DEPARTMENT OF CHEMISTRY

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

M.Sc. Chemistry

Fourth Semester

2025-26

DEPARTMENT OF CHEMISTRY
GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON
Syllabus and Marking Scheme for Fourth 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	**PHOTOCHEMISTRY AND SOLID STATE**	80	16	20	04	04
II	**ENVIRONMENTAL CHEMISTRY**	80	16	20	04	04
III	**BIO-INORGANIC AND SUPRAMOLECULAR CHEMISTRY**	80	16	20	04	04
IV	**CHEMISTRY OF MATERIALS AND RADIOCHEMISTRY**	80	16	20	04	04
V	Lab Course I **ANALYTICAL CHEMISTRY**	100	36	----	----	02
IV	Lab Course II **PROJECT**	100	36	----	----	02
	Total	**520**	**----**	**80**	**----**	**20**

04 Theory papers - 320
04 Internal Assessments - 80
01 Practical + 01 Project - 200
Total Marks - 600

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

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

SEMESTER IV

2025-26

PAPER- I

PHOTOCHEMISTRY AND SOLID STATE

Max. Marks : 80

Min. Marks : 16

Unit-I **Photochemicalreaction**

Interaction of electromagnetic radiation with matter, type of excitations, fate of excited molecules, Quantum yield, transfer of excitation energy, actionometry.

Determination of reaction mechanism-

Classification, rate constant and life times of reactive energy states determination of rate constant of reaction, effect of light intensity on the rate of photochemical reaction, types of photochemical reaction, photo dissociation, gas phasephotolysis.

Unit – II Photochemistry of Alkenes and Carbonyl Compound –

Intramolecular reaction of the olefinic bond geometric isomerism, cyclisation reaction, rearrangement of 1,4, & 1, 5, dienes. Intramolecular reaction of carbonyl compounds , unsaturated compounds.

Miscellaneous Photochemical Reaction :-

Photo Fries Rearrangement and Barton reaction.

Unit - III A. Solid state chemistry :-

General principles, experiment procedures, co-precipitation as a precursor to solid state reaction, kinetics of solid chemistry.

B. Crystal defects and non stoicheometry –

Perfect & imperfect crystal, intrinsic defects- point defects, line & plane defects. Thermodynamics of Schottky & Frenkel defects formation. Colour centers, non-stoichiometry & defects.

Unit - IV A. Electronic properties & band theory-

Metal, insulators & semiconductors, electronic structure of solid- band theory, bond structure of metals, insulators semiconductors, intrinsic & extrinsic semiconductors doping semiconductors, p-n junction, superconductors.

B. Photoconduction- photoelectric effects-

Quantum theory of paramagnetic- co-operative phenomenon magnetic domains, hysteresics.

LIST OF REFERENCE BOOKS:

1. Principles of the Solid State, H.V. Keer, Wiley Eastern.
2. Solid State Chemistry, N.B. Hannay
3. Solid State Chemistry, A.K. Chakrobarty, New Age International.
4. Solid State Chemistry and its Application, A.R. West, Plenum.
5. Fundamentals of Photochemistry, K.K. Rohtagi - Mukherji, Wiley-Eastern.
6. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
7. Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.
8. Photochemistry, R.P. Kundall and A Gilbert, Thomson Nelson.

	Departmental members	
Chairperson /H.O.D		
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M.Sc. CHEMISTRY

Semester IV

2025-26

Paper - II

ENVIRONEMNTAL CHEMISTRY

Max. Marks :

80Min. Marks :

16

Unit - I A. Environment

Introduction, composition of atmosphere, vertical temperature budget of the earth atmosphere system, vertical stability atmosphere. Biogeochemical cycles of C.N.P.S. and biodistribution of elements.

Unit – II Hydrosphere

Chemical composition of water bodies, Hydrological cycle. Aquatic pollution inorganic organic pesticide, agricultural, industrial & sewage , detergent, oil spill and oil pollutants, water quantity parameter dissolved oxygen, biochemical oxygen demand, solid metal, content of chloride , sulphate, nitrate and microorganism, water quality standards. Analytical method for measuring BOD.DO.COD, residual chloride and chloride demand.Purification and treatment ofwater.

Solids

Composition, micro, and macro nutrient, pollutants waste treatment.

Unit - III Atmosphere

chemical composition of atmosphere, chemical and photochemical reaction in atmosphere, smog formation, oxides of NOx and their effect, pollution by chemicals, VOC'S chloroflouro hydro carbons. Green house effect, acid rain, air pollutioncontrols

Unit-IV **Industrialpollution**

Cement, distillery, paper and pulp, thermal power, plants, nuclear power plants.

Environmental Toxicology

Chemical solution to environmental problems, biodegradability, principles of decomposition, better industrial processes, Bhopal gas tragedy.

LIST OF REFERENCE BOOKS

1. Environmental Chemistry, A. K. De, New Age International
2. Environmental Chemistry: Green chemistry and pollutants and ecosysytem, EricLict House
3. Environmental Chemistry, Sameer K. Bainergi
4. Environmental Chemistry, P. S. sindhu, New Age International
5. A text Book of Environmental Chemistry, Subramanyan
6. A text Book of Environmental Chemistry and Pollution Control, S. S. Dara, S Chand
7. Environmental Chemistry, B. K. Sharma, Krishna Publication

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M.Sc. CHEMISTRY

SEMESTER IV

2025-26

PAPER- III

BIO-INORGANIC AND SUPRAMOLECULAR CHEMISTRY

Max. Marks : 80

Min. Marks : 16

Unit-I **Bioinorganic and supramolecular& photo inorganicchemistry-**
Metal storage transport & Biomineralization Ferritin, transferrin & siderophores.

Calcium in Biology
Calcium in living cells, transport & regulation, molecular aspects of intramolecular processes, extracellular binding proteins,

Metal- nucleic Acid Interactions
Metals ion & metal complex interactions, metal complexes

Unit-II **Metalloenzymes-**
Zinc enzyme- carboxypeptides and carbonic anhydrase. Iron enzyme- catalase, peroxidase & cytochrome P-450.
Copper enzyme – superoxide dismutase. Molybdenum Oxatransferase enzyme- Xanthine oxidase. Coenzyme vitaminB

Unit-III **Metal and Metal chelates in Medicine**
Metal & disease, toxic effect of metals, metal chelates used for diagnosis & chemotherapy with particular reference to anticancer drugs.

Antibiotics
Synthesis of penicillin G, Penicillin V, ampicillin, chlorophenical, amoxicillin

Unit - IV Supramolecularchemistry : Concepts & Language
Molecular recognition, Molecular receptors for different types of molecules including arsenic substrates, design, & Synthesis of co receptor molecules and multiple recognition, Supramolecular reactivity and Catalysis.

Transport process & carrier

Supramolecular devices Supramolecular Photochemistry, supramolecular electronic, ionic & Switching devices. Some example of self assembly in supramolecular chemistry.

LIST OF REFERENCE BOOKS

1. Principles of structure and reactivity, J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, Pearson Education
2. Bioinorganic chemistry , K. Hussain Reddy, New Age International
3. Concise inorganic chemistry, J.D.Lee, Backwell Science
4. Inorganic chemistry, Shriver and Atkins,Oxford
5. Supramolecular chemistry- fundamental and application, Ariga, Katsuhiko, Kunitake, Toyoki, Springer

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M.Sc. CHEMISTRY

SEMESTER IV

2025-26

PAPER- IV Elective - A

CHEMISTRY OF MATERIALS & RADIOCHEMISTRY

Max. Marks :

80Min. Marks :

16

Unit-I **Chemistry ofmaterials**

Multiphase Materials

Ferrous alloys, stainless steels, and nonferrous alloys, properties of ferrous and non-ferrous alloys and their application.

Glasses, ceramics and refractories

Glassy state, glass formers and glass modifiers, application. Ceramic structures, Mechanical properties clay products.

Refractories, characterizations, properties & application

UnitII **Composites**

Introduction, Classifications, Binary and ternary composites based on metals, metal oxides, polymers, carbon allotropes and their energy storage, biomedical and environmental remediation applications.

Nanomaterials

Fundamental aspects, preparation methods, Characterization techniques-FTIR, UV-Vis, SEM, EDS, XPS and TEM, Their application towards antimicrobial, antifungal, anticancer, dye remediation, environmental ramadiatial applications.

Unit-III **Principle and application of TGA, DTA, & DSC.**

Polarimetry, Optical Rotatory Dispersion and Circular Dichroism

Introduction, polarized light, optical activity, application of polarimetry, ORD and CD, rotator dispersion, instrumentation, cotton effect, anamolous ORD curves, relationship between ORD and CD, Axial haloketone rule, the octant rule, applications of octant rule, applications of ORD and CD, advantages of CD over ORD, limitations of ORD andCD.

Unit - IV Radiation Chemistry

Primary radiation effects. Radiation dosimetry, Radio free radicals, Radiochemistry in different media, Radiation in chemical process.Industrial application of radiation.

Nuclear Models, stability of the nucleus, radio isotopes, application of Radio isotopes in physicochemical investigation.

Radio analytical techniques - Isotopic dilution methods, neutron activation analysis (NAA), radiometric titrations, measurement of radioactivity through with special reference to Gieger-Muller counter and application in agricultures and industry in health care in biology.

LIST OF REFERENCE BOOKS:

1 Carbon Dots: Recent Developments and Future Perspectives, ElyorBerdimurodov, Dakeshwar Kumar Verma, Lei Guo, April 2024 American Chemical Society, USA.

2 Carbon Dots in Biology: Synthesis, Properties, Biological and Pharmaceutical Applications, Berdimurodov Elyor Tukhliyivich and Dakeshwar Kumar Verma, 2024, De-Gruyter, Germany.

3 Instrumental Technique of Analytical Chemistry, H. Kour, Pragati Publication

4 Nanoparticles – Nanocomposites, Nanomaterials: An Introduction for beginners, Dieter Volarth, Villey–VCH

5 Composite Materials: Production Properties Testing, K. Shrinivasan, Narosa

6 Composite Materials, Shivanand, Ashian Book Publication

7 PhotoChemistry and Radiation Chemistry, James F. Wishart, Danial G. Nausera

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M.Sc. CHEMISTRY

SEMESTER IV

2025-26

PAPER- IV Elective - B

POLYMER CHEMISTRY

Max. Marks 80

Min. Marks 16

Unit – I Mechanism of Polymerization

Basic concepts- Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: Mechanism of condensation polymerization, mechanism of addition polymerization-free radical chain, cationic, anionic, coordination and mechanism of copolymerization. Polymerization conditions and polymer reactions.Polymerization in homogeneous and heterogeneous systems.

Unit - II Kinetics and Statistics of Polymerization

Kinetics and statistics of stepwise polymerization – reactivity and molecular size, kinetics and statistics, molecular weight control. Kinetics of free radical chain polymerization, equation for kinetic chain length, degree of polymerization and chain transfer; Kinetics of cationic polymerization; kinetics of anionic polymerization. Kinetics of heterogeneous polymerization using Ziegler Nattacatalysts.

Unit - III Structure and Properties

Morphology and order in crystalline polymers - configurations of polymer chains. Crystal structures of polymers. Polymer structure and physical properties- crystalline melting point T_m - melting points of homogenous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature , T_g - relationship between T_m and T_g, effects of molecular weight, diluents, chemical structure, chain topology, branching and crosslinking.

Unit - IV Polymer Processing

Plastics, elastomers and fibers, compounding. Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fiber spinning.

Polymer Characterization

Polymer solutions – Criteria of polymer solubility, thermodynamics of polymer solution – ideal solution, entropy, heat and free energy of mixing.

Analysis and testing of polymers - chemical, analysis of polymers, spectroscopic methods, X-ray diffraction study, microscopy, thermal analysis and physical testing tensile strength. Fatigue, impact, tear resistance, hardness and abrasionresistance.

LIST OF REFERENCE BOOKS

1. Polymer Science, Gowarikar, Vishwanathan, Sridhar, Willey Eastern.
2. Textbook of Polymer Science, F.W. Billmeyer, Jr.Wiley
3. Contemporary Polymer Chemistry, Alcock and Lambe, Prentice Hall.
4. Physics and Chemistry of Polymers, J.M.G. Cowic, Blackie, Academic Professional.
5. Funcitonal Monomers and Polymers, K. Takemoto, Y. Inaki and R.M. Ottanbrite.

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DEPARTMENT OF CHEMISTRY
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M.Sc. Chemistry
[Fourth Semester]
2025-26
Lab Course I
PROJECT WORK

Max. Marks 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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M.Sc. Chemistry
[Fourth Semester]
2025-26
Lab Course-II

Max. Marks : 100

MAJOR EXPERIMENTS
Analysis of alloys, ores and minerals

(i.) Ni alloy
(ii.) Cu, Ni, Zn alloy
(iii.) Steel
(iv) Solder metals
(v) Gun metals
(vi) Types metals
(vii) Coin analysis

MINOR EXPERIMENTS

EXTRACTION OF ORGANIC COMPOUNDS FROM NATURAL SOURCES

(i) Isolation of caffeine from leaves.
(ii) Isolation of Casein from milk.
(iii) Isolation of lactose from milk.
(iv) Isolation of nicotine dipicrate from tabacco.
(v) Isolation of Cinchonine from cinchona bark.
(vi) Isolation of Piperine from black pepper.
(vii) Isolation Lycopene from tomatoes.
(viii) Isolation of β-Carotene from carrots.
(ix) Isolation of Limonene from citrus rinds.
(x) Isolation of protein and carbohydrates from seeds -colour test
(xi) Extraction of Fatty oil from seeds and determination of refractive index of the oil.
(xii) Isolation of protein and carbohydrate (as reducing sugars) from seed-colour test.

BOOKS SUGGESTED:

1. Practical Organic chemistry by A. I.Vogel.
2. Practical Organic chemistry by Mann and Saunders.

3. Practical Organic chemistry by Garg and Saluja.
4. The Systematic Identification of Organic compounds, R. L. Shriner and D. Y. Curtin.
5. Semimicro Qualitative Organic Analysis, N.D.Cheronis, J.B. Entrikin and E. M. Hodnett.
6. Experimental Organic chemistry, M. P. Doyle and W. S. Mungall.
7. Small Scale Organic preparation, P. J. Hill.
8. Experimental Biochemistry, by B.S. Roa and V. Deshpande. I.K. International Pvt. Ltd.
9. Comprehensive Practical Organic Chemistry, Preparation and Qualitative Analysis, V.K. Ahluwalia and Renu Aggarwal, University Press.

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