

**CHEMISTRY**

The examination shall consist of three theory papers and one practical.

Paper & Course	Hrs/week	M.	Marks
Paper -I Inorganic Chemistry	2		50
Paper- II Organic Chemistry	2		50
Paper- III Physical Chemistry	2		50
Practical	4		75

**PAPER-I  
INORGANIC CHEMISTRY**

Time-3 Hrs.

M.M. 50

**NOTE:** The paper will be divided into **THREE** sections.

**Section-A** Ten questions (short type answer) two from each Unit will be asked. Each question will be of half mark and the candidates are required to attempt all questions. **Total 5 marks**

**Section-B** Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 5 marks.

**Total 25 marks**

**Section -**

Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any **TWO** questions. Each question will be of 10 marks.

**Total 20 marks**

**UNIT - I**

**Covalent Bond-** Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence Shell Electron Pair Repulsion (VSEPR) theory, regular and deviation from regular geometry. MO theory, homo-nuclear and heteronuclear (CO, NO, HF and HCl) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

**Ionic Solids** - Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond - free electron, valence bond and band theories.

**Weak Interactions-** Hydrogen bonding, Van der Waals forces.

## UNIT II

**s-Block Elements** - Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to metal alkyls and aryls.

**Chemistry of Noble Gases**-History of discovery, separation of inert gases, chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

## UNIT -III

**Group-13**- General properties, oxides, hydroxides, halides and hydrides of boron, diborane and higher boranes, borohydrides, borazine, oxyacids of boron, borax and borax bead test .

**Group-14**- General properties, inert pair effect, halides, oxides, silicates, silicones, graphitic compounds, carbides, cyanides and carbonyls, brief idea of fullerenes.

**Group-15**- General properties, hydrides, azides, halides, oxides and oxyacids of phosphorous, nitrogen fixation, fertilizers.

## UNIT - IV

**Group-16** - General properties, polymorphism, hydrides, halides, oxides and oxyacids of sulphur, thiosulphuric acid and salts, thionic acids and their salts, tetrasulphur tetranitride.

**Group-17** - General properties, hydrogen halides, oxides and oxyacids of halogens, interhalogen compounds, polyhalides, basic properties of halogens.

## UNIT - V

**Non -Aqueous Solvents** - Physical properties of a solvent, types of solvents and their general characteristics, Differentiating and leveling solvents, reactions in non-aqueous solvents with special reference to liquid  $\text{NH}_3$  and liquid  $\text{SO}_2$ .

**Acids and Bases** - Arrhenius, Bronsted - Lowry, Lux - Flood, solvent system and Lewis concepts of acid and bases, Usanovitch definition.

### Books Recommended

1. Concise Inorganic Chemistry: J. D. Lee
2. General Inorganic Chemistry: J. A. Duffy, Longman (2nd Ed.)
3. Principles of Inorganic Chemistry: B. R. Puri and L. R. Sharma
4. Basic Inorganic Chemistry: F.A.Cotton and G. Wilkinson, Wiley Eastern
5. Molecular Geometry : R. J. Gillespie, Van Nostrand Reinhold.
6. Inorganic Chemistry (Hindi Ed.): Suresh Ameta, A. Sharma and M. Mehta, Himanshu Pub.

oxides and oxyacids of sulphur, thiosulphuric acid and salts, thionic acids and their salts, tetrasulphur tetranitride.

**Group-17** - General properties, hydrogen halides, oxides and oxyacids of halogens, interhalogen compounds, polyhalides, basic properties of halogens.

#### UNIT - V

**Non -Aqueous Solvents** - Physical properties of a solvent, types of solvents and their general characteristics, Differentiating and leveling solvents, reactions in non-aqueous solvents with special reference to liquid  $\text{NH}_3$  and liquid  $\text{SO}_2$ .

**Acids and Bases** - Arrhenius, Bronsted - Lowry, Lux - Flood, solvent system and Lewis concepts of acid and bases, Usanovitch definition.

#### Books Recommended

1. Concise Inorganic Chemistry: J. D. Lee
2. General Inorganic Chemistry: J. A. Duffy, Longman (2nd Ed.)
3. Principles of Inorganic Chemistry: B. R. Puri and L. R. Sharma
4. Basic Inorganic Chemistry: F.A.Cotton and G. Wilkinson, Wiley Eastern
5. Molecular Geometry : R. J. Gillespie, Van Nostrand Reinhold.
6. Inorganic Chemistry (Hindi ed.): Suresh Ameta, A. Sharma and M. Mehta, Himanshu Pub.

## PAPER II ORGANIC CHEMISTRY

Time-3 Hrs.

M.M. 50

**NOTE : The paper will be divided into THREE sections.**

Section-A Ten questions (short type answer) two from each Unit will be asked. Each question will be of half mark and the candidates are required to attempt all questions.

**Total 5 marks**

Section-B Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 5 marks.

**Total 25 marks**

Section-C Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any **TWO** questions. Each question will be of 10 marks.

**Total 20 marks**

#### UNIT-I

**Structure and Bonding** - Localized and delocalized chemical bond, Van der Waals interaction, charge transfer complexes, resonance, hyperconjugation, aromaticity, electromeric, inductive and field effects, hydrogen bonding.

**Mechanism of Organic Reactions** - Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, types of organic reactions, energy considerations.

**Reactive Intermediates** - Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes, their formation and stabilities.

Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

## UNIT-II

**Stereochemistry of Organic Compounds** - Concept of isomerism, types of isomerism.

Optical Isomerism- Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization.

Relative and absolute configuration, sequence rules, D and L, R and S systems of nomenclature.

Geometric isomerism- determination of configuration of geometric isomers. E and Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Conformational isomerism- conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and Flying Wedge formulae.

Difference between configuration and conformation.

## UNIT-III

**Alkanes:** General methods of formation, physical & chemical properties. Mechanism of free radical substitution in alkanes with reference to halogenation, orientation, reactivity and selectivity.

**Cycloalkanes** - Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitation, ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings, the case of cyclopropane ring : banana bond.

**Alkenes, Dienes and Alkynes** - Brief introduction of alkenes, their formation with reference to mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes.

Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction, epoxidation, ozonolysis, hydration, hydroxylation and oxidation with  $\text{KMnO}_4$ , polymerization of alkenes, substitution at

applications of ethylene and propene.

Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes, structure of allene and butadiene, methods of formation, polymerization, chemical reactions - 1,2 and 1,4 - additions, Diels-Alder reaction.

**Alkynes:** Acidity of alkynes, mechanism of electrophilic and nucleophilic addition reactions, hydroboration, metal - ammonia reductions, oxidation and polymerization.

#### Unit - IV

**Arenes and Aromaticity** - Nomenclature of benzene derivatives, the aryl group, aromatic nucleus and side chain, structure of benzene, molecular formula and Kekule structure, stability and carbon - carbon bond lengths of benzene, resonance structure and M. O. picture.

Aromaticity: The Huckel rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of s and p complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel -Craft reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho-para ratio. Side chain reactions of benzene derivatives. Birch reduction, Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl.

#### UNIT -V

**Alkyl and Aryl Halides** - Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, mechanism of nucleophilic substitution reactions of alkyl halides,  $S_N^2$  and  $S_N^1$  reactions with energy profile diagrams, factors affecting  $S_N^2$  and  $S_N^1$  reactions.

Haloform reaction, Freons:

Methods of formation of aryl halides, nuclear and side chain reactions, the addition - elimination and elimination - addition reaction, mechanisms of nucleophilic aromatic substitution reactions.

Relative reactivities of alkyl halides v/s allyl, vinyl and aryl halides. synthesis and uses of DDT and BHC.

#### Books Recommended

1. A Text Book of Organic Chemistry: K. S. Tiwari, S. N. Mehrotra and N. K. Vishnoi.
2. Modern Principles of Organic Chemistry: M. K. Jain and S.C. Sharma
3. A Text Book of Organic Chemistry: (Vol. I & II) O. P. Agarwal,
4. A Text Book of Organic Chemistry: B. S. Bahl and Arun Bahl.

## PHYSICAL CHEMISTRY

Time-3 Hrs.

M.M. 50

NOTE : The paper will be divided into THREE sections.

**Section-A** Ten questions (short type answer) two from each Unit will be asked. Each question will be of half mark and the candidates are required to attempt all questions. **Total 5 marks**

**Section-B** Five questions (answer not exceeding 250 words) one from each Unit with internal choice will be asked and the candidates are required to attempt all questions. Each question will be of 5 marks. **Total 25 marks**

**Section-C** Four questions may be in parts covering all the five Units (answer not exceeding 500 words) will be asked. The candidates are required to attempt any TWO questions. Each question will be of 10 marks. **Total 20 marks**

## UNIT - I

**Mathematical Concepts** - Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of function like  $k_x$ ,  $e^x$ ,  $x^n$ ,  $\sin x$ ,  $\log x$ , maxima and minima, partial differentiation and reciprocity relations, integration of some useful

relevant functions, permutations and combinations, factorials, probability.

**Computers** - General introduction to computers, different components of a computer, hardware and software, input-output devices, binary numbers and arithmetic, introduction to computer languages, programming operating systems.

### UNIT - II

**Gaseous State** - Postulates of kinetic theory of gases, deviation from ideal behavior, Van- der Waals equation of state.

**Critical Phenomena** - PV isotherms of real gases, continuity of states, the isotherms of Van der Waals equation, relationship between critical constants and Van der Waals constants, the law of corresponding states, reduced equation of state.

**Molecular Velocities** - Root mean square, average and most probable velocities, qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter, liquefaction of gases (based on Joule - Thomson effect).

**Liquid State** - Intermolecular forces, structure of liquid (a qualitative description).

**Liquid Crystals** - Difference between liquid crystal, solid and liquid, classification, structure of smetic, nematic and cholestric phases, theory of liquid crystals and its applications, thermography and seven segments cell.

### UNIT-III

**Solid State** - Definition of space lattice, unit cell, Bravais lattices.

**Laws of crystallography**- (i) Law of constancy of interfacial angles (ii) Law of rationality of indices, Weiss and Miller indices (iii) Law of symmetry, symmetry elements in crystals, classification of crystals, X-ray diffraction by crystals, derivation of Bragg equation, determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method).

**Colloidal State** - Definition of colloids, classification of colloids.

**Solids in liquid (sols)**: Properties - kinetic, optical and electrical, stability of colloids, protective action, Hardy - Schulze law, gold number.

**Liquids in Liquid (emulsions)**: Types of emulsions, preparation, emulsifier,

**Liquids in solid (gels)**- classification, preparation and properties, inhibition, general applications of colloids.

### UNIT- IV

**Nuclear and Radiochemistry** - Elementary idea of nucleus, nuclear forces, packing fraction, mass defect and binding energy, nuclear fission and fusion reactions, calculation of Q - values of nuclear reactions, liquid drop and shell models of nucleus, theory of radioactivity, G. M. Counter, half life period, average life, radioactive disintegration, radioactive

steady state, group displacement law, radioactive series, separation and identification of isotopes, application of radioactivity and radioactive tracers.

## UNIT-V

**Atomic Structure** - Dual nature of electron, De Broglie equation, Davisson and Germer experiment, Heisenberg uncertainty principle, Schrodinger wave equation, significance of  $\psi$  and  $\psi^2$ , probability distribution curves, shapes of s, p and d - orbitals, Zeeman and Stark effects.

**Physical Properties and Molecular Structure** - Physical properties of liquids, vapour pressure, measurement of vapour pressure, heat of vaporization, Trouton's rule.

Surface tension, measurement of surface tension.

Viscosity and its measurement, effect of temperature on the surface tension and viscosity. use of these properties in determination of chemical constitution.

### Books Recommended:

1. Principles of Physical Chemistry: B. R. Puri and L. R. Sharma.
2. A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand.
3. Physical Chemistry, Pt. I & II : C.M. Gupta, J.K. Saxena and M. C. Purohit.
4. Physical Chemistry (Hindi Ed.) : Suresh Ameta, R.C.Khandelwal, R. Ameta & J. Vardia, Himanshu Pub.
5. Computers and Applications to Chemistry, Ramesh Kumari, Narosa Publishing House Pvt. Ltd.



application of radioactivity and radioactive tracers.

### UNIT-V

**Atomic Structure** - Dual nature of electron, De Broglie equation, Davission and Germer experiment, Heisenberg uncertainty principle, Schrodinger wave equation, significance of  $\psi$  and  $\psi^2$ , probability distribution curves, shapes of s, p and d - orbitals, Zeeman and Stark effects.

**Physical Properties and Molecular Structure** - Physical properties of liquids, vapour pressure, measurement of vapour pressure, heat of vaporization, Trouton's rule.

Surface tension, measurement of surface tension. Viscosity and its measurement, effect of temperature on the surface tension and viscosity. use of these properties in determination of chemical constitution.

#### Books Recommended:

1. Principles of Physical Chemistry: B. R. Puri and L. R. Sharma.
2. A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand.
3. Physical Chemistry, Pt. I & II : C. .M. Gupta, J. K. Saxena and M. C. Purohit.
4. Physical Chemistry (Hindi Ed.): Suresh Ameta , R.C.Khandelwal, R. Ameta and J. Vardia, Himanshu Pub.
5. Computers and Applications to Chemistry, Ramesh Kumari, Narosa Publishing House Pvt. Ltd.

## FIRST YEAR CHEMISTRY

### PRACTICALS 2007-2008

TIME: 5 Hrs.( one day)

M.M. 75

Distribution of Marks

Marks

#### Exercises-

1. Semi-micro Analysis of Inorganic mixture containing five radicals (excluding  $\text{Na}^+$  and  $\text{K}^+$ ). **20**
2. (i) Detection of extra elements (N, S, and halogen) if any and functional groups in given simple organic compounds. **10**  
(ii) Purification of the given organic compounds by crystallisation (charcoal) sublimation and determination of its m.p. **10**

OR

Determination of mixed melting points using urea-cinnamic acid mixtures of given compositions.

3. ONE physical Chemistry experiment **15**
4. Viva- Voce **10**
5. Records **10**

**Total**

## List of Experiments:

1. **Semi-micro Analysis of Inorganic mixture:** The mixture shall contain **Five** radicals at least two (two cations & two anions) soluble in water or in HCl. Two cations of the same group except II A & II B may be given. Not more than one interfering radical may be given. Interfering radical may not be given with typical anion combinations.

2. (i) Detection of extra elements (N,S, and halogen) if any and functional group in given simple organic compounds. (one organic compound from the following list be given for identification).

Carboxylic acids, Phenols, Alcohols, Carbohydrates, Aldehydes, Ketones, Nitro

Compounds, Amino compounds, Anilides, Amides, Esters, Thioamide,

Hydrocarbons, Halogen containing compounds

### (ii) Crystallization:

Concept of induction of crystallization

Phthalic acid from hot water (using fluted filter paper and stemless funnel)

Acetanilide from boiling water

Naphthalene from ethanol

Benzoic acid from water

Crystallization and decolourisation of impure naphthalene (100 g of naphthalene mixed with 0.3 of Congo Red using 1 g decolourising carbon) from ethanol.

**Simple Sublimation:** Camphor, Naphthalene, Phthalic acid and Succinic acid.

### Mixed Melting Point determination

Urea- Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1)

3. **Physical Chemistry Experiments-** Any one of the following experiments may be given in the examination.

### Distribution Law

(i) To study the distribution of iodine between water and  $\text{CCl}_4$ .

(ii) To study the distribution of benzoic acid between benzene and water.

(iii) To study the distribution of acetic acid between benzene and water

### Colloids:

To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi- and trivalent anions.

- (i) To determine the percentage composition of a given mixture (non interacting systems) by viscosity method.
- (ii) To determine the percentage composition of a given binary mixture by surface tension method
- (iii) To determine the parachor value of  $-CH_2-$  group.
- (iv) To determine the rheochor value of  $-CH_2-$  group.

### Transition Temperature

- (i) Determination of the transition temperature of the given substance by thermometric/ dilatometric method ( e.g.:  $MnCl_2 \cdot 4H_2O$ ,  $SrBr_2 \cdot 2H_2O$ )

### Thermochemistry

- (i) To determine the solubility of benzoic acid at different temperatures and to determine  $\Delta H$  of the dissolution process
- (ii) To determine the enthalpy of neutralisation of a weak acid/ weak base versus strong base/ strong acid and determine the enthalpy of ionisation of the weak acid/weak base
- (iii) To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born- Haber cycle.

1. Practical Chemistry - Giri, Bajpai and Pandey, S. Chand & Co. Ltd. New Delhi
2. Laboratory Manual in Organic Chemistry, R.K. Bansal, Willey Eastern
3. Experimental Organic Chemistry Vol.I & II, P.R. Singh, D.S. Gupta & K.S. Bajpai, Tata McGraw Hill.
4. Experiments in Physical Chemistry- J.C. Ghose, Bharti Bhawan
5. Experiments in General Chemistry, N.R. Rao & U.C. Agarwal, Eastern Press
6. Practical Chemistry- Suresh Ameta & P.B. Punjabi, Himanshu Publication.