EE 221L Lab Experiment #12

**Topic:** Magnetic Circuits and Measurements

**Date:**

**Preliminary:**

1. Bring your lab notebook and textbook.

**Introduction:**

The purpose of this experiment is to:

a) Investigate the relationship between peak value and rms value of various waveforms.

b) Investigate the impedance of a vhf antenna and add an impedance which will maximize average power transfer from a radio transmitter to the antenna.

**Prior to Lab Period:**

a. **Divide into 2 teams (A-M, N-Z)**
   
   a. We will have 2 benches set up, each with a different project.
   
   b. In your 30 minute time slot, rotate through each project.

**In the Lab**

1. Remember to record pertinent information in your lab book for each part of the experiment, such as:

<table>
<thead>
<tr>
<th>Date:</th>
<th>Time:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equipment:</th>
<th>Lab Bench #:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
<th>etc</th>
<th>etc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Project 1): Investigate the relationship between peak value and rms value of various waveforms.**

a) The lab bench should be equipped with a Tektronix GFC250 signal generator, a Tektronix TDS-2012 oscilloscope and a Tenma 72-410A “true rms” multimeter.

b) Set the signal generator up to output a 1.0 V_{peak}, 800 Hz sine wave. Use the scope to set the amplitude of the signal generator.

c) Review the controls on the scope. Get familiar with the function of each of the scope controls. Ask the TA for assistance if needed.

d) Sketch the waveform being output from the signal generator. Indicate peak, peak to peak, rms value, frequency, radian frequency, period, and phase angle parameters on your sketch. Underneath your waveform sketch, write the equation of the waveform.

e) Using the multimeter, measure the voltage being output by the signal generator. Compare your multimeter reading with your scope reading.
f) Set the signal generator up to output a 1.0 V\text{peak}, 800 Hz square wave. Use the scope to set the amplitude of the signal generator.

g) Sketch the waveform being output from the signal generator. Indicate peak, peak to peak, rms value, frequency, period, and phase angle parameters on your sketch.

h) Using the multimeter, measure the voltage being output by the signal generator. Compare your multimeter reading with your scope reading.

i) Set the signal generator up to output a 1.0 V\text{peak}, 800 Hz triangular wave. Use the scope to set the amplitude of the signal generator.

j) Sketch the waveform being output from the signal generator. Indicate peak, peak to peak, rms value, frequency, period, and phase angle parameters on your sketch.

k) Using the multimeter, measure the voltage being output by the signal generator. Compare your multimeter reading with your scope reading.

l) Disconnect the setup for the next group.

Project 2) Investigate the impedance of a VHF antenna and add an impedance which will maximize average power transfer from a radio transmitter to the antenna.

1. Review textbook section 11.3 which describes the technique used to accomplish maximum average power transfer.

2. The equipment at the lab bench consists of:
   - a combination RF (radio frequency) signal generator and impedance meter (MFJ-259B)
   - an antenna tuner (MFJ-945E)
   - a vhf antenna which is resonant at 50.31 MHz, but is to be used at 50.1 Mhz

3. Connect the signal generator / impedance meter, antenna tuner, and antenna as follows:
4. Make sure the “tune” button on the front of the tuner is in the “out” position. Leave all the other switch settings and knobs in their original positions. When in the “out” position, the tuner circuit is bypassed, and the impedance readings are those of the antenna. We will ignore the impedance of the feedline, which is approximately 50 ohms, for this exercise.

5. The display on the signal generator / impedance meter is read as follows:

6. Power up the signal generator / impedance meter. Set the frequency to 50.1 Mhz.

7. Record the R and X values of the antenna impedance. (Assume the reactance reading is capacitive).

8. Draw an equivalent circuit of the generator and antenna. Assume the output impedance of the signal generator is 45 ohms with no reactance.

9. Push the “tune” button of the antenna tuner “in”.

10. Record the R and X values of the antenna impedance.

11. Draw a new equivalent circuit of the generator, tuner, and antenna.

12. What components must be inside the tuner box?
    Hints: what component would make the reactance reading change from its original value in step 7 to the new value in step 10? From what you learned in section 13.5, explain what caused the R values to change.

13. Disconnect the setup for the next group.