B.Sc. in MPE, 1st Semester

Date: October 10, 2023
Time: 2:30PM – 4:00PM

(5)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Mid semester Examination
Course No.: Chem 4115
Course Title: Physical & Inorganic Chemistry

Winter Semester, A. Y. 2022-2023
Time: 1.5 hours
Full Marks: 75

There are 3 **(three)** 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)	Schrödinger equation is quite complex but can be represented in a simpler form $E\Psi = H\Psi$, where E is the energy and H is called Hamiltonian operator. Discuss the significance of Ψ and Ψ^2?	7	CO1, PO1)
	b)	Explain radial probability distribution curves for the 2s and 2p orbitals in a hydrogen atom.	8	(CO2, PO2)
	c)	Draw an energy level diagram that is valid for Be^{3+} ion and then find out the required wavelength (in nm) of the least energetic spectral line in the IR range for the Be^{3+} ion. (Given, $R_h = 10973731.6\ m^{-1}$).	10	(CO3, PO2)
2	a)	Describe how the Born-Haber Cycle can be used to identify the Lattice Energy of an ionic solid.	7	(CO1, PO1)
	b)	"Within any period, values of first ionization energy tend to increase with atomic number, except for small drops at the group IIIA and VIA elements." Explain using the elements of period II in the periodic table.	8`	CO2, PO2)
	c)	31.6 g of KNO_3 dissolves in 100 g of water at 20 °C. If the enthalpy change of this solution is $+26.3\ kJmol^{-1}$ then calculate the solubility of KNO_3 at 40 °C. On the basis of your result, investigate the impact of temperature on the solubility of KNO_3 in water.	10	(CO3, PO2)
3	a)	Discuss why the enthalpy change of neutralization is constant at $-57.1\ kJ\ mol^{-1}$ for a strong acid and a strong alkali but that for a weak acid and a strong alkali is less negative.	7	(CO1, PO1)
	b)	Derive the Kirchhoff Equation for explaining the effect of temperature on the enthalpy of reaction. Explain all the terms in the equation.	8	CO2, PO2)
.	c)	Illustrate the Hess's cycle for the following reaction, $2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(l)$. Calculate the enthalpy change of this reaction from the following data: $\Delta H^o_{f(NaHCO_3)} = -840.9\ kJmol^{-1}$, $\Delta H^o_{f(Na_2CO_3)} = -1130.7\ kJmol^{-1}$, $\Delta H^o_{f(CO_2)} = -393.5\ kJmol^{-1}$, $\Delta H^o_{f(H_2O)} = -286\ kJmol^{-1}$.	10	(CO3, PO2)