

Photonics (ECE 240A/B/C) – ECE MS Comp Exam, Fall 2013

Problem 1:

The line-spread function of a 2D imaging system is defined to be the response of that system to a 1D delta function passing through the origin of the input plane.

(a) In the case of a line excitation lying along the x axis, show that the line-spread function l and the point-spread function p are related by

$$l(y) = \int_{-\infty}^{\infty} p(x, y) dx$$

Where l and p are to be interpreted as amplitudes or intensities, depending on whether the system is coherent or incoherent, respectively.

(b) Show that for a line source oriented along the x axis, the 1D Fourier transform of the line-spread function is equal to a slice through the 2D Fourier transform of the point-spread function, the slice being along the f_y axis. In other words, if $\mathcal{F}(l)=L$ and $\mathcal{F}(p)=P$, then $L(f)=P(0, f)$.

(c) Find the relationship between the line-spread function and the step response of the system, i.e. the response to a unit step excitation oriented parallel to the x axis.

Problem 2:

Draw the schematic diagram of the set-up for intensity modulation of light using electro-optic crystal made of KDP. Include in the diagram all the components used and briefly describe the function of each component.

Problem 3:

Explain why the four level system is easier to realize population inversion comparing with the three level system.