Analog Electronic Circuits Lab (EC2.103, Spring 2022)

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Instructions:

1. Systematically record all your observations in the lab book (mandatory)
2. Save results in USB or take pictures
3. Make meaningful tables to summarize your findings and show it to the instructor(s) during the lab session only
4. Bring your calculators and DMM (if available)
5. Handle equipment carefully and report in case of any incidence
6. Enjoy your time in lab and strengthen your understanding about circuits

Experiment-9
Opamp Circuits

1. **VTC for opamp in negative and positive feedback configurations**
   Consider the feedback configurations shown in Fig. 1. Take $R_1 = R_2 = 10\ k\Omega$, supply voltages $=\pm 12$ V.

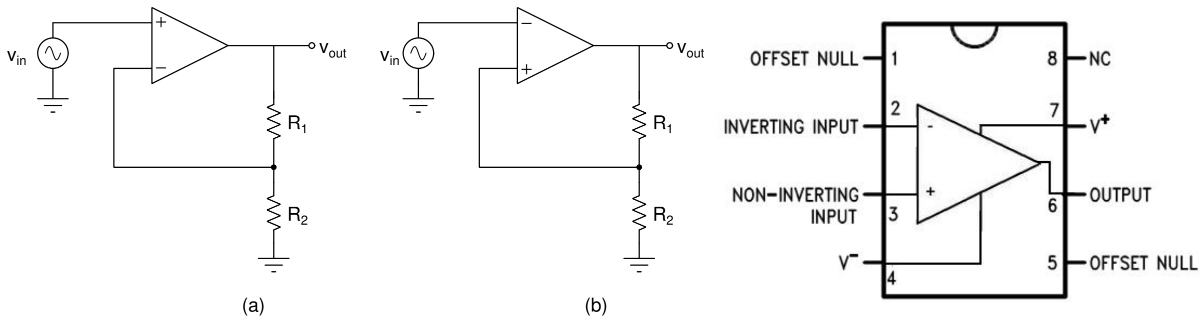

Figure 1

   (a) Identify the type of feedback in Figures 1(a) and (b).
   (b) Plot VTC (v_{out} vs v_{in}) for the circuits shown in Figures 1(a) and (b). Vary v_{in} from -VDD to +VDD (a sine wave with amplitude VDD, low frequency say 100 Hz) and plot v_{out}, use acquire mode. With the equipments available in lab you can choose supply voltages $=\pm 8$ V and $v_{in_{pp}}$ $=\pm 12$ V to clearly see the transitions on the VTC.
   (c) Which feedback mode exhibits regeneration/hysteresis. Briefly discuss.

2. **RC Oscillator (+ve feedback example)**
   Fig. 2 depicts an opamp based RC oscillator, where the time period of oscillation can be given as follows (derive it - home work)

$$T_{osc} = 2R_3C\ ln\left(1 + \frac{2R_2}{R_1}\right)$$

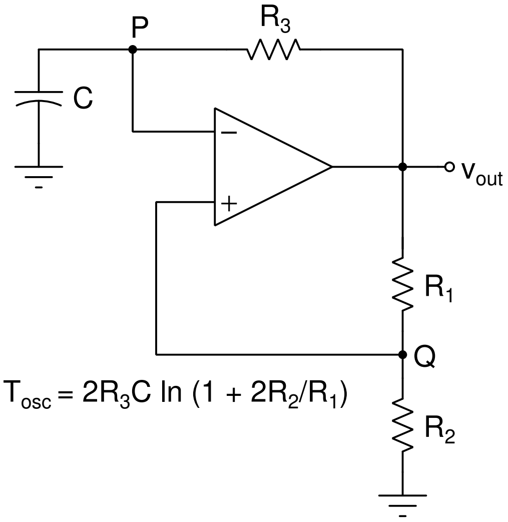

Figure 2

(a) Connect the circuit as shown in Fig. 2 with $R_1 = R_2 = 10\ k\Omega$, supply voltages $=\pm 12$ V, $R_3 = 1\ k\Omega$ and C = 1 μF. Theoretically calculate f_{osc}.

(b) Plot v_P, v_{out}, v_Q and report frequency of oscillation from measurement. Compare the measured frequency with the calculated value. Properly annotate voltage levels and time on all the plots.

3. **Integrator (-ve feedback example)**
Connect the circuit as shown in Fig. 3(a). $R_1 = 10\ k\Omega$, $R_2 = 1\ k\Omega$, $v_{in} = 0\ V$ (DC) C = 10 nF.

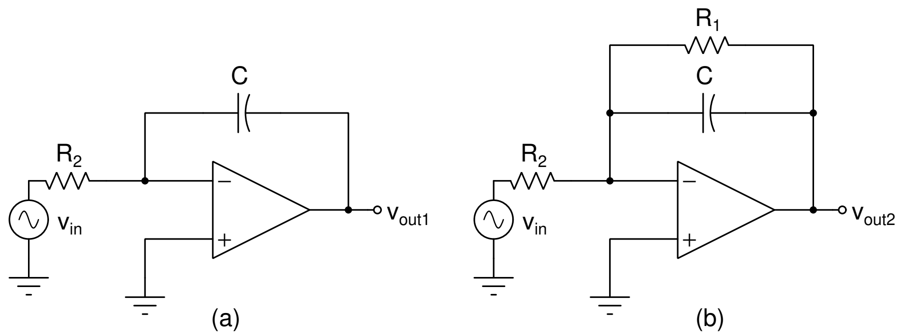

Figure 3

(a) Using oscilloscope, measure voltage at v_{out1}. Does it get saturated? (Hint: Due to DC offset of opamp, input will keep rising (or falling) (integrator action) till the opamp output get saturated.)

(b) Now connect the circuit as shown in Fig. 3(b) and measure voltage at v_{out2} using the oscilloscope. Does it get saturated? If not then what is the reason. (Hint:At staedy state ($t = \infty$), gain for DC-offset is 1+R_1/R_2.)

(c) In Fig. 3(b), apply a square wave at v_{in} with voltage levels of 0 (low) and 500 mV (high) and frequency of 50 kHz. Plot v_{out2} and v_{in}. Do you observe integrator action? Comment.

4. **Precision half-wave rectifier (-ve feedback example)**

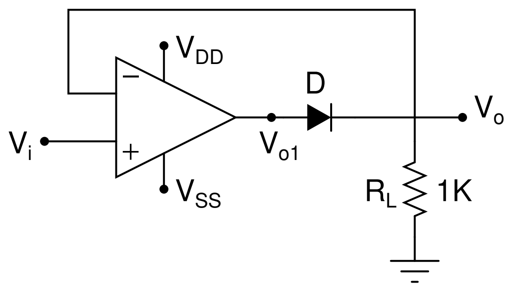

Figure 4: Half Wave Precision Rectifier

(a) Wire up the half-wave rectifier shown in the figure 4. Use ± 12 V supply for the op amp. With a sinusoidal input V_i $(1$ V peak, 100 Hz$)$, observe the output $V_o(t)$. Display V_o versus V_i using the **acquire** mode in the DSO and verify that the circuit performs half-wave rectification. Plot the obtained graph with proper annotation.

(b) As compare to the conventional diode/resistance based rectifier, what changes do you observe in the rectified output. Briefly explain.

5. **Course project**
Utilize rest of your lab time for the course project.