61421

IV Semester B.Sc. Examination, September/October 2022
(CBCS) (Freshers + Repeaters) (2017 – 18 and Onwards)
PHYSICS – IV
Optics and Fourier Series

Time : 3 Hours Max. Marks : 70

Instruction : *Answer **any five** questions from **each** Part.*

PART – A

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

1. a) Explain Huygen's principle.
   b) Deduce the law of refraction for a spherical wavefront on a plane surface using Huygen's principle. **(2+6)**

2. Obtain an expression for the thickness of a glass plate using Fresnel's biprism. **8**

3. a) What is a zone plate ?
   b) Derive an expression for the focal length of a zone plate. **(1+7)**

4. Describe with necessary theory, Fraunhofer diffraction at a single slit and arrive at conditions for position of maxima and minima. **8**

5. What are retarding plates ? Give the theory of retarding plates. **(2+6)**

6. a) What is meant by population inversion ?
   b) Describe with energy level diagram the construction and working of Ruby laser. **(2+6)**

7. Write the mathematical form of Fourier theorem and evaluate the Fourier coefficients. **8**

8. a) Define numerical aperture and acceptance angle of an optical fibre.
   b) Derive an expression for numerical aperture of an optical fibre. **(2+6)**

P.T.O.

PART – B

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

9. An air wedge of length 2.4×10^{-2} m is illuminated by a monochromatic light of wavelength 5893 Å. If the distance between successive fringe is 0.954×10^{-4} m, calculate the thickness of the object kept between the two optically plane glass forming the air wedge.

10. In a Newton's ring experiment, the diameter of the 5^{th} ring was 0.3×10^{-2} m and the diameter of 25^{th} ring was 0.8×10^{-2} m. If the radius of curvature of the plano-convex lens is 1 m, find the wavelength of light used.

11. A zone plate has a diameter of 10 mm. If a light of wavelength 6000 Å falls on it, it comes to focus at a distance of 0.8 m from the zone plate. Calculate the number of zones in the zone plate.

12. In Fraunhofer diffraction pattern due to a narrow slit a screen is placed 2 m away from the lens to obtain the pattern. If the slit width is 0.2 mm and the first minima lie 5 mm on either sides of the central maximum, find the wavelength of light.

13. A column of sugar solution of 0.2 m rotates the plane of polarisation of light through 34°. If the specific rotation of sugar solution is 0.0118 SI unit, calculate the concentration of the solution.

14. A laser beam is focussed on a surface area of 0.5 mm diameter. If the power of the laser source is 5 mW and the wavelength is 6328 Å, calculate the intensity and energy of the photons emitted.

15. Show that the function $f_1(x) = x^2$ and $f_2(x) = x^3$ are orthogonal in the interval $[-1, 1]$.

16. A ray is travelling from air to an optical fibre of core and cladding of refractive indices 1.48 and 1.46 respectively. Calculate the critical angle and numerical aperture.

PART – C

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

17. a) Does the fringe width decrease with the increase of separation between the coherent sources ? Explain.

    b) Are the interference pattern in reflected and transmitted light mutually complimentary ? Justify.

    c) Is it possible to get a diffraction pattern due to a wide slit ? Justify.

    d) Is angular dispersion independent of grating element ? Justify.

    e) Can sound waves be polarised ? Explain.

    f) Is laser a coherent light ? Justify.

    g) Can we express any function in the form of a Fourier series ? Explain.

    h) Can the refractive index of the core be less than the cladding ? Explain.
