Phys 375 HW 5
Fall 2009
Due 2 / 3 November, 2009

1. Pedrotti[3], 3rd edition, problem 8-1

The path difference for the two beams emerging from the interferometer is Δ_d = 2d cos θ where θ measures the inclination angle relative to the optic axis. This gives the interference condition 2d cos θ = m λ for integer m. Thus at a fixed θ close to zero, the number of fringes passing by is Δm = 2 Δd/ λ (Eqn. 8-8 in text). Here we get (2 0.014 cm)/523 = 436 nm.

2. One of the mirrors of a Michelson Interferometer is moved, and 1000 fringe-pairs, bright and dark, shift past the hairline in a viewing telescope during the process. If the device is illuminated with 500 nm light, how far has the mirror moved?

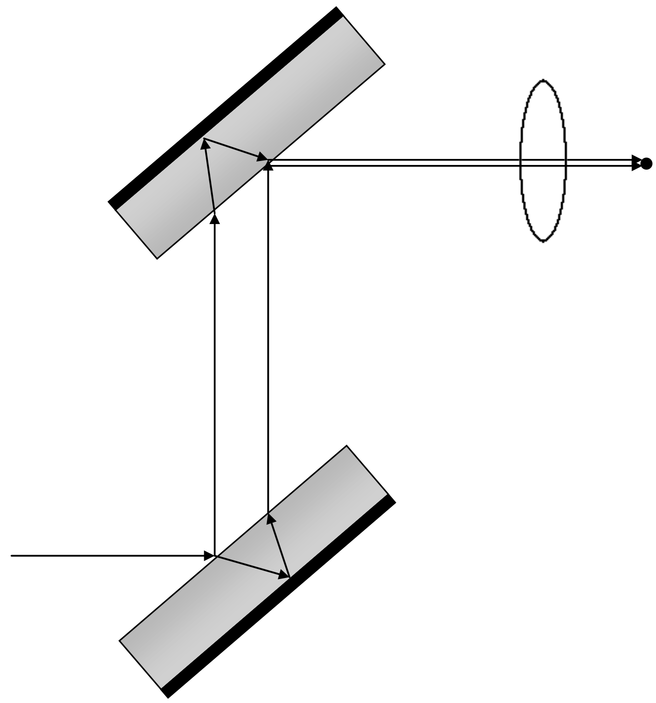
Use the same formula Δm = 2 Δd/ λ rearranged such that Δd = λ/2 Δm = (500 nm/2)(1000) = 0.25 mm.*

3. Pedrotti[3], 3rd edition, problem 8-5

(a) The change in the path length due to the presence of the cell with length L is Δd = L(n-1). Then using Eqn. 8-8 again we find n = (λ/2L) Δm + 1.

*(b) N = 2L (n-1)/ λ = 2*0.1 m*(1.00045-1)/589 nm = 153.*

4. A form of the Jamin Interferometer is illustrated below. How does it work? To what use might it be put?



When the incoming beam hits the first air-glass interface, part is reflected (R1) and part is transmitted (T1). R1 travels through air to the second splitter while T1 reflects off the mirror and reemerges into the air. At the second splitter, part of R1 is passed through the glass, yielding a T2 beam while T1 is reflected to give a R2 beam. This is an amplitude splitter. T2 and R2 are then combined at the observation point. The path lengths of T2 and R2 are the same above, but when a new medium is placed in one arm of the device an interference pattern is produced and can be used to measure the index of refraction. The interferometer can also be used to compare the flatness of one surface to a known optically flat surface.