Exam.Code:0905
Sub. Code: 6640

2062

B.E. (Bio-Technology) First Semester

Paper-ASPX01: 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) A mass of 2 kg is attached to a spring with constant 18 N/m. It is then displaced to the point x= 2. How much time does it take for the block to travel to the point x= 1?

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

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

(d) What do you understand by the gradient of a scalar? Explain the physical significance of its magnitude and direction.

(e) What is the difference between normal excited state and a metastable state?Explain the importance of metastable state in lasing action.

(f) In the Nicol Prism construction, a special glue Canada Balsam is used. Explain its importance in obtaining a plane-polarized light!

(g) Discuss various types of scatterings contributing to the attenuation of the signal propagating through an optical fiber.

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) Write down differential equation of motion, explaing various terms involved. Given that a mass of 1 kg is suspended from a spring of stiffness constant 25 N/m. If the frequency of natural oscillations is 1.2 times of the frequency of damped oscillations, find the damping constant. 4

Question 3

(a) Derive formulation for the displacement in forced mass-spring oscillator. Show that resonance of displacement occurs at frequency smaller than natural frequency of the system. 6

(b) Prove that in case of forced mechanical oscillator, Quality factor is equal to the amplification factor. 4

Question 4

(a) Write down the formulation for the reflection and transmission amplitude for the oblique incidence of an electromagnetic wave having B-field oscillations in perpendicular to the plane of incidence. Derive the formula for the angle of incidence at which wave will be fully transmitted. Discuss its importance in the polarization of electromagnetic waves. 6

(b) A plane monochromatic electromagnetic wave travels from 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 degrees with the normal to the interface? 4

P.T.O.

Part-B

Question 5

(a) Discuss the active medium, pumping and resonator in the He-Ne laser. Explain the various transitions using appropriately labelled energy-level diagram. 4

(b) Explain the importance of having a metastable state for laser output. Why is it difficult to obtain population inversion in two energy level systems? 3

(c) 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

Question 6

(a) You are provided with a piece of calcite crystal. How will you finish, mechanically, this crystal to obtain a plane-polarized light? Also, explain the polarization process using an appropriate diagram. What will be the change in your strategy, if provided with a quartz crystal? 4

(b) A lab had two light sources, one with circular polarization and the other one is unpolarized light. How can the nature of the light source be identified using phase retardation plates? 3

(c) A lab is equipped with a light source (wavelength = 500 nm) of circularly polarized light but an experimental work required to have linearly polarized light. One of the students decided to make use of phase retardation plate (refractive index of E-rays = 1.533 and refractive Index of O-rays = 1.544). What should be thickness of the phase retardation plate? 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) Differentiate between step and graded index fiber. Explain the importance of graded index fiber in controlling dispersion during transmission. 3

(c) Let's consider laser, with power 1 mW, entering an optical fiber link of length 40 km and attenuation coefficient 0.5 dB/km. In the optical fiber link there are 2 connectors and 4 splices with losses 0.5 dB/splice and 1 dB/connector. Calculate the power received at the output of the link. 3

x-x-x