D 30197 (Pages : 3) Name.....

Reg. No.....

FIFTH SEMESTER (CUCBCSS–UG) DEGREE EXAMINATION NOVEMBER 2022

Physics/Applied Physics

PHY 5B 08/APY 5B 09—PHYSICAL OPTICS AND MODERN OPTICS

(2017–2018 Admissions)

Time : Three Hours Maximum : 80 Marks

Section A

Answer in a word or a phrase.
Answer **all** *questions.*
Each question carries 1 *mark.*

1. In paraxial approximation, we confine to rays which pass ———— the axis.
2. Light rays are propagated through an optical fiber by the mechanism of ————.
3. The principle of holography was discovered by ————.
4. Lenses are coated with non-reflecting films to minimise ————.
5. The resolving power of grating is given by the equation ————.

True *or* False :

6. The light ray incident at an angle of incidence greater than acceptance angle on a step index fiber will be refracted through cladding.
7. In order to observe good interface pattern, the distance of the screen from the sources must be small.
8. Colours appear on a thin film and on a soap bubble due to dispersion.
9. In a negative uniaxial crystal, velocity of O-ray is less than velocity of E-ray.
10. In N-slit Fraunhoffer diffraction pattern, the principal maximum becomes sharper as N increases.

(10 × 1 = 10 marks)

Section B

Answer **all** *questions in two or three sentences.*
Each question carries 1 *mark.*

11. Explain Fermat's principle of extremum path.
12. What do you mean by optical direction cosine ?
13. Describe the conditions to obtain sustained interference pattern.

Turn over

14. What is the idea behind colour of thin films ?
15. What is meant by overlapping spectra in the spectra of a grating ?
16. Explain any two applications of holography.
17. Briefly explain acceptance angle and critical angle.

(7 × 2 = 14 marks)

Section C

Answer any **five** *questions in paragraph of about half a page to one page.*
Each question carries 4 *marks.*

18. Obtain system matrix for thin film, hence obtain thin lens formula.
19. Considering the super position of two sinusoidal waves, obtain the conditions for constructive and destructive interference.
20. With neat diagram, explain Michelson interferometer. Describe how it can be used to determine the difference in wavelength of two waves.
21. Explain the principle and construction of a zone plate.
22. Discuss Fraunhoffer diffraction at a circular aperture. Also explain the intensity distribution of the diffraction pattern.
23. Write brief note on : (a) Quarter wave plate ; Half wave plate.
24. Explain how hologram is constructed. What are the advantages ?

(5 × 4 = 20 marks)

Section D

Answer any **four** *questions.*
Each question carries 4 *marks.*

25. Two thin converging lenses of focal lengths 40 cm and 60 cm are placed co-axially 20 cm apart. Find the focal length of the combination.
26. In an interference experiment, the slit source is at a distance of 2 mm from the plane of the mirror. If the wavelength of the light used is 589 nm and the screen is kept at a distance of 1.5 m from the source. Calculate the fringe width.
27. Light of wavelength 5839 Å is reflected at near normal incidence from a soap bubble of refractive index 1.42. What is the least thickness of the film that will appear bright by reflection ?
28. Newton's ring are formed with red light of $\lambda = 670$ nm. The radius of the 20^{th} dark ring is found to be 1.1×10^{-2} m. Find the radius of curvature of the lens and the radius of 30^{th} ring.

29. A diffraction grating has 0.15 *m* of surface ruled with 6×10^5 lines per meter. What is its resolving power in the first order.

30. Calculate the thickness of double refracting plate capable of producing a path difference of $\lambda/4$ between ordinary and extra ordinary waves. Given $\lambda = 5500$ Å, $\mu_E = 1.54, \mu_0 = 1.53$.

31. A step index fiber has a core diameter of 200 μm, its numerical aperture is 0.29. Calculate the number of propagating modes of the fiber with an operating wavelength of 859 nm.

(4 × 4 = 16 marks)

Section E

Answer any **two** *questions.*
Answer in about two pages.
Each question carries 10 *marks.*

32. Explain with necessary theory, the formation of Newton's rings in reflected light. How can we use this arrangement to determine the wavelength of light ?

33. Discuss Fraungoffer diffraction due to a single slit. Find the positions of maximum and maximum intensity.

34. Explain the rectilinear propagation of light on the basis of Fresnel's half period zones.

35. Briefly explain an optical fiber. Using ray theory, discuss the mechanism of transmission of light with an optical fiber. Deduce on expression for numerical aperture of an optical fiber.

(2 × 10 = 20 marks)