**Project #4 Impedance Matching**

Design impedance matching sections for each of the following at a frequency of 10 GHz... Implement the design in microstrip configuration using duroid ($\varepsilon_r = 2.2$ and $h = 1/32''$).

- In each case demonstrate and discuss, with the relevant graphs that your design works. (You may have to make small changes in the lengths to achieve SWR=1.)
- In each case there are two solutions. Compare bandwidth defined for SWR $\leq 1.5$

1. **Single Stub Tuner** $Z_L = 100 + j\;80\;\Omega$ and $Z_0 = 75\;\Omega$
   
   (a) Short circuited 75Ω stub (Problem #5.4)
   (b) Open Circuited 75Ω stub (Problem #5.3)

2. **Quarter Wave Transformer** $Z_L = 100 - j\;100\;\Omega$ and $Z_0 = 75\;\Omega$
   
   (a) Use a shorted stub at the plane of $Z_L$
   (b) Use an extended transmission line to implement the QWT

3. **Double Stub Tuner** $y_L = 0.4 + j\;1.2\;\Omega$ with $Z_{OS} = Z_O$
   
   (a) Short circuited stubs $d_1 = 0$ and $d_2 = 0.375\;\lambda$ (Problem #5.10)
   (b) Open Circuited stubs $d_1 = 0$ and $d_2 = 0.125\;\lambda$ (Problem #5.9)

4. **Limped Element Circuit**
   
   (a) $Z_L = 75 - j\;100\;\Omega$ and $Z_0 = 50\;\Omega$ Problem #5.1a
   (b) $Z_L = 10 - j\;45\;\Omega$ and $Z_0 = 50\;\Omega$ Problem #5.1c