

END SEMESTER ASSESSMENT (ESA) B. Tech. DECEMBER 2019

UE15CY 101 – ENGINEERING CHEMISTRY

Maximum Marks: 100

Duration: 3 HOURS

ANSWER ALL QUESTIONS

1.	a	For a rigid diatomic molecule: (i) Derive the expression for moment of Inertia. (ii) Draw the energy level diagram for a rigid rotor diatomic molecule upto $J=4$. (iii) Calculate the energy required (in cm^{-1}) for the molecule to move from $J=2$ to $J=3$ level if $B=10.89 \text{ cm}^{-1}$.	6
	b	For a CO molecule which behaves like a harmonic oscillator, the vibrational spectral line is observed at 2140 cm^{-1} . (i) What is the applicable selection rule? (ii) Calculate reduced mass and force constant. (iii) Calculate the energy of level with $v=3$ in cm^{-1} . (Given: $C=3 \times 10^{10} \text{ cm/sec}$, $\hbar=3.14$, $h=6.625 \times 10^{-34} \text{ Js}$, $N=6.02 \times 10^{23}$, $1 \text{ amu} = 1.66 \times 10^{-27} \text{ kg}$, molar mass of $C=12 \text{ g}$, $O=16 \text{ g}$).	6
	c	State Franck-Condon principle.	2
	d	Draw a neat labeled phase diagram of water system, clearly indicate the triple point and critical point. Calculate the degree of freedom at the triple point.	6
2.	a	State Gibb's phase rule. Explain the term phase and component with an example.	5
	b	Derive Nernst equation for single electrode potential.	5
	c	A lead electrode containing 0.18 M lead sulphate and copper electrode containing 0.32 M copper sulphate were coupled using salt bridge. Write the half cell reactions, overall cell reaction, calculate E_{Cell}^0 and E_{Cell} at 25°C . (Given: $E_{\text{Pb}^{2+}/\text{Pb}}^0 = -0.13 \text{ V}$; $E_{\text{Cu}^{2+}/\text{Cu}}^0 = 0.34 \text{ V}$)	5
	d	Derive an expression for electrode potential of glass electrode.	5
3.	a	Describe the construction and working of Zinc-air battery. Why Zinc-air battery has high energy density?	5
	b	Discuss the following battery characteristics. (i) Capacity (ii) Cycle life	4
	c	Define fuel cell. Give the construction & working of $\text{H}_2\text{-O}_2$ solid-oxide fuel cell. Calculate the potential of the cell if its efficiency is 81.25% . (Given the enthalpy of formation of water is -285.83 kJ/mole).	7
	d	Mark the regions in which the following energy storage devices appear in the Ragone plot. (i) Fuel cell (ii) Li-ion battery (iii) Supercapacitor	4
4.	a	Define corrosion. Explain the electrochemical theory of corrosion taking iron as an example.	6
	b	Discuss how the following factors affect corrosion: (i) Nature of the corrosion product (ii) Temperature	4
	c	Write a note on pitting corrosion.	4
	d	Explain the process of Galvanization, mention one advantage and disadvantage of galvanization.	6
5.	a	Distinguish between thermoplastic and thermosetting plastics.	6
	b	Give the synthesis and application of Plexiglass.	5
	c	Calculate the number average, weight average and viscosity average of a polymer having 10 molecules of molecular weight is 2000, 15 molecules of molecular weight is 2500 and 25 molecules of molecular weight is 3000. (Given $a=0.67$)	6
	d	Write any three principles of green chemistry.	3