Course Title: Physics I   Course Code: PHY-101   Credit: 3.00
Time: 3.00 Hours   Full Marks: 150

*[N.B- The figures in the right margin indicate full marks. There are two sections in the question paper namely "**SECTION A**" and "**SECTION B**". Answer from both sections according to the instruction mentioned in each section.]*

SECTION A

There are **FOUR** questions. Answer any **THREE**   Marks

1. (a) Show that the differential equation of a progressive wave is $\dfrac{d^2 y}{dt^2} = v^2 \dfrac{d^2 y}{dx^2}$, where the symbols have their usual meanings.   **15**

   (b) Show that for a particle executing simple harmonic motion, the acceleration at any instant is $a = -\omega^2 y$, where the symbols have their usual meanings.   **10**

2. (a) What do you understand by interference of light waves?   **05**

   (b) Describe the necessary conditions for constructive and destructive interference by deriving the intensity equation $I = 4a^2 \cos^2 \dfrac{\delta}{2}$.   **20**

3. (a) Prove that the equation of Newton's formula for velocity of sound in gas is $V = \sqrt{\dfrac{P}{\rho}}$, where the symbols have their usual meanings.   **15**

   (b) Discuss the effect of temperature on the velocity of sound in gas.   **10**

4. (a) Derive the equation of Doppler effect when observer at rest and source in motion.   **15**

   (b) A motor car sounding a horn at a frequency of 100 hertz moves away from a stationary observer towards a rigid flat wall with a velocity of 36 km/hr. How many beats per second will be heard by the observer? [The velocity of sound in air at room temperature = 350 m/s]   **10**

[Turn over

SECTION B

There are **FOUR** questions. Answer any **THREE**   Marks

5. (a) Derive the necessary conditions under which elliptically and circularly polarized light   **15**
   are formed by deriving the general equation of ellipse, $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} - \dfrac{2xy}{ab}\cos\delta = \sin^2\delta$.

   (b) Show that at Brewster's angle the reflected and refracted rays are at right angles to   **10**
   each other.

6. (a) Prove the law of Malus, $I \propto \cos^2\theta$, where the symbols have their usual meanings.   **15**

   (b) Write short notes on half and quarter waveplate.   **10**

7. (a) Show that the moment of inertia of a uniform circular disc is $\frac{1}{2}MR^2$, where the symbols   **15**
   have their usual meanings.

   (b) Prove the perpendicular axes theorem for a plane lamina $I_Z = I_Y + I_X$, where the   **10**
   symbols have their usual meanings.

8. (a) Show that the moment of inertia of a uniform rod is $\frac{1}{12}ML^2$, where the symbols have   **15**
   their usual meanings.

   (b) Derive the following relations: angular momentum $L = I\omega$ and torque $\tau = I\alpha$, where   **10**
   the symbols have their usual meanings.