

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF NATURAL SCIENCES

Mid Semester Examination
Course Number: PHY 4221
Course Title: Engineering Physics II

Summer Semester A.Y. 2022 - 2023
Full Marks: 75
Time: 1.5 Hours

Please answer according to the order of the questions. Answer all **3 (Three)** questions. Figures in the right margin indicate full marks of questions whereas corresponding CO and PO are written within parentheses.

- 1.a)** Describe damped harmonic oscillation. 5
How would a car bounce after a bump under each of these conditions? (CO1)
(a) overdamping (PO1)
(b) underdamping
(c) critical damping
- b)** Formulate the differential equations for the damped harmonic oscillators, hence find the solution for it to obtain an expression for the displacement of a particle in the case of light damping. 15
(CO2)
(PO2)
- c)** A sewing machine needle moves in a path of 4 cm with a frequency of its oscillations of 10 Hz. Calculate its displacement and acceleration 1/120 s after crossing the center of its path. 5
(CO3)
(PO2)
- 2.a)** Differentiate between primitive and non-primitive unit cells. Give examples for both. 5
(CO1)
(PO1)
- b)** Explain atomic packing factor (APF) and show that the value of the APF for fcc lattice is 0.74. 10+5
(CO2)
(PO2)
- c)** Aluminium (atomic weight 27) has a fcc structure. Its density is $2.7 \times 10^3 \text{ kg/m}^3$. Compute the unit cell dimensions and the atomic diameter. 5
(CO3)
(PO2)
- 3.a)** Define the term quality factor of an oscillator and show how it depends on the damping coefficient. 5
(CO1)
(PO1)
- b)** i. Two simple harmonic vibrations are moving right angles to each other with same frequency but different amplitude and phases. Compare their resultant trajectories when the phase differences are π and $\pi/2$ radians. 7.5+7.5
(CO2)
(PO2)
ii. Show that the relation between Miller indices and interplanar spacing for a cubic lattice system is given by,
$$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$$
- c)** In a tetragonal crystal, the lattice parameter $a = b = 2.5 \times 10^{-10} \text{ m}$, and $c = 1.5 \times 10^{-10} \text{ m}$. Determine the interplanar spacing between consecutive (101) planes. 5
(CO3)
(PO2)