ENEE 408E Optical System Design

Design Projects #2, 9/28/04

Due 10/12/04

You would be well advised to go through the Code V Test Drive before completing these design projects.

For Code V problems provide the lens specifications, 2-D views of the lenses, spot diagrams, and MTF.

(1) A thick lens with $n = 1.5$ has $R_1 = 100mm, R_2 = -120mm$ with $d = 25mm$. Calculate the position of the principal planes and the focal length of the lens. Compare your paraxial calculations with the results from Code V. Use Code V to provide a plot of your final layout showing rays going through the focal point.

(2) Use Code V to calculate the amount of spherical aberration that results for the extreme rays traveling parallel to the axis, when the aperture (diameter) of the lens is 50mm. These are the rays that pass through the lens at the greatest distance from the axis. The magnitude of the spherical aberration is the diameter of the circle in the paraxial focal plane through which all rays pass.

(3) Design a biconvex lens with $R_1 = R_2$ and a focal length of 300mm using LAK8 glass. Do this both analytically and by using Code V. Code V can optimize the lens thickness. Choose the lens parameters so that the f/number of the lens is 4.

(4) Repeat question (3) but make the lens a plano-convex one.

(5) Repeat question (3) but optimize both surfaces of the lens for minimum aberration (sharpest image).

(6) Compare the spherical aberration for the extreme rays and the different lenses designed in questions (3), (4), and (5).

(7) Use Code V to design an achromatic doublet for wavelengths of 450nm and 650nm. Make the lens an f/4 lens with a focal length of 100mm.

(8) For each of the following imaging situations calculate:
(a) the position of the image
(b) whether the image is real or virtual
(c) linear and angular magnification
(d) draw a ray tracing diagram

(i) f=2; u=3
(ii) f=-2; u=3
(iii) f=2; u=1.5
(iv) f=-3; u=2
(v) a concave mirror with R=5; u=8
(vi) a concave mirror with R=5; u=3
(vii) a convex mirror with |R|=5; u=3

DO NOT USE CODE V FOR THIS PROBLEM.