COURSE & PROGRAM OUTCOMES OF CHEMISTRY

Programme Outcome:

1. Critical thinking (*PO1*):

Chemistry graduates are expected to achieve critical thinking ability to design, carry out, record and analyze the results of chemical reactions. They can have that much potential and confidence that they can overcome many difficulties with the help of their sharp scientific knowledge and logical approaches.

2. Knowledge and understanding (*PO2*):

The program provides the students with comprehensive understanding about the fundamentals of chemistry covering all the principles and perspectives.

3. Communication and employability skill (*PO3*)::

Students develop good communication skills in writing and speaking through vigorous training of recording experiments, viva-voce and presentations. Employability Skills shall enable the students to find jobs in core chemistry and other related fields.

Programme Specific Outcomes:

The Programme enables the students

***PSO1*:** To understand the fundamentals and basic concept of chemistry.

***PSO2*:** To develop the ability to apply the principles of chemistry.

***PSO3*:** To know the role of chemistry in nature and in society.

***PSO4*:** To develop skills in proper handling of apparatus and chemicals.

***PSO5*:** To develop analytical skill and problem solving skills requiring application of chemical principles.

***PSO6*:** To be exposed to the different processes used in industries and their application.

***PSO7*:** To acquire the ability to synthesis, separate and characterize compounds using laboratory and instrumentation techniques.

***PSO8*:** To be familiarized with the emerging areas of chemistry and their application in various spheres of chemical sciences and to apprise the students of its relevance in future studies.

Course outcomes:

B.Sc. Ist Sem (Paper 1)	
Unit name	**Course Outcome**
Atomic Structure and Periodic Properties	• Students will get the knowledge of periodic trends, arising from the arrangement of the periodic table. • Also provide students with an invaluable tool to quickly predict an element's properties. • How these trends exist because of the similar atomic structure of the elements.
Chemical Bonding-I	• The unit gives knowledge of different types of bonds present in molecules. • Students will get the knowledge of various types of hybridization and shapes of different inorganic and organic molecules. • Valence Shell Electron Pair Repulsion Theory (VSEPR) and shapes simple molecules/ions.
Mechanism of Organic Reactions:	• The unit gives a theoretical knowledge of multiple stages in an overall chemical reaction. • Also describes intermediates, transition states and states of all bonds broken and formed. • Enables students to understand the stereochemistry, major and minor product, mechanism of organic reaction.
Stereochemistry of Organic Compounds	• The unit gives the clear picture of two dimensional and three dimensional structures of the molecules and their role in reaction mechanism.
States of Matter-I	• Upon successful completion students should be able to: • State and apply ideal gas concept and perform calculations with ideal and real gases. • To learn depth knowledge about liquid states.
States of Matter-II	• To apply the concepts of colloids and gels. • Will understand the difference between crystalline solids and amorphous solids.
Practical paper	
Salt mixture analysis:	• The students will have the knowledge and skills to understand the laboratory methods and tests related to inorganic mixture analysis and qualitatively estimate anions and cations in samples.
Organic exercise	• Upon completion of this exercise the students will able to understand the absolute configuration of organic molecules with the help of models.
Physical exercise	• This exercise will provide the knowledge of estimation of surface tension

	of commercial products. • Also how to determine the relative surface tension of a given liquid.
B.Sc. IInd Sem (Paper 1)	
Chemical Bonding-II	• Will able to understand the bonding in inorganic compound.
Salient Features of s- and p-Block Elements	• The students will able to understand the bonding in inorganic molecules, salient features of s- and p- block elements.
Aliphatic Compounds:	• This unit provides students basic knowledge of reactions shown by aliphatic compounds.
Aromatic Compound	• Successful completion of this course will make students to describe the reactions shown by aromatic compounds.
Chemical Kinetics and Catalysis	• After completion the students will be able to derive the rate equations from mechanistic data. • The use of simple models for predictive understanding of physical phenomena associated to chemical kinetics. • The limitations and uses of models for the solution of applied problems involving chemical kinetics.
Thermodynamics I	• The application of mathematical tools to calculate thermodynamics. • The relationship between microscopic properties of molecules with macroscopic thermodynamic observables. • To make use of simple models for predictive understanding of physical phenomena associated to thermodynamics and its limitations.
Practical paper	
Inorganic exercise	• After completing this course, the students will be able to quantitatively find out the amount of acid or base in the samples.
Organic exercise	• To qualitatively differentiate among different classes of organic compounds.
Physical exercise	• To measure the relative viscosity of a given liquid.
B.Sc. IInd Year (Paper 1)	
Chemistry of Transition Elements (First Transition Series)	• The unit provides information on transition elements and their co-ordination compound of first transition series.
Chemistry of	• Give detailed knowledge second and third transition series elements and

Transition Elements (Second and Third Series)	their characteristics.
Oxidation and Reduction	• Students get basic knowledge of redox reaction.
Coordination Chemistry	• After completion of this unit the student will have knowledge of various terms involved in co-ordination chemistry, Werner's theory and VBT of transition metal complexes.
Chemistry of Lanthanides	• Get knowledge of Chemistry of Lanthanides.
Chemistry of Actinides	• Will able to understand the chemistry of Actinides.
Acids and Bases	• Will understand Arhenius, Bronsted-Lowry, Lewis concept of acids, bases, solvent system concept and effect of electron withdrawing and electron donating group.
Non Aqueous Solvents	• Students will be able to understand non-aqueous solvents such as liquid ammonia and liquid sulphur dioxide.
B.Sc. IInd Year (Paper 2)	
Electromagnetic Spectrum; Absorption Spectroscopy	After completing this unit, it is expected that students will be able to: • Understand the principles and theories of UV-visible spectroscopy. • Understand the principles and theories of IR spectroscopy. • Discuss the UV-Visible and IR spectroscopic methods in structure determinations.
Alcohols	After completing this unit, it is expected that students will be able to: • Discuss the physical and chemical properties of monohydrin, dihydric and trihydric alcohols. • Compare and contrast the structure and different reactions of primary, secondary and tertiary alcohols.
Phenols	• Get to know about nomenclature, structure, bonding phenol and mechanisms of phenol based reactions.
Ethers and Epoxides	After completion of this unit students will able to understand about different types of ether and epoxides, their synthesis and physical and chemical properties like acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening
Aldehydes and Ketones	After completing this unit, it is expected that students will be able to: • Understand different synthetic pathways of aldehydes and ketones. • Familiar with the mechanism of nucleophilic additions to carbonyl groups. • Use diols in the protecting of aldehydes and ketones.

Carboxylic Acids and their Derivatives	• This unit provides knowledge of different types of aliphatic and aromatic carboxylic acids. • Also includes synthesis and applications of carboxylic acid and their derivatives and functional groups inter conversion.
Nitrogen Containing Organic Compounds	• Students will have the knowledge of preparation, chemical reactions and mechanism of nucleophilc substitution reaction of nitroalkanes and nitroarenes.
Organic Synthesis via Enolates	• Understand acidity of hydrogen, alkylation, synthesis and condensation of ethylacetoacetate.
B.Sc. IInd Year (Paper 3)	
Thermodynamics II	• Will understand the concept of thermodynamics second law its application on various system and limitation. • Also get knowledge of different thermodynamical terms like entropy, Gibbs free energy etc and their variation with temperature, pressure and their application in numerical problem.
Chemical Equilibrium	• Students will have the knowledge of basic concepts of spontaneity and chemical equilibrium and able to apply these concepts in predicting the spontaneous reactions and will be able to solve the numerical problems based on these concept.
Phase Equilibrium	• Students will be able to learn the basic concepts phase equilibrium and able to find out degree of freedom of different component system and application of the concept.
Electrochemistry I	• The students will be able to describe the concepts of electrochemistry in detail and its applications. Also, they will be able to solve the numerical problems based on these concepts.
Electrochemistry II	• Students learn depth concepts about electrochemistry.
Surface Chemistry	• At the end of the unit students should be able to explain various adsorption processes, theory and its mechanisms on the surfaces.
Practical paper	
Gravimetric estimation	• Estimate various metals (Ba, Zn, Ni etc.)
Inorganic Synthesis	• Prepare different inorganic compounds.

Identification of Organic compound	• Able to identify various organic compounds.
B.Sc. IIIrd Year (Paper 1)	
Hard and Soft Acid-Base Theory	• After successfully completing this course, students will be able to understand the Classification of acids and bases as hard and soft. Pearson's hard and soft acid base concept, acid base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.
Metal-Ligand bonding in transition metal complexes	• After successfully completing this course, students will be able to understand the limitations of valence bond theory and an elementary idea about crystal field theory. • To learn about the crystal field splitting octahedral, tetrahedral, and square planar complexes, and factors affecting the crystal-field parameters
Magnetic Properties of Transition Metal Complexes	• To learn about theTypes of magnetic behaviorand methods of determining magnetic susceptibility for 3D metal complexes. • To learn about Gouy's and Quincke's methods, spin-only formula, correlation of μs and μeff values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes
Electronic Spectra of Transition Metal Complexes	• To learn about the Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, and spectrochemical series. Orgel energy level diagram for d1, d2 and d8, d9 states, discussion of the electronic spectrum of [Ti(H2O)6] 3+ complex ion.
Thermodynamic and Kinetic aspects of Coordination Compounds.	• To learn about the thermodynamic and kinetic stability of metal complexes and factors affecting the stability of coordination compounds.
B.Sc. IIIrd (Year Paper 2)	
Organometallic chemistry	• To learn about the basic concept of organometallic chemistry. • To learn about the mononuclear carbonyls, nature of bonding, structure, and preparation. EAN and 18- electron rule
Bioinorganic Chemistry	• To learn about the basic concept of bioinorganic chemistry. • To learn about the elementary idea of structure and oxygen binding mechanism in metalloporphyrins. • To learn about the Alkali and alkaline earth metal ions in biological system-mechanism of transport across the cell membrane.
Inorganic Polymers of Silicon and	• To learn about the basic concept of inorganic polymers. • To learn about the nature of bonding in inorganic polymers of silicon and phosphorus.

Phosphorus	
Spectroscopy	• To study the fundamental laws of spectroscopy and selection rules.
Organo-metallic Compounds	• To learn about the basic concept of organometallic compounds. • To learn about the structure, preparation methods and chemical reactions of organomagnesium and organozinc compounds.
Organo-sulphur compounds	• To learn about organosulphur compounds' nomenclature, structure, preparation methods and chemical reactions.
Hetrocyclic compounds	• To learn about Molecular orbital picture and aromatic characteristics, methods of synthesis and chemical reactions of pyrrole, furan, thiophene and pyridine.
Carbohydrates	• To learn about the classification, structure and nomenclature of monosaccharides. • To learn about the mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and shortening of aldose.
Amino Acids, Peptides, Proteins and Nucleic Acids	• To learn about the classification, structure, stereochemistry and preparation methods of Amino Acids, peptides, proteins and nucleic acids.
Fats, Oils and Detergents	• To learn about the Natural fats and common fatty acids, glycerides, hydrogenation of unsaturated oils, saponification value, iodine value and acid value.
Synthetic Polymers	• To learn about the history, functionality and importance of polymeric materials. • To study the kinetics of polymerization, crystallization and crystallinity of polymers. • To understand the nature and structure of polymers, determination of molecular weight of polymers, and Tg. • To study the preparation, structure, properties and application of different types of addition and condensation polymers.
Synthetic Dyes	• To learn about the colour and constitution, classification of dyes. Synthesis and uses of Methyl orange, Malachite green, Phenolphthalein, Fluorescein, Alizarin, and Indigo.
Natural Products	• Students of undergraduate courses are continuously being introduced to and encouraged by the different possibilities in this field. It helps students to think and perform to design and develop environmentally benign methods for organic synthesis.
B.Sc. IIIrd Year (Paper 3)	
Elementary	• Learning the Quantum Mechanics will help them to praise the beauty of

Quantum Mechanics	behavior of fundamental particles. It will assist them to get a suitable job in the relevant industrial and scientific field.
Spectroscopy	• To study the fundamental laws of spectroscopy and selection rules. • To get a vast knowledge of the principles, experimental techniques, and broad chemical application of Rotational, Vibrational, Electronic, and Raman spectroscopy.
Photochemistry	• To learn about various photochemical and photophysical processes like fluorescence, phosphorescence, etc., various laws of photochemistry, and the concept of quantum yield. Students can also learn about the detailed theoretical and mathematical treatment of reaction rate and the mechanism of unimolecular reactions
Physical Properties and Molecular Structure	• To learn about Optical properties and their relation with the chemical constitution, polarization, Clausius Mossotti equation, orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method, and refractivity method, dipole moment and its application in determining the structure of molecules.
Solutions and Colligative Properties	• To learn about Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity, and activity coefficient. • To learn about colligative properties. • To learn about experimental methods for determining various colligative properties.
Thermodynamics III	• To learn about the concept of entropy, the third law of thermodynamics, the unattainability of absolute zero, Nernst heat theorem.
Organic qualitative analysis	• Understand organic qualitative analysis; binary mixture of organic compounds separable by H_2O and $NaHCO_3$
Organic synthesis	• Get knowledge of organic synthesis; through nitration, halogenation, acetylation, sulphonation and simple oxidation.
Physical chemistry experiment	• Able to do experiments based on solubility, transition temperature and phase equilibria, thermochemistry and electrochemistry