PHY 431 Homework Set #7

Due November 10 at the start of class

1) ***Michelson Interferometer (30%)***
   a. [Hecht 9.36] One of the mirrors of a Michelson Interferometer is moved, and 1000 fringe-pairs shift past the hairline in a viewing telescope during the process. If the device is illuminated with 500-nm light, how far was the mirror moved?
   b. [Hecht 9.37] Suppose we place a chamber 10.0 cm long with flat parallel windows in one arm of a Michelson Interferometer that is being illuminated by 600-nm light. If the refractive index of air is 1.00029 and all the air is pumped out of the cell, how many fringe-pairs will shift by in the process?

2) Anti-reflection coating (25%)

A lens is to be coated with a thin film with an index of refraction of 1.2 in order to reduce the reflection from its surface at λ=5000 A°. The glass of the lens has a refractive index of 1.4.

   A. What is the minimum thickness of the coating that will minimize the intensity of the reflected light?
   B. In the above case the intensity of the reflected light is small but not zero. Explain. What need to be changed, and by how much, to make the intensity of the reflected light zero?

3) Diffraction from the Lens Pupil (25%)

An excellent camera lens of 60 mm focal length is accurately focused for objects at 15 m. For what aperture (stop opening) will diffraction blur of visible light (λ=550 nm) be roughly the same as the defocus blur for a star at infinity?

4) ***Resolution limit (20%)***

[Hecht 10.28] The Mount Palomar telescope has an objective mirror with a 508-cm diameter. Determine its angular limit of resolution at a wavelength of 550 nm, in radians, degrees, and seconds of arc. How far apart must two objects be on the surface of the Mood if they are to be resolvable by the Palomar telescope? The Earth-Moon distance is 3.844×10^8 m; take λ=550 nm. How far apart must two objects be on the Moon if they are to be distinguished by the eye? Assume a pupil diameter of 4.00mm.