The Open University of Sri Lanka
B.Sc. Degree Programme – Level 3
Department of Physics
Waves in Physics - PYU 1162 / PYE 3162
Open Book Test – II: 2009/2010
Duration: 1½ hrs.

Date: 03-05-2010   Time: 04.00 p.m. to 05.30 p.m.

Useful physical constants

Speed of sound in air = 340 m s^{-1}

Speed of electromagnetic waves = 3 × 10^8 m s^{-1}

Permittivity of free space, ε_0 = 8.85 × 10^{-12} F m^{-1}

Permeability of free space, μ_0 = 4π × 10^{-7} H m^{-1}

Answer all Questions

1. (a) Establish an equation to find your distance (in kilometers) from a lightening flash.

   (b) You are at a large cricket stadium and watching a cricket match. The commentary is being broadcast live through a single powerful speaker fixed at 300 m away from you. Another person at 4,000 km away from the stadium listens to the same commentary which is being broadcast live through a satellite. The satellite is directly above the listener at an altitude of 36,000 km. Who hears the commentary first and by what time difference?

   (c) Two speakers separated by 5 m are driven by the same source which is generating sound at 680 Hz. Initially, you are at one of the speakers, and then start moving along a line perpendicular to the line joining the speakers. At what distance you will detect (i) the first maximum intensity and (ii) the first minimum intensity?

   (30 marks)

2. (a) Explain briefly the Doppler Effect in sound.

   (b) Derive a general expression for the observed frequency, f_o, when a source emitting a sound at frequency, f_s, is moving with a velocity v_s and an observer hearing that sound is moving with a velocity, v_o.

(c) Two trains on separate tracks approach each other, with train A has a speed of 90 km h^{-1} and train B has a speed of 126 km h^{-1}. Train A blows its horn at a frequency of 500 Hz. What is the frequency heard by the driver of the train B?

(d) State the applications of Doppler Effect.

(35 marks)

3. (a) Does a wire connected to a battery emit electromagnetic waves? Explain briefly.

(b) Prove that the intensity, I, of an electromagnetic wave can be given by the expression,
$I = \dfrac{1}{2}\varepsilon_0 cE^2$.

(c) A FM radio station broadcasts on a frequency of 101 MHz with a power of 50,000 W.

   (i)   What is the wavelength of the radio waves produced by this station?

   (ii) Estimate the average intensity of the wave at a distance of 30 km from the transmitting antenna. Assume that the antenna radiates equally on all directions.

   (iii) Estimate the amplitude of the electric field at this distance.

(35 marks)

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