

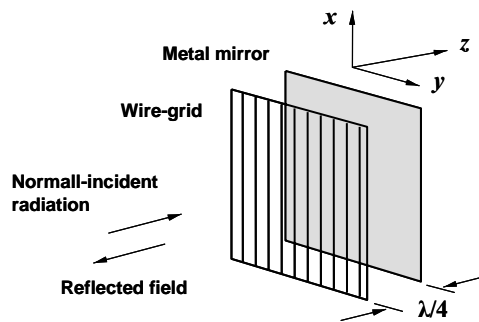
Reading Assignment:

Cheng: Chapter 8

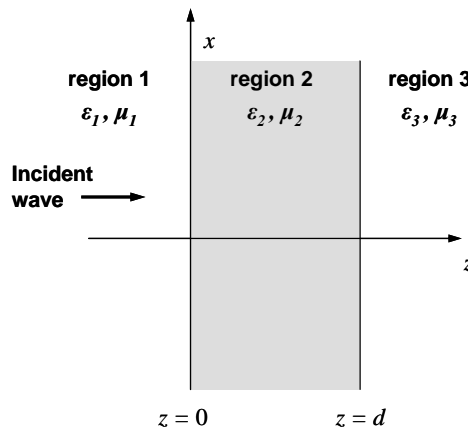
Homework #3**Due: Friday 3 February 2006**

- 1) Do P.8-30 in Cheng
- 2) Consider the situation shown below, where a mirror is placed a distance $\lambda/4$ behind a wire-grid polarizer. The wires are oriented in the x -direction. Determine the polarization of the reflected wave if the incident wave is linearly polarized according to

$$\bar{E}_{inc} = E_0 (\hat{x} + \hat{y}) e^{-jk_0 z}$$

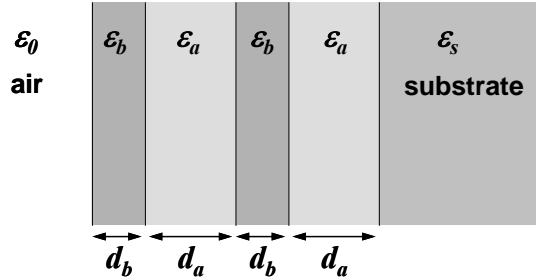


- 3) Consider a dielectric slab of thickness $d=7.5$ mm, and dielectric constant $\epsilon_2 = 4\epsilon_0$. The slab is surrounded by air, and is illuminated by a normally incident plane wave. Using the program of your choice (*e.g.* Excel, Mathematica, MATLAB, etc.), plot the fraction of transmitted power that is transmitted through this slab as a function of frequency, over the range of 1 to 20 GHz. Identify the points on the curve where the slab is a multiple of a half wavelength, or an odd multiple of a quarter wavelength.

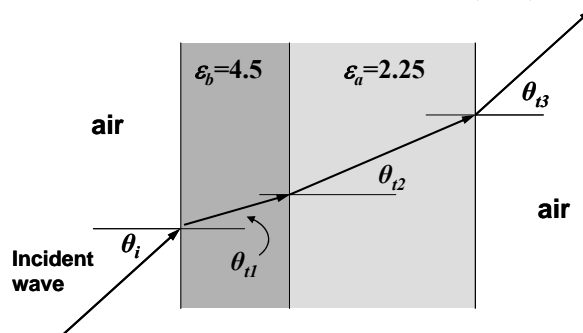


- 4) In integrated optoelectronics it is sometimes desirable to have a highly reflective but non-metallic substrate region. This can be achieved with a dielectric mirror stack, which is constructed by depositing alternating quarter-wavelength layers of two

different dielectric materials onto the substrate. In the picture below, there are four layers on a quartz substrate ($\epsilon_s = 3.78\epsilon_0$), where $\epsilon_a = 1.96\epsilon_0$, $d_a = \lambda_a/4$, $\epsilon_b = 9\epsilon_0$, and $d_b = \lambda_b/4$. Assume that a plane wave is normally incident from air on the front surface of this stack, and find the reflection coefficient at the front surface.



- 5) A uniform plane wave is incident at an angle of $\theta_i = 45^\circ$ on a pair of dielectric slabs as shown below. Calculate the angles of transmission θ_{t1} , θ_{t2} , and θ_{t3} .



- 6) A lossless dielectric slab ($\epsilon_r = 3$, thickness $d=5.0$ cm) is bounded on both sides by air. A *circularly polarized* plane wave of frequency 1.0 GHz is obliquely incident at an angle of $\theta_i = 60^\circ$. Find the fraction of the incident power which is reflected back into region-1.

