EXPERIMENT 4 *Integrator & Differentiator*

Objectives:

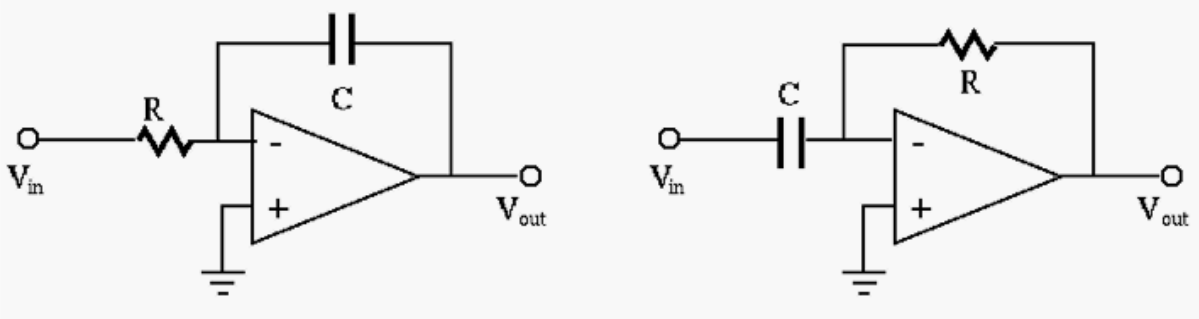
The objectives of this experiment are to observe and analyze the responses of op-amp integrator and differentiator circuits.

Materials:

Breadboard
DMM (Digital multi-meter)
Signal Generator
DC Power Supply
Oscilloscope
Resistor(s)
Capacitor(s)
LM741

Preliminary:

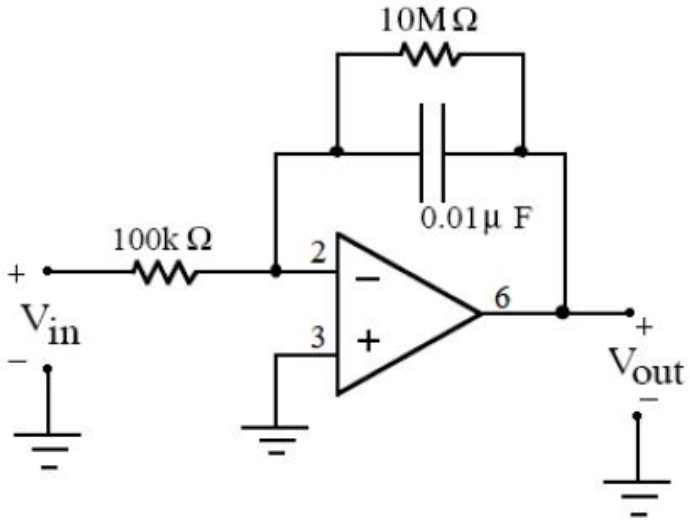
Circuits below are known as integrator and differentiator circuits. Solve both of the circuits with node-voltage method and verify that output voltage is integration and differentiation of the input voltage.



Procedure:

1. Construct integrator circuit below, apply following input voltages:

   a) Sine wave, Vp-p = 1V, f = 500 Hz
   b) Triangle wave, Vp-p = 1V, f = 500 Hz
   c) Square wave, Vp-p = 1V, f = 500 Hz



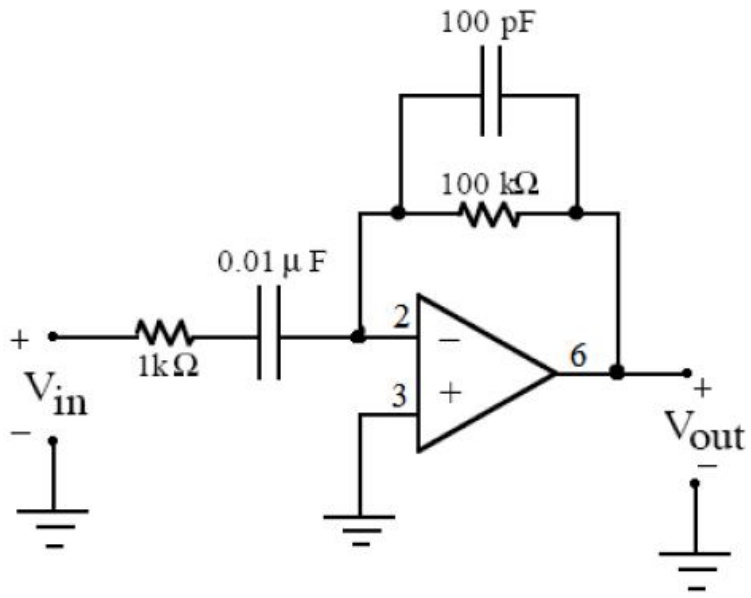
2. Record input and output waveforms one on the other. For your report, include your recordings and show that the output waveform is indeed the integral of the input waveform. Discuss this in your report.

3. Note that the 10MΩ resistor (a very large value) is not in the ideal integrator circuit.

   What is it there for? (Think about what would happen if a small DC component was present in the input waveform. What would integration of this constant do after a short time?) Try removing it and describe what happens. Discuss this in your report. Record V_{in} and V_{out} signals for each of the input waveforms (Apply same sine, triangle and square waves).

3. Construct differentiator circuit below, apply following input voltages:

   a) Sine wave, Vp-p = 1V, f = 50 Hz
   b) Triangle wave, Vp-p = 1V, f = 50 Hz
   c) Square wave, Vp-p = 1V, f = 50 Hz



4. Record input and output waveforms one on the other. For your report, include your recordings and show that the output waveform is indeed the derivative of the input waveform. Discuss this in your report.

5. Note here that the 100 pF capacitor (a very small value) is not in the ideal amplifier.

   Why do you think it is here? (Think about the derivative of a square wave, for example. Could high voltages damage a chip or put a significant noise into the circuit? Discuss this in your report. Record V_{in} and V_{out} signals for each of the input waveforms (Apply same sine, triangle and square waves).