

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

PAPER ID : 0929

Roll No.

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B. Tech.

(SEMESTER-III) THEORY EXAMINATION, 2012-13

LASER SYSTEMS AND APPLICATIONS

Time : 3 Hours]

[Total Marks : 100

Section – A

1. Attempt all question parts : **10 × 2 = 20**
- Show that population inversion is a condition of negative temperature.
 - Brief note on absorption and give the equation for the rate of absorption.
 - What do you mean by coefficient of gain ? Find the expression for it.
 - Write about Optical pumping and its schemes.
 - Mention the main components of LASER.
 - Specify the characteristics of LASER beam.
 - Why is a four level LASER more efficient than a three level LASER ?
 - List out the features of materials used for laser action.
 - Why a pulse laser is generally used for material processing ?
 - The near infrared laser is preferred for optical communication. Give the reason.

Section – B

2. Attempt any three question parts : **10 × 3 = 30**
- Illustrate about the following :
 - Spatial coherence
 - Temporal coherence

- (b) Derive the time independent and time dependant Schrodinger equation for a non-relativistic particle.
- (c) With a neat schematic diagram explain the principle of four level laser.
- (d) Enlist the conditions in which a laser will work in cw/pulse mode. Show that a cw laser is suitable for time measurement.
- (e) How communication gets facilitated using laser and fibre ? Estimate the number of telephone channels possible to have an optical fibre network using laser of wavelength $1.55 \mu\text{m}$.

Section – C

Attempt **all** questions.

10 × 5 = 50

3. Attempt any **two** parts :

(5 × 2 = 10)

- (a) Calculate the coherence length of a laser beam for which the bandwidth equal to 3000 Hz. The speed of light is $3 \times 10^8 \text{ m/s}$.
- (b) Obtain the relationship between the size of the source and the coherence of the field.
- (c) Define Q-factor of an optical resonator. Show that $Q = \nu_0 / \Delta\nu$, where ν_0 – resonant frequency and $\Delta\nu$ - full width at half maximum.

4. Attempt any **one** part :

(10 × 1 = 10)

- (a) Write the significance of Einstein's coefficients and explain the relation between Einstein's A and B coefficients.
- (b) Explain spontaneous emission and stimulated emission of radiation. Obtain a relation between transition probabilities of spontaneous and stimulated emission.

5. Attempt any **one** part :

(10 × 1 = 10)

- (a) Elaborate the generation and measurement of short laser pulses.
- (b) Elucidate the construction and working of excimer laser.

6. Attempt any **one** part :

(10 × 1 = 10)

- (a) Describe the working of He-Ne laser with a neat diagram. What are the characteristics of output laser beam from He-Ne laser ?
- (b) With necessary diagram, explain the construction and working of Nd-YAG laser.

7. Attempt any **two** parts :

(5 × 2 = 10)

- (a) Mention few applications of laser in medicine and explain any one.
- (b) Narrate the process of hole drilling with laser.
- (c) Which are the lasers suitable for surgical operations and list out their merits and demerits ?