Universidad Nacional de Colombia
Engineering Faculty
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Transmission Lines and Antennas (2016503) 2012-3
Exercises on Introductory Chapter

Most of these exercises are extracted from [1] and [2] as indicated in parenthesis.

1. [1, ex 1.1] Consider an infinite sheet of electric surface current density lying on the $z = 0$ plane, directed along $\hat{x}$ with complex magnitude J_0. The sheet separates two media, free-space for $z < 0$ and a dielectric with relative permitivity ϵ_r, μ_0 for $z > 0$. Find the resulting fields in the two regions. You can start by assuming plane wave solutions propagating away from the current sheet, then match boundary conditions for tangential fileds on the interface.

2. [1, ex 1.7] Consider a dielectric slab located in $0 \leq z \leq d$, infinite in the x, y directions, with relative permitivity ϵ_r and $d = \lambda_0/\sqrt{\epsilon_r}$. If there is free-space at both sides of the slab, compute the reflection coefficient for a plane wave propagating along $\hat{z}$.

3. [1, ex 1.10] A plane wave at 1GHz is normally incident on a thin copper sheet of thickness t.
   (a) Compute the transmission losses (in dB) of the wave at the air-copper and the copper-air interfaces. (Transmission losses are the ratio of the transmitted power to the incident power).
   (b) If the sheet is to be used as a shield to reduce the level of the transmitted wave by 150dB, what is its minimum thickness?

4. [2, ex 2.4] Using the time-domain form of Maxwell's Equations (and the continuity relation), show that given a good conductor with contuctivity σ and initial charge $\rho(\mathbf{r}, t = 0)$, the charge will evolve according to $\rho(\mathbf{r}, t) = \rho(\mathbf{r}, t = 0) \exp -t/\tau$ with $\tau = \epsilon/\sigma$.

5. [2, ex 2.17] The half-space $z < 0$ is filled with a material with permeability μ and permittivity ε. When a plane wave is incident normally on this material, show that the reflection and transmission coefficients are given by $\Gamma = (Z - Z_0)/(Z + Z_0)$ and $T = 1 + \Gamma$, where $Z_\dagger = \sqrt{\mu_\dagger/\varepsilon_\dagger}$ for medium †.

6. Use integral form of Gauss law to compute the capacitance per unit length of a pair of metallic coaxial cylinders of circular section with radii a and b with $a > b$ and with the intervening space filled by a dielectric having ε.

References

[1] D. M. Pozar, *Microwave Engineering*, 3rd ed. John Wiley & sons, 2005.

[2] R. E. Collin, *Foundations of Microwave Engineering.* IEEE press, 2001.