Printed Pages : 2 EOE-043

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0929 Roll No.

B.Tech.

(SEMESTER-IV) THEORY EXAMINATION, 2011-12

LASER SYSTEMS AND APPLICATIONS

Time : 3 Hours] *[Total Marks : 100*

Section – I

1. Attempt **all** questions. Each question carries **2** marks. $10 \times 2 = 20$
   (a) What is the difference between spontaneous emission and stimulated emission ?
   (b) Show that lasing is not possible in two level systems.
   (c) Draw a simple diagram of an optical cavity and discuss its role in laser action.
   (d) What are the advantages of four level laser systems over three level laser system ?
   (e) What is the importance of Q-switching in laser ?
   (f) Show that electrical pumping is most suitable for gas lasers.
   (g) Why Dye lasers are tunable ?
   (h) Stimulated emission is more probable at higher wavelengths than at shorter wavelength. Why ?
   (i) What is LIDAR ?
   (j) Name the lasers and their wavelength region which are used for laser surgery.

Section – II

2. Attempt any **three** out of five parts. Each part carries **10** marks. : $3 \times 10 = 30$
   (a) Obtain the relation between Einstein A and B coefficients. Comment the units in which these coefficients are expressed.
   (b) Consider an optical source in which the atoms are in thermodynamic equilibrium with radiation at temperature T = 1000 K. Assuming all the atoms to be in one of the two energy states E1 and E2 (E2 > E1). Find the fraction of atoms in excited state. The energy separation (E2 – E1) corresponds to wavelength of 6000 $\mathring{A}$.
   (c) Obtain the condition for laser action in a three level system. Give an example of a real three level laser.
   (d) With the help of neat energy level diagram explain the working of a He-Ne laser. What is the role of Helium in He-Ne laser ?
   (e) Discuss, how the laser can be used in Metrology ?

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Section – III

Attempt **all** questions. Each question carries **10** marks. **5 × 10 = 50**

3. Discuss the properties of laser light, which set it apart from ordinary light. Name some applications of laser light.

OR

Explain the concept of spatial and temporal coherence and show that the directionality of laser beam is related to the spatial coherence property of laser light.

4. Describe the main components of a laser. Derive the threshold condition for laser action.

OR

Answer the following questions :

(i) How the population inversion is achieved in a laser ? Show that population inversion is a condition of negative temperature.

(ii) Why the stimulated photon propagates in the same direction as the stimulating one in a laser ?

5. What do you mean by optical cavity ? What is the resonant optical cavity ? Describe the role of resonance cavity in producing laser light.

OR

Derive an expression for a resonant frequency in a resonator cavity with two mirrors of equal radii r, separated by a distance d.

6. Name a solid laser and explain its working on the basis of energy level diagram of the active ion/atom. What type of pumping is used for solid lasers and why ?

OR

What do you understand by the term remote sensing ? How is laser used in sensing the remote pollutants ? Discuss the mechanism involved.

7. Discuss on application of lasers in optical communication.

OR

How is the information carrying capacity of light waves much larger than that of micro-radio waves ? What are the different components of a light wave communication system and what are their characteristics ?
