

### Homework 6

Due Tuesday, May 17<sup>th</sup> in class

1. **(Dielectric Waveguide)** A symmetric dielectric slab waveguide, as shown in Figure 1, has  $n_1 = 1.462$ ,  $n_2 = 1.460$ . Suppose the operating wavelength is  $\lambda_0 = 1550$  nm.

- (a) What is the maximum slab thickness  $2d$ , for which there would only be a single mode that could propagate in the waveguide?
- (b) Assume  $d = 12$   $\mu\text{m}$ . How many TE modes can propagate simultaneously in the waveguide?

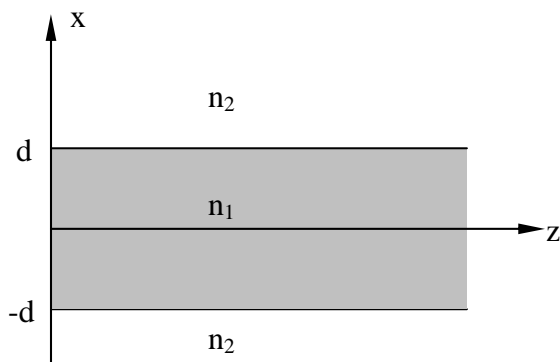


Figure 1.

2. **(Thin Film-On-Conductor Waveguide)**. A thin film-on-conductor waveguide is made of a thin film of lossless dielectric ( $\epsilon_d, \mu_0$ ) of thickness  $d$  on a perfectly conducting ground plane, as shown in Figure 2. The thin film is protected by a lossless dielectric coating ( $\epsilon_1, \mu_0$ ). Assume the widths and heights of the coating and the ground plane extend to infinity. The wave propagates in the  $y$  direction. Find the cut-off frequencies for the TE modes.

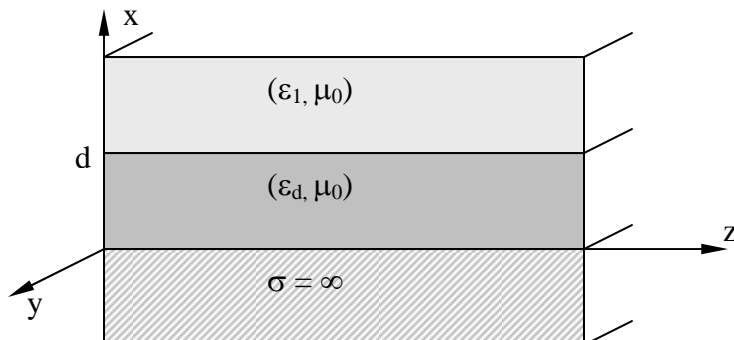


Figure 2.

3. **(Waveguide Dispersion)** Problem 14.23 in Hayt and Buck, 7<sup>th</sup> Ed. (14.15 in 6<sup>th</sup> Ed.).

4. **(FEMLAB simulation)** Use FEMLAB (2D In-plane TE waves model) to simulate the wave propagation in a dielectric slab waveguide. The structure of the waveguide is given in Figure 3. The working wavelength is 1550nm.

a). Use the uniform and Gaussian E field distributions at the input to excite the fundamental guided mode. Calculate and compare the coupling coefficients of the two cases. Plot the E field.

b). Is the TE<sub>2</sub> mode supported? If so, use a proper source to excite it so that the coupling coefficient is better than 90%. Plot the E field.

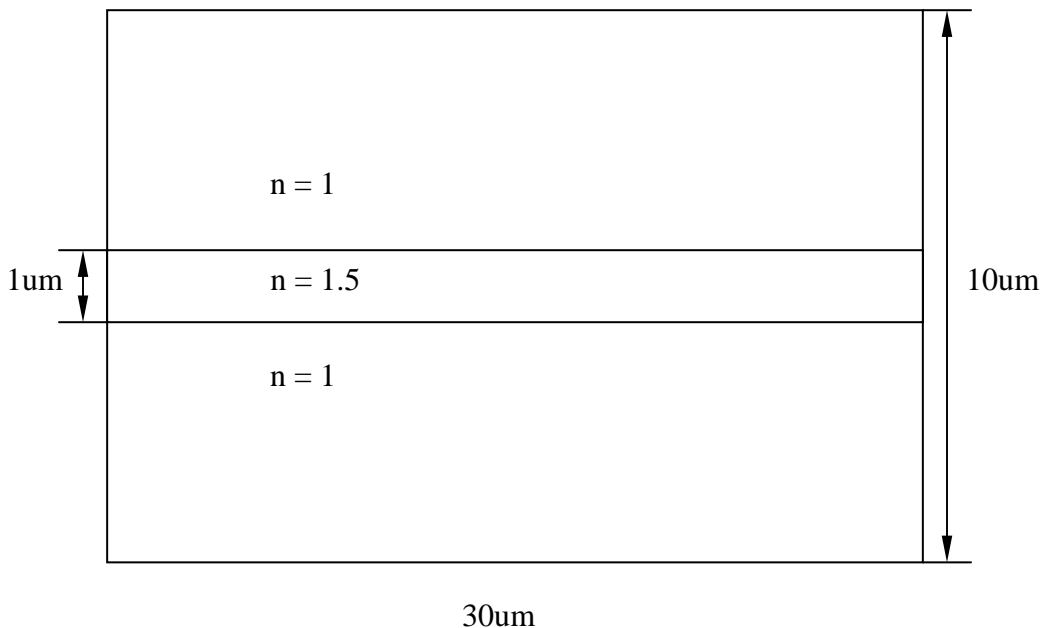


Figure 3.