Uva Wellassa University, Sri Lanka
End Semester Examination – December 2009
SCT 251-2 Physics II

Time: Two (02) hours

Total 05 Questions
Answer **four (04)** questions only

01) A mass m rest on a frictionless horizontal table and is connected to rigid supports via two identical springs each of relaxed length l_0 and spring constant k (Figure 01). Each spring is stretched to a length l considerably greater than to l_0. Horizontal displacements of m from its equilibrium position are labeled x and y.

I. Write down the differential equation of motion governing small oscillations in the x direction.

(05 marks)

II. Write down the differential equation of motion governing small oscillations in the y direction (assume $y <<< l$).

(05 marks)

III. In terms of l and l_0 calculate the ratio of the period of oscillation along x and y.

(05 marks)

IV. If at $t = 0$ the mass m is released from the point $x = y = A_0$ with zero velocity, what are its x and y coordinates at any later time t?

(05 marks)

V. Draw picture of the resulting path of m under the conditions of part (IV) if $l = 9l_0/5$.

(05 marks)

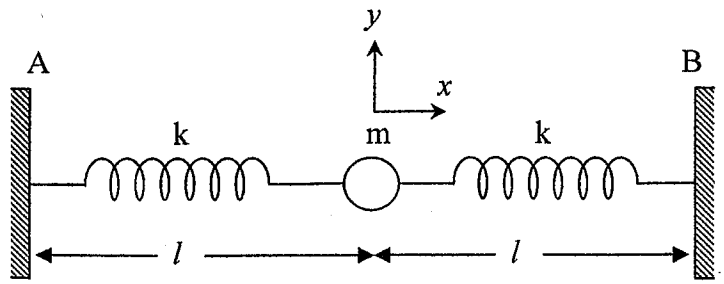

Figure 01

02) I. Obtain expressions for the displacement and the velocity of a mass executing forced oscillations as a function of frequency of the applied force under the linear damping and the restoring force, assuming steady state condition has been reached.

(15 marks)

II. Explain the amplitude resonance and the velocity resonance, and describe the difference between them.

(10 marks)

03) I. Describe the arrangement you would use to show the interference of light from two similar small sources and point out the conditions that are essential to the success of the experiment.

(05 marks)

II. Derive the formula relating the fringe width with the wavelength of the light and the constants of the apparatus in a Young's double slit experiment.

(15 marks)

III. In a Young's double slit experiment two narrow slits were 0.5 mm apart and the fringes were observed in a plane 100 cm from the plane of the slits. It was found that the distance from the first to the eleventh bright fringe was 9.72 mm. Calculate the wavelength of the light used.

(05 marks)

04) I. Explain clearly the following given below

(a) Superposition theorem
(b) Huygen's principle
(c) The phenomenon of interference
(d) Fraunhofer diffraction and Fresnel's diffraction
(e) Coherent sources

(3×5 marks)

II. A particle is simultaneously subjected to three simple harmonic motions, all of the same frequency and the x direction. If the amplitudes are 0.25, 0.30 and 0.15 mm, respectively and the phase difference between the first and second is 60^0 and between the second and third 30^0, find the amplitude of the resultant displacement and its phase relative to the first (0.25 mm amplitude) component.

(10 marks)

05) I. Convex surface with radius R forms an interface between two materials with different indexes of refraction μ_1 and μ_2. Consider a point object lying on the principle axis in the medium of refractive index μ_1 at a distance u, forms an image at a distance v in the denser medium. Derive following Gaussian relation for the surface.

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

(05 marks)

II. State the sign convention system you used.

(05 marks)

III. Each face of a double convex lens has radius of curvature R. The lens has index of refraction μ. The two faces are in contact with different substances with indices of μ_1 and μ_2. Show that an object must be placed at distance

$$s = \frac{R(\mu_1 + \mu_2)}{2\mu - (\mu_1 + \mu_2)}$$

from the lens in the first medium with index of refraction μ_1 to form an image the same distance from the lens in the second medium with the index of refraction μ_2. Find the magnification of the image.

(15 marks)

27