Exam.Code:0905
Sub. Code: 6640

2031

B.E. (Biotechnology), First Semester

APSX01: Applied Physics

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) If power of a 5 mW laser beam decreases to 30 μW after traversing through 40 km of an optical fiber. Calculate the coefficient of attenuation.
b) What do you understand by an Optic axis? Explain its importance in the polarization of the light waves.
c) Explain, with appropriate energy-level diagram, the transitions involved in a He-Ne laser.
d) A vibration insulator has stiffness constant 10 N/m and mass 65 kg. For which frequency range platform will be protected against the oscillations?
e) A particle is subjected to two simple harmonic motions in the same direction having equal amplitudes and equal frequency. If the resultant amplitude is equal to the amplitude of the individual motions, what is the phase difference between the individual motions?
f) Calculate the ratio of the times elapsed during reduction of the energy and amplitude to 1/e time of their maximum value.
g) What is the power absorption curve? Describe it graphically as well.

PART A

Question 2

a) The potential energy of a mass of 1 kg executing SHM is given by $2x^2 + 4x + 4$. Find the equilibrium position, force constant and the frequency of oscillations. 3
b) Derive formula for the charge across capacitor in series LCR circuit driven by an external supply. Discuss variation of charge amplitude with the angular frequency of the external supply. 4
c) An inductor, capacitor and resistor of values 0.2 H, 1 μF and 800 Ω are connected in series. Show that the circuit is oscillatory and calculate the frequency of oscillation and Q-factor. 3

Question 3

a) Derive equation of motion for an undamped LC circuit. Derive and discuss phase relation between charge and the induced emf in the circuit. 3
b) Write down equation of motion and its solution for a damped mass-spring syetm. Discuss conditions for under-, heavy- and critical-damping. 4
c) A plane monochromatic electromagnetic wave travels one medium (refractive index = 1.1) to another (refractive index = 2.2) with electric field oscillating within the plane of incidence. What will be the reflection and transmission coefficients for the system if incident wave makes an angle 60° with the normal to the interface.? 3

Question 4

a) A plane monochromatic electromagnetic wave travels one medium to another with oblique incidence on the interface. Associated electric field oscillates within the plane of incidence. Derive laws of reflection and refraction using boundary conditions. 4
b) An AC source with amplitude E_0=128V and frequency ω = 250Hz is connected to a series circuit consisting of a resistance R=100 Ω, a coil with inductance L= 0.4H and a capacitor C = 200μF. Find: i) the current amplitude in the circuit and ii) the frequency at which induced emf is maximum. 3
c) An oscillator consisting of mass of 0.2 kg, damping constant 4 N/m and spring constant 80 N/m is driven by a force F = 6 cos(30t) newton. Calculate the average power supplied by the driving force. 3

P.T.O.

PART B

Question 5

a) Describe Einstein's theory of radiations for laser. Derive relations between Einstein's coefficient of transition probabilities and give their significance. 4

b) For a step-indexed fiber, refractive indices of core and cladding are 1.5 and 1.477 respectively. Calculate acceptance angle and numerical aperture. 3

c) What do you understand by polaroid? Differentiate between H-Polaroid and K- Polaroid. 3

Question 6

a) Define numerical aperture and derive it in terms of refractive indices of core and cladding. Give its physical significance as well. 4

b) Two Nicol prims are set so that maximum light is transmitted. Through what angle should one of the prisms be rotated to reduce intensity to one half of the maximum intensity? 3

c) Explain the transitions involved in a Ruby laser! Why is it difficult to design with the system having two energy levels? 3

Question 7

a) What do you understand by polarization of light? Explain the usage of Nicol prism in obtaining plane polarized light. How does polarization confirm the transverse nature of light? 4

b) Explain the importance of stimulated emission, population inversion and metastable in laser operation. 3

c) Explain the intrinsic and extrinsic sensors based an optical fiber! Explain the concept of concept of a fiber-based displacement sensor. 3

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