Engineering Physics (BAS101)
List of Important Questions

UNIT-4 : Fiber Optics & Laser

|| Short Answer Type Questions ||

1. What is the basic working principle of Laser?
2. What is meta-stable state?
3. What is absorption of radiation in a laser?
4. Differentiate between spontaneous and stimulated emission of radiation.
5. Explain why lasing action is not possible in two energy levels system?
6. What do you mean by term population inversion in laser ? Explain the effect of temperature.
7. Explain how He-Ne laser is superior to Ruby laser. Also mention the role of He in this laser.
8. What are important areas of applications of the laser?
9. What is the basic principle of optical fiber communication ?
10. What do you mean by term "fractional change in refractive indices"?

|| Long Answer Type Questions ||

1. Show that the ratio of coefficients of spontaneous to stimulated emission of radiation is proportional to the third power of frequency of radiation.

   OR

   What are Einstein's coefficients A and B? Establish a relation between them.
2. Describe the construction and working of a Ruby laser with suitable energy level diagram.
3. Discuss the construction and working of a four levels He-Ne laser with necessary energy levels diagram.
4. What is an optical fiber? Give its construction and possible applications.
5. Describing the propagation mechanism in optical fiber, derive expressions for acceptance angle and numerical aperture (NA). Discuss the physical significance of NA and explain how does it depend on refractive indices of core and cladding?
6. Describe schematically, the basic elements of optical fiber communication system. What are the advantages of using it.
7. Classify step index and graded index optical fibers with necessary diagrams. Why single mode fibers are preferred for long distance communication? Mention its disadvantages also.
8. Explain attenuation in optical fiber. Discuss different mechanisms responsible for attenuation in optical fibers.
9. What is optical pulse dispersion in a fiber? Discuss various sources or reasons responsible for dispersion of optical signal in optical fibers. Why single mode fibers are dispersion- less and used for long distance communication?

|| Numerical Problems ||

1. Calculate the population ratio of two states in He-Ne laser that produces light of wavelength 6000 Å at 300 K.
2. Find the intensity of Laser beam of 1mW power and having diameter of 1.4mm. Assume that intensity is uniform through the beam.
3. The wavelength of He-Ne Laser is 632.8 nm and its output power is 3.147 mW. How many photons are emitted from laser per second?
4. In a Ruby laser total number of Cr^{+3} ions are 2.8×10^{19}. If the laser emits radiation of wavelength 7000Å, calculate the energy of the laser pulse and momentum of a photon.
5. A silica glass optical fiber has a core refractive index of 1.5 and cladding refractive index of 1.45. Calculate the numerical aperture, acceptance angle and critical angle of the optical fiber.
6. The numerical aperture of an optical fiber is 0.5 and core index of refraction is 1.54. Find the critical angle of the fiber.
7. If the fractional difference between core and cladding refractive indices of a fiber is 0.0135 and numerical aperture (NA) is 0.2425, calculate the refractive indices of the core and cladding materials.
8. The refractive index of core of a step index fiber is 1.46 and relative refractive indices difference is between core and cladding is 2%. Calculate numerical aperture of the fiber.
9. A step index fiber has core and cladding refractive indices 1.466 and 1.460 respectively. If the wavelength of light is 0.85μm, find the normalized frequency and the number of mode supported by the fiber. The diameter of core is 50μm.
10. A step index fiber has core refractive index 1.466 and cladding refractive index 1.460. Compute the maximum radius allowed for a fiber, if it is supports only one mode at a wavelength 1300 nm.
11. The optical power, after propagating through a fiber that is 500m long is reduced to 25% of its original value. Calculate the fiber loss in dB/Km.
12. A communication system uses a 10 km fiber having a loss of 2.5 dB/Km. Compute the output power if the input power is 500 μW.
13. A 100 km fiber is used in communication. The fiber has a 3.0 dB/km loss. What will be the output power when the input power fed at the input of optical fiber is 500 μW?