**D 121314** **(Pages : 2)** **Name.....**

**Reg. No.....**

**FOURTH SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, APRIL 2025**

(CBCSS)

Physics

PHY 4E 14—LASER SYSTEMS, OPTICAL FIBRES AND APPLICATIONS

(2019 Admission onwards)

Time : Three Hours Maximum : 30 Weightage

**Section A**

(8 *Short questions answerable within* 7.5 *minutes*)

*(Answer* **all** *questions, each carries weightage* 1)

1. Explain spontaneous and stimulated emissions.
2. Briefly explain four wave mixing.
3. Bring out the different applications of holography.
4. Define numerical aperture. State the relation between numerical aperture and acceptance angle.
5. What are leaky modes ? Explain the mechanism for their occurrence.
6. Explain briefly optical parametric oscillator.
7. What are the characteristic properties of laser light ?
8. Differentiate between step index and graded index fiber.

(8 × 1 = 8 weightage)

**Section B**

(4 *Essay questions, each answerable within* 30 *minutes*)

*(Answer any* **two** *questions, each carries weightage* 5)

9. Explain the theory of Q-switching. Discuss the generation of high-power pulses through Q-switching.
10. With an energy level diagram, explain the construction and working of the Helium-Neon laser.

**Turn over**

11. What is nonlinear polarization ? Derive an expression to prove the existence of the second and third harmonic generation.

12. Describe the applications of laser in : (a) Industrial application of lasers ; (b) Lasers in medicine ; and (c) Laser induced chemical reactions

(2 × 5 = 10 weightage)

## Section C

(7 *problems answerable within* 15 *minutes*)

*(Answer any* **four** *questions, each carries Weightage* 3)

13. Describe the theory of recording of image and reconstruction of image in a hologram.

14. An Nd:YAG laser emits 1064 nm. with a bandwidth of 0.1 nm. Determine the minimum possible laser pulse duration achievable from this laser without using any special techniques.

15. Derive an expression for Einstein co-efficients.

16. Calculate the gap in frequency between two longitudinal modes in a linear cavity whose optic length, L, = 225 mm.

17. Determine the radiance of a 5 mW helium-neon laser having an output diameter of 2 mm. and a divergence of 1 mrad.

18. Describe Z-scan technique.

19. A step index fibre has a numerical aperture of 0.395, core refractive index of 1.55. Calculate the refractive index of cladding, and the acceptance angle.

(4 × 3 = 12 weightage)