DEPARTMENT OF CHEMISTRY

COURSE CURRICULUM & MARKING SCHEME

M.Sc. CHEMISTRY
Semester - III

SESSION : 2024-25

ESTD: 1958

GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG, 491001 (C.G.)

(Former Name – Govt. Arts & Science College, Durg)

NAAC Accredited Grade A+, College with CPE - Phase III (UGC), STAR COLLEGE (DBT)

Phone : 0788-2212030

Website - www.govtsciencecollegedurg.ac.in, Email – autonomousdurg2013@gmail.com

Department of Chemistry

Govt. V.Y.T. PG Autonomous College

Durg (C.G.)

M.Sc. Chemistry

Third Semester

2024-2025

Syllabus and Marking Scheme for Third Semester

Session 2024-25

Paper No.	Title of the Paper	Marks Allotted in Theory		Marks Allotted in Internal Assessment		Credits
		Max	Min	Max.	Min.	
I	APPLICATIONS OF SPECTROSCOPY	80	16	20	04	05
II	BIO-ORGANIC CHEMISTRY	80	16	20	04	05
III	ENVIRONMENTAL CHEMISTRY	80	16	20	04	05
IV	Elective-A : BIO-INORGANIC AND SUPRAMOLECULAR CHEMISTRY Elective- B : NATURAL PRODUCTS Elective- C : POLYMER CHEMISTRY	80	16	20	04	05
V	Lab Course I GENERAL PRACTICAL	100	36	----	----	04
IV	Lab Course II PRACTICAL (A, B OR C)	100	36	----	----	04
	Total	**520**	----	**80**	----	**28**

04 Theory papers - 320

04 Internal Assessments - 80

02 Practical - 200

Total Marks - 600

Note: 20 marks = 01 credit in Theory Papers and 25 Marks = 01 Credit in Practical

The syllabus for M.Sc. Chemistry is hereby approved for the sessions 2023-24 and 2024-25

Name and Signatures	Departmental members **Name and Signatures**
Chairperson /H.O.D	1. .....
Subject Expert ..... (University Nominee)	2. .....
Subject Expert.....	3. .....
Subject Expert.....	4.....
Subject Expert.....	5. .....
Representative ..... (Industry)	6. .....
Representative ..... (Alumni)	7. .....
Representative ..... (Professor Science Faculty Other Dept.)	8. .....
	9. .....
	10. .....
	11. .....
	12. .....

M.Sc. CHEMISTRY

SEMESTER - III

2024-25

Paper - I

APPLICATIONS OF SPECTROSCOPY

Max. Marks 80
Min. Marks 16

Unit - I

Vibrational Spectroscopy

Instrumentation and sample handling in IR Spectroscopy, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (Ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds).Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance.FTIR.

Optical Rotatory Dispersion (ORD)and Circular Dichroism (CD)

Definition, deduction of absolute configuration, Octant rule for Ketones.

Unit - II

Nuclear Magnetic Resonance Spectroscopy

General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry, hindered rotation.

Carbon-13 NMR Spectroscopy

General consideration, chemical shift (aliphatic, olefinic alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimension NMR Spectroscopy, COSY, NOESY, DEPT, INEPT, APT and INADEQUATE Techiniques.

Unit - III

Electron Spin Resonance Spectroscopy

Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron).

Mossbauer Spectroscopy

Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin, (2) Sn^{+2} and Sn^{+4} compounds - nature of M - L bond coordination number, structure and(3) Detection of oxidation state and inequivalent MB atoms.

Unit –IV **Mass Spectrometry**

Introduction, ion production - EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc Lafferty rearrangement.Nitrogenrule.High-resolution mass spectrometry.Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

LIST OF REFERENCE BOOKS

1. Infrared and Raman Spectra: Inorg. and coordination compds, K., Nakamoto, Wiley.
2. Physical methods for Chemistry, R.S. Drago, Saunders Company.
3. Structural methods in Inorg. Chem.,. Ebsworth,. Rankin and S. Cradock, ELBS.
4. Progress in Inorg. Chem. Vol. 8, ed, F.A. Cotton, Vol. 15, ed., S.J. Lippard, Wiley.
5. Transition metal Chemistry ed. R.L. Corlin Vol. 3, Dekker.
6. Inorganic Electronic Spectroscopy, A.P.B. Lever, Elsevier.
7. NMR, NQR, EPR and Mossbauer Spectros. in Inorg. Chem., Parish, Ellis Horwood.
8. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.
9. Spectrometric Identification of org. compd R.M. Silverstein, G.C. Bassler and T.C.Morrill, John Wiley.
10. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
11. Application of Spectroscopy of organic compound J.R. Dyer, Prentice Hall.
12. Spectroscopic Methods in Org. Chem, D.H. Williams, I. Fleming, Tata McGraw Hill.

Question Paper Format and Distribution of Marks for PG Semester Examination

Question paper format for the Post-Graduate Examination has been revised from the Session 2022-23. The revised format will be applicable for all the question papers of Semester I, II, III & IV. The following are the main points of the new format:

1. The question paper will be of **80 marks**
2. Questions will be asked Unit-wise in each question paper.
3. From each Unit, the questions will be asked as follows :

Q.1 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**

Q.2 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**

Q.3 Short answer type question **(Answer in 200-250 words)** **(04 Marks)**

Q.4 Long answer type questions **(Answer in 400-450 words)** **(12 Marks)**

Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
Very Short (2 Questions) (Maximum two sentences)	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks
Short (1 Question) 200-250 words	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks
Long answer (1 Question) 400-450 words	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks

Note:

1. Question no. 1 and Question 2 will be compulsory.
2. Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
3. As mentioned above, two compulsory very short answer type questions (2+2 marks), one short answer type question with internal choice (4 marks) and one long answer type question with internal choice (12 marks) will be asked from each unit.
   Thus there will be questions of 20 marks from each unit and of total 80 marks from all the four units of the syllabus/syllabi.

M.Sc. CHEMISTRY

SEMESTER - III

2024-25

PAPER- II

BIO-ORGANIC CHEMISTRY

Max. Marks 80

Min. Marks 16

Unit - I

Enzymes

Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity lablelling and enzymes modification by site directed mutagenesis. Enzymekinetics, Michaelis- Menten and Lineweaver- Burk plots, reversible and irreversible inhibition.

Unit - II

Mechanism of Enzyme Action

Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanism for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A.

Kinds of reactions catalysed by enzymes

Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in isomerization reactions -cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.

Unit - III

Enzyme Models

Host - guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality. Biomimetics chemistry, crown ethers, Cryptates, Cyclodextrins, Cyclodextrin - based enzyme models, calixarenes, ionophores, micelles, synthetic enzymes or synzymes.

Co-Enzyme Chemistry

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD^+, $NADP^+$, FMN, FAD, lipoic acid, vitamin B_{12}. Mechanism of reactions catalyzed by the above cofactors.

Unit - IV

Biotechnological Applications of Enzymes

Large - scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry - brewing and cheese

making, syrups from corn starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA technology.

Biological Cell and its constituents

Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems, Helix coil transition.

LIST OF REFERENCE BOOKS:

1. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
3. Enzyme Chemistry: Impact and Appls, Ed. Collin J. Suckling, Chapman and Hall.
4. Enzyme Mechanisms Ed., M. I. Page and A. Williams, Royal Society of Chemistry.
5. Fundamentals of Enzymology, N.C. Price and L. Stevens, Oxford University Press.
6. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael D. Trevan, John Wiley.
7. Enzymatic Reaction Mechanisms, C. Walsh, W.H. Freeman.
8. Enzyme Structure and Mechanism, A. Fersht, W.H. Freeman.
9. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzier, Acad. Press.

Question Paper Format and Distribution of Marks for PG Semester Examination

Question paper format for the Post-Graduate Examination has been revised from the Session 2022-23. The revised format will be applicable for all the question papers of Semester I, II, III & IV. The following are the main points of the new format:

1. The question paper will be of **80 marks**
2. Questions will be asked Unit-wise in each question paper.
3. From each Unit, the questions will be asked as follows :

Q.1 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**

Q.2 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**

Q.3 Short answer type question **(Answer in 200-250 words)** **(04 Marks)**

Q.4 Long answer type questions **(Answer in 400-450 words)** **(12 Marks)**

Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
Very Short (2 Questions) (Maximum two sentences)	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks
Short (1 Question) 200-250 words	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks
Long answer (1 Question) 400-450 words	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks

Note:

1. Question no. 1 and Question 2 will be compulsory.
2. Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
3. As mentioned above, two compulsory very short answer type questions (2+2 marks), one short answer type question with internal choice (4 marks) and one long answer type question with internal choice (12 marks) will be asked from each unit.
   Thus there will be questions of 20 marks from each unit and of total 80 marks from all the four units of the syllabus/syllabi.

M.Sc. CHEMISTRY

SEMESTER - III

2024-25

PAPER- III

ENVIRONMENTAL CHEMISTRY

Max. Marks 80
Min. Marks 16

Unit - I

Environment

Introduction,Composition of atmosphere, vertical temperature, heat budget of the earth atmospheric system, vertical stability of atmosphere, Hydrological cycle. Biogeochemical cycles of C, N, P, S and O. Biodistribution of elements.

Industrial Pollution

Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants, metallurgy.Polymers, drugs etc.Disposal of wastes and their management.

Unit - II

Hydrosphere

Chemical composition of water bodies - lakes, streams, rivers and wet lands etc.
Aquatic pollution- Inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Water quality standards. Purification and treatment of water.

Soils

Composition, micro and macro nutrients, Pollution- fertilizers, pesticides, plastics and metals. Waste treatment. Biodegradability.

Unit - III

Atmosphere

Major regions of the atmosphere, earth's radiation balance. Chemical composition of atmosphere - Particles, ions and radicals their formation.Air pollution: Chemical and photochemical reactions in atmosphere, photochemical smog formation, oxides of N, C, S, O and their effect, pollution by chlorofluorohydro - carbons. Greenhouse effect, acid rain, air pollution controls and their chemistry.

Analysis of Air Pollution

Analytical methods for sampling and measuring air pollutants, continuous monitoring instruments.

Unit – IV

Analysis of Water Pollution

Analysis of water pollution: Analytical methods for measuring color, turbidity, total solids, conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica, phosphates and different forms of nitrogen, DO, BOD, COD, residual chlorine and chlorine demand. Heavy metal pollution - public health significance of cadmium, chromium, copper, lead, zinc, manganese, mercury and arsenic. General Instrumental techniques for the analysis of heavy metals in aqueous systems.

Analysis of Soil Pollution

Moisture, pH, total nitrogen, phosphorus silica, lime, magnesia, manganese, sulphur and alkali salts.

LIST OF REFERENCE BOOKS

1. Environmental Chemistry., S. E. Manahan, Lewis Publication
2. Environmental Chemistry., Sharma & Kaur, Krishna Publication.
3. Environmental Chemistry., A.K. De, Wiley Eastern.
4. Environmental Pollution Analysis, S.M. Khopkar, Wiley Eastern.
5. Standard methods of Chemical Analysis, F.J. Welcher vol.3 Van Nostrand Reinhold Co.
6. Elemental Analysis of Airborne Particles , Ed. S. Landsberger and M.Creatchman Gordon & Breach Sci. Publication.
7. Environmental Chemistry., C. Baird, W.H. Freeman.
8. Analytical Chemistry., G.D. Christian, J. Willey.
9. Fundamentals of Analytical. Chemistry. D.A. Skoog, D. M. West and F. J. Holler,

Question Paper Format and Distribution of Marks for PG Semester Examination

Question paper format for the Post-Graduate Examination has been revised from the Session 2022-23. The revised format will be applicable for all the question papers of Semester I, II, III & IV. The following are the main points of the new format:

1. The question paper will be of **80 marks**
2. Questions will be asked Unit-wise in each question paper.
3. From each Unit, the questions will be asked as follows :

Q.1 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**

Q.2 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**

Q.3 Short answer type question **(Answer in 200-250 words)** **(04 Marks)**

Q.4 Long answer type questions **(Answer in 400-450 words)** **(12 Marks)**

Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
Very Short (2 Questions) (Maximum two sentences)	**2 x 2 = 4 Marks**	**2 x 2 = 4 Marks**	**2 x 2 = 4 Marks**	**2 x 2 = 4 Marks**
Short (1 Question) 200-250 words	**1 x 4 = 4 Marks**	**1 x 4 = 4 Marks**	**1 x 4 = 4 Marks**	**1 x 4 = 4 Marks**
Long answer (1 Question) 400-450 words	**1 x 12 = 12 Marks**	**1 x 12 = 12 Marks**	**1 x 12 = 12 Marks**	**1 x 12 = 12 Marks**

Note:

1. Question no. 1 and Question 2 will be compulsory.
2. Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
3. As mentioned above, two compulsory very short answer type questions (2+2 marks), one short answer type question with internal choice (4 marks) and one long answer type question with internal choice (12 marks) will be asked from each unit.
   Thus there will be questions of 20 marks from each unit and of total 80 marks from all the four units of the syllabus/syllabi.

M.Sc. CHEMISTRY
SEMESTER III

2024-25

PAPER- IV Elective - A

BIOINORGANIC & SUPRAMOLECULAR CHEMISTRY

Max. Marks 80
Min. Marks 16

Unit-I

Metal Storage Transport and Biomineralization

Ferritin, transferring and siderophores

Calcium in Biology

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

Metal-Nucleic Acid Interactions

Metal ions and metal complex interactions. Metal-nucleic acids complexes.

Unit - II

Metalloenzymes

Zinc enzymes - carboxypeptidase and carbonic anhydrase. Iron enzymes - catalase, peroxidase and cytochrome P-450. Copper enzymes - superoxide dismutase.Molybdenumoxatransferase enzymes - xanthine oxidase. Cobalt enzyme - vitamin B_{12}.

Metals in Medicine

Metal deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs.

Unit - III

Supramolecular Chemistry - I

Concepts and language.

Molecular recognition

Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of coreceptor molecules and multiple recognition. Supramolecular reactivity and catalysis.

Unit - IV

Supramolecular Chemistry - II

Transport processes and carrier design. Supramolecular devices. Supramolecular photochemistry, Supramolecular electronic, ionic and switching devices. Some examples of self assembly in supramolecular chemistry.

LIST OF REFERENCE BOOKS:

1. Principles of Bioinorganic Chemistry, S J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S J. Lippard and J. S .Valentine, University Science Books.
3. Inorganic Biochemistry Vols I and II ed,G.L. Eichhorn, Elsevier.

4. Progress in Inorganic Chemistry, Vols 1 8 and 38 ed. J J. Lippard, Wiley.
5. Supramolecular Chemistry, J. M. Lehn, VCH.

Question Paper Format and Distribution of Marks for PG Semester Examination

Question paper format for the Post-Graduate Examination has been revised from the Session 2022-23. The revised format will be applicable for all the question papers of Semester I, II, III & IV. The following are the main points of the new format:

1. The question paper will be of **80 marks**
2. Questions will be asked Unit-wise in each question paper.
3. From each Unit, the questions will be asked as follows :

Q.1 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**
Q.2 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**
Q.3 Short answer type question **(Answer in 200-250 words)** **(04 Marks)**
Q.4 Long answer type questions **(Answer in 400-450 words)** **(12 Marks)**

Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
Very Short (2 Questions) (Maximum two sentences)	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks
Short (1 Question) 200-250 words	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks
Long answer (1 Question) 400-450 words	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks

Note:

1. Question no. 1 and Question 2 will be compulsory.
2. Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
3. As mentioned above, two compulsory very short answer type questions (2+2 marks), one short answer type question with internal choice (4 marks) and one long answer type question with internal choice (12 marks) will be asked from each unit.

   Thus there will be questions of 20 marks from each unit and of total 80 marks from all the four units of the syllabus/syllabi.

M.Sc. CHEMISTRY

SEMESTER III

2024-25

PAPER- IV Elective – B

NATURAL PRODUCTS

Max. Marks 80
Min. Marks 16

Unit- I **Terpenoids and Carotenoids**

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule.Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Geraniol, Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and Carotene.

Unit - II **Alkaloids**

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+) -Coniine, Nicotine, Atropine, Quinine and Morphine.

Unit - III **Steroids and Hormones**

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereo chemistry. Isolation, structure determination and synthesis of Cholestrol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldostrone. Biosynthesis of steroids.

Unit IV **Plant Pigments**

Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7 arabinoside, Cyanidin, Hirsutidin.Biosynthesis of flavonoids

Porphyrins

Structure and Synthesic of haemoglobin and chlorophyll

LIST OF REFERENCE BOOKS:

1. Natural Products: Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs D. V. Banthrope and J.B. Harbrone, Longman, Essex.
2. Organic Chemistry, Vol. 2, I.L. Finar, ELBS
3. Stereoselective Synthesis: A Practical Approach, M. Nogradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americans, Ed. Kurt Hostettmann, M.P, Gupta and A. Marston, Harwood Academic Publishers.
6. Introduction to Flavonoids, B. A.Bohm, Harwood Acedemic Publishers.

7. New Trends in Natural Product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
8. Insectcides of Natural Origin, Sukh Derv, Harwood Academic Publishers.

Question Paper Format and Distribution of Marks for PG Semester Examination

Question paper format for the Post-Graduate Examination has been revised from the Session 2022-23. The revised format will be applicable for all the question papers of Semester I, II, III & IV. The following are the main points of the new format:

1. The question paper will be of **80 marks**
2. Questions will be asked Unit-wise in each question paper.
3. From each Unit, the questions will be asked as follows :

Q.1 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**
Q.2 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**
Q.3 Short answer type question **(Answer in 200-250 words)** **(04 Marks)**
Q.4 Long answer type questions **(Answer in 400-450 words)** **(12 Marks)**

Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
Very Short (2 Questions) (Maximum two sentences)	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks
Short (1 Question) 200-250 words	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks
Long answer (1 Question) 400-450 words	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks

Note:

1. Question no. 1 and Question 2 will be compulsory.
2. Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
3. As mentioned above, two compulsory very short answer type questions (2+2 marks), one short answer type question with internal choice (4 marks) and one long answer type question with internal choice (12 marks) will be asked from each unit.

   Thus there will be questions of 20 marks from each unit and of total 80 marks from all the four units of the syllabus/syllabi.

M.Sc. Chemistry

Semester III

2024-25

Paper– IV Elective - C

POLYMER AND NANOCHEMISTRY

Max. Marks 80

Min. Marks 16

Unit – I

Introduction to Polymers

Basic concepts- Monomers, repeat units, degree of polymerization. Classification of polymers. Homo-polymers, copolymers; Linear, branched and cross linked polymers; Random, alternating, block and graft polymers; Tacticity of polymers. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

Polymer Properties and Characterization

Crystalline melting point and glass transition temperature and factors affecting Tm and Tg. 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 abrasion resistance.

Unit - II

Kinetics and Mechanism of Polymerization

Mechanism of condensation polymerization; addition polymerization –free radical, cationic, anionic, coordination and copolymerization.

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 Natta catalysts.

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.

Unit - III

Introduction to Nano-materials

Properties and uses of bulk and nano-materials; Optical, electrical and magnetic properties of nano-materials; quantum confinement, role of size and shape in nano-materials.

Synthesis of nano-materials

Synthesis of nano-crystals by reduction, solvo-thermal synthesis, photochemical synthesis, electrochemical synthesis, semiconductor nano-particles by arrested precipitation. Synthesis of nano-particles by green routes, thermolysis routes and sono-chemical routes, sol-gel, micelle and micro- emulsion methods.

Unit – IV **Characterization of nano-materials**

Instrumentation, operating principle and application of Energy dispersive X-ray spectroscopy (EDAX); FTIR; X-ray diffraction; AFM; SEM; TEM; Scanning probe microscopy; Optical microscopy and UV-VIS-IR spectroscopy.

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, Acadand Professional.
5. Funcitonal Monomers and Polymers, K. Takemoto, Y. Inaki and R.M. Ottanbrite.

Question Paper Format and Distribution of Marks for PG Semester Examination

Question paper format for the Post-Graduate Examination has been revised from the Session 2022-23. The revised format will be applicable for all the question papers of Semester I, II, III & IV. The following are the main points of the new format:

1. The question paper will be of **80 marks**
2. Questions will be asked Unit-wise in each question paper.
3. From each Unit, the questions will be asked as follows :

Q.1 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**

Q.2 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**

Q.3 Short answer type question **(Answer in 200-250 words)** **(04 Marks)**

Q.4 Long answer type questions **(Answer in 400-450 words)** **(12 Marks)**

Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
Very Short (2 Questions) (Maximum two sentences)	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks
Short (1 Question) 200-250 words	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks
Long answer (1 Question) 400-450 words	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks

Note:

1. Question no. 1 and Question 2 will be compulsory.
2. Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
3. As mentioned above, two compulsory very short answer type questions (2+2 marks), one short answer type question with internal choice (4 marks) and one long answer type question with internal choice (12 marks) will be asked from each unit.

   Thus there will be questions of 20 marks from each unit and of total 80 marks from all the four units of the syllabus/syllabi.

M.Sc. Chemistry
[Third Semester]
Laboratory Course I: General Practical
2024-25

M.M. 100

MAJOR EXPERIMENTS

INORGANIC CHEMISTRY

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 & silica etc.
3. Bauxite: Silica, Fe, Al, Be &Ti etc.
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

Polarography

1. Composition and stability constant of complexes.
2. Estimation of Pb^{2+} and Cd^{2+} / Zn^{2+} and Ni^{2+} ions in amixture of Pb^{2+} and Cd^{2+} / Zn^{2+} and Ni^{2+} by polarography.

Gravimetric Estimation

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

ORGANIC CHEMISTRY

Quantitative organic analysis

1. Estimation of sulphur by Messenger's Method.
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.

PHYSICAL CHEMISTRY

Spectroscopy

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.

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.

Distribution coefficient

1. To determine the formula of the complex formed between cupric ion & ammonia by distribution method .
2. To determine the equilibrium constant of the following reaction $KI+I_2 \rightarrow KI_3$

Thermodynamics

1. To determine the partial molar volume of solute and solvent in aqueous solutions at room temperature.
2. Determination of the temperature dependence of the solubility of a compound in two solvents (benzoic acid in water and in DMSO-water mixture) and calculate the partial molar heat of solution.

MINOR EXPERIMENTS

INORGANIC CHEMISTRY

Spectrophotometric Determinations

(i) Maganese / Chromium / Vanadium in steel sample
(ii) Nickel / Molybdenum / Tungsten / Vanadium / Uranium by extractive spectrophotometric method.
(iii) Fluoride / Nitrite / Phosphate
(iv) Iron-phenanthroline complex: Job's Method of continuous variations.
(v) Copper - Ethylene diamine complex: Slope-ratio method

Nephelometric Determinations

1. Sulphate
2. Phosphate
3. Silver

Separation and Quantitative Estimation of Binary and Ternary Mixtures by the use of following separation techniques

1. Paper chromatography-Cadmium and Zinc, Zinc and Magnesium
2. Thin-layer Chromatography-separation of Nickel, Manganese, Cobalt and Zinc. Determination of Rf values.
3. Solvent extraction.
4. Electrophoretic separation.

ORGANIC CHEMISTRY

Paper Chromatography

Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

Quantitative Analysis

1. Estimation of carbonyl group by hydrazone formation method
2. Estimation of Carboxylic group by titration method / silver salt method
3. Estimation of Glycine by titration method

PHYSICAL CHEMISTRY

Micelles

To determine the critical micelle concentration of the given surfactant by conductometric or surface tension measurement method.

pHmetry/ Potentiometry

To determine pK_a of the given dibasic and tribasic acids.

Determination of the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.

Acid-base titration in a non aqueous media using a pH meter.

Conductometry

1. To determine the degree of hydrolysis and hydrolysis constant of NH_4Cl /aniline hydrochloride at room temperature.
2. To study the effect of solvent on the conductance of acetic acid.

M.Sc. Chemistry
[Third Semester]
Laboratory Course II (A)
Practical
2024-25

M.M. 100

MAJOR EXPERIMENTS

Quantitative Analysis

Quantitative separation and determination of three components system using standard volumetric and gravimetric methods of analysis. The systems can any one of the following

i. Ba , Cu & Zn
ii. Cu, Ni & Zn
iii. Fe, Al & Ca
iv. Fe, Ca & Mg
v. Ag, Ni & Zn

MINOR EXPERIMENTS

Preparation

Preparation of selected inorganic compounds and their study by IR, electronic spectra, Mossbauer, ESR and magnetic susceptibility measurements.Handling of air and moisture sensitive compounds involving vacuum lines.

Selection can be made from the following :

1. Sodium amide, Inorg. Synth., 1946,2 , 128
2. Synthesis and thermal analysis of group fl metal oxalate hydrate, J. Chem. Ed., 1988, 65, 1024.
3. Atomic absorption analysis of Mg and Ca.
4. Trialkoxyboranes - Preparation, IR and NMR spectra.
5. $PhBCl_2$Dichlorophenyborane Synthesis in vacuum line.
6. Preparation of Tin (IV) iodide, Tin (IV) chloride and Tin (II) iodide, Inorg. Synth, 1953, 4, 119
7. Relative stability or Tin (IV) and Pb (IV). Preparation of ammonium hexachlorstannate $(NH_4)_2$ $SnCl_6$.,ammoniumhexachloroplumbate $(NH_4)_2PbCl_6$
8. Hexa- bis (4 -nitrophenoxy) cyclotriphosphazene.
9. Synthesis of trichlorodiphenylantimony (V) hydrate.Inorg.Synth.1985, 23, 194.
10. Sodium tetrathionate $Na_2S_4O_6$
11. Metal complexes of dimethyl sulfoxide (IR) $CuCl_2$,2DMSO, $PdCl_2$, 2DMSO, $RuCl_2$, 4DMSO. J. Chem. Edu. 1982,59,57

12. Synthesis of metal acetylcetonate : Magnetic moment, IR, NMR Inorg. Synth, 1957, 5, 130, 1963, 1, 183.
13. Bromination of Cr $(acac)_3$J.Chem. Edu. 1986,63,90
14. Magnetic moment of Cu $(acac)_2H_2O$.
15. Cis and Trans $[Co(en)_2\ Cl_2]^+$
16. Separation of optical isomer of cis-$[Co(en)_2Cl_2]$ Cl J. Chem. Educ., 1960,4369
17. Ion Exchange separation of oxidation state of vanadium. J.Chem. Edu. 1980, 57, 316, 1978, 55, 55.
18. Determination of Cr (III) Complex $[Cr(H_2O)_6]NO_3.3H_2O$, $[Cr(H_2O)_4]Cl_2.2H_2O$, $[Cr(en)_3]Cl_3$, $Cr(acac)_3$Inorg Synth, 1972, 13, 184.
19. Preparation of N,Nbis (salicyldehyde) ethylenediamine, salen R, Co(Salen) J. Chem. Educ. 1977, 54,443,1973,50670
20. Preparation of Fe (II) Chlorine (use it as Friendel - Craft chlorination source, J. Org. Chem. 1978,43,2423, J. Chem. Edu.1984, 61, 645, 1986, 63, 361.)
21. Reaction of Cr (HI) with a multidentare ligand a kinetic experiment (visible spectra Cr-EDTA complex,) J.A.C.S. 1953,75,5670
22. Preparation of [Co (phenonthroline- 5,6-quinone)] j.chem. Soc. A., 1970, 447; J. Chem. Edu. 1977,54,7 10
23. Preparation and use of ferrocene. J. Chem. Edu. 1966,43,73; 1976,53,730
24. Preparation of copper glycine complex, cis and Trans bisglycinato Copper (II) J. Chem. Soc Dalton, 1979,1901, J. Chem. Edu. 1982, 59, 1052.
25. Preparation of phosphine Pr_3P and its transition metal complexes.
26. Any other experiment such as converionof p-xylene to terephthalic acid catalyzed by $CoBr_2$ (homogeneous catalysis).

M.Sc. Chemistry
[Third Semester]
Laboratory Course II (B)
Practical
2024-25

Max Marks 100

MAJOR EXPERIMENTS

Extraction of organic compounds from natural sources

i. Isolation of Caffeine from tea leaves.
ii. Isolation of Casein from milk (the students are required to try some typical colour reactions of proteins).
iii. Isolation of lactose from milk (purity of sugar should be checked by TLC and paper chromatography and Rf value reported).
iv. Isolation of nicotine dipicrate from tobacco.
v. Isolation of Cinchonine from cinchona bark.
vi. Isolation of Piprine from black pepper.
vii. Isolation of Lycopene from tomatoes.
viii. Isolation of cystein from human hair.

MINOR EXPERIMENTS

Spectrophotometric (UV /VIS) estimations of the following

i. Amino acids
ii. Caffeine
iii. Carbohydrates
iv. Proteins

M.Sc. Chemistry
[Third Semester]
Laboratory Course II (C)
Practical
2024-25

M. M. 100

MAJOR EXPERIMENTS

1. To study the effect of temperature, concentration of the reactant and catalysts on the rate of hydrolysis of ester and to calculate energy of activation.
2. To study the kinetics of saponification of ethyl acetate by
   a. Volumetric method
   b. Conductometric method
3. To determine the relative strength of two acids by studying the hydrolysis of methyl acetate.
4. To study the kinetics of polymerization.
5. To determine the rate constant of hydrolysis / inversion of sugar using polarimeter.

MINOR EXPERIMENTS

1. To study the kinetics of cooling of hot water.
2. To study the autocatalytic reaction between $KMnO_4$ and oxalic acid.
3. To study the kinetics of oxidation of alcohol by chromic acid.
4. To prepare polymer and determine its molecular weight.
5. To study kinetics of oxidation of dyes using oxidizing agent.
6. Synthesis and characterization of nano- particles.

The syllabus for M.Sc. Chemistry is hereby approved for the sessions 2023-24 and 2024-25

Name and Signatures	Departmental members **Name and Signatures**
Chairperson /H.O.D	1. .....
Subject Expert ..... (University Nominee)	2. .....
Subject Expert.....	3. .....
Subject Expert.....	4.....
Subject Expert.....	5. .....
	6. .....
Representative ..... (Industry)	7. .....
Representative ..... (Alumni)	8. .....
Representative ..... (Professor Science Faculty Other Dept.)	9. .....
	10. .....
	11. .....
	12. .....