DEPARTMENT OF CHEMISTRY

COURSE CURRICULUM & MARKING SCHEME

M.Sc. CHEMISTRY
Semester – I, II, III, IV

SESSION : 2025-26

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.)

Syllabus

M.Sc. Chemistry

First and Second Semester (2025-26)

Third and Fourth Semester (2025-26)

DEPARTMENT OF CHEMISTRY

GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG

Approved syllabus for M.Sc. Chemistry by the Members of Board of Studies for Sessions 2025-26

The syllabus with the paper combinations is as under:

Semester I:

Paper I: MCH-101 **COORDINATION CHEMISTRY**	**Paper II: MCH-102** **ORGANIC REACTION MECHANISM**
Paper III: MCH-103 **MATHEMATICS FOR CHEMISTS,QUANTUM CHEMISTRY AND CHEMICAL DYNAMICS**	**Paper IV: MCH-104** **GROUP THEORY AND COMPUTER FOR CHEMISTS**
Lab Course I: MCHL-01 **INORGANIC CHEMISTRY PRACTICAL**	**Lab Course II: MCHL-02** **PHYSICAL CHEMISTRY PRACTICAL**

Semester II:

Paper I: MCH-201 **TRANSITION METAL COMPLEXES AND DIFFRACTION METHODS**	**Paper II: MCH-202** **CONCEPTS IN ORGANIC CHEMISTRY**
Paper III: MCH-203 **THERMODYNAMICS, ELECTROCHEMISTRY AND SURFACE CHEMISTRY**	**Paper IV: MCH-204** **SPECTROSCOPY**
Lab Course I: MCHL-03 **ORGANIC CHEMISTRY PRACTICAL**	**Lab Course II: MCHL-04** **ANALYTICAL CHEMISTRY PRACTICAL**

Semester III:

Paper I: MCH-301 **APPLICATIONS OF SPECTROSCOPY**	**Paper II: MCH-302** **BIO-ORGANIC CHEMISTRY**
Paper III: MCH-303 **ENVIRONMENTAL CHEMISTRY**	**Paper IV:** **Elective-A: MCH-304(A)** **BIO-INORGANIC AND SUPRAMOLECULAR CHEMISTRY** **Elective-B: MCH-304(B)** **NATURAL PRODUCTS** **Elective-C: MCH-304(C)** **POLYMER AND NANOCHEMISTRY** **Elective-D: MCH-304(D)** **NANOMATERIALS AND NANOTECHNOLOGY**
Lab Course I: MCHL-05 **GENERAL PRACTICAL**	**Lab Course II: MCHL -06(A), MCHL-06(B), MCHL-06(C)** **ELECTIVE PRACTICAL (A, B OR C)**

Semester IV:

Paper I: MCH-401 **SOLID STATE AND PHOTOCHEMISTRY**	**Paper II: MCH-402** **BIO-PHYSICAL CHEMISTRY**
Paper III: MCH-403 **ANALYTICAL CHEMISTRY**	**Paper IV:** **Elective-A: MCH-404(A)** **ORGANOTRANSITION METAL CHEMISTRY** **Elective-B: MCH-404(B)** **MEDICINAL CHEMISTRY** **Elective-C: MCH-404 (C)** **CHEMICAL KINETICS AND NUCLEAR CHEMISTRY** **Elective-D: MCH-404 (D)** **POLYMER CHEMISTRY**
Lab Course I: MCHL-07 **PROJECT**	**Lab Course II: MCHL-08(A), MCHL-08(B), MCHL-08(C)** **ELECTIVE PRACTICAL (A, B OR C)**

Note: Industrial Visit/Training is mandatory for all students as part of curriculum

The syllabus for M.Sc. Chemistry is hereby approved for the sessions 2025-26

Name and Signatures	Departmental members **Name and Signatures**
Chairperson /H.O.D	1. Dr. Bijo Pillai
Subject Expert ..... (University Nominee) 19/4	2. .....
Subject Expert.....	3. .....
Representative ..... (Industry) 19.4.25	4. Dr. Soma Sen
Representative ..... (Alumni)	5. Dr Sunitha Mathew
Representative .... (Professor Science Faculty Other Dept.)	6. .....
	7. .....
	8. Dr. Prerna Kathane
	9. Dr. Neha Jha
	10. .....
	11. .....
	12. .....

GENERAL INSTRUCTIONS FOR STUDENTS

1. The candidate has to obtain minimum 20% marks in each theory paper and internal assessment separately.
2. The candidate has to secure minimum 36% marks as an aggregate in order to pass that semester examination.
3. The internal assessment shall include class test, home assignment and seminar presentation.
4. Internal Assessment Examination will be as follows:
   i. Internal Test in each paper (20 marks)
   ii. Seminar (Power point presentation) in any one of the paper (20 marks). The marking of seminar shall be in terms of hard copy submission (10 marks) and presentation and open discussion (10 marks).
   iii. Assignment in each of the remaining papers (excluding the paper of Seminar. (20 marks)
   iv. Average of marks obtained in internal test + seminar in any one paper and marks obtained in internal test + assignment in rest of the papers will be calculated and taken into consideration.
5. The grading system will be followed in all semesters.

CREDIT ALLOTMENTS

- Theory Paper = 05 credits (04+01)
- Practical = 04 credits

TOTAL CREDITS/ SEMESTER

- 04 theory papers (100 each) and two practicals (100 each) in Semester - I, II & III : **20 + 08 = 28 credits**
- 04 theory papers (100 each) and one practical and one project in lieu of one practical (100 each) in Semester - IV: **20 + 08 = 28 credits**

TOTAL CREDITS / PROGRAMME

- 16 Theory + 08(Practical + Project work) – 80 + 32 = 112 credits

EVALUATION PATTERN

Theory 80 marks = 04 Credits

Question paper format for the Post-Graduate Examination has been revised from the Session 2018-19. 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.
   Internal Assessment 20 marks = 01 credit

- Unit test – One class test in each theory paper comprising 20 marks
- Seminar presentations (Power point) – Comprising 20 marks in any one paper
- Home assignments – Assignment of total 20 marks comprising of two long answer type questions of 10 marks each from rest the theory paper (excluding the seminar paper) The answer should be prepared with the help of standard reference books. (The titles of those books, authors, year of publication and publishers details should be mentioned in an appropriate way, at the end of each assignment).

Practical/Project work in lieu of practical of 100 marks =04 credits

Chairperson /H.O.D	Departmental members **(Name and Signatures)**
Subject Expert ..... (University Nominee)	1. ..... Dr. V.S. Gorde
Subject Expert.....	2. ..... Dr. Ajay P. Uke
Representative ..... (Industry)	3. .....
Representative ..... (Alumni & Student)	4. ..... Dr. Soma Sen
Representative ..... (Professor Science Faculty Other Dept.)	5. ..... Dr. S. Mathew
	6. .....
	7. .....
	8. ..... Dr. P. Kathane
	9. Dr. Neha Ithe ..... Neha Ithe
	10. .....
	11. .....
	12. .....

Department of Chemistry

Programme Specific Outcome (PSO)

Upon completion of the M.Sc. (Chemistry) Program, the students will be able to:

PSO1: Understand and explain the fundamental concepts in Physical Chemistry, Organic Chemistry, Inorganic Chemistry, Analytical Chemistry and its application.

PSO2: Apply various concepts, interpret/derive/deduce expressions, reaction mechanism, structure, etc

PSO3: Solve problems/numerical using basic chemistry knowledge and concepts.

PSO4: Carry out advanced experiments, investigate and explore through projects, record the observations, present the inference/results and discuss/interpret the result.

Department of Chemistry

Govt. V.Y.T. PG Autonomous College

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M.Sc. Chemistry

First Semester

2025-26

Syllabus and Marking Scheme for First 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	**MCH-101 COORDINATION CHEMISTRY**	80	16	20	04	05
II	**MCH-102 ORGANIC REACTION MECHANISM**	80	16	20	04	05
III	**MCH-103 MATHEMATICS FOR CHEMISTS, QUANTUM CHEMISTRY AND CHEMICAL DYNAMICS**	80	16	20	04	05
IV	**MCH-104 GROUP THEORY AND COMPUTER FOR CHEMISTS**	80	16	20	04	05
V	**MCHL-01 Lab Course I INORGANIC CHEMISTRY PRACTICAL**	100	36	------	-----	04
IV	**MCHL-02 Lab Course II PHYSICAL CHEMISTRY PRACTICAL**	100	36	-----	-----	04
	Total	**520**	**----**	**80**	**-----**	**28**

04 Theory papers - 320

04 Internal Assessments - 80

02 Practical - 200

Total Marks - 600

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

Note: Industrial Visit/Training is mandatory for all students as part of curriculum

M.Sc. CHEMISTRY

SEMESTER – I

2025-26

PAPER- I

MCH-101: COORDINATION CHEMISTRY

Course Outcome (CO):

After completion of the course, students would be able:

CO1: To understand Walsh diagram, bent rule, energetics of hybridization and MOT.

CO2: To know structure of carbonyls, nitrosyls, dinitrogen and dioxygen complexes.

CO3: To understand energy profile of a reaction and determination of stability constant of transition metal complexes.

CO4: To know mechanism and kinetics of substitution and electron transfer reaction in complexes.

M.Sc. CHEMISTRY
SEMESTER - I
2025-26
PAPER- I
MCH-101: COORDINATION CHEMISTRY

Max. Marks 80
Min. Marks 16

Unit - I

Stereochemistry and Bonding in Main Group Compounds

VSEPR, Walsh diagrams (tri -and penta- atomic molecules), $d\pi - p\pi$ bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

Metal π-Ligand Bonding

Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π- bonding and molecular orbital theory.

Unit –II

Metal π -Complexes

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.

Unit –III

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 pHmetry and spectrophotometry. Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories.

Unit –IV

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 favour 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, outersphere type reaction, cross reactions and Marcus-Hush theory, inner sphere type reactions.

REFERENCE BOOKS:

1. Advanced inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes& Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectrosocopy, A.B.P. Lever, Elsevier.
5. Magnetochemistry, R.L. Carlim, Springer Verlag.
6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.

7. Modern spectroscopy, J. M. Hollas, John Wiley.
8. Applied electron spectroscopy for chemical analysis Ed. H. Windawi and F.L. Ho, Wiley Interscience.
9. Mechanisms of Inorganic Reactions, Fred Basalo and Ralph G. Pearson, Wiley Eastern Private Ltd

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 2018-19. 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
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Note:

1. Question no. 1 and Question 2 will be compulsory.
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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.

Name and Signatures	Departmental members **(Name and Signatures)**
Chairperson /H.O.D	Dr. V. S. Geete
Subject Expert	Dr. Ajay Pillewan
.(University Nominee)	
Subject Expert.....	
Representative	
(Industry)	
Representative	
(Alumni)	
Representative	Dr. P. Kathane
(Professor Science Faculty Other Dept.)	

M.Sc. CHEMISTRY
SEMESTER-I
2025-26
PAPER- II
MCH-102: ORGANIC REACTION MECHANISM

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To understand the basic concepts and explain the mechanism and stereochemical aspects of elimination reactions.

CO2: To understand the mechanism and stereochemistry of nucleophilic substitution reactions.

CO3: To acquire the knowledge of mechanism of electrophilic substitution in aliphatic as well as aromatic compounds.

CO4: To understand the mechanistic and stereochemical concepts of addition reactions.

M.Sc. CHEMISTRY
SEMESTER-I
2025-26
PAPER- II
MCH-102: ORGANIC REACTION MECHANISM

Max. Marks 80
Min. Marks 16

Unit -I

Reaction Mechanism: Structure and Reactivity

Types of mechanism, types of reaction, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin Hammett principle, potential energy diagram, transition states, intermediates, methods of determining mechanism, isotopic effects. Effect of structure on reactivity - resonance and field effects, steric effects and quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft equation.

Elimination Reactions

The E2, E1 and E1cB mechanisms. Orientation of the double bond. Reactivity-effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

Unit-II

Aliphatic Nucleophilic Substitution

The S_N1, S_N2, mixed S_N1 and S_N2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds. Classical and non-classical carbocations, phenonium ions, nor-bornyl system, common carbocation rearrangements. The S_Ni mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, regioselectivity.

Aromatic Nucleophilic substitution

The S_NAr, S_N1, benzyne and $S_{RN}1$ mechanisms. Reactivity - effect of substrate structure, leaving group and attacking nucleophile, The von Richter, Sommelet - Hauser and Smiles rearrangements.

Unit - III

Aliphatic Electrophilic substitution

Bimolecular mechanisms S_E2, S_Ei and S_E1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

Aromatic Electrophilic substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, diazonium coupling, Vilsmeir reaction.

Unit-IV

Addition to carbon – carbon multiple bonds

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Hydrogenation of aromatic rings, hydrogenation of double and triple bonds.

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, organo zinc 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.

REFERENCE BOOKS:

1. Adv. Organic Chem., Reaction Mechanism and Structure, Jerry March John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundbery, Plenum
3. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell Univ. Press.
4. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice Hall.
5. Modern organic Reactions. H.O. House Benjamin
6. Organic Reactions and their mechanism, S. Kalsi, New Age International.
8. Reaction Mechanism in Org. Chemistry, S.M. Mukherji and S.P. Singh, Macmillan

Question Paper Format and Distribution of Marks for PG Semester Examination

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Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
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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.

Name and Signatures	Representative (Prof. Sc. Faculty Other Dept.)
Chairperson /H.O.D	.....
Subject Expert	**Departmental members**
(University Nominee)	
Subject Expert.....	
Representative	
(Industry)	
Representative	
(Alumni)	

M.Sc. CHEMISTRY SEMESTER - I

2025-26

PAPER- III

MCH-103: MATHEMATICS FOR CHEMISTS, QUANTUM CHEMISTRY AND CHEMICAL DYNAMICS

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To have basic knowledge of mathematics – vector, matrix algebra, probability, calculus and its application in chemistry which adds value to the program.

CO2: To understand the basic postulates of quantum mechanics and solve Schrodinger wave equation for quantum mechanical models variation theorem, perturbation theory and Huckel MO theory and its application.

CO3: To discuss the quantum mechanical aspect of angular momentum and spin, Russell-Saunders terms and coupling schemes, atomic states, atomic terms and evaluate term symbols.

CO4: To describe different theories of reaction rates, fast reactions and its methods, kinetics and mechanism of photochemical and unimolecular reactions.

M.Sc. CHEMISTRY SEMESTER - I

2025-26

PAPER- III

MCH-103: MATHEMATICS FOR CHEMISTS, QUANTUM CHEMISTRY AND CHEMICAL DYNAMICS

Max. Marks 80
Min. Marks 16

Unit-I

Vectors, Matrix Algebra and Probability

Vectors, dot, cross and triple products. 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) and their properties. Introduction to determinants.

Permutations and combinations and probability.

Calculus

Rules for differentiation, applications of differential calculus including maxima and minima, partial differentiation.

Basic rules for integration, integration by algebraic simplification, integration by parts, partial fraction and substitution.

First-order differential equations, homogeneous, exact and linear equations.

Unit-II

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.

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.

Unit-III

Angular Momentum

Ordinary angular momentum, eigen functions and eigen values of angular momentum, ladder operator, concept of spin, antisymmetry and Pauli's exclusion principle.

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.

Unit – IV

Chemical Dynamics

Methods of determining rate laws, Arrhenius equation, collision theory of reaction rates, steric factor, activated complex theory, kinetic salt effects, steady state kinetics. Photochemical reactions (Hydrogen-bromine and hydrogen - chlorine reactions), kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, flash photolysis and the nuclear magnetic resonance method. Dynamics of unimolecular reactions (Lindmann-Hinshelwood and Rice - Ramsperger- Kassel – Marcus [RRKM] theories of unimolecular reactions.

REFERENCE BOOKS:

1. Physical Chemistry, P.W. Atkins, ELBS
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill

3. Quantum Chemistry, Ira N. Levine, Prentice Hall
4. Coulsons Valence R. Mc. Weeny, ELBS
5. Chemical Kinetics, K.J. Laidler, McGraw-Hill
6. Kinetics and Mech. of Chemical Transformation, J. Rajaramanand J. Kuriacose, McMillan.
7. Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill.
8. Mathematics for Chemists, Bhupendra Singh

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 2018-19. 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:

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   - 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
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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.
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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.

Name and Signatures	Representative (Prof. Sc. Faculty Other Dept.)
Chairperson /H.O.D	.....
Subject Expert ..... (University Nominee)	**Departmental members**
Subject Expert.....	
Representative ..... (Industry)	
Representative ..... (Alumni)	

M.Sc. CHEMISTRY

SEMESTER – I

2025-26

PAPER- IV

MCH-104: GROUP THEORY AND COMPUTERS FOR CHEMISTS

Course Outcome (CO):

After completion of the course, students would be able:

CO1: To understand symmetry properties of compounds, character tables and their uses in spectroscopy.

CO2: To know principles involved in interaction of electromagnetic radiation with matter.

CO3: To understand basic structure of computers, memory and operating systems and 'C' language.

CO4: To learn development of small computer codes involving simple formula in chemistry.

M.Sc. CHEMISTRY SEMESTER – I

2025-26

PAPER- IV

MCH-104: GROUP THEORY AND COMPUTERS FOR CHEMISTS

Max. Marks 80
Min. Marks 16

Unit I **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.

Unit –II **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.

Unit –III **Introduction to Computers and Computing**

Basic structure and functioning of computers with a PC as an illustrative example. Memory, I/O devices. Secondary storage. Computer languages. Operating systems with DOS as an example. Introduction to UNIX and WINDOWS Data processing, principles of programming. Algorithms and flow- charts. Elements of computer language 'C'. Constants and variables. Operations and symbols. Expressions. Arithmatic assignment statement.

Unit – IV **Computer Programming in 'C' Language**

Input and Output. Format statement. Termination statements. Branching statements such as IF or GO TO statement. LOGICAL variables. Double precision variables. Subscripted variables and DIMENSION DO statement. FUNCTION and SUBROUTINE. COMMON and DATA Statements.

Development of small computer codes involving simple formula in Chemistry, such as Vander Waals equation, pH titration, Kinetics, radioactive decay. Evaluation of lattice energy and ionic radii from experimental data.

REFERENCE BOOKS:

1. Computers and Common Sense, R. Hunt and J. Shelley Prentice Hall.
2. Computers Chemistry, A.C. Norris.
3. Microcomputer Quantum Mechanics, Killngbeck, Adam Hilger.
4. Computer Programming in FORTRAN IV, V Rajaraman,Prentice Hall
5. An Introd. to Digital Computer Design. V. Rajaraman and T. Radhakrishan, Prentice Hall.
6. Physical Methods in Chemistry, R.S. Drago, Saunders College
7. Chemical Applications of Group Theory, F.A. Cotton.

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 2018-19. 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.

Name and Signatures	Departmental members (**Name and Signatures**)
Chairperson /H.O.D	
Subject Expert	
(University Nominee)	
Subject Expert.....	
Representative	
(Industry)	
Representative	
(Alumni)	
Representative	
(Professor Science Faculty Other Dept.)	

M.Sc. Chemistry [First Semester]
MCHL-01: Laboratory Course I
Inorganic Chemistry
2025-26

Course Outcome (CO):

After completion of the course, students would be able:

CO1: To understand the basic principles involved in separation and estimation of acidic and basic radicals in inorganic mixture.
CO2: To apply the knowledge of qualitative and quantitative estimations in real sample analysis.
CO3: To get 'Hands on Training' and develop skill for synthesis of various inorganic compounds.
CO4: To identify and characterize prepared compounds by spectral analysis.

M.Sc. Chemistry
[First Semester]
MCHL-01
Laboratory Course I
Inorganic Chemistry
2025-26

M. M. 100

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 ofsome 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. $[Cu(NH_3)_4]SO_4.H_2O$

REFERENCE 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.

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Representative ..... (Alumni)	
Representative ..... (Professor Science Faculty Other Dept.)	

M.Sc. Chemistry

[First Semester]

MCHL-02: Laboratory Course II

Physical Chemistry

2025-26

Course Outcome (CO):

After completion of the course, students would be able:

CO1: To understand basic concepts in Physical Chemistry through experiential learning.
CO2: To acquaint with the basic principles of equipment/instruments and its applications.
CO3: To develop observation skill and analytical skill through diverse practicals.
CO4: To develop teamwork spirit, scientific temper and logical thinking.

M.Sc. Chemistry
[First Semester]
Laboratory Course II
Physical Chemistry
2025-26

M. M. 100

Number of hours for each experiment: 3-4 hours

A list of experiments under different headings is given below. Typical experiments are to be selected from each type.

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. To determine the concentration of a solution of an optically active substance.

Thermodynamics

1. To determine heat of neutralization of an acid using Dewar flask.
2. To determine heat of solution of a substance by solubility method.
3. To determine the partial molar volume of solute and solvent in aqueous solutions at room temperature.
4. 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

Surface tension

1. To determine surface tension of an organic liquid by drop method.
2. To compare cleansing power of detergents.
3. To study the variation of surface tension with temperature.
4. To determine the critical micelle concentration of a soap by surface tension measurements.

Viscosity

1. To determine viscosity of an organic liquid using Ostwald viscometer.
2. To verify Kendall's equation.
3. To study the variation of viscosity with temperature.

Phase Equilibria

1. Determination of congruent composition and temperature of a binary system (e.g. diphenylamine benzophenone system.)
2. Determination of distribution coefficient of succinic acid between ether and water.
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.

Spectrophotometry

1. Verification of Beer-Lambert law and determination of concentration of unknown solution.
2. Effect of pH in aqueous coloured system.

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 pK_a of acetic acid and verification of Ostwald Dilution law

Potentiometry/pH metry

1. Determination of temperature dependence of EMF of a cell.
2. To determine pK_a of the given monobasic acid by pHmetric titration.
3. Determination of the dissociation constant of monobasic/dibasic acid by Albert- Serjeant method.

REFERENCE 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 McGraw Hill.

Name and Signatures	Departmental members **(Name and Signatures)**
Chairperson /H.O.D	
Subject Expert	
(University Nominee)	
Subject Expert.....	
Representative	
(Industry)	
Representative	
(Alumni)	
Representative	
(Professor Science Faculty Other Dept.)	

Department of Chemistry

Govt. V.Y.T. PG Autonomous College, Durg (C.G.)

M.Sc. Chemistry

Second Semester

2025-26

Syllabus and Marking Scheme for Second 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	MCH-201 TRANSITION METAL COMPLEXES AND DIFFRACTION METHODS	80	16	20	04	05
II	MCH-202 CONCEPTS IN ORGANIC CHEMISTRY	80	16	20	04	05
III	MCH-203 THERMODYNAMICS, ELECTROCHEMISTRY AND SURFACE CHEMISTRY	80	16	20	04	05
IV	MCH-204 SPECTROSCOPY	80	16	20	04	05
V	MCHL-03 Lab Course I ORGANIC CHEMISTRY PRACTICAL	100	36	-----	-----	04
IV	MCHL-04 Lab Course II ANALYTICAL CHEMISTRY PRACTICAL	100	36	-----	-----	04
	Total	**520**	-----	**80**	-----	**28**

04 Theory papers - 320

04 Internal Assessment - 80

02 Practical - 200

Total Marks - 600

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

Note: Industrial Visit/Training is mandatory for all students as part of curriculum

M.Sc. CHEMISTRY

SEMESTER - II

2025-26

PAPER- I

MCH-201: TRANSITION METAL COMPLEXES AND DIFFRACTION METHODS

Course Outcome (CO):

After completion of the course, students would be able:

CO1: To understand how to interpret electronic spectra of complexes.

CO2: To know magnetic properties of complexes of different geometry.

CO3: To understand principle of electron diffraction and x-ray diffraction and their uses in structure determination of compounds.

CO4: To understand neutron diffraction technique, metal cluster and metal polyacids.

M.Sc. CHEMISTRY
SEMESTER - II
2025-26
PAPER- I
MCH-201: TRANSITION METAL COMPLEXES AND DIFFRACTION METHODS

Max. Marks 80
Min. Marks 16

Unit-I

Electronic Spectra of Transition Metal Complexes

Spectroscopic ground states, correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of Dq, B and parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information.

Unit – II

Magnetic Properties of Transition Metal Complexes

Magnetic properties of octahedral, tetrahedral, tetragonally distorted square planar, trigonal bipyramidal and square bipyramidal complexes based on CFT, spin equilibrium, spin free and spin paired equlibria , quenching of orbital angular momentum by ligand field, Magnetic properties of complexes with A, E and T terms, spin orbit coupling.

Unit –III

X-Ray Diffraction

Bragg condition, Miller indices, Laue method, Bragg method, Debye – Scherrer method of X-Ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules, Ramchandran Diagram.

Electron Diffraction

Scattering intensity vs scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surfaces.

Unit-IV

Neutron Diffraction

Scattering of neutrons by solid and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

Metal clusters

Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbonyl and halide clusters, compounds with metal-metal multiple bonds.

Isopoly and Heteropoly Acids and Salts

Prepration, properties and structure of isopolyandheteropoly acids of molybdenum and tungsten.

REFERENCE BOOKS:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huheey, Harpes & Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectrosocopy, A.B.P. Lever, Elsevier.

5. Magnetochemistry, R.L. Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.
7. Modern spectroscopy, J. M. Hollas, John Wiley.
8. Applied electron spectroscopy for chemical analysis Ed. H. Windawi and F.L. Ho, Wiley Inter science.

Question Paper Format and Distribution of Marks for PG Semester Examination

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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.

Name and Signatures	Representative (Prof. Sc. Faculty Other Dept.) .....
Chairperson /H.O.D	**Departmental members**
Subject Expert ..... (University Nominee)	Dr. V.S. Geeta
Subject Expert.....	
Representative ..... (Industry)	
Representative ..... (Alumni)	

M.Sc. CHEMISTRY
SEMESTER - II
2025-26
PAPER- II
MCH-202: CONCEPTS IN ORGANIC CHEMISTRY

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: Recognize and distinguish between aromatic and antiaromatic compounds by their structures.

CO2: Explain different free radicals and mechanisms of different rearrangements via free radicals.

CO3: Learn the terminology associated with conformational analysis and stereochemistry of various compounds

CO4: Know the basic concept of different types of pericyclic reactions and rules governing them.

M.Sc. CHEMISTRY
SEMESTER - II
2025-26
PAPER- II
MCH-202: CONCEPTS IN ORGANIC CHEMISTRY

Max. Marks 80
Min. Marks 16

Unit –I **Nature of Bonding in Organic Molecules**

Localized and delocalized chemical bond, conjugation and cross conjugation, bonding infullerenes, Bonds weaker than covalent- addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes

Aromaticity

Aromaticity in benzenoid and non- benzenoid compounds, alternant and non- alternant hydrocarbons, Huckel's rule, energy level of pi - molecular orbitals, annulenes, antiaromaticity, homo-aromaticity, PMO approach.

Unit II **Free Radical Reactions**

Types of free radical reactions, free radical substitution mechanism at an Aromatic substrate, neighboring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto- oxidation, coupling of alkynes and arylation of aromatic compound by diazonium salts, Sandmeyer reaction. Free radical rearrangement, Hunsdiecker reaction

Unit –III **Conformational analysis**

Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding.

Stereochemistry

Elements of symmetry, chirality, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. 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.

Unit –IV **Pericyclic Reactions**

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3- butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffman correlation diagrams. FMO and PMO approach. Electrocyclic reactions- conrotarory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions- antarafacialand suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes.Sigmatropic rearrangements, suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3, 3-and 5,5- sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements.

REFERENCE BOOKS:

1. Advanced Organic Chemistry – Reaction Mechanism and Structure, Jerry March John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundbery, Plenum
3. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.

4. Pericyclic reactions, S.M. Mukherji, Macmillan India.
5. Reaction Mechanism in Org. Chem., S.M. Mukherji and S.P. Singh, Macmillan
6. Stereo Chemistry of Organic Compounds, D. Nasipuri, New Age International.
7. Stereo Chemistry of Organic Compounds, P.S. Kalsi, New Age International.
8.. Organic Chemistry, I.L.Finar, Vol. I & II, ELBS.

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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.

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M.Sc. CHEMISTRY
SEMESTER - II
2025-26
PAPER- III
MCH-203: THERMODYNAMICS, ELECTROCHEMISTRY AND SURFACE CHEMISTRY

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To have knowledge and understanding of basic concepts in classical thermodynamics – partial molar properties, fugacity, activity and activity coefficient, construct and apply phase diagrams to 3-component systems.

CO2: To illustrate the concepts in statistical thermodynamics – distribution, thermodynamic probability, partition function and its application and to compare various statistics. fundamental concepts of irreversible thermodynamics and discuss the application of its laws.

CO3: To explain and derive equations related to the theory of strong electrolytes – Debye-Huckel law and its extensions, structure/models and thermodynamics of electrified interfaces, polarography and its applications.

CO4: To describe and interpret various adsorption isotherms and its applications, concept and various aspects of micelles and macromolecules.

M.Sc. CHEMISTRY
SEMESTER - II
2025-26
PAPER- III
MCH-203: THERMODYNAMICS, ELECTROCHEMISTRY AND SURFACE CHEMISTRY

Max. Marks 80
Min. Marks 16

Unit-I

Classical Thermodynamics

Maxwell relations, Partial molar properties- concept, its significance and methods of determination, Concept of chemical Potential, Gibbs Duhem Equation, variation of chemical potential with temperature and pressure. Concept of fugacity, its significance and methods of determination. Non-ideal systems: excess functions for non-ideal solutions. Concept of activity and activity coefficient.

Application of phase rule to three component systems: solid-liquid system and liquid-liquid system, salting out effect.

Unit-II

Statistical Thermodynamics

Concept of distribution, thermodynamic probability and most probable distribution. Maxwell Boltzmann distribution, Partition functions - translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions. Applications of partitions functions, Fermi-Dirac statistics, Bose-Einstein statistics- distribution law.

Non-equilibrium Thermodynamics

Fundamental concepts, entropy production and entropy flow, phenomenological laws, Onsager's reciprocity relations, and irreversible thermodynamics for coupled reactions.

Unit – III

Electrochemistry

Electrochemistry of solutions: Ion- solvent interactions, Debye-Huckel theory for activity coefficient of electrolyte solutions, ionic strength, Debye-Huckel limiting law, Debye- Huckel- Onsager treatment and its extension.

Thermodynamics of electrified interface equations: Derivation of electro-capillarity, Lippmann equations, determination of surface excess.

Structure of electrified interfaces: Guoy-Chapman and Stern models. Over potentials, exchange current density, derivation of Butler-Volmer equation. Tafel plot. Polarography theory - Ilkovic equation, half wave potential and its significance.

UNIT –IV

Surface Chemistry

Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), Gibbs adsorption isotherm, BET equation and estimation of surface area using BET equation.

Micelles

Surface active agents, classification of surface active agents, micellization, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, reverse micelles.

Macromolecules

Polymer: definition, types of polymers, free radical mechanism of polymerization, molecular mass, number and mass average molecular mass, molecular mass determination (osmometry, viscometry and sedimentation).

REFERENCE BOOKS:

1. Thermodynamics, S.Glasstone
2. Statistical Thermodynamics, M.C.Gupta
3. Chemical Thermodynamics, Rastogi & Mishra
4. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum
5. Modem Electrochemistry Vol.-I and Vol.-II, J.O.M. Bockris and A.K.N.Reddy, Plenum
6. Introd. to Polymer Science, V.R. Gowarikar, N.V. Vishwanamanand J. Sridhar, Wiley Eastern.

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Note:

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(Industry)	
Representative	
(Alumni)	

M.Sc. CHEMISTRY
SEMESTER - II
2025-26
PAPER- IV
MCH-204: SPECTROSCOPY

Course Outcome (CO):

After completion of the course, students would be able:

CO1: To gain insight into the basic principle of molecular spectra and discuss rigid rotor, energy levels, origin of rotational spectra and its applications.
CO2: To understand the theories/principles, predict the functional groups and differentiate between IR and Raman spectra
CO3: To acquire knowledge of principle, technique, interpretation and applications of NMR spectroscopy.
CO4: To interpret the principle and applications of photo electron, photo acoustic and ESR spectroscopy.

M.Sc. CHEMISTRY
SEMESTER - II
2025-26
PAPER- IV
MCH-204: SPECTROSCOPY

Max. Marks 80
Min. Marks 16

Unit – I

Molecular Spectroscopy

Energy levels, molecular orbital, vibronic transitions, vibration progressions and geometry of the excited states, Franck - Condon principle, electronic spectra of polyatomic molecules. Emission spectra: radiative and non-radiative decay, internal conversion, spectra of transition metal complex, charge transfer spectra.

Microwave Spectroscopy

Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field. Applications.

Unit –II

Infrared spectroscopy

Review of linear harmonic oscillator, vibrational energy of diatomic molecules, zero point energy, force constant and bond strengths, anharmonicity. Morse potential energy diagram, vibration – rotation Spectroscopy, P, Q, R branches. Breakdown of Oppenheimer approximation, vibration of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal ligand vibrations, normal co-ordinate analysis.

Raman Spectroscopy

Classical and quantum theories of Raman effect – Pure rotational, vibrational and vibrational–rotational Raman spectra, selection rules, mutual exclusion principle. Resonance Raman Spectroscopy, coherent anti stokes Raman Spectroscopy (CARS)

Unit – III

Nuclear Magnetic Resonance Spectroscopy

Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, deshielding, spin- spin interactions, factors including coupling constant 'J'. Classification (ABX, AMX, ABC, AB etc), spin decoupling. Basic ideas about instruments, FT NMR, advantages of FT NMR, use of NMR in medical diagnostics.

Nuclear Quadruple Resonance Spectroscopy

Quadruple nuclei, Quadruple moments, electric field gradient, coupling constant, splitting, applications.

Unit –IV

Photoelectron Spectroscopy

Basic principle: photo-electric effect, ionization process, Koopmans theorem, photoelectron spectra of simple molecules, ESCA, chemical information from ESCA.

Photo acoustic Spectroscopy

Basic principles of photo acoustic spectroscopy (PAS), PAS gases and condensed systems, chemical and surface applications.

Electron Spin Resonance Spectroscopy

Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications.

REFERENCE BOOKS:

1. Modern Spectroscopy J.M. Hollas, Johan Wiley.
2. Applied Electron Spectroscopy for chemical analysis ed. H. Windawiand F.L. Ho, Wiley Interscience.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorg. Chem., R.V. Parish. Ellish Harwood.
4. Physical Methods in Chemistry, R.S. Drago, Saunders Company
5. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K.Nakamoto,Wiley.
6. Spectroscopic Methods in Organic Chemistry,D.H.Williams, I.Fleming, Tata McGraw- Hill.
7. Application of Spectroscopy of Organic Compounds, J .R. Dyer, Prentice Hall.

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 2018-19. 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.

Name and Signatures	Representative (Prof. Sc. Faculty Other Dept.)
Chairperson /H.O.D	.....
Subject Expert	**Departmental members**
(University Nominee)	
Subject Expert.....	
Representative	
(Industry)	
Representative	
(Alumni)	

M.Sc. Chemistry
[Second Semester]
MCHL-03: Laboratory Course I
Organic Chemistry
2025-26

Course Outcome (CO):

After completion of the course, students would be able:

CO1: To understand the basic principles involved in separation of organic binary mixture and identify the components by qualitative analysis.

CO2: To get trained in one step/two-step synthesis of commercially important organic compounds based on different chemical processes.

CO3: To learn about separation and purification of organic mixtures by chromatography

CO4: To identify and characterize prepared and separated compounds by IR spectral analysis.

M.Sc. Chemistry
[Second Semester]
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Organic Chemistry
2025-26

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M.Sc. Chemistry
[Second Semester]
Laboratory Course I: Organic Chemistry
2025-26

M. M. 100

MAJOR EXPERIMENTS

Organic Synthesis

(i) Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.
(ii) Synthesis of β-Naphthyl acetate / Hydroquinone diacetate.
(iii) Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol
(iv) Grignard reaction: Synthesis of triphenylmethanol from benzoic acid
(v) Aldol condensation: Dibenzalacetone from benzyldehyde
(vi) Sandmeyer reaction: p-chlorotoluene from p-toluidine / o- chlorobenzoic acid from anthranilic acid.
(vii) Acetoacetic ester Condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation.
(viii) Cannizzaro reaction: 4- chlorobenzaldehyde as substrate / Benzoic acid and benzyl alcohol.
(ix) Friedel Crafts Reaction: β-Benzoyl propionic acid from succinic anhydride and benzene.
(x) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and bromoaniline.
(xi) Clemmenson reduction: Hydrocarbons from ketones.
(xii) Nitration: Picric acid from phenol

Microwave assisted Synthesis

(xiii) Synthesis of benzoic acid from benzamide.
(xiv) Synthesis of N-aryl Phthalimides.

The products may be characterized by spectral techniques.

MINOR EXPERIMENTS

Qualitative Analysis

Separation, purification and identification of compounds of binary mixtures (solid-solid, liquid-solid) using chemical tests.

Identification of functional group of organic compounds by FTIR

Separation, purification and identification of compounds of binary mixtures TLC and column chromatography

Organic Synthesis

(i) Reduction: Acetic acid from ethanol.
(ii) Esterification: Oil of Wintergreen from salicylic acid.
(iii) Sulphonation: Sulphanilic acid from aniline.

REFERENCE BOOKS:

1. Practical Organic Chemistry by A.I. Vogel.
2. Practical Organic Chemistry by Mann and Saunders.
3. Practical Organic Chemistry by Garg and Salija.

Chairperson /H.O.D	Departmental members **(Name and Signatures)**
Subject Expert ..... (University Nominee)	Dr. V.S Preeti
Subject Expert.....	Dr Ajai P. Mani
Representative ..... (Industry)	
Representative ..... (Alumni)	
Representative ..... (Professor Science Faculty Other Dept.)	Neha Jha

M.Sc. Chemistry [Second Semester]
Laboratory Course II
Analytical Chemistry
2025-26

Max. Marks 100

EXPERIMENTS

1. **Error Analysis & Statistical Data Analysis**
   Statistical treatment for error analysis, standard deviation, linear least squares.
   Calibration of volumetric apparatus, burettes, pipette, standard flask, weight box, etc.
2. **Volumetric Analysis**
   Determination of iodine and saponification values of oil sample.
   Determination of DO, COD, BOD of water sample.
   Determination of hardness of water samples.
3. **Chromatography**
   Separation of cations and anions by
   Paper chromatography
   Column chromatography
4. **Flame Photometry**
   Determination of sodium and potassium by flame photometer
5. **Spectrophotometry**
   Determination of metal ions eg. Fe, Cu, Zn, Pb, etc. using inorganic reagent like SCN, an organic chelating agent like dithizone, cupferron, 8-hydroxyquinoline, etc. in aqueous / organic phase in the presence of surface active agents.
6. **Nephelometry / Turbidimetry**
   Determination of chloride, sulphate, phosphate, etc.
   Determination of turbidity in water samples.

MINOR EXPERIMENTS

1. **Conductometry**
   Estimation of aspirin from tablet.
   Determination of relative strengths of different acids.
   Determination of the strength of strong and weak acids in a given mixture conductometrically.
2. **pH metry**
   Determination of the strength of acid pHmetrically.
   Determination of the strength of strong and weak acids in a given mixture using a pH meter.
3. **Food Analysis**
   Determination of phosphate concentration in soft drinks.
   Detection of adulterants in food samples.
4. **Water analysis**
   Determination of pH and conductivity of water samples.
   Determination of TDS in water sample.
   Determination of fluoride in water sample.
5. **Soil Analysis**
   Determination of iron in soil samples.
   Determination of Nitrate – N in soil samples.
6. **Use of Computer program and Softwares**
   Application of computer and softwares in Chemistry.

REFERENCE BOOKS:

1. Computer and Common Sense, R. Hunt and J. Shelley, Prentice Hall.
2. Computational Chemistry, A.C. Norris.
3. Computer Programming in FORTRAN IV, V. Rajaraman, Prentice Hall.

Name and Signatures	Departmental members **(Name and Signatures)**
Chairperson /H.O.D	Dr. V. Sarada
Subject Expert	
(University Nominee)	
Subject Expert.....	
Representative	
(Industry)	
Representative	
(Alumni)	
Representative.....	
(Professor Science Faculty Other Dept.)	Dr. P. Kathane

Department of Chemistry

Govt. V.Y.T. PG Autonomous College

Durg (C.G.)

M.Sc. Chemistry

Third Semester

2025-26

Syllabus and Marking 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	**MCH-301 APPLICATIONS OF SPECTROSCOPY**	80	16	20	04	05
II	**MCH-302 BIO-ORGANIC CHEMISTRY**	80	16	20	04	05
III	**MCH-303 ENVIRONMENTAL CHEMISTRY**	80	16	20	04	05
IV	**MCH-304(A): Elective-A BIO-INORGANIC AND SUPRAMOLECULAR CHEMISTRY MCH-304(B): Elective-B NATURAL PRODUCTS MCH-304(C): Elective-C POLYMER AND NANOCHEMISTRY MCH-304(D): Elective -D NANOMATERIAL AND NANOTECHNOLOGY**	80	16	20	04	05
V	**MCHL-05: Lab Course I GENERAL PRACTICAL**	100	36	----	----	04
IV	**MCHL-06: Lab Course II ELECTIVE 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

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

Note: Industrial Visit/Training is mandatory for all students as part of curriculum

M.Sc. CHEMISTRY
SEMESTER - III
2025-26
Paper - I
MCH-301: APPLICATIONS OF SPECTROSCOPY

Course Outcome (CO):

After completion of the course, students would be able:

CO1: To gain detailed insight into the instrumentation and apply IR spectroscopy, explain ORD and CD, deduction of absolute configuration and octant rule for ketones.

CO2: To get to know in detail about the various effects, mechanism, correlations and advanced techniques related to proton and C-13 NMR spectroscopy and apply in structure determination.

CO3: To describe applications of ESR and Mossbauer spectroscopy in the study of bonding and structure.

CO4: To acquaint with the principle and interpret Mass spectra to elucidate structure of molecule on the basis of various spectral spectroscopic data.

M.Sc. CHEMISTRY
SEMESTER - III
2025-26
Paper - I
MCH-301: 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 Techniques.

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.

REFERENCE BOOKS

1. Infrared and Raman Spectra: Inorg. and coordination compds, K., Nakamoto, Wiley.
2. NMR, NQR, EPR and Mossbauer Spectros. in Inorg. Chem., Parish, Ellis Horwood.
3. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.
4. Spec. Identification of Org. Compd R.M. Silverstein, G.C. Bassler and T.C.Morrill, John Wiley.
5. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
6. Application of Spectroscopy of Organic compounds, J.R. Dyer, Prentice Hall.
7. Spectroscopic Methods in Org. Chem, D.H. Williams, I. Fleming, Tata McGraw Hill.

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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**
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Note:

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Chairperson /H.O.D	
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Subject Expert.....	
Representative ..... (Industry)	
Representative ..... (Alumni)	
Representative ..... (Professor Science Faculty Other Dept.)	

M.Sc. CHEMISTRY
SEMESTER – III
2025-26
PAPER- II
MCH-302: BIO-ORGANIC CHEMISTRY

Course Outcome (CO):

After completion of the course, students would be able:

CO1: The basic properties of enzymes, components of metabolic pathway and kinetics of enzyme action.

CO2: Mechanisms of enzyme action and different kinds of enzyme catalyzed reactions.

CO3: Different models of enzymes and co-enzymes, their structures and biological functions.

CO4: Biotechnological applications of enzymes and constituents of biological cell.

M.Sc. CHEMISTRY
SEMESTER - III
2025-26
PAPER- II
MCH-302: 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. Enzyme kinetics, 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.

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.

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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
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Note:

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Representative	
(Alumni)	

M.Sc. CHEMISTRY
SEMESTER - III
2025-26
PAPER- III
MCH-303: ENVIRONMENTAL CHEMISTRY

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To gain an insight into the various aspects of environment, biodistribution of elements, hydrological cycle, biogeochemical cycles and industrial pollutants.

CO2: To know about chemical composition of various types of water bodies, water standards, soil - micro and macro nutrients, sources of pollution, waste treatment and biodegradability.

CO3: To learn about major regions, chemical composition of atmosphere and chemistry of air pollution
and to understand the techniques of sampling, measuring and monitoring air pollutants.

CO4: To acquaint with the principle, sampling methods and procedure of analysis of water and soil parameters, public health significance of heavy metals and the general instrumental techniques.

M.Sc. CHEMISTRY
SEMESTER - III
2025-26
PAPER- III
MCH-303: 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.

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. Analytical Chemistry., G.D. Christian, J. Willey.
7. Fundamentals of Analytical. Chemistry. D.A. Skoog, D. M. West and F. J. Holler,

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Note:

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Name and Signatures	Departmental members (**Name and Signatures**)
Chairperson /H.O.D	
Subject Expert	
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Representative	
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M.Sc. CHEMISTRY SEMESTER III

2025-26

PAPER- IV

Elective – A

MCH-304(A): BIOINORGANIC & SUPRAMOLECULAR CHEMISTRY

Course Outcome (CO):

After completion of the course, students would be able:

CO1: To understand role of iron and calcium in biological system, their storage, transport and regulation.

CO2: To describe role and importance of metalloenzyme in biological system and uses of metals in medicine.

CO3: To understand molecular recognition of supramolecular compounds.

CO4: To explain transport processes and carrier design of supramolecular compounds, and supramolecular devices.

M.Sc. CHEMISTRY
SEMESTER III
2025-26
PAPER- IV
Elective - A
MCH-304(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.

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 2018-19. 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.

Name and Signatures	Departmental members **(Name and Signatures)**
Chairperson /H.O.D	
Subject Expert	
(University Nominee)	
Subject Expert.....	
Representative	
(Industry)	
Representative	
(Alumni)	
Representative	
(Professor Science Faculty Other Dept.)	

M.Sc. CHEMISTRY
SEMESTER III
2025-26
PAPER- IV
Elective – B
MCH-304(B): NATURAL PRODUCTS

Course Outcome (CO):

After completion of the course, students would be able:

CO1: To classify and explain the isolation, stereochemistry, synthesis of terpenoids and carotenoids
CO2: To explain structure, chemistry and significance of alkaloids
CO3: To describe structure and biosynthesis of steroids and hormones.
CO4: To discuss chemistry of plant pigments and porphyrins, their structures and synthesis.

M.Sc. CHEMISTRY
SEMESTER III
2025-26
PAPER- IV
Elective – B
MCH-304(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

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 2018-19. 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.

Name and Signatures	Departmental members **(Name and Signatures)**
Chairperson /H.O.D	Dr. V. S. Gode
Subject Expert	Dr. Jyoti Pillai
(University Nominee)	
Subject Expert.....	
Representative	
(Industry)	
Representative.....	(Dr. S Mathew)
(Alumni)	
Representative	(Dr. P. Kathane) Neha Tha
(Professor Science Faculty Other Dept.)	

M.Sc. Chemistry
Semester III
2025-26
Paper– IV
Elective - C
MCH-304(C): POLYMER AND NANOCHEMISTRY

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To define basic concepts of polymers, explain polymerization conditions and reactions, polymer properties, its characterization techniques

CO2: To discuss the kinetics/statistics/mechanism of polymerization and derive rate laws, and illustrate techniques of polymer processing.

CO3: To compare bulk and nanomaterials, explain the role of size, shape, properties and uses of nanomaterials, describe various methods for synthesis of nanoparticles

CO4: To describe the instrumentation/principle of various characterization techniques like EDAX, FTIR, SEM, TEM, etc and its application.

M.Sc. Chemistry
Semester III
2025-26
Paper– IV
Elective - C
MCH-304(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 crosslinked 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.

REFERENCE BOOKS:

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

5. The Chemistry of Nanomaterials: Synthesis, Properties, and Applications, Rao C.N.R., Muller and Cheetam, Wiley-VCH Verlag GmbH and Co.
6. Nanotechnology: Principles and Practices, Kulkarni S. K., Capitol Publishing Company.

Question Paper Format and Distribution of Marks for PG Semester Examination

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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.

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(Professor Science Faculty Other Dept.)	

M.Sc. Chemistry

Semester III

2025-26

Paper– IV

Elective - D

MCH-304(D): NANOMATERIALS AND NANOTECHNOLOGY

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To explain of basic concepts in nanotechnology, nanoscale, nano-dimension and properties.
CO2: To explain the preparation, characteristics and uses of nanomaterials
CO3: To understand and describe instrumentation/principle of various characterization techniques like DLS, FTIR, SEM, TEM, AFM etc and its application.
CO4: To discuss the various applications of nanomaterials especially in the field of biology.

M.Sc. Chemistry
Semester III
2025-26
Paper– IV
Elective - D
MCH-304(D): NANOMATERIALS AND NANOTECHNOLOGY

Max. Marks 80
Min. Marks 16

Unit – I **Introduction to Nanotechnology**

Introduction of nanotechnology, classification of nanostructures, nanoscale architecture, Summary of the electronic properties of atoms and solids, isolated atom, bonding between atoms, giant molecular solids, free electron model and energy bands, crystalline solids, periodicity of crystal lattices, electronic conduction, effects of the nanometre length scale, changes to the system total energy, Changes to the system structure, nanoscale dimensions and properties.

Unit - II **Nanomaterials**

Preparation and properties of nanoparticles, materials-metals, ceramics (oxide, carbides, sulphides, nitrides). Physical and chemical Methods, size and shape controlled synthesis, sol-gel methods, optical Properties, electrical and magnetic properties, application of nanoparticles.

Unit - III **Characterization Methods of Nanomaterials**

X-ray diffraction, Debye-Scherer formula, dislocation density, micro strain, synchrotron Radiation, principle and applications, Raman spectroscopy and its applications, dynamic light scattering (DLS). Electron microscopes: scanning electron microscope (SEM), transmission electron microscope (TEM), atomic force microscope (AFM), scanning tunneling microscope (STM), XPS, working principle, instrumentation and applications. Differential scanning calorimeter (DSC), Thermogravimetric/Diffferential Thermal Analyzer (TG/DTA), UV – Visible Spectrophotometer, FTIR, principle and applications, photoluminescence (PL) spectroscopy.

Unit – IV **Applications of Nanomaterials/Nanotechnology**

Nanobiology, bio-inspired nanomaterials, interaction between biomolecules and nanoparticles surfaces, different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies, applications of nano in biology, nanoprobes for analytical applications, current status of nanobiotechnology, future perspectives of nanobiology; nanosensors, electrochemical, nanobiosensors, smart dust; nanomedicines, nanodrug administration diagnostic and therapeutic applications.

REFERENCE BOOKS:

1. Nanoparticles: From Theory to Application Edited by Gu¨nter Schmid, @ 2004 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
2. Nanoparticles and Catalysis Edited by Didier Astruc @ 2008 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
3. Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller, Fraser Armstrong, Mike Hagerman Shriver and Atkin's Inorganic Chemistry, Fifth Edition, Oxford, 2010.
4. Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.
5. Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.
6. Nano: The Essentials: Understanding Nanoscience and Nanotecnology, T. Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
7. Handbook of Nanotechnology, Bharat Bhushan, Springer
8. Textbook of Nanoscience and Nanotechnology, B. S. Murty, Baldev Raj, James Murday. Springer

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 2018-20. 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.5 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**

Q.6 Very short answer type question **(Answer in one or two sentences)** **(02 Marks)**

Q.7 Short answer type question **(Answer in 200-250 words)** **(04 Marks)**

Q.8 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:

4. Question no. 1 and Question 2 will be compulsory.
5. Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
6. 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.

Name and Signatures	Departmental members **(Name and Signatures)**
Chairperson /H.O.D	Dr. V.S Geete Dr. S. Mathew Dr. P. Kalthane
Subject Expert	
(University Nominee)	
Subject Expert.....	
Representative	
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M.Sc. Chemistry
[Third Semester]
MCHL-05: Laboratory Course I
General Practical
2025-26

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To analyze inorganic elements in ore and minerals.
CO2: To apply the principle of flame photometer/polarography/gravimetry in quantitative analysis.
CO3: To estimate elements in organic compounds quantitatively using various methods.
CO4: To apply various concepts of Physical Chemistry and use instruments in studying various application.

M.Sc. Chemistry
[Third Semester]
MCHL-05: Laboratory Course I
General Practical
2025-26

M.M. 100

MAJOR EXPERIMENTS

INORGANIC CHEMISTRY

1. **Analysis of ores and minerals**
   Lime stone and dolomite: Silica, Sesquioxide (R_3O_3) Ca, Mg. L.O.I.etc.
   Haematite: Iron, Al, Ca, Mg. Acid insoluble & silica etc.
   Bauxite: Silica, Fe, Al, Be &Tietc.
   Cement: Silica, Fe, Al, Ca, Mg & SO_4^{2-}
2. **Flame Photometric Determinations**
   Sodium and Potassium when present together
   Calcium and Magnesium in tap water
3. **Polarography**
   Composition and stability constant of complexes.
   Estimation of Pb^2 + and Cd^{2+} / Zn^{2+} and Ni^{2+} ions in a mixture of $Pb^{2+}$and Cd^{2+} / $Zn^{2+}$and Ni^{2+} by polarography.
4. **Gravimetric Estimation**
   Determination of composition of Ni - DMG complex by gravimetric method.
5. **Volumetric Estimation**
   Determination of alkalinity and acidity of water.
   Determination of lime in soil.

ORGANIC CHEMISTRY

1. **Quantitative organic analysis**
   Estimation of sulphur by Messenger'sMethod.
   Estimation of nitrogen by KjeldahlMethod.
   Estimation of halogen by Fusion method / Stepnow'smethod.
   Determination of the percentage of number of hydroxyl groups in an organic compound by acetylation method.
   Estimation of amines/phenols using bromate bromide solution/or acetylation method.
2. **Microwave Synthesis of organic compounds**
   Synthesis of benzyl alcohol from benzyl chloride.
   Synthesis of propyl benzoate from benzoic acid.

PHYSICAL CHEMISTRY

1. **Spectroscopy**
   To verify the additivities of absorbance of a mixture of coloured substance in $KMnO_4$ and $K_2Cr_2O_7$solution.
   Determination of stoichiometry and stability constant of inorganic and organic complexes.
   To determine the indicator constant pK_a of methyl red spectrophotometically.
2. **Conductometry**
   To verify Debye Huckel Onsager limiting law for strong electrolytes.
   Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye Huckel's law.
3. **Polarimetry**
   To determine the concentration of unknown optically active substance.
   To determine the percentage composition of optically active substances in the mixture.
4. **Distribution coefficient**

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

MINOR EXPERIMENTS

INORGANIC CHEMISTRY

1. **Spectrophotometric Determinations**
   - (i) Manganese / 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

2. **Nephelometric Determinations**
   Sulphate, Phosphate, Silver
3. **Volumetric Determination**
   Determination of chloride in water sample.
   Determination of magnesium in soil sample.
4. **Separation and Quantitative Estimation of Binary and Ternary Mixtures by the use of following separation techniques**
   Paper chromatography-Cadmium and Zinc, Zinc and Magnesium
   Thin-layer Chromatography-separation of Nickel, Manganese, Cobalt and Zinc.
   Determination of Rf values.
   Solvent extraction.
   Electrophoretic separation.

ORGANIC CHEMISTRY

1. **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.
2. **Quantitative Analysis**
   Estimation of carbonyl group by hydrazone formation method
   Estimation of Carboxylic group by titration method /silver salt method
   Estimation of Glycine by titration method
3. **Synthesis of organic compounds**
   Synthesis of Salol from Salicylic acid
   Synthesis of iodoform from ethanol

PHYSICAL CHEMISTRY

1. **Micelles**
   To determine the critical micelle concentration of the given surfactant by conductometric method.
2. **Surface tension**
   To determine the parachor of the given liquid.
   Compare CMC of different surfactants by surface tension mrthod.
3. **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.

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Representative	
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(Professor Science Faculty Other Dept.)	

M.Sc. Chemistry
[Third Semester]
MCHL-06(A): Laboratory Course II
Elective Practical – A
2025-26

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To quantitatively separate inorganic ions in three component systems.
CO2: To estimate quantitatively the constituent cations using volumetric and gravimetric analysis.
CO3: To prepare selected inorganic compounds.
CO4: To interpret the characteristics using various techniques like IR, electronic spectra, etc.

M.Sc. Chemistry
[Third Semester]
MCHL-06(A): Laboratory Course II
Elective Practical – A
2025-26

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).
8. 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, N bis (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 multidentate 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 bis glycinato 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 conversion of p-xylene to terephthalic acid catalyzed by $CoBr_2$ (homogeneous catalysis).

Name and Signatures	Departmental members **(Name and Signatures)**
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Subject Expert.....	
Representative ..... (Industry)	
Representative ..... (Alumni)	Neha Jha
Representative ..... (Professor Science Faculty Other Dept.)	(Dr. P. Kathane)

M.Sc. Chemistry
[Third Semester]
MCHL-06(B): Laboratory Course II
Elective Practical – B
2025-26

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To understand various isolation methods and its applications.
CO2: To isolate and purification of various organic compounds from natural sources.
CO3: To estimate organic compounds using UV/Visible spectroscopic method.
CO4: To test various typical colour reactions and chromatographic techniques.

M.Sc. Chemistry
[Third Semester]
MCHL-06(B):
Laboratory Course II
Elective Practical - B
2025-26

Max Marks 100

MAJOR EXPERIMENTS

Extraction of organic compounds from natural sources

i. Isolation of Caffeine from tealeaves.
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 piperine from black pepper.
vii. Isolation of lycopene from tomatoes.
viii. Isolation of cystein from human hair.
ix. Isolation of limonene from citrus rind.
x. Isolation of eugenol from cloves.

Purification and Characterization:

Purification and biochemical characterization of the isolated products.

Extraction from seeds:

i. Extraction of fatty oil of seeds and determine refractive index of oil.
ii. Isolation of protein and carbohydrate (as reducing sugar) from seed and apply colour test.

Isolation of proteins

Isolation of proteins in a mixture by column-gel method.

MINOR EXPERIMENTS

Spectrophotometric (UV /VIS) estimations of the following

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

Name and Signatures	Departmental members (**Name and Signatures**)
Chairperson /H.O.D	
Subject Expert	
(University Nominee)	
Subject Expert.....	
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(Alumni)	
Representative	
(Professor Science Faculty Other Dept.)	

M.Sc. Chemistry [Third Semester]
Laboratory Course II
Elective Practical - C
2025-26

Course Outcome (CO):

After completion of the course, students would be able:

CO1: To understand basic concepts of kinetics and its various methods of study.
CO2: To acquaint with the various methods of determination of order of reaction.
CO3: To understand the influence of various physical parameters on rate of reaction.
CO4: To synthesize nanoparticles and interpret its characteristics.

M.Sc. Chemistry
[Third Semester]
MCHL-06(C): Laboratory Course II
Elective Practical - C
2025-26

MAJOR EXPERIMENTS

1. To study the effect of temperature on the rate of hydrolysis of ester and calculate energy of activation.
2. To determine the relative strength of two acids by studying the hydrolysis of methyl acetate.
3. To study the kinetics of polymerization.
4. Synthesis and characterization of nanoparticle of Fe_3O_4 by chemical method.
5. Synthesis of graphene oxide from graphene by chemical methods.
6. Synthesis of graphene oxide from graphene by green methods.

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 prepare polymer and determine its molecular weight.
4. Synthesis and characterization of Ag nano-particles by green method.
5. Synthesis and characterization of Ag nano-particles by chemical method.
6. Synthesis and characterization of Cu nano-particles by green method.
7. Synthesis and characterization of Cu nano-particles by chemical method.
8. Synthesis and characterization of Ni nano-particles by chemical method.
9. Synthesis and characterization of Ni nano-particles by green method.

Name and Signatures	Departmental members **(Name and Signatures)**
Chairperson /H.O.D	Dr. V.S Geete
Subject Expert ..... (University Nominee)	Dr. Jeen P. Mari
Subject Expert.....	
Representative ..... (Industry)	
Representative ..... (Alumni)	
Representative ..... (Professor Science Faculty Other Dept.)	(Dr P. Kathane) Neha Thar

Department of Chemistry

Govt. V.Y.T. PG Autonomous College

Durg (C.G.)

M.Sc. Chemistry

Fourth Semester

2025-26

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	**MCH-401 SOLID STATE AND PHOTOCHEMISTRY**	80	16	20	04	05
II	**MCH-402 BIO-PHYSICAL CHEMISTRY**	80	16	20	04	05
III	**MCH-403 ANALYTICAL CHEMISTRY**	80	16	20	04	05
IV	**MCH-404(A) Elective- A ORGANOTRANSITION METAL CHEMISTRY MCH -404(B) Elective-B MEDICINAL CHEMISTRY MCH 404(C) Elective- C CHEMICAL KINETICS AND NUCLEAR CHEMISTRY**	80	16	20	04	05
V	**MCHL-07 Lab Course I PROJECT**	100	36	----	----	04
IV	**MCHL-08 (A,B &C) Lab Course II ELECTIVE PRACTICAL (A, B OR C)**	100	36	----	----	04
	Total	**520**	**----**	**80**	**----**	**28**

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

20 marks = 01 credit in Theory Papers and 25 Marks = 01 Credit in Practical/Project work

Note: Industrial Visit/Training is mandatory for all students as part of curriculum

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	**MCH-401 SOLID STATE AND PHOTOCHEMISTRY**	80	16	20	04	05
II	**MCH-402 BIO-PHYSICAL CHEMISTRY**	80	16	20	04	05
III	**MCH-403 ANALYTICAL CHEMISTRY**	80	16	20	04	05
IV	**MCH-404(A) Elective- A ORGANOTRANSITION METAL CHEMISTRY MCH -404(B) Elective-B MEDICINAL CHEMISTRY MCH 404(C) Elective- C CHEMICAL KINETICS AND NUCLEAR CHEMISTRY**	80	16	20	04	05
V	**MCHL-07 Lab Course I PROJECT**	100	36	----	----	04
IV	**MCHL-08 (A,B &C) Lab Course II ELECTIVE PRACTICAL (A, B OR C)**	100	36	----	----	04
	Total	**520**	**----**	**80**	**----**	**28**

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

20 marks = 01 credit in Theory Papers and 25 Marks = 01 Credit in Practical/Project work

Note: Industrial Visit/Training is mandatory for all students as part of curriculum

M.Sc. CHEMISTRY
SEMESTER IV
2025-26
PAPER- I
MCH-401: SOLID STATE AND PHOTOCHEMISTRY

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: Understand the origin and nature of defects and crystals, electrically conducting solids and superconductors.
CO2: Apply the concept of band theory to explain the behavior of conductors.
CO3: Understand the important aspects of photochemistry, photochemical reactions of carbonyl compounds and aromatic compounds.
CO4: Identify the mechanism of rearrangement of different photo-cyclization reactions.

M.Sc. CHEMISTRY
SEMESTER IV
2025-26
PAPER- I
MCH-401: SOLID STATE AND PHOTOCHEMISTRY

Max. Marks 80
Min. Marks 16

Unit-I **Crystal Defects and Non-Stoichiometry**

Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies - Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centres, non-stoichiometry defects.

Organic Solids

Electrically conducting solids, organic charge transfer complex, organic metals, new superconductors.

Unit – II **Electronic Properties and Band theory**

Metals, insulators and semiconductors, electronic structure of solids – band theory, band structure of metals, insulators and semiconductors. Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors.

Optical properties- Optical reflectance, photoconduction - photoelectric effects.

Magnetic properties-Classification of materials: Quantum theory of paramagnetism-cooperative phenomena - magnetic domains, hysteresis.

Unit - III **Photochemical reactions and Reaction Mechanism**

Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecules, quantum yield, transfer of excitation energy, actinometry. Classification, rate constants and life times of reactive energy states - determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions - photo-dissociation, gas phase photolysis.

Photochemistry of Carbonyl and Aromatic Compounds

Intramolecular reactions of carbonyl compounds - saturated, cyclic and acyclic, β, γ - unsaturated and α, β - unsaturated compounds. Cyclohexadienones. Intermolecular cycloaddition reactions - dimerisations and oxetane formation. Isomerizations, additions and substitutions of aromatic compounds.

Unit - IV **Photochemistry of Alkenes**

Intramolecular reactions of the olefinic bond - geometrical isomerism, cyclisation reactions, rearrangement of 1, 4 and 1,5 dienes.

Miscellaneous Photochemical Reactions

Photo-Fries reactions of anilides. Photo-Fries rearrangment. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision.

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.

Question Paper Format and Distribution of Marks for PG Semester Examination

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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.

Name and Signatures	Departmental members **(Name and Signatures)**
Chairperson /H.O.D	
Subject Expert	
(University Nominee)	
Subject Expert.....	
Representative	
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Representative	
(Professor Science Faculty Other Dept.)	

M.Sc. CHEMISTRY
Semester IV
2025-26
Paper - II
MCH-402: BIOPHYSICAL CHEMISTRY

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To explain structure and function of cell membrane, ion transport, essential and trace metals, role of metal ions in biological processes, transport and storage

CO2: To describe structure and function of metalloproteins in electron transport processes and various nitrogenases model systems.

CO3: To elaborate DNA polymerization, metal complexes in transmission of energy, discuss bioenergetics of biochemical reactions, hydrolysis of ATP and synthesis of ATP from ADP.

CO4: To calculate average dimensions, explain chain configuration, protein folding problem, forces of biopolymer interaction, thermodynamics of biopolymer solutions and energy generation.

M.Sc. CHEMISTRY
Semester IV
2025-26
Paper - II
MCH-402: BIOPHYSICAL CHEMISTRY

Max. Marks 80
Min. Marks 16

Unit - I **Cell Membrane and Transport of Ions**

Structure and functions of cell membrane, ion transport through cell membrane. Nerve conduction.

Metals in Biological System

Essential and trace metals. Na^+, K^+ pump - Role of metal ions in biological processes. Transport and storage of dioxygen- Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanin and hemerythrin, model synthetic complexes of iron, cobalt and copper.

Unit – II **Electron Transfer in Biology**

Structure and function of metalloproteins in electron transport processes- cytochromes and ion- sulphur proteins, synthetic models. Nitrogenase - Biological nitrogen fixation, molybdenum nitrogenase, spectroscopic and other evidence, other nitrogenases model systems.

Unit - III **Bioenergetics and ATP Cycle**

DNA polymerization, glucose-storage, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water. Model systems. Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

Unit - IV **Statistical Mechanics in Biopolymers**

Chain configuration of macromolecules, statistical distribution end to end dimensions, calculation of average dimensions for various chain structures. Introduction to protein folding problem.

Biopolymer Interaction

Forces involved in biopolymer interaction. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Various types of binding processes in biological systems. Hydrogen ion titration curves.

Thermodynamics of Biopolymer Solutions

Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilbrium, muscular contractions and energy generation in mechanochemical system.

REFERENCE BOOKS

1. Principle 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, Vol. I and II, G.L. Eichhorn Elsevier.
4. Progress in Inorganic Chemistry, Vol. 18 and 38, ed J.J. Lippard. Wiley.

5. Principles of Biochemistry, A.L.Lehninger,Worth Publishers.
6. Macromolecules: Structure and Function, F.Wold, Prentice Hall.
7. Biophysical Chemistry, Gurtu and Gurtu, Pragati Prakashan.

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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.

Name and Signatures	Departmental members **(Name and Signatures)**
Chairperson /H.O.D	Dr. V.S. Geet.
Subject Expert	
(University Nominee)	
Subject Expert.....	
Representative	
(Industry)	
Representative.....	
(Alumni)	
Representative	
(Professor Science Faculty Other Dept.)	(Dr. P. Kathane)

M.Sc. CHEMISTRY
SEMESTER IV
2025-26
PAPER- III
MCH-403: ANALYTICAL CHEMISTRY

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To have basic idea of role of analytical chemistry, sampling methods, techniques and safety measures, define and calculate various statistical parameters and types of errors.

CO2: To explain into composition of blood and techniques for the analysis of body fluids, classify drugs and describe the screening methods.

CO3: To describe analysis of various contents in food, adulterants and contaminants in food.

CO4: To compare types of fuels, discuss analysis of various parameters, calorific value, explain applications of tracer techniques.

M.Sc. CHEMISTRY
SEMESTER IV
2025-26
PAPER- III
MCH-403: ANALYTICAL CHEMISTRY

Max. Marks 80
Min. Marks 16

Unit - I **Introduction of Analytical Chemistry**

Role of analytical chemistry. Classification of analytical methods- classical and instrumental. Basic idea of instrumental analysis. Selecting an analytical method. Volumetric glassware- cleaning and calibration of glassware. Sample preparations - dissolution and decompositions. Gravimetric techniques. Safety in the laboratory.

Errors and Evaluation

Definition of terms in mean and median. Precision- standard deviation, relative standard deviation. Accuracy - absolute error, relative error. Types of error in experimental data- determinate (systematic), indeterminate (or random) and gross. Sources of errors and the effects upon the analytical results. Methods for reporting analytical data. Statistical evaluation of data.

Unit - II **Analysis of body fluids**

Serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulins, barbiturates, acid and alkaline phosphatases. Immunoassay: principles of radio immunoassay (RIA) and applications. Blood gas analysis- trace elements in the body.

Drug analysis

Narcotics and dangerous drugs. Classification of drugs. Screening by gas and thin layer chromatography and spectroscopic measurements.

Unit - III **Food Analysis**

Moisture, ash, crude protein, fat, crude fibre, carbohydrates, calcium, potassium, sodium and phosphate. Food adulteration-common adulterants in food, contamination of food stuffs. Microscopic examination of foods for adulterants. Pesticide analysis in food products – general extraction and purification of samples. HPLC and Gas chromatography for organophosphates, Thin layer chromatography for identification of pesticides in food products.

Unit - IV **Fuel Analysis**

Types of fuels, Solid fuels- Ultimate and proximate analysis - heating values, grading of coal. Liquid fuels -flash point, aniline point, octane number and carbon residue. Gaseous fuels - producer gas and water gas, calorific value.

Radioactive techniques

Tracer technique, neutron activation analysis, counting technique - GM counter, ionisation and proportional counter.

REFERENCE BOOKS

1. Basic Concepts of Analytical Chemistry, S.M.Khopkar, Wiley Eastern.
2. Environmental Solution Analysis, S.M.Khopkar, Wiley Eastern

3. Standard method of Chemical Analysis, F.J. Welcher vol.41 Van nostrand Reinhold Co.
4. Elemental Analysis of Airborne practices Ed. S. Lands George & M.C. Reichmann, Gordon & Breach Sci. Pub.
5. Environmental Chem., C. Baird, W.H. Freeman.
6. Analytical Chem., G.D. Christian, J. Willey.
7. Fundamentals of Anal. Chem., A. Skoog, D. M. West & F. J.Holler

Question Paper Format and Distribution of Marks for PG Semester Examination

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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.

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Subject Expert	
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M.Sc. CHEMISTRY

SEMESTER IV

2025-26

PAPER- IV Elective – A

MCH-404(A): ORGANOTRANSITION METAL CHEMISTRY

Course Outcome (CO):

After completion of the course, students would be able:

CO1: To learn alkyls and aryls of transition metals, fluxionality in compounds.

CO2: To know synthesis, nature of bonding and reaction of alkylidenes & alkylidynes.

CO3: To learn preparation properties, nature of bonding and reactions of transition metal π- complexes.

CO4: To understand homogenous catalysis, bonding of hydrogen with transition metals.

M.Sc. CHEMISTRY SEMESTER IV
2025-26
PAPER- IV Elective – A
MCH-404(A): ORGANOTRANSITION METAL CHEMISTRY

Max. Marks 80
Min. Marks 16

Unit-I **Alkyls and Aryls of Transition Metals**

Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis.

Fluxinal Organometallic Compounds

Fluxionality and dynamic equilibria in compounds such as η2 - olefin, η^3 - allyl and dienyl complexes.

Unit II **Compounds of Transition Metal-Carbon Multiple Bonds**

Alkylidenes, alkylidynes, low valentcarbenes and carbynes - synthesis, nature of bond structural characteristics, nucleophilic and electrophilic reaction on the ligands, role in organic synthesis.

Unit - III **Transition Metal π - Complexes**

Transition metal π - complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and trienyl complexes, preparations, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.

Unit - IV **Homogeneous Catalysis**

Stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, Zeiglar-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction), oxopalladation reactions, activation of C-H bond.

Transition Metal Compounds with Bonds to Hydrogen

Transition metal compounds with bonds to hydrogen.

REFERENCE BOOKS:

1. Principles and Application of Organotransition metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton, and R.G. Finke, University Science Books.
2. The Organometallic chemistry of the transition metals, R.H. Crabtree, John Wiley.
3. Metallo - organic chemistry, A.J. Pearson, Wiley.
4. Organometallic chemistry, R.C. Mehrotra and A. Singh, New age International

Question Paper Format and Distribution of Marks for PG Semester Examination

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(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
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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:

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   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.

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Chairperson /H.O.D	
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M.Sc. CHEMISTRY
SEMESTER IV
2025-26
PAPER- IV Elective – B
MCH-404(B): MEDICINAL CHEMISTRY

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To classify drugs, explain drug design and important pharmacokinetic parameters.
CO2: To get an insight into psychoactive drugs, their synthesis and chemotherapy of mental diseases.
CO3: To discuss synthesis and properties of local anti-infective, cardiovascular, anti-malarial drugs.
CO4: To understand and explain biosynthesis/synthesis, structure and applications of antibiotics, types of cancers and chemistry of anti-neoplastic drugs.

M.Sc. CHEMISTRY
SEMESTER IV
2025-26
PAPER- IV Elective – B
MCH-404(B): MEDICINAL CHEMISTRY

Max. Marks 80
Min. Marks 16

Unit – I

Introduction to Drugs and Drug Design

Essential and orphan drugs, nomenclature of drugs-IUPAC, routes of drug administration, adverse effects of drugs- type, side effects and minimization. Development of new drugs and factors affecting it, procedures followed in drug design. Theories of drug activity: occupancy theory, rate theory, induced fit theory and macro-molecular perturbation theory. Quantitative structure activity relationship (QS AR). History and development of QSAR. Concepts of drug receptors. Elementary treatment of drug receptor interactions.

Pharmacokinetics

Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetics parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process.

Unit - II

Pharmacodynamics

Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, sulphonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in Medicinal Chemistry.

Psychoactive Drugs - The Chemotherapy of Mind

Introduction, neurotransmitters, CNS depressants, general anaesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazipines, buspirone, neurochemistry of mental diseases.Antipsychotic drugs-the neuroleptics, antidepressants, butyrophenones, serendipity and drug development, stereochemical aspects of psychotropic drugs.Synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin, ethosuximde, trimethadione, barbiturates, thiopental sodium, glutethimide.

Unit - III

Local Anti-infective Drugs

Introduction and general mode of action.Synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, p-amino salicyclic acid, isoniazid, ethionamide, ethambutal, fluconazole, econozole, griseofulvin, chloroquin and primaquin.

Cardiovascular Drugs

Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output, Direct acting arteriolar dilators.Synthesis of amyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolol, oxyprenolol. **Antimalarials**

Synthesis and properties of the following Antimalarial .Quinine, 8 - amino quinoline derivatives - Pamaquine, Primaquine, Pentaquie, Isopentaquine, 4-amino quinoline derivatives- Santoquine, camaquine, Acridine derivatives, - Mepacrine, AzacrinPaludrine, Pyremethamine.

Unit - IV

Antibiotics

Cell wall biosythesis, biosynthesis of cell wall polysaccharides, inhibitors, β - lactam rings, antibiotics inhibiting protein synthesis. Synthesis of penicillin G, penicillin V, ampicillin, amoxycillin, chloramphenicol, cephalosporin, tetracyclinand streptomycin.

Antineoplastic Agents

Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorehamine, cyclophosphamide, melphalan, uracil, mustards and6-mercaptopurine.Recent development in cancer chemotheraphy. Hormone and natural products.

REFERENCE BOOKS:

1. Introduction to Medicinal Chemistry, A Gringuage, Wiley - VCH.
2.. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed Robert F. Dorge.
3. An Introduction to Durg Design, S.S. Pandeya and J.R. Dimmock, New Age International.
4. Burger's Medicinal Chemistry and Drug Discovery, Vol.-1 (Chapter-9 and Ch -14) Ed. M.E. Wolff,John Wiley.
5. Goodman and Gilman's Pharmacological Basis of Therapeutics, MeGraw- Hill.
7. The Organic Chemistry of Drug Design and Drug Action, R.B. Silverman, Academic 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 2018-19. 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.

Name and Signatures	
Chairperson /H.O.D	Representative .....
Subject Expert	(Professor Science Faculty Other Dept.)
(University Nominee)	**Departmental members**
Subject Expert.....	
Representative (Industry)	

M.Sc. CHEMISTRY
Semester IV
2025-26
Paper– IV Elective - C
MCH-404(C): CHEMICAL KINETICS AND NUCLEAR CHEMISTRY

Course Outcome (CO):

After completion of the course, the students would be able

CO1: To understand types/kinetics of composite reactions and elucidate mechanism and derive rate laws, calculate various activation parameters and predict feasibility of reaction of its basis.

CO2: To explain the concept of acidity functions and illustrate the various rate correlations, isotopic effect and solvent effect.

CO3: To discuss various aspects of nuclear models, nuclear reactions and nuclear reactors.

CO4: To understand the principles of radioactivity, its measurements, counters, apply in determining reaction mechanism, structures, physicochemical properties and in chemical analysis.

M.Sc. CHEMISTRY
Semester IV
2025-26
Paper– IV Elective - C
MCH-404(C): CHEMICAL KINETICS AND NUCLEAR CHEMISTRY

Max. Marks 80
Min. Marks 16

Unit - I

Kinetics of Composite Reactions

Types of composite mechanism, rate equation for composite mechanisms- simultaneous and consecutive reactions, microscopic reversibility, some inorganic mechanisms- formation and decomposition of phosgene, decomposition of nitrogen pentoxide and ozone and thermal para-ortho hydrogen conversion.

Kinetics of Catalytic Reactions

Kinetics of acid-base catalysis: general and specific, hydrolysis of ester and amide; Enzyme catalysis, Micellar catalysis.

Activation Parameters

Activation parameters from experimental results- Arrhenius factor, standard free energy of activation, standard enthalpy of activation, entropy of activation and their physical significance.

Unit - II

Acidity function and various rate correlations

Hammett acidity function, various treatments of rate correlation, Linear Free Energy Relationship (LFER), The Hammett equation, Zucker-Hammett hypothesis, Bunnett-Olsen parameter.

Isotopic Effect

Theory of isotopic effects; Primary and secondary kinetic isotope effects. Heavy atom isotope effects, Tunneling effect. Kinetic solvent effects.

Solvent Effect

Qualitative theory of influence of solvent on reaction rate; Solvent effect in terms of dielectric constant, Grunwald - Weinstein parameter, Z and E values. Application of solvent polarity, Koppel - Palm treatment.

Unit-III

Nuclear Models

Shell model – magic numbers, salient features and merits; liquid drop model – analogy with liquid drop, merits, semi-empirical equation; Fermi gas model; collective model and optical model.

Nuclear Reactions

Nuclear fusion and fission; Nuclear fission – mass, energy and charge distribution of fission products; fission neutrons; liquid drop model.

Nuclear Reactors

Natural uranium reactors, classification of reactors – typical reactors, Breeder reactor.

Unit-III

Radioactivity

General characteristics of radioactive decay and decay kinetics, measurement of radioactivity: Ionization chamber, electron pulse counters – variation of pulse size with voltage, Geiger-Muller counter, proportional counter and scintillation counters.

Applications of Radioactivity

Typical applications of radioisotopes as tracers; chemical investigation: reaction mechanism and structure determination; physicochemical applications: solubility of sparingly soluble and surface area of a powder; analytical applications: isotope dilution analysis and neutron activation analysis, age determination and medical applications.

REFERENCE BOOKS

1. Chemical Kinetics, K.J. Laidler.
2. Chemical Kinetics, PaneteirShauchey.
3. Chemical Kinetics and Catalysis, Panchankov
4. Investigation of Reduction Rates and Mechanism of Reactions. Edward Lewis.
5. Correlation Analysis of Organic reactivity, John Shorter, Research Studies Press.
6. Physical Organic Chemistry, N.S. Isaacs, ELBS, Longmann.
7. Essentials of Nuclear Chemistry, H.J. Arnikar, New Age Publication

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Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
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Note:

1. Question no. 1 and Question 2 will be compulsory.
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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.

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Chairperson /H.O.D	Representative .....
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Subject Expert.....	
Representative (Industry)	
Representative (Alumni).....	

M.Sc. CHEMISTRY
Semester IV
2025-26
Paper– IV Elective - D
MCH-404(D): POLYMER CHEMISTRY

Course Outcome (CO):

After completion of the course, the students would be able

CO1: To explain the mechanism of various types of polymerization and conditions in homogenous and heterogenous systems.
CO2: To understand and discuss the kinetics and statistics in different kinds of polymerization.
CO3: To know about the structure and its effect on properties of polymer.
CO4: To have an insight into various polymer processing techniques, characterization, analysis and testing methods of polymers.

M.Sc. Chemistry

Semester III

2025-26

Paper– IV Elective - D

MCH-404(D): 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 hetrogeneous polymerization using Ziegler Natta catalysts.

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 cross linking.

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 abrasion resistance.

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.

DIRECTIVES FOR STUDENTS, FACULTY AND EXAMINERS

1. There shall be three sections (Section A, B, and C) in each theory paper.
2. Section A shall contain very short answer type questions (One or two line answer) or objective type questions (fill in the blank), **(no multiple choice questions)**
3. Section B shall contain short answer type questions with the maximum limit of 250 words.
4. Section C shall contain long answer/ descriptive type questions. The students are required to answer precisely with maximum limit of 450 words.
5. The students are required to study the content mentioned in the curriculum exhaustively.

EVALUATION PATTERN

Theory 80 marks = 04 Credits

1. Very short answer type questions – Altogether 10 questions are to be set from the entire syllabus, and shall be compulsory. (02X10 =20)

2. Short answer type question – Altogether 08 questions are to be set i. e. two from each unit with the internal choice. The candidates are required to solve one from each unit. (05X04 = 20)

3. Long answer type question – Altogether 08 questions are to be set i. e. two from each unit with the internal choice. The candidates are required to solve one from each unit. (10X04 = 40)

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

M.Sc. Chemistry
[Fourth Semester]
MCHL-07: Laboratory Course I
Project Work
2025-26

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To understand to survey literature and write review.
CO2: To design small reaction schemes/materials.
CO3: To prepare Project report, learn manuscript writing and get an idea of writing thesis.
CO4: To learn analysis, interpretation of data and validation of the results obtained.

M.Sc. Chemistry [Fourth Semester]
2025-26
Laboratory Course - I

MCHL-07: 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**

Name and Signatures	Departmental members **(Name and Signatures)**
Chairperson /H.O.D	
Subject Expert ..... (University Nominee)	
Subject Expert.....	
Representative ..... (Industry)	
Representative ..... (Alumni)	
Representative ..... (Professor Science Faculty Other Dept.)	

M.Sc. Chemistry
[Fourth Semester]
MCHL-08(A): Laboratory Course II
Elective Practical – A
2025-26

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To quantitatively analysis of metals in alloy, ore and mineral samples.
CO2: To understand the kinetics and mechanism of inorganic reactions.
CO3: To extract, separate inorganic biomolecules and interpret using electronic spectra.
CO4: To acquaint with complex preparations and theoretical study of its structure and identification using spectral analysis.

M.Sc. Chemistry [Fourth Semester]

2025-26

Laboratory Course II

MCHL-08(A): Elective Practical - A

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

Inorganic Reaction Mechanism

Kinetics and mechanism of following reactions

(i) Substitution reactions in octahedral complexes (acid hydrolysis and base hydrolysis)
(ii) Redox reaction in octahedral complexes
(iii) Isomerisation reaction of octahedral.

MINOR EXPERIMENTS

Bio-Inorganic Chemistry

(i) Extraction of chlorophyll from green leaves of students choice. Separation of chlorophylls and their electronic spectral study,
(ii) Complexation study of Cu(If) ion biologically important amino acids

Inorganic Photochemistry

(i) Synthesis of potassium ferrioxalate and determination of the intensityof radiation,
(ii) Photo - oxidation of oxalic by UO_2^+ sensitization.
(iii) Photodecomposition of H I. Determination of its quantam yield.

Complex preparations; theoretical study of structure and their identification by spectral analysis

(i) Cuprous mercuric Iodide
(ii) Tetra amine cupric sulphate
(iii) Ammonium hexachlorostannate

Name and Signatures	
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(University Nominee)	**Departmental members**
Subject Expert.....	
Representative (Industry)	
Representative (Alumni)	

M.Sc. Chemistry
[Fourth Semester]
MCHL-08(B): Laboratory Course II
Elective Practical – B
2025-26

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To understand the mechanism of multi-step synthesis of organic compound.
CO2: To learn about bromination and nitration of organic compounds through experiential learning.
CO3: To estimate organic constituents using spectral analysis.
CO4: To understand role of enzymes in synthesis of compounds.

M.Sc. Chemistry [Fourth Semester]

2025-26

Laboratory Course II

MCHL-08(B): Elective Practical - B

Max. marks 100

MAJOR EXPERIMENTS

Multi – step synthesis of organic compounds

(i) Beckmann rearrangement :Benzanilide from benzene (Benzene→Benzophenone →Benzophenoneoxime→Benzanilide)

(ii) Benzilic Acid rearrangement :Benzilic acid from benzoin (Benzoin → Benzil → Benzilic acid.

(iii) Skraup's synthesis (Synthesis of heterocyclic compounds) Quinoline from o- Aminophenol.

(iv) p-Bromoaniline from Aniline (Aniline → Actanilide → Bromoacetanilide →Bromoaniline)

(v) p -NitroacetanilidefromAcetanilide (Aniline → Acetanilide → Nitroacetanilide → p-Nitroaniline

(vi) m-Nitroaniline from benzene (Benzene→ Nitrobenzenen→ dinitrobenzene →m-nitroaniline)

(vii) Acridone from Anthranilic acid (Anthranilic acid → o-Chlorobenzoicacid → N-Phenylanthranilic acid → Acridone

(viii) Enzymatic Synthesis - Enzymatic reduction: Reduction of ethylacetoacetate using Baker's yeast to yield enantiomeric excess of S (+) ethyl - 3 -hydroxybutanone and determine its optical activity.

(ix) Synthesis using microwaves – Alkylation of diethyl malonate with benzyl chloride.

3-step synthesis of drugs

(i) Synthesis of Sulpha drug from aniline.

(ii) Synthesis of Paracetamol from nitrobenzene.

(iii) Synthesis of Acetaminophen from phenol.

MINOR EXPERIMENTS

Spectrophotometric(UV/ Vis) estimations

(i) Cholesterol

(ii) Ascorbic acid

(iii) Aspirin

(iv) Iron in vitamin tablets

(v) DNA

Name and Signatures	Departmental members
Chairperson /H.O.D	
Subject Expert	
(University Nominee)	
Subject Expert.....	
Representative (Industry)	
Representative (Alumni).....	
Representative	
(Professor Science Faculty Other Dept.)	

M.Sc. Chemistry
[Fourth Semester]
MCHL-08(C): Laboratory Course II
Elective Practical – C
2025-26

Course Outcome (CO):

After completion of the course, the students would be able:

CO1: To determine the order of reaction with respect to various reactants and overall order.
CO2: To study the effect of solvent, surfactant and substituent on rate of reaction.
CO3: To calculate ionic strength and study its influence on rate of reaction.
CO4: To calculate activation parameters using experimental data.

M.Sc. Chemistry
[Fourth Semester]
2025-26
Laboratory Course II
MCHL-08(C): Elective Practical - C

Max. marks 100

MAJOR EXPERIMENTS

1. To study the effect of concentration of the reactant and catalysts on the rate of hydrolysis of ester.
2. 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, frequency factor, enthalpy of activation, entropy of activation and free energy of activation.
3. To study the kinetics of saponification of ethyl acetate by (a)Volumetric method (b) Conductometric method
4. To study the influence of ionic strength on the reaction between potassium persulphate and iodide.
5. To study the Kinetics of reaction between H_2O_2 and KI.
6. To study the kinetics of reaction between sodium formate and iodine.
7. To study the kinetics of reaction between acetone and iodine.
8. To determine the rate constant of hydrolysis / inversion of sugar using polarimeter and factors effecting.
9. To study some simple enzyme catalysed reaction.
10. To determine plateau and optimal operating voltage of Geiger-Muller counter.

MINOR EXPERIMENTS

1. To study the oxidation of dyes by oxidizing agents.
2. To study the effect of surfactant on oxidation of dye / hydrolysis reaction.
3. To study the effect of solvent on oxidation of dye / hydrolysis reaction.
4. To study the kinetics of decomposition of complex between sodium sulphate and sodium nitroprusside.
5. To study the kinetics of oxidation of alcohol by chromic acid.
6. To determine colorimetrically the order of decomposition of complex of cerric ion and N-phenyl anthranilic ac
7. To study the effect of transition metal ion on the rate of hydrolysis/ oxidation reaction.
8. To examine the substituent effect on reaction rate.
9. To determine the dead time or resolving time of GM counter.
10. Simulation of Radioactive decay using rolling of dice.

NAME AND SIGNATURE:

	Departmental members	
Chairperson /H.O.D		
Subject Expert ..... (University Nominee)	1.....	8.....
	2.....	9.....
Subject Expert.....	3.....	10.....
Representative ..... (Industry)	4.....	11.....
	5.....	12.....
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	7.....	14.....
Representative ..... (Professor Science Faculty Other Dept.)		