PHYS 408 2010/11 term 2

Homework problem set #7 problems 1-3
Assigned: 07/03/2011
Written Solution due 11/03/2011 5 PM in Hennings 328
If you collaborated with anyone, please write their name at the top of your HW

Problem 1 (30 marks) (This isn't a typo)

Look at the HW #6 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 (30 marks

In this exercise we will work to understand how to visualize an image function f(x,y). Given an input wave U(x,y,z) there are several ways to visualize the image created. Consider this wave with

$$U(x,y,z) = 10e^{ik_z z}e^{i(\pi/3+3x+4y)}$$

in 2-D (x,y) plot the wavefronts of the image function at z=0. Next using matlab, gnuplot etc, give a 3-D plot of the magnitude and magnitude squared of the image function at z=0 (and provide a copy of your code)

now repeat the above with this wave

$$U(x,y,z) = 10e^{ik_z z}(e^{i(\pi/3+3x+4y)} + e^{i(-\pi/3-3x+4y)})$$

Problem 3 (40 marks)

Identical to the notation in lecture, the complex amplitudes of a monochromatic wave of wavelength λ in the *z=o* and *z=d* planes are *f(x,y*) and *g(x,y)* respectively. Use harmonic analysis (Fourier recipe) to determine *g(x,y)* in the following cases:

$$a)\quad f(x,y) = 1+\sin(\pi x/\Lambda)$$
$$b)\quad f(x,y) = \exp\left[i\pi(x+y)/4\Lambda\right]$$
$$c)\quad f(x,y) = \delta(\alpha x)$$
$$d)\quad f(x,y) = \delta(x-a)+i\delta(x+a)$$

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describe the physical nature of the wave *U(x,y,z*) at *z=0* and *z=d ie what makes up the wave.* You may use the Fresnel approximation to free-space.