Exam.Code:0906
Sub. Code: 6667

1058

B.E. (Mechanical Engineering)
Second Semester
APH-201: Oscillations and Optics
(Common with ECE, IT and EEE)

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 Section. Calculator is allowed.

x-x-x

I. Answer the following briefly:

a) Mention the differences between temporal and spatial coherence.
b) Why an extended source is required to obtain interference pattern in thin film?
c) A mass 'm' is suspended from a spring with a spring constant 'k'. The spring is then cut in half and the same mass is suspended from one of the halves. Which spring, the original or the half-spring, gives a greater frequency of oscillation when the mass is put into vertical simple harmonic motion?
d) Will ultrasonic waves show any polarization? Mention reasons for your answer.
e) How does diffraction pattern of single slit will change when the monochromatic source of light is replaced by a source of white light?

(5 x 2 =10)

SECTION-A

II (a) A massless spring of constant k is hung vertically and not extended. A mass m is attached to the spring and it stretches a distance x_0. (i) Find x_0 in terms of k, m and g. Now the spring is pulled down by an additional distance x. (ii) Write Newton's second law for total extension ($x+x_0$) and (iii) find the frequency of the motion when the spring is released. (5)

(b) Prove that for a forced oscillator in its steady state the average power supplied by the driving force equals that being dissipated against the frictional force. (5)

III (a) What are ultrasonic waves? Discuss its method of detection (3)

(b) A Simple harmonic motion with $\omega = 3s^{-1}$ has initial displacement and velocity 0.2 m and 2 ms^{-1} respectively. Express this as (i) $x(t) = A_0e^{i\omega t}$, determine $A_0 = a+ib$ from the initial conditions (ii) Using $A_0 = Ae^{i\phi}$, what are the amplitude A and phase ϕ of this oscillator? (c) What are the initial position and velocity if the phase is increased by $\pi/3$? (5)

(c) Mention the two things necessary for a system to execute S.H.M. (2)

IV (a) Two strings of tension T and mass densities μ_1 and μ_2 are connected together. Consider a traveling wave incident on the boundary. Show that the energy flux of the reflected wave plus the energy flux of the transmitted wave equals the energy flux of the incident wave. (5)

(b) Show that for a circuit with L = 10 millihenry, C = 1 μF and R = 0.1 ohm, the amplitude of the charge oscillations will be reduced to half in 0.14 sec. What is the quality factor of the circuit? ($\log_e 2 = 0.69$)

(5)

P.T.O.

SECTION-B

V (a) Derive relation between probabilities of spontaneous and stimulated emission in terms of Einstein's coefficients. (3)

(b) The arms of a Michelson interferometer differ in length by 325 nm. (i) If light of 650 nm is used in the interferometer, will there be destructive or constructive interference at the detector? (ii) At what visible wavelength will there be destructive interference at the detector? (4)

(c) Briefly explain the steps to produce the construction of image in Holography. (3)

VI(a) Explain with the help of a diagram discuss Newton's ring method. How this method is used to measure the wavelength of the monochromatic light. (5)

(b) Describe Fraunhofer's diffraction due to a single slit and deduce the positions of the maxima and minima. (5)

VII (a) What is a plane polarized light? Explain the various methods to produce plane polarized light from the reflected and refracted light. (5)

(b) Discuss in detail the various types of losses a light can suffer in passing through an optical fiber. (5)

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