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GS-302

IV Semester B.Sc. Examination, May/June - 2019
(NS - 2012-13 & onwards) (CBCS - 2015-16 & onwards)
(Repeaters) (Prior to 2017-18)

PHYSICS - IV

Physical Optics, Lasers and Fibre Optics

Time : 3 Hours Max. Marks : 70

Instruction : *Answer **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. **5x8=40**

1. (a) State and explain Huygen's principle. **3+5**
(b) Verify the law of refraction for a spherical wavefront at a plane surface using Huygen's wave theory.

2. (a) What are coherent sources ? Mention any one method of producing coherent sources. **3+5**
(b) Give the theory of Fresnel's biprism and obtain the expression for width of interference fringes.

3. (a) Describe how a plane wavefront can be divided into Fresnel's half period zones of radii proportional to square root of natural numbers. **5+3**
(b) Mention any three differences between a Zone-plate and a Convex lens.

4. (a) Define dispersive power and resolving power of a grating. **2+6**
(b) Obtain an expression for the resolving power of a plane transmission grating.

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

6. (a) Write two characteristics of laser beam. **2+6**
(b) Describe the construction and working of Helium-Neon laser with its energy level diagram.

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

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8. (a) What are coherent and incoherent bundles ? 2+6

(b) Derive an expression for the internodal dispersion in a step index multimode fibre.

PART - B

Solve **any five** problems. Each problem carries **four** marks. 5x4=20

9. When a thin sheet of transparent material of refractive index 1.52 is introduced in the path of one of the interference beams, the central fringe shifts to a position occupied by the tenth bright fringe. If the wavelength of light used is 548.1 nm, calculate the thickness of the material.

10. In Newton's rings experiment the diameters of third and ninth rings are 0.3 cm and 0.5 cm respectively. Calculate the diameter of fifteenth ring.

11. If the diameter of the central zone is 2.8 mm and a point source of light of wavelength 660 nm is placed 6 m away from the zone plate, find the position of the primary image.

12. A diffraction grating with 7000 lines per cm 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. Determine the concentration of a solution of length 0.25 m. which produces an optical rotation of 30°. The specific rotation of the solution is 0.0209 rad m^2 kg^{-1}.

14. A laser beam with power per pulse 2 mW lasts 10 ns, contains 7.5×10^7 photons per pulse. Calculate the wavelength of laser light.

15. Numerical aperture and fractional index difference of an optical fibre are 0.35 and 0.01 respectively. Calculate the refractive index of core and that of cladding.

16. What is the total number of modes when the wavelength of light is 1300 nm ? Given the core diameter as 50×10^{-6} m and numerical aperture of the fibre is 0.42.

PART - C

17. Answer **any five** of the following questions. Each question carries **two** marks. **5x2=10**

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

(b) Thin films of oil on water appear coloured when seen under sunlight. Why ?

(c) It is easy to observe diffraction effect in sound than in light. Explain.

(d) If the number of rulings in a grating is increased, what is its effect on the resolving power of grating ?

(e) A two level system is not suitable for laser action. Justify.

(f) What is the principle underlying in holography ?

(g) Light travels in straight lines, how it is yet transmitted through a curved optical fibre ?

(h) Are fibre optic sensors transducers ? Explain.

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