3 SEM TDC PHY M 1

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(November)

PHYSICS

(Major)

Course : 301

(Optics)

Full Marks : 60

Pass Marks : 24/18

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer from the following : 1×6=6

(a) A double convex lens will minimize spherical aberration, if the radii of curvature are in the ratio

(i) 1 : 2

(ii) 1 : 3

(iii) 1 : 4

(iv) 1 : 6

(b) In Ramsden's eyepiece

    (i) there is no cross-wire

    (ii) the cross-wire lies outside but in front of the field lens

    (iii) the cross-wire lies between the field lens and the eye lens

    (iv) None of the above

(c) If white light is used in Fresnel's biprism experiments, the fringe will be

    (i) white and dark

    (ii) yellow and black

    (iii) Central white fringe surrounded by a few coloured fringes

    (iv) Fringe pattern will not be observed

(d) In a diffraction pattern due to single slit of width a with incident light of wavelength λ with angle of diffraction θ, the condition for 1st minimum is

    (i) $\lambda \sin \theta = a$

    (ii) $a \cos \theta = \lambda$

    (iii) $a \sin \theta = \lambda$

    (iv) $\lambda \cos \theta = a$

(e) In Fraunhofer diffraction of a single slit with monochromatic light of wavelength λ, the width of the slit is a and the screen is at a distance D from the slit. If slit width a is decreased, the width of the central maximum

    (i) will increase

    (ii) will decrease

    (iii) remain unchanged

    (iv) may increase or decrease depending on the relative values of D and λ

(4)

(f) In Newton's ring arrangement, the diameter of rings is proportional to (λ = wavelength of light)

    (i) λ

    (ii) λ^2

    (iii) $\sqrt{\lambda}$

    (iv) $1/\sqrt{\lambda}$

2. Answer any six from the following : $2 \times 6 = 1$

(a) Explain briefly the defect coma.

(b) What are the differences between the fringes produced by a biprism and those by a Lloyd's mirror?

(c) In a biprism experiment, at a certain position of the eyepiece, the fringe width obtained is 0·2 mm. When the eyepiece is moved away by 50 cm, the fringe width becomes 0·3 mm. If the distance between the two sources is 0·3 cm, find the wavelength of the light used.

(d) What are Fresnel's half-period zones? Why is it so called?

(5)

(e) What do you mean by specific rotation and molecular rotation?

(f) What are normal dispersion and anomalous dispersion?

(g) Can a prism combination be used as an achromat? What is the requirement for such a combination?

3. (a) What is chromatic aberration? Find the condition for achromatism of the two thin lenses in contact. $1+3=4$

(b) Give the construction and working principle of a Ramsden's eyepiece. Why is it called a positive eyepiece? $4+1=5$

(c) Find an expression for the fringe width in case of Young's double slit. Show that the dark and the bright fringes are equally spaced. $3+1=4$

Or

A diffraction grating used at normal incident gives a line 5400 Å in certain order superposed on another line 4050 Å of the next higher order. If the angle of diffraction is 30°, how many lines/cm are there on the grating?   4

(d) Describe the working principle of a Michelson's interferometer. Discuss how you would determine the separation of two close spectral lines with the help of a Michelson's interferometer. 3+2

(e) Newton's rings are observed in reflected light of $\lambda = 5 \cdot 9 \times 10^{-7}$ m. The diameter of the 10th dark ring is 0·5 cm. Find the radius of curvature of the lens and the thickness of the air film.

4. (a) Describe and explain diffraction due to a straight edge.

(b) Discuss the phenomenon of Fraunhofer diffraction at a single slit. Find the expression for the width of the central maximum.

(c) Prove that the area of half-period zone on a plane wavefront is essentially independent of the order of the zone.

(d) In Fraunhofer diffraction pattern formed by a single slit, suppose that the slit width is 0·03 cm and the wavelength of light used is 6×10^{-5} cm. Find the diffraction angle for the first dark band.

5. (a) Define angle of polarization (i_p). State and prove Brewster's law. 1+2=3

(b) Write short notes on the following : 3½×2=7

(i) Polarimeter

(ii) Colour of thin flim

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