**Printed Pages : 3**

**NOE043**

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

PAPER ID : **199199**

**Roll No.**

# 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. 10×2=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 A°

2 Answer any two parts of the following. 10×2=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 $1.059 \times 10^{-30}$. Find the wave length of light emitted at a temperature T=330K. (Here given that h=6.6 × $10^{-34}$ J-S, k=1.38 × $10^{-23}$ J/K).

(b) Calculate the mode numbers of a laser beam of wavelength 4000 A° 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. 10×2=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,

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

(c) DefineQ-factor in optical resonator. Show that $Q = \frac{\upsilon_0}{\Delta\upsilon}$ where symbols have their usual meanings.

4 Answer any two parts of the following. 10×2=20

(a) Why $Cr^{3+}$ ions are doped in $Al_2O_3$ in ruby laser? Discuss the construction acid 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. 10×2=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?