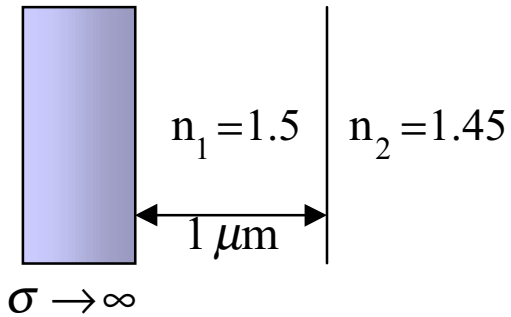
Final (2000/6/20)

Prob.1 (30)

(a) (10) A waveguide is formed by placing a sheet of perfectly conducting metal in parallel with the dielectric interface as shown below. How many guided TE modes are supp-orted in this waveguide for $\lambda = 1\mu m$? Give clear reasons for your answer.

(b) (10) Sketch the photon distribution for the fundamental TE mode in the waveguide.

(c) (10) We would like to increase the number of guided TE modes by one by changing the waveguide width. Determine the range of waveguide width required.



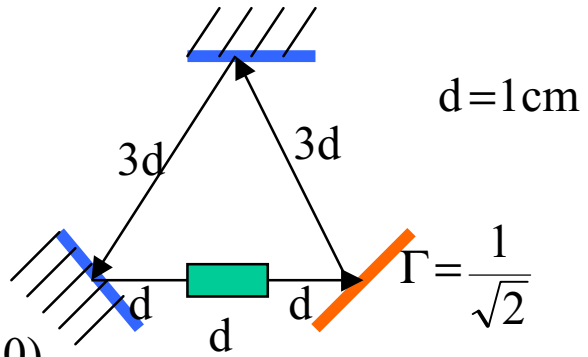
Prob 2. (30)

A ring laser has a gain material pumped by current injection inside a cavity made of two perfectly conducting metallic mirrors and one mirror with reflection coefficient $\Gamma = \frac{1}{\sqrt{2}}$ as shown below. Assume there is no reflection at the end facets of the gain material. Assume the laser has no internal loss.

(a) (10) How much threshold power gain should the gain material have in order for the laser to lase?

(b) (10) The output spectrum of the laser has multi-modes. What is the mode separation in Hz? (Assume the gain material has $n=3$)

(c) (10) The reflective index of the gain material has dependence on lightwave frequency around w_0 : $n(w)=n_0+n'(w-w_0)$ with positive n'. Does the mode separation in Hz between multi-modes around w_0 decrease or increase? Explain why.



Prob. 3 (40)

A PIN photoconductor has responsivity of 0.5 A/W at 1.55 μm.

(a) (10) What is the quantum efficiency of the detector?

(b) (10) In order to produce 1nA of detection current, how many photons should be incident on the detector per second?

(c) (10) If the dominat noise for the detector is the shot noise, what is the SNR of the detector in dB?

(d) (10) The detector is used in a 10Gbps optical communication system. The system requirement sets the minimum SNR to be 1dB. Assuming the shot noise is dominant, determine the minimum optical power that should be incident on the detector.