

| Course Code | Course Name | Credits |
|-------------|----------------------|---------|
| 26CH003 | GENERAL CHEMISTRY-II | 04 |

Course Objectives

- In this course, students acquire knowledge of the fundamentals of chemical bonding, including covalent and ionic bonds, Valence Bond and Molecular Orbital theories, Fajan's rules, and VSEPR concepts.
- They gain understanding of organic reaction mechanisms, including substitution and elimination reactions, and the behavior of reaction intermediates.
- Students develop the ability to analyze ion transport, electrochemical cells, and thermodynamic principles to explain energy, work, and heat changes in chemical systems.

Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Understand covalent and ionic bonding, including Valence Bond theory, Fajan's rules, and the Born-Haber cycle.
- Apply Molecular Orbital theory, VB theory, and VSEPR to predict molecular structure and bonding.
- Analyze reaction intermediates and mechanisms of substitution and elimination reactions.
- Evaluate ion transport, electrochemistry, and thermodynamic principles in chemical systems.

Unit 1 - Covalent Bond (12 Hrs.)

Mode of formation; properties of covalent compounds; Valence Bond Theory; postulates of Pauling-Slater's theory; different types of overlapping; ionic bond – mode of formation; properties of ionic compounds; inert pair effect; Born-Haber cycle; polarisation of ions; factors affecting polarisation; importance of polarisation; Fajan's rules and applications.

Unit 2 – Molecular orbital theory (12 Hrs.)

Postulates; bonding and antibonding molecular orbitals; molecular orbitals from atomic orbitals; energy level diagrams; bond order; electronic configuration of heteronuclear diatomic molecules (CO, NO, HF); comparison of VB and MO methods; VSEPR theory and shapes of simple inorganic molecules (BeCl₂, SiCl₄, PCl₅, SF₆, IF₇, NH₃, XeF₆, BF₃, H₂O); VB theory and hybridization (BeCl₂); applications of MO theory to H₂, He₂, N₂, O₂, HF, and CO.

Unit 3 - Reaction intermediates (12 Hrs.)

Carbocation, carbanion, free radicals with examples; aliphatic nucleophilic substitution – SN₁, SN₂ and SN_i reactions; reactivity – effects of structure of substrate, attacking nucleophile, leaving group and reaction medium; competition between substitution and elimination; elimination reactions – mechanisms of E₁ and E₂; cis and trans eliminations; Hofmann and Saytzeff's rule.

Unit 4 – Electrochemistry, Ion transport and conductivity (12 Hrs.)

Molar conductance and its temperature dependence; Kohlrausch's law; mobility of ions and conductivity; transport number of ions and its determination; Debye-Hückel-Onsager equation; Stokes-Einstein relation; activity of ions; Debye-Hückel theory (elementary ideas) of strong electrolytes; ionic strength of solutions; electrochemical cells; measurement of EMF; electrode potential and sign convention; different types of electrodes; calomel electrode; Nernst equation; electrochemical potential and its measurement; equilibrium constants and activity coefficients from standard electrode potentials.

Unit 5 - Thermodynamics (12 Hrs.)

Laws of thermodynamics; generalities and Zeroth law; kinds of energy; scope of the first and second laws; thermodynamic terms and definitions; heat; work of expansion; work of compression; maximum and minimum work; reversible and irreversible transformations; first law of thermodynamics; energy changes in relation to system properties; isothermal and adiabatic changes; thermodynamic state functions; exact and inexact differentials; Joule-Thomson experiment; relation between E and H; Cp and Cv.

Reference Books:

1. Concise Inorganic Chemistry, J.D. Lee, UK, Black well science. (2006).
2. Inorganic Chemistry, Principles of Structure and Reactivity, J.E. Huheey, E.A. Keiter, R.L. Keiter, O.K. Medhi, Pearson Education. (2006).
3. Advanced Organic Chemistry, Bahl, Arun Bahl, Sultan Chand. (1996).
4. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma, M.S. Pathania, Shoban Lal Nagin Chand & Co., (23rd edition), New Delhi, (1993).
5. Text book of Physical Chemistry, P.L.Soni, D.B. Dharmarke, Sultan Chand & Sons.

Websites and eLearning Sources:

1. <https://nptel.ac.in/courses/104103856>
2. https://youtu.be/TYU_JluleME?si=qRxXVgGxnNlms9Ki

| COs and Bloom's Taxonomy Mapping – 26CH003 | | |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Course Outcomes | On completing U.G. program the students will be able to | BTL |
| CO1 | Recall and explain concepts of chemical bonding (covalent and ionic), Valence Bond and Molecular Orbital theories, VSEPR, reaction intermediates, electrochemistry, and thermodynamics. | K1, K2 |
| CO2 | Apply VB, MO, and VSEPR theories to predict molecular structure and bonding; use thermodynamic and electrochemical equations to solve numerical problems. | K3 |
| CO3 | Analyze reaction mechanisms (SN1, SN2, E1, E2), factors affecting reactivity, ionic transport, and electrochemical behavior of systems. | K4 |
| CO4 | Evaluate bonding models (VB vs MO), stability of intermediates, and electrochemical processes based on experimental and theoretical data. | K5 |
| CO5 | Design and propose solutions to chemical problems involving bonding, reaction mechanisms, electrochemical systems, and thermodynamic processes. | K6 |

BTL K1 and K2 – remembering and understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6- Create

| Relationship Matrix – 26CH003 | | | | | | | | | | | | | |
|-------------------------------|--------------------------|-----|-----|-----|-----|-----|------------------------------------|------|------|------|------|------|-------------------|
| Course Outcomes | Programme Outcomes (POs) | | | | | | Programme Specific Outcomes (PSOs) | | | | | | Mean Score of Cos |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | |
| CO1 | 3 | 2 | 2 | 1 | 1 | 1 | 3 | 2 | 2 | 1 | 1 | 1 | 1.75 |
| CO2 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 1.75 |
| CO3 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 3 | 3 | 2 | 2 | 1 | 2 |
| CO4 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 3 | 2 | 1 | 2.08 |
| CO5 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2.41 |
| Total | | | | | | | | | | | | | 1.9 |

Mean Score: 3- High, 2- Medium/Moderate, 1-Low

