M.Sc (Previous), Chemistry Syllabus
Semester: I, Course Code:

(For Organic, analytical & physical chemistry)

(w.e.f 2024-25 admitted batch)

Paper- I: INORGANIC CHEMISTRY-I (core course 1)

UNIT-I: Structure & Bonding:

Applications of VSEPR, Valence Bond and Molecular orbital theories in explaining the structures of simple molecules- role of p and d orbitals in pi bonding. Application of MO theory to square planar ($PtCl_4^{2-}$) and Octahedral complexes (CoF_6^{3-}, Co $(NH3)_6$3+). Walsh diagram for H_2O molecule.

UNIT-II: Inorganic Cage and Ring Compounds:

Preparation, structure and reactions of boranes, carboranes, metallocarboranes, boron–nitrogen ($H_3B_3N_3H_3$), phosphorus–nitrogen ($N_3P_3Cl_6$) and sulphur-nitrogen (S_4N_4, (SN)x) cyclic compounds. Electron counting in boranes – Wade ‘s rules (Polyhedral skeletal electron pair theory). Isopoly and heteropoly acids.

UNIT-III: Coordination Compounds:

Crystal field theory - crystal field splitting patterns in octahedral, tetrahedral, tetragonal, square planar, square pyramidal and trigonal bipyramidal geometries. Calculation of crystal field stabilization energies. Factors affecting crystal field splitting energies – Spectrochemical series – Jahn – Teller effect, nephelauxetic effect – ligand field theory. Term symbols – Russell – Sander’s coupling – derivation of term symbols for various configurations. Spectroscopic ground states.

UNIT- IV: Electronic Spectra of Transition Metal Complexes:

Selection rules, breakdown of selection rules – Orgel and Tanabe- Sugano diagrams for d^1 – d^9 octahedral and tetrahedral transition metal complexes of 3d series – Calculation of Dq, B and β parameters. Charge transfer spectra. Magnetic properties of transition and inner transition metal complexes – spin and orbital moments – quenching of orbital momentum by crystal fields in complexes.

M.Sc. (P) Degree Examination
Semester: I, Paper Code:

(For Organic, analytical & physical chemistry)

(w.e.f 2024-25 admitted batch)

Paper- II: INORGANIC CHEMISTRY-I

Blue Print

Sl.No.	Unit No.	Unit name	Essay questions (15M)	Short questions (3M)	Total questions
1	I	Structure & Bonding	2	2	4
2	II	Inorganic cage and ring compounds	2	2	4
3	III	Coordination compounds	2	2	4
4	IV	Electronic spectra of transition metal Complexes	2	2	4
Total questions			**8**	**8**	**16**

M.Sc. Degree Examinations
Semester-I, Paper Code:
(Common for Analytical, Organic & Physical chemistry)
(W.e.f. 2024-25 admitted batch)
Paper-I: Inorganic chemistry-I (core paper 1)

Model Question Paper

Time: 3 hours **Maximum Marks: 60M**

Section-A

Answer all questions **(4x10=40M)**

1. i) Explain Walsh diagram for H_2O molecules.
   ii) Applications of VSEPR theory.

OR

2. Draw the MO energy level diagram for $[Co(NH_3)_6]^{3+}$, $[CoF_6]$ and discuss their magnetic properties.
3. Describe the preparation, structure and reactions of Boron-Nitrogen and Sulphur – Nitrogen Cyclic compounds.

OR

4. Write about: i) Homopoly and Heteropoly acids ii) Wades rules
5. Explain the crystal field splitting patters in tetrahedral and Square planar geometries with suitable examples.

OR

6. Discuss: i) Nephelauxetic effect. ii) Russell- Sanders Coupling.
7. Draw the Orgel diagram for $[TiCl_4]^-$ ion and $[Fe(CN)_6]^{3-}$ and explain the electronic transitions.

OR

8. Discuss how Tanabe-Sugano diagrams differ from Orgel diagram? Draw the Tanabe- sugano diagram for $[V(H_2O)]^{3+}$.

Section-B

Answer any five questions. **(5x4=20M)**

9. Write the rules of LCAO method.
10. Predict geometries of XeF_4, SF_4 molecules using VSEPR theory.
11. Write the structure and properties of borazole.
12. Discuss the factors affecting Crystal field splitting energy.
13. Describe the structure and properties of metallo carboranes.
14. Write an account of Spin- Orbital Coupling.
15. Discuss the different types of Paramagnetic behaviours.
16. Write a note on charge transfer spectra.

M.Sc (Previous), Chemistry Syllabus
Semester: I, Course Code:
(For Organic, analytical & physical chemistry)
(w.e.f. 2024-25 admitted batch)

Laboratory work (6 hrs. / Week)

Inorganic chemistry practicals –I

Mixture salt micro analysis: Max marks-100 marks (External – 60M + Internal-40M)

1. Qualitative inorganic analysis of mixture salt containing three anions (One Interfering) and three cations (Less familiar) from the following:

Anions: Carbonate, chloride, bromide, Iodide, nitrate, acetate, borate, phosphate, oxalate, tartrate, chromate and sulphate.

Cations: Lead, silver, mercury, copper, cadmium, molybdenum, iron, aluminium, ceric, zirconium, vanadium, zinc, manganese, nickel, cobalt, calcium, strontium, barium, potassium and ammonium & lithium.

2. Preparation of inorganic compounds:

1. Preparation of tetra ammine copper (II) sulphate.
2. Preparation of Tris (Thiourea) cuprous sulphate.

Scheme of valuation for Qualitative inorganic analysis

Max. Marks: 60 **Time: 3 hrs.**

Sl. No	Test	Description	Marks
1.	State		2
2.	Colour		2
3.	Odour		1
4.	Solubility		2
5.	Action of heat		3
6.	Flame test		3
7.	Any two preliminary tests for each anion	For one anion 1+1=2 Three anions 3x2=6	6
8.	Preparation of Sodium carbonate extraction		2
9.	Confirm test for each anion	For one anion: 2 Three anions 3x2=6	6
10.	Elimination of Interfering anion		2
11.	Cations main group separation table		1
12.	Correct cation group report	3x1	3
13.	Analysis of individual cation groups	3x2	6
	Correct Report	For each radical	6
14.	**Total for analysis**		**45**
15.	Viva-voice		5
16.	Record		10
17.	**Total marks**		**60**

- **If ammonium cation present:**
- **With sodium hydroxide solution test -2marks**
- **Nessler's reagent test -2marks**

M.Sc (Previous), Chemistry Syllabus
Semester-I, Course Code:
(Common for M.Sc. Analytical, Physical &Organic chemistry)
(w.e.f 2024-25 admitted batch)
Paper- II: ORGANIC CHEMISTRY-I (core course **2)**

UNIT-I: Nature of bonding in organic molecules and aromaticity 15Hrs

(A) Electronic Effects

Inductive effect, mesomeric effect (Resonance), hyperconjugation, steric effect, tautomerism, acidity and basicity of organic molecules

(B) Criteria of Aromaticity

The Energy Criterion for Aromaticity, Structural Criteria for Aromaticity, Electronic Criteria for Aromaticity, Relationship among the Energetic, Structural, and Electronic Criteria of Aromaticity, Huckle`s rule and MO Theory, aromaticity in benzenoid, non-benzenoid compounds, Aromaticity in Charged Ring Fused-Ring Systems, Heteroaromatic Systems, Annulenes: Cyclobutadiene, Benzene,1,3,5,7-Cyclooctatetraene, [10] Annulenes-1,3,5,7,9-Cyclodecapentaene Isomers, [12], [14], [16] and [18] annulenes, azulenes, fulvenes, fullerenes, ferrocene, anti-aromaticity, homo-aromaticity.

UNIT-II: Reaction Mechanism and Reactive intermediates 15Hrs

(A) Determination of reaction mechanism

Type of reactions with mechanism, Thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammet Equation, Curtin-Hammet Principle, Taft equaton. Potential energy diagrams, Transition states, Intermediates, methods of determining mechanisms, Isotope effects, Linear free energy relationships and their applications.

(B) Reactive intermediates

Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes, nitrenes and arynes

UNIT-III: Nucleophilic Substitution reactions 15Hrs

(A) Aliphatic nucleophilic substitutions

S_N1 and S_N2 reactions: mechanism, energy profile diagram, stereochemistry and evidence in favour of the mechanism, SET and Border line (mixed SN^1 and SN^2) mechanisms, Neighbouring group participation, Anchimeric assistance, Nonclassical carbocations, Phenonium ions, Norbornyl system. Factors influencing on nucleophilic substitution reactions: the structure of the substrate, the solvent, the nucleophile and the leaving group.

(B) Aromatic nucleophilic substitution

Aromatic Nucleophilic substitution: SN^2 (Ar) (Addition – Elimination), SN^1(Ar) and benzyne mechanisms (Elimination - Addition); evidence for the structure of benzyne. Von Richter Sommelet-Hauser and Smiles rearrangements.

UNIT-IV: Stereo Chemistry-I **15Hrs**

(A) Molecular representation of organic molecules

Wedge, Fischer, Newman and Sawhorse formula, their description, inter conversion.

(B) Molecular Symmetry and Chirality

Symmetry elements, Definition and classification of Stereoisomers, Enantiomer, Diastereomer, Invertomer, Homomer, Epimer, Anomer, Configuration and Conformation Configurational nomenclature: D, L and R, S nomenclature, Molecules with a single chiralcenter: Tetra and Tri coordinate chiral center, Molecules with two or more chiral centers:constitutionally unsymmetrical and symmetrical molecules.

(C) Geometrical Isomerism

Cis-trans, E, Z- and Syn & anti-nomenclature, Methods of determining configuration of Geometrical isomers using physical, spectral and chemical methods, Stability, Cis-trans inter conversion.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and structure, Jerry March, 6th Ed. (John Wiley & Sons).
2. Organic Chemistry, Paula Yurkanis Bruice, 4th Ed. (Printice Hall)
3. Organic chemistry-Clayden J. (Oxford)
4. Organic Chemistry, Wade, L.G. Jr. 5th Ed. (Pearson)
5. Advanced Organic Chemistry: Reactions and mechanisms, Miller Bernard & Other, 2nd Ed. (Pearson)
6. Mechanism and Theory in Organic Chemistry, Thomas H. Lowry, Kathleen S. Richardson, Harper & Row,
   (Publishers, Inc.).
7. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, 6th Ed., (Longman).
8. Reaction Mechanism in Organic Chemistry, P.S. Kalsi, 2nd Ed. (New Age International).
9. Organic Chemistry, R. T. Morrison and R. N. Boyd (Prentice-Hall)
10. Stereochemistry to Organic Compounds, E.L. Eliel (John Wiley).
11. Stereochemistry to Organic Compounds, D. Nasipuri, 2nd Ed. (New Age International).
12. Stereochemistry, P.S. Kalsi, 5th Ed. (New Age International).

M.Sc. Degree Examination

Semester-I, Course Code:

(Common for M.Sc. Analytical, Physical &Organic chemistry)

(w.e.f 2024-25 admitted batch)

Paper- II: ORGANIC CHEMISTRY-I

Blue Print

Sl.No.	Unit No.	Unit name	Essay questions (15M)	Short questions (3M)	Total questions
1	I	Nature of bonding in organic molecules and aromaticity	2	2	4
2	II	Reaction Mechanism and Reactive Intermediates	2	2	4
3	III	Nucleophilic Substitution reactions	2	2	4
4	IV	Stereo Chemistry-I	2	2	4
Total questions			**8**	**8**	**16**

M.Sc. Degree Examination
Semester-I, Course Code:
(Common for Analytical, Organic & Physical chemistry)
(w.e.f. 2024-25 admitted batch1
Paper-II: Organic chemistry-I
Model Question Paper

SECTION-A

Answer **ALL** Questions (4x10=40 Marks)

1. Write about the following (4+4+2)
   i) Inductive effect ii) Mesomeric effect iii) Hyperconjugation

OR

2. Write about the following (6+4)
   i) What are annulenes? Discuss the aromaticity of [10],[14] and [18] annulenes?
   ii) Explain aromaticity in azulenes and fulvenes
3. i) Explain thermodynamic and kinetic control reactions with examples (6+4)
   ii) How does isotopic labeling help in establishing the mechanism of a reaction?

OR

4. Explain the structure, stability and reactions of carbocations, carboanions and carbenes
5. Write about the following (4+6)
   i) What is anchimeric assistance? How do you distinguish phenomium ions from non-carbocations? Discuss give appropriate examples.
   ii) Explain factors that influence the nucleophilc substitution reactions

OR

6. Write the reaction and mechanisam of (5+5)
   i) Von Richter Rearrangement ii) Sommelet-Hauser Rearrangment
7. Write about the methods of determining configuration of Geometrical isomers using Physical, spectral and chemical methods. (10M)

OR

8. Write CIP rules and assign the R, S configurations with suitable examples

SECTION-B

Answer any **FIVE** of the following (5x4=20 Marks)

9. i)What is tautomerisam and write the examples

   ii) Why carboxylic acids are more acidic than phenols?

10. i) Explain why tropone possess high dpole moment?

    ii) Define Antiaromaticity and Homoaromaticity

11. Write about Taft equation and Hammett equation?
12. Explain structure and stability of carbine and nitrene

13. i)Write nucleophilic substitution reactions of allyl halides

    ii) Trans-2- chloro cyclohexanol gives epoxy cyclohexane in high yield on treat with base where as cis isomer does not react in the way. Explain why?

14. Explain the mechanism involved in aromatic nucleophilic substitution reactions
15. Defint the following with suitable examples
    i) Enantiomers ii) Diastereomers
16. Write a short note on i) Cis- Trans Isomerism ii) E-Z Nomenclature

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M.Sc.(P) Organic Chemistry Practical Syllabus
Semester: I, Course Code:
(For Organic, analytical & physical chemistry)
(w.e.f 2024-25 admitted batch)

Laboratory work (6 hrs./ Week)

Organic Chemistry practical's –I

Preparation, recrystallization, and determination of melting point & yield of the following compounds:
(i) Aspirin,
(ii) Nerolin,
(iii) Chalcone,
(iv) *p*-Nitro acetanilide,
(v) 2,4,6- Tribromoaniline,
(vi) *m*-Dinitrobenzene,
(vii) Phthalimide,
(viii) Diels-Alder adducts.

Books Suggested

1. Vogel 's Text Book of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J. D.Barnes and M. J. Thomas, 4th & 6th Ed. (Pearson Education Asia).

2. Vogel 's Text Book of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, P.W.G.Smith, A.R. Tatchell, 5 Ed. (Longman Scientific & Technical)

Scheme of Valuation

Internal Marks: 40M

External Marks: 60M **(Practical-50M, Record-10M)**

M.Sc. (P) Chemistry Syllabus
Semester-I, Course Code:
(Common for M.Sc. Analytical, Physical &Organic chemistry)
With effect from 2024-25 admitted batch
Paper- III: PHYSICAL CHEMISTRY-I (core course 3)

UNIT-I: Thermodynamics-I:

Concepts of partial molar properties – partial molar volume and its significance; Determination of partial molar volume: Graphical method, intercept method and apparent molar volume method. Partial molar free energy, chemical potential, Variation of chemical potential with T and P. GibbsDuhem equation-derivation and significance. Phase equilibrium- Derivation of phase rule from the concept of chemical potential. Ideal solutions - Thermodynamic properties of ideal solutions mixing quantities; Vapor pressure-Raoult 's law; Thermodynamic properties of ideally dilute solutions. Vapor pressure- Henry 's law. **Non-ideal systems** -Concept of fugacity, fugacity coefficient. Determination of fugacity; Non ideal solutions. Activities and activity coefficients; Standard-state conventions for non-ideal solutions; Determination of activity coefficients from vapor pressure measurements. Activity coefficients of non-volatile solutes using Gibbs-Duhem equation. Chemical equilibrium- effect of temperature on equilibrium constant- Van'tHoff equation

UNIT-II: Micelles and Macro molecules:

Surface active agents, classification of surface-active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization- phase separation and mass action models, Solubilization, micro emulsion, reverse micelles.

Polymer- definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of free radical polymerization. Molecular mass- Number and mass average molecular weight, molecular weight determination-End group analysis, Osmometry, viscometry, ultracentrifugation and light scattering methods.

UNIT-III: Chemical Kinetics:

Theories of reaction rates- Collision theory- Limitations, Transition state theory. Effect of ionic strength - Debye Huckel Theory-Primary and secondary salt effects; Effect of dielectric constant, effect of substituent, Hammett equation-limitations, Taft equation; Prediction of rate constants- Consecutive reactions, parallel reactions, opposing reactions (Uni molecular steps only, no derivation). Specific and general acid-base catalysis; Skrabal diagram; Fast reactions- different methods of studying fast reactions- flow methods, relaxation methods-temperature jump and pressure jump methods.

UNIT-IV: Photochemistry:

Electronic transitions in molecules, Franck-Condon principle. Electronically excited molecules- singlet and triplet states, spin-orbit interaction. Quantum yield and its determination; Actinometry - ferrioxalate and uranyl oxalate actinometers-problems. Derivation of fluorescence and phosphorescence quantum yields. Quenching effect- Stern Volmer equation. Photochemical equilibrium and delayed fluorescence - E type and P type.

Photochemical primary processes, types of photochemical reactions-photodissociation, addition and isomerization reactions with examples.

REFERENCE BOOKS.

1. 1. Physical Chemistry by Peter Atkins and Julio de Paula, Oxford University Press.

2. Physical Chemistry by G.W. Castellon, Narosha Publishing House

3. Physical Chemistry by W.J. Moore, Prentice Hall

4. Thermodynamics for Chemists, Samuel Glasstone

5. Chemical Kinetics by K.J. Laidler, McGraw Hill Pub.

6. Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.

7. Polymer Chemistry by Billmayer

8. Introduction to Polymer Science, V.R. Gowriker, N.V. Viswanadhan and J. Sreedhar.,Wiley Easter.

M.Sc. (P) Chemistry Syllabus

Semester-I, Course Code:

(Common for M.Sc. Analytical, Physical &Organic chemistry)

With effect from 2024-25 admitted batch

Paper- III: PHYSICAL CHEMISTRY-I

Blue Print

Sl.no	Unit no.	Unit name	Essay questions (10)	Short questions (4)	Total questions
1	I	**Thermodynamics-I:**	2	2	4
2	II	**Micelles and Macro molecules:**	2	2	4
3	III	**Chemical Kinetics:**	2	2	4
4	IV	**Photochemistry:**	2	2	4
Total questions			**8**	**8**	**16**

M.Sc. (P) Chemistry Syllabus

Semester-I, Course Code:

(Common for M.Sc. Analytical, Physical &Organic chemistry)

With effect from 2024-25 admitted batch

Paper- III: PHYSICAL CHEMISTRY-I

Model Question Paper

Time: 3 hours **Maximum Marks: 60M**

SECTION-A

Answer All Questions **(4X10=40Marks)**

1. i) Derive phase rule from thermodynamic considerations.
   ii) Explain chemical potential and derive Gibbs – Duhem equation.

OR

2. i)Derive an expression for the free energy change in mixing of ideal solutions.
   ii) An ideal solution is made from 5.00 mol of benzene and 3.25 mol of toluene. Calculate at 298 K and 1 bar pressure.
3. i)Explain the process of micellization and discuss the factors effecting CMC of Surfactants.
   ii) Write short notes on hydrophobic interactions and micro emulsions.

OR

4. i) Explain briefly Number average & weight average molecular weight of a polymer.
   ii) Derive an expression to determine the kinetic chain length of the polymer.
5. i)Write an account on primary and secondary salt effects.
   ii) Discuss the effect of dielectric constant of solvent on the rates of reactions.

OR

6. i)Write a note on Skrabal plots.
   ii) Discuss the principle involved in Relaxation Techniques to follow fast reactions.
7. i) Define Quantum yield. In a photo chemical reaction $A \rightarrow 2B +$, the quantum efficiency with 500nm light is 1.2 x 10^2 mol / Einstein. After exposure of 300 mmol of A to the light, 2.28 mmol of B is formed. How many photons were absorbed by A?
   ii) Discuss the kinetics of bimolecular collision quenching.

OR

8. i) Discuss fluorescence and delayed fluorescence.
   ii) Explain photo dissociation and photochemical oxidation reactions with examples.

SECTION – B

Answer any FIVE questions **(5x4=20Marks)**

9. Explain how partial molar volume is determined by density measurements?
10. What is vapour pressure? Derive Raoult‘s law
11. Outline any two methods of determination of CMC.
12. Explain briefly end group analysis.
13. Write short notes on potential energy diagram for a chemical reaction
14. Discuss the kinetics of consecutive reactions.
15. State and explain Frank-Condon principle.
16. Discuss briefly photochemical equilibrium.

M.Sc. (P) Chemistry Syllabus
Semester: I, Course Code:
(For Organic, analytical & physical chemistry)
(w.e.f 2024-25 admitted batch)
Physical Chemistry Practicals

Laboratory work (6 hrs. / Week)

Physical Chemistry practical's –I

1. Determination of critical solution temperature of phenol-water system.
2. Effect of added electrolyte on the CST of phenol-water system.
3. Conductometric titration of Strong acid versus Strong base
4. Dissociation constant of weak acid (CH3COOH) by conductometric method.
5. Conductometric titration of Weak acid vs Strong base.
6. Determination of cell constant
7. Adsorption of acetic acid on animal charcoal or silica gel.
8. Acid-catalyzed hydrolysis of methyl acetate
9. Determination of partial molar volume of solute –H_2O system by apparent molar volume method.

Scheme of Valuation

Internal Marks: 40M

External Marks: 60M (Practical-50M, Record-10M)

M.Sc (Previous), Chemistry Syllabus
Semester-I, Course Code:
(Common for M.Sc. Analytical, Physical &Organic chemistry)
With effect from 2024-25 admitted batch Paper- I:
GENERAL CHEMISTRY-I (skill oriented course 1)

UNIT-1 Basic Quantum Chemistry-I

Wave equation-interpretation of wave function-properties of wave function-normalization and orthogonalisation, Operators- linear and non-linear- commutators of operators. Postulates of quantum mechanics; setting up of operators to observables; Hermitian operator- Eigen values and Eigen functions of Hermitian operator; Expansion theorems. Eigen functions of commuting operators-significance. Simultaneous measurement of properties and the uncertainty principle.

UNIT-**II Basic Quantum Chemistry-II**

Wave mechanics of simple systems with constant potential energy, particle in onedimensional box- factors Influencing color transition- dipole integral, Symmetry arguments in deriving the selection rules, the concept of tunneling- particle in three - dimensional box. Calculations using wave functions of the particle in a boxOrthogonality, measurability of energy, position and momentum, average values and probabilities. Rigid rotor, Wave mechanics of systems with variable potential energy-simple harmonic oscillator-solution of wave equation- selection rules.

UNIT-III Fundamentals of Molecular Spectroscopy-I:

Microwave and IR- Spectroscopy- Rotational spectra of diatomic moleculesRigid rotor-Selection rules- Calculations of bond length- Isotopic effect, Second order stark effect and its applications. Infrared spectra of diatomic molecules- harmonic and anharmonic oscillators-Selection rules- Overtones- Combination bands- Calculation of force constant, anharmonicity constant and zero-point energy. Fermi resonance, simultaneous vibrational-rotational spectra of diatomic molecules.

Flame photometry: Theory and instrumentation, interferences, background correction, application.

UNIT- IV Fundamentals of Molecular Spectroscopy-II:

Raman and Electronic Spectra- Classical and quantum mechanical explanations- Rotational Raman and Vibrational Raman spectra. Electronic spectra of diatomic molecules- Vibrational Coarse structure- intensities of spectral lines- Franck-Condon principle- applications, Rotational Fine structure- band head and band shading. Charge transfer spectra.

Atomic Absorption Spectroscopy: Theory and instrumentation, sources if radiation (HCL and EDL), interferences, background correction, applications.

References/ Text books

1. Fundamentals of Molecular spectroscopy: by C.N. Banwell
2. Molecular spectroscopy: by B.K.Sharma
3. Molecular spectroscopy: by Aruldas
4. Introductory quantum mechanics: by A.K. Chandra
5. Quantum chemistry: by R.K. Pr

M.Sc Degree Examination

Semester-I, Course Code:

(For Organic, analytical & physical chemistry)

(w.e.f 2024-25 admitted batch)

Paper- IV: GENERAL CHEMISTRY-I

Blue Print

Sl.no	Unit no.	Unit name	Essay questions (10)	Short questions (4)	Total questions
1	I	**Basic Quantum Chemistry-I**	2	2	4
2	II	**Basic Quantum Chemistry-II**	2	2	4
3	III	**Fundamentals of Molecular Spectroscopy-I:**	2	2	4
4	IV	**Fundamentals of Molecular Spectroscopy-II**	2	2	4
Total questions			**8**	**8**	**16**

M.Sc. Degree Examinations
Semester-I, Paper Code:
Paper-IV General chemistry-I
(Common for Analytical, Organic & Physical chemistry)
(w.e.f. 2024-25 admitted batch)

Model question paper

Time: 3 hours **Maximum Marks: 60M**

SECTION-A

(4X10=40Marks)

Answer ALL questions

1. Give a detail account of setting up of operators for different observables

OR

2. Discuss the postulates of quantum mechanics.

3. Derive the solution for Schrodinger wave equation for a particle in one dimensional box with constant potential energy.

OR

4. Derive the solution for Schrodinger wave equation for simple harmonic oscillator. Add a note on selection rules.
5. i)Derive an expression for the rotational energy of rigid rotor. What are the selection rules?

   ii) The microwave spectrum of BrF exhibits a series of absorptions 0.714 cm-1 apart. Using the masses 79Br=78.92 and 19F=19.0, calculate the moment of inertia and inter nuclear distance.

OR

6. i) What is an anharmonic oscillator? Write the vibration selection rules and obtain the expressions for zero point energy, fundamental transition and first & second overtones.

   ii) The force constant of HF molecule is 9.7 x 102 Nm-1 . Calculate the wave number of radiation required to excite the molecule from V=0 to V=1 level

7. i) How do you explain Raman spectrum on the basis of classical and quantum mechanical theories?

   ii) Write the selection rules and explain the nature of pure rotational and pure vibrational Raman spectra.

OR

8. i) Describe the origin of PQR spectrum in rotational fine structure of the electronic spectrum of a diatomic molecule.

   ii) What is Franck-Condon principle? Write its application?

SECTON-B

Answer any FIVE questions. **5X4=20M**

9. What are Hermitian operators? Prove that Kinetic energy operator is Hermitian.
10. Write Born interpretation and properties of an acceptable wave function.
11. Describe the phenomenon of tunnelling.
12. Calculate the probability that a particle in the state with n=1 will be found between x =
    0.25L and x = 0.75L in a box of length L (with x = 0 at the left-hand end of the box)
13. Explain Fermi resonance
14. Determine the HC and CN bond lengths in HCN from the rotational constants B (1 H 12C 14N) =44.316 GHz and B (2 H 12C 14N) =36.208 GHz.
15. Explain the terms combination bands and hot bands.
16. How do you deduce the force constants of a diatomic molecule both in ground state and excited state using vibrational coarse structure of its electronic spectrum?

M.Sc. (Previous), Chemistry syllabus
Semester: I, Course code:
(For Organic, analytical and physical chemistry)
(w.e.f. 2024-25 admitted batch)

Paper-V: Instrumental methods of chemical analysis-I
(skill oriented course 2)

UNIT-I

NMR spectroscopy

NMR spectroscopy: Principle and theory, nature of spinning nuclei and its interaction with magnetic field.- Instrumentation- chemical shift, factors influencing chemical shift- spin spin coupling – coupling constant.

UNIT-II

Applications of NMR spectroscopy

Applications of NMR to structural elucidation, ^{1}H NMR – ethanol, dimethyl formamide, styrene, acetophenone- ^{19}F NMR – ClF_3, SF_4, PF_5, PCl_2F_2- Fluxional molecules – structure of $Fe(CO)_5$, $(\eta 1\text{-}C_5H_5)_2$ $(\eta 5\text{-}C_5H_5)_2$ Ti, $[RhMe(PMe_3)_4]$ – ^{13}C NMR- ^{11}B NMR spectra

UNIT-III

Applications of IR and Raman spectroscopy

Infrared spectroscopy: Number of fundamental vibrational modes – Factors influencing vibrational modes- characteristic group absorption wave numbers – application of Infrared spectroscopy to metal carbonyls
Raman spectroscopy: Theory of Raman spectroscopy- differences between Raman and IR spectra – Rule of mutual exclusion principle- applications of IR and Raman spectra , CO_2, N_2O,H_2O.

UNIT-IV

ESR spectroscopy

ESR spectroscopy: principle, g value, hyperfine splitting, Krammers degeneracy- difference between ESR and NMR spectra – application to study of free radicals- Benzene anion radical, CD_3 radical, radicals containing ^{14}N nucleus, Cu^{2+} complexes, ethyl radical.

Text Books:

1. Instrumental methods of analysis - H.H Willard, Meritt Jr. and J.A Dean
2. Principles of instrumental analysis - Skoog and West
3. Instrumental methods of analysis - B.K Sarma, Goel Publishing House, Meerut
4. Instrumental methods of Analysis - Chatwal and Anand
5. Instrumental methods of Analysis – Ewing
6. Inorganic chemistry – James E. Huheey, Ellen A. Keiter and Richard L. Keiter
7. Organic spectroscopy- William Kemp
8. Inorganic chemistry- Catherine E. Housecroft and Alan G. SharpeS

Reference Books:

1. Moutaser and D.W Gologhtly (Eds), ICP in Analytical Atomic Spectrometry, VeH Publishers, New York
2. G.I Moore, Introduction to ICP emission Spectrometry in Analytical Spectroscopy, Elsevier, Amsterdam

M.Sc. (Previous), Chemistry syllabus
Semester: I, Course code:
(For Organic, analytical and physical chemistry)
(w.e.f. 2024-25 admitted batch)

Paper-V: Instrumental methods of chemical analysis-I
(skill oriented course 2)

Time 3 Hours **Model question paper** **Max Marks: 60 M**

SECTION-A

Answer ALL Questions (4x10=40 Marks)

1. Explain the following terms
(a) Chemical shift (b) Spin- Spin Coupling

Or

2.Explain the principle and Instrumentation of NMR spectroscopy

3. Describe the expected low resolution and high resolution spectra of CH_3CH_2OH

Or

4.Sketch the ^{19}F NMR spectra of PCl_2F_3 and SF_4

5. Discuss the factors influencing the vibrational frequencies of the bonds

Or

6.What is the Rule of mutual exclusion principle? Write the different vibrantional modes of CO_2 and H_2O with respective to IR and Raman spectra

7. Explain the following in ESR spectra
(a) g-value (b) hyperfine structure

Or

8. How many lines will be observed in the ESR spectrum of benzene anion radical and ethyl radical?. What will be their relative intensity- explain.

SECTION-B

Answer any FIVE questions **(5x4=20 marks)**

1. what is coupling constant?
2.what kind nuclei exhibit the NMR phenomenon?
3. What is a fluxional molecule?
4.Write a note on ^{13}C NMR spectroscopy.
5. Write a note on Raman effect
6. How do you calculate the number of fundamental vibrations?
7.Write a note on Kramers degeneracy
8. Write the differences between NMR and ESR spectra.

Blue Print

Sl.no	Unit no.	Unit name	Essay questions (10)	Short questions (4)	Total questions
1	I	**NMR spectroscopy**	2	2	4
2	II	**Applications of NMR spectroscopy**	2	2	4
3	III	**Applications of IR and Raman spectroscopy**	2	2	4
4	IV	**ESR spectroscopy**	2	2	4
Total questions			**8**	**8**	**16**

M.Sc. (Previous), Chemistry syllabus
Semester: I, Course code:
(For Organic, analytical and physical chemistry)
(w.e.f. 2024-25 admitted batch)

OPEN ONLINE TRANS DISCIPLINARY COURSE

The open online courses can be opted from SWAYAM or any MOOCS platform. The students may be allowed to take the final test/SA from the same online platform. In case of the online test dates mismatch with semester end examinations, the college/Department shall conduct the final exam.

M.Sc. (Previous), Chemistry syllabus
Semester: I, Course code:
(For Organic, analytical and physical chemistry)
(w.e.f. 2024-25 admitted batch)
AUDIT COURSE-INDIAN KNOWLEDGE SYSTEM-I

INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM

WHAT IS IKS, Why DO WE NEED IKS, HISTORICITY OF IKS, SOME SALIENT ASPECTS OF IKS

PHILOSOPHICAL FOUNDATIONS OF INDIAN KNOWLEDGE SYSTEM

MAJOR SCHOOLS, THINKERS AND TEXTS

SOCIAL ORGANIZATION OF KNOWLEDGE IN INDIA

SEMESTER-II SYLLABUS

M.Sc. (P) Chemistry Syllabus
Semester-II, Course Code: CHE 202
(For Organic, Analytical & Physical chemistry)
(w.e.f 2024-25 admitted batch)
Paper-II: Inorganic Chemistry – II
(core course 4)

UNIT-I: 15Hrs

Metal cluster compounds - definition – evidences for existence of M-M bonds - conditions favourable for formation of M-M bonds – preparation, structure and bonding of the following metal cluster compounds.

$Re_2Cl_8^{2-}, Mo_2Cl_8^{4-}, Re_2(RCOO)_4X_2, Mo_2(RCOO)_4(H_2O)_2, Cr_2(RCOO)_4(H_2O)_2,$
$Cu_2(RCOO)_4(H_2O)_2, Cr_2Cl_9^{3-}, Mo_2Cl_9^{3-}, W_2Cl_9^{3-}, Re_3Cl_9, Re_3Cl_9^{3-}, Mo_6Cl_8^{4+},$
$Nb_6X_{12}^{2+}$ *and* $Ta_6X_{12}^{2+}$.

Polyatomic clusters – Zintle ions, Chevrel phases.

UNIT-II 15Hrs

Organometallic compounds - 16 and 18 electron rules. Isoelectronic relationship - Synthesis, structure, bonding and reactions of carbon monoxide, dinitrogen and nitric oxide complexes. Isolobal relationship – H, Cl, CH_3, $Mn(CO)_5$; S, CH_2, $Fe(CO)_4$; P, CH, $Co(CO)_3$. Synthesis, structure, bonding and reactions of metallocenes with special reference to ferrocene. Catalysis by Organometallic compounds – Homogeneous Catalysis – Alkene hydrogenation – Wilkinson ‘s catalyst, Hydroformylation.

UNIT-III 15Hrs

Metal Ligand equilibria in solution: Stepwise and overall formation constants and their interaction– trends in stepwise constants – factors affecting the stability of metal complexes– Pearson ‘s theory of hard and soft acids and bases (HSAB), chelate effect and its thermodynamic origin, determination of stability constants of complexes–spectrophotometric method and pH–metric method. Reactivity of metal complexes–inert and labile complexes. Explanation of lability on the basis of VBT & CFT.

Bio-Inorganic Chemistry: Metalloporphyrin with special reference to Hemoglobin & Myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}. Biological and abiological Nitrogen Fixation.

UNIT- IV 15Hrs

Inorganic Reaction Mechanisms: Substitution reactions of metal complexes – D, Id, Ia and A mechanisms – Ligand replacement reactions of octahedral complexes – Acid hydrolysis – factors affecting acid hydrolysis – Anation and Base hydrolysis of Cobalt(III) complexes. Ligand displacement reactions of square planar complexes of platinum (II). Factors affecting

square planar substitution – trans effect (theories) Electron transfer reactions of complexes – concept of complementary and non-complementary reactions with examples. Inner and outer sphere mechanisms.

Text books:

1. Advanced Inorganic Chemistry by F.A. Cotton and R.G. Wilkinson, IV Edition, John, John Wiley and Sons, New York, 1980.
2. Inorganic Chemistry by J.E. Huheey, III edition, Harper International Edition, 1983.
3. Organometallic Chemistry-A unified approach by A. Singh and R.C. Mehrotra, Wiley Eastern Ltd.
4. Inorganic Chemistry by Shriver and Atkins, Oxford University Press (1999)
5. Theoretical Inorganic Chemistry, II Edition by M.C. Day and J. Selbin, Affiliated East-West press Pvt. Ltd.
6. Mechanisms of Inorganic reactions in solution by D.Benson, MCgraw Hill, London, 1968.
7. Inorganic chemistry by K.F. Purcell and J.C.Kotz, W.B. Saunders company, New York, 1977.
8. Elements of Bioinorganic Chemistry by G.N. Mukherjee and Arabinda Das, U.N. Dhur&sons Pvt. Ltd, Calcutta

M.Sc. (P) Chemistry Syllabus
Semester-II, Course Code: CHE 202
(For Organic, Analytical & Physical chemistry)
(w.e.f 2024-25 admitted batch)
Paper-II: Inorganic Chemistry – II

Blue Print

Sl.No.	Unit Name	Essay	Short	Total questions
1	Unit-I Metal cluster compounds	2	2	4
2	Unit-II Organometallic compounds	2	2	4
3	Unit-III Metal Ligand equilibria in solution & Bio-Inorganic Chemistry	2	2	4
4	Unit-IV Inorganic Reaction Mechanisms	2	2	4
	Total	**8**	**8**	**16**

M.Sc. (P) Chemistry Syllabus
Semester-II, Course Code: CHE 202
(For Organic, Analytical & Physical chemistry)
(w.e.f 2024-25 admitted batch)
Paper-II: Inorganic Chemistry – II

Model question paper

Time:3 hours **Maximum: 60Marks.**

Section-A

Answer all questions **(4x10=40)**

1. Discuss the structure and bonding in $Re_2Cl_8^{-2}$ and $Mo_2Cl_8^{4-}$

or

2. What are polyatomic clusters? Write the general methods of preparation of metal cluster compounds by taking suitable examples.
3. Write the synthesis of ferrocene. Discuss the structure and bonding in ferrocene.

or

4. Discuss the structure, bonding and reactions of nitric oxide.
5. Define stepwise and overall formation constants of metal- ligand complexes with examples. Explain the factors influencing the suitable of metal complexes.

or

6. Discuss the biological role of alkali and alkaline earth metals with special reference of Ca^{2+}
7. Explain I_a and I_d inorganic reaction mechanisms with one example each.

or

8. Explain the base hydrolysis of Cobalt(III) complexes.

Section-B

Answer Any Five questions. **(5X4=20M)**

9. Define metal cluster compounds. Write are the favourable conditions for the formation of M-M bonds.
10. Give evidences for existence of M-M bonds.
11. State and explain 16 and 18 electron rules.
12. Explain the isolable relationship with examples.
13. Explain the Pearson‘s concept of Hard and Soft acids with are example each
14. Write a short note on Nitrogen Fixation.
15. Explain the mechanism of Acid Hydrolysis with an example.
16. Explain the outer sphere reaction mechanism of metal complexes by taking one example.

M.Sc. Degree Examination
Semester-II, Course Code: CHE 203
(Common for M.Sc. Analytical, Physical &Organic chemistry)
(With effect from 2024-25 admitted Batch)
Paper-III: Organic Chemistry-II (Core course-5)

UNIT-I

Stereo Chemistry-II & Elimination Reactions **15 Hrs.**

(A) Stereoisomerism in molecules without chiral Center: Axial chirality

Allenes, Alkylidenecycloalkanes, spiranes, nomenclature, Atropisomerism: biphenyl derivatives, nomenclature, **Planar chirality:** Ansa compounds, paracyclophanes, trans-cyclooctene, Helicity

(B) Conformations of Cyclic Systems

Conformations of cyclobutane, cyclopentane, cyclohexane, mono and disubstituted cyclohaxanes.

(C)Elimination Reactions: Type of elimination reactions, mechanisms, Stereochemistry and Orientation, Hofmann and Saytzeff rules, Syn elimination versus anti-elimination, Competition between elimination and substitution, dehydration, dehydrogenation, dehalogenation, decarboxylative eliminations and pyrolytic eliminations

UNIT-II

Addition Reactions **15 H**

(A) Addition to Carbon – Carbon Multiple Bonds: Mechanistic and stereo chemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, region and chemo selectivity, orientation and reactivity, Hydrogenation of double and triple bonds, hydrogenation of aromatic rings, Hydroboration.

(B) Addition to Carbon-Hetero Multiple Bonds: Steric course of addition reactions to C=O and C=N, Aldol, Cannizzaro, Perkin, Knoevenagel, Claisen-Schmidt, Claisen, Dieckman, Benzoin and Stobbe condensations, Reformatsky reaction, Tollen's reaction, Prins reaction: Wittig, Grignard, Mannich, and Michael reaction, Hydrolysis of Carbon-Nitrogen bond, Isocyanates and isothioyanates.

UNIT-III

Molecular Rearrangements **15 H**

Types of molecular rearrangements, migratory aptitude*;*

Rearrangements to electron deficient carbon: Pinacol-pinacolone, Wagner-Meerwein, Tiffeneau – Demjanov, Dienone – Phenol, Arndt-Eistert synthesis*;*

Rearrangements to electron deficient nitrogen: Beckmann, Hofmann, Curtius, Schmidt and Lossen rearrangements;

Rearrangements to electron deficient oxygen: Baeyer-villiger, Hydro peroxide rearrangement and Dakin rearrangements; Neber rearrangement, Benzil-Benzilic acid and Favorskii rearrangements

UNIT-IV

Heterocyclic Compounds and Spectroscopy

(A) Heterocyclic compounds **15 H**

Classification and Nomenclature of heterocyclic systems, Importance of heterocyclic compounds as drugs, synthesis and reactivity of the following systems: Quinoline, Isoquinoline, Indole, Pyrazole, Imidazole, Oxazole, Isoxazole,

(B) Spectroscopy

Basic principles and Applications of UV, IR, NMR and Mass.

Books Suggested:

1. Stereochemistry to Organic Compounds, E.L. Eliel (John Wiley).
2. Stereochemistry to Organic Compounds, D. Nasipuri, 2nd Ed. (New Age International).
3. Stereochemistry, P.S. Kalsi, 5th Ed. (New Age International).
4.
5. Advanced Organic Chemistry-Reactions, Mechanism and structure, Jerry March, 6th Ed. (John Wiley & Sons).
6. Modern Organic Reactions, H. O. House (Benjamin)
7. Structure and Mechanism in Organic Chemistry C. K. Inglod (Comell University Press).
8. Organic Chemistry, Paula Yurkanis Bruice, 4th Ed. (Printice Hall)
9. Organic chemistry-Clayden J. (Oxford)
10. Organic Chemsitry, Wade, L.G. Jr. 5th Ed. (Pearson)
11. Organic Chemistry, Salmons, P.W. & Others, 8th Ed. (John Wiley & Sons)
12. Advanced Organic Chemistry: Reactions and mechanisms, Miller Bernard & Other, 2nd Ed. (Pearson)
13. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, 6th Ed., (Longman).
14. . Reaction Mechanism in Organic Chemistry, P.S. Kalsi, 2nd Ed. (New Age International).
15. Stereochemistry to Organic Compounds, E.L. Eliel (John Wiley).
16. Stereochemistry, P.S. Kalsi, 5th Ed. (New Age International). Organic Chemistry Structure and Reactivity, Ege Seyhan, 3rd Ed. (AITBS)
17. Heterocyclic Chemistry, J.A.Joule, K. Kills and G. F. Smith, Chapman and Hall
18. Heterocyclic Chemistry, T.L.Gilchrist, Longman Scientific Technical
19. Heterocyclic Chemistry, Raj.K. Bansal
20. An Introduction to the Heterocyclic Compounds, R. M. Acheson, John Wiley.
21. Spectroscopic Methods in Organic Chemistry- Forth Edition, D.H. Williams and I. Fleming Tata - McGraw Hill, New Delhi, 1990.
22. Organic Spectroscopy- Second Edition, W.Kemp, ELBS Macmillan, 1987.
23. Applications of absorption spectroscopy of Organic Compounds J.R.Dyer, Prentice Hall of India, New Delhi, 1984.
24. Spectrometric identification of Organic Compounds-Fourth Edition, R.M. Silverstein: G.C.Vassiellr and T.C. Merill, Johne Willey, Singapore, 1981.

M.Sc. Degree Examination
Semester-II, Course Code: CHE 203
(Common for M.Sc. Analytical, Physical &Organic chemistry)
(With effect from 2024-25 admitted Batch)
Paper-III: Organic Chemistry-II (Core Course-5)

Blue Print

Sl.No.	Unit No.	Unit name	Essay questions (10M)	Short questions (4M)	Total questions
1	I	Stereochemistry-II & Elimination Reactions	2	2	4
2	II	Addition Reactions	2	2	4
3	III	Molecular Rearrangements	2	2	4
4	IV	Heterocyclic Compounds and Spectroscopy	2	2	4
Total questions			**8**	**8**	**16**

M.Sc. Degree Examination
Semester-II, Course Code: CHE 203
(Common for M.Sc. Analytical, Physical &Organic chemistry)
(With effect from 2024-25 admitted Batch)
Paper-III: Organic Chemistry-II (Core Course-5)

Model Question paper

SECTION-A

Time 3 hours Max Marks: 60M

Answer **ALL** Questions (4x10=40 M)

1. Write about the following
   i) Explain Optical activity in Allenes
   ii) Conformational analysis in monosubstituted cyclohexane derivatives

   (or)
2. Write about the following
   i) Write the stereochemistry and orientation effect in elimination reactions
   ii) Pyrolytic eliminations
3. Write about the the following
   i) Discuss the regio, orientation and reactivity in addition reactions
   ii) Hydroboration

   (or)
4. Write about the following
   i) Michel addition (ii) Perkin reaction.
5. Write about the following
   i) Pinacole-Pinacolone rearrangement. ii) Bayer-Villiger rearrangement.

   (or)
6. Write about the following
   i) Favorskii rearrangement. ii) Beckmann rearrangement.
7. Write any three methods of preparation for the following compounds.
   i) Indole ii) Quinoline iii) Imidazole

   (or)
8. i) Write the principle of NMR Spectroscopy
   ii)Discuss the factors effecting IR spectroscopy

SECTION- B

Answer any **FIVE** of the following (5x4=20 M)

9. Draw the stable conformations of disubstituted cyclohexane derivatives
10. Write suitable examples for dehydration and dehydrohalogentation
11. (i)Explain why cis-2-butene gives (dl) mixture of 2,3-dibromobutane on addition of bromine.
    (ii) Addition of HX on alkene is regioselective. Why?
12. Write Prins and witting reactions with suitable examples
13. Write reaction and mechanism of Dakin and Neber rearrangement.
14. Write reaction and mechanism of Arndt-Eistert and Benzil-Benzilic rearrangement.
15. Write the reactivity of isoquinoline and oxazole
16. Write briefly about Mclaferty rearrangement and Nitrogen rule

M.Sc. (P) Chemistry Syllabus
Semester-II, Course Code: CHE 204
(Common for M.Sc. Analytical, Physical &Organic chemistry)
With effect from 2024-25 admitted batch
Paper- IV: PHYSICAL CHEMISTRY-II (Core Course-6)

UNIT-I: **15Hrs**

Surfaces and Interfaces: Physisorption and chemisorption. Langmuir, Freundlich and Brunauer-Emmett-Teller (BET) isotherms. Surface catalysis: Langmuir-Hinshelwood, Enzyme Catalysis-Michael-Menten Model, Lineweaver-Burk plot and Eaide plot.

Physical chemistry of colloids: Surface tension: the theory and measurement methods of surface tension and surface free energy viscosity, Self-assembly, stability and properties of colloids: isotherms and surface area, Colloidal particle characterization: The forces acting on individual colloidal particles and the interactions between them, Zeta potential: The zeta potential and electrophoretic mobility of an ion, and the relation between them.

UNIT -II: **15Hrs**

Thermodynamics-II- Brief review on entropy; entropy changes accompanying specific process – expansion, phase transition, heating, measurement of entropy. Nernst heat theorem; Third law of thermodynamics- Determination of the absolute entropy- Apparent exceptions to Third law of thermodynamics.

Statistical Thermodynamics: Objectives of statistical thermodynamics, Concept of distributions, Types of ensembles. Thermodynamic probability, Most probable distribution Law – Partition Function, (Definition and significance): Molar and molecular partitions- translational, rotational, vibrational and electronic partition functions- Relation between thermodynamic functions (E, H, S, G and C_v) and the partition functions

UNIT-III: **15Hrs**

Electrochemistry I: Electrochemical cell- Galvanic and electrolytic cell. Concentration cell with and without transference, Effect of complexation on redox potential- ferricyanide/ ferrocyanide couple, Iron (III) phenonthroline / Iron (II) phenonthroline couple. Determination of standard potential, solubility product equilibrium constant and activity coefficients from EMF data.

Bjerrum theory of ion association (elementary treatment), Concept of activity and activity coefficients in electrolytic solutions. The mean ionic activity coefficient. Debye-Huckel theory of electrolytic solutions. Debye-Huckel limiting law (derivation not required), Calculation of mean ionic activity coefficient; Limitations of Debye-Huckel theory. Effect of dilution on equivalent conductance of electrolytes - Anomalous behavior of strong

electrolytes. Debye Huckel-Onsagar equation – verification and limitations, Fuel Cells.

UNIT-IV: 15Hrs

Electrochemistry II: The electrode-electrolyte interface. The electric double layer. The Helmholtz-Perrin parallel-plate model, the Gouy-Chapman diffuse-charge model and the Stern model.

Electrodics: Charge transfer reactions at the electrode-electrolyte interface, Exchange current density and over-potential.

Derivation of Butler-Volmer equation, High field approximation, Tafel equation, Low field equilibrium, Nernst equation.

Voltametry-Concentration polarization, experimental techniques

Books:

1. Text book of Physical Chemistry by Samuel Glasstone, McMillan Pub.
2. Physical Chemistry by W.J.Moore, Prentice Hall
3. Physical Chemistry by G.W. Castellon, Narosha Publishing House
4. Physical Chemistry by Peter Atkins and Julio de Paula, Oxford University Press.
5. Modern Electrochemistry, 2A & 2B, JOM Bockris & A.K.N.Reddy, Plenum publishers
6. Introduction to Electrochemistry, S.Glasstone.
7. Fundamentals of Molecular Spectroscopy, Banwell
8. Spectroscopy by Straw & Walker.
9. Statistical thermodynamics , M.C.Gupta
10. Statistical Thermodynamics, M.Dole

M.Sc. (P) Chemistry Syllabus

Semester-II, Course Code: CHE204

(Common for M.Sc. Analytical, Physical &Organic chemistry)

With effect from 2024-25 admitted batch

Paper- IV: PHYSICAL CHEMISTRY-

Blue Print

Sl.No.	Unit Name	Essay	Short	Total questions
1	Unit-I Surfaces and Interfaces	2	2	4
2	Unit-II Thermodynamics-II	2	2	4
3	Unit-III Electrochemistry I	2	2	4
4	Unit-IV Electrochemistry II	2	2	4
Total number of questions		**8**	**8**	**16**

M.Sc. (P) Chemistry Syllabus

Semester-II, Course Code: CHE204

(Common for M.Sc. Analytical, Physical &Organic chemistry)

With effect from 2024-25 admitted batch

Paper- IV: PHYSICAL CHEMISTRY-

Model Question Paper

Time: 3 Hours Max Marks: 60

SECTION-A

Answer all questions (4x10=40)

1. Derive BET equation?

OR

2. Explain self assembly, stability and properties of colloids?
3. Define the third law of thermodyanamics and determine the absolute entropy of substances

OR

4. Derive the rotational and translational partition molecular function
5. Discuss the emf of the concentration cells with and without transference.

OR

6. Define debye-Huckle theory and write their limitations and write the effect of dilution on equivalent conductance of electrolytes
7. what is mean by electrical double layer and write briefly about The Helmholtz-Perrin parallel-plate model, the Gouy-Chapman diffuse-charge model

OR

8. Derive the Derivation of Butler-Volmer equation

SECTION-B

Answer **Any Five** questions. (5X4=20 Marks)

9. Explain Lineweaver-Bulk plot and Eaide plot?
10. Explain the zeta potential of colloidal paricle ?
11. Write briefly about electrochemical and electrolytic cells?
12. Explain the Nernst heat theorem.
13. Derive the partition function for enthalpy and Gibbs-free energy
14. Write a short note on fuel-cells
15. Write a note on Charge transfer reactions at the electrode-electrolyte interface
16. Write about Taft equation?

M.Sc. (Previous), Chemistry Syllabus
Semester: II, Course Code: CHE 205
(For Organic, analytical & physical chemistry)
(w.e.f. 2024-25 admitted batch)
Inorganic Practicals

Laboratory work (6 hrs. / Week)

Inorganic Chemistry Practicals –II

Quantitative analysis:

Volumetric:

1. Determination of Ferric iron by photochemical reduction
2. Determination of Nickel by EDTA
3. Determination of Calcium and Magnesium in a mixture by EDTA
4. Determination of Ferrocyanide by Ceric sulphate
5. Determination of Copper (II) in presence of iron(III)

Gravimetric:

6. Determination of Zinc as Zinc pyrophosphate
7. Determination of Nickel from a mixture of Copper and Nickel.

Scheme of valuation for Qualitative Inorganic Analysis

Max Marks-100 Marks **(External – 60M + Internal-40M)**

Max. Marks: 60 M
Times: 3 hrs.

Sl.No.	Item	Marks
1.	Writing description for first 15 minutes	5
2.	Preparation of standard solution.	10
3.	Correct tables & formulas	10
4.	Result: < 2%	20
5.	Viva-voice	5
6.	Record	10
	Total	**60**
Result: 2- 5%		20
Result: 5 - 10%		15
Result: 10% <		10

M.Sc. (P) Chemistry Practical Syllabus

Semester-II, Practical Code: CHE 206

For Organic, analytical & physical chemistry)

(w.e.f 2024-25 admitted batch)

Organic Chemistry Practicals

ORGANIC CHEMISTRY PRACTICALS –II

Systematic qualitative analysis of an organic mixture containing two compounds

Identification of method of separation and the functional group(s) present in each of them and preparation of one solid derivative for the conformation of each of the functional

Books Suggested

1. Vogel ‘s Text Book of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J. D.Barnes and M. J. Thomas, 4th & 6th Ed. (Pearson Education Asia).

2. Vogel ‘s Text Book of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, P.W.G.Smith, A.R. Tatchell, 5 Ed. (Longman Scientific & Technical)

Scheme of Valuation

Internal Marks: 40M

External Marks: 60M (Practical-50M, Record-10M)

M.Sc. (P) Chemistry Practical Syllabus

Semester-II, Practical Code: CHE 207

For Organic, analytical & physical chemistry)

(w.e.f 2024-25 admitted batch)

Physical Chemistry Practicals

Laboratory work (6 hrs. / Week)

Physical Chemistry Practicals –II

1. Distribution of iodine between $CHCl_3$ and water
2. Distribution of I_2 between $CHCl_3$ and aq.KI solution- calculation of equilibrium constant.
3. Determination of Coordination number of cuprammonium cation.
4. Titration of mixture Strong acid and weak acid versus Strong base by conductometry.
5. Titration of Strong acid Vs Strong Base – pH – metry.
6. Titration of mixture of ($NaHCO_3$ + Na_2CO_3) Vs HCl – pH- metry.
7. Titration of Strong acid Vs Strong Base using Quinhydrone electrode.
8. Titration of Fe^{+2} Vs $K_2Cr_2O_7$ – potentiometry
9. Verification of Beer-Lambert's law by Iron-thiocyanate system –colorimetry.
10. Determination of single electrode potential of Cu^{2+}/Cu and estimate the given unknown concentration.

Scheme of Valuation

Internal Marks: 40M

External Marks: 60M (Practical-50M, Record-10M)

M.Sc (P) Chemistry Syllabus
Semester-II, Course Code: CHE 201
(For Organic, Analytical & Physical chemistry)
(w.e.f 2024-25 admitted batch)
Paper-IV General Chemistry-II (Skill oriented course 3)

UNIT-I: 15 Hrs

Basic Quantum Chemistry-III- Hydrogen atom- solution of R (r), Φ (ϕ) and Θ (θ) equations. Probability density in orbitals- shapes of orbitals- Perturbation theory- Time independent perturbation theory (only first order perturbation is to be dealt with)- application to ground state energy of Helium atom- Variation principle- applications- calculation of zero-point energy of harmonic oscillator- many electron atom- Hartee-Fock self-consistent field method (qualitative treatment only)

UNIT-II 15 Hrs

Molecular symmetry and Group Theory in chemistry: Basic concepts of symmetry and Group Theory-Symmetry elements, symmetry operations and point groups- Schoen flies symbols- Classification of molecules into point groups- Axioms of Group theory- Group multiplication tables for C2v and C3v point groups- Similarity transformations- and classes- Representations- reducible and irreducible representations, Mullikan symbols, Orthogonality theorem and its implications, Character table and its anatomy.

UNIT-III 15 Hrs

Treatment of analytical data: Accuracy and precision- Classification of errors- Determinate and Indeterminate errors Minimization of errors- Absolute and Relative errors, propagation of errors-Distribution of Indeterminate errors- Gaussian distribution- Measures of central tendency-Measures of precision- Standard deviation- Standard error of mean- student‘s test- Confidence interval of mean- Testing for significance- Comparison of two means- F-test- Criteria of rejection of an observation- Significant figures and computation rules.

UNIT-IV 15 Hrs

Introduction to computer programming- FORTRAN 77: Basic structures and functioning of computer with P.C. as an illustrative example- Main memory- Secondary storage memory- input/output devices- computer languages- operating systems- principles of algorithms-and flow charts-constants and variables- Arithmetic expressions- Arithmetic statements Replacement statement- IF statement- logical IF and BLOCK IF statements- GOTO statements-subscripted variable and DIMENSION statement. DO statement- Rules for DO statement- Functions and subroutines- Development of FORTRAN statements for simple formulae in chemistry such as Vander Waals equation- pH of a solution- First order rate equation- Cell constant-Electrode potential. Flow charts and computer programs for a) Program for the calculation of Cell Constant, Specific Conductance and Equivalence. b) Rate Constant of First order reaction or Beer‘s law by linear least square method. c) Hydrogen ion concentration of a strong acid solution/Quadratic equation. d) Solution for Vander Waals equation or Hydrogen ion concentration of a monoprotic weak acid e) Standard deviation and Variance of univariant data

Suggested Books:

1. Introductory Quantum chemistry: by A.K. Chandra

2. Group theory for Chemistry: by A.K. Bhattacharya,

3. Chemical Applications of Group Theory by FA Cotton, 3rd Edition, Wiley Inter science, New York

4. Introductory Group theory for chemists: by George Davidson

5. Vogel ‘s text book of quantitative analysis: by Vogel

6. Fundamentals of Analytical chemistry: by Skog and West

7. Principles of computer programming (FORTRAN 77 IBM PC): by Rajaraman

8. Basics of computers for chemists: by P.C. Jurs ‖ M.Sc. Degree Examinations

M.Sc. (P) Degree Examination
Semester-II, Course Code: CHE 201
(For Organic, Analytical & Physical chemistry)
(w.e.f 2024-25 admitted batch)
Paper-IV General Chemistry-II

Blue Print

Sl.No.	Unit No.	Unit name	Essay questions (10M)	Short questions (4M)	Total questions
1	I	Basic Quantum Chemistry- II	2	2	4
2	II	Molecular Symmetry & Group Theory	2	2	4
3	III	Treatment Of Analytical Data	2	2	4
4	IV	Introduction To Computer Programming	2	2	4
Total questions			**8**	**8**	**16**

M.Sc. (P) Degree Examination
Semester-II, Course Code: CHE 201
(For Organic, Analytical & Physical chemistry)
(w.e.f 2024-25 admitted batch)
Paper-IV General Chemistry-II

Model Question Paper

Time:3hours **Maximum: 60M**

Section-A

Answer all questions **(4x10=40M)**

1. Using the principles of time – independent perturbation theory, obtain the energy of the ground state energy of Helium atom

OR

2. Discuss the variation theorem and apply it to calculate the zero-pointenergy of harmonic oscillator
3. i) What is character table? Explain its significance with an example.
   ii) Write the Schoen flies notation of point groups.

OR

4. i) Differentiate between reducible and irreducible representation of group.
   ii) Explain the matrix representation of C2v and C3v point groups.
5. i) Give an account on determinate and indeterminate errors? Give an example for each.
   ii) Write a short note on significant figures and computation rules.

OR

6. i)What is f-test and t- test? How is its useful in chemical analysis?
   ii) Differentiate the terms accuracy and precision.
7. i)Explain the basic structures and functions of computers with PC

   ii)Write flow chart and computer programming for cell constant, pH of solution and electrode potential

OR

8. Explain computer programmes for rate constant of first order reaction and standard deviation.

SECTION – B

Answer any Five question **5X4=20M**

9. Write the wave function of 2P- orbital and explain its shape?
10. Write the Schrödinger wave equation for He+ ion and separate the variables.
11. Define symmetry and symmetry operations and explain with an example
12. Deduce the point groups for C_6H_6
13. Write a short note on absolute errors with example.
14. Calculate standard deviation for the following 2.056, 3.040, 3.098, 3.108, 3.114 and 5.178
15. Give an account on output device in computers
16. Write short notes on secondary storage memory and principles of algorithm

M.Sc. (Previous), Chemistry syllabus
Semester: 2, Course code:
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(w.e.f. 2024-25 admitted batch)

Paper-V: Instrumental methods of chemical analysis-II
(skill oriented course 2)

UNIT-I

Chromatographic methods – Ion exchange chromatography – Distribution coefficient – Liquid chromatography – High performance liquid chromatography – principle, instrumentation, detectors- Gas chromatography- principle, Instrumentation, columns, detectors.

UNIT-II

Thermal methods of analysis – Thermogravimetry- theory, instrumentation, applications with special reference to $CuSO_4.5H_2O$, $CaCO_3$, $(COOH)_2.2H_2O$.

Differential thermal analysis – principle, instrumentation, difference between TG and DTA, applications

Differential scanning calorimetry – principle, instrumentation, applications to inorganic and organic compounds.

UNIT-III

Electro analytical Methods of Analysis-1: Voltammetry and polarographic analysis- principle, instrumentation, residual current, migration current, diffusion current, half wave potential, Ilkovic equation, advantages and disadvantages of DME, applications.

UNIT-IV

Mass spectrometry: Basic principles, Instrumentation, detectors, Isotope abundances, The molecular ion,basic fragmentation types and rules.

Gas chromatography – Mass spectrometry (GC-MS)

High performance Liquid Chromatography – Mass spectrometry (HPLC-MS)

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Paper-V: Instrumental methods of chemical analysis-II
(skill oriented course 4)

Time 3 Hours **Model question paper** **Max Marks: 60 M**

SECTION-A

Answer ALL Questions (4x10=40 Marks)

1. write an essay on theory and instrumentation of Gas Chromatography

Or

2. Discuss about the theory, instrumentation and applications of HPLC
3. Discuss the principle and applications of thermo gravimetry for the analysis of $CuSO_4.5H_2O$ and C2C2O4.2H2O

Or

4. Give principle and instrumentation of DTA
5.Explain the following (i)Half wave potential (ii) Ilkovic equation

Or

6.Write about theory and instrumentation of polarography
7.Write about basic fragmentation types and rulesin mass spectrometry

Or

8. Write an essay on GC-MS

SECTION-B

Answer any FIVE questions **(5x4=20 marks)**

9. Write a note on distribution coefficient
10. What is ion exchange chromatography
11.Compare the techniques TG and DTA
12. What is DSC
13.Write about residual current and migration current
14. What are the advanyages and disadvantages of DME
15. Write a note on electron impact ionization source.
16.Write the procedure for the identification of isotopes in mass spectra.

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Sl.No.	Unit No.	Unit name	Essay questions (10M)	Short questions (4M)	Total questions
1	I	Chromatographic methods	2	2	4
2	II	Thermal methods of analysis	2	2	4
3	III	Electro analytical methods of analysis	2	2	4
4	IV	Mass spectrometry	2	2	4
Total questions			**8**	**8**	**16**

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OPEN ONLINE TRANS DISCIPLINARY COURSE

The open online courses can be opted from SWAYAM or any MOOCS platform. The students may be allowed to take the final test/SA from the same online platform. In case of the online test dates mismatch with semester end examinations, the college/Department shall conduct the final exam.

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INDIAN INTELLECTUAL HERITAGE

Intellectual heritage and culture