HW4 due to 11/9 (submit online at NTUCOOL before 9 am)

1.

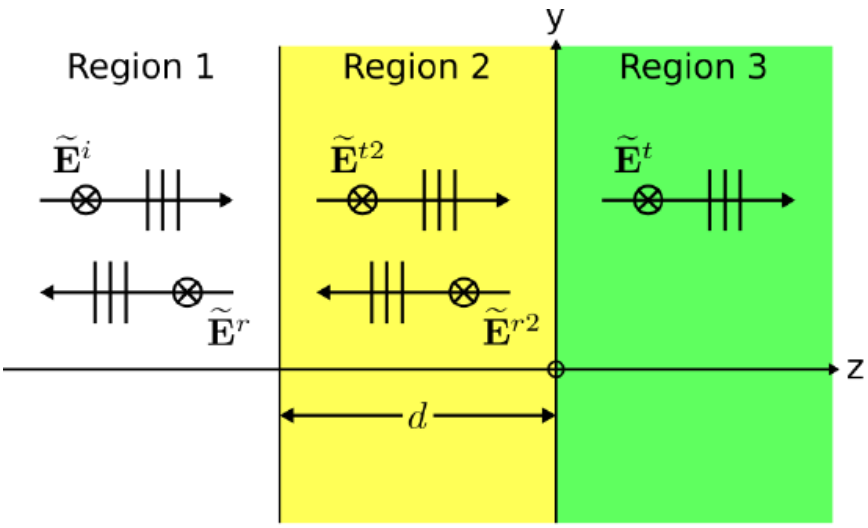
8.3 A plane wave traveling in a medium with $\varepsilon_{r_1} = 9$ is normally incident upon a second medium with $\varepsilon_{r_2} = 4$. Both media are made of nonmagnetic, non-conducting materials. If the magnetic field of the incident plane wave is given by

$$\mathbf{H}^{i} = \hat{\mathbf{z}}\, 2\cos(2\pi \times 10^{9} t - ky) \qquad \text{(A/m)}.$$

(a) Obtain time-domain expressions for the electric and magnetic fields in each of the two media.

(b) Determine the average power densities of the incident, reflected, and transmitted waves.

2. (a) For a plane wave illumination with the operation frequency of 10 GHz, the regions 1 and region 3 are air. The region 2 is a dielectric material with the relative permittivity of 4. Thickness of the regions, d, is 2 cm. Use the boundary conditions at the interface and find out the reflection at the interface between regions 1 and 2 and the transmission coefficient at the interface between regions 2 and 3. (b) Use CST to plot the reflection and transmission coefficients spectrum from 5 to 15 GHz. In addition, plot the power reflection and transmission spectrum from 5 to 15 GHz.



3. Use the equation (8.106) to find out the cut-off frequency of the rectangular waveguide WR137 (TE_{10} mode). Use CST to plot the reflection and transmission coefficient of this waveguide and its electric and magnetic fields in the cross section view along the waveguide.