15. The numerical aperture and refractive index of cladding of an optical fibre when surrounded by air are 0.24 and 1.60 respectively. Determine the refractive index of its core. If the same optical fibre is in a medium of refractive index 1.33, find its acceptance angle.

16. In a step index optical fibre, the refractive index of core is 1.5 with core diameter of 40 μm and fractional change in refractive index as 0.015 which is operating at 850 nm, estimate the number of modes.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

17. a) Is the shape of the emerging wavefront from a convex lens, when a point source is placed at its focus, curved ? Explain.

    b) Does interference phenomenon reveal the transverse nature of light ? Explain.

    c) Can ordinary visible light be used to study the crystal structure ? Explain.

    d) Comment on the statement "The resolving power of a grating is independent of grating constant". Then how can the resolving power be increased ?

    e) Is the population inversion the equilibrium or non-equilibrium condition of the material ? Justify.

    f) Name two commonly used devices which makes use of polarized light.

    g) It is noticed that on rotation of the polarizer, the intensity of light varies but never reduces to zero. Mention the nature of polarization of light that is incident on the polarizer.

    h) In free space, is the electromagnetic wave Transverse Electric (TE) or Transverse Magnetic (TM) ? Explain.

SE – 155

Fourth Semester B.Sc. Examination, September 2020
(Repeaters) (CBCS – 2015-16 and Onwards / Prior to 2017-18)
PHYSICS – IV
Physical Optics, Lasers and Fibre Optics

Time : 3 Hours Max. Marks : 70

Instructions : *i) Use of only non programmable scientific calculator is **permitted**.*
*ii) Answer **any five** questions from **each** Part.*

PART – A

Answer **any five** questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) Verify the law of reflection for a spherical wavefront at a plane reflecting surface using Huygen's wave theory.
   b) What is a wave front ? Describe Huygen's construction of a wavefront. **(5+3)**

2. a) What are the main two methods of producing Coherent sources ?
   b) Describe with necessary theory the formation of interference fringes in thin films by transmitted light. **(2+6)**

3. a) Distinguish between Fresnel and Fraunhofer diffraction.
   b) Describe how a plane wavefront can be divided into Fresnel's half period zones of radii proportional to square root of natural numbers. **(2+6)**

4. a) What is the resolving power of an optical instrument ?
   b) Describe the theory of diffraction grating for oblique incidence (minimum deviation method). **(2+6)**

5. a) Explain spontaneous and stimulated emission of radiation.
   b) Explain in detail the basic components of a laser.
   c) What is Holography ? Mention the principle involved in holography. **(2+3+3)**

6. a) Give Huygen's explanation of double refraction for uniaxial crystals.
   b) What is half wave plate ? Arrive at the expression for the thickness of half wave plate. **(4+4)**

P.T.O.

7. a) Why are glass fibres preferred in Optical fibres ?
   b) What are coherent bundles ?
   c) What is Numerical aperture ? Derive an expression for the numerical aperture with a neat diagram. **(2+1+5)**

8. a) Define (i) Attenuation coefficient (ii) Cutoff wavelength and write the expressions for the same.
   b) Write a note on fibre optic sensors. **(4+4)**

PART – B

Solve **any five** problems. **Each** problem carries **four** marks. **(5×4=20)**

9. On placing a thin glass sheet in the path of one of the interfering beam of a biprism setup, the central fringe was found to shift through a distance equal to thrice the fringe width. Calculate the thickness of the sheet. Given the refractive index of sheet is 1.5 and the wavelength of light used is 589.3 nm.

10. In a Newton's ring experiment, the diameters of fifth and fifteenth dark rings are 0.336 cm and 0.590 cm respectively. If the radius of curvature of the curved surface of plano-convex lens used be 1 m, find the wavelength of light used.

11. In an experiment with diffraction at a straight edge, the distance between slit and the edge is 1.2 m and that between edge and the screen is 2.5 m. If the wavelength of light used is 560 nm, find the separation of first three bright fringes.

12. The two head lights of an approaching vehicle on a level road are 1.1 m apart. If the diameter of the pupil of an observer (eye) is 3 mm, find the distance of the observer from the vehicle for just resolution. Assuming the mean wavelength of light as 668.2 nm.

13. Calculate the ratio of population of the two energy states of a laser in which the transition among the two states results in the emission of photons of wavelength 694.3 nm at a temperature of 20°C. Given Boltzmann constant $k = 1.38 \times 10^{-23} JK^{-1}$ and Planck's constant = 6.63×10^{-34} JS.

14. 15 g of sugar is dissolved in 150 ml of water. The resultant solution obtained when placed in a column of length 20 cm in polarimeter rotates the plane of polarization by 17°. Calculate the specific rotation of sugar solution.