Exam.Code:0905
Sub. Code: 6191

2023

B.E. 1st Year (First Semester)

ASP-X01: Applied Physics

(Common with CSE, BIO-TECH., IT, ECE, CIVIL, 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 Part.

x-x-x

Question 1 : Attempt any 5 questions 2×5 = 10

(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.

(b) Derive differential and linear equation of motion for simple pendulum executing SHM. What is the effect of length of the pendulum on the time period of oscillations?

(c) Explain the power absorption curve using an appropriate diagram including the definition of the bandwidth.

(d) Calculate the gradient of the scalar $R = x^2y^3z^4$

(e) Why is it easier to obtain stimulated emission for radiations in micro-wave region then visible region?

(f) Two Nicol prisms are aligned to have maximum intensity for the transmitted light. Through what angle should one of the prims to be rotated to reduce the intensity to half of its maximum value?

(g) Profile of the refractive index of the core and cladding affects the signal dispersion. Explain it using step and graded indexed fibers.

Part A

Question 2

(a) Derive differential and linear equation of motion for a damped mass-spring system. Discuss, qualitatively, conditions for under-, over-and critical dampings. 6

(b) Explain the meaning of Quality-factor for an LCR damped system. The Q-value of RCL circuit with C = 2 micro-farad, L = 0.2 H and frequency 8 kHz is 100. What will be the frequency of oscillatory discharge if the resistance is reduced to zero. 4

Question 3

(a) Show that, in forced LCR circuit, average power supplied by the driving force is equal power dissipated due to resistive component. 6

(b) In a forced LCR circuit, find the frequency for which potential drop across capacitor is maximum. 4

Question 4

(a) Derive formulation for reflection and transmission amplitude for the oblique incidence of an electromagnetic wave having E-field oscillations in the plane of incidence. Discuss phase relation between incident and the reflected components. 6

(b) A plane monochromatic electromagnetic wave travels from one medium (refractive index = 1.15) to another (refractive index = 1.95) with a magnetic field oscillating perpendicular to the plane of incidence. What will be the reflection and transmission coefficients for the system if the incident wave makes an angle 45 degrees with the normal to the interface? 4

Part B

Question 5

(a) Describe construction and working of a He-Ne laser. What are its advantages over the Solid-state laser? 4

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(b) How does output radiation of stimulated and spontaneous emission differ? What is the reason of these differences? What is the dependence of their transition probabilities on the frequency of the used radiation? 3

(c) What is the line shape function for an optical light source? Describe various methods responsible for the broadening of the line shape function. 3

Question 6

(a) Explain the construction and working of a Nicol Prism to obtain plane polarized light. Explain the difficulty if Nicol Prism is constructed with the quartz crystals. 4

(b) A lab is equipped with a light source (wavelength = 600 nm) of elliptically polarized light but experimental work is required to have linearly polarized light. One of the students decided to make use of a phase retardation plate (refractive index of E-rays = 1.489 and refractive index of O-rays = 1.567). What should be the thickness of the phase retardation plate? 3

(c) What are the polaroids? Explain the working principle of polaroids. Discuss its important applications. 3

Question 7

(a) What do you understand by intermodal dispersion? Derive its formulation for a step-index fiber. How does graded indexed fiber reduces intermodal dispersion? 4

(b) What do you understand by Material Dispersion Coefficient? Explain its dependence on the properties of the light source and the fiber material. 3

(c) A 5 mW laser beam passes through a 26 km long fiber of attenuation coefficient 0.2 dB/km. Calculate the power at the output end. 3