

676.

Problem 47.14 (RHK)

We have to show that in a grating with alternately transparent and opaque strips of equal width, all the even orders (except $m = 0$) are absent.

Solution:

We are given a grating with alternately transparent and opaque strips of equal width. Let the width of the strips be a . Therefore, the separation between the successive transparent strips will be $2a$. The principal maxima are given by the grating equation

$$2a \sin \theta = m\lambda, \quad m = 0, \pm 1, \pm 2, \dots$$

We note that because of the finite size of the slits the grating spectrum will be within the diffraction envelope of a slit of width a . The diffraction envelope is

proportional to $(\sin \alpha / \alpha)^2$, where $\alpha = \pi a \sin \theta / \lambda$. The intensity minima in diffraction due to a slit of width a will therefore be at locations given by the equation

$$a \sin \theta = n\lambda, \quad n = 1, \pm 2, \pm 3, \dots$$

Therefore, the even orders of the grating principal maxima will be at the location of the minima of the diffraction envelope produced because of the finite size of the slit width and will not be seen.

