Problem Set 2
Due Tuesday February 18, 2003

1. In the figures below make a qualitative plot of the described impedance as a function of frequency (DC to $\infty$) on the provided Smith Chart (or use your own). Indicate the direction of the curve with arrowheads.

(a) An ideal inductor and capacitor.
(b) A lossy capacitor.
(c) A section of lossy transmission line.
(d) A series $LCR$ circuit.
2. (a) Find the TEM characteristic impedance and propagation constant for a lossless coaxial cable of inner and outer radius of $a$ and $b$ filled with a uniform dielectric. (b) Find the optimal value of characteristic impedance to minimize loss using equations derived in class. (c) Find the optimal value of impedance to maximize the power handling capability of the line.

3. Consider a microstrip transmission line made with a conductor of width $w$ and surface resistance $R_s$ on top of a lossless dielectric of thickness $d$. Estimate the loss per unit length of this line by assuming the ground return current flows under the strip with a profile obtained from an electrostatic analysis of a charged filamental line. Verify the validity of your results with ADS.

4. Compute the propagation constant and phase and group velocity for a uniform distributed circuit line with an infinitesimal section given by the following equivalent circuits (elements are per unit length):

(a) Filter-type distributed circuit. (b) Backward-wave transmission line.

5. (Collin, “Foundations of Microwave Engineering” problem 4.11) For the following microwave circuit, evaluate the power transmitted to the load $Z_L$. Find the standing-wave ratio in the two transmission-line sections. Assume $Z_L = 2Z_1$, $X_1 = X_2 = Z_1$, $V_g = 5V$ (peak). Repeat your calculation with the Smith Chart.

6. (Ramo et al., “Fields and Waves in Communication Electronics” problem 5.10b) The standing wave radio on an ideal 70-Ω line is measured as 3.2, and the voltage minimum is observed 0.23 wavelength in front of the load. Find the load impedance using the Smith chart.

7. Do you plan to do a project in this course? Is your project related to your research? Briefly describe some of your project ideas.