ECE 584 Homework 4

1. Problem 1.1 in text.

2. Assume an \( \hat{x} \) directed current sheet at \( z=0 \) as in example 1.3 pg. 22 in text. Assume a lossy dielectric with a small loss tangent, such that

\[
\overline{E}_x = -\hat{x} \frac{J_0}{2\eta} e^{-\alpha z} e^{-jkz}
\]

where

\[
\alpha \cong \omega \sqrt{\mu \varepsilon} \tan \delta \frac{\tan \delta}{2}.
\]

Show that the power flux density \( P_0 \), flowing out of the right face (at \( z=1/2 \)) of a closed volume given by

\[
-\frac{1}{2} \leq z \leq \frac{1}{2} \\
-\frac{1}{2} \leq x \leq \frac{1}{2} \\
-\frac{1}{2} \leq y \leq \frac{1}{2}
\]

is equal to half the source power density \( P_s \) minus the power dissipated \( P_l \) in the volume in the region \( 0 \leq z \leq \frac{1}{2} \).