SM – 347

IV Semester B.Sc. Examination, May/June 2018
(CBCS) (Freshers) (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) Verify the law of reflection for a spherical wave front incident on a plane surface using Huygen's wave theory.

   b) Obtain an expression for the displacement of fringes when a thin transparent film is introduced in the path of one of the interfering beams in biprism. **(4+4)**

2. a) Describe with theory the formation of bright and dark interference fringes in the light reflected from a thin film.

   b) What are Newton's rings ? Explain. **(6+2)**

3. a) Derive an expression for the focal length of a zone plate.

   b) Mention any three differences between a zone plate and a convex lens. **(5+3)**

4. Explain Fyaunhofer diffraction at a single slit. Deduce the expressions for positions of central maximum, secondary maxima and minima. **8**

5. What are retarding plates ? Give the theory of retarding plates. **8**

6. a) What is meant by spontaneous and stimulated emissions ?

   b) Describe with energy level diagram the construction and working of Ruby laser. **(3+5)**

7. a) State Fourier's theorem.

   b) Analyse the triangular wave by Fourier theorem. **(2+6)**

P.T.O.

8. a) Define Numerical aperture. Derive an expression for numerical aperture of an optical fibre.

   b) Write a note on attenuation in an optical fibre due to bending losses. (5+3)

PART – B

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

(Velocity of light $C = 3 \times 10^8 ms^{-1}$)

(Boltzmann constant $k = 1.38 \times 10^{-23} JK^{-1}$)

9. In a Biprism experiment bands of width 0.02×10^{-2}m are observed at 1 m from the slit. On introducing a convex lens 0.3 m away from the slit, two images of the slit are seen 0.7×10^{-2}m apart at 1 m distance from the slit. Calculate the wavelength of light used.

10. A beam of monochromatic light of wavelength 582 nm falls normally on a glass wedge with the wedge angle of 20 seconds of an arc. If the refractive index of glass is 1.5, find the number of dark fringes per cm of the wedge length.

11. A narrow slit illuminated with monochromatic light of wavelength 589 nm is placed at a distance of 0.1 m from a straight edge. If the distance between the straight edge and the screen is 1.9 m, calculate the distance between the first and the fourth dark bands.

12. A diffraction grating containing 6×10^5 lines/m is used at normal incidence. Calculate the dispersive power of the grating in the second order spectrum of wavelength 500 nm.

13. A certain length of 5% solution causes, the optical rotation of 20°. How much length of 10% solution of the same substance will cause 35° rotation ?

14. Light from a 2.5 mW laser source of aperture diameter 1.8×10^{-2}m and wavelength 500 nm is focussed by a lens of focal length 0.20 m. Compute :

   a) the area and

   b) the intensity of the image.

15. Obtain a Fourier expression for $f(x) = x^3$ for $-\pi < x < \pi$.

16. A step index fibre is with a core of refractive index 1.55 and cladding of refractive index 1.51. Compute the intermodal dispersion per kilometer of length of the fibre and the total intermodal dispersion in a 15 km length of the fibre.

PART – C

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

a) Can we observe the interference pattern when the two coherent sources are too far apart ? Explain.

b) Why Newton's rings are circular but air wedge fringes are straight ?

c) Is coloured spectrum seen when we look at a white source of light through a muslin cloth ? Explain.

d) Is telescope with large diameter of the objective preferred to observe heavenly bodies ? Explain.

e) Is there any change in the intensity of light after polarization ? Explain.

f) Under thermodynamic equilibrium is population inversion a negative temperature state ? Justify.

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

h) Are there any basic conditions to be satisfied for the transmission of light through an optical fibre ? Explain.
