

Program Outcome (Science and Arts):

- i) To obtain up to date knowledge of the subject involved
- ii) To provide holistic education to the students together with the skills of employment and entrepreneurship through innovative learning.
- iii) To promote innovative thinking in the subject concerned.
- iv) To provide practical knowledge of the subjects concerned in laboratories
- v) To develop keen interest for research and innovation in the subject concerned.
- vi) To promote their creative thinking and communication skills through project works and presentations.
- vii) To apply the subject knowledge in solving problems in the society through field studies and social interactions
- viii) To develop the sense of responsibility among the students for the environment conservation and sustainable development.
- ix) To develop awareness among the students regarding good health and hygiene through sports.
- x) To promote ethnic culture through cultural activities.
- xi) To promote the spirit of team work through various group activities.

Program Specific Outcome: (PSO)

Chemistry:

1. Helps in the understanding of the development of chemistry from old age till today
2. Gives an idea about the structure, bonding and properties of matters.
3. Gives an idea about the applications of chemistry in different fields e.g. medicine, food technology, plastics, paints, ceramics, crude oil extractions, glass, cement, space research etc. etc.
4. Gives an idea about different qualitative and quantitative analysis techniques in the laboratory and industry.
5. Gives an idea about the environment, problems related to environment pollution and its control.
6. Gives an idea about the scope of basic science research in solving day to day problems of society.
7. Gives an idea about the scope of computational chemistry in research and in the learning of chemistry.
8. Helps in developing the ability to synthesise, separate and characterize compounds using laboratory and instrumentation techniques.

Course outcome:

Semester	Code of paper, title of the paper	Course Outcome
1	C I: INORGANIC CHEMISTRY-I (Credits: Theory-04)	Unit1: Atomic Structure: Gives an idea about the various theories underlying the structure of atom. It also deals with important principles involved in writing electronic configuration and the development and importance of quantum chemistry.
		Unit 2: Periodicity of elements: Discusses on the development of periodic table, periodic properties and their variations along the group and period.
		Unit 3: Chemical bonding: Deals with ionic, covalent, metallic and co-ordinate bonding of molecules along with the forces involved in each kind of bonding.
		Unit 4: Oxidation-Reduction: Importance of oxidation reduction in chemical reactions, examples, balancing of reactions on the basis of oxidation reduction. Redox equations, Standard Electrode Potential and its application to inorganic reactions.
	C I LAB: (Credits: Practicals-02)	Gives an idea about volumetric and redox titrations.
	C II: PHYSICAL CHEMISTRY-I (Credits: Theory-04)	Unit 1: Gaseous state: Gives an idea about ideal and real gases, various equations of states, viscosity of gases, kinetic phenomenon and related problems
		Unit 2: Liquid state: Gives an idea about various properties of liquids like vapour pressure, viscosity, parachor, their determinations and factors affecting them.
		Unit 3: Solid state: Deals with the laws of crystallography, Bragg's equation, study of crystal systems, crystal defects and underlying problems.
		Unit 4: Ionic equilibrium: Deals with ionisation of ionic solids, pH, hydrolysis of salts, buffer solutions, solubility and solubility products.
	LAB-C II LAB (Credits: Practicals-02)	Viscosity, surface tension, pH determination in the laboratory.

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	C III: ORGANIC CHEMISTRY- I (Credits: Theory-04)	Unit1: Basics of Organic Chemistry Gives an idea about classification, nomenclature, bond fission, electron displacement mechanisms and reaction mechanisms.
		Unit2: Stereochemistry: Gives an idea about geometrical and optical isomerism
		Unit 3: Chemistry of Aliphatic Hydrocarbons Gives an idea about Carbon-Carbon sigma bonds, pi bonds, Cycloalkanes and Conformational Analysis
		Unit 4: Aromatic Hydrocarbons Gives an idea about aromatic compounds, aromaticity, Huck's rule, structure and properties.
	LAB-C II LAB (Credits: Practicals-02)	Gives an idea about Purification of organic compounds by crystallization, Determination of the melting points, Determination of boiling point of liquid compounds, testing purities of compounds on the basis of melting points and chromatography.
	C IV: PHYSICAL CHEMISTRY- II (Credits: Theory-04)	Unit 1: Chemical Thermodynamics: Deals with the terms involved, 1 st law, 2 nd law and 3 rd law of thermodynamics and free energy functions.
		Unit2: Systems of Variable Composition: Deals with partial molar quantities, Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.
		Unit 3: Chemical Equilibrium: Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity, Lachatelliers principle and applications
		Unit 4: Solutions and Colligative Properties: Various laws related to solutions, colligative properties, applications and numerical problems.
	C IV LAB (Credits: Practicals-02)	Determination of heat capacity of a calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide, enthalpy of ionization of ethanoic acid, enthalpy of hydration of copper sulphate, solubility of benzoic acid in water and determination of ΔH .

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	C V: INORGANIC CHEMISTRY-II (Credits: Theory-04)	<p>Unit1: General Principles of Metallurgy Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy.</p> <p>Unit2: Acids and Bases: Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.</p> <p>Unit 3: Chemistry of s and p Block Elements: Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Study of the compounds with emphasis on structure, bonding, preparation, properties and uses.</p> <p>Unit 4: Noble Gases: Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF₂, XeF₄ and XeF₆; Nature of bonding in noble gas compounds</p> <p>Unit 5: Inorganic Polymers: Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.</p>
	LAB-C V LAB (Credits: Practicals-02)	Iodo / Iodimetric Titrations, Inorganic preparations of Cu ₂ Cl ₂ , MnPO ₄ .H ₂ O, Potash alum
	C VI: ORGANIC CHEMISTRY-II (Credits: Theory-04)	<p>Unit 1: Chemistry of Halogenated Hydrocarbons: Preparation and reactions of <i>Alkyl halides</i>, <i>Aryl halides</i>, Organometallic compounds of Mg and Li.</p> <p>Unit2: Alcohols, Phenols, Ethers and Epoxides: Preparation, properties and reactions of alcohols, phenols, ethers and epoxides.</p> <p>Unit 3: Carbonyl Compounds: Name reactions of carbonyl compounds and Active methylene compounds</p> <p>Unit 4: Carboxylic Acids and their Derivatives: Preparation, physical</p>

		properties and reactions of monocarboxylic acids, acid chlorides, anhydrides, esters and amides
		Unit 5: Study of Sulphur containing compounds
	C VI LAB (Credits: Practicals-02)	Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group, Organic preparations, Hydrolysis of amides and esters
	C VII: PHYSICAL CHEMISTRY-III (Credits: Theory-04)	Unit1: Phase Equilibria: Concept of the degrees of freedom, phases, and components. phase diagram for one component systems, with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions. Three component systems, water-chloroform-acetic acid system, triangular plots, <i>Binary solutions</i> .
		Unit 2: Chemical Kinetics: Study of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.
		Unit 3: Catalysis: Types of catalysts, mechanism of catalytic reactions, factors affecting catalytic reactions. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.
		Unit 4: Surface chemistry: Physical adsorption, chemisorption, adsorption isotherms.
	C VII LAB (Credits: Practicals-02)	Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it, study of distribution coefficient, kinetics of reactions, Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

4	VIII: INORGANIC CHEMISTRY-III (Credits: Theory-04)	Unit 1: Coordination Chemistry: Study of Werner's theory, CFSE in weak and strong fields, IUPAC nomenclature of coordination compounds, and isomerism in coordination compounds. Labile and inert complexes.
		Unit 2: Transition Elements: Study of transition elements with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states.
		Unit3: Lanthanoids and Actinoids: Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides
		Unit4: Bioinorganic Chemistry: Gives an idea about the metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine. Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron.
	C VIII LAB (Credits: Practicals-02)	Estimation of Ni(II), Cu(II), Fe(III), Inorganic Preparations of Tetraamminecopper (II) sulphate, <i>Cis</i> and <i>trans</i> $K[Cr(C_2O_4)_2 \cdot (H_2O)_2]$, Potassium tris(oxalate)ferrate(III), Chromatography of metal ions. Paper chromatographic separation of following metal ions: Ni (II) and Co (II)
	C IX: ORGANIC CHEMISTRY-III (Credits: Theory-04)	Unit 1: Nitrogen Containing Functional Groups Preparation and important reactions of nitro and compounds, nitriles and isonitriles, Amines, Diazonium Salts and synthetic applications.
		Unit2: Polynuclear Hydrocarbons Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.
		Unit3: Heterocyclic Compounds Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrimidine, Pyrrole, Thiophene, Pyridine .
		Unit4: Alkaloids Study of natural occurrence, General structural features, Isolation and their

		<p>physiological action. Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.</p> <p>Unit5: Terpenes: Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral, Neral and α-terpineol.</p>
	C IX LAB (Credits: Practicals-02)	Functional group test for nitro, amine and amide groups, Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds)
	C X: PHYSICAL CHEMISTRY-IV (Credits: Theory-04)	<p>Unit1: Conductance Study of conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules. Applications of conductance measurements.</p>
		<p>Unit2: Electrochemistry Study of Faraday's laws of electrolysis, Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb₂O₃ electrodes.</p>
		<p>Unit3: Electrical & Magnetic Properties of Atoms and Molecules Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment and molecular polarizabilities and their measurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement, molecular interpretation.</p>
	C X LAB (Credits: Practicals-02)	Conductometric and potentiometric titrations.
5	C XII: PHYSICAL CHEMISTRY V (Credits: Theory-04)	<p>Unit 1: Quantum Chemistry Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" Qualitative treatment of simple harmonic oscillator model of vibrational motion: Angular momentum, Rigid rotator model of rotation of diatomic molecule.</p>

		<p>Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution. Qualitative treatment of hydrogen atom and hydrogen-like ions. Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2</p>
		<p>Unit2: Molecular Spectroscopy: Study of principles, applications of Rotation spectroscopy, Vibrational spectroscopy, Raman spectroscopy, Electronic spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy, Electron Spin Resonance (ESR) spectroscopy</p>
		<p>Unit 3: Photochemistry Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.</p>
	<p>C XII LAB (Credits: Practicals-02)</p>	<p>UV/Visible spectroscopy & Colourimetry</p> <ul style="list-style-type: none"> • Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units ($J \text{ molecule}^{-1}$, $kJ \text{ mol}^{-1}$, cm^{-1}, eV). • Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$. • Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds. • IV. Verify Lambert-Beer's law and determine the concentration of $CuSO_4/KMnO_4/K_2Cr_2O_7$ in a solution of unknown concentration • Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture. • Study the kinetics of iodination of propanone in acidic medium.

6	C XIII: INORGANIC CHEMISTRY-IV (Credits: Theory-04)	Unit1: Theoretical Principles in Qualitative Analysis (H₂S Scheme): Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions
		Unit2: Organometallic Compounds Study of the definition and classification of organometallic compounds on the basis of bond type, Metal carbonyls, Ferrocene: Metal Alkyls.
		Unit 3: Reaction Kinetics and Mechanism Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.
		Unit3: Catalysis by Organometallic Compounds Study of the following industrial processes and their mechanism: <ol style="list-style-type: none"> 1. Alkene hydrogenation (Wilkinsons Catalyst) 2. Hydroformylation (Co salts) 3. Wacker Process 4. Synthetic gasoline (Fischer Tropsch reaction) 5. Synthesis gas by metal carbonyl complexes
	C XIII LAB (Credits: Practicals-02)	Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations.
	C XI: ORGANIC CHEMISTRY-IV (Credits: Theory-04)	Unit1: Organic Spectroscopy General principles and applications of <i>UV Spectroscopy, IR Spectroscopy and NMR Spectroscopy.</i>
	Unit 2: Carbohydrates Study of occurrence, classification and their biological importance, Monosaccharides, Disaccharides and Polysaccharides.	
	Unit3: Dyes Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and	

		Fluorescein; Natural dyes –structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.
		<p>Unit4: Polymers</p> <p>Introduction and classification including di-block, tri-block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index. Polymerisation reactions</p> <p>Fabrics – natural and synthetic rubbers – natural and synthetic, polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.</p>
	C XI LAB (Credits: Practicals-02)	<ol style="list-style-type: none"> 1. Extraction of caffeine from tea leaves. 2. Preparation of sodium polyacrylate. 3. Preparation of urea formaldehyde. 4. Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars. 5. Qualitative analysis of unknown organic compounds containing monofunctional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols, etc. 6. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided). 7. Preparation of methyl orange.