Lab Report
LTSpice Experiment - II

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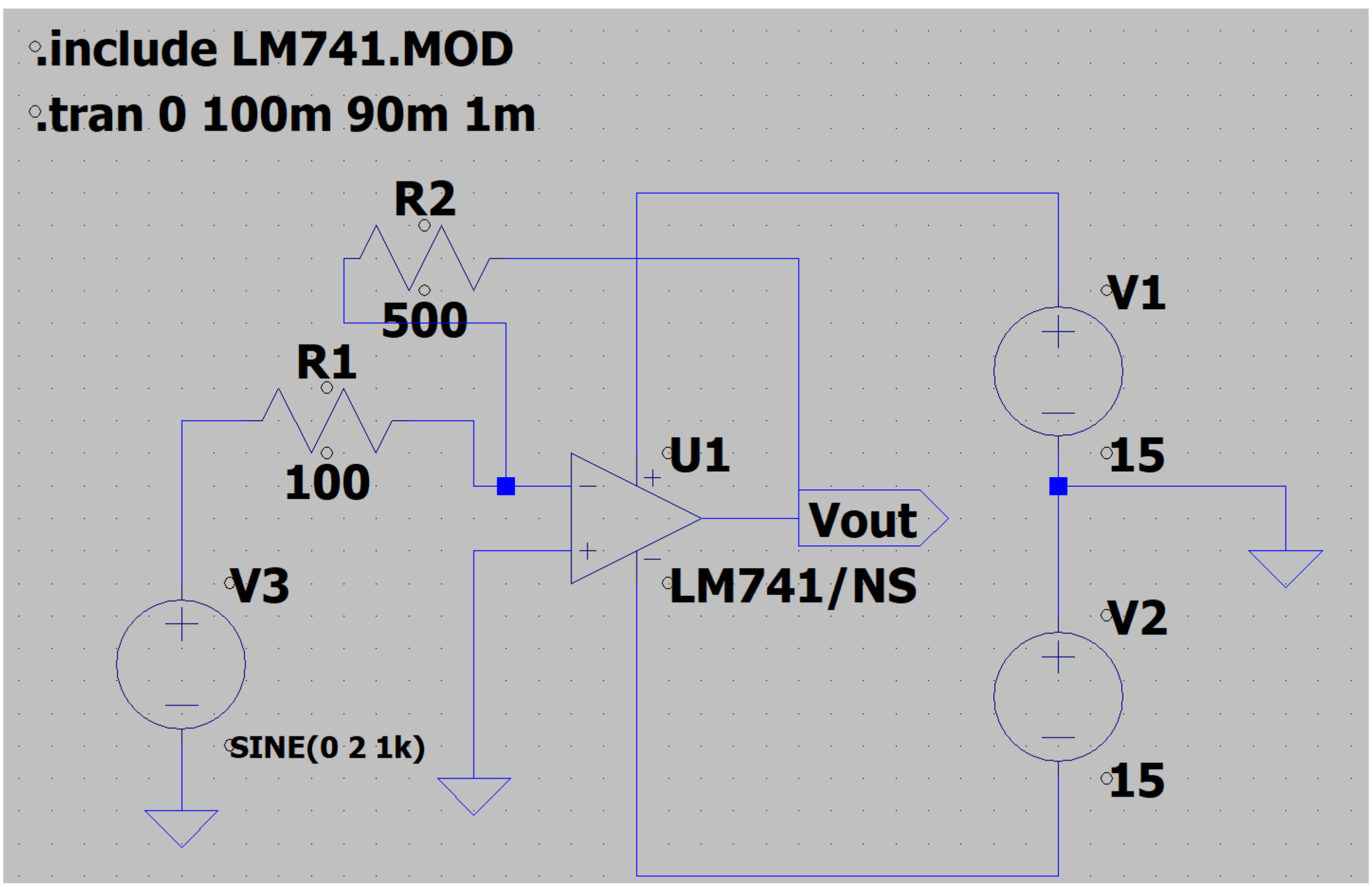
1. Inverter Amplifier Using OP-AMP

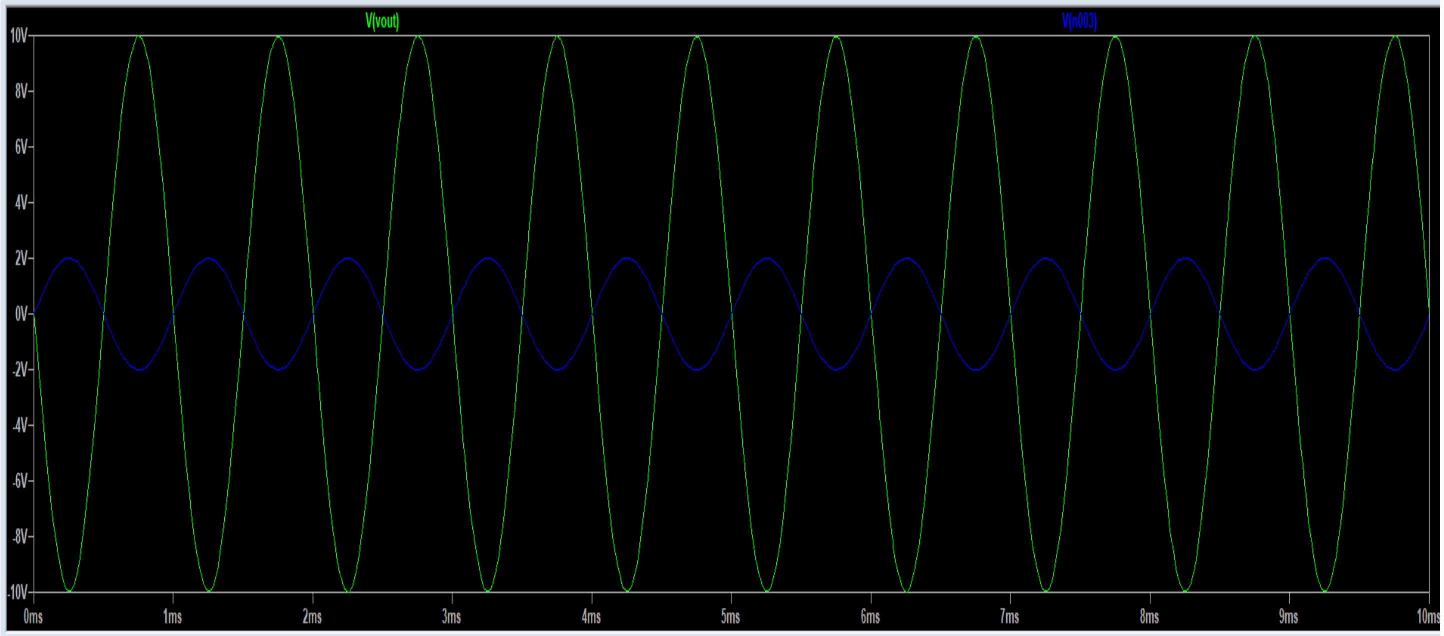
Aim: Design an Inverting Amplifier using OP-AMP and observe the gain for different input Waveforms.

Theory: An Inverting Amplifier using OP-AMP is a type of amplifier with an output 180 degree out of phase to the input waveform. The input waveform is amplified by a factor AV and its phase will be opposite.
AV is known as the Open-loop gain of the amplifier. In an inverting amplifier, the input to be amplified is applied to the inverting terminal of OP-AMP through a resistor R1.
Rf is the feedback resistor. Rf and R1 together determine the gain of the amplifier.
RL is the load resistor and amplified output can be observed across it. Based on the values of Rf and R1, one can decide the gain of the amplifier which will, in turn, decide the peak amplitude of the output waveform.

Circuit Diagram:



Output:



Gain:

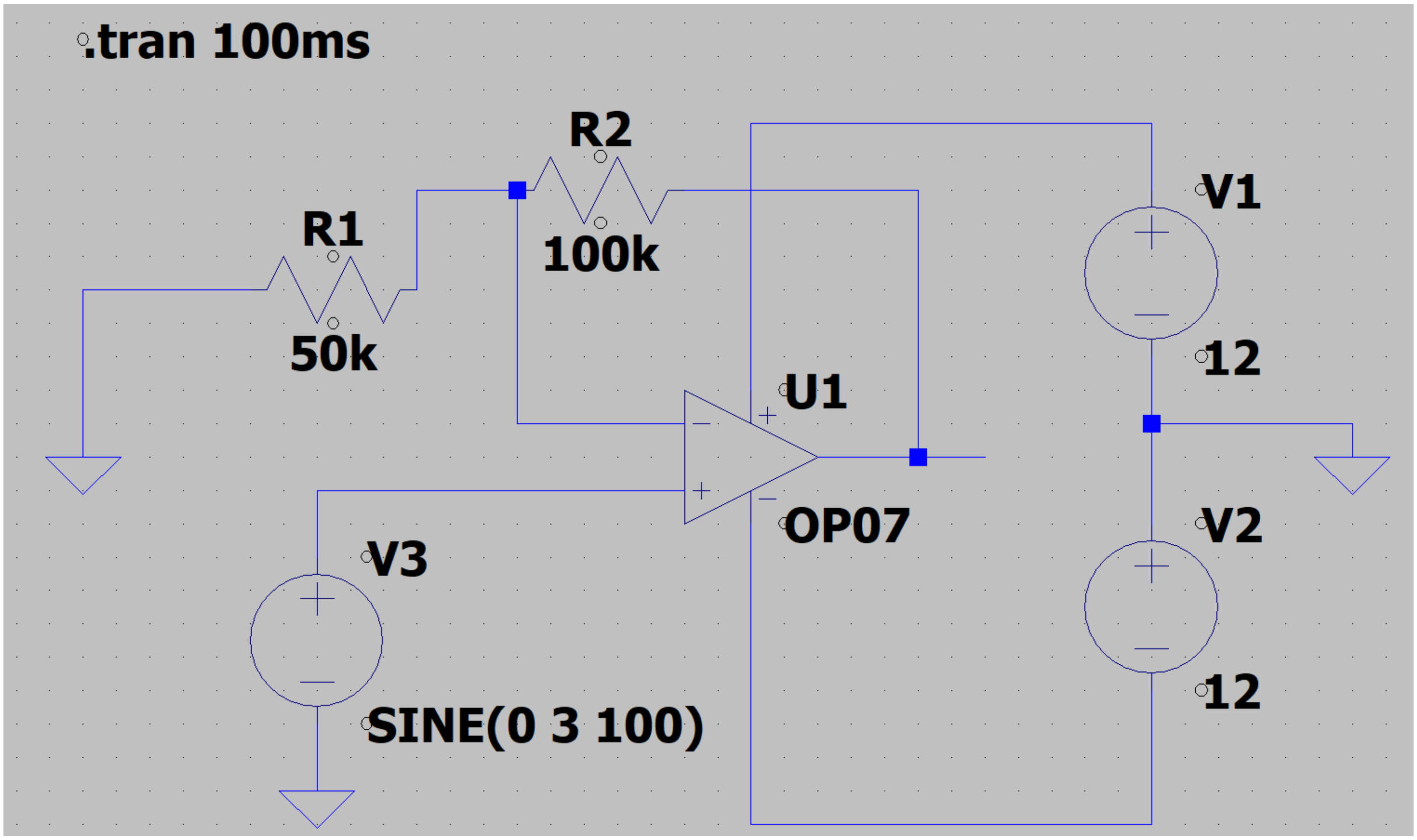
Here, AV = -5.

2. Non-Inverting Amplifier Using OP-Amp

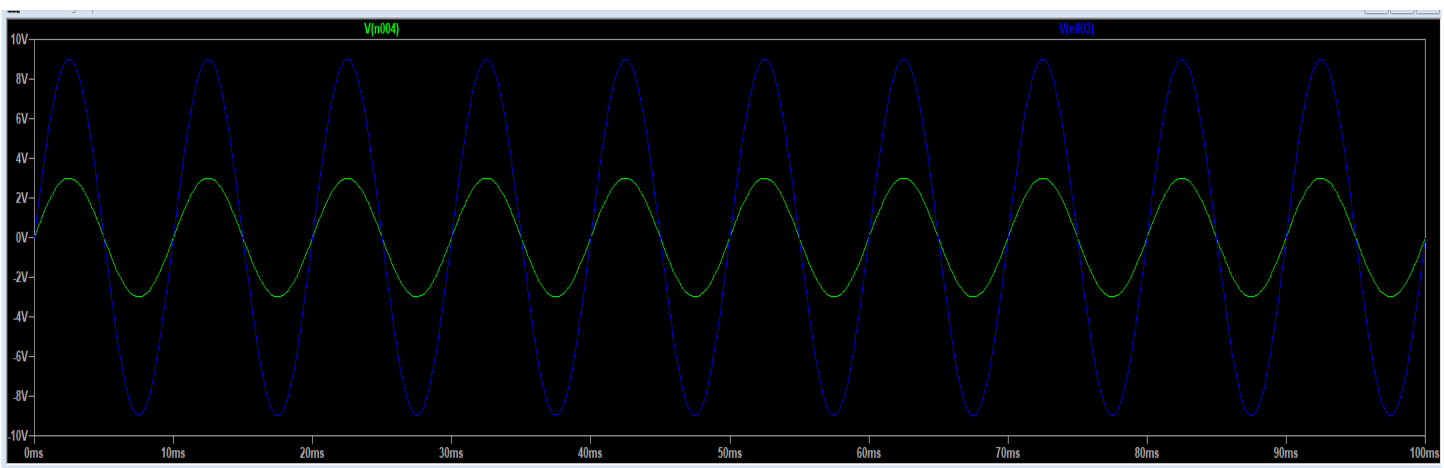
Aim: Design a Non-inverting Amplifier using OP-AMP and observe the gain for different input Waveforms.

Theory: In this configuration, the input signal (Vin) is applied to the non-inverting terminal of an OP-AMP, which means the output waveform will be in phase with the input waveform. In this case, Rf and R1 make a voltage divider circuit and a small part of the output voltage is fed back to the input terminal. Due to this negative feedback, this closed-loop configuration provides good stability compared to the inverting amplifier.
Based on the values of Rf and R1, one can decide the gain of the amplifier to get the desired
The peak amplitude of the output waveform.

Circuit diagram:



Output:



Gain:

Here, gain = 1 + RF/R1

Or, AV = 3

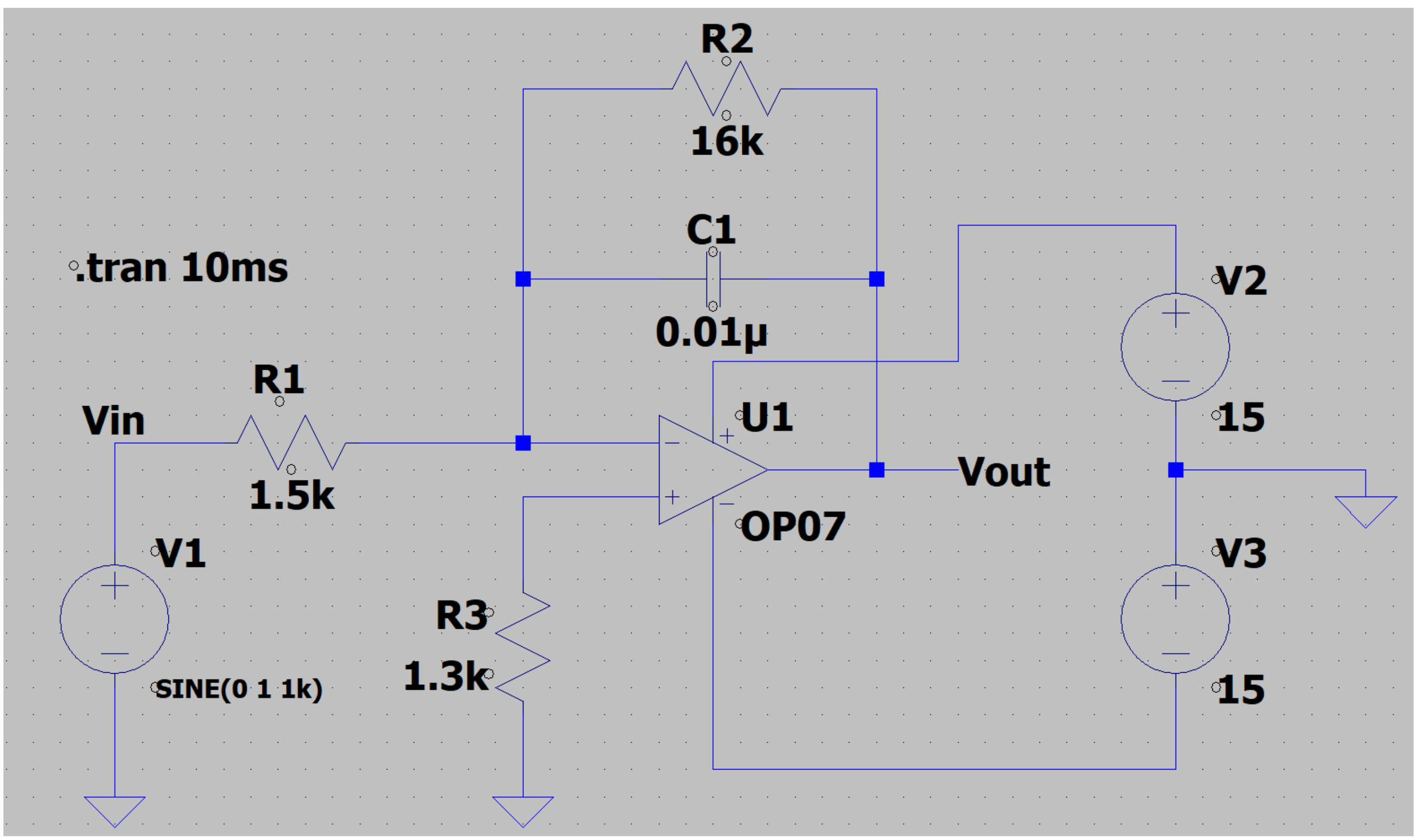
3. Integrator Using OP-AMP

Aim: Design an active integrator and plot the output waveform at different levels of the input Voltage.

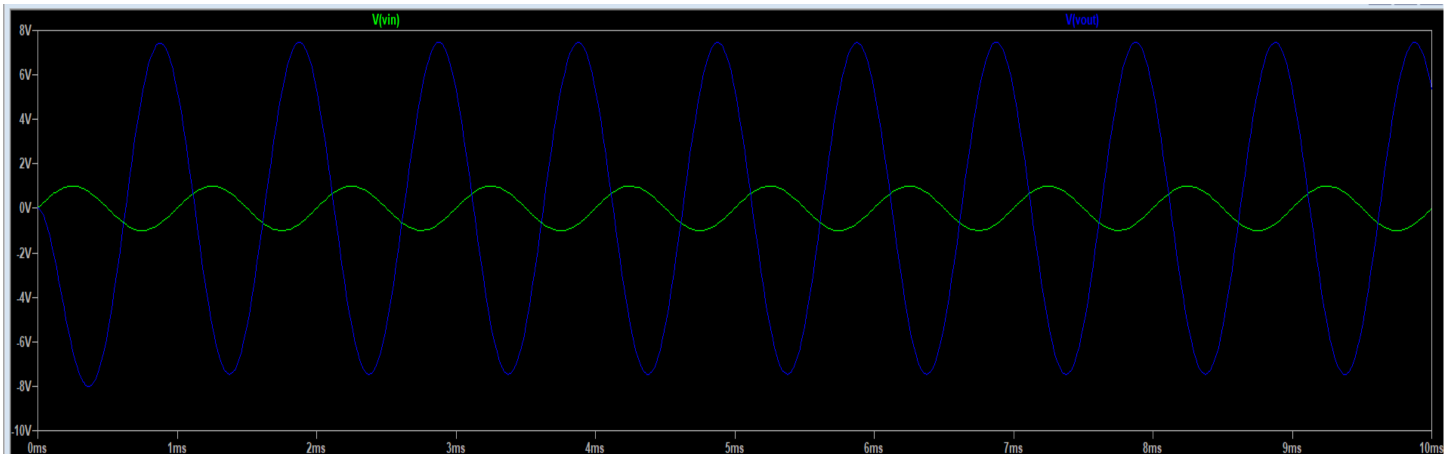
Theory: Operational amplifiers can be used as part of a positive or negative feedback amplifier or as an adder or subtractor type circuit using just pure resistances in both the input and the feedback loop. But what if we were to change the purely resistive (R_f) feedback element of an inverting amplifier with a frequency-dependent complex element that has a reactance, (X), such as a Capacitor, C.

By replacing this feedback resistance with a capacitor, we now have an RC Network connected across the operational amplifier feedback path, producing another operational amplifier circuit commonly called an Op-amp Integrator circuit.

Circuit diagram:



Output:

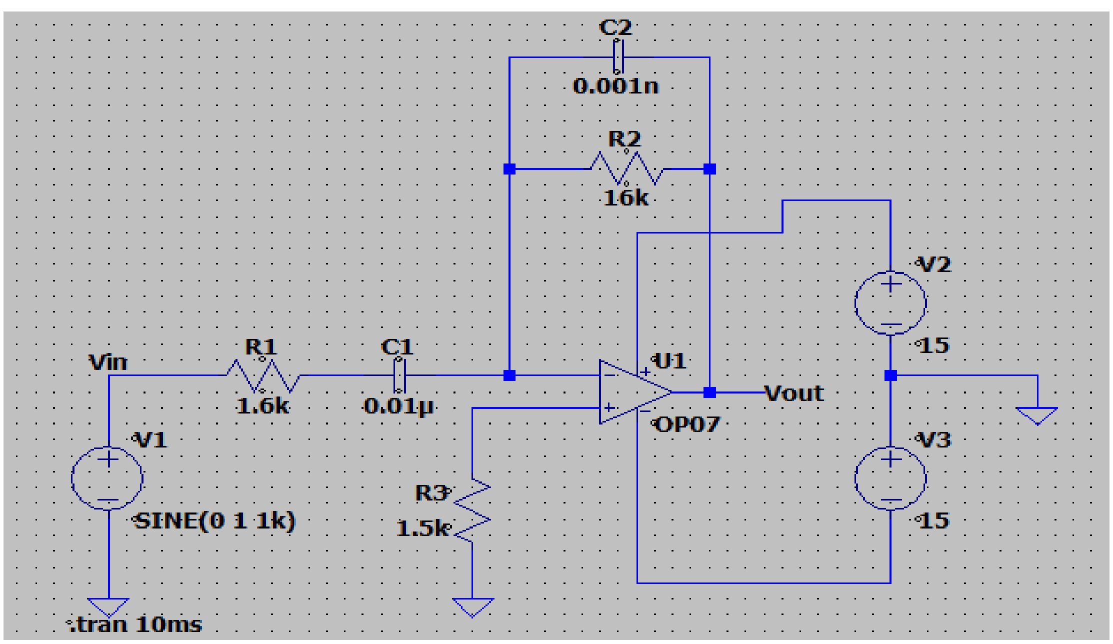


4. Differentiator using OP-AMP

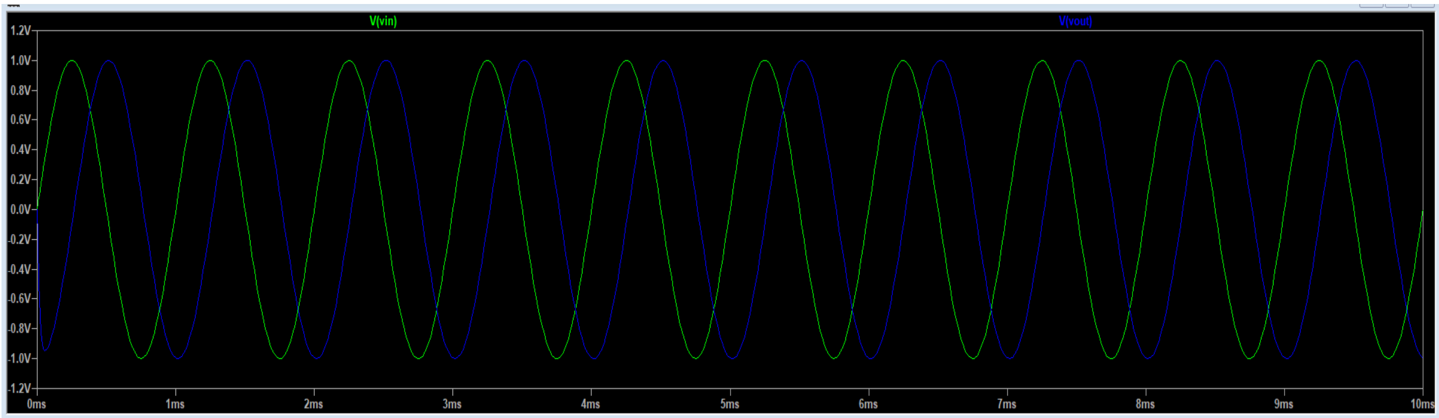
Aim: Design an active differentiator and plot the output waveform at different levels of the input voltage.

Theory: A differentiator circuit may be obtained by replacing the capacitor with an inductor in Fig. 3 for an integrator. In practice, this is rarely done since inductors are expensive, bulky and inefficient devices. The circuit diagram below shows a fundamental differentiator circuit constructed with a capacitor and a resistor.
For an ideal op-amp, the current flowing through the capacitor is equal to the current flowing through the resistor. The output is thus proportional to the derivative of the input.
As the integrator is sensitive to DC drifts, the differentiator is sensitive to high-frequency noise. The differentiator thus is a great way to search for transients but will add noise. However, an integrator will decrease noise.

Circuit diagram:



Output:


V(vin)
V(vout)
1.2V
1.0V
0.8V
0.6V
0.4V
0.2V
0.0V
-0.2V
-0.4V
-0.6V
-0.8V
-1.0V
-1.2V
0ms
1ms
2ms
3ms
4ms
5ms
6ms
7ms
8ms
9ms
10ms