MICROWAVE ENGINEERING

## Problem #1: Normalized Impedance and Admittance

Using just your calculator, answer the following questions:

a. Given the characteristic impedance of a transmission line $Z_0$, write the equations to calculate normalized impedance $Z_L$ and normalized admittance $Y_L$.
   $z_L = ?$
   $y_L = ?$
b. Next, write the equations to "denormalize" the impedance and admittance given $Z_0$.
   $Z_L = ?$
   $Y_L = ?$
c. If $Z_0$=75 Ω, what is the normalized impedance given $Z_L = 25 + j100$ Ω?
d. If $Z_0$=60 Ω, what is the impedance given the normalized impedance $z_L = 2 + j0.5$?
e. If $Z_0$=30 Ω, what is the normalized admittance given $Y_L = 0.1 + j0.02$ $\Omega^{-1}$?
f. If $Z_0$=55 Ω, what is the admittance given the normalized admittance $y_L = 2 + j1$?

## Problem #2: Converting Between Impedance and Admittance

Given the characteristic impedance of a transmission line is 50 Ω, calculate the following by hand and using the Smith chart. Include your Smith Charts showing your work with this assignment.

a. Calculate $Y_L$ given $Z_L = 150 - j25$ Ω.
b. Calculate $Z_L$ given $Y_L = 0.3 - j0.1$ $\Omega^{-1}$.

## Problem #3: Impedance Transformation

a. A lossless transmission line has distributed parameters $C$ = 150 pF/m and $L$ = 375 nH/m. It operates at 2.4 GHz and is connected to a load with impedance 15-$j$25 Ω. Use a Smith chart to calculate the input impedance 2.0 cm from the load. Also determine the VSWR of the circuit.

b. A lossless transmission line has distributed parameters $C$ = 100 pF/m and $L$ = 250 nH/m. It operates at 1.0 GHz and is connected to a load with impedance 25+$j$100 Ω. Use a Smith chart to calculate the input impedance 1.6 cm from the load. Also determine the VSWR of the circuit.

Note: Include your Smith Charts showing your work with this assignment.

## Problem #4: Single Stub Tuning

A 75 Ω transmission line operates at 5.0 GHz and is composed of two conductors suspended in air. The line feeds a load with complex impedance $Z_L = 75 - j30\ \Omega$.
Design a single stub tuning network to match the transmission line to the load. Draw a diagram of your design. What is the resulting VSWR after the matching circuit is incorporated? Provide your Smith Chart showing your work with this assignment.