MS – 299

IV Semester B.Sc. Examination, May 2016
(CBCS – 15 – 16 and Onwards)
PHYSICS – IV
Physical Optics, Laser and Fibre Optics
(NS-Repeater-2012-13 and Onwards)

Time : 3 Hours

Max. Marks : 7

Instructions : *Answer* ***any five*** *questions from Part – A,* ***five*** *questions from Part – B and* ***five*** *questions from Part – C.*

PART – A

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

1. Explain Huygen's principle and deduce the law of reflection for a spherical wave on a plane surface. 8

2. Derive an expression for the shift in the fringes in the interference pattern due to introduction of a thin mica sheet in the path of one of the interfering beams in the Biprism experiment. 8

3. a) What is a zone plate ? What are positive and negative zone plates ?
   b) Describe the action of a zone plate and show that it acts like a convex lens. (3+5)

4. Describe with necessary theory Fraunhofer diffraction at a single slit and hence obtain the directions of central maximum, secondary maxima and minima. 8

5. a) What are spontaneous and stimulated emissions in two level system ?
   b) Derive the relation between transition probabilities of spontaneous and stimulated emissions in terms of Einstein's coefficients. (2+6)

6. What are retarding plates ? Give the theory of retarding plates. 8

7. a) Explain :
      i) Numerical aperture
      ii) Acceptance angle of an optical fibre.
   b) Derive an expression for numerical aperture. (4+4)

8. a) What are coherent and incoherent bundles ?
   b) Derive an expression for the internodal dispersion in a step index multimode fibre. (2+6)

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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) (2+6)

7. a) State Fourier's theorem.

   b) Analyse the triangular wave by Fourier theorem.

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M – 347

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.

PART – B

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

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

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

. 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.

. 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.

. 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.

. 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.

. 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 ?

. 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.

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

. 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

PART – C

7. 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.

PART – C

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

) The interference patterns of the reflected rays and transmitted rays in thin film are complementary. What does this mean ?

) Can interference be obtained by using two independent sources ? Explain.

) Why does a zone plate exhibit the defect of chromatic aberration ? Explain.

) How does the width of the central maximum change when the width of the slit is increased in a single slit Fraunhoffer diffraction ?

) What is the principle of holography ?

) 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 ?

) What is meant by TE mode and TM mode ?

) What is meant by pulse dispersion in optical fibres ?

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 the position occupied by the 8^{th} 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^{th} and 10^{th} dark rings are 0.40 cm and 0.70 cm respectively. Find the diameter of the 16^{th} 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^{st} and 4^{th} dark fringes. The wavelength of light used is 560 nm.

12. A diffraction grating with 7×10^5 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 8×10^7 photons per pulse. Calculate the wavelength of laser light.

14. 0.01 Kg of an optically active substance is dissolved in 10^{-4} m^3 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 μm ?
    Given : Core diameter to be 45 μm and the numerical

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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 Fraunhoffer 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)**

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