F - 982

M.Sc. (Fouth Semester)
EXAMINATION, MAY-JUNE, 2022
PHYSICS
Paper Second
(Laser Physics and Applications)

Time : Three Hours]   *[Maximum Marks : 80*

Note : Attempt all sections as directed.

(Section-A)

(Objective/Multiple Choice Questions)

(1 mark each)

Note- Attempt all questions.

Choose the most appropriate answer.

1. Laser was invented by

   (A) Einstein

   (B) Prof. C.V. Raman

   (C) Town & shallow

   (D) Neil Bohr

2. The correct relationship between coherence "L" and Coherence time "τ" is

   (A) $L = \dfrac{c}{\tau}$

   (B) $L = \tau c$

   (C) $L = \dfrac{\tau}{c}$

   (D) $L^2 = \tau c$

3. An optical resonator is a system of -

   (A) Mirrors between which the active medium is placed

   (B) Mirrors between which the active medium cannot be placed

   (C) Mirrors between which only the pumping device is placed

   (D) None of the above

4. The active medium in a ruby laser is -

   (A) A single crystal of calcium carbonate ($CaCO_3$)

   (B) A single crystal of chromium oxide (Cr_2O_3)

   (C) A single crystal of aluminium oxide (Al_2O_3)

   (D) None of the above

5. An optic fibre is -

   (A) An opaque conduit along which light signals can move over a long distance with very little loses

   (B) A transparent conduit (an artificial channel) along which light signals can move over a long distance very little losses

   (C) A transparent conduit along which signals can move over long distance with heavy losses

   (D) None of the above

6. Pulse laser is -

   (A) Ruby laser

   (B) He-Ne laser

   (C) Chemical laser

   (D) Semiconductor laser

7. The ratio of rate of stimulated emission and rate of self emission is

   (A) $\left(\dfrac{1}{e^{h\nu/kT} - 1} \right)$

   (B) $e^{h\nu/kT}$

   (C) $e^{h\nu/kT} - 1$

   (D) $e^{h\nu/KT}$

8. The wavelength of Ruby laser beam is

   (A) $6328 A^o$

   (B) $5000 A^o$

   (C) $6943 A^o$

   (D) $6000 A^o$

9. Laser isotope separation uses the concept of -

   (A) Difference in atomic number

   (B) Difference in charge

   (C) Difference in nuclear mass

   (D) Difference in colour

10. Second harmonic generation is a -

   (A) Two photon process

   (B) Three photon process

   (C) Four photon process

   (D) None of the above

11. The ratio of Einstein coefficients A_{21} and B_{21} is given by -

(A) $\dfrac{A_{21}}{B_{21}} = \dfrac{\hbar^3 w^3}{\pi^2 c^3}$

(B) $\dfrac{A_{21}}{B_{21}} = \dfrac{\hbar w^3}{\pi^2 c^3}$

(C) $\dfrac{A_{21}}{B_{21}} = \dfrac{\hbar^2 w^3}{\pi^2 c^3}$

(D) $\dfrac{A_{21}}{B_{21}} = \dfrac{\hbar^2 w^3}{\pi^2 c^3}$

12. Laser beam is not -

(A) Monochromatic

(B) Unidirectional

(C) Coherent

(D) Non-Coherent

13. For Laser action, the minimum number of energy states of activated substance should be -

(A) 1

(B) 2

(C) 3

(D) Zero

14. Tunable laser is -

(A) Dye Laser

(B) Semiconductor Laser

(C) He-Ne Laser

(D) Ruby Laser

15. The scattering of radiation with change of frequency is called -

(A) Raman Scattering

(B) Rayleigh's Scattering

(C) Hyper Raman Scattering

(D) None of the above

16. Line broadening mechanism is -

(A) Homogeneous broadening

(B) Non-homogeneous broadening

(C) Both (A) and (B)

(D) None of the above

17. If S is the energy density of light field, then the intensity is given by -

(A) $I = \delta/\nu$

(B) $I = \delta \nu$

(C) $I = \dfrac{\nu}{\delta}$

(D) None of the above

18. The fingerprints can be detected by -

   (A) Argon ion laser

   (B) CO_2 laser

   (C) Dye laser

   (D) Ruby laser

19. Lidar is also known as -

   (A) Li-radar

   (B) Li-Ar radar

   (C) Laser radar

   (D) None of the above

20. If the FWHM spectral width is $\Delta\lambda$, then coherence length L will be -

   (A) $\dfrac{L}{\Delta\lambda}$

   (B) $\dfrac{\lambda}{L}$

   (C) λL

   (D) $\dfrac{\lambda^2}{\Delta\lambda}$ The ratio of Einstein coefficients A_{21} and B_{21} is

given by The ratio of Einstein coefficients A_{21} and B_{21} is given by The ratio of Einstein coefficients A_{21} and B_{21} is given by The ratio of Einstein coefficients A_{21} and B_{21} is given by

(Section- B)

(Very Short Answer Type Questions)

(2 marks each)

Note : Attempt all questions.

1.   What do you mean by spontaneous emission?

2.   What is Q-factor?

3.   What is the principle of CO_2-laser?

4.   What is phone matching?

5.   What is Rayleigh's scattering?

6.   What is ether drift?

7.   What is pulse dispersion?

8.   What do you mean by optical mixing?

(Section - C)

(Short Answer Type Questions)

(3 marks each)

Note : Attempt all questions.

1. Explain coherence and monochromacity.

2. What do you mean by solid state lasers?

3. What is Harmonic generation?

4. What do you mean by Laser Spectroscopy?

5. Discuss laser applications in astronomy.

6. What is optical fibre?

7. Explain Quantum yield.

8. Explain anti-stoke scattering.

Section D

(Long Answer Type Questions)

(5 marks each)

Note:- Attempt all questions.

1. Discuss Einstein's quantum theory of radiation.

OR

Discuss two and three laser systems with suitable examples.

2. Discuss molecular gas lasers and their applications.

OR

Discuss laser amplifiers and their applications.

3. Explain multi-quantum photoelectric effect in detail.

OR

Discuss photo-acoustic Raman spectroscopy and its potential uses in industry.

4. Discuss thermonuclear fusion and its applications.

OR

Discuss propagation of light in a medium with variable index.