PHY385H1F – "Introductory Optics"
Problem Set 6
Due: **December 4**, 2012

Instructions: Please complete the following problems on separate paper. SHOW ALL YOUR WORK. You will be graded more on correct method than correct answer. If you take an equation from the Hecht text, please give the equation number and page number.

Total Possible: 20 points.

Based on Chapter 8 of Optics (4th Edition) by Eugene Hecht, ©2002 by Addison-Wesley:

1. [**6 points**] Linear polarized light with vertical polarization (parallel to *y*) is incident upon (1) a half-wave plate with slow axis at 45°, (2) a linear polarizer with transmission axis at 45° and (3) a quarter-wave plate with fast axis vertical. Write the Jones Vector, and describe the polarization state of the emerging light.

Based on Section 9.1 of Optics (4th Edition) by Eugene Hecht, ©2002 by Addison-Wesley:

2. [**6 points**] Show that if one beam of a two-beam interference setup has an irradiance of N times that of the other beam, the fringe visibility is given by

$$V = \frac{2\sqrt{N}}{N+1}$$

Note that the fringe visibility is defined as:

$$V \equiv \frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}}$$

Based on Chapter 10 of Optics (4th Edition) by Eugene Hecht, ©2002 by Addison-Wesley:

3. [**5 points**] The width of a long, narrow, rectangular slit is measured in the laboratory by means of its diffraction pattern on a screen which is a distance of 2 m from the slit. When illuminated normally with a parallel beam of laser light (632.8 nm), the diffraction pattern consists of a bright principal maximum surrounded by fainter fringes. Each pair of fringes is separated by a dark minimum. The distance between the third dark minimum on one side of the principal maximum and the third dark minimum on the other side of the principal maximum is measured to be 5.625 cm. Assuming Fraunhofer diffraction, what is the slit width?

4. [**3 points**] Consider the far-field diffraction pattern of a single slit of width 2.125 μm, when illuminated normally by a collimated beam of 550 nm light. Determine the irradiance at a point which makes an angle of 5.0° to the central axis. Express the irradiance as a fraction of the central maximum irradiance, $I_{\max}$.