INTERFERENCE OF LIGHT
Problem set 1 (STK)

1. Two coherent sources of the same frequency have intensities I_0 and $2I_0$. What is the ratio of maximum to minimum intensity in their interference pattern?

2. In the double-slit interference experiment, as shown in Fig. 1, suppose the separation between two slit is $d = 0.1$ mm and distance betweeen the slit and the screen is $D = 1.20$. The incident light is monochromatic with a wavelength $\lambda = 600$ nm.

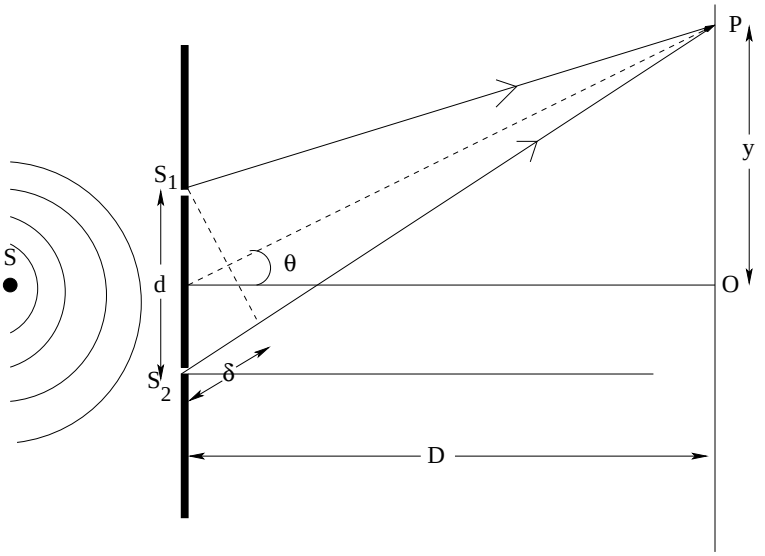

Figure 1: Young's double-slit experiment

(a) What is the phase difference between the two waves arriving at a point P on the screen when $\theta = 0.8^0$?

(b) What is the phase difference between the two waves arriving at a point P on the screen when $y = 4.00$ mm

(c) At what angle of diffraction, the phase difference between the two waves arriving at point P is $\phi = \frac{3}{3}$ rad.

(d) At what angle of diffrction, the path difference is $\frac{\lambda}{4}$?

(e) calculate the spacing between two adjacent bright fringes on the viewing screen.

(f) What is the distance between the 4^{th} order fringe and the center line on the viewing screen?

3. In the Youngs double-slit experiment, suppose the separation between the two slits is $d = 0.320$ mm. If a beam of 500 nm light strikes the slits and produces an interference pattern. How many maxima will there be in the angular range $30^0 < \theta < 30^0$?

4. In a Young's double slit experiment green light of wavelength 500 Å was used. The separation between two consecutive dark fringe was found to be 5 mm when a screen was placed at a distance of 1 m from the slits. Find the separation between the slits.

5. When a thin film of transparent plastic is placed over one of the slit in Young's double slit experiments, the central bright fringe system is displaced by 5 fringes. The refractive index of the material is 1.5 and the effective wavelength of the light is 5500 Å.
   (a) By how much does the film increase the optical path?
   (b) What is the thickness of the material of the film.

6. A Fresnel biprim of refractive intex 1.732 and with apex angle of 0.850^0 is used to form interference fringes. Find the fringe separation for red light of wavelength 6563 Å when the distance between the slit and the prism is 25.0 cm and that between the prism and the screen is 75.0 cm.

7. (a) In the Fresnel biprism arrangement, show that $d = 2a(\mu-1)\alpha$, where a represents the distance from the source to the base of the prism. α is the angle of the prism and μ is the refractive index of the material of the biprism.
   (b) In a typical biprism arrangement $\frac{b}{a} = 20$, and a sodium light ($\lambda = 5893$ Å), one obtains a fringe width of 0.1 cm, here b is the distance between prism and the screen, $\mu = 1.5$, calculate α.

8. Fringes are produced by a biprism at the focal plane of a eyepiece, which is 1 m from the slit. A convex lens inserted between the biprism and the eyepiece, produces two images of the slit in its two positions. In one case, the two images of the slit are 4.05 mm and in the other are 2.9 mm apart. If sodium light ($\lambda = 5893$ Å) be used , find the distance between two consecutive bright bands.

9. In a Newton's rings experiment, air film is replaced by a liquid film of refractive index $\frac{4}{3}$. In what proportion would the diameters of the rings change?

10. The radii of the 10^{th} and 15^{th} rings in Newton's rings experiment are 0.2 cm and 0.8 cm respectively. Find the wavelength of light if the radius of curvature of the convex surface of the plano convex lens is 100 cm.

11. In the Newton's ring arrangement if the incident light consists of two wavelength 4000 Å and 4002 Å. Calculate the distance (From the point of contact) at which the rings will disappear. Assume that the radius of curvature of the curved surface is 400 cm.