ENSC 220 – Lab #3: RL Circuit (Due Nov. 7, 2005)
Version 2.1 Oct. 31, 2005

OBJECTIVE
- Wind and test an inductor. This inductor will be used in AM radio project in a subsequent lab.

PREPARATION
- Read Lab Handbook 2.3.4 (Capacitors) and 2.3.5 (Inductors)
- Read Appendix III (pp. 227) on standard capacitor values.

EQUIPMENT
- Basic lab tools and breadboard
- Dual DC power supply
- Digital Multimeter (DMM), Fluke 8010A
- Function Generator, Wavetek 182A or equivalent
- Oscilloscope, Tektronix 2235 or similar
- LRC bridge
- Connnecting wire
- Wire and core for inductor
- Emery paper
- Tape

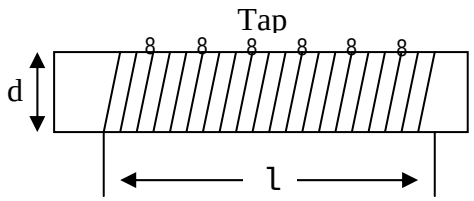
NOTES:
- Connect your circuit neatly and logically on your breadboard to facilitate toubleshooting.
- Set the DC offset on the function generator to "0".

METHOD:
- **INDUCTOR**

1. Construct the inductor

The inductance L of an air-core inductor is approximated by:
$L = (d^2 n^2) / (18d + 40l)$
where:
L = inductance (measured in uH)
d = coil diameter (inches)
l = coil length (inches)
n = number of turns.

You will be supplied with #26 AWG enamelled wire (0.0170" diameter) and a 5" piece of nominal 3/4" (actual O.D.1-1/16") plastic pipe to construct your inductor (you should not need any more than 30' of wire). You will probably want to experiment with inductances in the range of 50 - 200 μH. This will come handy when you build your AM radio for Lab-5. You can build a "tapped" inductor by inserting a twisted wire loop "tap" at several sites along the length of the inductor.



2. Use the LRC bridge to measure your total inductance and that of each tap. Compare to calculation.

3. Also devise your own method to measure the total inductance (e.g., based on a step/natural response technique) using the terminal characteristic for an inductor: $v = L\, di/dt$. Compare to calculation.

4. Create a series RL circuit with your inductor. Choose a resistor to give a reasonable time constant (few milliseconds). Using the signal generator apply a voltage square wave to the RL circuit (0 to few volts). Use a frequency that allows the RL circuit to fully decay after each voltage rising or falling edge (i.e. at least 5 times the time constant). Using the oscilloscope capture the voltage across the resistor and the inductor for both the rising and falling edge. Set the trigger to start at the rising edge. Capture traces that show the applied wave, and one device's voltage (R or L) for both edges in one plot (have one pair for R and a second for L). This shows the natural response of the circuits. Measure the time constant and compare to your estimate. Measure the peak current in each cycle).