Exam.Code:0905
Sub. Code: 6644

2072

B.E. (Bio-Technology) First Semester

APH-101: Oscillations and Optics

(Common with IT and CSE)

Time allowed: 3 Hours

Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Part.*

x-x-x

Question 1: Attempt any five of the following:- (5x2)

(a) Show that the rate of loss of energy of a damped oscillator is equal to the rate of work done against the resistive force.

(b) What do you understand by power resonance in a forced LCR oscillator? Discuss one example in electrical devices where concept of resonance is used.

(c) A double-slit interference experiment is carried out with monochromatic light in air. What will the effect on the position of central maxima and its width if whole apparatus is immersed in water?

(d) Why is the diffraction of sound waves more evident in daily experience than that of the light waves?

(e) What is the difference between normal excited state and a metastable state? Explain the importance of metastable state in lasing action.

(f) Two Nicol prisms are aligned to have maximum intensity for the transmitted light. Through what angle should one of the prims to be rotated to reduce the intensity to half of its maximum value?

(g) For a step-indexed fiber, refractive indices of core and cladding are 1.5 and 1.477 respectively. Calculate acceptance angle and numerical aperture.

Part-A

Question 2

(a) The displacement of a particle executing SHM is given by $x = A\cos(\omega t)$. Find the displacement at which kinetic energy of the particle is equal to its potential energy. 3

(b) A simple pendulum has a time period of 1 second and an amplitude 500 mm. After 100 complete oscillations, its amplitude reduces to 50 mm. Calculate the quality factor and the relaxation time. 4

(c) In a forced LCR circuit, find the frequency for which potential drop across capacitor is maximum. 3

Question 3

(a) An Inductor 'L' is connected in series with Capacitor 'C' which is fully charged with charge 'q'. Assuming zero internal resistance, derive equation of motion for system and discuss variation of current with time. What is the phase relation between charge and current in this oscillating system? 3

(b) In a damped LCR oscillators, if the value of capacitance is increased what will be the effect on relaxation time and quality factor? 2

(c) Derive formula for the average power dissipated in a forced LCR circuit and discuss its variation with the frequency of driving force. 5

Question 4

(a) What is the magnetostrictive effect? Explain how can it be used for generation of ultrasonic waves? 3

(b) Derive wave equation and its solution for 1-dimensional transverse string wave. Discuss the variation of wave velocity with the time and medium properties. 4

(c) Two strings of linear densities 0.5 gm^{-1} and 2 gm^{-1} are joined together with a tension of 50 N. Calculate the coefficient of reflection and transmission of amplitude. 3

P.T.O.

Part B

Question 5

(a) What do you understand by coherent sources? Explain methods for achieving coherent sources with Division by Wavefront and Amplitude (two example for each). 5

(b) Derive mathematical theory for a hologram formation. What are the applications of holography? 3

(c) Define numerical aperture and formulate it in terms of refractive indices of core and cladding. Give its physical significance as well. 2

Question 6

(a) What is Rayleigh criterion of resolution? Derive expression for the resolving power of Diffraction grating. 4

(b) Describe construction and working of a He-Ne laser. What are its advantages over the Solid-state laser? 4

(c) What do you understand by extrinsic and intrinsic sensors with fiber? How can fiber be used in designing a displacement sensor? 2

Question 7

(a) A thin sheet of glass (with refractive index 1.65) is placed on one of the slits of the Young's double slit experiment. The central maxima shifts its position to that originally occupied by 10th fringe. Calculate the thickness of sheet, assuming wavelength of light to be 550 nm. 3

(b) For a slit of width 0.2 mm, in an arrangement of single-slit Fraunhofer diffraction, first minima is observed at 5 mm at either side of central maxima. If the distance between lens and screen is 2 m, calculate wavelength of used light. 3

(c) What is wire grid polarizer? Explain its working in producing polarizer and also explain its limitation in usage for the polarization of visible light. 4

x-x-x