**18U508** (Pages: 3) Name: ……..……..

Reg. No……..…….

**FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2020**

(CUCBCSS-UG)

(Regular/Supplementary/Improvement)

**CC15U PH5 B08 - PHYSICAL OPTICS AND MODERN OPTICS**

Physics- Core Course

(2015 Admission onwards)

Time: Three Hours Maximum: 80 Marks

## Section A

Answer ***all*** questions. Each question carries 1 mark.

1. An optical path is defined as the product of _____ and refractive index of the medium.
2. _____ matrix is relevant when light travels in a straight line motion in a homogeneous medium.
3. The central ring of the Newton's ring due to transmitted light is _____
4. In the _____ class of diffraction, the source or the screen or both are at finite distances from the aperture causing diffraction.
5. Define the term specific rotation.

Write True or False

6. Effect of refraction through a spherical surface can be characterized by a 2x2 matrix.
7. The spectra obtained with a grating are comparatively pure than those with a prism.
8. A hologram can store more than a photographic plate.
9. A fiber communication system does not need repeaters for transmission of signal for large distances.
10. The fringes obtained from two perfectly plane surfaces are not equal.

**(10 x 1 = 10 Marks)**

## Section B

Answer ***all*** questions in two or three sentences. Each question carries 2 marks.

11. Write down the three results obtained from Fermat's principle.
12. Give system matrix for a ray travelling through an optical system.
13. State the principle behind the interference obtained by division of wave front and amplitude methods.
14. Define numerical aperture for optical fiber.

15. Explain a diffraction grating.
16. What do you mean by a half –wave plate?
17. State Brewster's law and what is Brewster window?

**(7 x 2 = 14 Marks)**

**Section C**

Answer any ***five*** questions in a paragraph. Each question carries 4 marks.

18. Obtain the system matrix for a thick lens.
19. Explain Fresnel's biprism, and how it is used to determine the wavelength of light?
20. What are conditions for producing Haidinger's fringes? How is it different from Newton's rings?
21. Discuss the intensity distribution caused by Fraunhofer diffraction at a circular aperture.
22. Discuss the applications of fiber optic sensors.
23. Explain the method of producing plane, circularly and elliptically polarized light.
24. Give the working principle of an optical fiber. How graded index fiber differ from step index fiber?

**(5 x 4 = 20 Marks)**

**Section D**

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

*Problems- write all relevant formulas, all important steps carry separate marks.*

25. Use Fermat's principle to determine the mirror equation for an object point at a distance less than R/2 from a concave mirror of radius of curvature R.
26. In the Newton rings arrangement, the radius of curvature of the curved side of the planoconvex lens is 100cm. For $\lambda = 6 \times 10^{-5}$cm, what will be the radii of the $9^{th}$ and $10^{th}$ bright rings?
27. A grating (with 15,000 lines per inch) is illuminated by sodium light. The grating spectrum is observed on the focal plane of a convex lens of focal length 10cm. Calculate the separation between the D1 and D2 lines of sodium. The wavelengths of the $D_1$ and $D_2$ lines are 5890 and 5896Å respectively.
28. Calculate the thickness of a half wave plate and a quarter wave plate of quartz for a wavelength of 5000Å. Here $\mu_E$ is 1.553 and $\mu_O$ is 1.544.
29. Consider a step index fiber with n1 = 1.474 and n2 = 1.470 and having a core radius a = 4.5μm. Determine the numerical aperture, acceptance angle and cutoff wavelength of the optical fiber?





30. Find the radius of the first half period zone on a zone plate, behaving like a convex lens of focal length 60cm. Given λ as 6000Å.
31. Two plane glass plates are placed on top of each other, and on one side a cardboard is introduced to form a thin wedge of air. Assuming that a beam of wavelength 6000Å is incident normally, and there are 100 interference fringes per centimeter, calculate the wedge angle.

**(4 x 4 = 16 Marks)**

**Section E** (Essays)

Answer any ***two*** questions. Each question carries 10 marks.

32. Describe Michelson interferometer and explain how it is used to standardize the meter. Explain how circular, straight and white light fringes are formed.
33. Discuss Fraunhofer type of diffraction produced by a narrow slit illuminated by monochromatic light. Obtain the positions of the maxima and minima and draw a diagram to indicate the distribution intensity of light in the diffraction pattern.
34. Distinguish between (1) plane (2) circular and (3) elliptical polarization. Discuss the production of linearly polarized light by reflection and refraction. How would you produce and detect circularly polarized light?
35. Explain the principles of holography, with necessary theory and diagram for recording and reading out for a hologram. Also give any one application of holography.

**(2 x 10 = 20 Marks)**

*******