Parvatibai Chowgule College of Arts and Science
Autonomous

B.Sc. Semester End Examination, January 2022

Semester: III
Subject: Physics
Title: Optics (Elective)
Duration: 2 Hours   Max. Marks: 45

Instructions: 1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Use of non-programmable calculator is allowed.
4. Symbols have their usual meaning unless specified.

Q. 1. Answer <u>any three</u> of the following: **(9)**

i. Explain chromatic aberration and obtain an expression for longitudinal chromatic aberration for an object at a finite distance. (3)

ii. When seen by the reflected white light, why an excessively thin film appears to be perfectly black, whereas a thick film shows no colours but appears white? (3)

iii. Describe the diffraction pattern formed by a narrow wire illuminated by a monochromatic light from a narrow slit parallel to the wire. What changes do you expect if the wire is thick? (3)

iv. What is Brewster's law? Show that when a ray is incident at the Brewster's angle, the reflected ray is perpendicular to the refracted ray. (3)

Q. 2. Answer <u>any two</u> of the following: **(12)**

i. (a) Derive the condition of achromatism for two thin lenses of focal lengths f_1 and f_2, when they are made up of same material but separated by a distance 'd'. (3)

(b) Derive the condition for minimum spherical aberration of two thin lenses of focal lengths f_1 and f_2, when they are separated by a distance 'd'. (3)

ii. Describe and explain the formation of Newton's rings in reflected monochromatic light. Prove that in reflected light (i) diameters of dark rings are proportional to the square-roots of natural numbers and (ii) diameters of bright rings are proportional to the square roots of odd numbers. (6)

iii. Describe the diffraction pattern at a straight edge. Obtain expressions for the distance of n^{th} bright band and n^{th} dark band from the edge of geometrical shadow. (6)

P.T.O.

Q. 3. Answer <u>any two</u> of the following: **(12)**

i. (a) How can (i) the elliptically polarized light and (ii) the circularly polarized light be produced? (3)

(b) How would you distinguish between (i) unpolarized light and circularly polarized light, and between (ii) elliptically polarized light and a mixture of plane polarized light and unpolarized light. (3)

ii. State Rayleigh's criterion for resolution. Derive an expression for the resolving power of a prism. (6)

iii. Calculate and show in a diagram the positions of the cardinal points and the focal points of Ramsden eyepiece. Support your answer with appropriate diagram. (6)

Q. 4. Answer the following: **(12)**

(A) Answer the following questions:

i. Calculate the focal lengths of the components of an achromatic telescopic objective having a focal length of 30 cm, made from crown glass and flint glass. Dispersive powers of crown and flint glasses are 0.012 and 0.02 respectively. (3)

ii. A square piece of cellophane film with refractive index 1.5 has a wedge-shaped section so that its thickness at two opposite sides is t_1 and t_2. When fringes are viewed normally using a light source of wavelength 6000 A.U., the number of fringes appear on the film is 10. Calculate the difference t_2-t_1. (3)

iii. When plane waves from a monochromatic source fall normally on a plane grating, having 500 lines per mm, it is observed that the second order spectral line is deviated through 30^0. Find the wavelength of the source of light. (3)

iv. A ray of light is incident on the surface of a glass plate of refractive index 1.5 at the polarising angle. Calculate the angle of refraction of the ray. (3)

OR

(B) Answer the following questions:

i. Find the magnification of an object at a distance of 4 cm from the nearer of a system of two thin convex lenses, separated by a distance of 4cm; the focal length of each lens being 8 cm. (3)

ii. A very narrow vertical slit is illuminated with monochromatic light of wavelength 5461 A.U. A vertical wire of 0.1 cm diameter is placed in front of the slit, parallel to it. A screen is placed 3 meters from the wire. Calculate the band-width within the geometrical shadow. (3)

P.T.O.

iii. Calculate the focal length of the combination of coaxially placed two thin convex lenses separated by 10 cm, and satisfying the condition of no chromatic aberration and minimum spherical aberration. (3)

iv. A tube 20 cm long, filled with a solution of 15 gm of cane sugar in 100 cc of water is placed in the path of polarized light. Find the angle of rotation of the plane of polarization if the specific rotation of cane sugar is 66^0. (3)

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