Comments on Readings from Textbook

The text (Radmanesh) has a breadth of topics covered. It goes much beyond the simple "lumped circuits" that we will use in EE133 and gets to "microwave plumbing" using strip lines etc. Here are brief summary ("take-home message") notes about what is being used (immediately)from the text. There are assigned reading sections. It is expected that you will read what is assigned.

Chapter 6--read ALL of it!

Sections 6.1-6.3--components radiate and couple by electric fields. This affects behavior of the circuit and causes EMI which is a major product (environmental) concern.

Section 6.4--The relationship between wavelength and propagation velocity is a key parameter. Propagation velocity scales speed-of-light by root-of-dielectric- constant. "Lumped" component approximations are used when dimensions of components are much, much less than wavelength.

Section 6.5.1-2--wires and resistors aren't as simple as what we've seen in past lab classes (i.e. EE122). Wires are also inductive (due to skin effect) and resistors show both inductive and capacitive effects with frequency...See Fig. 6.12 and note that we are working at ~20MHz.

Section 6.5.3--In addition to the normal things about capacitors (i.e. C=Q/V for constant-valued caps) we define the component Quality Factor (Q): Q=Xc/Req. For a "perfect" capacitor, Req=0 and Q=infinite. Real capacitors have finite Q. Again, Fig. 6.19 emphasizes that components have changing behavior with frequency...(sorry, it isn't a perfect world!)

Section 6.5.4--Inductors are out new friend in EE 133...we NEED them in a serious way. Fig. 6.24 is our introduction to "tuned circuit". The frequency plot in Fig. 6.25 shows us that in addition to the fact that the inductor (too) changes behavior, it shows a "peaking" in [Z] which has to do with both it's resonance (with parasitic C) and its quality factor: Q=XL/RS (see text and following examples).

Section 6.6--From here on we shift gears to talk about CIRCUITS. Since we are considering frequency selective circuits, we have a Band-Width (BW) that is defined: BW=2*pi[f2(3dB)-f1(3dB)]. The Circuit Quality Factor, or Circuit Q is: 2*pi*fo/BW, where fo is the center frequency (or resonant frequency). The Insertion Loss is another key term which compares the ratio (expressed in dB...20log_10(ratio)) of behavior with ideal vs. non-ideal components.

Section 6.7--Two simple filters (LP with RC; HP with RL) and then TUNED Circuit with R-LC. For the tuned circuit we see (again) a Q-factor: Q=Rp/Xp (where Xp is either due to C or L--effects are equal at resonance).

Section 6.7.2--Impedance transformations are critical to all our work, beginning in Lab 1. The rules are:
define Qc=Qs=Qp (where Qc=Rp/Xp for shunt and
Qc=Xs/Rs for series)
The relationship between Rp and Rs is:
Rp=(Qc^2 + 1) Rs
Once Qc is determined and either Rp or Rs is computed, the new component value (either transformed L or C) is computed based on the corresponding shunt or series formula. Example 6.8 is exactly what is needed for Lab 1. Example 6.9 gives computation of Insertion Loss (in case you forgot that we just defined it above :) and Example 6.10 gives a design-oriented example.

Section 6.8--Impedance Transformers are again a key (and essential concept). Basically, assuming that there is negligible phase difference across a series combination of C's or L's, simple voltage-divider relationships result in two powerful scaling relationships. You will use the inductive (Tapped-L) transformer in Lab 1 to measure Q using a 50 Ohm probe (while not "killing" the circuit Q which has Rp>>50 Ohms). Example 6.11 is for a capacitive (Tapped-C) transformer; this example is very close to what is used in the feedback loop to create a Colpitts Oscillator (if you REALLY want to see one NOW...go to Chapter 17, Fig. 17.15(c) and you got it).

Section 6.9--Although we are only beginning in EE133, soon we will want to match stages. For example, when we build our LNA (low noise amplifier) we want to match it to the antenna. Simple matching rule (that you remember from EE 101) is that Rs=RL. The complete rule (in addition) includes: Xs=-XL. Basically, the comlex Zs=ZL*. Example 6.12 gives a useful (but simple) illustration of matching, basically using the parallel and series conversions (per section 6.7.2).

Sections 6.9.1-6.9.3--give more detailed matching examples (which will be deferred until a bit later in the quarter). It should be noted that as we discuss the Smith Chart and related methodology (see Chapter 9) that many of these examples will be revisited in Chapters 10 and 11.

FINIS Chapter 6