



PES University, Bangalore
(Established under Karnataka Act 16 of 2013)

UE15CY101

END SEMESTER ASSESSMENT (ESA) B.Tech I SEMESTER- DECEMBER 2015

UE15CY101- ENGINEERING CHEMISTRY

Time: 3 Hrs		Answer All Questions	Max Marks: 100
1.	a)	Draw a neat labeled phase diagram of lead - silver system. Discuss its application in desilverisation of lead.	5
	b)	State Gibb's phase rule. Derive Gibb's phase rule for a system at equilibrium using principles of thermodynamics.	5
	c)	Explain why simple harmonic oscillator model cannot be used to describe the vibration of a real diatomic molecule. Give an expression for the allowed energy levels of Anharmonic oscillator. Draw the energy level diagram and show the transitions corresponding to fundamental absorption, first and second overtones.	6
	d)	Calculate the reduced mass and moment of inertia of HCl if the bond length is 1.27 \AA . Calculate the energy corresponding to $J=0$, $J=1$ and $J=3$ levels in cm^{-1} . (Given atomic masses of H & Cl are 1.008 and 35.45 respectively, $1 \text{ amu} = 1.66 \times 10^{-27} \text{ kg}$, $N=6.023 \times 10^{23} \text{ mol}^{-1}$, $h = 6.626 \times 10^{-34} \text{ J s}$, $c = 3 \times 10^8 \text{ m s}^{-1}$).	4
2.	a)	For a galvanic cell, $\text{Pt}/\text{Fe}_{(\text{aq})}^{2+}(0.5 \text{ M}), \text{Fe}_{(\text{aq})}^{3+}(0.48 \text{ M})//\text{Br}_{2(\text{aq})}(0.8 \text{ M}), \text{Br}_{(\text{aq})}^{-}(0.38 \text{ M})/\text{Pt}$. i) Write electrochemical reactions at anode and cathode. ii) Calculate E_{cell}^0 . iii) Calculate E_{cell} at 298 K. Given $E_{(\text{Fe}^{2+}/\text{Fe}^{3+})}^0 = 0.77 \text{ V}$, $E_{(\text{Br}_2/\text{Br}^-)}^0 = 1.07 \text{ V}$.	5
	b)	Calculate equilibrium constant of the reaction, $\text{Ni} + 2\text{Fe}^{3+} \rightleftharpoons \text{Ni}^{2+} + 2\text{Fe}^{2+}$ Comment on the spontaneity of the reaction. (Given: $E_{(\text{Ni}^{2+}/\text{Ni})}^0 = -0.25 \text{ V}$, $E_{(\text{Fe}^{2+}/\text{Fe}^{3+})}^0 = 0.77 \text{ V}$).	4
	c)	How is glass electrode constructed? Derive an expression for the potential of glass electrode. How do you determine pH of unknown solution using glass electrode? Give relevant electrode representation.	7
	d)	What is electrode concentration cell? Give an example. Calculate the potential of concentration cell given by, $\text{Fe}/\text{FeSO}_4(0.09 \text{ M})//\text{FeSO}_4(2.48 \text{ M})/\text{Fe}$ at 298 K.	4
3.	a)	With the help of neat diagram discuss the construction and working of zinc air battery. Account for the high energy density of zinc air battery.	5
	b)	Define following battery characteristics with relevant mathematical expressions and units for each. i. Capacity ii. Power density.	4
	c)	What is oxygen sensor? Explain the construction and working of oxygen sensor in automobiles with appropriate electrochemical reaction and Nernst equation.	6
	d)	In fuel cell based breath analyser, i. Describe the principle. ii. Name the electrolyte used. iii. Write the electrochemical reactions.	5

PTO

SRN

4.	a)	Calculate the charge in coulombs that would be required to deposit 20 g of silver from silver sulphate solution. If the potential drop across the cell is 3.0 volt, how much energy will be consumed? Atomic weight of silver=108. In the above electroplating bath if the article to be coated is of irregular shape, give any two ways in which throwing power of electroplating bath can be improved.	5
	b)	Explain the determination of nitrate content in water sample by colorimetric method.	5
	c)	An iron tank is partially filled with water. For the above situation: i. Identify the type of corrosion. ii. Identify the anode and cathode region. iii. Write the corrosion reaction at anode and cathode. iv. Suggest and explain in brief a corrosion control technique.	6
	d)	Discuss, how mild steel steam boiler undergoes caustic embrittlement? (Write appropriate chemical reactions).	4
5.	a)	Give the synthesis of following polymers. i. PMMA from acetone ii. Butyl rubber from isobutylene.	6
	b)	Explain the structure property relationships in following polymers. i. High crystallinity of Teflon. ii. Low tensile strength of natural rubber. iii. High chemical resistance of cured epoxy polymer.	6
	c)	How polyaniline is converted to conducting polyaniline? (Explain with relevant structures).	4
	d)	Give any four principles of green chemistry.	4