

Total No. of Printed Pages—5

3 SEM TDC PHY M 1

2015

(November)

PHYSICS

(Major)

Course : 301

(Optics)

Full Marks : 60

Pass Marks : 24 (Backlog)/18 (2014 onwards)

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer from the following : $1 \times 6 = 6$

(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) The distance between the two plano-convex lenses in Huygens eyepiece is

(i) f

(ii) $2f$

(iii) $\frac{2}{3}f$

(iv) $\frac{3}{2}f$

(c) How is the interference pattern in Young's double-slit experiment affected if sodium light is replaced by red light of the same intensity?

(i) The fringes will vanish

(ii) The fringes will become brighter

(iii) The fringe width will decrease

(iv) The fringe width will increase

(d) Two coherent sources of intensity ratio $1 : n$ are employed in an interference experiment. The ratio of intensities of the maxima and minima in the interference pattern is

(i) $\left(\frac{n+1}{n-1}\right)$

(ii) $\left(\frac{n+1}{n-1}\right)^2$

(iii) $\left(\frac{\sqrt{n}+1}{\sqrt{n}-1}\right)$

(iv) $\left(\frac{\sqrt{n}+1}{\sqrt{n}-1}\right)^2$

(e) The half-intensity maximum in case of a single-slit diffraction pattern occurs when the following condition is satisfied

(i) $\sin \theta = 0.223 \frac{\lambda}{a}$

(ii) $\sin \theta = 0.443 \frac{\lambda}{a}$

(iii) $\sin \theta = 0.886 \frac{\lambda}{a}$

(iv) $\sin \theta = \frac{2\lambda}{a}$

(f) The Babinet's compensator may be used for production and analysis of

(i) linear polarization

(ii) circular polarization

(iii) elliptical polarization

(iv) All of the above

2. (a) What is an achromatic system? What is a perfect achromatic system? 1+1=2

(b) Can a prism combination be used as an achromat? What is the requirement for such a combination? 1+1=2

(c) Why is it necessary to use a narrow source for Fresnel's biprism? 2

(d) How does colour appear in thin films? 2

(e) If the distance between the rulings of a grating is made very large, what will be the effect observed? 2

(f) What is normal spectrum? Is the spectrum produced by a prism normal? 1+1=2

3. (a) Show that in Huygens eyepiece, both the minimization conditions for spherical and chromatic aberration are satisfied. 3

(b) What is the reason for the presence of coma in a lense? Derive an expression for Abbe's sine condition. Show that coma disappears for a lens satisfying Abbe's sine condition. 1+3+1=5

(c) Obtain the intensity distribution pattern for diffraction due to a single slit. 5

Or

What are absent spectra and ghost line in case of a grating?

(d) Lights of wavelengths 5000 \AA and 5200 \AA fall on a grating having 5000 lines/cm. If a lens of focal length 2 m is used to form spectra on a screen, find the distance between the lines in (i) the first order and (ii) the third order. 1+1=2

4. (a) How can the thickness of a thin film be measured using interference? 5
- (b) Two candles or two torches can never produce interference pattern. Explain. 2
- (c) The dark region in the interference pattern represents the destruction of light energy. Does it mean that interference is a violation of the conservation of energy principle? 3
- (d) The convex surface (radius of curvature 400 cm) of a plano-convex lens rests on a concave surface of 500 cm radius and Newton's rings are viewed by reflected light of wavelength 5.9×10^{-5} cm. Calculate the diameter of the 5th bright ring seen. 4
- (e) Explain analytically, why the fringes in Fabry-Perot interferometer are very narrow and the resolving power of the interferometer is very high. 5
5. Answer any *two* from the following :
- (a) What is optical activity of a medium? What are dextrorotatory and levorotatory media? 2+2=4
- (b) State and prove Malus' law. 4
- (c) Obtain the condition for elliptical polarization of light. 4