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Exam. Code: 0906
Sub. Code: 33294

2015
B.E., Second Semester
ASP-X01: Applied Physics
(Common with EEE, BIO, ECE, CIVIL, MECH)

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) A man stands on a platform which vibrates simple harmonically in a vertical direction at a frequency of 5 Hz. After which value of displacement, man will lose contact with platform?

(b) Two 1-D SHM perpendicular to each other superpose. What will be the equation of motion for the resultant wave if two waves have different frequency but same amplitude and phase?

(c) What will be the working condition of a vibration insulator at the natural frequency of the system?

(d) Show that the divergence of the gradient of a scalar quantity is the same as the Laplacian operator acting on that scalar quantity.

(e) What is difference between radiative and non-radiative transitions? What is the role of non-radiative transitions in laser?

(f) Prove that when angle of incidence is equals to the Brewster angle, the reflected and refracted rays are normal to each other.

(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) Write down the linear equation of motion (electrical LCR system) for an oscillatory damped motion. Discuss it graphically as well. Define and derive quality factor and the relaxation time in terms of the electrical components. 6

(b) Define and formulate relaxation time and quality factor for a damped oscillator. In an oscillating RLC circuit with L = 10 mH, R = 2 Ohms and C = 1.5F, how much time elapses before the amplitude of the oscillations drops to half its initial value? 4

Question 3

(a) Derive formulation for the charge across capacitor in forced LCR oscillator. Show that resonance of charge occurs at frequency smaller than natural frequency of the system. 6

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

Question 4

(a) What are the Frsenel's equations for electromagnetic wave propagation? Derive Brewster's law using Fresnel's equations and explain its importance in the polarization of the electromagentic wave. 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

P.T.O.

Part B

Question 5

(a) Derive the relation between transition probability of stimulated and spontaneous emission in a thermodynamic equilibrium. Discuss this condition to conclude that why is it easier to design laser with longer wavelengths. 4

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

(c) Explain the concept of light amplification and attenuation, while passing through a medium. Discuss the factors controlling light amplification. 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) How should the polarizer and analyzer be adjusted so that the intensity of light is reduced to 25% of its original intensity before polarization? 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) 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

(c) What do you understand by extrinsic and intrinsic sensors with fiber? How can fiber be used in designing a displacement sensor? 3

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