FRAUNHOFER DIFFRACTION OF LIGHT
Problem set - 2 (STK)

1. A convex lens of focal length 20 cm is placed after the slit a=of width 0.6 mm. If a plane wave of wavelength 6000 Å falls normally on the slit, calculate the separation between the second minima on either side of the central maximum. Calculate the ratio of the intensity of the principal maximum to the first maximum on either of the principal maximum.

2. In a double-slit experiment, where slit width b = 8.8 $\times 10^{-3}$cm, separation between two slit d = 7.0 $\times 10^{-2}$ cm, how many interference minima will ocuur between two diffration minima on either side of the central maxima? ($\lambda = 6.238 \times 10^{-5}$)

3. Plane wave of blue light, $\lambda = 4340$ Å, fall on a single slit, then pass through a lens with a focal length of 85.0 cm. If the central band of the diffraction pattern on the screen has a width of 2.450 mm, find the width of the single slit.

4. A double slit of width 0.650 mm separated by a distance between centers of 2.340 cm . With a mercury arc as a source of light, the green line $\lambda = 5460$ Å is used to observe the Fraunhofer diffraction pattern 100 cm behind the slits.
(a) Assuming the eye can resolve fringes that subtend 1 minute of orc, what magnification would required to just resolve the fringes?
(b) How many fringes could be seen under the central maximum?
(c) How many under the first side maximum?

5. Since two equal slits width d= b form a single slit twice the width of either of the slits, Prove that the intensity distribution of double slit reduces to the intensity expression for single slit of width 2b.

6. A convex lens of focal length 20 cm is placed after slit of width 0.6 mm. If a plane wave of wavelength 6000 Å falls normally on the slit, calculate the separation between the second minima on either side of the central maxima.

7. (a) Consider a diffraction grating of width 5 cm with slits of width 0.0001 cm separated by a distance of 0.0002 cm. What is the corresponding grating element? How many order would be observable at $\lambda = 5.5 \times 10^{-5}$ cm? Calculate the width of the principal maximum. Would there be any missing order?
(b) Calculate the dispersion in the different order. (c) What will be the resolving power in each order?

8. Light of two wavelengths, $\lambda = 5600$ Å and $\lambda = 5650$ Å. falls normally on a plane transmission grating having 2500 lines per cm. The emerging parallel light is focused on the flat screen by a lens of 120 cm focal length. Find the distance on the screen in centimeter between two spectrum lines.
   (a) in the first order
   (b) in the second order.

9. A grating (with 15000 lines/inch) is illuminated by white light containing wavelength components 4000 - 7000 Å.
   (a) Show that the first order and second order spectra will never overlap. (b)Calculate the angular width of the first and second order spectra.

10. Consider sodium D1 and D2 lines of wavelength 5890 and 5896 Å incident on a plane transmission grating. What will be the minimum number of lines in order to resolve first order spectrum of D1 and D2 lines?

11. In the minimum deviation position of a diffraction grating the first order spectrum corresponds to an angular deviation of 30^0. If $\lambda = 6 \times 10^{-5}$ cm, calculate the grating element.