LASER

3.4 Assignment

3

CHAPTER OUTLINE

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What is LASER

LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. The LASER action was first proposed by Einstein. But, the term LASER is also, used for a device that generates an intense beam of coherent monochromatic electromagnetic light by stimulated emission of photons from excited atoms or molecules.

HISTORY OF LASER

1917: *On the Quantum theory of radiation* – Einstein's paper.
• 1954: MASER by Townes *et al*.
• Means of Acquiring Support for Expensive Research
• 1958: Townes (1964) and Schawlow (1981) conceive basic ideas for a laser.
• 1960: LASER coined by Gould.
• 1960: First laser (Ruby) by Maiman.
• 1961: First HeNe laser, then rapid invention of most lasers …
• 1977: Gordon Gould awarded the patent for the laser.

In 1958, Charles H. Townes and Arthur L. Schawlow showed that the effect of stimulated emission can be amplified to produce a practical source of light, which is coherent and can travel long distances without appreciable spread of the beam width. Such a light source is called LASER, an acronym for Light Amplification by Stimulated Emission of Radiation.

The He-Ne laser was the first continuous wave (CW) laser ever constructed. It was built in 1961 by Ali Javan, Bennett, and Herriott at Bell Telephone Laboratories.

Subjective Type Questions

1. What is Laser? What are the properties of Laser?
2. Write the differences between Visible light and Laser.
3. Describe the principle of operation of Laser.
4. What do you mean by spontaneous emission?
5. Write the important features of spontaneous emission.
6. What do you mean by stimulated emission?
7. Write the important features of stimulated emission.
8. What are the differences between spontaneous and stimulated emission?
9. Write three applications of Laser.
10. What do you mean by population inversion?
11. Why population inversion is necessary for stimulated emission?
12. What do you mean by pumping? Write different type of pumping.
13. Describe the operation of He-Ne Laser with suitable block diagram.
14. Discuss about the advantaged and disadvantages of He-Ne Laser.
15. What is Hologram? Write its uses.

Objective Type questions

This set of Engineering Physics Multiple Choice Questions & Answers (MCQs) focuses on “Laser”.

1. Which of the following is a unique property of laser?

a) Directionality b)Speed c)Coherence d)Wavelength

2. Which of the following is an example of optical pumping?

a) Ruby laser b) Helium-Neon laser c) Semiconductor laser d) Dye laser

3. When laser light is focused on a particular area for a long time, then that particular area alone will be heated.

a) True b) False

4. Calculate the wavelength of radiation emitted by an LED made up of a semiconducting material with band gap energy 2.8eV.

a) 2.8 Å b) 4.3308 Å c) 5548.4 Å d) 4430.8 Å

5. Calculate the number of photons, from green light of mercury ($\lambda = 4961$ Å), required to do one joule of work.

a) $4524.2\times10^{18}/m^3$ b) $2.4961\times10^{18}/m^3$ c) $2.4961/m^3$ d) 2.4961/m

6. Which of the following can be used for the generation of laser pulse?

a) Ruby laser b) Carbon dioxide laser c) Helium neon laser d) Nd- YAG laser

In order to produce the laser beam, it is essential to achieve population inversion. Population inversion is the process of achieving more electrons in the higher energy state as compared to the lower energy state. But, in general, the lower energy state has more electrons than the higher energy state. However, after achieving population inversion, more electrons will remain in the higher energy state than the lower energy state.

7. What is the need to achieve population inversion?

a) To excite most of the atoms b) To bring most of the atoms to ground state

c) To achieve stable condition d) To reduce the time of production of laser

8. Laser is called as a non-material knife.

a) False b) True

9. DVD uses the laser.

a) True b) False

10. Which of the following is used in atomic clocks?

a) Laser b) Quartz c) Maser d) Helium

11. Which of the following is a four-level laser?

a) ND: YAG b) Ruby c) He-Ne d) Argon laser

12. The difference between He-Ne Laser is _____

a) It gives pulsed output b) It gives a non-continuous laser beam

c) It gives a continuous laser beam d) No difference

13. He-Ne laser is a type of _____

a) Solid laser b) Liquid laser c) Gas laser d) Diode laser

14. Which pumping method is used in He-Ne laser?

a) Optical Pumping b) Electrical Excitation c) Chemical Pumping d) Direct Conversion

15. The He-Ne laser operates at a wavelength of _____

a) 540 nm b) 632 nm c) 690 nm d) 717 nm

16. The number of photons emitted for a 2.5 mW He-Ne laser is _____

a) 4.9×10^{15} b) 5.9×10^{15} c) 6.9×10^{15} d) 7.9×10^{15}

17. He-Ne laser is used in Holography.

a) True b) False