PES University, Bangalore
(Established under Karnataka Act No. 16 of 2013)

UE17CY101

END SEMESTER ASSESSMENT (ESA) B.Tech II SEMESTER MAY 2018

UE17CY101: ENGINEERING CHEMISTRY

Time: 3 Hrs	Answer All Questions	Max Marks: 100

1.	a)	Derive Gibbs phase rule from principles of thermodynamics.	4
	b)	Draw a labeled phase diagram of Pb-Ag silver system. Explain, how it is used in the purification of Argentiferrous lead ore.	6
	c)	Anharmonic oscillator model represents the vibration of diatomic molecule better than the simple harmonic oscillator model. Justify. Write an expression for vibrational energy of diatomic molecule behaving as anharmonic oscillator (in cm^{-1}). Calculate the frequency of fundamental absorption in terms of wave number. Calculate the spacing between two consecutive vibrational levels in CO (use concept of simple harmonic oscillator model). Given that the force constant of CO is 1902 N m^{-1}. Atomic mass of C=12, O=15.9994, N=6.023 x 10^{23} mol^{-1}, c = 3x 10^8 m s^{-1}	7
	d)	Draw the energy level diagram for ground and excited vibrational state of a molecule and show the electronic vibrational transition if the internuclear distance increases to a very small extent. Draw the spectrum arising out of it.	3
2.	a)	What is liquid junction potential (LJP)? State true or false and justify, Salt bridge eliminates LJP by allowing electrons to pass through it in a galvanic cell. Write the representation of a cell without LJP.	3
	b)	Following cell is formed during potentiometric titration of Fe^{2+} ions vs standard $K_2Cr_2O_7$ solution before equivalence point. Ag/AgCl/Cl⁻(0.1 N)//Fe^{2+}(0.8 M),Fe^{3+}(0.08 M)/Pt. For the above cell, i). What is the role of silver-silver electrode? ii).Write the reactions at anode and cathode. iii) Calculate standard cell potential. iv). Calculate cell potential at 298 K. Given: $E^0_{Fe3+,Fe2+}$ = 0.77 V, $E^0_{Ag/AgCl/Cl-}$ = 0.22 V.	6
	c)	Identify the type of galvanic cell given below and justify your answer. Pt/H_2(8 atm)/HCl(0.5 M)/H_2(2 atm)/Pt Calculate the potential of above cell at 298 K.	4
	d)	Glass electrode is a type of ion selective electrode. For the glass electrode, i).Write the equilibrium reaction responsible for origin of potential. ii). Give the electrode representation of glass electrode. iii). Derive an expression for the potential of glass electrode. iv). Glass electrode is coupled with saturated calomel electrode to measure unknown pH. The cell potentials measured are 0.215 V and 0.385 V in contact with a solution of pH = 7 and with solution of unknown pH respectively. Calculate the pH of unknown solution. Given: E_{SCE} = 0.244 V.	7

3.	a)	Calculate the energy density (in Wh/kg) and power density (in W/kg) of 20 kg lead acid battery which contains 5 kg anode material and discharges constant current for 10 hours. The voltage of the battery is 2 V. Given: Atomic mass of lead is 207.2, number of electrons transferred in the redox reaction is 2, F = 96500 C.	4
	b)	Lithium ion battery is safer than lithium battery. Justify For lithium ion battery, i). Give the construction of battery. ii). Write the anode and cathode reaction during charging of the battery. iii). What is the reason for high electricity storage density of lithium battery?	6
	c)	Draw a neat labeled diagram of alkaline fuel cell (AFC). Answer the following in alkaline fuel cell. i). Write the electrochemical reaction at anode and cathode. ii). Give one major disadvantage of AFC. III). Calculate the efficiency of AFC if the cell voltage is 1.23 V. Given: $H_2 + 1/2O_2 \longrightarrow H_2O$ $\Delta H^0 = -285.8$ kJ	7
	d)	What is Ragone plot? Draw ragone plot and locate capacitors, supercapacitors, batteries and fuel cells on it.	3

4.	a)	Discuss the following factors which affect the nature of deposition during electroplating. i). Current density, ii). pH How many grams of chlorine gas can be produced by electrolysis of NaCl by passing 20 ampere current for 30 minutes? Atomic mass of chlorine=35.5.	6
	b)	What is the effect of ratio of anode and cathode area on the rate of corrosion? In this context justify the following, Ruptured tin coating on iron is more dangerous than ruptured zinc coating on iron.	4
	c)	Describe the chemical conversion coating method used to protect aluminium articles from corrosion. In the above method, i). How sealing is done and what is the reaction taking place during sealing? ii). How colored aluminium articles are made?	6
	d)	When an iron article is exposed to acid medium in the absence of oxygen, Account for the following, i). Iron becomes brittle. ii). Corrosion control can be achieved by the addition of antimony oxide as an inhibitor.	4

5.	a)	Butyl rubber is an important synthetic rubber. i).Give the synthesis of butyl rubber from its monomers. ii).Why butyl rubber can be vulcanized? iii).Vulcanised butyl rubber has high mechanical strength. Give reason.	6
	b)	Write the structure and explain corresponding properties of following polymers. i). High mechanical strength of Kevlar. ii).High electrical conductance of conducting polyaniline.	6
	c)	Why molecular weight of polymer is expressed as average molecular weight. Calculate weight average and viscosity average molecular weight of a polymer which contains 10 molecules with molecular weight 2×10^3 and 20 molecules with molecular weight 5×10^2. Given: Exponent in Mark–Houwink equation a=0.7.	5
	d)	Explain briefly any three principles of green chemistry.	3