13 A

D5BPH1703 (S3) (PAGES 2) Reg. No.....

Name: .....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2022

(Supplementary – 2017 & 2018 Admissions)

PHYSICS

APHY5B08T: PHYSICAL OPTICS AND MODERN OPTICS

Time: 3 Hours **Maximum Marks: 80**

SECTION A: Answer *all* questions. Each carries 1 mark.

1. State Fermat's Principle of extremum path.
2. State superposition principle.
3. What is diffraction?
4. What are zone plates? Mention the two types of it.
5. Show that reflected and refracted rays are at right angles to each other when the ray is incident at polarising angle.
6. Explain the working of a half wave plate.
7. What is the principle of holography?
8. What is step index fibre?

(8 × 1 = 8 Marks)

SECTION B: Answer any *six* questions. Each carries 4 marks.

9. Deduce expression for first and second focal distances from thin lens formula.
10. Show that the phenomenon of interference does not violate law of conservation of energy.
11. Two light waves of same intensity are superimposed. Find the maximum and minimum intensities.
12. Derive an expression for the fringe width in wedge shaped films.
13. Show that the area of Half Period Zones are equal.
14. Derive an expression for the width of the central maximum of Fraunhofer single slit diffraction.
15. What is Malu's law? At what conditions maximum and minimum intensity of light is obtained.
16. Derive an expression for acceptance angle of an optic fibre.
17. Show that the total number of total internal reflections in fibre cable of length L is $N = L \tan \theta_r / 2a$

(6 × 4 = 24 Marks)

(PTO)

SECTION C: Problems: Answer any *eight* questions. Each carries 4 marks.

18. What is the refractive index of material of a plano-convex lens, if radius of curvature of the convex surface is 10 cm and focal length is 30 cm.
19. A convex lens (refractive index=1.5) has a focal length of 10 cm. Find its focal length if it is immerced in water.
20. Light is incident normally on a glass plate of thickness 0.5×10^{-6} m and index of refraction is 1.5. Which wavelength of light in visible region are strongly reflected by the plate.
21. Two plane glass surfaces in contact along one edge are seperated at the opposite edge by a thin wire. If 20 fringes are observed between these edges in sodium light of normal incidence, what is the thickness of the wire? (Wavelength of Sodium light is 5890 A^0)
22. Using light of wavelength $\lambda=5.9 \times 10^{-7}$ m, it is found that in a thin film of air 7 fringes occur between two points. What is the difference in film thickness at these points?
23. Newton's rings are formed by reflected light of wavelength 6250 A° with a liquid between the plain and curved sufaces. If the diameter of the 10^{th} bright ring is 5 mm and the radius of curvature of the curved surface is 1.2 m., calculate the refractive index of the liquid.
24. The diameter of first ring of a zone plate is 1.1 mm. If plane waves of wavelength $\lambda=6 \times 10^{-7}$ m fall on the plate, where should the screen be placed so that light is focused to a bright spot?
25. Light of wavelength $\lambda=6000$ A° is incident normally on a diffraction grating 5 cm wide. The first order spectrum is formed at 30^0 from the normal. Find the total number of lines on the grating.
26. A plane wave ($\lambda=5000$ A°) is incident normally on a long narrow slit of width 0.5 mm. Calculate the angles of diffraction corresponding to the first three minima.
27. Calculate the thickness of a quarter wave plate for wavelength $\lambda=6500$ A°. The refractive indices of the material are $\mu_e = 1.553$ and $\mu_o = 1.544$.
28. An optical fibre with $\mu_1 = 1.52$ and $\theta_1=32^0$ and a = 25 μm. Calculate the skip distance
29. A step index fibre with $\mu_1 = 1.52$ and $\mu_2 = 1.50$. Calculate the numerical aperture and the acceptance angle.

(8 × 4 = 32 Marks)

SECTION D: Long answer: Answer any *two* questions. Each carries 8 marks

30. Explain the superposition principle and obtain an expression for the resultant intensity of two waves. What are the conditions for maximum and minimum intensity?
31. Give the theory of diffraction grating and explain how it can be used for measuring wavelength of given monochromatic source of light.
32. Explain how the concentration of sugar solution is found by using polarimeter.
33. Explain with the help of necessary theory, the recording and reconstruction of Holographic images.

(2 × 8 = 16 Marks)