EE119 Discussion Section 2

(02/01/10)

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1. **Birefringence – optical axis, ordinary ray, extraordinary ray; wave plates**

   Example:

   a) A quarter-wave plate retards one direction of polarization of light by a phase of $\pi/4$ relative to the other polarization. A material has an index of refraction of 1.6 along the slow axis and 1.4 along the fast axis. (i) How thick should this material be cut for it to be a quarter-wave plate for 400nm light? What other larger thicknesses could the plate have and still work as a quarter-wave plate? (ii) If a linearly polarized light is normally incident on this quarter-wave plate, how would you orient the plate so that the emerging light becomes circularly polarized? elliptically polarized? or remains linearly polarized?

   b) **Hecht 8.39** Draw a quartz Wollaston prism, showing all pertinent rays and their polarization states. (Refer to p345 of the book)

2. **Thin Lens Imaging – analyzing using three rays; real and virtual images; transverse and longitudinal magnification**

   Example:

   a) An object (2cm in height) is positioned 5cm to the left of a positive thin lens with a focal length of 10cm. Draw appropriate ray diagrams. Describe the resulting image (i.e. where it images and what the longitudinal and transverse magnifications are) using both the Gaussian and the Newtonian equations.

   b) A bug that is 1cm tall is crawling towards a lens that has a focal length of 20cm. How big does the bug appear when it is 15cm away from the lens? How much bigger does the bug appear when it is 10cm away from the lens than when it is 8 cm away from the lens? If the bug is crawling at a rate of 1 cm/second when it is 10 cm away from the lens, how quickly is its size changing?

   c) A lantern slide 8.0cm high is located 3.50m from a projection screen. Design a lens to meet the requirement of projecting an image 1.0m high.

3. **Reflecting Prisms – changing the orientation of an image and/or direction of propagation** Examples: the Porro prism; the Dove prism, etc