Exam. Code: 0905
Sub. Code: 6644

1079

B. Engg. (1st Year)-1st Semester

Bio Technology

APH-101: Oscillations and Optics

***(Common with IT and CSE)***

Time allowed: 3 Hours | Max. Marks: 50

***NOTE:*** *Attempt five questions in all, including Q. No. 1 which is compulsory and selecting atleast two questions from each Part.*

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**Question 1: Attempt any five!** **10**

a) What is the heavy damping? What are its applications in mechanical instruments?
b) Why the radiations in case of stimulated emissions are coherent in contrary to the spontaneous emissions?
c) What do you understand by coherent sources? What will be the effect on interference pattern if monochromatic light is replaced with white light?
d) A vertical U-tube of uniform cross-section area A contains liquid of density ρ and height h. Evaluate the period of oscillation if liquid is disturbed from its equilibrium position.
e) What do you understand by phase retardation plate? How does it help in converting plane polarized light in the circularly polarized light?
f) Explain the various possible losses in signal while propagating through an optical fibre.
g) In a single-slit diffraction grating element is doubled. What will be the change in the highest visible maxima?

**Part A**

**Question 2**

a) Derive formula for the charge in case of an underdamped electrical oscillator. What will be the effect on logarithmic decrement if value of inductance is halved? 4
b) An LCR circuit has an inductance L = 0.12 mH, a capacitance C = 0.6 μF and resistance R = 500 ohms in the series. Calculate limiting value of relaxation time if circuit is oscillatory. 3
c) Describe an experimental method to measure speed of ultrasonic wave in a liquid. 3

**Question 3**

a) Derive and discuss the variation of current amplitude and power dissipated with the driving force frequency in forced LCR oscillator. 5
b) In a forced LCR circuit, how does quality factor relates with band width of the absorption curve? Translate this quality factory in terms of circuit LCR components. 3
c) Using conservation of energy, derive differential and linear equation of motion for charge oscillation in a LC circuit. 2

**Question 4**

a) What is the impedance in transverse string waves? Two strings of linear densities 0.5/gm and 2/gm are joined together and stretched with a force of 50 N. Calculate the coefficient of reflection and transmission of amplitude. 4
b) Differentiate in particle and wave velocity of a wave motion. Derive relation wave and particle velocity for a transverse wave in the string. 3
c) 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 current with time. What is the phase relation charge and current in this oscillating system? 3

***P.T.O.***

Part B

**Question 5**

a) A surface of refractive index 1.42 is to be coated with a film of magnesium fluoride ($\mu$= 1.1) to minimize the reflection. Calculate the minimum thickness of film for normal incidence of light of wavelength 500 nm. 3

b) Explain how coherent sources are obtained in Micheleson's interferometer. How is this setup used to determine small difference in the wavelength? 4

c) Explain active medium, metastable, and resonator used in He-Ne laser. 3

**Question 6**

a) What is the physical significance of numerical aperture? Derive formula of numerical aperture in terms of 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) For double-slit Fraunhoffer Diffraction, derive condition for maxima and minima. Explain the concept of missing order. 5

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. 2

c) Calculate the thickness of a quarter wave plate of quartz crystal for light of wavelength 5000 angstrom with no = 1.544 and ne = 1.533. 3

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