92

RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B. Sc. (General) Degree
First Year - Semester II Examination – March / April 2013

PHY 1102 - WAVES AND VIBRATIONS

Answer <u>two</u> questions <u>including the first question.</u> **Time: 1 hour**

Use of a non-programmable calculator is permitted.

1. (a) Derive the equation of motion for a Simple Harmonic Oscillator. [10 marks]

(b) A 3 kg mass attached to a spring undergoes Simple Harmonic Motion (SHM) on a frictionless horizontal surface with the period of motion of 4.5 s. If the mass was originally pulled back 12 cm from the equilibrium position and released, find the following.

(i) Total mechanical energy of the system. [05 marks]
(ii) The maximum velocity of the mass. [10 marks]
(iii) The position of the mass when half of the mechanical energy is in the form of "potential energy". [10 marks]

(c) Write down the equation of motion for a Damped Harmonic Oscillator. [05 marks]

(d) A damped harmonic oscillator consists of a block (m = 3.93 kg), a spring (k = 11.4 N/m), and a damping force (F = -**b**v; where **b** is the damping constant and v is the velocity of the block). Initially, it oscillates with an amplitude of 24.3 cm. Because of the damping, the amplitude falls to 0.716 of the initial value at the completion of 4 oscillations. Calculate the value of **b**.

[10 marks]

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2. (a) What are "Lissajous figures"? [05 marks]

(b) A particle is subjected to two simple harmonic vibrations in directions at right angles to one another given by;

$y = \sin(2\omega t - \delta)$
$x = \sin(2\omega t)$

Use a graphical method to construct the Lissajous figures for the following two cases. [40 marks]

(i) $\delta = 135°$ (ii) $\delta = 225°$

(c) Briefly comment on these two Lissajous figures. [05 marks]

3. Write short notes on the following.

(i) Redshift in astronomy. [12 marks]

(ii) Amplitude-Phase diagrams. [12 marks]

(iii) Formation of standing waves. [14 marks]

(iv) Kundt's tube experiment. [12 marks]

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