Optics 513 - Optical Testing and Testing Instrumentation Lab

Lab #3 - Refractive Index Measurement:
Abbe Refractometer
Goniometer
Brewster's Angle

The purpose of this lab is to become familiar with several methods of measuring refractive index.

Procedure:

- Use the goniometer to measure the prism angle, angle of minimum deviation, and the refractive index of the prism provided.

- Use the Abbe refractometer to measure the refractive index and dispersion of
    a) the lens
    b) the prism
    c) a liquid sample.

CAUTION: The illuminating and measuring prisms in the Abbe are made of glass with a high refractive index. They are inherently soft. Be careful not to add any more scratches. Do not touch the reference prism when applying the matching fluid. If too much fluid is used, the test piece will slide off. The manner in which the surface of the measuring prism is treated will determine the useful life of the instrument.

- Using the 633nm polarized HeNe laser, measure Brewster's angle and compute the refractive index from it.

Questions:

Goniometer

1) What is your measurement uncertainty in the
   a) Prism angle?
   b) Angle of minimum deviation?
   c) Refractive index?

2) What is the precision of the refractive index measurement? What sets the limits on precision?

3) What factors affect the accuracy of the measurement?

Abbe Refractometer

1) What is the measurement uncertainty in the refractive index? Explain.

2) What is the precision of the refractive index measurement? What sets the limits on precision? What is the precision of the dispersion measurement?

3) What factors affect the accuracy of the measurement?

4) Why should the refractive index of the contact liquid used in measuring the index of a solid sample be higher than the index of the sample?

5) How close should the index of the matching fluid be to the sample? How close should the index of the matching fluid be to the reference prism?

6) How do scratches on the reference prism affect the measurement and its accuracy?

7) Describe in words the light path when
   a) the sample is illuminated.
   b) the scale is illuminated.

8) How would you modify the model of the Abbe refractometer used in the lab to make the measurements either more accurate or easier to perform?

Brewster's Angle

1) What are the major sources of error in the measurement?

2) How do your measured values compare with tabulated data in the Schott glass catalog for BK7?

3) How would you propose to increase the accuracy of the measurements?