

CHEMISTRY

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

<u>Paper & Course</u>	<u>Hrs/week</u>	<u>M. Marks</u>
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-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

Chemistry of Elements of First Transition Series -

Characteristic properties of d-block elements (colour, variable valency, magnetic and catalytic properties and ability to form complexes). Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.

Chemistry of Elements of Second and Third Transition Series - General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.

UNIT II

Oxidation and Reduction - Use of redox potential data, analysis of redox cycle, redox stability in water - Frost, Latimer and Pourbaix diagrams, principles involved in the extraction of the elements.

Coordination Compounds - Werner's coordination theory and its experimental verification, effective atomic number concept, nomenclature of coordination compounds, isomerism in coordination compounds.

146

valence bond theory of transition metal complexes, chelate and chelate effects.

UNIT- III

Chemistry of Lanthanides - Electronic structure, oxidation states and ionic radii, lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

Chemistry of Actinides - General feature and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides

UNIT- IV

Gravimetric Analysis- Principles, solubility, formation and preparation of precipitation, colloidal properties, ageing and contamination of the precipitates, coprecipitation and post-precipitation.

Simple Organic Reagents used in Inorganic Analysis- 8- Hydroxyquinoline, Dimethylglyoxime, α -nitroso- β -naphthol, Anthranilic acid, Arsonic acids, Cupron and Cupferron.

UNIT- V

Chromatography - Basic principles, instrumentation and application of adsorption, and partition chromatography, ion exchange separation.

Errors in Quantitative Analysis - Accuracy and precision, determinate, indeterminate and accidental errors, precision of a single measurement, precision of mean.

147

rejection of a result, errors in a derived result, methods of checking the accuracy of analysis, significant figures, computation values.

Book Recommended:

1. Text Book of Quantitative Inorganic Analysis: A. I. Vogel (Chapter- I, II and XXIII).
2. Text Book of Quantitative Inorganic Analysis: I. M. Kolthoff and E. R. Sandell.
3. Concise Inorganic Chemistry: J. D. Lee.
4. General Inorganic Chemistry: J. A. Duffy.
5. Principle of Inorganic Chemistry: B. R. Puri and L. R. Sharma.
6. Basic Inorganic Chemistry: Cotton and Wilkinson and Gaus, Willey.
7. Inorganic Chemistry (Hindi ed.): Suresh Ameta, A. Sharma and M. Mehta, Himanshu Pub.

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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.

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Total 20 marks

Unit-I

Alcohols and Epoxides

Unsaturated alcohols- Vinyl and Allyl alcohol

Dihydric alcohol - Nomenclature, method of formation and chemical reactions of vicinal glycols.

Pinacol- Pinacolone rearrangement.

Trihydric alcohols - Formation and chemical reactions of glycerol.

Epoxides - Synthesis and reactions of epoxides, orientation of epoxide ring opening.

Phenols - Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion.

Reactions of phenols - Electrophilic aromatic substitution, acylation and carboxylation, Mechanism of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer-Tiemann reaction.

Unit II

Aldehydes and Ketones - Synthesis, chemical and physical properties of aromatic aldehydes and ketones, mechanism of nucleophilic addition to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives, Wittig reaction, Mannich reaction.

Use of acetals as protecting group. Oxidation of aldehydes, Baeyer- Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmenson, Wolff-Kishner, LiAlH_4 and NaBH_4 reductions, Halogenation of enolizable ketones.

Introduction to α, β - unsaturated aldehydes and ketones.

Unit III

Carboxylic Acids and their derivatives - Nomenclature, structure and bonding, acidity of carboxylic acids, effects of substituents on acid strength, mechanism of carboxylation, Methods of formation, physical properties and chemical reactions of dicarboxylic acids oxalic, succinic and phthalic acid.

Substituted Acids - Methods of formation & chemical reactions of halo acids, hydroxy acids, malic, tartaric, citric and salicylic acids.

Unsaturated Acids - Acrylic and cinnamic acid.

Introduction to acids derivatives - Preparation, properties and uses of acid halides, amides, anhydrides and esters. Interconversion of acid derivatives by nucleophilic acyl substitution. Mechanism of HVZ reaction, Hofmann - bromamide reaction and ester hydrolysis.

UNIT - IV

Organic compounds of Nitrogen: - Preparation & chemical reactions of nitroarenes. Reactivity of nitro substituted arenes.

Aromatic amines, classification, preparation, properties and uses of primary amino compounds -aniline, acetanilide, nitroanilines.

Secondary amino compounds- diphenylamine and N-methylaniline

Tertiary amino compounds- Triphenylamine and N,N-dimethylaniline

Aryl alkyl amine- Benzylamine

Basic strength of amines- similarities and differences between aliphatic and aromatic amines.

Diazonium salt- formation, properties and synthetic uses of benzene diazonium salts, Diazo coupling & its mechanism.

Organic Sulphur Compounds: Preparation and properties of thiols, sulphonic acid, sulphonyl chloride, saccharides, chloramine - T, dichloramine-T and sulphonamides.

UNIT V

Polynuclear Hydrocarbons - Nomenclature of naphthalene and anthracene derivatives, preparation and properties of naphthalene, anthracene, naphthol, naphthylamine, naphthaquinone and anthraquinone.

Mechanism and orientation of electrophilic substitution reaction in naphthalene and anthracene.

Organometallic Compounds - Preparation, properties and synthetic uses of organo lithium and organo zinc compounds.

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 & 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.
5. A Text Book of Organic Chemistry: P. L. Soni.
6. Organic Chemistry: (Vol. I, II & III) S. M. Mukherji, S. P. Singh and R.P. Kapoor.
7. Organic Chemistry (Hindi Ed.) : Suresh Ameta, P. B. Punjabi and B. K Sharma, Himanshu Pub.

Paper-III

PHYSICAL CHEMISTRY

Time-3 Hrs.

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

Thermodynamics - I : Definition of thermodynamic terms, system, surrounding, etc., types of systems, intensive and extensive properties, state and path functions, their differentials, thermodynamics process, concept of heat

work:

First law of Thermodynamics - Statement, definition of internal energy and enthalpy, heat capacity, heat capacities at constant volume and pressure and their relationship, Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU and dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Thermochemistry: Standard state, standard enthalpy of formation, Hess's law of heat summation and its applications, Heat of reaction at constant pressure and at constant volume, Enthalpy of neutralization, bond dissociation energy and its calculation from thermochemical data, temperature dependence of enthalpy, Kirchhoff's equation.

UNIT-II

Thermodynamics - II : Second law of thermodynamics: need for the law, different statements of the law, Carnot cycle and its efficiency, Carnot theory, thermodynamic scale of temperature.

Concept of entropy: Entropy as a state function, entropy as a function of V and T, entropy as a function of P and T; entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium, entropy change in ideal gases and mixing of gases.

Third Law of Thermodynamics - Nernst heat theorem.

statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz function, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, variation of G and A with P, V and T.

Chemical Equilibrium - Equilibrium constant and free energy, thermodynamic derivation of law of mass action, distribution law and phase rule, Le Chatelier's principle, Nernst's distribution law for solute, principle of extraction of solute from solution and washing of precipitates.

Reaction isotherm and reaction isochore - Clapeyron equation and Clausius - Clapeyron equation, applications, partial molar quantities, partial molar volume and its distribution, chemical potential and its physical significance, Gibbs-Duhem equation.

UNIT-III

Macromolecules - Nomenclature, classification, properties of polymer, mass of macromolecules, number average and weight average molecular mass, determination of molecular weight by osmotic pressure, viscosity and light scattering and sedimentation (ultra centrifuge) methods.

Surface Chemistry - Sorption at surfaces, physical and chemical adsorption, Freundlich, Langmuir and Gibbs adsorption isotherms and their derivation, Streaming

156

potential electrophoresis and electroosmosis.

UNIT-IV

Phase Equilibrium - Statement and meaning of the terms - phase, component and degree of freedom, derivation of Gibb's phase rule, phase equilibrium of one component system- water, CO_2 and S - system.

Phase equilibria of two component system - Solid - liquid equilibria, simple eutectic, Bi-Cd, Pb-Ag systems, desilverization of lead.

Solid solutions - Compound formation with congruent melting point (Mg - Zn) and incongruent melting point, ($\text{NaCl} - \text{H}_2\text{O}$), ($\text{FeCl}_3 - \text{H}_2\text{O}$) and ($\text{CuSO}_4 - \text{H}_2\text{O}$) systems, freezing mixtures, acetone - dry ice.

Liquid - liquid mixtures: Ideal liquid mixtures, Raoult's and Henry's law, Non -ideal system, azeotropes: HCl - H_2O and ethanol - water systems.

Partially miscible liquids: phenol - water, trimethylamine - water, nicotine - water systems, lower and upper consolute temperature, effect of impurity on consolute temperature.

Immiscible liquids, steam distillation.

UNIT V

Electrochemistry : Types of reverse electrode : gas - metal ion, metal-metal ion, metal-insoluble salt - anion and redox electrodes, electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode

157

potential, standard hydrogen electrode-reference electrodes-standard electrode potential, sign conventions, electrochemical series and its significance, electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurements, computation of cell EMF. Calculation of thermodynamic quantities of cell reactions (ΔG , ΔH and K) polarization, over potential and hydrogen over voltage. Concentration cell with or without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

Ionic Equilibria - Arrhenius theory of electrolyte and its application, Ostwald's dilution law, its uses and limitations. Debye - Huckle theory of strong electrolytes, asymmetric, electrophoretic, Debye- Falkenhagen and Wein effects, Activity coefficient, mean activity coefficient, ionic strength, Debye- Huckel limiting law.

Books Recommended:

1. Principle of Physical chemistry: B. R. Puri Sharma and M. S. Pathania,
2. A Text Book of Physical Chemistry: A. S. Negi and S.C. Anand.
3. A Text Book of Physical Chemistry: Kundu and Jain.
4. Physical Chemistry (Hindi Ed.): Suresh Ameta, R.C.Khandelwal, R. Ameta and J. Vardia.

SECOND YEAR CHEMISTRY PRACTICALS 2006-2007

Distribution of Marks

Time 5 Hrs. (one day)

M.M. 75

Marks

Exercises-

1. Volumetric estimation

20

or

Gravimetric analysis

2. Determination of R_f values and identification of given organic compounds using thin layer / paper chromatography.

10

3. Identification of given organic compound through functional group analysis

10

4. Physical chemistry Experiments

15

5. Viva - Voce

10

6. Record

10

Total

75 Marks

List of Experiments

(1) Volumetric Analysis: (Any one of the following exercise may be given in the examination.)

Determination of acetic acid in commercial vinegar using NaOH.

Determination of alkali content- antacid tablet using HCl.

Estimation of calcium content in chalk as calcium oxalate using permanganate.

Estimation of hardness of water by EDTA.

(e) Estimation of ferrous and ferric ions by dichromate methods.

(f) Estimation of copper using thiosulphate.

(g) Estimation of Mg^{2+} , Ca^{2+} or Ba^{2+} complexometrically.

OR

Gravimetric Analysis :

Analysis of Cu as $CuSCN$ and Ni as Ni (dimethylglyoxime)

Note: Candidates are required to prepare standard solutions by proper weighing.

2. Thin Layer Chromatography :

Determination of R_f values and identification of organic compounds.

(a) Separation of green leaf pigments (spinach leaves may be used)

(b) Preparation and separation of 2,4-dinitrophenylhydrazones of acetone, 2-butanone,

160

hexane-2-and 3-ones using toluene and light petroleum(40:60)

(c) Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5)

Paper Chromatography:

Determination of R_f values and identification of organic compounds in a mixture of amino acids / monosaccharides.

3. Identification of Organic Compounds:

An organic compound from the following list be given for systematic identification:

(i) Formic, Acetic, Propanoic and Butanoic acids.

(ii) Phenols- Phenol, Resorcinol, Hydroquinone, p-Cresol, α -Naphthol, β -Naphthol.

(iii) Alcohols- Methyl, Ethyl, Propyl, Isopropyl, n-butyl, isobutyl and tert. butyl alcohol.

(iv) Carboxylic acids- Oxalic, Tartaric, Citric, Succinic, Benzoic, Cinnamic, Salicylic, Phthalic acids

(v) Carbohydrates- Glucose, Fructose, Cane sugar and Starch.

(vi) Aldehydes- Formaldehyde, Acetaldehyde and Benzaldehyde.

(vii) Ketones- Acetone, Methyl ethyl ketone, Acetophenone and Benzophenone.

161

(viii) Nitro compounds - Nitrobenzene, p- Nitrotoluene and m- Dinitrobenzene.

(ix) Amino compounds - Aniline, o-, m- and p- toluidine, α -Naphthylamine and β -Naphthylamine.

(x) Anilides - Acetanilide and Benzanilide.

(xi) Amides - Acetamide, Benzamide and Urea.

(xii) Esters - Methyl acetate, Ethyl acetate.

(xiii) Thioamide - Thiourea.

(xiv) Hydrocarbons - Benzene, Toluene, Naphthalene and Anthracene.

(xv) Halogen containing compounds - Chloroform, Chloral hydrate, Iodoform, Chlorobenzene, p- Dichlorobenzene and p- Dibromobenzene.

4. Physical chemistry experiments- Any one of the following experiments may be given in the examination.

Chemical Kinetics:

(i) To determine the specific reaction rate of the hydrolysis of methyl acetate/ ethyl acetate catalyzed by hydrogen ions at room temperature.

(ii) To study the effect of acid strength on the hydrolysis of an ester.

162

(iii) To study kinetically the reaction rate of decomposition of iodide by peroxydisulphate.

(iv) To study the hydrolysis of an ester in presence of a base.

(iv) To determine the relative strength of two acids using ester hydrolysis.

Phase Equilibrium

(i) To study the effect of a solute (e. g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. Phenol-water system) and to determine the concentration of that solute in the given phenol-water system.

(ii) To construct the phase diagram of two component (e. g. diphenylamine- benzophenone) system by cooling curve method.

Adsorption:

(i) To study the adsorption of acetic acid by activated charcoal and test the validity of Freundlich or Langmuir adsorption isotherm.

(ii) To study the adsorption of oxalic acid by activated charcoal and test the validity of Freundlich or Langmuir adsorption isotherm.

Books Recommended:

1. Practical chemistry - Giri, Bajpai and Pandey, S. Chand & Co. Ltd. New Delhi

163

- 2 Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern
- 3 Experimental Organic Chemistry Vol.I & II, P.R. Singh, D.S. Gupta & K.S. Bajpai, Tata Mc Graw Hill
- 4 Experiments in Physical Chemistry- J.C. Ghose, Bharti Bhawan
- 5 Experiments in General Chemistry, C.N.R. Rao & U.C. Agarwal, Eastern Press
- 6 Practical Chemistry- Suresh Ameta & P.B. Punjabi, Himanshu Publication.