Indian Institute of Technology, Delhi
Minor 2: EPL 443 Holography and Optical Information Processing
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1. Four object functions and their corresponding Fraunhofer diffraction intensity patterns are shown below. Identify the diffraction pattern corresponding to each of the object functions by providing brief reasoning. **(10 points)**

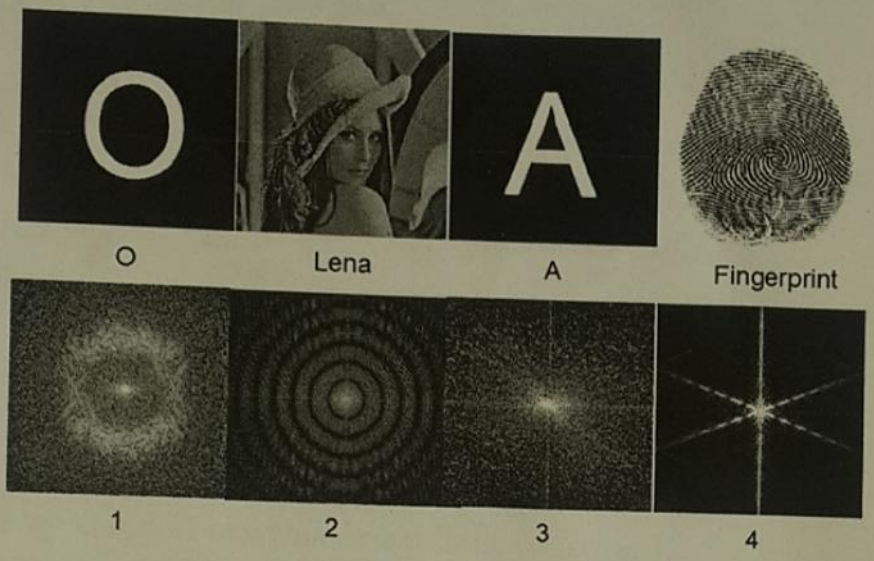

Figure 1: Top row shows four object functions and the bottom row shows their Fraunhofer diffraction patterns in random order.

2. Using Fresnel approximation, show that the Helmholtz equation takes the para-axial form given by: **(10 points)**

$$[i\frac{\partial}{\partial z} + \frac{\nabla_{xy}^2}{2k} + k]\, u(\vec{r}) = 0.$$

You may find the following relation useful: $H_{Fresnel}(f_x, f_y) = \exp[ikz - i\lambda z\,(f_x^2 + f_y^2)]$.

3. A 4F imaging system has a rectangular Fourier plane aperture of size $(2B_x \times 2B_y)$.
(a) Find the coherent impulse response of the system. **(2.5 points)**

(b) Find the OTF of the system and sketch the MTF along the x-dimension. **(2.5 points)**

(c) What is the incoherent cut-off frequency for this system ? **(2.5 points)**

(d) Sketch the approximate system MTF when the system has aberrations. **(2.5 points)**