PHYS3038 Fall 2015
Homework #10
Due date: 24 Nov 2015

Problems:

10.25* Suppose that we have a laser emitting a diffraction-limited beam ($\lambda_0 = 632.84$ nm) with a 2-mm diameter. How big a light spot would be produced on the surface of the Moon a distance of 376×10^3 km away from such a device? Neglect any effects of the Earth's atmosphere.

10.29* A transmission grating whose lines are separated by 3.0×10^{-6} m is illuminated by a narrow beam of red light ($\lambda_0 = 694.3$ nm) from a ruby laser. Spots of diffracted light, on both sides of the undeflected beam, appear on a screen 2.0 m away. How far from the central axis is each of the two nearest spots?

10.33* Light from a laboratory sodium lamp has two strong yellow components at 589.5923 nm and 588.9953 nm. How far apart in the first-order spectrum will these two lines be on a screen 1.00 m from a grating having 10 000 lines per centimeter?

10.37 Prove that the equation

$$a(\sin \theta_m - \sin \theta_i) = m\lambda \qquad [10.61]$$

when applied to a transmission grating, is independent of the refractive index.

10.52* Collimated light from a krypton ion laser at 568.19 nm impinges normally on a circular aperture. When viewed axially from a distance of 1.00 m, the hole uncovers the first half-period Fresnel zone. Determine its diameter.

10.53* Plane waves impinge perpendicularly on a screen with a small circular hole in it. It is found that when viewed from some axial point P the hole uncovers $\frac{1}{2}$ of the first half-period zone. What is the irradiance at P in terms of the irradiance there when the screen is removed?