DEPARTMENT OF CHEMISTRY

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

M.Sc. Chemistry

THIRD Semester

2025-26

DEPARTMENT OF CHEMISTRY
GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON
Scheme for Third Semester

Session 2025-26

Paper No.	Title of the Paper	Marks Allotted in Theory		Marks Allotted in Internal Assessment		Credits
		Max	Min	Max.	Min.	
I	**CHROMATOGRAPHIC TECHNIQUES AND APPLICATIONS OF SPECTROSCOPY**	80	16	20	04	04
II	**BIOCHEMISTRY**	80	16	20	04	04
III	**ORGANOTRANSITION METAL COMPLEXES**	80	16	20	04	04
IV	**PHOTOINORGANIC AND ANALYTICAL CHEMISTRY**	80	16	20	04	04
V	Lab Course I **ANALYTICAL PRACTICAL**	100	36	----	----	02
IV	Lab Course II **PROJECT**	100	36	----	----	02
	Total	**520**	----	**80**	----	**20**

4 Theory papers - 320

04 Internal Assessments - 80

02 Practical - 200

Total Marks - 600

Note: 25 marks = 01 credit in Theory Papers and 50 Marks = 01 Credit in Practical

for A.K. Sharma
(Dr. DICW)

DEPARTMENT OF CHEMISTRY
GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON
M.Sc. CHEMISTRY

SEMESTER - III

2025-26

Paper - I

CHROMATOGRAPHIC TECHNIQUES AND APPLICATIONS OF SPECTROSCOPY

Max. Marks : 80
Min. Marks : 16

Unit - I Chromatographic Techniques

Introduction, classification of chromatographic methods

Basic principles and applications of partition chromatography, paper chromatography, column chromatography, high performance liquid chromatography, thin layer chromatography and gas chromatography.

Mossbauer Spectroscopy –

Basic principle spectroscopy parameters and spectrum display , application of the technique to the studies of (i) bonding & structures of Fe^{2+} and Fe^{+3} compounds including those of intermediate spin detection of oxidation state &inequivalant MBatoms.

Unit - II Ultraviolet & visible Spectroscopy –

Various electronic transition (185-800) nm, Beer Lambert law, effect of solvent on electronic transitions ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes conjugated polyenes. Fieser – Woodwards rules for conjugated dienes and carbonylcompounds.

Vibrational Spectroscopy

Symmetry and shapes of AB_2, AB_4 and AB_6 made of ambidentate Ligand, ethylene diamine and diketonato complex.

Infrared Spectroscopy –

Instrumentation & sample handling, characteristic vibrational frequencies of alkanes, aromatic compounds, alcohol, ether, phenols and amines.Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, acids, lactones and conjugated carbonylcompounds).

Effect of hydrogen bonding and solvent effect on vibrational frequency, overtones, combination bonds and Fermi resonance F.T.I.R.

Unit - III Nuclear Magnetic Resonance Spectroscopy-

General introduction and Definition , chemical shift , spin-spin interaction , shielding mechanism of measurement , chemical shift value and correlation for protons bonding to carbon .(aliphatic, olefinic, aldehydic & aromatic and other nucleic alcohols, phenols, enols, carboxylic acids amines, amides and mercapto), chemical exchange, effect of deuteration complex, spin-spin interaction between two three (first other spectra) virtual coupling, stereochemistry, hindered rotation, simplification of complex spectra nuclear magnetic double resonance, contact shift reagent solvent effect, Fourier transform technique nuclear overhousear effect (NOE), resonance of other nuclei –F,P.

Nuclear Magnetic Resonance of Paramagnetic Substances in Solution-

The contact and pseudo contact shifts, factors affecting nuclear relaxations. Some applications including biochemicalsystems.

Unit –IV Carbon-13 NMR Spectroscopy

General consideration, chemical shift (aliphatic, aromatic, heteroaromatic& carbonyl carbon), coupling constant.

Two dimension NMR spectroscopy – COSY, NOESY.

Mass Spectroscopy

Introduction, ion production-EICL, FD and FAB, factors affecting fragmentation, ion analysis ion abundance. Mass spectral fragmentation of organic compounds, common functional group, molecular ion peak, metastable peak. Maclaferty rearrangement, nitrogen rule, High resolution mass spectrometry.Examples of mass spectral fragmentation of organic compounds with respect to their structuredetermination.

LIST OF REFERENCE BOOKS

1. Modern Spectroscopy J.M. Hollas , JohanWiley.
2. Applied Electron Spectroscopy for chemical analysis ed. H. Windawi and F.L. Ho, WileyInterscience.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry , R.V. Parish, EllishHarwood.
4. Physical Methods in Chemistry , R.S. Drago , SaundersCompany.
5. Infrared and Raman Spectra : Inorganic and Coordination Compounds, K. Nakamoto ,Wiley.
6. Spectroscopy Methods in Organic Chemistry D.H. Williams , I. Fleming , Tata McGraw-Hill
7. Application of Spectroscopy of Organic Compounds, J.R.Dyer, PrenticeHill.

	Departmental members	
Chairperson /H.O.D		
Subject Expert ..... (University Nominee)	1.....	8.....
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DEPARTMENT OF CHEMISTRY
GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON
M.Sc. CHEMISTRY

SEMESTER - III

2025-26

PAPER- II

BIOCHEMISTRY &BIOMOLECULE

Max. Marks : 80
Min. Marks : 16

Unit I Bioinorganic Chemistry

Metal ion in biological system

Essential and trace metals Na^+/K^+ pumps, Role of metal ion in biological process.

Bioenergetic and ATP cycle

Metal complexes in transmission of energy, chlorophylls, photosynthesis and photosystem in cleavage of water.

Electron transfer in Biology

Electron transport process-cytochromes & iron sulphur proteins.

Transport and Storage of Dioxygen

Heme proteins and oxygen uptake, structure and function of Haemoglobin, myoglobin, chemocyanin and chemerythrin, Model synthetic complex of iron, cobalt, copper.

Nitrogenous base

Biological nitrogen fixation , molybdenum nitrogenase.

Unit II Bioorganic Chemistry

Enzymes

Chemical & Biological catalysis, remarkable properties of enzymes like calalytic power, specificity and regulation. Fisher's lock & key and koshland's induced fit theory, identification and labeling, Enzyme kinetics, Michaelis-Menten and Linewaever-Burk plots, reversible & irreversibleinhibition.

Mechanism of Enzyme Action

Transition state theory, orientation & steric effect, acid - base catalysis. Covalent catalysis, strain or distortion complexes of some typical enzyme, mechanism for lysoenzyme & carboxypeptidase A.

Co-enzyme Chemistry

Cofactor as derived from vitamin, coenzyme, prosthetic group apoenzymes, structure and biological function of coenzyme A. Thymine pyrophosphate, pyridoxal phosphate, NAD^+, $NADP^+$, vitamin B_{12}.

Unit - III Biomolecules

Classification of carbohydrates; Classification based on physical properties, chemical properties, functional groups **and** reducing nature **Monosaccharides;** Chemistry of D-glucose and D-fructose; Sources and isolation, Reactions of hydroxyl groups, aldehyde groups, Reactions of ketone group, Miscellaneous reactions of glucose, Structural elucidation of glucose, Miscellaneous reactions of D-glucose and D-fructose, Inter-conversions; Aldose to ketose, Ketose to aldose, Aldose to higher aldose, Aldose to lower aldose, Aldose to higher ketose**Disaccharides;** Chemistry of sucrose , Chemistry of lactose, Chemistry of maltose, Chemistry of trehalose**Polysaccharides;** Chemistry of starch, Chemistry of cellulose, Chemistry of glycogen, Chemistry of chitin

Peptides, Proteins and Nucleic Acid: Chemical and enzymatic hydrolysis of proteins to peptides, secondary structure of proteins, forces responsible for holding of secondary structure. Tertiary structure of proteins folding and domain structure, quaternary structure.Amino acid metabolism, degradation and biosynthesis of amino acids, sequence determination.

Unit–IV BiophysicalChemistry

Bioenergetics-

Standard free energy change in biochemical reaction, exergonic and endergonic reaction, hydrolysis of ATP, synthesis of ATP from ADP.**Thermodynamics of BiopolymerSolutions**

Thermodynamics of biopolymer solutions osmotic pressure, membrane equilibrium, muscular contraction & energy generation in mechanochemical system.

Transport of ions

Ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport, nerve conduction.

Biopolymers & their molecular weights

Evaluation of size, shape molecular weight and extent of hydration of biopolymers by various experimental techniques like sedimentation and viscosityelectrophoresis.

LIST OF REFERENCE BOOKS:

1. Handbook of Biomolecules: Fundamentals, Properties and Applications, Dakeshwar Kumar Verma and CB Verma, Elsevier, Australia, 2023
2. Bioinorganic and supramolecular chemistry , P. S. Kalsi, New age international
3. Principles of structure and reactivity, J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, Pearson education
4. Concise inorganic chemistry, J.D.Lee, Backwellscience
5. Inorganic chemistry, Shriver and Atkins,Oxford
6. Inorganic chemistry, Catherine Housecraft, pearsoneducation
7. Handbook of Biomolecules, CB Verma, Dakeshwar Verma, Elsevier, 2022.

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GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON
M.Sc. CHEMISTRY
SEMESTER - III
2025-26
PAPER- III
ORGANOTRANSITION METAL COMPLEXES

Max. Marks : 80
Min. Marks : 16

Unit - I Alkyls and Aryl of Transition Metals-

Type, routes of synthesis, stability & decomposition pathways.

Compound of Transition Metals- Carbon Multiple Bonds-

Alkylidenes, alkylidynes, low valent carbine & carbene synthesis ,nature of bond, structural characteristics, nucleophilic and electrophilic reaction on the ligands.

Unit - II Transition Metal π-Complexes

Transition Metal-π complexes with unsaturated organomolecules, alkenes, alkynes, dienedienyl, arene and complexes, preparation, properties, nature of bonding and structural features and their characterization. Important reactions relating to nucleophilic and electrophilic attack on ligands.

Unit-III **Transition Metal Compounds with Bonds to Hydrogen-**

Preparation and characterization of Transition metal compounds with Bonds to hydrogen.

Fluxional organometallic Compounds-

Fluxional and dynamic equilibria in compounds such as y^2olefin , y^3allyl and dienyl complexes.

Sandwich Compounds:-

Ferrocene and other Metallocene, preparation, reaction and their spectral analysis

Unit – IV Stoichiometric reaction for catalysis, homogenous catalysis, hydrogenation, Zeiglar-Natta polymerization of olefins, catalytic reaction involving carbon monoxide such as hydrocarbonylation of olefin (oxo reaction), oxopalladation reaction activation of C-H bonds.

LIST OF REFERENCE BOOKS

1. Organometallic Compounds: Synthesis, Reactions, and Applications, Dakeshwar Kumar Verma and J. Aslam, February 2023, ISBN:9783527351787, 2023 Wiley VCH GmbH, Germany
2. Inorganic Chemistry ,Puri, Sharma, kalia, milestonepublisher
3. Principles of structure and reactivity, J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, Pearson education
4. Concise inorganic chemistry, J.D.Lee, Backwell Science
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M.Sc. CHEMISTRY

SEMESTER III

2025-26

PAPER- IV

PHOTOINORGANIC AND ANALYTICAL CHEMISTRY

Max. Marks : 80
Min. Marks : 16

Unit-I **Error andEvaluation**

Definition of terms in mean and median, precision, standard deviation. Relative standard deviation, accuracy absolute error, relative error, type of error in experimental data determinate (systematic), indeterminate of random and gross. Sources of errors and the effects upon the analytical results.Method for reporting analytical data, the use ofstatistics.

Analysis of soil, fuel, body fluids and drugs

Analysis of soil moisture, PH, Total nitrogen, phosphorus, lime manganese, sulphur and alkali salts.

Unit - II Fuel analysis

Liquid and gas, liquid fuels, flash point, aniline points octane number, gaseous fuels, producer gas and water gas-calorific value.

Clinical chemistry

Composition of blood collection and preservation sample, clinical analysis, serum electrolytes, blood glucose, blood urea, uric acid, albumin barbitutary, immuno assay principle radioimmunoassay (RIA) and application. The blood group analysis, trace elements in the body.

Unit - III Excited states of Metal complexes

Excited states of metal complexes, Comparisons with organic compounds, electronically excited states of metal complexes. Charge transfer spectra, charge transfer excitations, method for obtaining charge transferspectra.

Unit - IV Redox Reaction by Excited Metal Complexes

Energy transfer under condition of weak interaction and strong interaction – exciplex formation , condition of the excited states to be useful as redox reactions, excited electron transfer , metal complexes as attractive condition

(2,2-bipyridine and 1,10-phenonthroline complexes), illustration of reducing and oxidizing character of Ruthenium (bipyridine complexes).
Comparison with $Fe(bipy)_3$ role of spin – orbit coupling life time of comparison, application of redox process , transformation of low energy reaction into high energy products, chemical energy intolight.

LIST OF REFERENCES BOOKS:-

1. Inorganic Chemistry, Puri, Sharma, Kalia, Milestone Publisher
2. Principles of structure and reactivity, J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, Pearson Education
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DEPARTMENT OF CHEMISTRY
GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON
M.Sc. Chemistry
[Third Semester]
Laboratory Course I
ANALYTICAL PRACTICAL
2025-26

M.M. 100

MAJOR EXPERIMENTS

Analysis of ores and minerals

1. Lime stone and dolomite: Silica, Sesquioxide (R_3O_3) Ca, Mg. L.O.I. etc.
2. Haematite: Iron, Al, Ca, Mg. Acid insoluble & silicaetc.
3. Bauxite: Silica, Fe, Al, Be &Tietc.
4. Cement: Silica, Fe, Al, Ca, Mg &SO_4^{2-}

Flame Photometric Determinations

1. Sodium and Potassium when present together
2. Calcium and Magnesium in tap water

Gravimetric Estimation

Determination of composition of Ni - DMG complex by gravimetric method.

Quantitative organic analysis

1. Estimation of sulphur by Messenger'sMethod.
2. Estimation of nitrogen by Kjeldahl Method.
3. Estimation of halogen by Fusion method / Stepnow's method.
4. Determination of the percentage of number of hydroxyl groups in an organic compound by acetylation method.
5. Estimation of amines/phenols using bromate bromide solution/or acetylation method.

MINOR EXPERIMENTS

Spectroscopy Determinations

1. To verify the additivities of absorbance of a mixture of coloured substance in $KMnO_4$ and $K_2Cr_2O_7$ solution.
2. Determination of stoichiometry and stability constant of inorganic and organic complexes.
3. To determine the indicator constant pK_a of methyl red spectrophotometically.

4. Characterization of the complexes by electronic and IR spectral data.
5. Maganese / Chromium / Vanadium in steelsample
6. Nickel / Molybdenum / Tungsten / Vanadium / Uranium by extractive spectrophotometric method.
7. Fluoride / Nitrite /Phosphate
8. Iron-phenanthroline complex: Job's Method of continuous variations.
9. Copper - Ethylene diamine complex: Slope-ratio method

Conductometry

1. To verify Debye Huckel Onsager limiting law for strong electrolytes.
2. Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye Huckel's law.
3. To determine the degree of hydrolysis and hydrolysis constant of NH_4Cl /aniline hydrochloride at room temperature.
4. To study the effect of solvent on the conductance of acetic acid.

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DEPARTMENT OF CHEMISTRY
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M.Sc. Chemistry
[Third Semester]
Laboratory Course II
PROJECT
2025-26

M.M. 100

Each student will be allotted one project of 100 marks. The project can be either theoretical or experimental.

Distribution of marks:-

Project work	-	60
Presentation	-	20
Viva	-	20
Total	-	**100**

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