(2)

B. Sc. in EEE, 2nd Semester

17 May, 2023
Time: 10.00 AM -1.00 PM

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

Semester Final Examination
Course Number: Phy 4221
Course Title: Engineering Physics II

Summer Semester: 2021 - 2022
Full Marks: 150
Time: 3 Hours

Answer **All** questions. The symbols have their usual meanings. Marks of each question and the corresponding CO and PO are written in brackets.

Sec A

1.	(a)	Describe the term X-ray diffraction related to crystallography. Explain what information you get from X-ray diffraction of a crystal.	6	(CO1) (PO1, PO2)
	(b)	Deduce an expression relating the Miller indices and inter planar distance for orthorhombic crystal system.	14	(CO2) (PO1, PO2)
	(c)	Calculate the wavelength of X-rays that are diffracted 43.4 degree by copper crystal, whose lattice constant 'a' is 0.3615 nm. Separate determinations indicate that this diffraction peak for copper is the first order for d_{111}.	5	(CO3) (PO1, PO2)
2.	(a)	Define crystal defects? Explain briefly various types of defects that are observed in a solid	10	(CO1) (PO1, PO2)
	(b)	Explain Lisajous figures. Deduce the resultant motion for various values of the phase differences for the following two simple harmonic motions of same frequency ω but having different displacements in two perpendicular directions which act simultaneously on a particle: $x=p \sin(\omega t+\alpha)$, and $y = q \sin \omega t$.	15	(CO3) (PO1, PO2)
3.	(a)	Formulate the differential equations for the damped harmonic and forced oscillators.	6	(CO1) (PO1, PO2)
	(b)	Evaluate the differential equation for damped harmonic oscillator to obtain an expression for the displacement.	14	(CO2) (PO1, PO2)

(c) Two light springs of spring constants k_1 and k_2 and a block of mass m are in one-line AB on a smooth horizontal table such that one end of each spring is on rigid supports and the other end is free as shown in Fig. 1 below. The distance CD between the free ends of the springs is *60 cm*. If the block moves along AB with a velocity *60 cm/s* in between the springs, calculate the period of oscillation of the block. (k_1 = *1.8 N/m*, k_2 = *3.2 N/m*, m = *250 g*). 5 (CO3) (PO1, PO2)

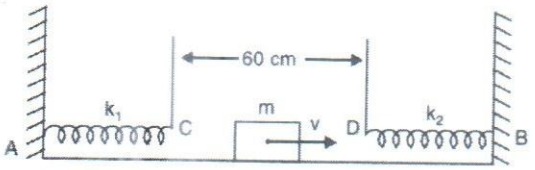

Fig. 1

Sec B

4. (a) Define Compton scattering. 5 (CO5) (PO1)

(b) Deduce an expression for the change in wavelength of a photon undergoing a Compton scattering. 12 (CO5) (PO1)

(c) Compare Compton scattering between x-rays ($\lambda \approx 25$ pm) and visible light ($\lambda \approx 600$ nm) at a particular angle of scattering. Find out also their (i) Compton shift and (ii) fractional wavelength shift. 8 (CO5) (PO1)

5. (a) Explain how the average life time of a radioactive substance depends on the decay constant. Describe the important applications of radioactive isotopes. 8 (CO6) (PO1)

(b) Explain with schematic diagram the binding energy per nucleon versus mass number curve. 10 (CO7) (PO1)

(c) Describe the characteristics of nuclear force. Define nuclear fission and fusion reactions. 7 (CO7) (PO1)

6. (a) Describe briefly different types of waves with appropriate examples. 8 (CO8) (PO1)

(b) Draw schematically the potential energy, kinetic energy, and mechanical energy as a function of time for a linear harmonic oscillator. At which position energy is all kinetic and at which position it is all potential? 8 (CO8) (PO1)

(c) Show that the average power of a wave depends on the square of its amplitude and also on the square of its angular frequency. 9 (CO8) (PO1)