

Optics 505

Exam #1

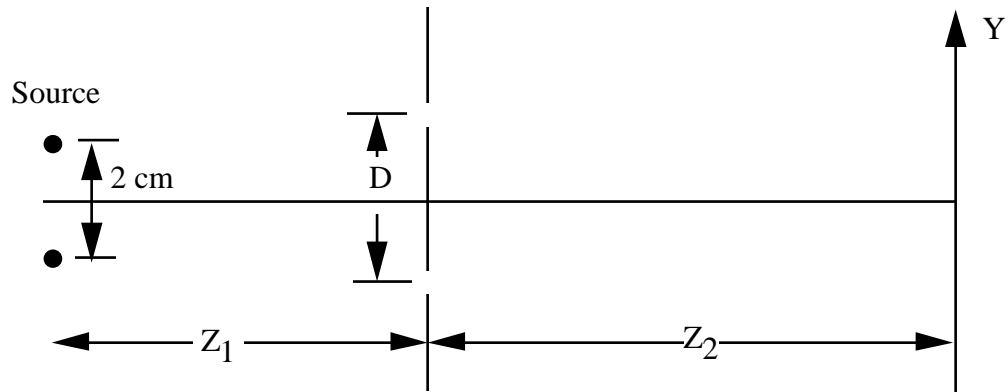
February 26, 1998

- 1) A 633 nm wavelength linearly polarized source is used with a Young's two pinhole interferometer where the pinhole separation is 2 mm. The same amount of light is transmitted through each pinhole. A half-wave plate is placed over one pinhole where the fast axis of the half-wave plate is at an angle of 20 degrees relative to the direction of polarization of the incident light.
 - a) (10 Pts) What is the fringe spacing, in units of microns, if the fringes are observed at a distance of approximately 500 mm from the two pinholes?
 - b) (10 Pts) What is the fringe contrast with the half-wave plate in place if the fringe contrast is unity when the half-wave plate is removed?

- 2) Newton's interference fringes are observed with a plano-convex lens resting on a second spherical-convex glass surface. The radius of curvature of one convex lens surface is 5 meters and the radius of curvature of the second convex glass surface is 20 meters. The two spherical surfaces are touching in the center.
 - a) (10 Pts) What is the radius of the 4th bright fringe if the wavelength is 550 nm?
 - b) (10 Pts) Let the source have two wavelengths, 550 and 575 nm. How many bright fringes do we have for the 550-nm wavelength before the fringe visibility drops to a minimum?

- 3) A solid Fabry Perot interferometer is made by putting high reflectivity coatings on the ends of a 5 mm thick piece of glass having a refractive index of 1.5. The circular fringes are observed by looking in the focal plane of a 75 mm focal length lens. The wavelength is 500 nm.
 - a) (10 Pts) What is the fringe order number at the center of the circular fringe pattern?
 - b) (10 Pts) What is the radius (in units of mm) of the 10th bright fringe from the center of the circular fringe pattern?
 - c) (5 Pts) What is the resolving power if the smallest change in wavelength that can be measured is 0.01 Angstrom?

- 4) In the Young's two pinhole experiment shown below the light source consists of two equally bright "point" sources incoherent with respect to each other. One source is above the axis 1 cm and the other source is below the axis 1 cm. Let the wavelength be 500 nm and let $Z_1 = 1$ m.
- a) (10 Pts) What is the smallest value of D for zero fringe contrast if Z_2 is 1.2 m?
- b) (5 Pts) What is the smallest value of D for zero fringe contrast if Z_2 is 2.4 m?



- 5)
- a) (5 Pts) In 10 words or less compare Fabry Perot transmission interference fringes for the case where the mirrors have a small amount of absorption to the ideal case where there is no absorption.
- b) (5 Pts) What can be said about fringe localization if the source is a point source?
- c) (10 Pts) A thin transparent sheet of index n and thickness L is inserted perpendicular to the beam axis in one arm of a Michelson two-beam interferometer. If the plate is withdrawn, determine the distance and direction through which the mirror in that arm must be moved in order to duplicate the fringes observed prior to the removal.