Department of Chemistry

Govt. P. G. College Khargone M.P.

Outcomes of UG course

Course Outcomes B.Sc. First year Chemistry	
Course	After successful completion of three-year degree program in BSc students should be able to
Physical Chemistry **Unit 1**	1. Use of log table and antilog table in calculations. 2. Students will be able to learn differentiation of functions, maxima and minima, integration of some useful functions. 3. Solve the numerical problems based on ideal gas equation. 4. Understand the term PV isotherm, root mean square average and most probable velocities. 5. Know the meaning of collision numbers, mean free path and collision diameter.
Unit 2	1. Understand the difference between liquid crystal, solid and liquid. 2. Understand the classification and structure of nematic and cholesteric phases. 3. Understand laws of crystallography. 4. Describes Bragg's law. 5. Explain the structure of ionic solids.
Unit 3	1. Define the average and instantaneous rate of reaction. 2. Write an expression for rate constant K for first, second and third order reaction. 3. Solve the numerical problems based on rate constant. 4. Describe collision theory and transition state theory.
Unit 4	1. Describe theory of radioactivity. 2. Distinguish between nuclear fission and nuclear fusion reaction. 3. Understand the meaning of half-life period, isotopes, isobars and isomers. 4. Know the application of radiochemistry in daily life.
Unit 5	1. State the law of mass action. 2. Understand the use of Le-Chatelier's principle in heterogeneous system. 3. Define lyophilic and lyophobic colloids. 4. Understand the use of Hardy Schulz rule. 5. Classify emulsions and describe their preparation and properties. 6. Understand the uses of colloids.

Course	Outcomes
Inorganic chemistry **unit 1**	1. Students will able to state the de- Broglie relation and Heisenberg uncertainty principle. 2. Define an atomic orbital in terms of quantum numbers. 3. Derive an expression for Schrodinger wave equation. 4. Know the significance of ψ and ψ^2. 5. State Aufbau principle, Pauli Exclusion Principle and Hund's rule. 6. Write the electronic configuration of atoms. 7. Understand the meaning of atomic and ionic radii, ionization energy, electron affinity and electronegativity.
unit 2	1. Describe valence bond theory and its limitations. 2. Predict the directional properties of covalent bonds. 3. Determine shapes of simple inorganic molecules and ions and types of hybridization. 4. Describe the VSEPR theory and MO theory.
unit 3	1. Describe the lattice defects in solids and their effect on properties. 2. To understand Born-Haber cycle in determining lattice energy of ionic solids. 3. Know the meaning of lattice energy, solvation energy, polarizing power and polarizability of ions. 4. Understanding the intermolecular forces (hydrogen bonding van der wall forces. 5. To understand the various applications of noble gases.
unit 4	1. Understand the meaning of term diagonal relationship. 2. Explain the general characteristics of the compounds of the alkali metals. 3. Recognises the anomalous properties of lithium. 4. Illustrate the biological importance of sodium and potassium. 5. Describe structure and properties of some important compounds of boron.
unit 5	1. Understand the methods of preparation of diborane and higher boranes. 2. To understand the structure of diborane.

Course	Outcomes
Organic chemistry **Unit 1**	1. Understand the shapes of atomic orbitals. 2. Know the meaning of various terms hybridization, inductive effect, electrometric effect. 3. Distinguish between inductive effect and electrometric effect. 4. Distinguish between resonance and hyperconjugation. 5. Understand clathrate or cage complexes and their uses. 6. Understand the mechanism of organic reactions (S_N^1 and S_N^2).

Unit 2	1. Understand the nomenclature of alkanes and cycloalkanes and their methods of preparation. 2. Describe conformations in alkanes. 3. Describe the stability of cycloalkanes by using Baeyer's Strain theory. 4. Understand conformations of cyclohexane and their relative stabilities.
Unit 3	1. Understand the nomenclature of alkanes and their preparation methods. 2. Describe regioselectivity of dehydrohalogenation of alkyl halide. 3. Describe Markovnikov's rule and peroxide effect. 4. Understand the mechanism of hydroboration and uses of hydroboration oxidation. 5. To explain electrophilic addition and free radical addition reactions.
Unit 4	1. Describe the methods of preparation of cycloalkanes. 2. Describe the conformation of cycloalkanes. 3. Describe Diels Alder reaction. 4. Understand nomenclature and isomerism in dienes and alkadienes. 5. Describe the preparation of conjugated alkadienes. 6. Explain 1,2 and 1,4 electrophilic addition reaction of bromine on 1,3-butadiene.
Unit 5	1. Describe structural isomerism in organic molecules. 2. Describe stereoisomerism in organic molecules. 3. Explain optical isomerism and determine specific rotation of optically active compound. 4. Understand the concept of chirality. 5. Distinguish between meso compounds and racemic mixture. 6. Describe D/ L configuration. 7. Distinguish between enantiomer and diastereomers. 8. Recognise R and S configuration.

B.Sc. Second year chemistry	
Course	**Outcomes**
Paper 1 **Physical chemistry**	1. Describe law of thermodynamics. 2. Know the meaning of entropy and residual entropy. 3. Know the meaning of phase, component and degree of freedom. 4. Solve the cell reaction and calculate EMF. 5. Solve the numerical problem based on call Kohlrausch law. 6. Solve the numerical problem based on Nernst equation. 7. Realise the terms ionic strength and activity coefficient equation, DHO equation. 8. Realise the term adsorption, adsorbent and Freundlich and Langmuir adsorption isotherms. 9. Understand the adsorption of gases by solid type of isotherms. 10. Find out the acidity, basicity and pKa value on pH metre.

Paper 2 **Inorganic chemistry**	1. Know the meaning of various terms involved in coordination chemistry. 2. To understand Werner's formulation of complexes and identify the types of valences. 3. Know the meaning of effective atomic number, chelate effect and hapticity. 4. Draw the geometrical and optical isomers of complexes. 5. Study the electronic configuration of lanthanides and actinides. 6. Describe Frost, Latimer And Pourbaix diagrams. 7. Define Arrhenius, Bronsted Lowry acid and bases. 8. Describe the Lewis concepts of acids and bases. 9. Describe magnetic and spectral properties of lanthanides and actinides. 10. Know the meaning of lanthanide contraction and actinide contraction. 11. Understand reactions in non-aqueous solvents with reference to liquid ammonia and liquid sulphur dioxide.
Paper 3 **Organic chemistry**	1. Know the meaning of chromophore and auxochrome, bathochromic shift, hypsochromic, hyperchromic and hypochromic shift. 2. To study UV and IR spectroscopy. 3. Interpretation of IR spectra of simple organic compounds. 4. Understand the factors affecting UV absorption spectra. 5. Study the various name reaction with examples. 6. Study the preparation of alcohols, phenols, aldehydes, ketones, ethers, carboxylic acids and amines and their chemical properties. 7. Recognise the reagents for the transformation from aldehydes to carboxylic acid. 8. Recognise the reagents and conditions used for the reduction of aldehyde and ketone to alcohol. 9. Utilise reductive amination for the synthesis of amines. 10. Define keto- enol tautomerism.

B.Sc. third year Chemistry	
Course	**Outcomes**
Paper 1 **Physical chemistry**	1. Solve the Schrodinger equation to obtain wave functions. 2. Understand the role of uncertainty in quantum mechanics. 3. To determine whether or not two physical properties can be simultaneously measured. 4. Understand de Broglie hypothesis and uncertainty principle. 5. Derive Schrodinger equation. 6. Know the postulates of quantum mechanics. 7. Learn one dimensional box mechanics of particle. 8. Compare between M.O. and V.B. Models. 9. Understand the construction of M.O.'s by LCAO method. 10. Know the valence bond model of hydrogen ion. 11. Derive the expression for rotational spectra for the transition from J to J+1. 12. Understand Franck Condon principle. 13. Understand the application of UV spectroscopy to organic molecules. 14. To understand the harmonic oscillation.

	15. Able to recognise different regions for different spectroscopy. 16. Able to explain the concept used in black body radiation. 17. Able to use concept of polarizability. 18. Able to use concept of selection rules. 19. To understand the laws of photochemistry. 20. Know the meaning of fluorescence and phosphorescence and non-radioactive processes. 21. Able to explain photochemical reactions Norrish type-1 and type- 2 reactions. 22. To understand optical activity and Clausius Mossotti equation.
Paper 2 **Inorganic chemistry**	1. Understand the classification of hard and soft acid base. 2. Understand HSAB concept of Pearson. 3. To understand application of hard soft acid base theory. 4. To understand the preparation, classification, properties and applications of silicones. 5. Able to explain preparation and properties of phosphazenes and their uses. 6. Twin dust and limitations of VBT. 7. Get knowledge of crystal field theory. 8. To study crystal field splitting of d orbitals. 9. Able to explain factors affecting thermodynamic stability of complexes. 10. Able to explain factors affecting the rate of substitution reactions in square planar complexes. 11. Know the meaning of diamagnetism, paramagnetism, ferromagnetism and antiferromagnetism. 12. Able to determine ground state term symbol. 13. Able to explain LS coupling. 14. To study Orgel energy level diagram. 15. Able to explain oxidative addition and insertion reactions. 16. To understand the role of metal ions in biological system. 17. To understand the role of metal ions in oxygen transport. 18. Able to recognise role of porphyrin rings in haemoglobin. 19. Able to recognise role of haemoglobin and myoglobin in biological system.
Paper 3 **Organic Chemistry**	1. Able to explain common terms in NMR spectroscopy such as chemical shift, coupling constant and describe how they are affected by molecular structure. 2. Able to explain PMR spectra of simple organic molecules. 3. To understand applications of UV, IR and NMR spectroscopy for simple organic molecules. 4. To study organometallic compounds such as Grignard reagent and their applications. 5. To study preparation and properties of organic polymers and their uses. 6. Able to know general structure elements of cyclic monosaccharide and disaccharides. 7. Able to draw particular carbohydrate structure. 8. To understand application of hydrogenation reaction. 9. Know the meaning of saponification value iodine value and acid value. 10. Able to explain formation of synthetic detergents. 11. Able to explain mutarotation. 12. Know the meaning of amino acid, peptide, proteins and nucleic acid. 13. To understand isoelectric point and electrophoresis.

	14. Able to explain double helix structure of DNA. 15. Able to determine peptide structure. 16. To understand denaturation of proteins. 17. Able to classify dyes. 18. To understand and classify pericyclic reactions. 19. Get the knowledge of Woodward Hoffmann rule. 20. To study electrocyclic reactions cycloaddition reaction and sigmatropic shift. 21. To understand FMO approach.

Department of Chemistry

Govt. P. G. College Khargone M.P.

Course outcomes of PG course

Programme Outcomes **M. Sc. Chemistry**	
Department of Chemistry	After successful completion of two-year degree program in chemistry student should be able to
Programme outcomes	1. Understand the background of organic reaction mechanism, complex structures, instrumental methods of chemical analysis, molecular rearrangements and separation techniques. 2. Learns about the potential uses of analytical chemistry, medicinal chemistry and organometallic chemistry. 3. Work in the pure interdisciplinary and multidisciplinary areas of chemical sciences and its applications. 4. Analyse data obtained from sophisticated instruments like UV-visible HPLC, FT-IR for the structure determination and chemical analysis. 5. Understanding the causes of environmental pollution and can open up new methods for environmental pollution control. 6. Learn about the potential uses of medicinal chemistry and polymers. 7. Identify the different types of Organotransition metal complexes catalysed reactions and apply the above concepts to explain different catalytic reactions.
Program specific outcomes	1. Study of organometallic reactions. 2. Understand good laboratory practices and safety. 3. Understand and apply principles of organic chemistry for understanding the scientific phenomenon in reaction mechanisms. 4. Understand the various types of aliphatic and aromatic nucleophilic substitution reaction. 5. Learn the familiar name reactions and their reaction mechanisms. 6. Study of elimination reactions and pericyclic reactions.
Course Outcomes **M. Sc. Chemistry Semester-I**	
Course	**Outcomes** After completion of these courses students should be able to
Physical chemistry	1. Understand the terms ionic strength, activity, activity coefficient, fugacity and degree of freedom. 2. Understand the applications of phase rule to three component systems. 3. Learn applications of variation method and perturbation theory.

	4. Know the Schrodinger equation, postulates of quantum mechanics, eigenvalues and eigenfunctions. 5. Learn mechanics of particles in one- and two-dimensional box. 6. Know the statistical thermodynamics and various partition functions. 7. Know the applications of Huckel theory to conjugated systems.
Inorganic chemistry	1. Understand VSEPR theory and Walsh diagram. 2. To understand Bent rules and energetics of hybridization. 3. Know the meaning of stepwise and overall constants. 4. Understand factors affecting the stability of metal complexes. 5. Understand chelate effect and its thermodynamic origin. 6. Know the reaction mechanism of transition metal complexes, inert and labile complexes. 7. Understand limitations of crystal field theory (CFT). 8. Understand the applications of HSAB theory.
Organic chemistry	1. Explain aromaticity in benzene and non-benzenoid compounds alternate and non-alternant hydrocarbons. 2. Know the terms, antiaromaticity, homo-aromaticity. 3. Study of crown ether complexes, cryptands and inclusion compounds. 4. Know the meaning of elements of symmetry, chirality, threo and erythro isomer, enantiotopic and diastereotopic atoms. 5. Distinguish enantiomers and diastereomers. 6. Realise optical activity in biphenyls, allenes and spirane lacking chiral carbon. 7. Learn about structure stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. 8. Learn about S_N1 and S_N2, mixed S_N1 and S_N2 and SET mechanisms. 9. Learn classical and non-classical carbocations, NGP by π and σ bonds. 10. Understand the application of NMR spectroscopy in the detection of carbocations. 11. Understand phase transfer catalysis. 12. Learn Hammonds postulates.
Group theory and Spectroscopy	1. Discuss the concept of symmetry elements, symmetry operation and point groups. 2. Classify and recognise the symmetry elements and their operations as required to specify molecular symmetry and possible point groups from symmetry elements and be able to find point groups of molecules by systematic procedure. 3. Derive character table for C_{2v} and C_{3v} point group. 4. Learn application of symmetry and group theory in IR spectroscopy. 5. Explain harmonic oscillators, rigid rotor models and their quantum mechanical description. 6. Learn basic principles of photoelectron spectroscopy.

Course Outcomes M. Sc. Chemistry Semester-II	
Paper-I Inorganic Chemistry	1. Discuss spectroscopic ground state term, orgel diagram and TS diagram (Tanabe Sugano) 2. Discuss selection rules for electronic spectroscopy. 3. Calculate 10 Dq, B and earring β parameters. 4. Know the preparation and properties of transition metal nitrosyl, dinitrogen and dioxygen complexes. 5. Explain the classification of metal clusters and compounds. 6. Explain magnetic properties of transition metal complexes. 7. Describe ORD and cotton effect. 8. Understand the application of ORD and cd for the determination of absolute configuration of complexes and isomerism due to non-planarity of chelate rings.
Paper-II Organic Chemistry	1. Discuss aromatic electrophilic substitution reaction and arenium ion mechanism. 2. Discuss aromatic nucleophilic substitution reaction and benzyne mechanism. 3. Explain types of free radical reaction and free radical substitution mechanism. 4. Explain neighbouring group participation in aliphatic electrophilic substitution. 5. Explain mechanism and stereochemical aspect of addition reactions involving electrophiles and nucleophiles and free radicals. 6. Understand and explain Sharpless asymmetric epoxidation. 7. Describe mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds acid esters and nitriles. 8. Explain the mechanism of condensation reactions involving enolates. 9. Study E-2, E1 and E1cb mechanisms. 10. Learn pericyclic reactions electrocyclic ene reaction cycloaddition cheletropic reaction, sigmatropic rearrangement and analysis by correlation diagram FMO and PMO approach. 11. Explain Woodward Hoffmann selection rules for all the pericyclic reactions and solve problems based on FMO approach.
Paper-III Physical Chemistry:	1. Explain collision theory and activated complex theory of reaction rates. 2. Study the Lindemann-Hinshelwood and Rice-Ramsperger Marcus theories of unimolecular reactions. 3. Study the Laplace equation, Kelvin equation and B.E.T. Equation. 4. Know the micellization, CMC and factors affecting the CMC of surfactants. 5. Learn about kinetics of polymerization and mechanism of polymerization. 6. Solve problems on molecular mass, number and average molecular mass of a polymer school.

	7. Explain molecular mass determination by Osmometry, Viscometry, Diffusion light scattering and Sedimentation methods. 8. Write down Debye Huckel theory of electrolytic solution and derive Debye Huckel Onsager equation. 9. Derive Butler Volmer equation. 10. Understand the principle of polarography and Ilkovic equation half wave potential and its significance.
Paper-IV **Spectroscopy and diffraction methods:**	1. Study the chemical shift and factors influencing chemical shift. 2. Understand spin-spin interaction and factors influencing coupling constant J. 3. Study of ^{13}C- NMR spectroscopy, FT- NMR, type of ^{13}C-NMR spectra. 4. Learn NQR spectroscopy and its applications. 5. Learn basic principles of ESR spectroscopy. 6. Understand zero field splitting and Kramer's degeneracy, isotropic and anisotropic hyperfine coupling constants. 7. Learn X-ray method of analysis numerical problems miller indices and Bragg method. 8. Learn measurement technique and elucidation of structure of simple gas phase molecules by electron diffraction method.
Course Outcomes **M. Sc. Chemistry Semester-III**	
Paper-I **Application of Spectroscopy-I**	1. Understand electronic spectroscopy for d^1- d^9 systems in octahedral and tetrahedral and square planar complexes. 2. Understand vibration spectroscopy Raman spectroscopy and its applications. 3. Study NMR spectroscopy, chemical shift, shielding and deshielding mechanism. 4. Study principle of Mossbauer spectroscopy and its applications.
Paper-II **photochemistry**	1. Study of photochemistry of carbonyl compounds, alkenes, dienes, polyenes, and aromatic compounds. 2. Study photo rearrangement Barton reaction, application of photochemical reaction. 3. Study photochemistry of cyclohexadienones, intermolecular cycloaddition reactions.
Paper-III **Environmental Chemistry**	1. Different concepts of atmosphere, stratospheric and tropospheric Chemistry. 2. Study the concepts of acid rain, photochemical smog, atmospheric aerosols, global climate, gases in hydrosphere, organic matter in water, humic material, metals in aqueous environment. 3. Know the meaning of dissolved oxygen, biological oxygen demand and chemical oxygen demand and its determination. 4. Study causes of toxicity due to heavy metals. 5. Understand the concept of ozone layer depletion, greenhouse effect and global warming.

	6. Explain pesticides, classification, properties and uses of organochlorine pesticides. 7. Explain harmful effects of polychlorinated biphenyls and polynuclear aromatic hydrocarbons. 8. Explain case study Bhopal gas tragedy Chernobyl disaster three-mile Island Minamata disease and London smog.
Paper-IV **Organotransition Metal Chemistry**	1. Describe the structure and bonding in the main group and transition metal organometallic compounds. 2. Describe the reactivity and reaction mechanism in various organometallic compounds. 3. Describe the multicentre bonding in different Organotransition metal compounds. 4. Apply the acquired knowledge to explain the catalysis by various transition metal organic compounds. 5. Understand the uses of organocopper compounds in organic synthesis. 6. Understand the mechanism of Ziegler-Natta polymerization of olefins. 7. Explain fluxionality in allyl and dienyl complexes.
Paper-V **Polymers**	1. Understand the concept of polymers, monomers, degree of polymerization and classification of polymers. 2. Know the number, weight and viscosity average molecular weights and measurement. 3. Explain analysis and testing of polymers. 4. Explain structure properties and applications of inorganic polymers. 5. Explain structure properties and applications of sulphur and phosphorus-based polymers.
Course Outcomes **M. Sc. Chemistry Semester-IV**	
Paper-I **Application of Spectroscopy-II**	1. Solve numerical problem based on Beer Lambert law. 2. Solve structural problems based on UV, visible, IR spectroscopy. 3. Record and interpret the UV, visible and IR spectra for structural analysis. 4. Understand the factors affecting UV absorption spectra. 5. Discuss the problem of UV, IR and NMR. 6. Study of ^{1}H NMR spectroscopy; chemical shift, correlation for protons bonded to carbon and other nuclei. 7. Study of ^{13}C-NMR spectroscopy. 8. Two-dimensional NMR techniques; COSY, homo and heteronuclear, 2D resorts spectroscopy, NOESY and the applications. 9. Study of mass spectrometry; instrumentation, various methods of ionization E1, C1, FD, ESI and FAB, MALDI.

Paper-II **Solid State Chemistry**	1. Describe general principles and classification, preparation of solids, solid-state reactions, preparation and properties of thin films. 2. Describe the importance and properties of defects in solid. 3. Describe the free electron band theories of solids. 4. Illustrate the optical, magnetic and electrical properties of solids. 5. Design and development of solid materials with required properties based on the structure of solids. 6. Analyse the physical, chemical, unique, optical, electrical magnetic, thermal and mechanical properties of solids. 7. Describe various types of liquid crystals and theories of LC.
Paper-III **Biochemistry**	1. Discuss the role of metal ions in biological systems. 2. Describe the function of haemoglobin and myoglobin, hemocyanin and hemerythrin. 3. Study cytochromes and iron sulphur proteins. 4. Understand biological nitrogen fixation and its mechanism. 5. Describe Fischer's lock and key and Koshalands induced fit hypothesis of enzyme catalysis mechanism. 6. Study the Michalis Menten equation and Lineweaver Burk plots. 7. Explain enzyme mechanism for chymotrypsin, ribonuclease lysozyme and carboxypeptidase. 8. Describe vitamins, coenzymes, prosthetic groups and apoenzymes. 9. Describe biotechnological applications of enzymes. 10. Study the DNA and RNA in living systems, functions of enzymes and protein synthesis of ATP from FDP and biopolymer interactions.
Paper-IV **Analytical Chemistry**	1. Explain the fundamentals of analytical chemistry and steps of a characteristic analysis. 2. Estimate the types of errors in chemical analysis. 3. Expresses the term such as mean, median, precision, accuracy, absolute error and relative error. 4. Expresses the term such as standard deviation, variance, relative standard deviation and coefficient of variance. 5. Interpret different gravimetric analysis methods, employees the gravimetric calculations. 6. Determine dissolved oxygen and biological oxygen demand and chemical oxygen demand.
Paper-V **Medicinal Chemistry**	1. Study of antimicrobial drugs, antibacterial, antifungal, antiviral, antimalarial etc. 2. Know the drug designing and development, their SAR and QSAR. 3. Describe mode of action of different drugs. 4. Study the role of drugs to inhibit the particular enzymes and treatment of disease. 5. Study the antibiotics and non-steroidal anti-inflammatory drugs. 6. Describe the factors that affect drug absorption distribution metabolism and excretion.