

PHGN511 Homework #4
Due Friday, Sep. 24, 2004 at the beginning of class

Be sure to show the contours in the complex plane you use for each of the integrals. Also, Mathematica will definitely help check your answers, but show your work.

- 1) Butkov 2.37 part e (this looks hard but it isn't if you keep track of terms, and remember the form of the binomial expansion).
- 2) Butkov 2.38 part d
- 3) Evaluate the real integral (it isn't hard, but you will need to think a bit about the best contour to use):

$$\int_0^{\infty} \frac{\sqrt{x} dx}{(1+x^4)}$$

- 4) Evaluate the integral (this is a Fourier Transform) :

$$\int_{-\infty}^{\infty} \frac{e^{ikx} dx}{\text{Cosh}(x)}$$

- 5) For the final problem, we want to find the residue of $1/\text{Log}^2 Z$. Its intended to be Mathematica practice, so please do this one entirely in a Mathematica notebook using Mathematica's text features to answer questions and make comments.
 - a) First tell me if this function has a singularity, and where it is.
 - b) Second, we want to do a series expansion about the singularity. I don't want you to do the expansion, but I want you to briefly tell me a method you could use to obtain it. I also want to know what the expected radius of convergence of the series expansion would be. As usual, explain your reasoning.
 - c) Now, use mathematic to obtain the series expansion about the singularity.
 - d) From part c, tell me the order of the singularity
 - e) From part c, determine the residue at the singularity
 - f) Now use Mathematica's residue feature to confirm the answer.