

2016

OPTION—C

Paper : 60430

(LASER AND ITS APPLICATION)

1. Choose the correct answer from the following : 1×6=6

(a) The ratio of probability of spontaneous emission to probability of stimulated emission is proportional to

(i) ν

(ii) ν^2

(iii) ν^3

(iv) ν^4

(b) What is the necessary and sufficient condition for a laser to start oscillating?

(i) Population inversion should be large

(ii) Losses should be zero

(iii) Threshold condition should be satisfied

(iv) Pumping should be strong

(c) The wavelength 6328 Å of He-Ne laser is due to transition from

(i) 3s-2p level

(ii) 3s-3p level

(iii) 2s-2p level

(d) In case of fringes produced by coherent beams of equal amplitude, fringe visibility is equal to

(i) 1

(ii) 0

(iii) 0.5

(iv) 2

(e) If n_1 and n_2 be the indices of core and cladding respectively of an optical fibre, then

(i) $n_2 > n_1$

(ii) $n_2 \geq n_1$

(iii) $n_1 \geq n_2$

(iv) $n_1 > n_2$

(f) If the same beam of light is reflected back and forth through a medium, then its magnetic rotation

(i) increases

(ii) decreases

(iii) remains same

2. (a) What is population inversion? Discuss optical pumping as a method of achieving population inversion. Why is it necessary for stimulated emission?

(b) Discuss the basic principle of laser action. What are the main components of a basic laser system? 3+3=6

(c) What are the essential conditions for laser oscillation? Derive an expression for longitudinal modes in a laser cavity. 2+4=6

Or

Discuss the threshold condition for laser oscillation. Show that gain per unit length at threshold

$$g = \alpha + \frac{1}{2L} \log_e \left(\frac{1}{R_1 R_2} \right)$$

where α is the total loss coefficient and the second term represents the transmission loss through the mirrors.

2+4=6

3. (a) Describe with suitable diagram the principle, construction and working of a ruby laser. 6

(b) Discuss the working of an ammonia-beam maser. 3

4. (a) What are spatial coherence and temporal coherence? The coherence length of sodium D line ($\lambda = 5890 \text{ \AA}$) is 2.5 m. Calculate the coherence time and spectral width of the line. $2+2+2=6$

(b) Define visibility of fringes. Interference fringes of intensity 0.3 are formed by two light beams having intensities in the ratio 1 : 9. Show that the degree of coherence is only 50%. $1+2=3$

5. What are different classes of optical fibre? What is graded index fibre? What are the advantages of a graded index fibre over a step index fibre? Find the numerical aperture of a step index fibre when the refractive index of the core is 1.51 and that of the cladding is 1.47. $2+2+2+3=9$

Or

Describe the structure of a typical optical fibre. What do you mean by core and cladding of an optical fibre? $5+2+2=9$

6. What is Kerr effect? What is Kerr constant? Describe a Kerr cell and explain how it can be used as an electro-optic shutter.

$2+1+3+3=9$