

ODD SEMESTER EXAMINATION, 2024 – 25

Ist yr (Ist Sem) B. Tech.

ENGINEERING CHEMISTRY

Duration: 3:00 hrs

Max Marks: 100

Note: - Attempt all questions. All Questions carry equal marks. In case of any ambiguity or missing data, the same may be assumed and state the assumption made in the answer.

Q 1.	<p>Answer any two parts of the following (10x2= 20)</p> <p>a) (i) On the basis of band theory, differentiate between insulator, conductor and semiconductor (5 marks)</p> <p>(ii) Outline the postulate of valence bond theory. Also give structure and hybridization of XeO₄. (5 marks)</p> <p>b) Draw the molecular orbital diagram of NO and CO molecule. Calculate bond order and predict its magnetic behavior. (10 marks)</p> <p>c) Discuss crystal field theory in tetrahedral complex. Explain why, [Ni(CN)₄]²⁻ diamagnetic, whereas [NiCl₄]²⁻ is paramagnetic. (10 marks)</p>
Q 2.	<p>Answer any two parts of the following. (10x2= 20)</p> <p>a) (i) Calculate the standard free energy change (ΔG°) of the reaction :</p> $\text{CO(g)} + \frac{1}{2} \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)} \quad \Delta H^\circ = -282.84 \text{ kJ}$ <p>The standard entropy of CO₂(g), CO(g) and O₂(g) are 213.8, 197.9 and 205.01 JK⁻¹mol⁻¹, respectively. (5 marks)</p> <p>(ii) Write a short note on Ellingham diagrams. (5 marks)</p> <p>b) Define Hess law and its limitation. The heats of combustion of C(s, graphite), H₂(g) and CH₄(g) at 298 K and 1 atm are respectively -393.50 kJ/mol, -285.83 kJ/mol and -890.36 kJ/mol. What is the enthalpy of formation for CH₄? (10 marks)</p> <p>c) Derive Nerst equation and give its significance. Consider a cell reaction:</p> $\text{Zn} / \text{Zn}^{2+} [0.01\text{M}] \text{Cu}^{2+} [0.001\text{M}] / \text{Cu}$ <p>Standard reduction potential of Zn²⁺ and Cu²⁺ are -0.76V and 0.34V respectively. Write half-cell reactions, complete cell reaction and calculate EMF of the cell. (10 marks)</p>
Q 3.	<p>Answer any two parts of the following. (10x2= 20)</p> <p>a) (i) Explain reverse osmosis method for the softening of hard water. (5 marks)</p> <p>(ii) Describe different type of coating methods for the prevention of corrosion. (5 marks)</p> <p>b) Discuss the principle of lime-soda treatment of hard water along with chemical reaction involved in removal of permanent hardness. Calculate the amount of lime and soda required for softening 10000 liters of water, using 20 ppm of sodium aluminates as coagulant. Impurities in water are as follows: Ca²⁺ = 160 ppm, Mg²⁺ = 96 ppm, CO₂ = 22 ppm and HCO₃⁻ = 111 ppm. (10 marks)</p> <p>c) Discuss factor effecting rate of corrosion. How corrosion can be prevented using cathodic protection corrosion. (10 marks)</p>
Q 4.	<p>Answer any two parts of the following. (10x2= 20)</p> <p>a) (i) Differentiate between chain-growth polymerization and step-growth polymerization (5 marks)</p> <p>(ii) Explain the stages involved in the production of biogas. Compare the impact of use of biogas on the environment. (5 marks)</p>

	<p>b) (i) Give the preparation, properties and application of PMMA and PET. (5 marks)</p> <p>(ii) What is conducting polymer. Discuss the method to increase the conductivity of conducting polymer. (5 marks)</p> <p>c) Discuss the working of bomb calorimeter along the correction in calculation of GCV. The following data were obtained when coal sample was tested in bomb calorimeter: Weight of coal burnt= 0.5 g Weight of water taken= 1500g, Water equivalent of bomb and calorimeter= 1000g, Rise in temperature= 2.4°C, Fuse wire correction= 18cal, Acid correction= 40cal, Cooling correction= 0.12°C. If the 10 % hydrogen is present in given coal, then calculate NCV and GCV of coal. (10 marks)</p>
Q 5.	<p>Answer any two parts of the following. (10x2= 20)</p> <p>a) (i) The spacing between lines in rotational spectra of HBr is 16.94 cm^{-1}. Calculate the bond length of the molecule (Mass of H= 1 and Mass of Br=80) (5 marks)</p> <p>(ii) One of the fundamental vibrational modes of H_2O occurs at 3652 cm^{-1}. What would be the frequency of the corresponding vibration for D_2O. (5 marks)</p> <p>b) What is the principle of NMR spectroscopy? Why is TMS used as an internal standard in NMR spectroscopy? A compound having molecular formula $\text{C}_4\text{H}_9\text{Br}$ gave the following signals in its ^1H NMR spectra:</p> <p style="text-align: center;">δ 1.04 (6H, d), δ 1.95 (1H, m), δ 3.33 (2H, d),</p> <p>Giving reasons assign the structures for the compound (10 marks)</p> <p>c) Write a short note on any two from the following</p> <ol style="list-style-type: none"> i. Electrophilic addition reaction ii. Nucleophilic substitution reaction iii. Synthesis of Asprin (10 marks)
