D4APH2202 **(2 Pages)** **Name.....**
Reg.No.....

FOURTH SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2024
(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. Give an example for four level laser system. With neat diagram discuss why lasing action is easy in four level laser system.
2. Discuss the technique for obtaining Q-switched pulse using mechanical method.
3. Explain the working of a semiconductor laser.
4. Discuss Four-wave mixing.
5. Explain quality factor of cavity.
6. Discuss the energy level diagram of an Argon laser.
7. Describe the use of Laser in medicine.
8. Distinguish between step index and graded index fiber.

(8 × 1 = 8 weightage)

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

9. Derive the laser rate equation for three level systems and explain the conditions for population inversion.
10. Explain the modes of a rectangular cavity and discuss the advantage of open cavity? Also explain the quality factor of cavity.
11. Discuss how lasers are used in fusion reaction. Explain the working of a laser induced fusion reaction.
12. Discuss the wave equation in step index fiber.

(2 × 5 = 10 weightage)

(P.T.O.)

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

13. Calculate the relative population of two states of a laser that produces light of wavelength 5421 A° at 300 K. $k_B = 8.6X10^{-5}$ eV/K.

14. In a particular laser system, E (excited)= 20.66 eV, E (metastable)= 18.70 eV and E(ground)= 0eV. Find the wavelength emitted at 300K.

15. Describe second harmonic generation in lasers.

16. The wavelength of emission of a system is 6000 Å and the coefficient of spontaneous emission is 106/s. Determine the coefficient of stimulated emission.

17. Find the fractional burn-up of a fuel in a fusion reaction in which density= 0.25g/cm^3 and R= 3 cm.

18. Compute numerical aperture and acceptance angle from the following data. μ1(core) = 1.53, μ2(cladding)= 1.48.

19. Compute the cut-off parameter and the number of modes of a fibre of core diameter 50 μm and μ1= 1.47, μ= 1.45 and operating wavelength= 0.85μm.

(4 × 3 = 12 weightage)