

Exam.Code:0905
Sub. Code: 6644

1108
B.E. (Biotechnology)
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. 1 which is compulsory and selecting two questions from each Part.

x-x-x

Question 1: Attempt any five!

10

- What is the heavy damping? What are its applications in mechanical instruments?
- Why the radiations in case of stimulated emissions are coherent in contrary to the spontaneous emissions?
- How does the interference pattern by reflection in thin films differ from that by refraction? What is the reason of differences in two patterns?
- At what displacement from the mean position, kinetic energy is half of its maximum value? Explain!
- Effect of polarization is only possible with the transverse waves. Explain!
- What is the pulse dispersion in an optical fibre? How it can be reduced?
- If wavelength of the incident light is halved in a n-slit diffraction experiment, what will be the effect on the highest order of principal maxima?

Part A

Question 2

- Derive and explain various methods for quantitative measurement of the damping effect in a damped oscillator. 4
- Verify if the discharge of a capacitor of $1 \mu\text{F}$ through a resistor of 400 ohms and inductor of 0.1 H is oscillatory or not. 3
- What is piezoelectric effect? Explain the principle and working of an experiment to measure speed of ultrasonic waves in a liquid. 3

Question 3

- Derive formula for the average power dissipated by the damping force in a forced oscillator. Show that it is equal to the average power supplied by the driving force. 5
- Show that the band width of the resonance absorption curve defines the phase angle range $\tan \phi = \pm 1$. 3
- Two particles undergoing SHM have the same frequency and amplitude but differ in phase by 90° . At what time these will have same displacement? 2

Question 4

- Derive and explain the characteristic impedance in a string. What are conditions for the impedance matching? 3
- What are the differences between transverse and longitudinal waves? Derive wave equation for the transverse waves in a string. 4
- 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 frequency of oscillation. 3

(P.T.O)

Question 5

- a) What is the wavelength in visible region for which the film of refractive index 1.38 and thickness 10^{-6} cm will be non-reflecting? 3
- b) Explain the principle and working of the Michelson Interferometer. How will you measure small differences in wavelength of two waves? 4
- c) Explain the principle, construction and working with energy level diagram of a Ruby laser. 3

Question 6

- a) Define numerical aperture for an optical fibre and derive its value in terms of the refractive index of core and cladding. 3
- b) If core index is 1.5 and that of cladding is 1.48, what will be the maximum angle allowing light be guided through the fibre? 3
- c) Using well labeled diagrams discuss the recording and reconstruction processes of Holography. 4

Question 7

- a) Discuss the theory of Fraunhofer diffraction at a single slit and extend it to the case of double slit with comparison of the pattern obtained. Explain the significance of missing order. 4
- b) Show that in a diffraction grating with grating element 0.002 mm and light of wavelength 550 nm, third and higher order principal maxima are not visible. 3
- c) Calculate the thickness of a quarter wave plate of quartz crystal for light of wavelength 5000 angstrom with $n_o = 1.544$ and $n_e = 1.533$. 3

x-x-x