

### Important Numerical from Physical Optics (Interference)

- 1) A soap film of refractive index  $4/3$  and of thickness  $1.5 \times 10^{-4}$  cm is illuminated by white light incident at an angle of  $60^\circ$ . The light reflected by it is examined by a spectroscope in which a dark band corresponding to wavelength of  $5 \times 10^{-3}$  cm is found. Calculate the order of interference of dark band.
- 2) A soap film  $5 \times 10^{-5}$  cm thick is viewed at an angle of  $35^\circ$  to the normal. Find wavelength of light in the visible spectrum. Which will be absent from the reflected light ( $\mu = 1.33$ )
- 3) Two coherent sources are 0.18 mm apart and the fringes are observed on the screen 80 cm away. It is found that with a certain monochromatic source of light the fourth bright fringe is situated at a distance of 10.8 mm from the central fringe. Calculate the wavelength of light.
- 4) In a Young's double slit experiment the separation of four bright fringes is 2.4 mm when the wavelength of light is  $6 \times 10^{-7}$  m. The distance from the slit to the screen is 1 m. Calculate the separation of the two slits.
- 5) The wave of yellow light has its wavelength  $5893 \times 10^{-10}$  m and a speed of  $3 \times 10^8$  ms<sup>-1</sup> in air. Find the speed and wavelength of the wave in glass of refractive index 1.5.  
[Ans:  $2 \times 10^8$  m/s;  $3928.66 \times 10^{-10}$  m/s]
- 6) Suppose that Young's experiment is performed with light of wavelength 500 nm. The slits are 1.2 mm apart and viewing screen is 5.4 m from the slit. How far apart are the bright fringes near the centre of the interference pattern? [TU 2074]
- 7) Newton's rings arrangement is used with a source emitting two wavelength  $\lambda_1$  and  $\lambda_2$ . It is found that the  $n^{\text{th}}$  dark ring due to  $\lambda_1$  coincides with  $(n+1)^{\text{th}}$  dark ring due to  $\lambda_2$ . Find the diameter of  $n^{\text{th}}$  dark ring. ( $\lambda_1 = 6 \times 10^{-5}$  cm,  $\lambda_2 = 5.9 \times 10^{-5}$  cm and radius of curvature of the lens,  $R = 90$  cm) [TU 2073]
- 8) Newton's ring formed by sodium light viewed normally. What is the order of dark ring which will have double the diameter of  $50^{\text{th}}$  ring? [TU 2073]
- 9) In a Newton's ring experiment the diameter of  $10^{\text{th}}$  ring changes from 1.4 cm to 1.27 cm when a liquid is introduced between the lens and the plate. Calculate the refractive index of the liquid. [TU 2072]
- 10) A thin film of acetone ( $\mu=1.25$ ) coats a thick glass plate ( $\mu=1.50$ ). White light is incident normal to the film. In the reflections, fully destructive interference occurs at 600 nm and fully constructive interference at 700 nm. Calculate the thickness of the acetone film.
- 11) A 600-nm-thick soap film ( $\mu=1.40$ ) in air is illuminated with white light in a direction perpendicular to the film. For how many different wavelengths in the 300 to 700 nm range is there (a) fully constructive interference and (b) fully destructive interference in the reflected light?
- 12) Interference fringes were produced by Young's double slits method, the wavelength of light being  $6 \times 10^{-7}$  m. When a film of material  $3.6 \times 10^{-3}$  cm thick was placed over one of the slits, the fringes pattern was displaced by a distance equal to 30 times that between two adjacent fringes. Calculate the refractive index of the material.
- 13) In a double-slit arrangement the slits are separated by a distance equal to 100 times the wavelength of the light passing through the slits. (a) What is the angular separation in radians between the central maximum and an adjacent maximum? (b) What is the distance between these maxima on a screen 50.0 cm from the slits?
- 14) In a double-slit experiment, the distance between slits is 5.0 mm and the slits are 1.0 m from the screen. Two interference patterns can be seen on the screen: one due to light of wavelength 480 nm, and the other due to light of wavelength 600 nm. What is the separation on the screen between the third-order ( $n=3$ ) bright fringes of the two interference patterns?