Engineering Physics
06PHY12
Assignment 4

Answer the following questions

1. Explain the process of *induced absorption, spontaneous emission* and *stimulated emission*. Obtain an expression for energy density of radiation under equilibrium condition in terms of Einstein's Co-efficients. [10]
2. Explain the conditions for the production of laser. Obtain an expression for the energy density of photons in terms of Einstein's coefficients. [10]
3. What is population inversion? Explain the necessity of population inversion for lasing. Write the construction and working of He-Ne Laser. [10]
4. What are semiconductor diode lasers? Describe with energy band diagram the construction and working of semiconductor diode laser. Mention the uses of diode lasers. [10]
5. Explain the basic principles involved in laser action. [6]
6. What are the applications of laser? Explain. [5]
7. Describe briefly the application of lasers in welding, cutting and drilling. Mention the nature and property of the lasers used. [6]
8. Write a note on measurement of pollutants in atmosphere using laser. [5]
9. Write the principle of holography. With neat sketches explain in brief recording of a hologram and reconstruction of images. [6]
10. What is Holography? Explain the construction of Hologram. [6]

Solve the following problems

1. Find the ratio of population of two energy levels out of which one corresponds to metastable state if the wavelength of light emitted at $330\,K$ is $632.8\,nm$. [4]
2. A laser medium at the equilibrium temperature $300\,K$ has two energy levels with a wavelength separation of $1\,\mu m$. Find the ratio of population densities of the upper and lower levels. [4]
3. Find the ratio of population of the two energy states of the Ruby laser, the transition between which is responsible for the emission of photons of wavelength $694.3\,mm$. Assume the ambient temperature as $27^o\,C$. [4]
4. Calculate the ratio of Einstein coefficient (A_{12}/B_{12}) stimulated to spontaneous emission for wavelength $1.39\,\mu m$ at $300\,K$. [6]
5. Calculate the energy difference in eV between the two energy levels of the Ne atoms of a He-Ne gas laser, the transition between which results in the emission of a light of wavelength $632.8\,nm$. Also calculate the number of photons emitted per second, if the optical power output is $2\,mW$. [6]

6. A Helium-Neon laser is emitting laser beam with an average power of $4.5\,mW$. Find the number of photons emitted per second by the laser. The wavelength of the emitted radiation is $6328\,\mathring{A}$. [6]

7. A laser operating at $632.8\,nm$ emits 3.182×10^{16} photons per second. Calculate the output power of the laser. If the input power is $100\,watt$, find the percentage of power converted into coherent light energy. [4]

8. A pulse from laser with power $1.0\,mW$ last for 10.0 nano seconds. If number of photons emitted per second is 3.491×10^7 calculate the. wave length of laser. [2]

***