Problem Set 2023-8
Physics 265
First Semester, AY 2023-2024
Release Date: 22 September 2023
Due: 6 January 2024
10 points per number

1. Fraunhofer diffraction pattern by a circular aperture (Section 8.5.1, Born & Wolf). Generate the normalized (I_0 = 1) intensity contour plot *I(x, y)* that is produced by a point light source (located at infinity, λ = 0.550 micron) via a uniformly-illuminated lens of radius r = 1 cm, focal length f = 3 cm and refractive index n = 1.53.

   The origin of the *x*-*y* plane coincides with the lens focus. Intensity resolution of contour plot: 0.05

2. For f = 3 cm and n = 1.153, plot the fullwidth at half maximum (FWHM) value of the normalized central spot as a function of circular aperture radius r where: $0.1 \leq r$ (cm) ≤ 10 (512 data points) and λ = 0.550 micron.

   Discuss briefly the salient features and implications of your results.

3. Fraunhofer diffraction pattern by a rectangular aperture (Section 8.5.1, Born & Wolf). Generate the normalized (I_0 = 1) intensity contour plot *I(x, y)* that is produced by a point light source (located at infinity, λ = 0.550 micron) via a uniformly-illuminated cylindrical lens of dimensions: $a = 2b$ = 2 cm, f = 3 cm, n = 1.53.

   The origin of the *x*-*y* plane coincides with the lens focus. The longer side of the lens is parallel with the *y*-axis. Intensity resolution of contour plot: 0.05

4. Fraunhofer diffraction pattern by a square aperture (Section 8.5.1, Born & Wolf). Generate the normalized (I_0 = 1) intensity contour plot *I(x, y)* that is produced by a point light source (located at infinity, λ = 0.550 micron) via a uniformly-illuminated cylindrical lens of dimensions: $a = b$ = 2 cm, and f = 3 cm.

   The origin of the *x*-*y* plane coincides with the lens focus. The longer side of the aperture is parallel with the *y*-axis. Intensity resolution of contour plot: 0.05.

5. For the same aperture size, plot the diagonal FWHM of the central spot as a function of the ratio a/b where: $0.1 \leq a/b \leq 10$ (512 data points) and λ = 0.550 micron.

   Discuss briefly the salient features and implications of your results.

END