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(Pages : 2)

Name.....

Reg. No.....

FOURTH SEMESTER M.Sc. DEGREE EXAMINATION, JUNE 2019

(CUCSS—PG)

Physics

PHY 4E 13—LASER SYSTEMS, OPTICAL FIBRES AND APPLICATIONS

(2017 Admissions)

Time : Three Hours

Maximum : 36 Weightage

Section A

Answer all questions, each question carries weightage 1.

1. Briefly explain mode locking.
2. Find the ratio between Einstein's co-efficients in red He-Ne laser. Given wavelength of He-Ne laser is 632.8nm.
3. Distinguish between collision broadening and Doppler broadening in laser.
4. Describe the advantages of fibre laser and indicate how they are achieved.
5. Give the setup of flash lamp pumped pulsed ruby laser. Describe laser spiking in ruby laser.
6. What are the requirements for second harmonic generation ?
7. Describe multi quantum photoelectric effect.
8. Describe Z-scan technique.
9. Discuss any *two* applications of spatial frequency filtering.
10. Describe any *one* method of isotope separation using laser.
11. Distinguish between step index fiber and graded index fiber. Which one do you prefer for communication purpose ? Give reason.
12. How is light propagated through optical fibers ? What are the advantages of communication through optical fibers ?

(12 × 1 = 12 weightage)

Turn over

Section B

Answer any two questions, each question carries weightage 6

13. Explain the theory of Q-switching. Discuss the generation of high power pulses through Q-switching.
14. Illustrate the theory of the parametric amplification in a nonlinear crystal.
15. Describe the theory and experimental techniques of third harmonic generation.
16. Describe the applications of laser in (a) Material processing (b) Laser tracking.

(2 × 6 = 12 weightage)

Section C

Answer any four questions, each question carries weightage 3.

17. For a ruby laser, given that the wave length emitted is 6943\AA , $t_{sp} = 3 \times 10^{-3}\text{s}$, refractive index of the active medium is = 1.76, reflectivity of two mirrors are 0.9, find the threshold value for $N_1 - N_2$ if the average loss per unit length is assumed to be zero. Given the normalized line shape function is equal to 1.1×10^{-12} .
18. Compare the CO_2 laser with He-Ne Laser with respect to energy level diagram, frequency of emission, pumping and efficiency.
19. Find the phase matching criteria and hence the refractive index criteria for the efficient second harmonic generation.
20. Describe the theory of recording of image and reconstruction of image in a hologram.
21. For a step index fiber with $n_1 = 1.48$, $n_2 = 1.46$ show that all the rays making an angle $< 9^\circ.47$ with the z axis will be guided through the fiber.
22. Consider a step index fiber with $n_1 = 1.461$, $n_2 = 1.458$ and $a = 5\text{mm}$. Show that the fiber is single moded for the wavelength $> 1.22 \mu\text{m}$.

(4 × 3 = 12 weightage)