

**SEMESTER - II**  
**SEMESTER-II: CHEMISTRY THEORY COURSE [C -201]**  
**6- Credits: 100 Marks**

**UNIT-1**

**1. Basics of ionic compounds**

**[6 Hours]**

Introduction, characteristics of ionic solids, Born Haber cycle and its application, Max Born equation, limiting radius ratio  
Relation between radius ratio, co-ordination number and crystal structure  
Derivation of  $r^+/r^-$  ratio in triangular, planar, square planar, body centered and tetrahedral crystal lattices. Defects in ionic crystals (stoichiometric and non-stoichiometric), study of N & P types of semi-conductors

**2. Basics of Co-ordination Chemistry**

**[6 Hours]**

Werner theory, types of ligands (simple ligands,  $\pi$ -acid ligands, according to number of donating electrons, chelating ligands) with definition and examples  
Co-ordination number and geometry related to co-ordination number.  
Isomerism and its classification (structural and stereo isomerism)  
Structural isomerism: (1) ionization and (2) hydration (3) co-ordination (4) co-ordination positions (5) polymerization and (6) linkage isomerism  
Geometric/cis-trans isomerism in  $ML_4$  and  $ML_6$  types of complexes

**UNIT-2**

**3. Chemistry of elements of 3d series**

**[6 Hours]**

Introduction, definition, electronic configuration, reversal of energies of 3d and 4s orbitals, physical properties such as atomic properties (atomic radii, ionic radii, and ionization potential), metallic conductivity, melting point & boiling point, density, reducing properties, tendency of formation of alloys, catalytic properties, magnetic and spectral properties. Calculation of spin only magnetic momentum of inner orbital and outer orbital complexes  $[NiCl_4]^{-2}$ ,  $[Ni(CN)_4]^{-2}$ ,  $[FeF_6]^{-4}$ ,  $[Fe(CN)_6]^{-4}$

**4. Solid State**

**[6 Hours]**

Forms of solids, unit cells, crystal systems, Bravais lattices  
Laws of crystallography: (1) Law of Symmetry, (2) Law of constancy of interfacial angles and (3) law of rational indices  
Miller and Weiss indices  
Bragg's law X-Ray diffraction methods: Rotating crystal method and Powder method  
Structures of NaCl and KCl  
Numericals

**UNIT-3**

**5. Cycloalkanes**

**[12 Hours]**

Introduction and classification of ring system (monocyclic and polycyclic, size, number of carbon atom common between the two rings)

IUPAC nomenclature of cycloalkanes (including simple spiro compounds, fused ring and bridged ring systems-bicyclic only)  
Method of preparation of small ring cycloalkanes: Intra-molecular Wurtz's reaction, Simmons-Smith, Diels-Alder reaction  
Chemical Properties of Cycloalkanes: Substitution Reactions, Addition Reactions, Baeyer's Strain Theory and its limitations (puckering)  
Conformations, conformational analysis, conformation of ethane, propane and butane

#### **UNIT-4**

##### **6. Aromatic Hydrocarbons**

**[12 Hours]**

Aromaticity: Criteria for (aromatic, non-aromatic and anti-aromatic), applications of Huckel's rule to simple annulene, cyclic carbocation/anion.  
Electrophilic aromatic substitution reactions of benzene with mechanisms, theory of effect of substituents on reactivity and orientation (with resonating structures for activating and deactivating groups)  
Electrophilic aromatic substitution reactions with mechanisms: Halogenation, nitration, sulphonation, Friedel-Crafts alkylation, Friedel-Crafts acylation

#### **UNIT-5**

##### **7. Ionic Equilibrium**

**[12 Hours]**

Types of electrolytes, degree of dissociation and factors affecting degree of dissociation  
Ionic product of water, dissociation constants of weak acids and bases  
Common ion effect and calculation of concentrations of OH<sup>-</sup> ions (NH<sub>4</sub>Cl+NH<sub>4</sub>OH) and H<sup>+</sup> ions (H<sub>2</sub>S+HCl),  
Solubility and solubility products of sparingly soluble salts  
Applications of solubility product principle (solubility, whether precipitate out, salt out, and inorganic qualitative analysis)  
Hydrolysis of salts: Definition of hydrolysis of salts, Salts of strong acids and bases.  
Relation among K<sub>h</sub>, K<sub>a</sub>, or K<sub>b</sub> and K<sub>w</sub>. Degree of hydrolysis and pH of the solution of salts of weak acids and strong bases, salts of weak bases and strong acids and salts of weak bases and weak acids.  
Buffer solutions: Definition and types of buffer solutions, Buffer action, Derivation of Henderson-Hassel Balch equation  
Numericals

#### **Reference Books:**

- UGC Inorganic Chemistry – Volume-II H. C. Khera ( Pragati Prakashan)
- Coordination Chemistry- Gurdeep Chatwal and M. S. Yadav
- Advanced Inorganic Chemistry by S. K. Agarwala & Keemti Lal (A Pragati Edition)
- Concise of Inorganic Chemistry - J. D. Lee
- Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli and Arun Bahl, S. Chand & Co. New Delhi

- Elements of Physical Chemistry, B. R. Puri, L. R. Sharma and Madan Pathania, Vishal Publishing Co. Jalandhar.
- Physical Chemistry, B. K. Sharma, Goel Publication House. Meerut.
- Organic Reaction Mechanism, including Reaction Intermediates, , V. K. Ahluwalia, Ane's Chemistry active series.
- Organic Chemistry, Vol-1, by Sultanat, Ane's Student Edition, Ane Book Pvt Ltd
- Undergraduate Organic Chemistry, Vol-1, Jagdamba Singh, L.D.S.Yadav, Pragati Prakashan, 8th edition-2013

## SEMESTER - II

### SEMESTER-II: CHEMISTRY PRACTICAL COURSE [C -202]

#### 3- Credits : 50 Marks

Note Practical Examination:

- Total Marks :50 Marks {35 Marks External & 15 Marks internal}
- Duration : 3½ hrs
- Two Exercises to be performed:
  - **Exercise – I:** Inorganic Qualitative analysis : 20 Marks (2 Hrs)
  - **Exercise – II:** Volumetric Analysis : 15 marks (1½ Hr)

#### Exercise-I: Qualitative Analysis of Inorganic Salts:

[20 Marks]

(Minimum 12 salts-containing two radicals)

Inorganic salts containing anion (chloride, bromide, iodide, nitrate, nitrite, sulphate, sulphite, sulphide, carbonate, phosphate (soluble & insoluble), oxide, chromate and dichromate)

#### Exercise-II: Inorganic volumetric analysis

[15 Marks]

(Standard solution should be given)

- Quantitative estimation of  $\text{Cu}^{2+}$  in a given  $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$  solution using 0.01M EDTA solution
- Quantitative estimation of  $\text{Ni}^{2+}$  in a given  $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$  solution using 0.01M EDTA solution
- Quantitative estimation of  $\text{Zn}^{2+}$  in a given  $\text{ZnCl}_2$  solution using 0.01M EDTA solution
- Quantitative estimation of  $\text{Fe}^{2+}$  by dichromate method (Internal indicator method)
- Determination of total hardness of water by EDTA
- Determination of acetic acid in a commercial vinegar using 0.1M NaOH solution
- Determination of alkali in antacid using 0.1M HCl solution
- Analysis of some industrial product based on volumetric analysis

## PAPER STYLE

### INSTRUCTIONS

- B. Sc. Chemistry Syllabus for Semester I & II consists of FIVE units
- All units carry equal weightage (14 Marks each)
- There must be one question from each unit
- Each subtopic must be given due weightage in question paper
- 70 Marks for Semester End Examination (External) & 30 marks for Internal Examinations
- Time duration: 2 ½ Hours

#### Question 1: Answer the following (UNIT-1)

**Total Marks: 14**

- Four objective questions each of one Mark :  $1 \times 4 = 4$
- Answer any one out two each of two Marks:  $1 \times 2 = 2$
- Answer any one out two each of three Marks:  $1 \times 3 = 3$
- Answer any one out two each of five Marks:  $1 \times 5 = 5$

#### Question 2: Answer the following (UNIT-2)

**Total Marks: 14**

- Four objective questions each of one Mark :  $1 \times 4 = 4$
- Answer any one out two each of two Marks:  $1 \times 2 = 2$
- Answer any one out two each of three Marks:  $1 \times 3 = 3$
- Answer any one out two each of five Marks:  $1 \times 5 = 5$

#### Question 3: Answer the following (UNIT-3)

**Total Marks: 14**

- Four objective questions each of one Mark :  $1 \times 4 = 4$
- Answer any one out two each of two Marks:  $1 \times 2 = 2$
- Answer any one out two each of three Marks:  $1 \times 3 = 3$
- Answer any one out two each of five Marks:  $1 \times 5 = 5$

#### Question 4: Answer the following (UNIT-4)

**Total Marks: 14**

- Four objective questions each of one Mark :  $1 \times 4 = 4$
- Answer any one out two each of two Marks:  $1 \times 2 = 2$
- Answer any one out two each of three Marks:  $1 \times 3 = 3$
- Answer any one out two each of five Marks:  $1 \times 5 = 5$

#### Question 5: Answer the following (UNIT-5)

**Total Marks: 14**

- Four objective questions each of one Mark :  $1 \times 4 = 4$
- Answer any one out two each of two Marks:  $1 \times 2 = 2$
- Answer any one out two each of three Marks:  $1 \times 3 = 3$
- Answer any one out two each of five Marks:  $1 \times 5 = 5$