

FOURTH SEMESTER M.Sc. DEGREE EXAMINATION, MARCH 2020

(CUCSS)

Physics

PHY 4E 13—LASERS AND FIBRE OPTICS

(2012 Admissions)

Time : Three Hours

Maximum : 36 Weightage

Part A*Answer all questions.**Each question carries a weightage of 1.*

1. What is meant by population inversion in a laser ?
2. What is the significance of A and B co-efficients ?
3. Describe the basic concepts of a laser.
4. How can you achieve low pass and high pass filtering in optics ?
5. What factors determine the non-linear polarization of a system ?
6. What do you understand by 'Numerical Aperture' of a fiber ?
7. How spectral dispersion occurs in a fiber ?
8. Explain leaky modes in a fiber.
9. What are the different insertion losses in a fiber ?
10. Explain Rayleigh scattering.
11. What do you mean by splicing ?
12. How do you determine refractive index by the reflection method ?

(12 × 1 = 12 weightage)

Part B*Answer any two questions.**Each question carries a weightage of 6.*

13. Establish the rate equations of transactions for three level laser. Solve the equations for a typical laser in steady state and hence derive an expression for threshold pumping power.

Turn over

14. What is the role of optical resonator in a laser device. Describe with energy level diagram the working of He-Ne laser.
15. What is meant by propagation modes in a fiber? Using simple ray picture, determine the maximum number of modes that can propagate in a planar step index fiber.
16. What is meant by OTDR? Explain how you can measure attenuation using this?

(2 × 6 = 12 weightage)

Part C

Answer any **four** questions.

Each question carries a weightage of 3.

17. A He-Ne laser emitting a wavelength of 6328\AA has a beam diameter of 2 mm at the exit pupil. How large would be its diameter at target 100 km away assuming that divergence is diffraction limited only.
18. Consider a He-Ne laser cavity of length 50 cm mounted between two mirrors of reflectivity $r_1 = 0.998$ and $r_2 = 0.980$. Determine the threshold gain for the system.
19. Calculate the refractive index of the core and cladding of a fiber with numerical aperture = 0.2 and $\Delta = 0.012$.
20. Consider a step index fiber of $n_1 = 1.46$ and $n_2 = 1.45$. If fiber acts as a single mode fiber for wavelength $\lambda = 1\ \mu\text{m}$, what is the core radius of the fiber possible?
21. A continuous 10 Km long fiber has a loss of 1.2 db/km. What is the required input power if the fiber has a loss of 2.0 db/km.
22. Determine the cut-off wavelength for a step index fiber to exhibit single mode operation when the core refractive index and radius are 1.46 and $4.5\ \mu\text{m}$ respectively with the relative index difference being 0.25 %.

(4 × 3 = 12 weightage)