110B Homework 9

1. (30 points) Parameters of a dielectric waveguide: Light of free-space wavelength of 0.8 μm is guided by a thin planar film of width d=2μm and refractive index n=1.6.
(a) Determine the critical angle θ_c.
(b) Determine the number of TE modes.
(c) Determine the bounce angle θ and the group velocity of the m=0 TE mode.

2. (20 points) Effect of cladding: As in 1, light of free-space wavelength of 0.8 μm is guided by a thin planar film of width d=2μm and refractive index n=1.6. However, this thin film is now surrounded by a medium of refractive index of 1.4.
(a) Determine the critical angle θ_c.
(b) Determine the number of TE modes.

3. (20 points) Resonance frequencies of a resonator:
(a) Determine the spacing between adjacent resonance frequencies in a resonator constructed of two planar mirror separated by a distance of d=15 cm in air (n=1).
(b) A transparent plate of thickness 2.5 cm and refractive index n=1.5 is placed inside the resonator. It is antireflection coated at both the surface so we can neglect their reflection. Determine the spacing between the resonance frequencies of the resonator.

4. (30 points) Calculate the intensity transmission through two different parallel mirrors as a function of the incident light frequency. The first mirror has a reflectivity R=0.98, and the second mirror has a reflectivity R=0.99. The mirror separation is 1 mm.