PHYS 408 2010/11 term 2

Homework problem set #6 problems 1-4
Assigned: 25/02/2011
Written Solution due 04/03/2011 5 PM in Hennings 328
If you collaborated with anyone, please write their name at the top of your HW

Problem 1 (20 marks) (This isn't a typo)

Look at the HW #5 solutions I posted and pick one problems that you may have gotten wrong. Describe in words what you may have done wrong and what your misconceptions were. And explain what you didn't understand and what techniques you needed to know in order to solve the problem. Explain in words what you have learned from this.

If you feel you solved all of the problems correctly, then pick a problem and try to find and explain three misconceptions that might lead a person to answer wrongly. To be an expert, you must learn to identify the possible conceptual difficulties that a person may have in order to communicate with them effectively

Problem 2 (25 marks

Prove the result of Figure 4.2-2 on page 118. you will need to use the paraxial approximation and the standard transmittance of a spherical lens. This result proves a lens takes the Fourier transform of an input image where the Fourier transform appears at the focal plane. *Hint: complete the square in the exponential*

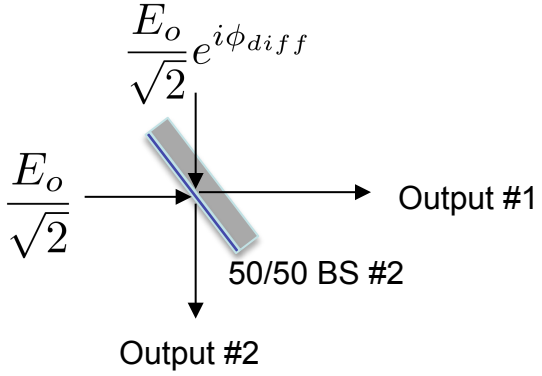
Problem 3 (25 marks

IN YOUR OWN WORDS using the time reversal argue that one of the fields must have a pi phase shift:

$$E_{out1} = \frac{1}{2}E_o(1 \pm e^{i\phi_{diff}})$$

$$E_{out2} = \frac{1}{2}E_o(1 \mp e^{i\phi_{diff}})$$

HINT: Read the section on Stokes parameters in the Steck text.



Problem 4 (30 marks

The image function f(x,y) usually found by evaluating the input wave $U_{in}(x,y,z)$ at some fixed z (usually z=0). However what if you have been given the image function f(x,y) and need to find the the input wave $U_{in}(x,y,z)$?

a) If f(x,y) is created by a single plane wave, then

$$U(x,y,z)_{plane} = f(x,y)_{plane}e^{ik_z z} = f(x,y)e^{i\sqrt{k^2-k_x^2-k_y^2}z}$$

However this is not generally true. Using physics and an understanding of what f(x,y) represents explain why it only works for a single plane wave.

b) Now consider this image function in x dimension $f(x) = \delta(x-b) + e^{ix10^6 sin\alpha}$

and determine the input field (U,z) that created it in two different ways.

i) Using physics and what the concept of the image function is you should be able to immediately write down the answer….but you must justify your answer using physics (not just write down the result)
ii) Using an expression similar to 4.1-5, find U(x,z). Of course, it should be the same as i)