PHYS3038 Fall 2015
Homework #8
Due date: 10 Nov 2015

Problems:

9.35 A Michelson Interferometer is illuminated with monochromatic light. One of its mirrors is then moved 2.53×10^{-5} m, and it is observed that 92 fringe-pairs, bright and dark, pass by in the process. Determine the wavelength of the incident beam.

9.40 Given that the mirrors of a Fabry–Perot Interferometer have an amplitude reflection coefficient of $r = 0.8944$, find

(a) the coefficient of finesse,

(b) the half-width,

(c) the finesse, and,

(d) the *contrast factor* defined by

$$C \equiv \frac{(I_t/I_i)_{\max}}{(I_t/I_i)_{\min}}$$

9.41 To fill in some of the details in the derivation of the smallest phase increment separating two resolvable Fabry–Perot fringes, that is,

$$(\Delta\delta) \approx 4.2/\sqrt{F} \qquad [9.73]$$

satisfy yourself that

$$[\mathscr{A}(\theta)]_{\delta = \delta_a \pm \Delta\delta/2} = [\mathscr{A}(\theta)]_{\delta=\Delta\delta/2}$$

Show that Eq. (9.72) can be rewritten as

$$2[\mathscr{A}(\theta)]_{\delta=\Delta\delta/2} = 0.81\{1 + [\mathscr{A}(\theta)]_{\delta=\Delta\delta}\}$$

When F is large γ is small, and $\sin(\Delta\delta) = \Delta\delta$. Prove that Eq. (9.73) then follows.

9.43* Satisfy yourself of the fact that a film of thickness $\lambda_f/4$ and index n_1 will always reduce the reflectance of the substrate on which it is deposited, as long as $n_s > n_1 > n_0$. Consider the simplest case of normal incidence and $n_0 = 1$. Show that this is equivalent to saying that the waves reflected back from the two interfaces cancel one another.

9.45 Determine the refractive index and thickness of a film to be deposited on a glass surface ($n_g = 1.54$) such that no normally incident light of wavelength 540 nm is reflected.

9.47* A glass camera lens with an index of 1.55 is to be coated with a cryolite film (n $\approx$ 1.30) to decrease the reflection of normally incident green light ($\lambda_0 = 500$ nm). What thickness should be deposited on the lens?