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PES University, Bangalore

(Established under Karnataka Act No. 16 of 2013)

UE16CY101

DEC 2016: END SEMESTER ASSESSMENT (ESA) B.TECH. I SEMESTER

UE16CY101- ENGINEERING CHEMISTRY

Time: 3 Hrs | Answer All Questions | Max Marks: 100

1.	a)	Derive Gibb's phase rule for an equilibrium system consisting of 'C' components distributed between 'P' phases.	4
	b)	The water system is a single component system. I. Draw a well labeled phase diagram of water system and identify the different areas, lines and points (triple point and critical point) in the phase diagram of water system. II. Mention the temperature and pressure corresponding to critical point. III. Mention the temperature and pressure below which sublimation of water takes place . IV. What do you understand by metastable equilibrium?	6
	c)	Derive an expression for the moment of inertia of a rigid diatomic molecule. Write an expression for the change in energy when a diatomic molecule possessing permanent dipole moment undergoes rotational transitions. The first spectral line in the rotational spectrum of **HBr molecule** appears at 17.19 cm^{-1}. Calculate the moment of inertia of HBr molecule . (Given: gram molar mass of H=1.0, Br=79.9 , π=3.14, h=6.627x10^{-34}Js, 1 amu=1.66x10^{-27} Kg, c=3x10^{10}cm/s, Avagadro's number=6.023x10^{23})	5
	d)	State Frank-Condon principle. Draw the energy level diagram and the spectrum showing electronic transitions when the upper electronic state of a diatomic molecule has the **same equilibrium inter-nuclear distance** as the lower electronic state. Explain the spectrum using Frank-Condon principle.	5
2.	a)	A galvanic cell is constructed using Ag/AgCl/Cl^- (0.1 M) and Pt/Sn^{4+}(0.01 M), Sn^{2+}(0.1 M) electrodes. (Given: $E^0_{Ag-AgCl} = 0.222\ V$, $E^0_{Sn^{4+}/Sn^{2+}} = 0.15\ V$, R=8.314 J/K/mol, F=96500C/mol) i. Write the representation for the above constructed cell. ii. Write half cell reactions and overall cell reaction. iii. **Derive Nernst equation** for the above cell reaction using thermodynamic principles. iv. Determine E^0_{cell} and E_{cell} at 298 K. v. Calculate the equilibrium constant for the above cell reaction.	10
	b)	The representation of an electrode concentration cell is given below; Pt / $Cl_{2(g)}$ (0.5 atm) / Cl^- (0.65 M) / $Cl_{2(g)}$ (*p* atm) / Pt i. Write the reactions taking place at anode and cathode in the above galvanic cell ii. Calculate the pressure '*p*' given E_{cell}= 0.011 V at 298 K and $E^0_{Cl2(g)/Cl^-} = 1.36\ V$.	4
	c)	What are ion selective electrodes ? Derive an expression for electrode potential of an ion selective electrode. . Explain how an ion selective electrode is used to determine ionic concentrations.	6
3.	a)	Answer the following for a Zinc – air battery. i. Draw a neat labeled diagram of Zn – air battery. ii. Write the reactions taking place during discharge of the battery. iii. Define energy density of a battery and calculate energy density of zinc - air battery in watt hour /kg if 5.6g of Zn is stored in the battery weighing 25.5g. Given; voltage of the given Zinc –air battery is 1.3 V and gram molar mass of zinc is 65.38 .	7
	b)	Give examples of batteries which possess the following battery characteristics and Justify your answer; (i) Long shelf life (ii) high voltage.	4

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	c)	Name an electrolyte used in solid oxide $H_2 - O_2$ fuel cell . Why is this fuel cell operated at a very high temperature ? Calculate the energy efficiency of the fuel cell if E^0_{cell} = 1.05 V, Enthalpy of formation of water = - 285.3 KJ/mol, F=96500 C/mol.	5
	d)	Mark the regions in which the following energy storage devices appear in the Ragone Plot : (i) Fuel cell (ii) Lithium –ion battery and (iii) Supercapacitor.	4
4.	a)	Discuss electrochemical theory of corrosion of iron metal undergoing corrosion in an environment containing oxygen. How is the amount of oxygen in a corrosive environment affect the corrosion process.	6
	b)	What is inorganic coating? Explain the process of phosphating. Give one application of the process.	4
	c)	Discuss the importance of complexing agent in electroplating process. Give an example of a complexing agent used in electroplating process.	4
	d)	Complete the following table for **decorative chromium plating :**	6

1. Electroplating bath composition	
2. Anode	
3. Cathode	
4. Application	
5. Two reasons for not using Chromium anodes	

5.	a)	Give a method of synthesis of plexiglass from acetone. Is plexiglass a thermoplastic or a thermosetting plastic? Justify.	5
	b)	What are the structural requirements for a polymer to be conducting? Write the structure of conducting polyaniline.	3
	c)	What are polymer composites? Give the synthesis of Carbon fiber from polyacrylonitrile (with reactions). Write one application of carbon fiber reinforced polymers.	6
	d)	With the help of a graph, explain how tensile strength varies with average molecular weight of a polymer. Calculate **weight average molecular weight** and **viscosity average molecular weight** of a polymer sample having the following distribution: 70 molecules of molecular mass 800, 100 molecules of molecular mass 2500 and 130 molecules of molecular mass 3500. (The Mark – Houwink co-efficient 'a' in the viscosity measurements = 0.65)	6