(4)

B. Sc. Engg. (CEE)/1st Sem **09 October 2023 (Morning)**

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Mid Semester Examination
Course Code: PHY 4153
Course Title: Physics I

Winter Semester: 2022 - 2023
Full Marks: 75
Time: 1.5 Hours

There are **4 (Four)** questions. Answer 3 **(Three)** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Any other statements, if necessary.

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1. (a) What are Lissajous figures? Mention a few uses of them. **(05) (CO1) (PO1)**

   (b) Find the general equation of a particle in which two simple harmonic motions acting simultaneously at right angle to each other having frequency ratio 1:1. Hence, find the equation for a straight line and an ellipse. **(15) (CO2) (PO2)**

   (c) Two simple harmonic motions acting simultaneously on a particle are expressed by the equations: **(05) (CO3) (PO2)**

   $$y_1 = 3\sin(\omega t + \pi/6)$$
   $$y_2 = 5\sin(\omega t + \pi/3)$$

   Calculate (i) amplitude, (ii) phase constant, and (iii) time period of the resultant vibration.

2. (a) State free, damped and forced vibrations. **(05) (CO1) (PO1)**

   (b) Find the general solution of forced vibration. Discuss the resonant condition of it. **(15) (CO2) (PO2)**

   (c) A harmonic oscillator of quality factor 12 is subjected to a sinusoidal applied force of frequency one and half times the natural frequency of the oscillator. If the damping is small, obtain (i) the amplitude of the forced oscillation in terms of its maximum amplitude and (ii) the angle by which it will be out of phase with the driving force. **(05) (CO3) (PO2)**

3. (a) What do you understand by coherent waves? Write down the Huygens principle of wave propagation. **(05) (CO1) (PO1)**

   (b) Discuss the working principle of the Newton's rings experiment and also discuss how the radius of curvature of a plano-convex lens is measured by this experiment. **(15) (CO2) (PO2)**

   (c) A parallel beam of light of wavelength 589 nm is incident on a thin glass plate, whose refractive index is 1.5, such that the angle of refraction into the plate is 60°. Calculate the thickness of the glass plate for a first order dark fringe produced by reflected light. **(05) (CO3) (PO2)**

4. (a) Distinguish between Fresnel and Fraunhofer diffraction of light. (05) (CO1) (PO1)

(b) Derive the intensity expression for double-slit Fraunhofer diffraction of light and show that the intensity of light of central maximum of this double-slit is 4 times the intensity of central maximum of a single slit diffraction. Assume that the intensity for a single-slit diffraction is $I = I_o \frac{\sin^2 \beta}{\beta^2}$, where the symbols have their usual meaning. (15) (CO2) (PO2)

(c) Light of wavelength 500 nm passes through a slit of 0.2 mm wide. The diffraction pattern is formed on a screen 60 cm away. Determine the angular spread of central maximum. (05) (CO3) (PO2)