University of Asia Pacific  
Department of Basic Sciences and Humanities  
Final Examination, Spring - 2013  
Program: B.Sc Engineering (Civil)

Course Title: Physics I  
Course Code: PHY-101  
Credit: 3.00  
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

1. (a) Show that the differential equation of a progressive wave is \( \frac{d^2 y}{dt^2} = v^2 \frac{d^2 y}{dx^2} \), where the symbols have their usual meanings.  
   Marks: 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.  
   Marks: 10

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

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

3. (a) Prove that the equation of Newton’s formula for velocity of sound in gas is \( v = \sqrt{\frac{p}{\rho}} \), where the symbols have their usual meanings.  
   Marks: 15

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

4. (a) Derive the equation of Doppler effect when observer at rest and source in motion.  
   Marks: 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]
   Marks: 10

[Turn over]
SECTION B

There are FOUR questions. Answer any THREE

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

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

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

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

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

(b) Prove the perpendicular axes theorem for a plane lamina \( I_z = I_y + I_x \), where the 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 their usual meanings.

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