NAVAL POSTGRADUATE SCHOOL
Monterey, California

EC 3210 MIDTERM EXAM I 10/99 Prof. Powers

- This exam is open book and notes.
- There are three problems; each is equally weighted.
- Partial credit will be given; be sure to do some work on each problem.
- Be sure to include units in your answers.
- Please circle or underline your answers.
- Do *NOT* do any work on this sheet.
- Show *ALL* work.
- Enter your name in the space provided.

1	
2	
3	
Total	

Name: _____

1. A laser mirror arrangement has the dimensions shown in Fig. 1 The laser operates at 800 nm and produces a power of 5 mW.

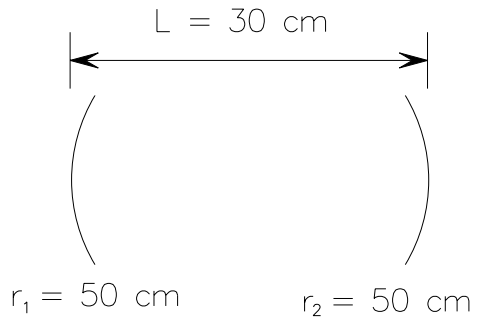

Figure 1: Optical resonator dimensions for Prob. 1.

(a) Calculate the beam divergence of the laser.

(b) Calculate the radiant intensity, J, of this laser.

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2. An officer performs an experiment at a wavelength of 500 nm with a Mach-Zehnder interferometer setup shown. First, she fills the test cell (with a 2-cm length) with air ($n = 1.00$) and sets the parallel paths 6.00 cm apart from each other as shown in the solid lines in Fig. 2.

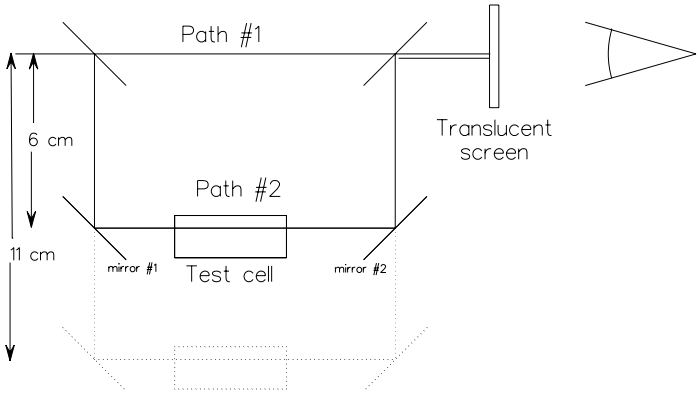

Figure 2: Set up for Prob. 2

She records a set of fringes on the screen.

Then she moves the mirrors and the test cell so that the parallel paths are 11.00 cm apart (as shown in the dotted-line section of Fig. 2) and fills the test cell with a liquid having an index of refraction of 3.5. She then again records the fringes.

Calculate the number of periods, N, that the fringes have moved between the two fringe recordings.

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3. Consider a half-waveplate. The fast axis of the waveplate is oriented horizontally; the slow axis is oriented vertically.

   The input wave is elliptically polarized. The maximum magnitude of the component along the fast axis is 5; the maximum magnitude of the component along the slow axis is 2. The phase difference between the fast-axis component and the slow-axis component is 30°.

   (a) At the input face of the waveplate, calculate the angle, α, of the major axis of the ellipse and sketch the orientation of the elliptical polarization in a figure (similar to Fig. 3.6 on p. 51 of the course notes). (The point of view of the sketch should be that seen by the observer on the output side of the waveplate.)

   (b) The output light is also elliptically polarized. Calculate the angle, α', of the major axis of the output ellipse and sketch the orientation of the elliptical polarization in a figure (similar to Fig. 3.6 on p. 51 of the course notes). (The point of view of the sketch should be that seen by the observer on the output side of the waveplate.)