

2017

OPTION—C

Paper : 60430

( LASER AND ITS APPLICATIONS )

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

(a) The quality factor ( $Q$ ) of a cavity resonator is high, if

(i) the amount of energy stored in the cavity is small

(ii) the amount of energy dissipated in the cavity is large

(iii) the line width is small

(iv) the line width is large

(b) In which of the following mechanisms the adiabatic expansion of the gas is utilized for creating population inversion between two energy levels?

(i) Electrical pumping

(ii) Optical pumping

(iii) Chemical pumping

(iv) Gas dynamic pumping

(c) In ammonia beam maser, separation between upper level and lower level ammonia molecules ( $\text{NH}_3$ ) is done by using the properties/property of

(i) repulsion between the electric field and upper state  $\text{NH}_3$  molecules, and attraction between electric field and lower state  $\text{NH}_3$  molecules

(ii) repulsion between the electric field and lower state  $\text{NH}_3$  molecules, and attraction between the electric field and upper state  $\text{NH}_3$  molecules

(iii) repulsion between electric field and lower state  $\text{NH}_3$  molecules

(iv) attraction between the electric field and upper state  $\text{NH}_3$  molecules

(d) The degree of coherence is higher, if

(i) the degree of monochromaticity is lower

(ii) the degree of monochromaticity is higher

(iii) the degree of divergence of the beam is higher

(iv) the degree of polarization is lower

(e) If  $\mu_1$  and  $\mu_2$  be the refractive indices of core and cladding respectively of an optical fibre, then

(i)  $\mu_1 < \mu_2$

(ii)  $\mu_2 < \mu_1$

(iii)  $\mu_1 \leq \mu_2$

(iv)  $\mu_2 \leq \mu_1$

(f) The phenomenon of splitting of spectral lines emitted by a source into a set of lines due to the application of a strong magnetic field is called

(i) Stark effect

(ii) Zeeman effect

(iii) Faraday effect

(iv) Kerr effect

2. (a) State the different types of processes through which transition between two energy levels of atoms can take place. Discuss how the Einstein's coefficients are related to these processes.  $3+4=7$

Or

Show that Planck's black-body radiation formula can be derived by using Einstein's coefficients. Under what condition the probability of absorption is equal to that of stimulated emission?  $6+1=7$

(b) What is meant by population inversion? Discuss the different types of mechanism used to create population inversion.  $1+4=5$

(c) Derive the threshold condition for laser oscillation.

3. (a) Describe the construction and working of a He-Ne laser. Whether CW or pulse is produced in this laser? 4+1=5
- (b) Explain the principle of generation of laser in semiconductor. 4
4. (a) Describe briefly about five basic requirements for the generation of laser. 5
- (b) Discuss the different types of coherence in laser. 4
5. (a) Describe with diagram how a signal is transmitted through an optical fibre. Also define acceptance cone and acceptance angle of an optical fibre. 4+2=6
- (b) A typical relative refractive index difference of an optical fibre tube design for long distance transmission is 20%. Estimate the numerical aperture and critical angle at core-cladding interface with the fibre, where core refractive index is 1.46. 3
- 6 What is Faraday effect? Describe with necessary arrangement how this effect can be experimentally demonstrated. What is meant by Verdet's constant? 2+6+1=9