

B.Sc.(Hons.) Part II

BCH-201 : Inorganic Chemistry

Marks : 50

1. **Acids and Bases** : Arrhenius, Brönsted-Lowry, Luxflood, Solvent System and Lewis concepts of acids and bases. Factors affecting strengths of Lewis acids and bases. 7
2. **Non-aqueous Solvents** : Physical properties of a solvent for functioning as an effective reaction medium. Types of solvents and their general characteristics. Reactions in liquid ammonia and liquid sulfur dioxide. 7
3. **Chemistry of p-block elements (Groups 15, 16, 17 and 18)** : Group trend in periodic properties, hydrides, oxides, oxyacids and halides. Structures of oxides and oxyacids of nitrogen, phosphorus, sulphur, selenium, tellurium and halogens. Chemistry of cyclophosphazines and tetrasulphur tetranitride. Basic properties of iodine, structure and bonding of interhalogens and polyhalides, compounds of xenon. 16
4. **Transition Metals** : Characteristic properties of 3d elements – ionic radii, oxidation states, complexation tendency, magnetic behaviour and electronic spectral properties. Spectrophotometric estimation of metal ions. 8
5. **Lanthanides** : Comparative study of lanthanide elements with respect to electronic configuration, atomic and ionic radii, oxidation state and complex formation. Lanthanide contraction. Occurrence and principles of separation of lanthanides. 8
6. **Coordination Compounds** : Werner's theory, nomenclature, chelates, stereo-chemistry of coordination numbers 4, 5 and 6. Various types of isomerism in coordination complexes. Important applications of coordination compounds. Theories of metal-ligand bonding in transition metal complexes- Sidgwick effective atomic number concept, valence bond theory of coordination compounds. 14

Books Recommended

1. "Concise Inorganic Chemistry", **J. D. Lee**, 5th Edition (1996), Chapman & Hall, London.
2. "Modern Inorganic Chemistry", **R. C. Aggarwal**, 1st Edition (1987), Kitab Mahal, Allahabad.
3. "Basic Inorganic Chemistry", **F. A. Cotton, G. Wilkinson, and Paul L. Gaus**, 3rd Edition (1995), John Wiley & Sons, New York.

BCH-202 : Organic Chemistry

Marks : 50

1. **Petroleum and Petrochemicals** : Origin of petroleum, composition, refining, reforming, fractionation, cracking, knocking. Octane number, Cetane number, kerosene, naphtha, LPG, synthetic petrol, petrochemicals. 5
2. **Benzene** : Structure, aromaticity, Huckel rule. 4
3. **Electrophilic Aromatic Substitutions** : Mechanisms of nitration, halogenation, sulphonation and Friedel-Crafts (alkylation and acylation) reactions. Effects of substituents on reactivity and orientation. 6
4. **Aryl Halogen Compounds** : Chlorobenzene, comparative reactivity of aryl, benzyl, vinyl and allyl halides. Side chain chlorination of toluene. DDT and BHC. Nucleophilic aromatic substitution in aryl halides. 5
5. **Aromatic Aldehydes and Ketones** : Preparation and important reactions of benzaldehyde and acetophenone. 4
6. **Carboxylic Acids and their Derivatives** : Carboxylic acids, general preparation and reactions. Comparative acidity of carboxylic and sulphonic acids. Benzoic, phthalic and cinnamic acid. General chemistry of acid chlorides, acid anhydrides, amides and esters 6
7. **Penols** : Phenol, catechol and resorcinol; general methods of preparation and reactions. Relative acidity of phenol, alcohol and carboxylic acid. Reimer-Tiemann and Kolbe reactions. 4
8. **Nitrogen Containing Compounds** : Nitrobenzene and its reduction products. Comparative basicity of aliphatic and aromatic amines. Hinsberg test for amines. Diazonium salts : preparation and synthetic applications. 8
9. **Carbohydrates** : Classification, characteristic reactions of aldoses and ketoses. Glucose-structure (including cyclic structure), mutarotation. Fructose (reactions only). 6
10. **Heterocyclic Compounds** : Synthesis and reactions, aromatic character of furan, pyrrole, thiophene and pyridine. 6
11. Problems based on chemical reactions and structure covering the above topics. 6

Books Recommended :

1. "Organic Chemistry", **R. T. Morrison and R. N. Boyd**, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
2. "Organic Chemistry", **S. M. Mukherji , S. P. Singh, and R. P. Kapoor**, 1st Edition (1985), 5th Reprint (1999), New Age International (P) Ltd. Publishers, New Delhi.
3. "Organic Chemistry – Structure and Reactivity", **Seyhan N. Ege**, AITBS publishers, Delhi (1998).
4. "Organic Chemistry", **Paula Y. Bruice**, 2nd Edition , Prentice-Hall International Inc, New Jersey, International Edition (1998).

BCH-203 : Physical Chemistry

Marks : 50

1. **Thermodynamics** : Limitation of First Law, spontaneous processes and Second Law of Thermodynamics, Carnot cycle, entropy, entropy changes in reversible and irreversible processes and of universe, physical concept of entropy, entropy changes of an ideal gas in different processes, entropy of an ideal gas, entropy changes in mixture of gases. Third Law of thermodynamics, variation of entropy with temperature, determination of absolute entropies of liquid and gases. The concept of residual entropy. Applications of Third Law.

Free energy and its concept, Gibbs and Helmholtz free energies and their relationship, variation of free energy with temperature and pressure. Maxwell's relations, Gibbs-Helmholtz equations, its application for the determination of ΔG , ΔH , ΔS of a reversible cell reaction. Criteria for reversible and irreversible processes based on entropy and free energy concept. Thermodynamics of phase transition-Claapeyron-Clausius equation and its applications. 15

2. **Phase Equilibria** : Phase rule, phase, component, degree of freedom, thermodynamic derivation of phase rule, phase diagrams of one component systems (water and sulfur), two component systems (phenol-water, lead-silver, tin-magnesium). The distribution law, applications to cases of dissociation and association of solutes in one of the phases, solvent extraction, equilibrium constant from distribution coefficient ($KI + I_2 = KI_3$). 10

3. **Electrochemical Cells** : Galvanic cells, reversible and irreversible cells, cell *emf* and its measurement.. Reactions in reversible cells, free energy and *emf* of reversible cell. Single electrode potential (Nernst equation), its measurement and sign convention. Standard electrode potential. *Emf* of reversible cell from electrode potentials. Types of reversible electrode, reference electrodes. Applications of *emf* measurements : determination of ionic activities, pH, potentiometric titrations (acid-base, redox, precipitation type reactions), equilibrium constant. Concentration cells with and without transference. Liquid junction potential and its elimination. Overvoltage, experimental determination of hydrogen overvoltage, application of overvoltage. Fuel cells (hydrogen-oxygen, hydrocarbon-oxygen), Commercial cells (primary and secondary cells), dry cell, acid and alkali storage cells. 15

4. **Surface and Colloids Chemistry** : Adsorption- Langmuir and Freundlich isotherms. Multi layer adsorption-BET equation (no derivation) and its application to surface area measurement. Sols (reversible and irreversible), emulsions and emulsifiers, association colloids (micelles), gels. Applications of colloids. 6

5. **Solid State** : Structural distinction between liquid and solid, crystalline state, crystal systems, crystal lattices, space lattice, unit cell, law of rational indices, Miller indices, crystals and x-rays (the Bragg's equation). 6

6. **Kinetics of Complex Reactions** : reversible (first order in both directions), concurrent, consecutive reactions. Unimolecular gas reactions (Lindmann theory), steady-state approximations, theory of absolute reaction rate and its thermodynamical formulation, temperature dependence of frequency factor, numerical problems. 8

Books Recommended

1. "Physical Chemistry", **P. C. Rakshit**, 5th Edition (1985), 4th Reprint (1997), Sarat Book House, Calcutta.
2. "Principles of Physical Chemistry", **B. R. Puri, L. R. Sharma, and M. S. Pathania**, 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
3. "Physical Chemistry", **K. J. Laidler and J. M. Meiser**, 3rd Edition, Houghton Mifflin Comp., New York, International Edition (1999).