IIT DELHI
EPL443 - Major

5 May 2010
8.00 – 10.00 AM
Total Marks = 50

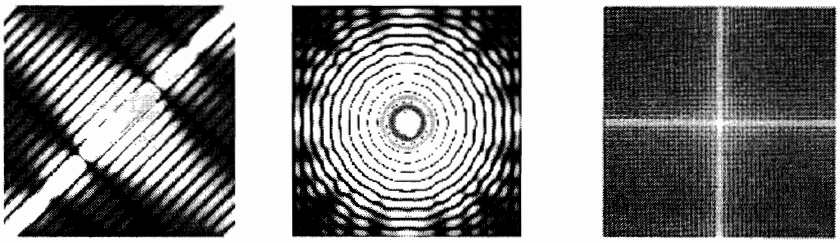
Q.1. Write down any FOUR Fourier transform theorems **(2)**

Q.2. Consider a linear system defined by S{ }, such that $g_2(x_2,y_2) = S\{ g_1(x_1,y_1) \}$. Explain the case under which one can write g_2 as the convolution of g_1 with impulse response of the system. **(5)**

Q.3. Consider two functions, $f_1(x) = \sin(\alpha x)$ and $f_2(x) = \begin{cases} 1 & -1 < x < 1 \\ 0 & \text{otherwise} \end{cases}$

Is it possible to discretely sample these functions without losing any information?
If the answer is YES – then what is the maximum allowed distance between the samples.
If the answer is NO – explain why. **(5)**

Q.4. Sketch roughly the images, which produced the following Fraunhofer diffraction patterns . **(3)**



a b c

Q.5. Show that exact FT of an object illuminated by coherent parallel beam can be obtained if the object is at the front focal plane of a lens. **(5)**

Q.6. Consider an object which has perfect periodicity of amplitude transmittance in both x and y directions. On this object, there exists a small opaque defect. Using a spatial filtering experiment,
(a) is it possible to remove the defect and get the periodic object?
(b) is it possible to remove the periodic object and visualize the defect?
Describe briefly about the filter(s) to be used. **(4)**

Q.7. It is required to record a Vanderlugt filter for obtaining auto-correlation of an object of width 1cm, using a lens of focal length 10cm. If the laser used is of wavelength 500nm, what should be the minimum angle at which the reference beam should be used? **(5)**

Q. 8. Explain Fourier Transform hologram and show that reconstructed image from this hologram is stationary even when the hologram is translated in its own plane. **(5)**

Q.9. (a) Using a diagram, find the expression for fringe spacing when two plane waves interfere. **(4)**
(b) Consider a reflection hologram recorded using laser of wavelength 650nm, and the average angle between the recording beams is 120 degrees inside a photographic emulsion of ref. index 1.5. After photographic development, the emulsion had a shrinkage of 1%. Find out the peak wavelength at which the object is reconstructed, when the hologram is illuminated with white light. **(4)**

Q. 10. (a) Explain Leith-Upatnieks (off-axis) hologram **(4)**
(b) Find the minimum reference angle needed for recording an off-axis hologram. **(4)**