Homework #1

The following are some relatively simple questions involving Fourier Transforms. Understanding these will help you understand some of the equations that are used during the class. While they may look a little intimidating, the integration and differentiation is not hard; it is algebra.

1. Consider the integral . Split the integration into the ranges and work out the result of each. By summing the ranges show that the result is zero. We use this quite a lot.

1. Consider as a definition . (For reference, the “2” is standard for Fourier Transforms in diffraction.) By substituting y=x-a show that (being careful about how you substitute inside an integral

This shows that a shift of the origin (here along x) leads to a exponential multiplier. Again, we will use this result.

1. Using the integral , by substituting show that .

Note the “a” to “1/4a” in the Gaussians – we will use this inverse relationship in class.

1. Show that if , then and

These relationships come up later in the class when I will briefly discuss dynamical theory.

1. With the definitionsand, Using the definitions, show that

This is called a convolution, and has an important role in simplifying many elements of diffraction.