DEPARTMENT OF CHEMISTRY

GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON (C.G.)

B.Sc. (Honours)

Major - Chemistry

Seventh Semester

2025-26

DEPARTMENT OF CHEMISTRY

GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON

Syllabus and Marking Scheme for

B.Sc. (Honours)

Major - Chemistry

Seventh Semester

Session 2025-26

Paper	Title of the Paper	Credit	Marks (ESE + IA)	Total Marks
DSC	Coordination Chemistry: Structure, Bonding, and Reactivity	3	80 + 20	100
DSC LAB	Coordination Chemistry: Structure, Bonding, and Reactivity Lab	1	40 + 10	50
DSE-I	Mathematical Methods, Chemical Dynamics, and Quantum Principles in Chemistry	3	80 + 20	100
DSE LAB	Mathematical Methods, Chemical Dynamics, and Quantum Principles in Chemistry Lab	1	40 + 10	50
DSE-II	Reaction Mechanisms in Organic Chemistry: Basic Principles and stereochemistry	4	80 + 20	100
DSE-III	Group Theory, Principles of Spectroscopy and Computer Applications in Chemistry	4	80 + 20	100
GE	Basics of Chemistry	4	80 + 20	100

GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

B. Sc. (Honours) (session 2025-26)

Major - Chemistry

Coordination Chemistry: Structure, Bonding, and Reactivity	
Session: **2025-26**	Program: **B. Sc. (Honours)**
Semester: VII	Subject: Chemistry
Course Type: DSC	Course Code:
Course Title:	Coordination Chemistry: Structure, Bonding, and Reactivity
Credit: 03	Lecture: 60
M.M. : 100 = (ESE 80 + IA 20)	Minimum Passing Marks: 40%

Title	**Coordination Chemistry: Structure, Bonding, and Reactivity**
Course Objectives	**Unit -1** ➢ To understand fundamental theories of chemical bonding in coordination compounds, including VBT, CFT, and MOT. ➢ To analyze structural distortions, π-bonding, and hybridization effects in transition metal complexes. **Unit-2** ➢ To introduce the structure, bonding, and classification of metal π-complexes with π-acceptor ligands. ➢ To explore their synthesis, properties, and applications using concepts like the 18-electron rule and spectroscopic techniques. **Unit-3** ➢ To provide a fundamental understanding of metal-ligand equilibria, stability constants, and factors influencing complex formation. ➢ To explore the kinetics and thermodynamics of metal complexes, including methods for determining formation constants and reactivity profiles. **Unit-4** ➢ To understand the formation constants, stability, and reactivity of metal-ligand complexes. ➢ To explore methods for determining formation constants and the kinetic and thermodynamic aspects of metal complex reactions.
Learning Outcomes	**Unit 1 -** Students will understand bonding theories (VBT, CFT, LFT, MOT) and their applications in coordination chemistry. They will analyze molecular geometry, metal-ligand interactions, and distortion effects in transition metal complexes.

	Unit 2 - Students will be able to explain the synthesis, structure, and bonding of metal π-complexes using the 18-electron rule and ligand characteristics. **Unit 3 -** Students will understand stability trends, stepwise formation constants, and the chelate effect in metal-ligand equilibria. They will apply kinetic and thermodynamic concepts to analyse complex. **Unit 4 -** Students will be able to analyze the stability and formation constants of metal-ligand complexes, understanding the chelate effect and factors influencing complex stability.

Unit	Lectures	Content
I	15	**Theories of Chemical Bonding in Co-ordination Chemistry** Basic knowledge of VBT, CFT, VSEPR, Walsh diagrams (tri- and penta-atomic molecules), dπ – pπ bonds, bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. Jahn-Teller distortion, causes of distortion Metal π-Ligand Bonding. Limitation of and applications of valence bond theory, crystal field theory, ligand field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π- bonding and molecular orbital theory
II	15	**Metal π -Complexes** π-acceptor ligands, 18 e- rule, Hepaticity, Sandwich compounds, Preparation and chemical properties of Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.
III	15	**Metal Ligand Equilibria in Solution** Stepwise and overall formation constants and their interaction, trends

		in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH metry and spectrophotometry. Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories.
IV	**15**	**Reaction Mechanism of Transition Metal Complexes** Kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reaction, cross reactions and Marcus-Hush theory, inner sphere type reactions.

List of Books	• Advanced inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley. • Inorganic Chemistry, J.E. Huhey, Harpes & Row. • Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon. • Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier. • Magnetochemistry, R.L. Carlim, Springer Verlag. • Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon. • Modern spectroscopy, J. M. Hollas, john Wiley. • Applied electron spectroscopy for chemical analysis Ed. H. Windawi and F.L. Ho, Wiley Interscience. • Mechanisms of Inorganic Reactions, Fred Basalo and Ralph G.Pearson, Wiley Eastern Private

Coordination Chemistry: Structure, Bonding, and Reactivity Lab	
Session: **2025-26**	Program: **B. Sc. (Honours)**
Semester:	Subject: **Chemistry**
Course type: DSC LAB	Course Code:
Course Title :	Coordination Chemistry: Structure, Bonding, and Reactivity Lab
MM: 50 (40 + 10)	Minimum Passing Marks: **20**
Credit : 01	

List of Practicals

MAJOR EXPERIMENTS

Qualitative analysis

Qualitative analysis of mixture containing eight radicals including two less common metals from among the following by semi micro method.

Basic Radicals :

Ag, Pb, Hg Bi, Cu, Cd, As, Sb, Sn, Fe, Al, Cr, Zn, Mn, Co, Ni, Ba, Sr, Ca, Mg, Na, K, Ce, Th, Zr, W, Te, Ti, Mo, U, V, Be, Li, Au, Pt.

Acidic Radicals :

Carbonate, Sulphite, Sulphide, Nitrite, Nitrate, Acetate, Fluoride, Chloride, Bromide, Iodide, Sulphate, Borate, Oxalate, Phosphate, Silicate, Thiosulphate, Ferricyanide, Sulphocyanide, Chromate, Arsinate and Permanganate.

Quantitative Analysis

Separation and determination of two metal ions in ores, alloys, or mixtures in solution, one by volumetric and the other by gravimetric methods.

MINOR EXPERIMENTS

Estimations

(a) Phosphoric acid in commercial orthophosphoric acid.
(b) Boric acid in borax.
(c) Ammonia in an ammonium salt.
(d) Manganese dioxide in pyrolusite.
(e) Available chlorine in bleaching powder.
(f) Hydrogen peroxide in a commercial sample.

Preparations

Preparation of selected inorganic compounds and their study by I.R. Electronic spectra, Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds. Theoretical study of structure and their identification of some preparations by spectral analysis

1. $VO(acac)_2$
2. $TiO(C_9H_8NO)_2 2H_2O$
3. Cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
4. $Na[Cr(NH_3)_2(SCN)_4]$
5. $Mn(acac)_3$
6. $K_3[Fe(C_2O_4)_3]$
7. Prussian Blue, Turnbull's Blue.
8. $[Co(NH_3)_6][Co(NO_2)_6]$
9. Cis-$[Co(trien)(NO_2)_2]Cl.H_2O$
10. $Hg[Co(SCN)_4]$
11. $[Co(Py)_2Cl_2]$
12. $[Ni(NH_3)_6]Cl_2$
13. $Ni(DMG)_2$
14. $[Cu(NH_3)_4]SO_4.H_2O$

List of Books	1. Vogel's Text Book of Qualitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS. 2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly, Prentice Hall.

Mathematical Methods, Chemical Dynamics, and Quantum Principles in Chemistry	
Session: **2025-26**	Program: **B. Sc. (Honours)**
Semester: VII	Subject: Chemistry
Course Type: DSE-VII A	Course Code:
Course Title:	Mathematical Methods, Chemical Dynamics, and Quantum Principles in Chemistry
Credit: 03	Lecture: 60
M.M. : 100 = (ESE 80 + IA 20)	Minimum Passing Marks: 40%

Title	**Mathematical Methods, Chemical Dynamics, and Quantum Principles in Chemistry**
Course Objectives	Unit-1 ➢ To develop a strong foundation in vectors, matrix algebra, probability, and calculus. ➢ To enable analytical problem-solving using differentiation, integration, and linear algebra techniques. Unit-2 ➢ To introduce the principles of quantum mechanics and solve the Schrödinger equation for simple systems. ➢ To understand quantum angular momentum, spin, and the Pauli exclusion principle in atomic structure. Unit-3 ➢ To explore approximate methods like the variation theorem and perturbation theory for solving quantum systems. ➢ To understand the electronic structure of atoms and apply molecular orbital theory to conjugated systems. Unit -4 ➢ To understand chemical reaction kinetics, including rate laws, collision theory, and activated complex theory. ➢ To explore fast reactions, enzyme kinetics, and unimolecular reaction theories
Learning Outcomes	**Unit 1** - Students will be able to apply vector operations, matrix algebra, and calculus to solve mathematical. They will also understand and use concepts of probability and differential equations.

	Unit 2 - Students will be able to solve the Schrödinger equation for basic quantum systems and interpret the results. **Unit 3** - Students will learn to apply the variation theorem and perturbation theory They will gain a deep understanding of molecular orbital theory for conjugated systems. **Unit 4** - To understand chemical reaction kinetics, including rate laws, collision theory, and activated complex theory.

Unit	Lectures	Content
I	15	**Vectors, Matrix Algebra and Probability** Vectors, dot, cross and triple products etc. The gradient, divergence and curl. Addition and multiplication, inverse, adjoint and transpose of matrices, special matrices (symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, unit, diagonal, unitary, etc.) and their properties. Introduction to determinants, Permutations and combinations and probability. **Differentiation and Integration** Rules for differentiation, applications of differential calculus including maxima and minima partial differentiation. Exact first-order differential equations, homogeneous, exact and linear equations, Basic rules for integration, integration by algebraic simplification, integration by parts, partial fraction and substitution
II	15	**Quantum Chemistry** Time-independent Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz. particle in one dimensional and three-dimensional box, concept of degeneracy, the harmonic oscillator, the rigid rotor, the hydrogen atom. **Angular Momentum** Ordinary angular momentum, eigen functions and eigen values of angular momentum, ladder operator, concept of spin, antisymmetric and Pauli's exclusion principle

III	15	**Approximate Methods** The variation theorem and perturbation theory (first order and non-degenerate). Applications of variation method and perturbation theory to hydrogen and helium atom. **Electronic Structure of Atoms** Russell-Saunders terms and coupling schemes. Atomic states, atomic terms and term symbols. **Molecular Orbital Theory** Huckel theory of conjugated systems, Applications to ethylene, butadiene and cyclobutadiene
IV	15	**Chemical Dynamics** Method of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory, ionic reaction, kinetic salt effects, steady state kinetics. Photochemical reaction (hydrogen-bromine and hydrogen-chlorine reactions). Homogeneous catalysis, kinetics of enzyme reaction, general features of fast reaction, study of fast reaction by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method. Dynamics of unimolecular reaction, Lindmann-Hinshelwood and Rice–Ramsperger–Kassel–Marcus (RRKM) theories of unimolecular reaction.

List of Books	• Physical Chemistry, P.W. Atkins, LBS • Introduction to Quantum Chemistry, A.K. Chandra, Tata McGrawHill • Quantum Chemistry, Ira N. Levine, Prentice Hall • Coulson's Valence R. Mc. Weeny, ELBS • Chemical Kinetics, K.J. Laidler, McGraw-Hill • Kinetics and Mechanism of Chemical Transformation, J. Rajaraman and J. Kuriakose, McMillan. • Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw-Hill. • Mathematics for Chemists, Bhupendra Singh

Mathematical Methods, Chemical Dynamics, and Quantum Principles in Chemistry Lab	
Session: **2025-26**	Program: **B. Sc. (Honours)**
Semester:	Subject: **Chemistry**
Course type: DSE LAB (Gr A)	Course Code:
Course Title :	Mathematical Methods, Chemical Dynamics, and Quantum Principles in Chemistry Lab
MM: 50 (40 + 10)	Minimum Passing Marks: **20**
Credit : 01	

List of Practicals

MAJOR EXPERIMENTS

Adsorption

1. To study surface tension – concentration relationship for solution (Gibb's equation).
2. To study the adsorption of oxalic acid on charcoal and to verify Freundlich adsorption isotherm.

Chemical Kinetics

1. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
2. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.

Polarimetry

1. Determine the specific and molecular rotation of optically active substance.
2. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.

MINOR EXPERIMENTS

Phase Equilibria

1. Determination of congruent composition and temperature of a binary system (e.g. diphenylamine-benzophenone system.)
2. Determination of glass transition temperature of a given salt (e.g., $CaCl_2$)
3. To construct the phase diagram for three component system (e.g., chloroform – acetic acid-water).

Solutions

1. Determination of molecular weight of non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
2. Determination of molecular weight of non-volatile substances by Landsberger's method.

Conductometry

1. To determine the basicity of an organic acid.
2. Determination of solubility and solubility product of sparingly soluble salts (e.g. $PbSO_4$, $BaSO_4$) conductometrically.
3. Determination of the strength of strong and weak acids in a given mixture conductometrically.
4. Determination of pK_a of acetic acid and verification of Ostwald Dilution law

Potentiometry/pH metry

1. Determination of the strength of strong and weak acids in a given mixture using a potentiometer /pHmeter.
2. Determination of temperature dependence of EMF of a cell.
3. To determine pK_a of the given monobasic acid by pH metrictitration.
4. Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method.

Use of Computer Programs

The students will learn how to operate a PC and how to run standard Programs with data preferably from physical Chemistry laboratory. Further, the student will operate Word Processing software such as MS-WORD, MS-Excel, MS-Powerpoint. Introduction to structure drawing, spread sheet and chemistry related softwares chem draw, chem sketch, origin pro.

List of Books	1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman. 2. Findley's Practical Physical Chemistry, B. Plevitt, Longman. 3. Experimental Physical Chemistry, R.C. Das and B. Behra, Tata McGrawHill.

Reaction Mechanisms in Organic Chemistry: Basic Principles and stereochemistry	
Session: **2025-26**	Program: **B. Sc. (Honours)**
Semester: VII	Subject: Chemistry
Course Type: DSE-~~H~~ 7 B	Course Code:
Course Title:	Reaction Mechanisms in Organic Chemistry: Basic Principles and stereochemistry
Credit: 4	Lecture: 60
M.M. : 100 = (ESE 80 + IA 20)	Minimum Passing Marks: 40%

Title	**Reaction Mechanisms in Organic Chemistry: Basic Principles and stereochemistry**
Course Objectives	**Unit -1** ➢ To explore the electronic effects in organic reactions, stereochemistry, and conformational analysis of organic molecules. ➢ To understand the concepts of chirality, asymmetric synthesis, and the impact of molecular conformation on reactivity. **Unit 2** ➢ To study the generation, structure, stability, and reactivity of various organic reaction intermediates. ➢ To explore the relationship between structure and reactivity in organic reactions, including the Hammett equation and linear free energy relationships. **Unit 3** ➢ To understand the mechanisms and stereochemistry of addition reactions to carbon-carbon and carbon-heteroatom multiple bonds. ➢ To explore the reduction and condensation reactions involving carbonyl compounds and enolates in organic synthesis. **Unit 4** ➢ To study the mechanisms of nucleophilic substitution and elimination reactions, including their reactivity, regioselectivity, and the effect of substrate structure. To explore aromatic nucleophilic substitution and various elimination mechanisms, including E1, E2, and E1cB.
Learning Outcomes	**Unit 1 -** Students will learn the electronic effects, resonance, and conjugation in organic reactions and apply them in synthesis. They will understand stereochemistry and their implications in organic reactions.

	Unit 2 - Students will understand the properties of reaction intermediates like carbocations, carbanions, and free radicals. They will apply the Hammett equation and other methods to analyze the effect of structure on the reactivity of organic compounds. **Unit 3** - Students will apply mechanistic principles to addition reactions, including Markovnikov and anti-Markovnikov rules. They will gain expertise in metal hydride reductions and condensation reactions. **Unit 4** - Students will understand and apply the mechanisms of SN1, SN2, and aromatic nucleophilic substitution reactions. They will analyze and predict the outcomes of elimination reactions

Unit	Lectures	Content
I	15	**Fundamental concepts of organic reactions** Electronic effects in organic molecules; inductive effective, electrometric effect, hyperconjugation, resonance, mesomeric/resonating effect, tautomerism, Conjugation in organic compounds, bonding in Fullerenes, bonds weaker than covalent, addition compounds. **Stereochemistry** Elements of symmetry, chirality, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis using chiral reagent, chiral catalysts, chiral auxiliary and chiral substrates (Felkin-Anh model and Cram's rule), Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. Stereochemistry of the compounds containing nitrogen, Sulphur and phosphorus. **Conformational analysis** Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to

		unavoidable crowding.
II	**15**	**Reaction Intermediates** Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes, nitrenes, benzyne and ylides **Reaction Mechanism: Structure and Reactivity** Types of organic reactions, kinetic and thermodynamic control reactions and stability, Effect of structure on reactivity- resonance, steric effects and quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants (σ constant).
III	**15**	**Addition to carbon – carbon multiple bonds** Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regioselectivity and chemo selectivity, orientation and reactivity. Hydrogenation of aromatic rings, hydrogenation of double and triple bonds, Markovnikov and anti-Markovnikov rules. **Addition to Carbon-Hetero multiple bonds** Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds. Acids, esters and nitriles. Addition of Grignard reagent, organozinc and organo-lithium reagents to carbonyl and unsaturated carbonyl compounds, Wittig reaction. Mechanism of condensation reaction involving enolates – Claisen, Mannich, Benzoin, Perkin and Stobbe reactions
IV	**15**	**Substitution reactions** **Aliphatic Nucleophilic Substitution** The SN^1, SN^2, mixed SN^1 and SN^2 and SET mechanisms, regioselectivity; retention and inversion of configuration, racemization, the neighboring group mechanism, neighboring group participation by; acetoxy group, π bonds, σ bonds, phenonium ions, norbornyl system, common carbocation rearrangements. The SN_i mechanism, Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic

		carbon, Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium. **Aromatic Nucleophilic substitution** Addition elimination (Activated complex mechanism) and elimination-addition (benzyne mechanism) reactions, Reactivity- effect of substrate structure, leaving group and attacking nucleophile, The von Richter, Sommelet - Hauser and Smiles rearrangements. **Elimination Reactions** The E^1, E^2 and E^1cB mechanisms, orientation of the double bond, reactivity, effects of substrate structures, attacking base, the leaving group, temperature, and the medium, mechanism and orientation in pyrolytic elimination (E_i), Elimination versus substitution reaction.

List of Books	• Advanced Organic Chemistry – Reaction Mechanism and Structure, Jerry March john Wiley. • Handbook of Organic Name Reactions: Reagents, Mechanism and Applications, 1st Edition - August 14, 2023, Authors: Dakeshwar Kumar Verma, Y. Dewangan and CB Verma, ISBN: 9780323959483, Elsevier, Netherland • Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press. • Organic Chemistry, R.T. Morrison and R.N. Boyd, PrenticHall. • Modern organic Reactions. H.O. House Benjamin • Principles of Organic Synthesis, R.O.C. Normon and J.M. Coxon, Blackie, Academic &Professional. • Organic Reactions and their mechanisms. Kalsi, New Age International. • Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan • Stereo Chemistry of Organic Compounds, D. Nasipuri, New Age International.

Group Theory, Principles of Spectroscopy and Computer Applications in Chemistry	
Session: **2025-26**	Program: **B. Sc. (Honours)**
Semester: VII	Subject: Chemistry
Course Type: DSE-~~IIE~~ ~~7C~~	Course Code:
Course Title:	Group Theory, Principles of Spectroscopy and Computer Applications in Chemistry
Credit: 4	Lecture: 60
M.M. : 100 = (ESE 80 + IA 20)	Minimum Passing Marks: 40%

Title	**Group Theory, Principles of Spectroscopy, and Computer Applications in Chemistry**
Course Objectives	**Unit-1** ➢ To study symmetry elements, group theory, and their applications in chemistry, with a focus on character tables and spectroscopy. ➢ To understand group representations and the importance of the great orthogonality theorem. **Unit-2** ➢ To explore the interaction of electromagnetic radiation with matter and the principles of spectroscopy. ➢ To understand the Born-Oppenheimer approximation and energy levels in rotational, vibrational, and electronic transitions. **Unit-3** ➢ To introduce computer structure, operating systems, and the principles of programming using algorithms and flowcharts. ➢ To teach the basics of C programming, including constants, variables, and arithmetic operations **Unit-4** ➢ To understand the principles and instrumentation of Atomic Absorption Spectroscopy (AAS), flame photometry, and nephelometry for qualitative and quantitative analysis. ➢ To explore the applications of AAS and flame photometry for individual elements such as arsenic, cadmium, and lead.
Learning Outcomes	**Unit 1 -** Students will apply group theory and character tables to analyse molecular symmetry in chemistry. **Unit 2 -** Students will analyse electromagnetic radiation

	interactions and apply selection rules in spectroscopy. They will understand the Born-Oppenheimer approximation **Unit 3** - Students will understand computer functions, operating systems, and basic programming principles. **Unit 4** - Students will learn the principles and instrumentation of AAS, flame photometry, and nephelometry.

Unit	Lectures	Content
I	15	**Symmetry and Group Theory in Chemistry** Symmetry elements and symmetry operation, definition of group, subgroup, relation between order of a finite group and its subgroup. Conjugacy relation and classes. point symmetry group. Schonflies symbols, representations of groups by matrices (representation for the Cn, Cnv, Cnh, Dnh etc. groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their uses in spectroscopy
II	15	**Unifying Principles** Electromagnetic radiation, interaction of electromagnetic radiation with matter absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering. Uncertainty relation and natural line width and natural line broadening, transition probability, results of the time dependent perturbation theory, transmission moment, selection rules, intensity of spectral lines. Born-Oppenheimer approximation, rotational, vibrational and electronic energy levels.
III	15	**Introduction to Computers and Computing** Basic structure and functioning of computers with a PC as an illustrative example with DOS as an example, Introduction to UNIX and WINDOWS data processing, principals of programming,

		Algorithms and flow- charts. Elements of computer language C, Constant and variables, Operations and symbols, Expression, Arithmetic assignment statements.
IV	**15**	**Atomic Absorption Spectroscopy** Principle and instrumentation, flame atomization, hollow cathode lamps, interference in AAS, applications of AAS in qualitative and quantitative analysis. The Techniques of Atomic Absorption Spectrometry, The Individual Elements for Arsenic (As), Cadmium (Cd), Calcium (Ca), Magnesium (Mg), Manganese (Mn), Iron (Fe), Lead (Pb), Zinc (Zn). Flame photometric methods: Basic principle and instrumentation, interference in flame photometry, applications in quantitative analysis. Nephelometric method: Principle and instrumentation, applications in analysis.

List of Books	• Computers and Common Sense, R. Hunt and J. Shelley, Prentice Hall. • Computers Chemistry, A.C. Norris. • Microcomputer Quantum Mechanics, Killingbeck, Adam Hilger. • Computer Programming in Fortran IV, V. Rajaraman, Prentice Hall. • An Introduction to Digital Computer Design, V. Rajaraman and T. Radhakrishnan, Prentice Hall. • Physical Methods in Chemistry, R.S. Drago, Saunders College. • Chemical Applications of Group Theory, F.A. Cotton. • Group Theory and its Chemical Applications, P.K. Bhattacharya, Himalya Publishing House. • Instrumental Methods of Analysis, B.K. Sharma, Krishna Publication. • Atomic Absorption Spectrometry, Bern hard We1z, Michael Sperling, WILEY-VCH.

Basics of Chemistry	
Session: 2025-26	Program: B. Sc. (Honours with Research)
Semester: VII	Subject: Chemistry
Course Type: GE – II	Course Code:
Course Title:	Basics of Chemistry
Credit: 4	Lecture: 60
M.M. : 100 = (ESE 80 + IA 20)	Minimum Passing Marks: 40%

Title	Basics of Chemistry
Course Objectives	Students will have a basic knowledge atomic structure and periodic table, chemical bonding and molecular structure, metals and metallurgy, some important organic and inorganic compounds.
Learning Outcomes	**Unit 1** - Students will understand atomic structure and periodic table. **Unit 2** - Students will analyse chemical bonding and molecular structure. **Unit 3** - Students will understand metals and metallurgy. **Unit 4** - Students will learn about some important organic and inorganic compounds.

Unit	Lectures	Content
I	15	**Unit-I: Atomic Structure and Periodic Table** Review of Bohrs theory and its limitations, dual behaviour of matter and radiation, de-Broglies relation, Heisenberg Uncertainty principle. Quantum number, Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half filled and completely filled orbitals, Anomalous electronic configurations. Periodicity of elements Periodicity of Elements: s, p, d block elements, the long form of periodic table.
II	15	**Unit-II : Chemical Bonding and Molecular Structure** Ionic Bonding: General characteristics of ionic bonding. Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions

		on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.
III	15	**UNIT-III : Metals and Metallurgy** Position of metals in the periodic table and general properties. Mineral ore, difference between mineral and ore. concentration, roasting, smelting, refining of ores Metallurgy of copper and iron, electrolytic refining of copper, Baeyer's process for refining of bauxite ore into alumina, Hall Heroult process,leaching process of gold, refining of gold, corrosion of metals, alloys.
IV	15	**Unit-IV : Some Important Organic and Inorganic Compounds** Alkane, alkene, alkynes, alcohol, phenol, acetic acid, properties and uses some general natural and synthetic polymers (polythene, polyvinyl choloride)., Teflon soap and detergents. Properties and uses, Method of production manufacture [~~water~~, washing soda, baking soda, bleaching powder and plaster of Paris.] Preparation of building material - lime, cement, glass and steel.

List of Books	• Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). • Douglas, McDaniel and Alexader: Concepts and Models in Inorganic Chemistry, John Wiley. • Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

DEPARTMENT OF CHEMISTRY

GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON

Syllabus and Marking Scheme for

B.Sc. (Honours)

Major - Chemistry

Eighth Semester

Session 2025-26

Paper	Title of the Paper	Credit	Marks (ESE + IA)	Total Marks
DSC	Metal Complexes	3	80 + 20	100
DSC LAB	Metal Complexes Lab	1	40 + 10	50
DSE-I	Reaction Mechanism	3	80 + 20	100
DSE LAB	Reaction MechanismLab	1	40 + 10	50
DSE-II	Thermodynamics and Electrochemistry	4	80 + 20	100
DSE-III	Introduction to Spectroscopy	4	80 + 20	100
DSE-IV	Natural Products and Medicinal Chemistry	4	80 + 20	100