

B.Sc. DEGREE EXAMINATION NOVEMBER 2022  
BRANCH III - PHYSICS  
THIRD SEMESTER

COURSE : MAJOR – CORE

PAPER : OPTICS

TIME : 3 HOURS

MAX. MARKS : 100

SECTION – A

ANSWER ALL QUESTIONS: (25 x 1 = 25)

I CHOOSE THE CORRECT ANSWERS: (10 X 1 = 10)

- Technically, the number of cardinal points, if the medium on either side of the lens be the same is  
(a) 3 (b) 6  
(c) 2 (d) 4
- Expression for power of a thick lens is  
(a)  $P_1 + P_2 - P_1 P_2 \frac{t}{\mu}$  (b)  $P_1 + P_2 + P_1 P_2 \frac{t}{\mu}$   
(c)  $P_1 - P_2 + P_1 P_2 \frac{t}{\mu}$  (d)  $P_1 - P_2 - P_1 P_2 \frac{t}{\mu}$
- The equivalent focal length of the lenses in the Ramsden's eyepiece is  
(a)  $3f/2$  (b)  $f$   
(c)  $2f/3$  (d)  $3f/4$
- If two lenses of focal length " $f_1$ " and " $f_2$ " separated by a distance " $d$ ", then the condition for achromatism is,  
(a)  $d = f_1 + f_2$  (b)  $d = f_1 - f_2$   
(c)  $d = (f_1 + f_2)/2$  (d)  $d = (f_1 - f_2)/2$
- Fringes of equal inclination are known as  
(a) Brewster's fringes (b) straight fringes  
(c) Localized fringes (d) Haidinger fringes
- In an experiment with Michelson's interferometer, what is the wavelength of the light used, if the mirror is to be moved through 0.0059mm to merge 20 rings?  
(a) 5900 Å (b) 2950 Å  
(c) 5900 nm (d) 2950 nm
- A diffraction pattern is obtained using a beam of red light. What happens if the red light is replaced with blue light?  
(a) no change (b) bands become narrower  
(c) bands become broader (d) bands disappear
- The radii of half period zones are proportional to  
(a)  $1/\sqrt{n}$  (b)  $1/n$   
(c)  $n$  (d)  $\sqrt{n}$
- For a calcite crystal,  $\mu_o$  and  $\mu_e$  are the refractive indices of the crystal for O - rays and E - rays respectively, then along the optic axis of the crystal  
(a)  $\mu_o = \mu_e$  (b)  $\mu_o > \mu_e$   
(c)  $\mu_o < \mu_e$  (d) cannot predict
- The transverse nature of light was conclusively proved by  
(a) Interference of Light (b) Polarization of Light  
(c) Diffraction of Light (d) Dispersion of Light

**II FILL IN THE BLANKS:****( 5 x 1 = 5 )**

11. One of the important objections to Huygen's principle is its inability to account for the absence of a ----- in actual practice.
12. Two types of distortion are -----, -----.
13. Colour of thin film is due to ----- of light.
14. Expression for the resolving power of a grating is -----.
15. Quartz is an example of ----- uniaxial crystal.

**III ANSWER BRIEFLY:****( 5 x 2 = 10 )**

16. State Snell's law.
17. What is meant by interference of light?
18. Differentiate between Fresnel and Fraunhofer diffraction.
19. On what factors does the amount of optical rotation depend?
20. What is Rayleigh's criteria for resolution?

**SECTION – B****ANSWER ANY FIVE QUESTIONS:****( 5 x 6 = 30 )**

21. A thick double convex lens has the radii of curvature of its surfaces as 20 cm and 30 cm. The refractive index is 1.6 and the thickness is 6 cm. Calculate the focal length and the positions of the principal planes.
22. Find the radii of curvature for a lens of  $f = 10 \text{ cm}$ ,  $\mu = 1.5$  for which parallel incident light has minimum spherical aberration.
23. Newton's rings are formed with red light of wavelength 670nm. The radius of the 20<sup>th</sup> ring is found to be  $1.1 \times 10^{-2} \text{ m}$ . Find the radius of curvature of the lens and the radius of the 30<sup>th</sup> ring.
24. Define resolving power of a telescope. Calculate the aperture of the objective of a telescope which may be used to resolve stars separated by  $6.1 \times 10^{-6}$  radians for light of wavelength 589.6nm.
25. What are half wave and quarter wave plates? Calculate the thickness of quartz plates which will introduce path differences of  $\lambda/2$  and  $\lambda/4$  for light of wavelength  $5.9 \times 10^{-7} \text{ m}$ . Principle refractive indices are  $n_o = 1.544$  and  $n_e = 1.553$ .
26. How would you produce and detect circularly polarized light?
27. List the similarities and differences between a zone plate and a convex lens.

**SECTION – C****ANSWER ANY THREE QUESTIONS:****( 3 x 15 = 45 )**

28. State Fermat's principle of least time and deduce the fundamental laws of reflection and refraction.
29. Describe with theory the construction of Huygen's eyepiece and locate the cardinal points. What are the relative merits and demerits of Huygen's eyepiece with respect to that of Ramsden's?
30. Describe Fresnel's biprism method of producing interference fringes and determining the wavelength of monochromatic light.
31. Discuss the theory of diffraction grating. Describe in detail how you would use a transmission diffraction grating to determine the wavelength of light.
32. Give Fresnel's explanation for the optical activity. What is specific rotatory power? Describe Laurent's half shade polarimeter method of determining the specific rotation of sugar solution.

