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Exercises on Introductory Chapter

These exercises have been extracted from [1], the original number is indicated in parenthesis.

1. (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. (1.7) 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. (1.10) 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. (Example in Chapter 1, pag. 26) The semispace $z > 0$ is filled with a good conductor ($\sigma \gg \omega\epsilon$) and a plane wave impinges normally from free-space $z < 0$. The idea is to compute the total power transmitted into the conductor by using the Poyinting theorem:
   (a) Consider a cylindrical surface with its side parallel to z and caps parallel to xy plane. One of the caps is positioned at $z = 0^+$, the other at $z \to \infty$
   (b) Compute the poyinting vector on the surface and compute its inwards flow.
   (c) In what faces is the flow non-zero? based on this, how do you interpret the total flow computed above?

References

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