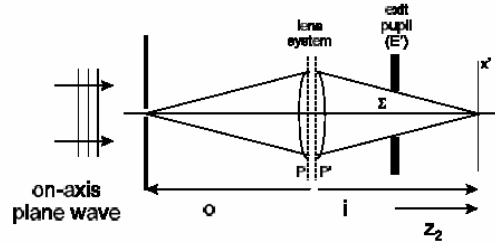
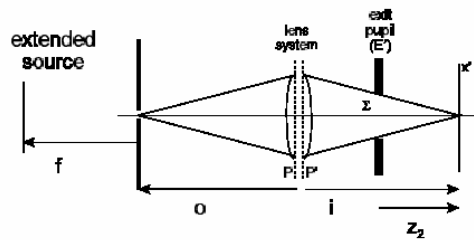


D-D1) In the systems below, the pinholes are small compared to the wavelength of light, such that the transmitted light behaves as a spherical wave. Parameters include:  $o = 2f$ ,  $i = 2f$ ,  $z=f$ ,  $f = 100$  mm,  $\lambda_0 = 0.5$   $\mu\text{m}$  and  $\Sigma$  is round with a 2 mm radius. For (a) and (b), the source illuminates the pinhole with equal irradiance. In each case, calculate the irradiance in the image and plot the irradiance profile. Normalize your result with respect to the peak irradiance.

a.) On-axis plane wave



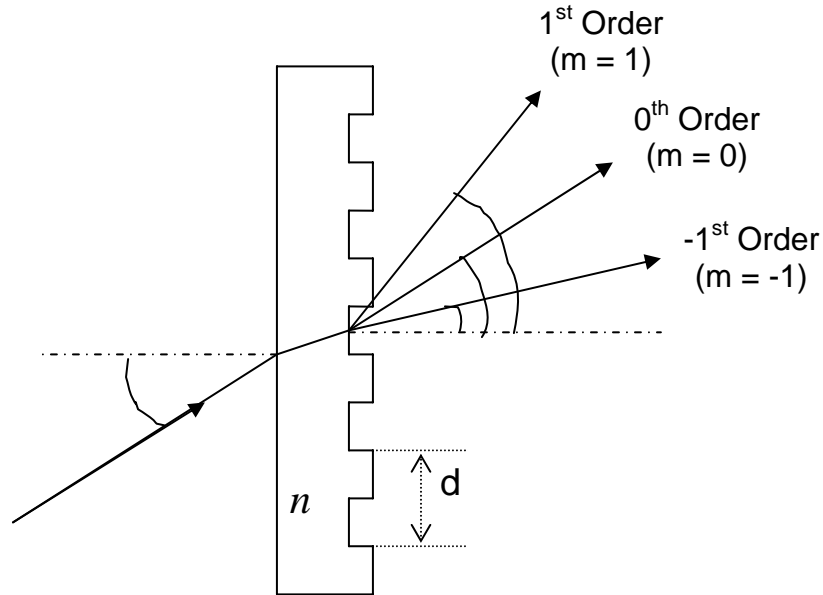
b.) Extended source (round) with radius  $a = 10$  mm.



D-D2) Prove that the equation

$$d(\sin \theta_m - \sin \theta_i) = m\lambda$$

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



D-D3) A circular aperture yields a Fraunhofer diffraction pattern with the first dark ring of radius  $r_1$ . Give an explanation as to whether the radius of the first dark ring increases or decreases when a circular central obscuration is inserted inside the circular aperture.

D-D4) Two telescopes are being used to image a star too small to be resolved by either system. One telescope has a circular aperture of diameter  $W$ , while the second has a square aperture of width  $W$ . Give the relative on axis irradiance for the two telescopes.

D-D5) A circular aperture yields a Fraunhofer diffraction pattern with the first dark ring of radius  $r_1$ . Give an explanation as to whether the radius of the first dark ring increases or decreases when a circular central obscuration is inserted inside the circular aperture.