

FOURTH SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2022
(Regular/Improvement/Supplementary)

PHYSICS
FPHY4E13 - LASER SYSTEMS, OPTICAL FIBRES AND APPLICATIONS

Time: 3 Hours

Maximum Weightage: 30

Part A: Short answer questions. Answer *all* questions. Each carries *one* weightage.

1. What are the conditions for minimum threshold value for population inversion?
2. What is stimulated emission?
3. Give the concept of multiquantum effect.
4. What is meant by frequency mixing?
5. Define Numerical aperture.
6. What are the advantages of using optical fibers?
7. Compare a hologram and a photograph.
8. What is meant by spiking?

(8 × 1 = 8 weightage)

Part B: Essay questions. Answer any *two* questions. Each carries *five* weightage.

9. Obtain the laser rate equations for a 3-level laser system.
10. Explain the phenomena of second harmonic and third harmonic generation in a non linear medium. Obtain the phase matching condition for second harmonic generation.
11. Explain the principle of spacial frequency filtering. Explain in detail the formation of image pattern in this technique. What are its applications?
12. Compare the propagation mechanism and properties of step index and graded index fibers. Explain single mode and multimode fiber? Obtain an expression for numerical aperture and modes of a step index fiber.

(2 × 5 = 10 weightage)

Part C: Problems. Answer any *four* questions. Each carries *three* weightage.

13. Calculate the pulse width and spacial length of mode -locked pulse of He-Ne laser with
 $\Delta\nu = 1.5 \times 10^9$ Hz.
14. Describe how mode locking is effected in lasers?

(P.T.O.)

15. Find the ratio of population of two states in a He-Ne laser that produces a light of wavelength 6328 \AA at $27 \text{ }^\circ\text{C}$.
16. Explain the working of Fibre laser.
17. Give the concept of z scan.
18. Calculate the laser energy required for a laser induced fusion reaction in a fuel of density 300 Kg m^{-3} , fuel radius is 0.1 m . The fraction of energy used up for heating is 0.1 .
19. A step index fibre is made with a core of refractive index 1.54 , a diameter of $295 \text{ }\mu\text{m}$ and a fractional refractive index difference of 7×10^{-4} . It is operated at a wavelength of $1.3 \text{ }\mu\text{m}$. Find the V number and the number of modes that the fibre will support.

(4 × 3 = 12 weightage)