Roll No. 2500101606

Total Pages : 04

003103

Dec. 2025

B.Tech. (First Semester)

Chemistry (CHU-141-V/BSC-102)

Time : 3 Hours] [*Maximum Marks : 75*

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other.

Part A

1. (a) What is a p-type semiconductor ? Name any *two* trivalent impurity atoms used to create a p-type semiconductor. **1.5**

   (b) State any *two* differences between London dispersion forces and dipole-dipole forces. **1.5**

   (c) What conditions must a molecule satisfy to be considered chiral ? **1.5**

   (d) S_N2 reactions occur with inversion of configuration. Justify. **1.5**

(e) Explain the difference between temporary hardness and permanent hardness. **1.5**

(f) Give the significance of the Gibbs free energy. **1.5**

(g) How many distinct ^1H NMR signals would you expect for 3-chlorobutane ? **1.5**

(h) Why is the Arrhenius definition insufficient for explaining acid-base reactions in non-aqueous solvents ? **1.5**

(i) Explain the method of cathodic protection for preventing corrosion. **1.5**

(j) Write the electrophiles in the Friedel-Craft nitration and sulphonation reactions. **1.5**

Part B

2. (a) Discuss the Nernst equation. Derive the equation for a general redox reaction and explain each term. Discuss at least three important applications of the Nernst equation in electrochemistry, including pH measurement and determination of ion concentration. **10**

(b) Discuss the Diels-Alder reaction with two examples. Explain the mechanism and stereochemistry of the reaction. **5**

3. (a) Define Electronegativity. Discuss the differences between Pauling's and Mulliken's scales of electronegativity. Explain, how electronegativity differences can be used to predict the type and polarity of chemical bonds ? **5**

(b) Derive the expression for the total energy and normalized wave function for the particle of mass (m) in 1 – D box with length L moving with potential $V(x) = 0$, $0 < x < L$, otherwise $V(x)$ is infinite. **10**

4. Explain the following terms : **15**

(i) Pi-molecular orbitals of butadiene

(ii) Potential Energy Surface (PES) diagram

(iii) Configurations and conformational isomer

(iv) Synthesis of paracetamol

(v) Methods of softening water

5. (a) Explain Fajan's rules for predicting the covalent character of ionic compounds. Give examples to illustrate each rule. 5

(b) Discuss the principle, selection rules and applications of vibrational spectroscopy. 10

6. (a) Explain the Ellingham diagram. Discuss, how it is constructed and interpreted ? Explain its applications in metallurgy for the extraction of metals and describe its limitations 10

(b) Explain, why real gases deviate from ideal behaviour. Write the van der Waals equation and discuss the effect of intermolecular forces and molecular volume on gas behaviour. Illustrate with examples. 5

7. Explain the following terms : 15

(i) Hyperchromic Shift and Bathochromic shift

(ii) Fluorescence and phosphorescence

(iii) Residual entropy

(iv) Role of doping on band structures.

(v) Enantiomers and diastereomers.

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