EE6240 Homework 1: Due Wednesday 31/08/2011

1. Impedance transformation networks are widely used in power amplifier designs to enable a specific amount of power to be delivered to a load. Owing to supply voltage limitations, a downward impedance transformation of the antenna resistance is usually necessary. Suppose we wish to deliver 1W of power to a 50Ω antenna at 2.4GHz, but the power amplifier has a maximum peak-to-peak output swing of only 4V.

a) What is the maximum power that can be delivered to the load without a matching network?

b) Design a high-pass T-match network with a Q=5 using ideal passive components that can deliver the desired power to the load.

c) Verify the above results using any appropriate simulator of your choice: Eldo (preferred), Spectre or Hspice. Plot S_{11} (magnitude in dB) and Z_{in} (magnitude in Ω and phase in °) versus frequency from 10MHz-10GHz. Also, determine the –3dB bandwidth from your simulation, and compare the Q derived from the BW definition with the Q that you designed for.

d) Design the inductor of the above T-match network in ASITIC. You may use either square or octagonal spirals (i.e. no circular spirals), and maximum outer diameter is 200µm.

e) Re-run the matching network simulation after replacing the ideal inductor with the π-model generated from ASITIC to see how the impedance matching has been affected. Again, plot S_{11} (magnitude in dB) and Z_{in} (magnitude in Ω and phase in °) versus frequency from 10MHz-10GHz. Try to maximise Q and f_{SR} in (d) above, as that will reduce the deviation from ideal behaviour.