15c Fourier Optics Lab Exercises to be Submitted

1. Draw ray optics explanations of imaging due to a lens and imaging due to a pinhole camera. Provide two reasons people use cameras with lenses rather than pinhole cameras.
2. Draw the wave fronts and k vectors corresponding to a plane wave propagating along the z direction
3. Draw the wave fronts and k vectors corresponding to a diverging spherical wave
4. Draw the wave fronts and k vectors corresponding to a converging spherical wave
5. Write the mathematical expression for all of the waves above given that they propagate with velocity c.
6. Given a spherical diverging point source at z= -R , calculate the phase shift as a function of (x,y) in the z=0 plane that would convert the diverging spherical wave into a plane wave propagating along the z direction
7. For the exercise where you looked at diffraction due to a single vertical slit with square edges explain the changes you observed in the image of the slit when you closed the aperture and when you inserted the needle to block the central spot in the fourier transform plane. Compare the diffraction pattern for the square slit with the diffraction pattern for the smooth slit and explain any differences
8. How does this diffraction pattern for the double slit compare with what you got in part 7 of the previous section where you used the applet to create two slit interference?
9. For the square wave diffraction grating how did you double the frequency you saw in the 4f plane and how did you produce a sine wave grating in the 4f plane?
10. When you looked at the diffraction pattern due to the squares, what happened when you used tape to create a slit in the Fourier transform plane? Explain your results.
11. Provide an equation for the optical transmission mask required to convert a plane wave into a spherical wave. Note you have created a simple hologram. Next week’s lab will look at more complex holograms.