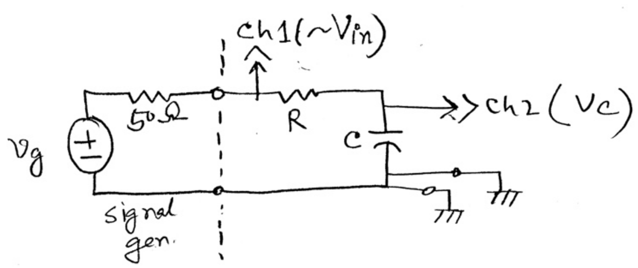
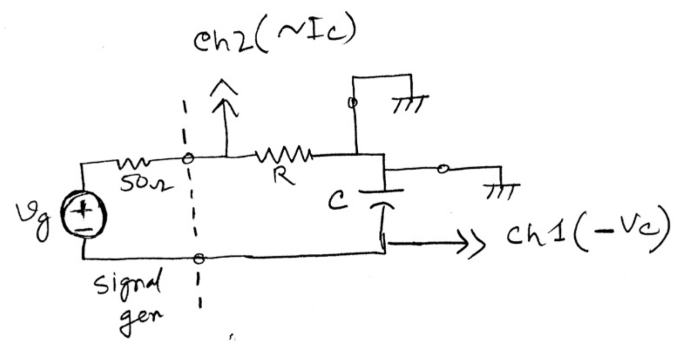
Lab 3 Appendix

1. Build a single time constant (STC) RC circuit and determine its time constant $\tau=(50+R)xC$.

(You can use 22nF capacitor and 910Ω or higher resistor this experiment.)

2. Observe the charging and discharging phase of capacitor by applying a square wave voltage of 200 mV (p-p) and a period $T = 1/f \geq 5\tau$ (period of input signal is long enough to observe the complete charging and discharging phase of the capacitor). You can observe the current waveform for this (series) circuit by observing the voltage drop (V_R) across the resistor 'R'. (Actual value of the current is V_R/R.) To observe the capacitor voltage and current waveforms simultaneously, place the ground of the two oscilloscope probes at the common node of the capacitor C and the resistor R.





3. Store the input voltage, the capacitor voltage and current waveforms (in CSV format) in an USB flash drive. Compare your experimental data with the theoretical prediction for an ideal STC RC circuit voltage, current.

4. Explain the direction and shape of capacitor voltage and current.

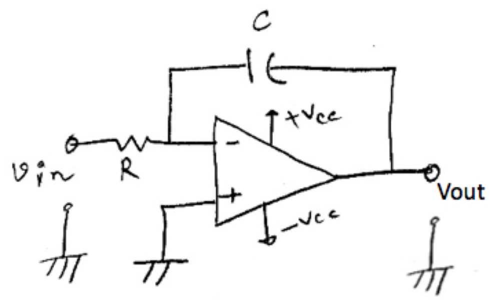
5. Comment on the power consumed/ generated by capacitor (following passive sign convention).

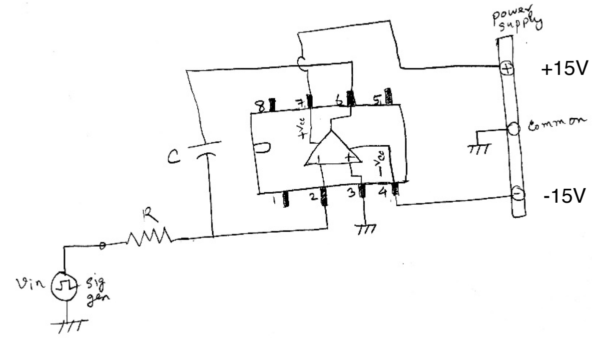
6. Is the capacitor voltage an integration of input voltage?

7. Now change the period (/frequency) of the input square wave to $T = 1/f < \tau/2$. Store the input voltage, the capacitor voltage and current waveforms. Compare the charging discharging characteristics with theoretical prediction for an ideal STC RC circuit.

8. Is this an integrator circuit (compare the input voltage and the capacitor voltage)? Explain your observation.

9. Now build an active RC integrator circuit with a 741 OpAmp. Use +15V and -15V from DC power supply as +VCC and –VCC for OpAmp.





10. Apply an input square wave of 200 mV (p-p) and a period (/frequency) of $T = 1/f \geq 5\tau$.

Observe (and store) the input voltage, the capacitor voltage and current waveforms for this active RC circuit.

11. Is this an integrator circuit?

12. Change the period of input square wave to $T = 1/f < \tau/2$. Observe (and store) the input voltage, the capacitor voltage and current waveforms. Is this an integrator?

13. Does this active RC circuit has a different time constant 'τ' than you calculated in the first part [(R+50)xC]? Considering the fact that an ideal OpAmp has an output resistance of zero (0). What would be the charging/discharging time for the capacitor (C) in this active integrator circuit?

14. Now build an (passive) RL circuit. Use the inductor provided in your lab kit. You can use an ~100 Ω resistor for this circuit.

15. Apply a square wave input (200 mV p-p) and observe (and store) the input voltage, the inductor voltage and current waveforms. You would need to choose the frequency of the input square wave that would allow you to observe transient (charging/discharging) behavior of the inductor (charging and discharging).

16. Comparing these waveforms of your RL circuit with theoretical prediction for an ideal STC RL circuit and estimate the value of inductor (L) you are using in this circuit.