- **Department of Chemistry**
- **Course Outcomes.**
- **F Y B Sc.**

- **Semester -1**

CH-111: Physical and Inorganic Chemistry	• Develop an ability to use conceptual and mathematical tools to express and predict atomic and molecular behavior. • Predict atomic structure, chemical bonding or molecular geometry based on accepted models. • Convert scientific equation in straight line to get physical parameter for slope and intercept. • Physical and chemical properties of some elements. • VSPER Theory and shape of molecules.
CH-112: Organic and Inorganic Chemistry	• Able to understand general properties and applications of organic compounds. • Learn structural effect, purification technique and solvent properties. • Common and IUPAC nomenclature of various type of organic compound. • Study and understand alkane, alkene and alkyne preparation and properties. • Learn S- block elements (Alkali metals and Alkaline earth metals) • Understand concept of Arrhenius theory, Bronsted- Lowry theory, and Lewis theory. • Learn ionic product of water and Buffer solutions.
CH-113: Chemistry Practical	Students should understand, • Calibration of apparatus like volumetric flask, pipette and burette. • Determination of heat of solution, equivalent weight, surface tension etc. • Inorganic qualitative analysis. • Preparation of solution and standardization of instruments.

- **Semester -2**

CH-121: Physical and Inorganic Chemistry	Students should understand, • Second law of thermodynamics • Cell constant and use of it to obtain specific and equivalent conductance. • Physical properties of liquid state such as surface tension and viscosity. • Types of bonding and types of overlaps. • Steps involve in metallurgical process.
CH-122: Organic and Inorganic Chemistry	Students should understand, • Preparations, reactions and properties of halogen derivatives of Alkane. • Preparations, reactions and properties of Alcohol, Ether and Epoxide. • Preparations and reactions of carbonyl group. • Preparation of carboxylic acids. • Determine the Molecular weight, formula weight, equivalent weight of organic compounds. • Electronic structures, size of atoms and ions, ionization energy, metallic and nonmetallic of p-block elements.
CH-123: Chemistry Practical	Students should understand, • Determine the viscosity and relative viscosity of liquids. • Conductometric titration. • Organic qualitative analysis.

	• Quantitative analysis by volumetric method

- **S Y B Sc.**

- **Semester -1**

CH 231: Physical and Inorganic Chemistry	Students should understand, • Electronic structures, size of atoms and ions, ionization energy, metallic and nonmetallic of d-block elements. • Concept of Helmholtz free energy • Numerical calculations of Gibbs free energy. • Concept of vapor pressure of liquids. • Metallic Bond. • Metallurgy of Aluminum.
CH 232: Organic and Analytical Chemistry	Students should understand, • Review the concept of isomers and discuss the isomer which results from free rotation of C-C-single bond, from a chirallity, from restricted rotation, R, S and E, Z nomenclature. • Study of amines their formation reactivity. • Study of reactivity, preparation and reactions of organo Li, Cu, Zn compounds. • Importance of analytical chemistry in analysis of compounds by titrimetric, gravimetric and instrumental methods. • Know the importance of sampling methods and ways of interpretation of results of analysis. • Determine the causes of errors and their minimization during analysis • Learn the application of types of titrations for quantitative analysis of the samples.
CH 233: Chemistry Practical	Students should understand, • Determine thermodynamic parameter • Volumetric analysis by titrimetric, gravimetric and instrumental methods • Techniques of chromatography for separation of components in the mixture. • Preparation and purification of organic compounds. • Preparation of inorganic complexes.

- **Semester -2**

CH 241: Physical and Inorganic Chemistry	Students should understand, • Colligative properties and its application calculation of molecular weight of solutes • Concept of electromotive force and its measurement • Classification of electrodes. • Properties of Lanthanides and actinides. • Extraction and separation technique of Lanthanides and actinides. • Concept of combination of atomic orbitals like s-s, s-p, p-p, p-d & d-d. • Molecular orbital diagram of homo and hetronuclear diatomic molecules.
CH 242: Organic and Analytical Chemistry	Students should understand, • Synthesis and reaction of 5, 6 member and condensed heterocyclic systems.

	• Synthesis of synthetic reagents and their synthetic utility. • Know the mechanism and stereochemistry of E1, E2 reaction. • Concept of quantitative analysis by gravimetric methods. • Separation of analytes in samples by thin layer, paper and column chromatographic methods.
CH 243: Chemistry Practical	Students should understand, • Qualitative analysis of organic compounds. • Qualigative properties depression of freezing point and elevation of boiling point. • Estimate of Nickel and Barium gravimetrically. • Use of potentiometer for determination of standard electrode potential.
• **T Y B Sc.**	
• **Semester -1**	
CH 351: Physical Chemistry	Students should understand, • Spontaneous and non spontaneous processes. • Theory and principal of electrochemical cell. • Laws of photochemistry (Grothus Draper Law and Stark Einstein law) • To predict phase equilibrium and spontaneity of reaction. • To define phase of matter, describe phase change and interpret and construct phase diagram • Various devices to measure the radiation from radioactive sample.
CH-352: Inorganic Chemistry	Students should understand, • Basic concept of the co-ordination compound, and identify the types of given ligand, chelates. • Different physical method for the study of complexes. • Nomenclature of co-ordination compound. • Effective atomic number (EAN) and how to calculate EAN for any given complexes. • Modern theories of metal-ligand bond related to valence bond theory. • Application of CFT related to different geometry i.e. Square planer, tetrahedral, Octahedral. • Basic concept about CFT. Stabilization energy related to weak and strong field, limitation of theory and John Teller distortion. • Difference between V.B.T., C.F.T. and M.O.T.
CH-353: Organic Chemistry	Students should understand, • The Inductive, resonance, hypercojugation and sterric effect. • Concept of aromaticity electrophilic and nucleophilic aromatic substitution reaction. • Molecular rearrangement involving migration to C, N and Oxygen. • Drawing the resonating structures. • Understand Nucleophilic substitution reactions. • Understanding electrophilic addition reactions.
CH-354: Analytical Chemistry	Students should understand, • Procedure of extraction of metal ions using Solvent Extraction process. • Application of Ion Exchange Chromatography method for the separation of cations and anions using different types of resins. • Applications of Size Exclusion Chromatography for the separation of

	analytes based on their size and shapes. • Working of Gas Chromatographic unit and apply the knowledge to separate volatile compounds in sample. • Principle, choice of column materials for HPLC and its application. • Principles of Electrophoresis and choice of techniques of electrophoresis for various applications
CH-355: Industrial Chemistry	Students should understand, • Concept of Industrial chemistry. • The manufacturing of sugar. • Types of fertilizer and manufacturing of ammonium sulphate, Urea, super triple phosphate. • Fermentation process and preparation of Beer, spirit and alcohol from molasses. • The aspects of small scale industry.
CH 356: B Environmental Chemistry	Students should understand, • Atmosphere and air Pollution. • Hydrosphere and water pollution. • Water treatment and effluent management. • Instrumental methods in environmental analysis. • The green house effect and global warming.
CH-357: Physical Chemistry Practical	Students should understand, • To prepare molar and normal solutions of various concentrations. • Determine concentration of unknown solutions by colorimetric method. • Measure the pH, pKa and Ka of various acids by potentiometry. • Measure refractive index, molar refraction and unknown concentration of various solvents. • Determination of molecular weight of a given Substance by steam distillation and viscometric method.
CH 358: Inorganic Practical	Student should understand, • Preparation of various inorganic complexes. • Chromatographic technique (paper chromatography). • Estimate Lead and Iron by gravimetric method. • Estimate Titanium and Iron by Spectrophotometric method. • Volumetric analysis of manganese and nickel.
CH 359: Organic Practical	Students should understand, • Separate and analyze binary water insoluble mixture • Separate and analyze binary water soluble mixture • Estimate - acetamide, glucose by volumetric method • Determination of saponification value of fatty oils.
	• **Semester -2**
CH-361: Physical Chemistry	Students should understand, • Types of spectra, Rotational, Vibration and Electronic energy level diagrams • Culture a basic understanding of how molecular spectra can be use • Difference between order to determine atomic and molecular properties.

	• First, second and third order reaction and able to discribe reaction rate. • Concept anisotropic, isotropic and polymorphism, • Concept Photoelectric effect, X- ray analysis, Compton Effect and Heisenberg's uncertainty principle.
CH-362: Inorganic Chemistry	Students should understand, • Electronic structure, Extraction, uses, oxidation states and biological role of Cu. • Basic theory of Acid and bases. • Hard and Soft acid bases concept theories, application and limitations. • Different types and theories of Corrosion and how to protect Metal from corrosion. • Concept of passivity, it's types and causes. • VSEPR theory to know structure containing lone pair of electron and shape of different molecules and anions. • Occurrence, extraction, Properties and uses of transition and Inner transition Elements.
CH-363: Organic Chemistry	Students should understand, • Common terms in spectroscopy. • Learn Physical methods of structure determination which includes IR, UV and NMR. • Solve the problems based on IR, UV and NMR. • Retro synthesis. • Predict synthons and equivalent reagents. • Solve the problems based on retro synthesis. • Study of natural products for the determination structure of extracted natural compounds.
CH-364 Analytical Chemistry	Students should understand, • Concepts of spectrometry, know the principles of instruments and their applications. • Principle, working and applications of Flame and Plasma Emission Spectrometry. • Principle, Instrumentation and application of Atomic Absorption Spectrophotometry. • Principle, Instrumentation and applications of Turbidimetry and Nephelometry. • Principle, Instrumentation and applications of thermo gravimetric methods like TGA, DTA and DSC.
CH-365: Industrial Chemistry	Student should understand, • To know about petroleum Industry and different useful products from this industry. • The process of manufacturing of daily use material like sopes and detergents and drugs. • The surface coating by dyes, pants and pigments
CH 366: Polymer Chemistry	Students should understand, • The basic concepts of polymerization. • The different methods of polymerization. • Various polymerization techniques.

	• The preparation, properties and applications of Polyethylene, Polypropylene, Polyvinyl chloride, Polystyrene, Polyacrylonitrile, Polycarbonates, Phenol-formaldehyde resins, Epoxy resins, Polyester (PET), Polyamides (nylon 6 and nylon 66), Polyvinyl alcohol, Polylactic acid and Polyaniline. • Concept Glass transition temperature.
CH-367: Physical Chemistry Practical	Students should understand, • Investigate the reaction rate. • To determine strength and basicity of acid using conductometer. • Determination of optical activity of compound by polarometric method. • Degree of hydrolysis by pH metric method. • The thermal property of substance.
CH-368: Inorganic Practical	Students should understand, • Estimate ores and alloy by gravimetric and volumetric method. • Separate and analyze binary mixtures by qualitative method
CH-369: Organic Practical	• Students should understand, Preparation of various organic compounds and derivatives.

M. Sc. I

- **Semester -1**

CH-P-110: Physical Chemistry I	Students should understand, • Quantum mechanical Principles and equation with electronic structure of atoms, molecules etc. • Mechanics of particle in one, two and three dimensional box. • Learn parent - daughter relationship, application of radioactivity, NAA, IDA. Effect of radiation and units of radiation. • Learn the Fricke and cerric sulphate dosimeter. • Ionic strength, activity coefficient and DHO equation. • Relation between adsorbate and adsorbent.
CH-130: Inorganic Chemistry Paper I	Students should understand, • Molecular orbitals and its orientation. • Geometry and shape of the molecule • Bond angle and dipole moments of the inorganic molecule. • 18 electron rule and application. • Point group of inorganic molecules. • Preparation and properties of transition metal by various methods. • Concept of symmetry elements in molecules.
CH-150: Basic Organic Chemistry	Students should understand, • Stereo chemical principles, enantiomeric relationship R and S, E and Z. • Nomenclature in C, N, S, P containing compound. • SN1, SN2 and SNi mechanism and stereochemistry. • NGP by pi and sigma bonds, classical and non -classical carbonations • Alkylation and acylation reaction. • Types of addition, elimination and substitution reaction. • Type of elimination reaction E1, E2, E1-CB and stereochemistry of elimination reactions.

Semester -2	
CH-P-210: Physical Chemistry II	Students should understand, • The relation between energy and flow of energy with physical parameters. • The average behavior of a mechanical system whose exact state is uncertain. • The statistical thermodynamics and various partition functions. • The rate of reaction with mathematical model and conditions for gating a maximum yield in industrial product. • The molecular spectroscopy: I.R, Raman, electronic and Mossbauer and its application.
CH-230: Inorganic Chemistry Paper II	Students should understand, • Learn mechanism in transition metal complexes. • Rate law and their interpretation • Learn radius ratio rule of coordination no 3, 4, 6. • Born-Haber cycle to calculate lattice energy. • Classification, uses and catalytic steps of catalyst reactions. • Structure of atom, Hunds rule, Term symbol, calculation of microstates, orbital selection rule. • Know metal complexes involved in biological systems:- Vitamin-B12, Chlorophyll, Hemoglobin.
CH-250: Name Reactions, Synthetic Organic Chemistry & Spectroscopy	Students should understand, • Various name reaction with example. • Synthetic reagents of oxidation and reduction for solving the example. • Mechanism of rearrangements reaction. • Factors affecting on UV absorption spectra. • Interpretation of IR spectra. • Problems of UV, IR and NMR.
CH-290: General Chemistry	Students should understand, • Problems on Chemometrics Mean and Standard deviation. • Theory of electrogravimetric analysis, Electrolytic separation and determination of metals. • Instrumentation, choice of Mobile Phase, Solvent Treatment systems, Pumping systems, Sample injection systems, Columns, Detector for High Performance Liquid Chromatography. • Principle, theory of Glass Membrane Potential, The Alkaline and Acid Error, Standard Buffers, Accuracy of pH , Measurements with the pH-meter, types Ion selective Electrodes. • Voltammetric Electrodes, Detectors, Amperometric Sensors, Amperometric Titrations. • Phosphorescence, Fluorescence and Photo luminescent phenomena used for determination of mixtures.
CH-P-1: Physical Chemistry Practical	Students should understand, • Prepare molar and normal solutions of various concentrations. • Determine concentration of unknown solutions and degree of hydrolysis and hydrolysis Constant by Canductometrically.

	• Determine stability constant of a complex ion and standard free energy change ΔG^0 and equilibrium constant by potentiometry. • Investigate the rate constant for depolymerization , energy of activation and order of the reaction • Calculate Hammett constant of a given substituted Benzoic acid by pH measurement. • Determine the amount of Aspirin in the given tablet. • Determine specific rotation and percentage of two optically active substances by polarimetrically.
CH:I-1: Practical Course Inorganic Chemistry	Students should understand, • Perform gravimetric and volumetric analysis ores. • Analyse binary mixtures by gravimetric and volumetric method. • Determine the lattice energy of binary salt. • Strength determination by pH metry method. • Prepare various inorganic complexes and determination of its Percent purity. • Analyse iron from given drug sample and calcium in milk sample. • Perform paper chromatographic technique. • Estimate phosphate from waste water by spectrophotometry. • Amount of Cu determination by iodometric method (Potentiometrically).
CH-O-1: Organic Chemistry Practical	Students should understand, • Chemistry software's like ISI draw, chem. Draw, Chem sketch. • Draw the different structure of organic compound, sketch design reaction mechanism scheme of addition and substitution reaction. • Thin layer chromatography technique for completion of reaction. • Single and two stage preparation. • Apply knowledge of Green principle for organic synthesis • Make use of soxhlet extractor and steam distillation assembly for Purification of organic compound.

M. Sc. II (Organic Chemistry)

- **Semester -1**

CH-350: Organic Reaction Mechanism	Students should understand, • Compare the major and minor product of variety of organic reaction. • Understand accepted mechanism of organic reaction including all intermediates • Solve the problems on Taft and Hammet constant. • Understand Concave upward and downward deviation. • Learn the type's hydrolysis of ester. • Solve problems on Anchimetric assisted reaction.
CH-351: Spectroscopic Methods in Structure Determination	Student should understand, • Principle, instrumentation and application of ^{1}H, ^{13}C, ^{15}N, ^{19}F, ^{31}P-NMR and Mass spectroscopy. • 2D NMR techniques for the organic compounds with interaction of homo and hetero nuclei. • Applications of NMR in the elucidation for the structure of organic and

	Bio-organic molecules. • Analyze reaction sequences by using spectroscopic technique.
CH-352: Organic Stereochemistry	Students should understand, • The basic concepts of stereo chemistry and spatial arrangement of the atoms in the molecule. • The chiral selective reagents in the organic transformations for the selective chiral products in asymmetric synthesis. • How to selectively introduce chiral auxiliaries for the synthesis of useful drug molecules. • The ORD and CD and its applications for the Cotton effect.
CH-353: Free radical, photochemistry and pericyclic reaction	Students should understand, • Quantum yield and electronic states. • Norrish-I and Norrish-II cleavages, Paterno-Buchi reaction. • Photochemistry of olefins and arenes: 1, 2- , 1, 3- and 1, 4- additions. • Free radical reaction contain Halogen, Sulphur, and, Selenium Group transfer reaction. • Selection rule for thermal and photochemical reactions. • Frontier molecular orbital approach [FMO] and Aromatic transition state approach according to Huckel and Mobius system.
Semester -2	
CH-450: Chemistry of Natural Products	Students should understand, • Biological importance of vitamins B1, B2, B6, folic acid, B12, C, D1, E, K1, and K2. • Classify sources of various vitamins. • Structure stereochemistry and biogenesis of hardwickiic acid, Camptothecin and podophyllotoxin • Role of enzyme in reactions. • Synthesize natural organic compounds by chemical methods. • Stereochemistry of natural product.
CH-451: Synthetic Methods in Organic Chemistry	Students should understand, • Transition metal complexes in organic synthesis: Rh, Pd, Co, Fe, Ni, Pt, Ru, Grubb's catalyst and Ziegler Natta catalyst,. • Design the organic compounds by use of synthetic reagents • Role of Umpolung in organic synthesis. • Protection and deprotection in the synthesis of polypeptide and polynucleotide. • Know basic principles of green chemistry and design green synthesis. • Use ecofrindly green reagents, solvents, catalysts and reaction conditions.
CH-452: Heterocyclic chemistry, Chiron approach, chiral drugs and medicinal chemistry	Students should understand, • Synthetic routes, their reactions and reactivity for variety of heterocyclic compounds and applications. • Important Terms – Receptor, therapeutic index, bioavailability, Drug assay and drug potency used in medicinal chemistry. • Structure of triose, Pentose, hexose, Stereochemistry and reaction of Glucose, Confirmation and anomeric effects in hexoses. • Synthesis and Pharmacological activity of S-Ibuprofin , S-Metaprolol,

	(+) Ephedrime • Basic Pharmacokinetics of drugs, anti Microbial drugs, Antifungal, Antibacterial, antiviral, antiprotozoals. • Chiron approach basic concepts and Synthesis.
CH-O2: Organic Practical Chemistry M.Sc. II	Students should understand, • Separate organic compounds in different phases. • Qualitative test to analyze functional group of organic compounds. • Distillation technique. • Detect elements N, S, and X in organic compounds. • Purification techniques of organic compounds.
CH-O-3: Three Stage Preparations	Students should understand, • Perform three stage preparations. • Draw the reaction mechanism. • Purify the organic compounds by crystallization. • Perform chromatographic technique to check completion of reaction. • Apply the knowledge about different reaction conditions
CHO-4: Short Research Project	Students should understand, • Literature survey for the topic of the project. • Standardize reaction conditions for synthesis, new methods of synthesis, isolation of product and give mechanism. • Handle instruments for analysis and discuss their experimental results. • Used ICT tools to prepare project reports and present it using Power point presentation. • Work within a small team to achieve a common research goal.

M. Sc. II (Inorganic Chemistry)

- **Semester 1**

CH-330: Coordination Chemistry	Students should understand, • Types of mechanisms. • Substitution reaction of octahedral and square planer complexes. • Steriochemical changes in octahedral complexes. • Biological role of S-block elements. • Biological role of transition elements. • Metals in Medicine.
CH-331: Inorganic Polymer Chemistry	Students should understand, • Basic Concepts, Synthesis, Characterization and application of Zeolites. • Supramolecular Chemistry. • Metal cluster. • Macrocyclic complexes.
CH- 332: Solid State Chemistry	Students should uderstand, • Classification of Defect of solid. • Lattice Imperfection of solid. • Types of amorphous Solids and there classification. • Types and properties of ceramic material. • Types and properties of composite material. • Types of Semiconductor devices. • Magnetic Behavior of material.

CH- 333: Some selected topics in Inorganic Chemistry	Students should uderstand, • Basic principles of Group Theory. • Basic and applied Chemistry. • The chloroalkali Industry, Nobel gases, Metal-ligand equilibrium in solutions.

Semester 2

CH-430: Applications of Group Theory and Coordination Chemistry	Students should uderstand, • Hybridization scheme in sigma and pi bonding of atomic orbital. • Molecular orbital theory. • Transformation properties of H_2O, NH_3 and BF_3 molecule. • Molecular term Symbol for transition metal complxes. • Electronic spectra of metal complexes. • IR Spectroscopy conditions. • Ligand field theory of coordination compound.
CH- 431: Physical Methods in Inorganic Chemistry	Students should uderstand, • Nuclear magnetic resonance spectroscopy. • Electron spins resonance spectroscopy. • Mossbauer spectroscopy. • Mass spectroscopy. • Thermal methods TGA, DTG, DTA, DSC.
CH-I-2: Practical Course	• Analysis of Cement, Eliminite, Steel, Bronze, Fertilizer, Soil. • Analysis of vitamin C. • Estimation of Fe from soap bar. • Analysis of pigment, POP. • Complexomtry of bismuth titration**.**
CH-I-3 : Practical Course	Students should uderstand, • Synthesis Purification and analysis of coordination complexes of simple and chelating ligands. • Phase diagram study. • TGA • Stability constant of metal complex. • Kinetic masking. • Argentometry.
CH-I-4: A short research project	• Students should uderstand, • Literature survey, Research Methodology and Industrial tour.

Program Outcomes

	Job opportunities for B.Sc. (Chemistry) students • The course helps the students in improving their diverse skills in various areas such as laboratory skills, numerical and computing skills, ability to approach to the problems both analytically and logically, time management skills, etc. • As a Chemist in the Sugar, Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Rubber, Petroleum, Pesticide, Food industries.

	• As a Chemist in Municipal Corporation, Water treatment plant. • For Research and Development department of Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Rubber, Petroleum, Pesticide, Food, Plastic, Ceramic, Perfumery, Agrochemical industries. • In the Q.C. department of pharmaceutical, chemical, soap, detergent, surfactant, cement, fermentation, dye, rubber, petroleum and pesticides industries. • In the Q.A. Executive in Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Rubber, Petroleum, Pesticide, Food industries. • In the Production section and plant operator in Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Paper Rubber, Petroleum, Pesticide, Food industries. • As an analyst in synthetic labs, Forensic Science Department, etc. • As a Marketing Representative (M.R.) for the Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Paper, Rubber, Petroleum, Pesticide, Food products. • As a Analytical Chemist, Biomedical Chemist, Chemical Engineering Assistant, Industrial Research Scientist, Lab Chemist, Materials Technologist, Production Chemist, Production Officer, Quality Controller, R&D Chemist, Research & Development, Safety Health And Environment Specialist, Teacher.