Question Bank for LASER and Fiber Optics

Lasers

1. What is LASER?

2. Discuss its different characteristics of a laser beam. [or Differentiate between the laser and ordinary light].

3. Explain absorption, spontaneous emission and stimulated emission in relation with suitable diagrams.

4. Write short note on stimulated emission explaining its importance for laser production.

5. State Boltzmann's distribution law and hence show that in normal conditions ground state will remain most populated.

6. Explain Einstein's A and B coefficients in relation with the theory of lasing.

7. What is meant by metastable state? What is its significance?

8. Explain population inversion, active system and pumping.

9. What is meant by pumping? Why it is necessary for laser production? Discuss different types of pumping mechanisms.

10. Explain why simple heating cannot achieve population inversion.

11. Why lasing cannot be obtained using only two energy levels?

12. Distinguish between 3-level and 4-level lasers.

13. What is an optical resonator? Explain how it plays a key role in laser production.

14. Explain the construction and working of Ruby and He-Ne lasers with energy level diagrams.

15. List the applications of laser in different fields.

Fiber optics

1. What is an optical fiber? What is the main principle involved in its working?

2. With a neat diagram explain the structure of an optical fiber.

3. Explain the following terms related to optical fiber: a) critical angle, b) acceptance cone, c) numerical aperture and d) V-number.

4. Classify the optical fibers on the basis of refractive index profile, on the basis of modes and on the basis of materials.

5. Differentiate between the step-index and graded-index (GRIN) fiber.

6. Discuss different loss mechanisms encountered in an optical fiber.

9. What is attenuation in an optical fiber?

10. What is meant by dispersion in an optical fiber?

11. What are the advantages of optical fiber over conventional cables?

Numerical Problems on LASER

1. A pulsed laser is constructed with a ruby crystal. The ruby rod contains typically a total of 3×10^{19} Cr^{3+} ions. If the laser emits at 6940 Å wavelength, find

(i) the energy of one emitted photon.

(ii) the total energy available per laser pulse.

[Ans. 1.787 eV, 8.587 J]

2. A laser having power of 75 mW, wavelength 720 nm and an aperture 5 mm is focussed with a lens of focal length of 0.1 m. Calculate the area and intensity of the image.

[Ans. 2.074×10^{-10} m^2, 3.616×10^8 W/m^2]

3. In a He-Ne laser system, the two energy levels of Ne involved in lasing action have energy values of 20.66 eV and 18.70 eV. Population inversion occurs between these two levels. What will be the wavelength of the laser beam produced?

[Ans. 633.76 nm]

Numerical Problems on Optical Fiber

1. Find out the numerical aperture and acceptance angle of an optical fibre. [Given, n1 =1.55, n2 = 1.50]

2. A fibre cable has an acceptance angle of 30^o and a core index of refraction of 1.4. Calculate the refractive index of the cladding.

3. In an optical fiber, the core material has R.I 1.6 and R.I. of clad material is 1.3. What is the value of critical angle? Also calculate the value of angle of acceptance cone.

4. Optical power of 1 mW is launched into an optical fiber of length 100 m. If the power emerging from the other end is 0.3 mW, calculate the fiber attenuation.

5. What is the attenuation in dB/km, if 15% of the power fed at the launching end of a 0.5 km fiber is lost during propagation?