Name:

Enrolment No:

UPES
UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Program: B.Tech (APE-UP, APE-GAS, Chemical, Mechanical, CSF, OSS, OG, IOT&SC, Dev-Ops, Bigdata and AI (11 branches)

Course: Chemistry **Semester: II**
Course Code: CHEM 1011 **Time 03 hrs.**
No. of pages: 3 **Max. Marks: 100**

Instructions: 1. Write your enrollment number at the space provided on top of the question paper
2. Do not write anything on question paper except your enrollment number
3. Attempt all parts of a question at on place only
4. Internal choice is given in question No. 9 and 10

SECTION A

S. No.		Marks	CO
Q 1	Find the interplanar distance of a crystal of nanomaterial in which a series of planes produce first order reflection with an angle of 22.5° from a copper X-ray tube (wavelength is 1.539 A).	4	CO5
Q 2	Explain: a. Thermoplastic polymers b. Vulcanization	4	CO5
Q 3	Explain cathodic protection to prevent corrosion of iron.	4	CO3
Q 4	The enthalpies of combustion of carbon, hydrogen and sucrose ($C_{12}H_{22}O_{11}$) are -393.5, -286.2 and -5644.2 kj/mole respectively. Calculate the enthalpy of formation of sucrose.	4	CO1
Q 5	Calculate the molar conductance of NH_4OH if molar conductances of NaOH, NaCl and NH_4Cl are 248.61, 126.45 and 149.75 Sm^2mol^{-1} respectively.	4	CO3

SECTION B

Q 6 (i)	A sample of coal was analysed as follows: Exactly 3.2000 g was weighed in a silica crucible. After heating for one hour at 110°C, the residue weighed 2.9450 g. The crucible next was covered with a vented lid and strongly heated for exactly 7 minutes at 950±20°C. The residue weighed 2.5485 g. The crucible was then heated without cover, until a constant weight was obtained. The last residue was found to weigh 0.7685 g. Calculate the % results of the above analysis.	4	CO1
(ii)	6.8 mole of PCl_5 are produced at equilibrium by the interaction of 8.1 mole of PCl_3 and 9.3 mole of Cl_2 vapours at 444°C and 1.5 atm pressure. Calculate the equilibrium constant at this temperature of the reaction.	6	CO2

Q 7	0.40 g of $CaCO_3$ was dissolved in HCl and the solution was made upto 1 litre with distilled water. 100 ml of the above solution required 30 ml of EDTA solution on titration. 100 ml of a given hard water sample required 35 ml of same EDTA solution on titration. After boiling the same hard water sample, 100 ml of boiled water utilized 10 ml of EDTA solution. Calculate temporary, permanent and total hardness of water.	**10**	**CO4**
Q8 (i)	A first order reaction has a rate constant value of 4.5 X 10^3 sec^{-1} at 1^oC and an activation energy of 58 kJ mol^{-1}. Find out the temperature at which the rate constant would be 1 X 10^4 sec^{-1}	**6**	**CO2**
(ii)	Explain: a. Polydispersity index and its significance. b. Bakelite is thermally resistant	**4**	**CO5**
Q9	What do you understand by hardness of water? Explain hot and cold lime soda process to soften the hard water mentioning related equations. OR a. 10,000 litre of hard water was made soft with zeolite. The exhausted zeolite required a total amount of 80 litre of NaCl solution containing 150 gram/litre of sodium chloride for regeneration. Calculate the hardness of water. b. 400 ml of water sample on titration with N/25 H_2SO_4 using phenolphthalein as indicator, gave the end point when 15 ml of acid were run down. Another lot of 400 ml of the sample also required 15 ml of the acid to obtain methyl orange end point. What type of alkalinity is present in the sample and what is its magnitude?	**6 + 4**	**CO4**
	SECTION-C		
Q 10 (i)	a. A sample of water contains following impurities: $Mg(HCO_3)_2$ = 73 mg/L; $CaCl_2$ = 222 mg/L; $MgSO_4$ = 120 mg/L; $CaSO_4$ = 82 mg/L. Calculate the quantity of lime (74% pure) and soda (90% pure) needed for softening 50,000 L of water. (atomic wt. of Mg = 24; Ca = 40; S = 32; O = 16; Cl = 35.5; C = 12) b. Give an example of each of cation exchange resin and anion exchange resin. OR In what terms, hardness of water is represented and why? Explain zeolite process to soften the hard water with related equations.	**8 + 2** **10**	**CO4**
(ii)	For the given cell at 25°C $Cu(s)/ Cu^{2+}(aq)$ // $Ag^+(aq)/ Ag(s)$ a. Write down the half cell reactions b. Write complete cell reaction c. Calculate E^o_{cell}. d. Predict the spontaneity of the reaction. e. If the concentration of Cu^{2+} and Ag^+ in solution is 0.01M and 0.05 M respectively, calculate EMF of the cell.	**10**	**CO3**

	Given, $E^o(Cu^{2+}/Cu) = +0.34$ V and $E^o(Ag^+/Ag) = +0.80$ V OR a. Calculate the equilibrium constant for the reaction at 25°C Zn / Zn^{2+} (0.05M) // Ag^+ (0.01M) /Ag Given, $E^o(Zn/Zn^{2+}) = +0.76$ V and $E^o(Ag^+/Ag) = +0.80$ V b. Calculate the single electrode potential for copper metal in contact with 0.2M Cu^{+2} solution. $E^\circ(Cu^{2+}/Cu) = 0.34$V.	**6 + 4**	
Q 11(i)	The resistance of a 0.5N solution of an electrolyte occupying a volume between two platinum electrodes 1.56cm apart having an area of 5.8cm^2 is 36Ω. Calculate the equivalent conductance of the solution.	**6**	**CO3**
(ii)	Explain why? a. Bolt and nut are made of same metal. b. Pitting corrosion is much more prone to provoke an immense loss than uniform corrosion generally does?	**4**	**CO3**
(iii)	a. Discuss sol-gel method for the synthesis of nano material; give one advantage and one disadvantage of the process. b. Why is finely divided Ni preferred rather than Ni metal in catalytic processes?	**6 + 2**	**CO5**
(iv)	An alkene on reductive ozonolysis gives one mole of acetaldehyde and one mole of acetone. Deduce the structure and name of the alkene.	**2**	**CO1**

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SECTION A (All questions are compulsory) 5 x 4 = 20 Marks

S. No.		Marks	CO
Q 1	Calculate the activation energy for the reaction: $2N_2O_5$ (g) → $4NO_2$ (g) + O_2 (g) Given, $k_1 = 7.78 \times 10^{-7}$; $T_1 = 273K$; $k_2 = 3.46 \times 10^{-5}$; $T_2 = 298$ K	4	CO2
Q 2	**i)** What are the different factors which affect corrosion? **ii)** Why does corrosion occur in steel pipe connected to copper plumbing?	4	CO3
Q 3	A sample of 0.50 g of an organic compound was treated according to Kjeldahl's method. The ammonia evolved was absorbed in 50 ml of 0.5 M H_2SO_4. The residual acid required 60 mL of 0.5 M solution of NaOH for neutralisation. Find the percentage of nitrogen in the compound.	4	CO1
Q 4	Explain bulk polymerization with advantages.	4	CO5
Q 5	21 ml of standard hard water (containing 15g $CaCO_3$/liter) required 24 ml EDTA solution for end point. 100 ml of water sample required 18 ml EDTA solution while water sample after boiling required 12 ml EDTA solution. Calculate temporary hardness of water.	4	CO4

SECTION B (All questions are compulsory) 5 x 8 = 40 Marks

Q 6	**i)** The angle of diffraction 2θ for a first order nature was found to be 27° using X- rays of wavelength 2.29Å. Calculate the distance between two diffracted planes. **ii)** Write a short note on vulcanization of rubber.	4 + 4	CO5
Q 7	Explain about the following:	8	CO3

	i) Pitting corrosion **ii)** Cathodic protection		
Q 8	**i)** The Kp for the reaction $PCl_5 \leftrightarrow PCl_3 + Cl_2$ is 640 mm at 775 K. Calculate the percentage dissociation of PCl_5 at equilibrium pressure of 160 mm. At what pressure, will the dissociation be 50% ?. **ii)** Derive rate constant of 2^{nd} order reaction of type A + A → Products.	**4 +4**	**CO2**
Q 9	Describe softening of water by cold and hot lime-soda process. **OR** Describe the zeolite and ion exchange processes for softening of hard water.	**8**	**CO4**
Q 10	Draw and discuss conductometric curves for following titrations: **i)** CH_3COOH and NaOH **ii)** NH_4OH and CH_3COOH **OR** **i)** Define Kohlrausch law and give its applications. **ii)** Calculate the Λ^0 for acetic acid, given, Λ^0 (CH_3COONa), Λ^0 (NaCl), Λ^0 (HCl) is 91 S $cm^{-2}mol^{-1}$, 126 S $cm^{-2}mol^{-1}$, 426 S $cm^{-2}mol^{-1}$ respectively. Calculate the degree of dissociation of the acid given the molar conductivity of the acid at the given concentration is 16.5 S $cm^{-2}mol^{-1}$. Λ^0 (CH_3COOH) = ?	**8**	**CO3**
SECTION-C (All questions are compulsory)		**2 x 20 = 40 Marks**	
Q 11	**i)** 100 ml of a water sample consumes 7 ml ($\frac{N}{50}$) H_2SO_4 up to end point, using phenolphthalein as indicator but 100 ml of same water sample consumes 14 ml ($\frac{N}{50}$) H_2SO_4 up to the end point, using methyl orange as indicator. Determine the type of alkalinity and calculate the alkalinity of the water sample. **ii)** The hardness of 10000 liter of sample of water was completely removed by zeolite softener. The zeolite softener required 60 liter of NaCl solution containing 1.5 kg/liter of NaCl. Calculate the hardness of water solution. **iii)** Consider the reaction $2\ Ag^+ + Cd \leftrightarrow 2\ Ag + Cd^{+2}$. The standard reduction potential of $Ag^+|\ Ag$ and $Cd^{+2}|Cd$ are 0.80 and -0.40 volt respectively. a) Calculate the standard EMF. b) Will the total emf of the reaction be more positive and negative of Cd^{+2} is 0.01 M rather than 1 M. **iv)** How are polymers classified based on tacticity?	**6 + 4 + 6 + 4**	**CO3, CO4, CO5**
Q 12	**i)** Estimate different hardness present in hard water sample from the following data obtained in soap titration method, when 100 ml of water is titrated with soap solution:		

	a) Standard hard water (400 mg/L of $CaCO_3$) = 36.6 mL b) Total hardness = 18.6 mL soap solution c) Permanent hardness = 6.2 mL soap solution d) Lather factor= 0.6 mL soap solution. **ii)** Zn(s) | Zn^{2+}(0.01M) || Pb^{2+}(1.0M) | Pb(s) Given: $E^o_{Pb^{2+}/Pb}$ = -0.12V and $E^o_{Zn^{2+}/Zn}$ = -0.76V, Calculate E_{cell} of the cell. **iii)** Describe synthesis of nanomaterial by micro emulsion technique **iv)** Explain why is HCV greater than LCV. At what condition HCV = LCV. **OR** **i)** Calculate the amount of lime (84% pure) and soda (92% pure) required for treatment of 20,000 liters of water, which contains following impurities: Ca $(HCO_3)_2$ = 40.5 ppm; Mg $(HCO_3)_2$ = 36.5 ppm; $MgSO_4$ = 30.0 ppm; $CaSO_4$ = 34.0 ppm; $CaCl_2$ = 27.75 ppm NaCl = 10.0 ppm. (Atomic weight of Ca=40; Mg= 24; Cl=35.5; Na= 23) Also, calculate temporary and permanent hardness of water sample. **ii)** A particular cell when filled with 0.05 M solution of NaCl gave a resistance of 140 ohm at 20°C , while with 0.05 M solution of HCl gave a resistance of 75 ohm. Calculate the molar conductivity of HCl solution. Given conductivity of 0.05 M NaCl is 0.00141 S cm^{-1}. **iii)** Describe sol-gel method for of synthesis of nanomaterials. **iv)** 2.499 g of coal sample was taken in silica crucible and heated in oven maintained at 110°C for one hour. The weight after heating was 2.368 g. The same sample was analysed for volatile matter and weight obtained was 1.75 g the sample as further heated to get ash content 0.95 g. Calculate the percentage of moisture, volatile matter, ash and fixed carbon.	**6+4+5 + 5**	**CO4, CO3, CO5, CO1**