Exam.Code:0905
Sub. Code: 6644

1078

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 Section. Calculators are allowed.

x-x-x

1. Answer the following briefly:
   a) Explain the spiking in Ruby laser.
   b) For transverse waves on a string, is the wave speed the same as the speed of any part of the string? Explain the difference between these two speeds. Which one is constant?
   c) Mention the various requirements to obtain an image from the hologram.
   d) Make a neat diagram of phenomena of beat showing the beat period and frequency.
   e) Explain why dependence of mass is in the relationship of time period of a mass attached to the spring whereas there is no such dependence in the time period of a pendulum.

(5 x 2 = 10)

SECTION-A

II (a) A particle executes a simple harmonic motion of time period T. Find the time taken by the particle to go directly from its mean position to half the amplitude. (3)

(b) Define quality factor, mean life-time and relaxation time for a damped harmonic oscillator. Obtain a relation between quality factor and relaxation time. (3)

(c) The oscillations of a tuning fork of frequency 200 cycles per second die away to 1/e times their amplitude in 1 second. Show that the reduction in frequency due to air damping is exceedingly small. (4)

III(a) Discuss the phase behavior of the displacement and velocity of a forced mechanical oscillator. (5)

(b) Two infinitely long strings having linear mass densities m_1 and m_2 are connected together smoothly and are under the same tension T. Consider a progressive wave travelling along the positive direction of X-axis and incident on the boundary at x = 0. Derive expressions for the reflected and transmission coefficient in terms of the characteristic impedances of the two parts of the string. Discuss the rigid and free boundaries limiting cases. (5)

IV (a) Two waves passing through a region are represented by

$y = (1.0\ \text{cm}) \sin [(3.14\ \text{cm}^{-1})x - (157\ \text{s}^{-1})t]$

and $y = (1.5\ \text{cm}) \sin [(1.57\ \text{cm}^{-1})x - (314\ \text{s}^{-1})t]$

Find the displacement of the particle at x = 4.5 cm at time t = 5.0 ms. (3)

(b) An alternating voltage, amplitude V_0 is applied across an LCR series circuit. Show that the voltage at current resonance across either the inductance or the condenser is QV_0. (3)

(c) What are ultrasonic waves? Discuss the various methods of their detection. (4)

SECTION-B

V (a) Describe Fraunhofer's diffraction due to a single slit and deduce the positions of the maxima and minima. Show that the relative intensities of successive maxima are nearly 1:1/22:1/61. (5)

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(b) Describe the construction and working of the Michelson's interferometer How would you use it to measure the wavelength of monochromatic light? (5)

VI(a) Three nicols prisms are placed such that first and third are mutually perpendicular. Unpolarized light is incident on first nicol prism, the intensity of light emerges from third nicol prism is 1/16 the intensity of incident light. Find the angle between first and third nicol prisms. (3)

(b) Differentiate between three level and four level systems for lasing action. (4)

(c) Discuss in brief the attenuation and dispersion mechanisms in optical fibres. Further explain how it is controlled in a graded index fibre? (3)

VII(a) How interference is connected in holography to freeze the object and diffraction is connected to unfreeze the object? (3)

(b) Discuss the various methods to produce plane polarized light. (4)

(c) Angular width of central maximum in the Fraunhofer diffraction pattern of a slit is measured. The slit is illuminated by light of wavelength 6000 Å. When the slit is illuminated by light of another wavelength, the angular width decreases by 30%, calculate the wavelength of this light. The same decrease in the angular width of central maximum is obtained when the original apparatus is immersed in a liquid. Find the refractive index of the liquid. (3)

x-x-x