# Optics 505
## Exam #1

**February 25, 1999**

1) a) (5 Pts) Suppose a half-wave plate is rotated at a rate $\omega$ between stationary crossed polarizers. Give the ratio of the modulation frequency of the emergent flux density to the rotation frequency of the half-wave plate.

b) (5 Pts) A Michelson interferometer is adjusted to give circular fringes. Where are the fringes localized?

c) (5 Pts) How does the spatial frequency of the circular fringes obtained using a Michelson interferometer depend upon distance from the center of the fringe pattern?

d) (5 Pts) What are the four filters we associate with the four Stokes parameters?

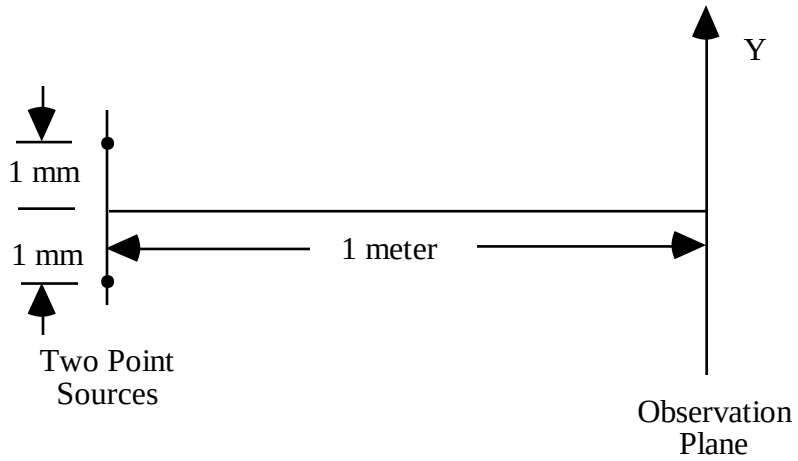
e) (5 Pts) What is the purpose of a compensator plate in a Michelson interferometer?

2) Two spherical waves are interfered as shown below.

a) (10 Pts) What is the wavelength if the fringe spacing is 200 microns?

b) (5 Pts) What is the fringe visibility if the relative intensity of the two spherical waves is 4 to 1? State any assumptions you are making.

c) (5 Pts) Let the two interfering beams have the same intensity. What is the fringe visibility if the two beams are linearly polarized and the direction of the polarization for the two beams differs by 30 degrees?




3) (10 Pts) A lateral shear interferometer produces a lateral shear of 2 mm in the x-direction. Give an expression describing the loci of bright fringes if the phase distribution $\vartheta(x,y)$ of the wavefront under test is given by $\vartheta(x,y) = 4\,\pi\,(x^2+y^2)/cm^2$, where x and y range from –1 cm to +1 cm.

4) A Michelson Stellar interferometer is used to measure the separation of binary stars.

a) (10 Pts) What is the separation of the binary stars, in micro-radians, if the first minimum of fringe visibility is obtained with a 2-meter mirror separation? The wavelength is 500 nm.

b) (10 Pts) An unresolved single star is observed using the Michelson Stellar interferometer having the 2-meter mirror separation. A spectral filter is used that passes a spectrum that extends from 500 nm to 550 nm. How many interference fringes are observed between the zero-order fringe and the first minima of the fringe visibility function. State any assumptions being made.

c) (5 Pts) Repeat Part b for a 3-meter mirror separation.

5) A 10 mm thick Fabry-Perot interferometer is illuminated with light of wavelength 550 nm. Assume the mirrors produce a phase change upon reflection of zero degrees. The focal length of the lens placed after the Fabry-Perot is 350 mm.

a) (10 Pts) What is the radius of the first bright fringe if the refractive index between the mirrors is 1.0?

b) (10 Pts) What is the radius of the first bright fringe if the refractive index between the mirrors is 1.3?