B.Sc. in EEE, 1st Semester

Date: 8 April 2026 (Afternoon)
Time: 2:30 PM -4:30 PM

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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF NATURAL SCIENCES(NSc)

Final Examination Winter Semester, A. Y. 2024-2025
Course No.: Chem 4121 Time: 2 hours
Course Title: Engineering Chemistry Full Marks: 120

There are **4 (four)** questions, answer **all** of them. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

1	a)	Explain the formation of covalent bond with potential energy diagram.	7	CO1 PO1
	b)	Discuss the followings: (1) metallic bond (2) octet rule.	8	CO1 PO1
	c)	Discuss molecular orbital theory (MOT). Apply MOT, sketch the molecular orbital diagram of CO molecule and explain the followings: (1) bond order of CO molecule. (2) bond dissociation energy. (3) magnetic property. (4) stability of CO molecule.	15	CO2 PO1
2	a)	Describe the classification of liquid crystals.	7	CO1 PO1
	b)	Discuss the followings: (1) law of equilibrium. (2) characteristics of chemical equilibrium. (3) energy diagram of *sp* hybridization of carbon atom.	8	CO1 PO1
	c)	Derive an expression that shows the effect of temperature on the chemical equilibrium. If the degree of dissociation of PCl_5 is α, find out an expression for equilibrium constant *Kc* and *Kp* for the following reaction. $PCl_5\ (g) \rightleftharpoons PCl_3\ (g) + Cl_2\ (g)$. 2.0 moles of acetic acid and 3.0 moles of ethyl alcohol are allowed to come to equilibrium at 298K. If the equilibrium constant of the reaction at this temperature is 4.0, what is the equilibrium concentration of ethyl acetate?	15	CO2 PO1
3	a)	Describe the factors that affect the solubility.	7	CO1 PO1
	b)	Sketch the phase diagram of water system. Indicate the fusion, sublimation, vaporization curves with boiling and melting point. Mention the critical temperature and pressure in the diagram. Calculate the degree of freedom at the triple point.	8	CO2 PO1

c) Discuss Raoult's law for lowering of vapor pressure of a solvent due to addition of a non-volatile solute. 15 CO2 PO1

0.273 *m* aqueous solution of KCl has the of density of 1.011×10^3 g/L. Calculate the molarity of the solution.

4 a) Show that at constant pressure, $\Delta H = q_p$ 7 CO2 PO1

b) Explain the following terms: entropy, osmotic pressure, heat capacity and spontaneous process. 8 CO1 PO1

c) State and explain Hess's law. 15 CO2 PO1

The table below shows some values of standard enthalpy changes. Sketch the Born-Haber cycle and calculate the formation enthalpy of $MgF_2(s)$ using these values.

Name of enthalpy change	ΔH^o /kJ mol^{-1}
Sublimation of Mg	+150
Dissociation of F_2	+159
1st ionization energy of Mg	+735
2nd ionization energy of Mg	+1445
Electron affinity of F	–328
Lattice energy of MgF_2	–2957