783.

Problem 52.33 (RHK)

A high powered laser beam $(\lambda = 600 \text{ nm})$ *with a beam diameter of* 11.8 cm *is aimed at the Moon,* 3.82×10^5 km *distant. The spreading of the beam is caused only by the diffraction effects. The angular location of the edge of the central diffraction disk is given by*

$$\sin\theta = \frac{1.22\lambda}{d},$$

where d *is the diameter of the beam aperture. We have to find the diameter of the central diffraction disk at the Moon's surface.*

Solution:

For the problem the following data has been given:

Diameter of the beam, $d = 12$ cm,

Wavelength of the laser bean, $\lambda = 600$ nm.

Using the result that the angular location of the edge of the central diffraction disk is given by

$$\sin\theta = \frac{1.22\lambda}{d},$$

we calculate the angle of the central diffraction disk. We get

$$\sin\theta = \frac{1.22 \times 600 \times 10^{-9}\ \text{m}}{12 \times 10^{-2}\ \text{m}}$$

$$= 61 \times 10^{-7}.$$

$$\therefore \quad \theta = 61 \times 10^{-7}\ \text{rad.}$$

The diameter of the central diffraction disk on the Moon's surface

will be given by

$$2\times \text{ distance to the Moon} \times \theta = 2 \times 3.8 \times 10^{8} \times 61 \times 10^{-7}\ \text{m}$$

$$= 4.63\ \text{km.}$$