

**END SEMESTER ASSESSMENT (ESA) B TECH. I SEMESTER APRIL 2021**  
**UE20CY101 - ENGINEERING CHEMISTRY**

**Time: 3 hours****Answer All Questions****Max marks: 100**

1	a)	The rotational constant of ICl is $0.1142 \text{ cm}^{-1}$ . Calculate the reduced mass, moment of inertia and bond length of ICl molecule. (Given: Atomic masses of I = 126.9 amu and Cl = 34.9688 amu, Avagadro's number = $6.023 \times 10^{23}$ , Speed of light = $3 \times 10^{10} \text{ cm/s}$ , $\pi = 3.14$ , Planck's constant = $6.627 \times 10^{-34} \text{ Js}$ , 1 amu = $1.66 \times 10^{-27} \text{ kg}$ )	6
	b)	State Franck-Condon principle. With the help of suitable diagram, show the vibrational-electronic transition and corresponding spectrum if transition takes place from $v'' = 0$ to $v' = 2$ .	3
	c)	For a diatomic molecule showing anharmonic oscillations : i) Write the selection rule ii) Draw energy level diagram showing fundamental absorption, first and second overtones. iii) Define zero point energy.	5
	d)	i) How are nanomaterials classified based on their dimensions? Give an example for each of them. ii) Explain why melting point of nanoparticles is different from that of the bulk materials.	6
2	a)	Derive Gibb's phase rule using thermodynamic principles.	4
	b)	For a Pb-Ag system : (i) Why is reduced phase rule used? (ii) Draw a neat labeled phase diagram. (iii) Give the temperature and composition values at eutectic point.	5
	c)	For a cell represented by $\text{Fe}/\text{Fe}^{2+} (0.28 \text{ M}) // \text{Cl}^- (0.35 \text{ M}) / \text{Cl}_2 (1 \text{ atm}) / \text{Pt}$ i) Name the types of electrodes used in the above cell. ii) Write the half cell reactions taking place at anode and cathode iii) Calculate $E^\circ_{\text{cell}}$ and $E_{\text{cell}}$ at 298 K. [Given : $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44 \text{ V}$ , $E^\circ_{\text{Pt}/\text{Cl}_2/\text{Cl}^-} = 1.36 \text{ V}$ , $R = 8.314 \text{ J/K/mol}$ , $F = 96500 \text{ C/mol}$ ]	7
	d)	Discuss construction of a glass electrode. What is alkaline error? Mention any one advantage of a glass electrode.	4
3	a)	Define shelf life of a battery. Why do reserve batteries have a very long shelf life? Discuss the construction and working of Mg-AgCl reserve battery (with reactions).	6
	b)	Why do Lithium batteries have high electricity storage density? Calculate the electricity storage density ( $\text{amp hour kg}^{-1}$ ) of a Lithium battery which stores 2.08 g of Lithium. Total weight of the battery is 72.6 g. (Given : $F = 96500 \text{ C/mol}$ , gram atomic mass of Li is 7g)	4
	c)	i) Draw a neat labeled diagram of Direct $\text{CH}_3\text{OH} - \text{O}_2$ Polymer electrolyte membrane fuel cell and write the reactions taking place at anode and cathode. ii) Explain why the above fuel cell is operated between $60^\circ\text{C}$ and $90^\circ\text{C}$ ? iii) Calculate the efficiency of the $\text{H}_2 - \text{O}_2$ alkaline fuel cell if the cell voltage is 1.22 V, enthalpy of formation of water is $-285.3 \text{ kJ/mol}$ and $F = 96500 \text{ C/mol}$ .	8
	d)	What are supercapacitors? Give any two factors which affect the capacitance of a supercapacitor?	2

4	a)	Discuss the various steps involved in galvanisation. Mention one advantage and one disadvantage of galvanization .	6
	b)	Explain the impressed cathodic current method for corrosion protection. What is H <sub>2</sub> embrittlement?	5
	c)	With a suitable example explain differential aeration corrosion . Write the reactions taking place at anode and cathode.	5
	d)	Discuss the effect of the following on extent of corrosion: i) Anodic and Cathodic polarisation ii) Temperature	4
5	a)	Calculate the number average molecular weight and weight average molecular weight of a polymer which contains 10 molecules with molecular weight 3800, 20 molecules with molecular weight 4900 and 30 molecules with molecular weight 6300 molecular weight.	4
	b)	Write the reaction for synthesis of Kevlar. Why is Kevlar stronger than steel on an equal weight basis(give two reasons)? Give any one application of Kevlar.	6
	c)	Define conducting polymers. Draw the structure of any one conducting polymer and write the two structural features of a conducting polymer. Mention any two ways by which doping is done to get a conducting polymer.	6
	d)	What are biodegradable polymers? Give two examples. Explain the two steps involved in biodegradation of polymers.	4

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