

Printed Pages : 3



NOE043

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

PAPER ID : 199199

Roll No.

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B. Tech.

(SEM. IV) THEORY EXAMINATION, 2014-15
LASER SYSTEMS & APPLICATIONS

Time : 3 Hours]

[Total Marks : 100

Note: (1) Attempt all questions.

(2) All questions carry equal marks.

1 Answer any two parts of the following. $10 \times 2 = 20$

- (a) Explain the physical significance of the wave function. Derive Schrodinger time dependent wave equation starting from Schrodinger time independent wave equation.
- (b) Explain the phenomenon of stimulated emission indicating the features which differentiate it from spontaneous emission.
- (c) What do you mean by efficiency of a laser? A gas laser is generating a laser beam of power 4mW. Calculate the number of photons emitted by the laser. The wavelength of emitted radiation is $6800 \text{ \AA}$

2 Answer any two parts of the following. $10 \times 2 = 20$

- (a) Show that population inversion is a condition of negative temperature. The ratio of population of two energy levels out of which upper levels corresponds to a metastable state is 1.059×10^{-30} . Find the wave length of light emitted at a temperature $T=330\text{K}$. (Here given that $h=6.6 \times 10^{-34}$ J-S, $k=1.38 \times 10^{-23}$ J/K).
- (b) Calculate the mode numbers of a laser beam of wavelength $4000 \text{ \AA}$ in blue region in a cavity of length 40 cm .
- (c) Why laser action cannot take place in two level systems? Write the rate of equation in four level lasers & obtain the condition for threshold oscillation.

3 Answer any two parts of the following. $10 \times 2 = 20$

- (a) What is pumping? How can it help in achieving population inversion? Differentiate b/w optical and electrical pumping scheme.
- (b) What is the threshold condition for laser oscillation and show that gain per unit length at threshold,

$$q = \alpha + \frac{1}{2L} \log_e \left(\frac{1}{R_1 R_2} \right), \text{ where symbols have their usual meanings?}$$

- (c) Define Q-factor in optical resonator. Show that $Q = \frac{\nu_0}{\Delta\nu}$ where symbols have their usual meanings.

4 Answer any two parts of the following. $10 \times 2 = 20$

- (a) Why Cr^{3+} ions are doped in Al_2O_3 in ruby laser? Discuss the construction and working of ruby laser?
- (b) Draw a neat diagram of CO_2 laser and explain its working. How CO_2 laser is more efficient than other lasers?
- (c) Discuss the semiconductor laser? Give the applications of semiconductor diode lasers.

5 Answer any two parts of the following. $10 \times 2 = 20$

- (a) How the eye surgery is made using lasers. Discuss its advantage over other kind of surgeries.
 - (b) What is LIDAR? Discuss its components and their role. How atmospheric pollutants are measured using LIDAR?
 - (c) What is holography? Explain recording and reconstruction of a hologram. How a small piece of hologram can give complete information about the object?
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