

IV Semester B.Sc. Examination, May 2017  
 (F+R) (NS – 2012-13 and Onwards)  
 (CBCS-2015-16 and Onwards)  
 PHYSICS – IV  
 Physical Optics, Laser and Fibre Optics

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. (8×5=40)

1. a) Mention two methods of obtaining coherent sources.  
 b) Give the theory of Fresnel's biprism and obtain an expression for the bandwidth of interference fringes. (2+6)
2. a) Why does the centre of Newton's ring pattern appear dark in reflected light ?  
 b) Explain with a diagram and necessary theory, the interference in a wedge shaped thin film. Obtain an expression for the fringe width. (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) Define dispersive power and resolving power of a grating.  
 b) Obtain an expression for the resolving power of a plane transmission grating. (2+6)
5. a) Mention three important characteristic properties of laser light.  
 b) Derive a relation between Einstein's coefficients  $A_{21}$  and  $B_{21}$ , where the symbols have their usual meaning. (3+5)
6. a) Define optical activity. What are dextro and leavorotatory substances ?  
 b) What are retarding plates ? How can circularly polarized light be produced and detected ? (3+5)



7. a) What is an optical fibre ? Explain the principle involved in its working.  
b) Define numerical aperture. Obtain an expression for the same.
8. a) Define (i) Modes in fibre (ii) Cut-off wavelength.  
b) Explain different types of losses in an optical fibre.  
c) Write any two applications of optical fibres.

## PART - B

Solve **any five** problems. **Each** problem carries **four** marks.

9. When a thin sheet of transparent material of refractive index 1.60 is introduced in the path of one of the interfering beams of biprism, the central fringe shifts to a position occupied by the 8<sup>th</sup> bright fringe. If the wavelength of light used is 550 nm, calculate the thickness of the material.
10. In Newton's ring experiment, the diameters of the 4<sup>th</sup> and 10<sup>th</sup> dark rings are 0.40 cm and 0.70 cm respectively. Find the diameter of the 16<sup>th</sup> dark ring.
11. In an experiment on diffraction of light at straight edge, the distance between the slit and the straight edge is 1.5 m and that between the straight edge and screen is 3.2 m. Find the separation between the 1<sup>st</sup> and 4<sup>th</sup> dark fringes. The wavelength of light used is 560 nm.
12. A diffraction grating with  $7 \times 10^5$  lines per meter is set at normal incidence. Calculate the dispersive power of the grating in the second order spectrum if the wavelength of light is 600 nm.
13. A laser beam with power per pulse 2.2 mW lasts 10 ns and contains  $8 \times 10^7$  photons per pulse. Calculate the wavelength of laser light.
14. 0.01 Kg of an optically active substance is dissolved in  $10^{-4}$  m<sup>3</sup> of water. The solution is placed in a polarimeter tube of length 0.2 m. Calculate the specific rotation of the substance if the angle of rotation of plane of vibration produced by the solution is 20°.
15. Numerical aperture and fractional index difference of an optical fibre are 0.30 and 0.02 respectively. Calculate the refractive index of the core and the cladding.
16. What is the total number of modes when the wavelength of light is 1.35  $\mu\text{m}$  ?  
Given : Core diameter to be 45  $\mu\text{m}$  and the numerical aperture to be 0.40.



PART - C

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

17. a) The interference patterns of the reflected rays and transmitted rays in thin film are complementary. What does this mean ?
  - b) Can interference be obtained by using two independent sources ? Explain.
  - c) Why does a zone plate exhibit the defect of chromatic aberration ? Explain.
  - d) How does the width of the central maximum change when the width of the slit is increased in a single slit Fraunhofer diffraction ?
  - e) What is the principle of holography ?
  - f) What is the nature of polarization of light incident on a polarizer when, on rotating the polarizer, the intensity varies but never reduces to zero ?
  - g) What is meant by TE mode and TM mode ?
  - h) What is meant by pulse dispersion in optical fibres ?
-