MODEL QUESTIONS: LASER

1) Explain induced absorption, spontaneous emission and stimulated emission when radiation interacts with matter

2) Explain the characteristic properties of LASER

3) Derive the expression for energy density of radiation in terms of Einstein coefficients and compare it with Planck's law of radiation.

4) What is Boltzmann factor? On which parameters does it depend?

5) Mention the conditions for lasing action.

6) Discuss the requisites for Laser system.

7) Discuss 3-level and 4-level lasing schemes in detail. Mention the advantages of 4-level scheme.

8) Explain the working of an optical resonator / Laser cavity in a laser with a neat sketch.

9) Explain construction and working of He-Ne laser with the help of energy level diagrams.

10) Why is the partial pressure of He more than that of Ne in He-Ne laser?

11) With neat sketches, explain the construction and working of semiconductor laser.

12) What are the advantages of semiconductor laser?

13) What is LIDAR? Explain the principle of working and uses of LIDAR.

14) Explain how lasers are used for precise measurement of deflection of bridges.

MODEL QUESTIONS: OPTICAL FIBERS

1) Explain the mechanism of light propagation in an optical fiber with suitable diagram.

2) Define Acceptance angle and Numerical Aperture (NA) of optical fiber. Derive an expression for NA in terms of refractive indices of core and cladding.

3) Define fractional index change. Derive the relation between fractional index change and Numerical aperture.

4) With neat sketches, discuss different types of optical fibers.

5) What is intermodal dispersion in optical fibers? Explain how intermodal dispersion is minimized in graded index fiber.

6) What is intra-modal dispersion? Explain.

7) Define attenuation in optical fibers. Discuss the various causes of attenuation.

8) Discuss the point to point communication using optical fibers. What are the advantages of optical communication?

Problems for Practice

1) Two energy levels are separated by 1.95 eV. At what temperature will the ratio of populations be 10^{-29}? Also Calculate the ratio of A_{21}/B_{12}.

2) The output power of a continuous wave laser is 5mW at a lasing wavelength of 100 μm. How many photons are emitted per second? Calculate the ratio of spontaneous to stimulated emission at 300K.

3) Calculate the radius of core of an optical fiber so as to support 2450 modes to 0.865μm carrier wave if the core refractive index is 1.55 and the fractional index change is 0.002.

4) An optical fiber communication system consists of two fiber links of lengths 4 km and 9 km with attenuation coefficients 1.2 dB/km and 1.4 dB/km respectively. The input is provided by a laser which emits 10^{19} photons per second at a wavelength of 650 nm. Calculate the output power.

5) Calculate the acceptance angle, fractional index change, numerical aperture of an optical fiber of core and clad refractive indices 1.49 and 1.485 respectively.

6) The attenuation coefficient of an optical fiber is 2.2dB/km. What fractional initial optical power remains after travelling (i) 2 km and (ii) 6 km through the fiber?

7) What should be the power input to a continuous laser source of efficiency 0.55 which is connected to the launching end of an optical fiber of attenuation coefficient 4.5 dBkm^{-1}, so that the power received at the other end distant 10km from the launching end is 56mW?