B.Sc. (Hons.) Part I

BCH-101 : Inorganic Chemistry

Marks : 50

1. ***Atomic Structure*** : Idea of de Broglie matter waves. Heisenberg uncertainty principle. Schrödinger wave equation, significance of wave functions, Atomic orbitals. Quantum numbers. Aufbau and Paulis exclusion principles. Hund's multiplicity rule. Variation of orbital energies with atomic number and energy level diagram, electronic configuration of elements, effective nuclear charge and shielding; radial and angular wave functions and distribution curves, shape of s,p,d orbitals and their characteristics.10

2. ***Periodic Properties :*** Atomic and ionic radii, ionization energy, electrode potential (use of redox potential-reaction feasibility), electron affinity and electronegativity – definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour. 10

3. ***Chemical Bonding*** **:** (i) ***Ionic Bond*** – Types of ionic solids, radius ratio effect and coordination number, limitations of radius ratio, lattice defects, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability, Fajan's rules. 6

   (ii) ***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 such as NH_3, H_3O^+, SF_4, ClF_3 ICl_2^-, and H_2O by valence shell electron pair repulsion (VSEPR) theory, linear combination of atomic orbitals (LCAO), bonding, nonbonding and antibonding molecular orbitals. Applications of MO theory to explain the stability of homo and hetero dinuclear diatomic molecules, multi-centre bonding in electron-deficient molecules. 12

(iii) ***Bond Energy*** **:** Dissociation and average bond energies – determination, periodic trends and applications. Metallic Bond : Free electron, valence bond and band theories. Weak Interactions: Hydrogen Bond – experimental evidence, van der Waal's forces. 4

4. ***s-Block Elements*** **:** Hydride (classification, general methods of preparation and salient features), hydration energies, solvation and complexation tendencies of alkali and alkaline-earth metals, principle of metallurgical extraction, Chemistry of Li and Be, their anomalous behaviour and diagonal relationships, alkyls and aryls; role in biology. 8

5. ***p-Block Elements*** **:** Comparative study (group-wise) of group 13 & 14 elements with respect to periodic properties. Compounds such as hydrides, halides, oxides and oxyacids; diagonal relationship; preparation, properties, bonding and structure of diborane, borazine and alkalimetal borohydrides. Preparation, properties and technical applications of carbides and fluorocarbons. Silicones and structural principles of silicates. 10

Books Recommended

1. *"A New 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-102 : Organic Chemistry

Marks 50

1. ***Structure and Reactivity*** **:** Atomic orbitals, hybridization, orbital representation of methane, ethane, ethene, ethyne and benzene; polarity of bonds – inductive, resonance and steric effects and their influence on acidity and basicity of organic compounds. 6
2. ***Organic reaction mechanisms*** **:** Heterolytic and homolytic cleavage, nucleophiles, electrophiles and free-radicals; substitution, addition and elimination reactions; energy profile diagrams-transition states (general considerations). 5
3. ***Alkanes*** **:** Conformations of ethane and n-butane; mechanism of chlorination of methane. 3
4. ***Alkyl halides*** **:** Preparation and reactions, SN1 and SN2 mechanisms. Grignard reagents- preparation and synthetic applications. 5
5. ***Alkenes*** **:** E1 and E2 mechanisms, Elimination versus substitution reactions, Addition reactions (electrophilic and free radical), Hydration, hydroxylation, hydroboration, epoxidation and ozonolysis. 6
6. ***Dienes*** **:** Conjugated and isolated dienes, resonance stabilization, 1,2-versus 1,4-addition, Diels-Alder reaction. 3
7. ***Alkynes*** **:** Reduction, electrophilic addition, acidity and metal acetylides. 2
8. ***Alcohols*** **:** Comparative study of dehydration, oxidation, substitution and esterification of primary, secondary and tertiary alcohols. 4
9. ***Aldehydes and Ketones*** **:** Nucleophilic addition reactions, aldol condensation, Cannizzaro reaction, oxidation and reduction, Haloform reaction. 6
10. ***Aliphatic Caboxylic Acids*** **:** General preparattion and reactions of mono- and di-carboxylic acids. 3
11. ***Polymers and Polymerization*** **:** Elementary treatment - Alkene polymerization and condensation polymers – polyethylenes, nylons and terylene. 4
12. ***Active methylene compounds*** **:** Preparation and synthetic applications of ethyl acetoacetate and diethyl malonate, Tautomerism. 6
13. ***Stereochemistry*** **:** Fischer, saw-horse and Newman projection formulae. Chirality-optical activity, enantiomerism and diastereoisomerism involving one and two chiral centers, configuration, geometrical isomerism, D/L, R/S and E/Z nomenclatures. 7

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. Mukherjee, S. P. Singh, and R. P. Kapoor**, 1st Edition (1985), New Age International (P) Ltd. Publishers, New Delhi.
3. *"Organic Chemistry – Structure and Reactivity",* **Seyhan N. Ege**, 3rd Edition (1998), AITBS Publishers and Distributtors, Delhi.
4. *"Organic Chemistry",* **Paula Y. Bruice**, 2nd Edition, Prentice-Hall, Interrrnational Edition (1998).

BCH-103 : Physical Chemistry

Marks : 50

1. ***Gaseous State* :** Kinetic theory of gases, ideal gas laws and kinetic theory. Collision in a gas- mean free path, collision diameter, collision number. Behaviour of real gases - the van der Waal's equation, brief mention of other equations of state. Critical phenomena - critical constants of a gas and their determination, continuity of state, the van der Waals equation and critical state, Principle of corresponding states, liquefaction of gases. 8

2. ***Liquid State* :** Surface tension of liquids, capillary action, surface tension and temperature, interfacial tension, surface active agents, the Parachor and chemical constitution (atomic and structural parachors). Viscosity of liquids, experimental determination of viscosity coefficient, its variation with temperature.6

3. ***Thermodynamics* :** Introduction of different terms and processes in thermodynamics : [systems (isolated, closed, open) and surrounding, macroscopic properties (extensive and intensive), kinds of processes], First Law of thermodynamics and internal energy, state and state functions (exact differential), sign convention for heat and work, nature of work, path dependence of work and heat. Enthalpy, heat changes at constant volume and constant pressure, heat capacities (C_v , C_p) and relation between them for ideal gases.

   Reversible and irreversible processes, maximum work, thermodynamic quantities (w, q, ΔU, ΔH) for isothermal and adiabatic reversible expansion of ideal gases. Ideal gas law for adiabatic reversible expansion, comparison of adiabatic and isothermal reversible expasion. Joule-Thomson effect, Joule-Thomson coefficient in ideal and real (van der Waal) gases, inversion temperature.

   Change in internal energy (ΔU) and enthalpy (ΔH) of chemical reactions, relation between ΔU and ΔH, variation of heat of reaction with temperature (Kirchhoff's equation). 15

4. ***Electrochemistry* :** Arrhenius theory of electrolytic dissociation, classification of electrolytes; Hydrolysis of salts, hydrolysis constant, buffer solutions, indicators and theory of acid-base indicators.

   Migration of ions : transference number and its determination (Hittorf and Moving Boundary methods). Conductance of solutions, variation of molar conductance with concentration (Kohlrausch square root law), Kohlrausch law of independent migration of ions, ionic mobility, hydration of ions, application of conductance measurements (degree of dissociation of weak electrolytes, dissociation constant of weak acids, determination of solubility of sparingly soluble salts, degree of dissociation of water, conductometric titrations). 15

5. ***Chemical Kinetics* :** Order and molecularity of a chemical reaction, basic kinetic laws of first and second order reactions, analysis of kinetic data for the determination of the rate constant and order, effect of temperature on reaction rates (Arrheninus equation), collision theory of rates of bimolecular reactions. 6

6. ***Nuclear Chemistry* :** Isotopes : their separation and applications. Nuclear forces, nuclear binding energy, stability of nucleus, energy changes in nuclear reactions, Bethe notation, nuclear fission and fusion. Uses of nuclear radiations (radiation, sterilization, radiation energy for chemical synthesis). Radio isotopes as a source of electricity. 10

Books Recommended

1. *"Physical Chemistry",* **P. C. Rakshit,** 5th Edition (1988), 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).