UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2021

Course: Physical Chemistry-I   **Semester: I**
Program: B.Sc. Chemistry   **Duration: 03 hrs.**
Course Code: CHEM 1004   **Max. Marks: 100**

Instructions: *1) All questions of **all sections** are compulsory*
2) The use of scientific calculator is allowed
*3) All questions of **Section A** are compulsory*
*4) In **Q 4 of Section B**, there is an internal choice, attempt **any one***
*5) In **Q 2, Section C**, there is an internal choice, attempt **any one***

	SECTION A	**(5Qx 4M = 20 Marks)**	
		Marks	**COs**
Q 1	Show the following planes in a cubic unit cells having the following Miller indices (hkl): A) 123 B) 222	2 x2 = 4	**CO1**
Q 2	Explain whether a gas would approach ideal gas behavior or deviate from it under the following conditions: A) It is compressed to a small volume at a constant temperature B) Temperature is raised keeping the volume constant	2 x 2 = 4	**CO2**
Q3	A) Define the term 'solubility product' B) The solubility of CaF_2 in water at 20^0C is 15.6 mg per dm^3 of solution. Calculate the solubility product of CaF_2	2 x 2 = 4	**CO3**
Q4	The viscosity of an oil is 0.05 N m^{-2} s and its density is 0.97 g cm^{-3} at 298 K. How long a given volume of the oil will take to flow through a viscometer if the same volume of water takes 90 s? Given η (H_2O) = 0.0009 N m^{-2} s and ρ (H_2O) = 1 g cm^{-3}	4	**CO1**
Q5	Explain why? a) a solution of Na_2CO_3 is alkaline b) a solution of $CH_3COO\ NH_4$ is neutral	2 x 2 = 4	**CO3**

	SECTION B (4Qx10M = 40 Marks)		
Q 1	A) Derive and explain Bragg's equation B) Explain why one should employ monochromatic X-rays in studying the reflections from the faces of the crystals? What would happen if instead polychromatic X-rays are employed?	6 + 4 = 10	**CO1**
Q2	Describe *Ostwald's Viscometer* method for the measurement of viscosity of a liquid.	10	**CO1**
Q3	A) Show that for the hydrolysis of cations $K_h = K_w / K_b$ Comment on the information you get from the above expression B) Calculate at 25^0C the hydrolysis constant and its degree of hydrolysis in 0.01 M solution of sodium acetate. Given that $K_a(HAc) = 1.8 \times 10^{-5}$ M	5 x 2 = 10	**CO3**
Q4	Define the law of corresponding states. Derive the reduced equation of state for van der Waals equation of state OR Following the Maxwell distribution of molecular speeds, derive the expression for: (i) root mean square speed (ii) most probable speed	10	**CO2**
	SECTION-C (2Qx 20M= 40 Marks)		
Q 1	A) Illustrate the titration of a strong monoprotic acid with a strong base with the help of an example and explain the titration curve B) Write a note on acid-base indicators	10 x 2 = 20	**CO3**
Q2	A) Discuss the crystal structure of sodium chloride B) Explain Clausius - Clapeyron equation and its application OR A) Give postulates of Kinetic theory of gases. Starting from the postulates of kinetic theory of gases, derive the kinetic gas equation $pV = mNu^2/3$ B) Calculate the values of molar heat capacities of a mono-, di- and tri-atomic molecules (both linear and non-linear)	10 x 2 = 20	**CO1**