b>V</b>	<b>Material Chemistry</b>					
	1	Ionic conductors - sodium, $\beta$ - alumina, sodium-sulphur battery. Intercalation - layered compounds - graphitic compounds	3	Understand about ionic conductors	Lecture and power point presentation	Evaluation through class test, quiz and group discussion
	2	Special applications of solid state materials. High energy battery, lithium cells	3	Explain the applications of solid state materials	Lecture with videos	
	3	Introduction - techniques for synthesis of nanophase materials - sol-gel synthesis- electro deposition - inert gas condensation	3	Learn about nano materials	Seminar	Formative assessment I
	4	mechanical alloying - properties of nanophase materials - applications of nanophase materials, composite materials	3	Know about applications of nanophase materials	Power point presentation and seminar	
	5	Superconductivity - introduction - examples of superconducting oxides - applications of superconducting materials	3	Understand the applications of nano chemistry	Demonstration	

Course Instructor: Dr. R. Gladis Latha

HOD: Dr. M. Anitha Malbi

Semester - VI

Major Core XI: PHYSICAL CHEMISTRY

Course Code: CC2063

Hours per week	Credits	Total hours	Marks
5	5	75	100

**Objectives:**

- To understand the theories of reaction rate, adsorption and catalysis
- To learn phase rule and phase equilibria
- To know the concepts of symmetry elements, symmetry operations and point groups

**Course Outcome**

COs	Upon completion of course students will be able to	PSO Addressed	Cognitive Level
CO - 1	understand the theories of reaction rate, adsorption and catalysis	PSO - 1	U
CO - 2	construct phase diagrams for one and two component systems	PSO - 3	C
CO - 3	recall colligative properties and their applications	PSO - 2	R
CO - 4	predict the point groups of molecules	PSO - 3	E
CO - 5	construct group multiplication table for simple molecules	PSO - 7	C

**\*Total Hours: 75 (Including lectures, assignments and tests)**

Unit	Module	Topic	Hours	Learning Outcome	Pedagogy	Assessment/ Evaluation
<b>I</b>	<b>Chemical kinetics</b>					
	1	Rate of reaction, expression of rate, factors influencing rate of reaction, order and molecularity	3	Know the factors influencing rate of reaction	Lecture with videos	Evaluation through class test, quiz, group discussion and problem solving.  Formative assessment I
	2	Differences between order and molecularity, zero, first and second order reaction, definition- examples, derivation of rate constant and half-life period	3	Analyze the differences between order and molecularity	Lecture	

	3	Methods of determining order of reaction, differential, integral, half-life and Ostwald's isolation methods. Temperature dependence of reaction rates, Arrhenius equation, significance	3	Understand the methods of determining order of reaction	Lecture	
	4	Temperature coefficient, energy of activation, effect of catalyst, calculation of energy of activation	2	Recognize the energy of activation and effect of catalyst	Lecture	
	5	Theories of reaction rates, collision theory of bimolecular gaseous reactions, activated complex theory, comparison of collision theory	2	Understand the theories of reaction rates	Lecture	
	6	Activated complex theory. Lindeman's theory of unimolecular reactions	2	Compare activated complex theory and Lindeman's theory	Lecture with power point presentation	
<b>II</b>	<b>Phase Equilibria</b>					
	1	Concept of phase, components, degrees of freedom, definitions and examples, derivation of Gibb's phase rule	2	Understand the concept of phase and components	Lecture	Evaluation through class test, quiz and group discussion
	2	Phase diagram for one component system, water and sulphur systems. Two component system, reduced phase rule	2	Compare phase diagrams for one and two component system	Lecture with power point presentation	Formative assessment I
	3	Simple eutectic system, lead-silver system, Pattinson's process of de-silverisation of lead, freezing mixtures, KI-H <sub>2</sub> O system	4	Illustrate the phase diagrams of simple eutectic systems	Lecture	
	4	Formation of compounds with congruent melting point, zinc-magnesium system and FeCl <sub>3</sub> -H <sub>2</sub> O system	4	Analyze the formation of compounds with congruent melting point	Lecture and group discussion	

	5	Formation of compounds with incongruent melting points, $\text{Na}_2\text{SO}_4\text{-H}_2\text{O}$ system. Solid-gas equilibria, $\text{CuSO}_4\text{-H}_2\text{O}$ system. Efflorescence, deliquescence and hygroscopy	3	Explain the formation of compounds with incongruent melting points	Lecture	
<b>III</b>	<b>Catalysis and Adsorption</b>					
	1	Catalysis, characteristics, different types, homogeneous, heterogeneous, acid-base catalysis and auto catalysis	2	Understand the different types of catalysis	Lecture	Evaluation through class test, quiz, group discussion and problem solving  Formative assessment II
	2	Theories of catalysis, intermediate compound formation theory and adsorption theory	3	Know the theories of catalysis	Lecture	
	3	Kinetics of enzyme catalysis, Michaelis-Menten equation, derivation and applications of catalysis	2	Acquire knowledge on applications of catalysis	Lecture	
	4	Adsorption, definition- physisorption and chemisorption, differences, factors influencing adsorption of gases on solids	3	Elucidate the factors influencing adsorption of gases on solids	Lecture	
	5	Adsorption isotherms, types, Freundlich and Langmuir monolayer adsorption isotherms	2	Categorize the types of adsorption isotherms	Lecture with videos	
	6	Gibbs adsorption isotherm, BET theory of multilayer adsorption, applications of adsorption. Adsorption indicators	3	Describe the applications of adsorption	Lecture with power point presentation	
<b>IV</b>	<b>Solutions and Colligative Properties</b>					
	1	Solutions of non-electrolytes, solutions of liquids in liquids, vapour pressure of non-ideal solutions, type I, type II and type III	3	Illustrate the vapour pressure of non-ideal solutions	Lecture	Evaluation through class test, quiz, group discussion and

	2	Vapour pressure, composition and boiling point, composition curves of completely miscible binary solutions, type I, type II and type III. Theory of fractional, azeotropic and steam distillations	3	Understand the composition curves of completely miscible binary solutions	Lecture	problem solving  Formative assessment II
	3	Solubility of partially miscible liquids - phenol-water system, triethylamine – water system and nicotine water system. Colligative properties, definition and examples	2	Explain the solubility of partially miscible liquids	Lecture	
	4	Osmotic pressure, Laws of osmotic pressure, van'tHoff theory of dilute solutions, isotonic solution. Elevation of boiling point, molal boiling point elevation constant or ebullioscopic constant	2	Describe osmotic pressure and elevation of boiling point	Lecture	
	5	Determination of molar mass from elevation of boiling point. Depression of freezing point, molal freezing point depression constant or cryoscopic constant	3	Understand depression of freezing point	Lecture with power point presentation	
	6	Determination of molar mass by depression of freezing point. Abnormal results and van't Hoff factor	2	Know to determine molar mass by depression of freezing point	Lecture with power point Presentation	
<b>V</b>	<b>Group theory</b>					
	1	Symmetry elements and symmetry operations, definition of identity (E), proper rotational axis (n), mirror plane ( $\sigma$ ), inversion centre (i) and rotation reflection axis ( $S_n$ )	3	Understand symmetry elements and symmetry operations	Lecture with videos	Evaluation through class test, quiz and group discussion

	2	Symmetry operations generated by symmetry elements- H <sub>2</sub> O, NH <sub>3</sub> , BF <sub>3</sub> , [PtCl <sub>4</sub> ] <sup>2-</sup> , H <sub>2</sub> O <sub>2</sub> (cis and trans) and CH <sub>4</sub> as examples	4	Know the symmetry operations generated by symmetry elements	Lecture and problem solving	Formative assessment I
	3	Matrix representation of symmetry operations. Comparison of molecular and crystallographic symmetry	3	Explain the symmetry operations	Lecture with videos	
	4	Group postulates, abelian and cyclic groups, group multiplication table, molecular point groups	2	Interpret cyclic groups and point groups	Lecture with power point presentation	
	5	Point group assignment to simple molecules like H <sub>2</sub> , HCl, CO, H <sub>2</sub> O, NH <sub>3</sub> and CO <sub>2</sub> . Determination of point groups	3	Determine the point groups for simple molecules	Lecture with videos	

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