DEPARTMENT OF CHEMISTRY

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

B.Sc.

Major - Chemistry

Sixth Semester

2025-26

DEPARTMENT OF CHEMISTRY

GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON

Syllabus and Marking Scheme for

B.Sc.

Major - Chemistry

Sixth Semester

Session 2025-26

Paper	Title of the Paper	Credit	Marks (ESE + IA)	Total Marks
DSC6	Physical Chemistry-II	3	80 + 20	100
DSC6 LAB	Physical Chemistry-II Lab	1	40 + 10	50
DSE-I	An Introduction to Spectroscopy: Principles and Applications	4	80 + 20	100
DSE-II	Elementary Quantum Mechanics and Photochemistry	4	80 + 20	100
SEC	Green Methods in Chemistry-I (Project Based)	2	40 + 10	50

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

Four Year UnderGraduate Programme (FYUGP) Session 2025-26

Major - Chemistry

Session: **2025-26**	Program: B.Sc.
Semester: VI	Subject: Chemistry
Course Type: DSC 6	Course Code:
Course Title:	**Physical Chemistry-II**
Credit: 03	Lecture: 60
M.M. 100 = (ESE 80+IA 20)	Minimum Passing Marks: 40

Title	Physical Chemistry-III
Course Objectives	Students will have a basic knowledge of aliphatic hydrocarbons, cycloalkanes and conformational analysis, aromatic hydrocarbons and halogenated hydrocarbons.
Learning Outcomes	**Unit 1-** Students will have an insight of solutions and colligative properties. **Unit 2 -** Students will understand about chemical equilibrium. **Unit 3-** Students will have a basic idea aboutchemical kinetics. **Unit 4 -** Students will have an insight view about phase equilibrium and Nerst distribution law.

Units	Lectures	Topics
I	15	**Solid State Chemistry** Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, Seven crystal systems and fourteen Bravais Lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method, Crystal defects
II	15	**Colloids and Surface Chemistry** Classification, Optical, Kinetic and Electrical properties of colloids, Coagulation, Hardy Schulze Law, Flocculation value, Protection, Gold number, Emulsion, Micelles and types, Gel, Synthesis and thixotrophy, application of colloids Physical absorption, chemisorptions, adsorption isotherms (Langmuir and Freundlich), Nature of adsorbed state, Qualitative discussion of BET

III	15	**Chemical Kinetics** Rate of reaction, Factors influencing rate of reaction, rate law, rate constant, Order and molecularity of reactions, rate determining step, Zero, First and Second order reactions: Rate and Rate law, Methods of determining order of reaction, Chain reactions Temperature dependence of reaction rate, Arrhenius theory, Physical significance of Activation energy, Collision theory, demerits of collision theory, non mathematical concept of transition state theory
IV	15	**Phase Equilibrium and Nerst Equation** A. Phase rule, Phase, component and degree of freedom, derivation of Gibbs phase rule, Clausius-claperon equation and its application to solid -Liquid, Liquid-Vapor and solid Vapour, limitation of phase rule, applications of phase rule to one component system: Water system and sulphur system Application of phase rule to two component system: Pb-Ag system, Zn-Mg system, Ferric chloride-water system, desilveriaztion of lead, congruent and incongruent, melting point and eutectic point, Three component system: Solid solution liquid pairs B. Nerst distribution law, Henry's law, application, solvent extraction

List of Books

- G. M. Barrow: Physical Chemistry Tata McGraw-Hill (2007).
- G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004).
- C. Kotz, P. M. Treichel& J. R. Townsend: General Chemistry Cengage Lening India Pvt. Ltd., New Delhi (2009).
- H. Mahan: University Chemistry 3rd Ed. Narosa (1998).
- R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
- F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
- F. Shriver and P. W. Atkins: Inorganic Chemistry, Oxford University Press.
- Puri, B. R., Sharma, L. R. and Pathania, M. S., Principles of Physical Chemistry, S Chand Publishers (2010)
- Gary Wulfsberg: Inorganic Chemistry, Viva Books Pvt. Ltd.

Physical Chemistry-II Lab

Session: **2025-26**	Program: B.Sc.
Semester: VI	Subject: Chemistry
Course type: DSC 6 LAB	Course Code:
Course Title :	**Physical Chemistry-II Lab**
MM: 50 (40 + 10)	Minimum Passing Marks: 20

Credit – 01

List of Practicals

A. Surface Tension measurements

1. Determine surface tension by (i) drop number (ii) drop weight method
2. Surface tension composition curve for a binary liquid mixture.
3. To determine the percentage composition of a given binary mixture by surface tension method (acetone & ethyl methyl ketone).

B. Chemical Kinetics

1. To determine the specific rate of hydrolysis of methyl/ethyl acetate catalysed by hydrogen ions at room temperature.
2. To study the effect of acid strength on the hydrolysis of an ester
3. To compare the strength of HCl and H_2SO_4 by studying the kinetics of hydrolysis of ethyl alcohol

List of Books	• I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn. • F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman, 1960. • B.D. Khosla: Senior Practical Physical Chemistry, R. Chand & Co. • Ahluwalia, V.K. & Agarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.

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

B. SC. (Multiple Major) - DIPLOMA COURSE (session 2024-25)

Major - Chemistry

An Introduction to Spectroscopy: Principles and Applications	
Session: **2025-26**	Program: B.Sc.
Semester: VI	Subject: Chemistry
Course Type: DSE -I 6 A	Course Code:
Course Title:	An Introduction to Spectroscopy: Principles and Applications
Credit: 4	Lecture: 60
M.M. : 100 = (ESE 80 + IA 20)	Minimum Passing Marks: 40%

Title	**An Introduction to Spectroscopy: Principles and Applications**
Course Objectives	➢ To understand the fundamental principles of spectroscopy, including electromagnetic radiation, spectrometer components, and molecular degrees of freedom. ➢ To study rotational, vibrational, UV-Vis, and NMR spectroscopy, covering energy levels, selection rules, spectral interpretation, and molecular structure determination. ➢ To analyze the effects of factors like isotopic substitution, conjugation, chromophores, and functional groups on spectral characteristics. ➢ To develop skills in interpreting spectra (IR, UV, NMR) for structural elucidation of organic compounds and applying spectroscopy in chemical analysis.
Learning Outcomes	**Unit 1**-Students will understand the rotational spectrum of diatomic molecules, including energy levels, selection rules, and spectral intensity. They will also learn to determine bond length and analyze isotope effects. **Unit 2** - Students will understand molecular vibrations, selection rules, and IR band intensities. They will also learn to interpret IR spectra of simple organic compounds and apply IR spectroscopy in structural analysis **Unit 3**- Students will understand the principles of UV absorption spectroscopy, including electronic transitions and spectral shifts. They will also learn to analyze UV spectra and apply UV spectroscopy in studying conjugated systems. **Unit 4** -Students will understand the principles of 1H^1H1H NMR spectroscopy, including chemical shift, spin-spin splitting, and signal interpretation. They will also learn to elucidate the structures of simple organic compounds using UV, IR, and NMR spectroscopy.

Unit	Lectures	Content
I	15	**Spectroscopy -I** Introduction; electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom. **Rotational Spectrum** Diatomic molecules. Energy levels of a rigid rotator (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution), determination of bond length, qualitative description of non-rigid rotator, isotope effect.
II	15	**Vibrational Spectrum** **Infrared (IR) spectroscopy** molecular vibrations. Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, finger print region, characteristic absorptions of various functional groups of different class of organic compounds and interpretation of IR spectrum of simple organic compounds such as acetic acid, benzaldehyde, pentanol, propanone, Application of IR spectroscopy
III	15	**Electromagnetic Spectrum: Aborption spectra** **UV absorption spectroscopy** -absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transition, effect of conjugation. Concept of chromophore and auxochrome. Bathchromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones. Application of UV spectroscopy
IV	15	**NMR Spectroscopy.** Proton magnetic resonance (H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1, 2-tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques:

List of Books	• Organic Spectroscopy – William Kemp, Palgrave Macmillan, 3rd Edition (1991). • Fundamentals of Molecular Spectroscopy – C.N. Banwell & Elaine M. McCash, McGraw-Hill Education, 4th Edition (1994). • Introduction to Spectroscopy – Donald L. Pavia, Gary M. Lampman, George S. Kriz, Cengage Learning, 5th Edition (2014). • NMR Spectroscopy: Basic Concept and Applications – P.K. Bhattacharya, Narosa Publishing House, 2nd Edition (2015). • Organic Spectroscopy – Y.R. Sharma, S. Chand Publishing, 6th Edition (2019). • Spectroscopy of Organic Compounds – P.S. Kalsi, New Age International Publishers, 6th Edition (2007).

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

B. SC. (Multiple Major) - DIPLOMA COURSE (session 2024-25)

Major - Chemistry

GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)	
Elementary Quantum Mechanics and Photochemistry	
Session: 2025-26	**Program: B.Sc.**
Semester: VI	Elementary Quantum Mechanics and Photochemistry
Course type: DSE -II 69	**Course Code:**
Credit: 04	**Lecture:** 60
MM: 100 (80 + 20)	Minimum Passing Marks: 40%

Title	**Elementary Quantum Mechanics and Photochemistry**
Course Objectives	The course aims to develop an understanding of quantum mechanics principles, including wave functions, quantum numbers, and molecular orbitals, along with photochemical processes such as fluorescence, phosphorescence, and energy transfer mechanisms.
Learning Outcomes	**Unit 1-**. Students will understand fundamental quantum phenomena such as black body radiation, the photoelectric effect, and the Bohr model. **Unit 2 -** Students will understand Schrödinger's wave equation, its significance. They will also learn quantum mechanics postulates, quantum numbers, and the wave functions of hydrogen-like atoms. **Unit 3-** Students will understand molecular orbital theory, hybridization, bonding and antibonding orbitals, and compare MO and VB models for molecular structure analysis. **Unit 4 -** Students will understand the interaction of radiation with matter, photochemical laws, excited-state processes, and phenomena like fluorescence, phosphorescence, and energy transfer in photosensitized reactions.

Unit	Lectures	Content
I	15	**Elementary Quantum Mechanics-I** Black body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. de Broglie hypothesis, the Heisenberg's uncertainty principle, Sinosoidal wave equation, Hamiltonian operator.
II	15	**Elementary Quantum Mechanics-I** Schrodinger's wave equation and its importance, Physical interpretation of the wave function, Postulates of quantum mechanics, particle in a one-dimensional box. Schrodinger's, wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions.
III	15	**Elementary Quantum Mechanics -II** Molecular orbital theory (basic ideas, criteria for forming M.O. and A.O., Construction of M. O's by LCAO-H, ion, calculation of energy levels from wave functions, Physical picture of bonding and antibonding wave functions, Concept of σ, σ^*, π, π^* orbitals and their characteristics, Hybrid orbitals-SP, SP^2, SP^3 Calculation of coefficients of A. O.'s used in these hybrid orbitals. Introduction to valence bond model of H2, comparison of M.O. and V.B. models
IV	15	**Photochemistry** Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus-Drapper law. Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions energy transfer processes (simple examples).

List of Books	• Principles of Quantum Mechanics – R. Shankar, Springer, 2nd Edition (1994) • Quantum Chemistry" – Ira N. Levine, Pearson Education, 7th Edition (2013) • Molecular Quantum Mechanics" – P.W. Atkins & R.S. Friedman, Oxford University Press, 5th Edition (2010) • Quantum Chemistry" – Donald A. McQuarrie, University Science Books, 2nd Edition (2007) • Introductory Quantum Mechanics" – Richard L. Liboff, Pearson Education, 4th Edition (2002) • Quantum Chemistry – A.K. Chandra, Tata McGraw-Hill, 4th Edition (1994) • Quantum Chemistry – R.K. Prasad, New Age International Publishers, 4th Edition (2020) • Quantum Mechanics – V.K. Thankappan, New Age International Publishers, 2nd Edition (2003) • Modern Molecular Photochemistry – Nicholas J. Turro, University Science Books, Revised Edition (1991) • Essentials of Molecular Photochemistry – A. Gilbert & J. Baggott, CRC Press, 1st Edition (1991) • Physical Chemistry – Peter Atkins & Julio de Paula, Oxford University Press, 11th Edition (2017) (Includes photochemistry topics) • Fundamentals of Photochemistry" – K.K. Rohatgi-Mukherjee, New Age International Publishers, 3rd Edition (2017) • Photochemistry – Jagdamba Singh & Jaya Singh, Pragati Prakashan, 1st Edition (2010) • Textbook of Photochemistry – Amit Kumar, Vikas Publishing House, 1st Edition (2012)

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

B. SC. (Multiple Major) - FYUG (session 2025-26)

Major - Chemistry

Session: **2025-26**	Program: B.Sc.
Semester: VI	Subject: Chemistry
Course Type: SEC	Course Code:
Course Title:	**Green Methods in Chemistry (Project Based)**
Credit:	2
M.M. : 50 (40 + 10)	Minimum Passing Marks: 40%

Title	Green Methods in Chemistry (Project Based)
Course Objectives	• To inspire the students about the chemistry which is good for human health and environment. • To evaluate suitable technologies for the remediation of hazardous substances. • To acquire the knowledge of the twelve principles of green chemistry and how to apply in green synthesis. • To make students aware about the benefits of using green chemistry.
Learning Outcomes	By the end of this course, students will be able to: • Think to design and develop materials and processes that reduce the use and generation of hazardous substances in industry. • Get ideas of innovative approaches to environmental and societal challenges. • Know how chemicals can have an adverse/potentially damaging effect on human and vegetation. • Critically analyse the existing traditional chemical pathways and processes and creatively think about bringing environmentally benign reformations in these protocols. • Convert biomass into valuable chemicals through green technologies.

PROJECT

A project may be undertaken in the form of a case study or otherwise data can be collected. The topic of the project should be chosen in consultation with the assigned supervisor and the candidate should prepare a summary/synopsis of the proposed project related to some of the topics taken from the syllabus. Student projects aim to enhance learning beyond traditional lectures and assignments by encouraging active participation, critical thinking, and problem-solving. Projects help students develop valuable skills, such as teamwork, time management, communication, and the ability to apply theoretical knowledge to practical situations.

NOTE :

1. Project is equal to 30hrs on field experience.
2. Project shall be discipline specific of 45-60 hours (2 credits) with duration 1-2 weeks.
3. Project will be part-time (weekly 4hrs in the academic session for 12-13 weeks).
4. The student should submit the final Project report to the mentor for completion of the project.

MARKING SCHEME :

Internal Assessment test - 10 Marks

Project - 30 Marks

Viva-voce - 10 Marks

Total - 50 Marks