

M. Sc. IIIrd Semester

Serial No.	Courses	Code	Description	Credits	Max. Marks (100)
12	Core Course X	MSCCHE CC-10	Application of Spectroscopy	5	100
13	Core Course XI	MSCCHE CC-11	Bio-inorganic Chemistry	5	100
14	Core Course XII	MSCCHE CC-12	Environmental Chemistry and Green Chemistry	5	100
15	Core Course XIII	MSCCHE CC-13	Bio- Organic Chemistry	5	100
16	Core Course XIV	MSCCHE CC-14	Practical (Inorganic Chemistry)	5	50+50
17	AECC-2		Human values and professional ethics & gender sensitization	3+2	50+50

M. Sc. IVth Semester

Serial No.	Courses	Code	Description	Credits	Max. Marks (100)
18	Elective Course-1	MSCCHE EC-1a	Inorganic Chemistry Special	5	100
19	Elective Course-1	MSCCHE EC-1b	Physical Chemistry Special	5	100
20	Elective Course-1	MSCCHE EC-1c	Organic Chemistry Special	5	100
21	Elective Course-1	MSCCHE EC-2a	Inorganic Chemistry Special Practical	5	50+50
22	Elective Course-1	MSCCHE EC-2b	Physical Chemistry Special Practical	5	50+50
23	Elective Course-1	MSCCHE EC-2c	Organic Chemistry Special Practical	5	50+50
24	DSE-1 or GE-1			5	100

Candidates should choose one among the following groups- 1a & 2a or 1b & 2b or 1c & 2c

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Semester -I
Core Course -I
Inorganic I

Full Marks -70

Credits-5

3 Bonding and Stereochemistry

Unit-I (a) VSEPR theory, Walsh diagram (triatomic molecules), $d\pi - p\pi$ bonding, Bent rule and energetic of hybridization.

(b) M.O. diagram for hetero- nuclear di- and triatomic molecules. Bonding in Boranes, carboranes, Wades rule Anti ferromagnetic coupling.

Unit-II Magneto chemistry

e-e interaction, Term Symbols, spin orbit coupling Quenching of orbital contribution in metal complexes. Derivation of expression with small and large multiple width. Anomalous magnetic moments, magnetic properties of inner transition elements.

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 formation constants by pH metery and spectrophotometry.

Unit-IV Reaction Mechanism of Transition metal complexes.

Inert and labile complexes, kinetic application of VBT and CFT, kinetics of octahedral substitution, acid hydrolysis, base hydrolysis, CB mechanism, evidences of CB mechanism, Anation reaction, reaction without M-L bond cleavage, substitution reactions in square planar complexes, The trans-effect, Theories of trans-effect, Electron transfer reactions-inner and outer sphere mechanism. Marcus-Hush theory.

Unit-V

Isopoly and Heteropolyacids.
Isopoly and Heteropoly Acids and salts, Isopoly and Heteropoly acids and salts of Mo and W. structure of isopoly and heteropoly anions.

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Books Recommended :

1. Concise Inorganic Chemistry- J.D. Lee
2. Inorganic Chemistry- T. Moeller.
3. Modern Aspects of Inorganic chemistry- H.J. Emeleus and A.G. Sharpe
4. Introduction to ligand field- B.N. Figgis
5. Inorganic Reaction Mechanism- Basalo and Pearson
6. Chemical bonding- O.P. Agrawal/ Coulson
7. Structural Principles in Inorganic Chemistry-W.E. Addison
8. Introduction the Magneto Chemistry- A. Earshasw
9. Principle of Inorganic Chemistry- James Hubey

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Semester-I
Core Course -II
Physical Chemistry-I

Full Marks -70

Credits-5

Unit-I Macromolecules

Types of polymers, Kinetics and mechanisms of polymerization, Molecular mass-number and mass average molecular mass, determination of molecular mass by osmometry, viscosity and light scattering method.

Unit-II Electro Chemistry

- (i) Electrode potential in terms of chemical potential and activity.
- (ii) Debye Huckel theory of conductance of electrolytic solution, its application and limitation.
- (iii) Quantitative treatment of Debye Huckel limiting law and its modification for finite size ions, effect of ion solvent interaction on activity coefficients, Debye Huckel-Umsager equation.
- (iv) Butler-Volmer equation under equilibrium and non equilibrium Exchange current density, Tafel Plot.

Unit-III Chemical Dynamics

- (a) Mechanism and Dynamics of consecutive and opposing reactions.
- (b) Activated complex theory of Uni-molecular reaction.
- (c) Mechanism and Dynamics of photolysis of acetaldehyde and photo dimerisation of Anthracene, Polymerization and Auto oxidation reaction. Study of fast reaction by flow method and relaxation method.

Unit-IV Chemical Thermodynamics

- (a) Partial molar properties in ideal mixture, Chemical Potential, its determination and variation with temperature and pressure, Gibbs Duhem equation.
- (b) Fugacity and activity, variation with 'T' and 'P', determination of Fugacity of a gas mixture, Duhem- Margules equation and its application.

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Unit-V Statistical Thermodynamics

Ensembles, Thermodynamic probability, Boltzman Distribution Law, Boltzman Planck Equation, Partition function and its significance, Relationship with thermodynamic functions. Translational, Rotational, Vibrational and Electronic partition function. Its application in the case of monatomic and diatomic molecules, Sakure-Tetrode Equation.

Books Suggested: *Recomendation - 1*

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|-------------------------------------|-------------------------------|
| 1. Physical Chemistry | : P.W. Atkins (ELBS) |
| 2. Comprehensive Physical Chemistry | : Hemant Snehil |
| 3. Theoretical Physical Chemistry | : Glstone |
| 4. Physical Chemistry | : M.G. Borrow. |
| 5. Modern Electrochemistry | : JOM Bakris and A.K.N. Reddy |
| 6. Text Book of Polymer Science | : F.W. Billmayer jr. |
| 7. Advanced Physical Chemistry | : Gurdeep Raj |

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Semester-I
Core Course -III
Organic Chemistry-I

Full Marks -70

Credits-5

Unit-I Nature of Bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, resonance, hyperconjugation, tautomerism. Aromaticity in benzenoid and non- benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, energy level of molecular orbitals, annulenes, antiaromaticity, homo- aromaticity, PMO approach.

Unit-II Stereochemistry:

Chirality, elements of symmetry, molecules with more than one chiral centre, diastereomerism. Determination of relative and absolute configuration, Methods of resolution, optical purity, prochirality, enantiotopic and diastereotopic atoms, groups and faces, asymmetric synthesis, conformational analysis of cycloalkanes (six membered rings), decalins, Effect of conformation on reactivity, optical activity in absence of chiral carbon[(biphenyls, allenes and spiranes), chirality due to helical shape, stereospecific and stereoselective synthesis. stability and reactivity of carbocations,

Unit-III Reaction Mechanism: Structure and Reactivity:

Types of reactions, kinetic and thermodynamic control, Hammond's postulate, Curtin-H ammet principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects. Generation, structure, carbanions, free radicals, carbenes and nitrenes. Effect of structure on reactivity. The Hammett equation and linear free energy relationship. substituent and reaction constants. Taft equation.

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Unit-IV Aliphatic Nucleophilic Substitution:

The S_N2 , S_N1 , mixed S_N1 and S_N2 , S_Ni and SET mechanisms. The neighbouring group mechanisms, neighbouring group participation by π and σ bonds anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, Reactivity- effects of substrate structure, attacking nucleophile, leaving group and reaction medium. Ambident nucleophiles and regioselectivity. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon.

Aromatic Nucleophilic Substitution: The ArS_N1 , ArS_N2 , 2° S_Ni attack benzyne and $SRN1$ mechanisms. Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The Von-Richter, Sommelet - Hauser, and Smiles rearrangements.

Unit-V Aliphatic Electrophilic Substitution:

Bimolecular mechanisms - $SE2$ and $SE1$. Electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

Elimination Reactions: Mechanism and orientation in pyrolytic elimination. Mechanism and application of Cope elimination, Chugaev reaction, Peterson reaction.

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Books Recommendation:

1. Advanced Organic Chemistry- Reactions Mechanism and Structure by Jerry March.
2. A guide Book to Mechanism in Organic Chemistry by Peter Sykes.
3. Organic Chemistry by R.T. Morrison and R.N. Boyd.
4. Advanced Organic Chemistry by Jagdamba Singh and L.D.S. Yadav.
5. Reaction Mechanism in Organic Chemistry by S.M. Mukherji and S.P. Singh.
6. Stereochemistry of Organic Compounds by D. Nasipuri.
7. Stereochemistry of Organic Compounds by P.S. Kalsi.
8. Advanced Organic Chemistry by F.A. Carey and R.J. Sundberg.
9. Organic Synthesis by Jagdamba Singh, L.D.S. Yadav and Jaya Singh.

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Semester-I
Practical (Physical Chemistry)
(Core Course -IV)

Full Marks -50

Duration of Exam 6 hrs.

Credits-5

Any one experiment-

30 Marks

1. Water equivalent of calorimeter and determination of
 - (i) Heat of solution of potassium nitrate
 - (ii) Heat of neutralization of strong acid and strong base.
 - (iii) Basicity of polybasic acids.
2. Determination of rate constant of hydrolysis of methyl acetate in acid medium.
3. The study of saponification of ethyl acetate by sodium hydroxide and determination of rate constant.
4. To determine the distribution coefficient of
 - (i) Acetic acid
 - (ii) Benzoic acidbetween water and benzene by partition method.
5. Determination of specific and molar rotation of sucrose in different concentrations and to determine the concentration of given solution.
6. Determination of rate constant of inversion of cane sugar^{using polarimeter}.
7. i) Determination of Dissociation constant of acetic acid, by conductometric titration.
ii) Solubility product of sparingly soluble salt.

Viva-voce-15

Note books-5

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Semester-I

AECC-1

Environmental Sustainability and Swachchha Bharat Abhiyan Activities

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