EELE 250 Laboratory No. 4, Basic Circuits and Signals

Scope:

- Study the steady-state (DC) and transient responses of RL and RC Circuits.
- Study the transient response RL and RC Circuits.
- Study time constants.
- Use signal generator.
- Use oscilloscope.

Home Preparation:

- Review Hambley Chapters 3 to 4.4
- Recall: $v_c(t) = V_\infty + (V_0 - V_\infty)\cdot\exp(-t/RC)$
- For the circuit shown on Fig. 4.1, switch S1 has been open for a long time and switch S2 has been closed for a long time. At time t=0 seconds S1 closes and S2 opens. Determine the equation for the voltage across the capacitor in Fig. 4.1 for t ≥ 0 seconds.

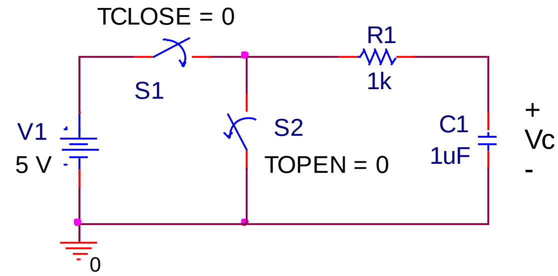

Fig. 4.1

- For the circuit shown on Fig. 4.2, switch S1 has been closed for a long time and switch S2 has been open for a long time. At time t=0 seconds S1 opens and S2 closes. Determine the equation for the voltage across the capacitor in Fig. 4.2 for t ≥ 0 seconds.

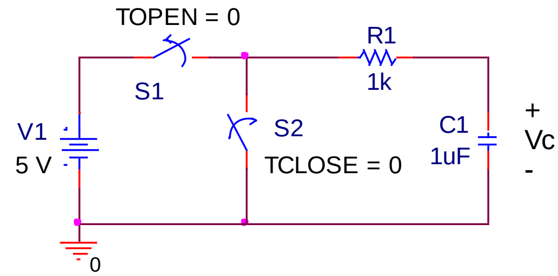

Fig. 4.2

- Recall: $i_L(t) = I_\infty + (I_0 - I_\infty)\cdot\exp(-t/(L/R))$
- For the circuit shown on Fig. 4.3, switch S1 has been open for a long time and switch S2 has been closed for a long time. At time t=0 seconds S1 closes and S2 opens. Determine equations for the voltage across the resister and the current through the inductor in Fig. 4.3 for t ≥ 0 seconds.

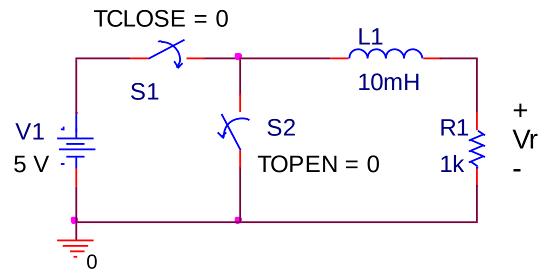

Fig. 4.3

- For the circuit shown on Fig. 4.4, switch S1 has been closed for a long time and switch S2 has been open for a long time. At time t=0 seconds S1 opens and S2 closes. Determine equations for the voltage across the resister and the current through the inductor in Fig. 4.4 for t ≥ 0 seconds.

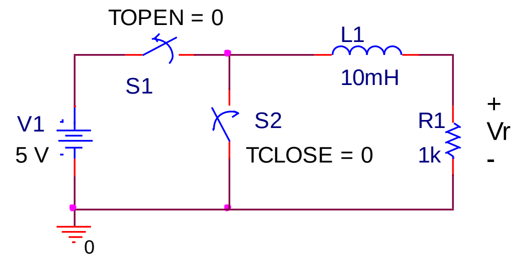

Fig. 4.4

Laboratory experiments:

1) Breadboard the circuit shown in Figure 4.5.

- Measure the current through the inductor.
- Measure the voltage across the resistor.
- Find the dc resistance of the inductor using the DMM. (Actual inductors have a small but non-zero resistance at dc.)
- Verify that KVL is satisfied for this dc circuit.

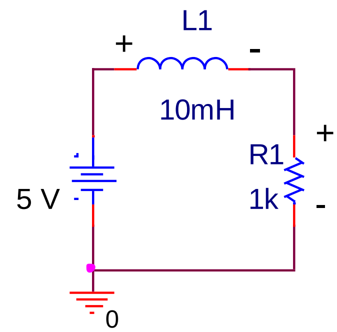

Fig. 4.5

2) Substitute the DC source in experiment (1) with a square wave signal, from the signal generator, with V_{MAX} = 5V, V_{MIN} = 0 V, and a frequency of **10 kHz**, as shown in Fig. 4.6. (Set the square signal to 5 volts peak-to-peak and adjust the dc offset of the signal until V_{MIN} is achieved.)

- Connect Channel 1 (set to dc coupling) of the oscilloscope to record the voltage across the source and Channel 2 to record the voltage across the resister. Use the MATH function of the o-scope set to Ch1 – Ch2 to view the voltage drop across the inductor.
- Carefully make a *detailed* sketch in your notebook of all three voltage signals.
- Use the recording feature of the oscilloscope to record the trace of both signals. Print and paste the graphs in your notebook.
- From the o-scope display, determine the time constant for this circuit. Detail the procedure used to find the time constant in your notebook.
- Present the results of these experiments. Highlight the important features. Comment on the results.

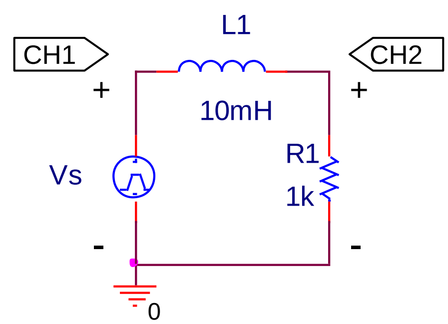

Fig. 4.6

---

3) Breadboard the circuit shown in Figure 4.7

- Measure the voltage across the capacitor.
- Measure the current through the resistor.

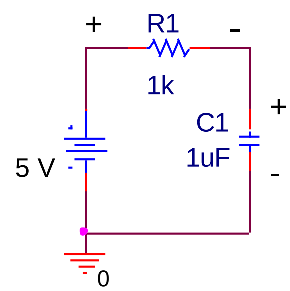

Fig. 4.7

4) Substitute the DC source in experiment (3) with a square wave, with V_{MAX} = 5V, V_{MIN} = 0 V, and a frequency of **50Hz**, as shown in Fig. 4.8.

- Connect Channel 1 of the oscilloscope to record the voltage across the source and the Channel 2 to record the voltage across the capacitor. Use the MATH function of the o-scope set to Ch1 – Ch2 to view the voltage drop across the resistor.
- Sketch in your note book all three voltage signals.
- Use the recording feature of the oscilloscope to record the trace of both signals. Print and paste the graphs in your notebook.
- From the o-scope display, determine the time constant for this circuit.
- Comment on the results.

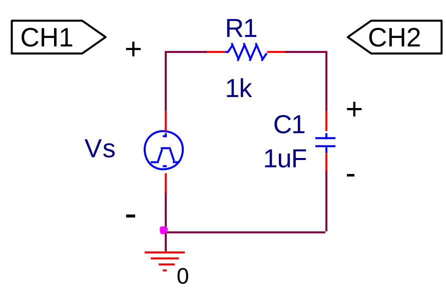

Fig. 4.8

In these experiments you have seen responses (signals) which change exponentially from an initial to a final value. Can you think of a mechanical system where you will observe a similar response?