

Diffraction

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Assignment : Fresnel & Fraunhofer Diffraction

Submission due date: 17/05/2020

Q.1) (a) In a double slit interference pattern the 12th order maximum is observed at a point when light of wavelength $\lambda_1 = 6000\text{\AA}$ is used. What order will be visible at the same point if the source is now replaced by light of wavelength $\lambda_1 = 4800\text{\AA}$?

(b) The central maximum of the envelope of the double-slit interference pattern contains exactly 9 fringes. Determine the angles where fringes will appear between the first and second minima of envelope.

Q.2) (a) A plane transmission grating at normal incidence diffracts a line of wavelength 540nm for a certain order superposed on another line of wavelength 405nm of the next higher order. If the angle of diffraction be 30° , find the grating element.

(b) Consider a grating with slit of width $a = 0.001\text{mm}$ separated by a distance of 0.002mm . How many orders would be visible at $\lambda = 500\text{nm}$?

(c) Find the least-width that a diffraction grating must have to resolve two Sodium D-lines ($\lambda_1 = 5890\text{\AA}$ & $\lambda_2 = 5896\text{\AA}$) in the second order. The number of lines per cm of the grating is 820.

(d) Sodium light is incident normally on a plane transmission grating having 3000 lines per cm. Find the direction of the first order for the D-lines and the width of the grating necessary to resolve them.

(e) A transmission grating is 4cm long and having 4000 lines/cm. Compute the resolving power of the grating for $\lambda = 5900\text{\AA}$ in the first order spectrum. Will this grating separate the sodium line doublet?

(f) You are given two plane transmission gratings G_1 and G_2 . The grating G_1 is of width 3cm and has 3000 lines, while G_2 is of width 2cm and has 2000 lines. Compare the resolving powers of these two gratings.

Q.3) (a) Find the separation of two points on the moon that can be resolved by a 500cm telescope. The distance of moon is $3.8 \times 10^5\text{km}$ and eye is most sensitive to light of wavelength 5500\AA .

(b) The resolving power of the human eye is about 1 minute of arc. Find the angular separation in seconds of arc of the closest two stars resolvable by a reflecting telescope with 8cm objective, 1.5m focal length, $80\times$ eyepiece. Assume that wavelength of light is 6000\AA .

Q.4) A zone plate is constructed by drawing a concentric circles of radii equal to that of a dark Newton's rings formed by a equiconvex lens of radius of curvature $R = 2\text{m}$. Find the first focal length of the zone plate (for same λ).