OPTI 435/535 Homework #2 Due: September 30, 2009

Undergrads do problems 1 through 3
Grads do all four problems

1. A wavefront error is given by $W(r,\theta) = -0.001r^2 - 0.0005\, r^2 \cos 2\theta + 0.00005\, r^4$. What is the power error $d\phi$ associated with this wavefront? For the horizontal meridian, plot $d\phi$ for pupil diameters ranging from 2 mm to 8 mm. Plot $d\phi$ as a function of $\theta$ for a pupil diameter of 4 mm. (Note that r is the radial coordinate in the pupil, so r ranges from 1 mm to 4 mm for pupil diameters of 2 mm to 8 mm).

2. The sag of a paraboloid is given by $z = \frac{x^2 + y^2}{2R}$. What is the Mean Curvature H of the surface? Show that the Mean Curvature of the paraboloid is the same as a sphere of radius R at the origin.

3. Show that a biconic surface can be written as:

$$(\text{sag})z = \frac{r^2 / R_{\text{eff}}}{1 + \left[1 - (K_{\text{eff}} + 1) r^2 / R_{\text{eff}}^2\right]^{1/2}}$$

where $R_{eff}$ and $K_{eff}$ are the effective Radius of Curvature and Effective Conic Constant, respectively. What are the expressions for $R_{eff}$ and $K_{eff}$?

**********Grads Only**********

4. In class we showed that the spherical aberration can be obtained from raytracing data from

$$d\phi = \frac{n'}{P'M'} - \frac{n'}{P'F'}$$

where P'M' is the distance from the rear principal plane to the marginal ray focus, P'F' is the distance from the rear principal plane to the rear focal point and n' is the index of the vitreous humor. Plot the spherical aberration of the Gullstrand-LeGrand and Arizona Eye models for ray heights ranging from 0 to 4 mm.