

CHEMISTRY SYLLABUS
B.Sc.I Sem -I
(Effective from session 2013-14)

The examination in Chemistry of First semester shall comprise of one theory paper, internal assessment and practical examination. Theory paper will be of 3 Hrs. duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of 6 hours duration and carry 50 marks. The following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question in every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of Semester-I (8 marks).

Unit I (14L)

A] Periodic Properties: Atomic and ionic radii. Types of atomic radii (only definitions - covalent radius, metallic radius, Van der Waals' radius and ionic radius). Periodic trends in atomic and ionic radii. Ionization energy, electron affinity and electronegativity (definition and periodic trends). Effect of ionization energy and electronegativity on different properties of elements namely metallic and non-metallic character, relative reactivity, oxidizing and reducing properties., Scales of electronegativity Pauling scale and Mulliken Scales. Electronegativity and partial ionic character of a covalent bond. [6] Screening effect, screening constant and effective nuclear charge. Slater's rules for calculating screening constant. Problems. [2]

B] Ionic bonding: Definition of ionic bond, types of cations. Factors affecting ionic bond formation (energetic of ionic bond formation ionization energy, electron affinity and lattice energy). Born Lande equation (no derivation) to calculate lattice energy. Born-Haber's cycle to determine lattice energy. Solvation and solvation energy, factors affecting solvation energy, Determination of solvation energy. Solubility of ionic solids, lattice energy and solvation energy. [6]

Unit II (14L)

A] S-Block element: Comparative study of 1st and 2nd group elements with reference to electronic configuration, ionisation energy, oxidation states, reactivity and flame colouration. Diagonal relationship between Li and Mg. [5]

B] P-Block element: Comparative study of 13th, 14th and 15th group elements with reference to electronic configuration, ionisation energy, oxidation states. Concept of inert pair effect. Diagonal relationship between Be and Al. Structure of diamond and graphite. Abnormal behaviour of nitrogen. Hydrides of boron- preparation (from BCl_3 and NaBH_4 two), properties (action of heat, water, alkali and oxygen), structure and bonding in diborane. Carbides, types of carbides and fullerenes. [9]

Unit III (14L)

A] Electronic Displacements: Inductive effect, Electromeric effect, Resonance and Hyperconjugation (definition, and applications of these effects). [3]

B] Reactive Intermediates: Carbocations, Carbanions and free radicals: their generation stability and reactions. [2]

C] Aliphatic Hydrocarbons: Alkanes: Methods of formation: i)Wurtz reaction and ii)CoreyHouse reaction,Reactoins: i)Halogenatiom (With mechanism), ii) Aromatisation. [2]
Alkenes: Methods of formation (With mechanism): i)Dehydrohalogenation of alkyl halides (E1 & E2) ii) Dehydration of alcohols, Reactions: Electrophilic and free radical addition of HX and X₂ (with mechanism). [3]
Alkynes: Preparation from vicinal and germinal dihalides, ReactionHydrogenation. [2]
 Alkadienes: Classification,1,3-Butadiene- Preparation from cyclohexene, Reactions- Addition of H₂ , Br₂ and HBr. [2]

Unit IV- Aromatic Hydrocarbons (14L)

A] Nomenclature and Isomerism of Aromatic Compounds. Structure of Benzene: Kekule structure and Molecular orbital structure.[4]
B] Aromaticity and Huckel's rule: Aromatic, antiaromatic and nonaromatic systems. [4]
C] Mechanism of Electrophilic Aromatic Substitution: Nitration, Friedal Craft Alkylation and Acylation.Nuclear and Side Chain Halogination, Birch Reduction. [4]
D] Orientation: Effect of substituent groups. Activating and deactivating groups. Theory of reactivity and orientation on the basis of inductive and resonance effects (-CH₃ , -OH, -NO₂ and -Cl groups). [2]

Unit V : Thermodynamics (14L)

Adiabatic and Isothermal processes. Work done in adiabatic and isothermal processes, Evaluation of different expressions showing relationship between pressure, volume and temperature. First law of Thermodynamics and its limitations, Need of Second law. Carnot's heat engine, derivation of expression for the work done and efficiency of Carnot's engine. Statements of Second law of thermodynamics. Concept of Entropy, Physical significance of Entropy, Derivation of expression for the Entropy change for an ideal gas in terms of pressure, temperature and volume. Entropy change for an ideal gas for isothermal, isobaric and isochoric processes, Entropy of fusion, sublimation, vapourization, transition and its calculations. Entropy change for reversible and irreversible processes. Entropy change as a criteria for spontaneity. Numericals. [14]

Unit VI (14L)

A] Gaseous State: Postulates of Kinetic theory of gases, Derivation of Kinetic gas equation. RMS, Average and Most probable velocities and their relationship. Maxwell-Boltzmann distribution law of molecular velocities (only qualitative treatment), Mean free path, collision number and collision diameter. Deviation of real gases from ideal gas behaviour. Vanderwaal's equation of state and its derivation for real gases. Critical phenomenon, Andrew's experiment - isotherm of CO₂ . Critical state, critical constant, P_c, V_c and T_c in terms of Vanderwaal's constants 'a' and 'b'. Reduced equation of state and its derivation. Law of corresponding state. Numericals. [10]
B] Phase Rule: Statement of phase rule, explanation of phase, number of components and degree of freedom. Application of phase rule to water and sulfur system. [4]

Chemistry Practicals
B.Sc. I Sem I

Total Laboratory Sessions: 26

Marks: 50

Exercise 1: Inorganic Qualitative analysis

(12 Laboratory sessions)

Semimicro qualitative analysis of inorganic salt mixture containing two acidic radicals and two basic radicals of same or different groups. At least six mixtures to be given. Analysis of basic radicals to be done by using spot test reagents. Following radicals to be given carbonate, nitrite, sulphite, sulphide, chloride, bromide, iodide, nitrate and sulphate, silver(I), lead(II), copper(II), bismuth(III), cadmium(II), tin(II), arsenic(III), antimony(III), iron(III), chromium(III), aluminium(III), nickel(II), cobalt(II), manganese(II), zinc(II), calcium(II), strontium(II), barium(II), magnesium(II).

Exercise II: Organic Preparations

(14 Laboratory sessions)

1. Preparation of acetanilide (Acetylation).
2. Preparation of Benzanilide (Benzoylation).
3. Preparation of m-di-Nitrobenzene (Nitration).
4. Preparation of tri-Bromoaniline from Aniline (Bromination).
5. Preparation of Benzoic acid from Benzamide (Hydrolysis).
6. Preparation of Benzoic acid from benzaldehyde (Oxidation).
7. Preparation of phenylazo – β – naphthol dye (Diazotisation).
8. Preparation of sulphanilic acid from aniline (Sulphonation). Organic Preparations Using Green Chemistry Concept
9. Acetylation of primary amine (Preparation of acetanilide).
10. Base catalysed Aldol Condensation (Synthesis of dibenzal propanone).

Note: a) Student should perform the single stage preparation with the help of given procedure. b) Melting point and percentage yield should be reported. c) The sample should be submitted. d) Students should recrystallize the sample with suitable solvent. e) Students should know the reaction and its mechanism of given single stage preparation.

Distribution of Marks for Practical Examination

Time: 6 hours (One Day Examination)

Marks: 50

Exercise-I 18

Exercise-II 18

Viva-Voce 07

Record 07 ————— Total: 50

CHEMISTRY SYLLABUS

B.Sc.I Sem -II

Total Lectures: 84

Marks: 80

Unit I (14L)

A] Polarisation-Definition, polarising power, polarizability, effect of polarization on nature of bond. Fajan's rules of polarisation and its applications. [4]

B] Covalent bonding-Directional nature of covalent bond. Hybridisation, types of hybridisation to explain geometries of NH_4^+ ion, PCl_5 , SF_6 and IF_7 . [4]

C] Acids and Bases-Theory of solvent systems and Lux-Flood concept of acids and bases. Hard and soft acids and bases. Pearsons HSAB or SHAB principle with important applications. [6]

Unit II (14L)

A] P-Block Elements-Comparative study of 16th and 17th group elements with reference to electronic configuration, ionization energy and oxidation states. Oxidising properties of halogens with reference to oxidation potential. Interhalogen compounds, structure and bondings. Introduction to fluorocarbons. [6]

B] Noble Gases-Inertness of noble gases. Compounds of noble gases only structure and bonding in XeF_2 , XeF_4 , XeF_6 , XeO_3 and XeO_4 [2]

C] Nonaqueous Solvents-Requirements of a good solvent. Water as an universal solvent. Physical properties of solvents namely liquid range, dielectric constant, dipole moment, heat of vaporisation and solubility behaviour. Classification of solvents. Acid base, precipitation, redox, solvolysis and complexation reactions in liquid ammonia. Merits and demerits of liquid ammonia as a solvent. [6]

Unit III (14L)

A] Alkyl Halides: Synthesis of vinyl chloride from acetylene and allyl chloride from propylene, Reactions of both with aqueous and alcoholic KOH, Comparison of reactivity of vinyl and allyl chloride. [4]

B] Aryl Halides: Synthesis chlorobenzene from benzene, phenol and benzene diazonium chloride, Synthesis of benzyl chloride from toluene and benzyl alcohol, Reactions of both with aqueous KOH, NH_3 and sodium ethoxide, Comparison of reactivity of chlorobenzene and benzyl chloride. Benzyne intermediate mechanism. [4]

C] Alcohols: Dihydric alcohols: Ethylene glycol- Preparation from ethylene, ethylene chloride and ethylene oxide, Reactions- with Na, PCl_5 , CH_3COOH , ZnCl_2 , conc. H_2SO_4 and dehydration with heat. Trihydric alcohols: Glycerol- Preparation from propylene, Reactions with Na, HCl, PCl_5 , HNO_3 and KHSO_4 . Pinacol- pinacolone rearrangement (mechanism). [6]

Unit IV (14L)

A] Phenols: Methods of formations a) from aniline b) from cumene. Acidic character, Reaction of Phenols- a) Carboxylation (Kolb's reaction), b) Fries Rearrangement, c) Claisen Rearrangement and d) Reimer – Tiemann reaction. [6]

B] Ethers: Diethyl ether- Preparation by Williamson's synthesis and continuous etherification process, Reactions-with cold and hot HI. [4]

C] Epoxides: Synthesis of ethylene oxide from ethylene and styrene oxide from styrene. Ring opening reactions of both catalysed by acid and alkali. [4]

Unit V - Physical Properties and Molecular Structure (14L)

A] Electrical Properties: (i) Polar and non-polar molecules. Dipole moment. (ii) Induced polarization and orientation polarization. Clausius-Mossotti equation (only qualitative treatment). (iii) Measurement of dipole moment by temperature and refractivity methods. (iv) Applications of dipole moment for the determination of molecular structure. i.e. percentage ionic character of covalent bonding, molecular geometry, cis-trans isomers, ortho, meta and para isomers of a disubstituted benzene. [7]

B] Magnetic Properties: (i) Paramagnetic and diamagnetic substances, origin of paramagnetism, diamagnetism, ferromagnetism and antiferromagnetism. (ii) Volume, specific, mass and molar susceptibility. Relationship between molar magnetic susceptibility and magnetic moment. (iii) Relationship between magnetic moment and number of unpaired electrons. (iv) Gouy's balance method for determination of magnetic susceptibility. (v) Application of magnetic moment in the determination of molecular structure. (vi) Numericals. [7]

Unit VI - Chemical Kinetics (14L)

Explanation of terms like rate of reaction, order of a reaction and molecularity. Definition with one example of zero, first and second order reaction. Half life period of a reaction. Derivation of rate equation for first and second order reaction with equal initial concentration and different initial concentration of a reactant. Characteristics of first and second order reaction. Examples of first and second order reaction and their kinetics study with modified rate equation viz. the reactions (i) decomposition of H_2O_2 , (ii) reaction between $\text{K}_2\text{S}_2\text{O}_8$ and KI, (iii) hydrolysis of methyl acetate catalyzed by acid, (iv) saponification of ethyl acetate by NaOH and (v) inversion of cane sugar. Determination of order of a reaction by integration, graphical, equifractional change, van Hoff's differential method and Ostwald's isolation method. Effect of temperature on reaction rates. Arrhenius equation, activation energy and its determination using Arrhenius equation. Numericals. [14]

Chemistry Practicals B.Sc. I Sem II

Total Laboratory Sessions: 26

Marks: 50

Exercise I: Organic Qualitative Analysis (16 Laboratory Sessions)

Complete analysis of simple organic compounds containing one or two functional groups and involving following steps:

- 1) Preliminary examinations
- 2) Detection of the elements
- 3) Detection of functional groups
- 4) Determination of m.p./ b.p.
- 5) Preparation of derivative and its m.p./ b.p.

6) Performance of spot test if any.

1) Acids : Oxalic acid, Benzoic acid, Salicylic acid, Phthalic acid.

2) Phenols : Resorcinol, α -naphthol, β -naphthol.

3) Aldehydes : Benzaldehyde, Glucose.

4) Bases : Aniline, p-Toluidine

5) Nitro compounds: m-Dinitrobenzene.

6) Amides : Benzamide, Urea, Acetamide.

7) Hydrocarbons: Naphthalene, Anthracene.

8) Halogen compounds : Chloroform, Chlorobenzene.

Exercise II: Physical Chemistry Experiments

(10 Laboratory Sessions)

1) To determine surface tension of a given unknown liquid by Stalagmometer (Density measurement is must).

2) To determine coefficient of viscosity of unknown liquid by Ostwald's viscometer (Density measurement is must).

3) To compare cleaning power of detergent samples by Stalagmometer.

4) To determine parachor value of $-\text{CH}_2-$ group by Stalagmometer.

5) To determine unknown percentage composition of given ethanol-water mixture by viscometer.

6) To determine activation energy of a reaction between $\text{K}_2\text{S}_2\text{O}_8$ and KI.

7) To determine heat of solution of KNO_3 .

Distribution of Marks for Practical Examination

Time: 6 hours (One Day Examination)

Marks: 50

Exercise-I 18

Exercise-II 18

Viva-Voce 07

Record 07 ————— Total: 50