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 : 70

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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PART – B

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

9. In an experiment with biprism, the fringes are 0.2 mm thick and are observed 1.5 m away from the slit. A convex lens introduced between the biprism and screen gives an image of the sources which are separated by 0.7 cm on the screen. If the lens is 30 cm from the slit, find the wavelength of light used.
10. A plane convex lens of radius 0.5 m is placed on an optically flat glass plate and is illuminated by monochromatic light. The diameter of the 10^{th} dark ring in the reflected light is 0.125 cm. Calculate the wavelength of light used.
11. A narrow slit illuminated by light of wavelength 6000 Å is placed at a distance of 3 m from a straight edge. If the distance between the straight edge and the screen is 6 m, calculate the distance between the first and the 4^{th} dark band.
12. Calculate the minimum number of lines on a grating required to resolve the spectral lines of wavelength 5770 Å and 5790 Å in the second order spectrum.
13. Calculate the concentration of the sugar solution if the plane of polarization is rotated through an angle of 26.4° while travelling through 0.2m length of the solution, given specific rotation of sugar solution as 0.011 rad m^2kg^{-1}.
14. Calculate the energy difference in eV between the two energy levels of the Ne atoms of a He-Ne gas laser, the transitions between which results in the emission of light of wavelength 630 nm. Also, calculate the number of photons emitted per second, if the optical power output is 2mW.
15. An optical fibre has a numerical aperture of 0.2 and a cladding refractive index of 1.55. Determine the acceptance angle for the fibre in water that has a refractive index of 1.33.
16. What is the total number of mode when the wavelength of light is 1300 nm ? Given the core diameter as 50 μm and numerical aperture of the fibre is 0.42.

PART – C

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

17. a) Does the interference phenomena obey the law of conservation of energy ? Explain.
    b) Thin films of oil on water appear coloured when seen under sunlight. Why ?
    c) Is diffraction more pronounced in sound or light waves ? Explain.
    d) In single slit Fraunhofer diffraction, how does the width of central maximum change when the width of the slit is increased ?
    e) Can sound waves be polarized ? Explain.
    f) If on rotation of the polarizer, the intensity of light varies, but never reduces to zero, then what is the nature of polarization of light incident on the polarizer ?
    g) Light travels in straight line, yet how is it transmitted through a curved optical fibre ?
    h) What happens if wave guide parameter becomes less than 2.405 ? Explain.