EEL 4514 - Homework 2
Due February 17, 2005

The following homework consists of two types of problems. The problems marked SP (study problems) do not need to be turned in for a grade. However, this material may be covered on the exam. The other problems must be turned in for a grade.

1. Problem 2.1-1 from the textbook
2. Problem 2.1-2 from the textbook

SP1. Problem 2.1-3 from the textbook
3. Problem 2.2-1

SP2. Problem 2.3-4
4. Problem 2.4-3

5. A cellular communication system operating in the 11.9 GHz band has the antenna at the base station (BS) located 60 m above ground. At a typical mobile station (MS), the antenna is located 2 m above ground. Consider communication on the forward link, which is the link from the BS to the MS. Treat the ground as a uniform, flat surface that acts as a perfect ground plane, with reflection coefficient 1. The channel model is the two-path model (one line-of-sight path and one ground reflection path) that was described in class. If the received power at 100 m is 30 dBm, use MATLAB to plot the received power (in dBm) from 100 m to 200 km. Use the command 'semilogx' to plot the distance axis in a log scale. Turn in your plot and a “.m” file that provides the commands to generate your plot. Do not make any approximations about the amplitudes of the signals on the two paths.

6. Repeat the previous question, but assume that the ground’s reflection coefficient is -1. In other words, the sinusoid reflected from the ground has a 180 degree phase shift. This is a more realistic assumption for most channels. After you generate your plot, estimate the slope of the received power vs. distance curve for large distances. Express your answer in dB/decade.

7. A LTI filter has impulse response

\[ h(t) = \begin{cases} 
\sin\left(\frac{\pi}{2}t\right), & 0 \leq t < 2 \\
0, & \text{otherwise}.
\end{cases} \]

If the input to the filter is the unit pulse of duration 1, \( p(t) \), find the output.

8. The signal \( s(t) \) is given by

\[ s(t) = \begin{cases} 
t, & 0 \leq t < 1 \\
1, & 1 \leq t < 2 \\
(3 - t), & 2 \leq t < 3 \\
0, & \text{otherwise}
\end{cases} \]
which is illustrated above.

This signal is input to an LTI filter with impulse response

\[ h(t) = p(t) = \begin{cases} 
1, & 0 \leq t < 1 \\
0, & \text{otherwise.} 
\end{cases} \]

Find the output signal \( r(t) = [s \ast h](t) \) for \(-\infty < t \leq \infty\). Give a mathematical expression for \( r(t) \) and sketch \( r(t) \).

SP3. Problem 2.5-2 in textbook

SP4. Problem 2.5-3 in textbook

9. Problem 2.5-4 in textbook

SP5. Problem 2.5-6 in textbook

10. Problem 2.6-1 in textbook