Group No:
ID No:

Experiment-05

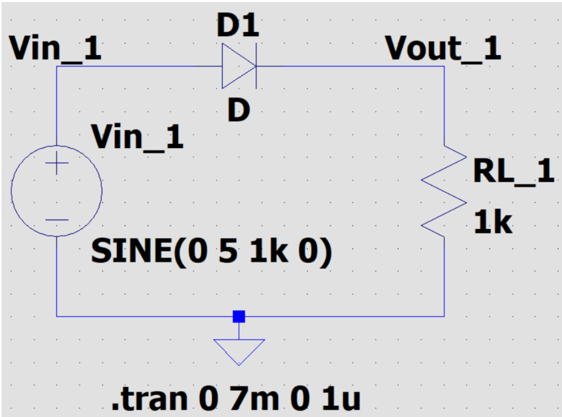
Study of Op-Amp and Diode Circuits Using LTspice Software

CSE251: Electronic Devices and Circuits Lab

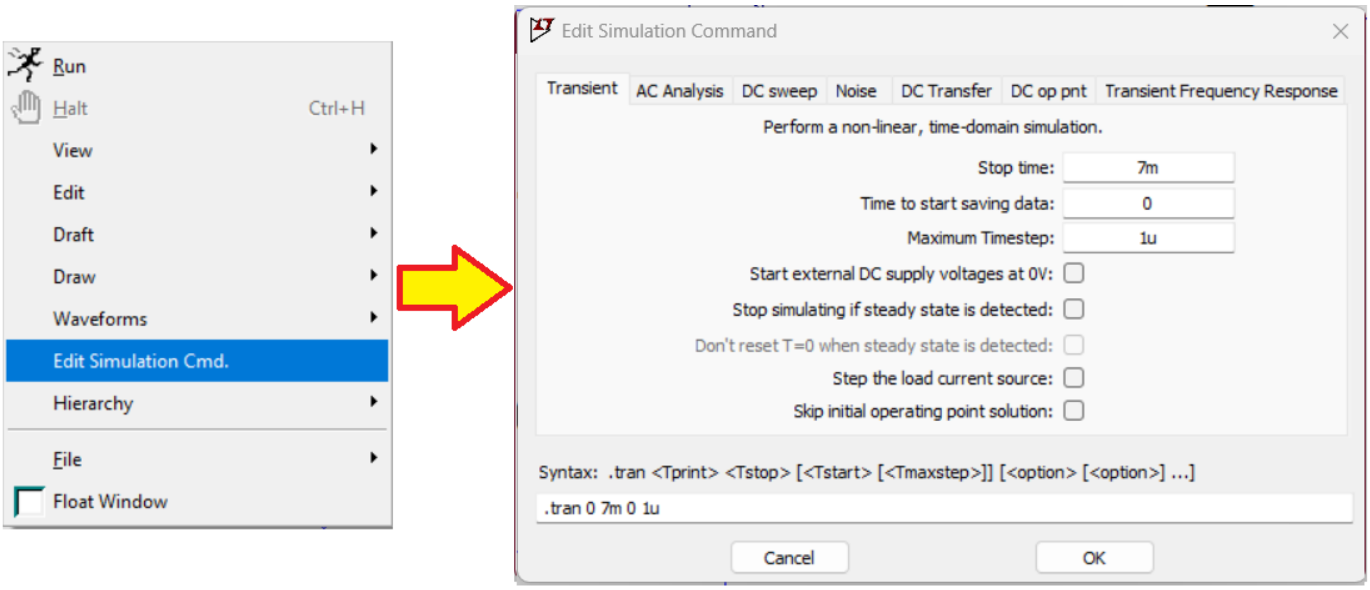
Objective

The aim of this experiment is to familiarize the students with the simulation of different circuits consisting of op-amps and diodes using LTspice software.

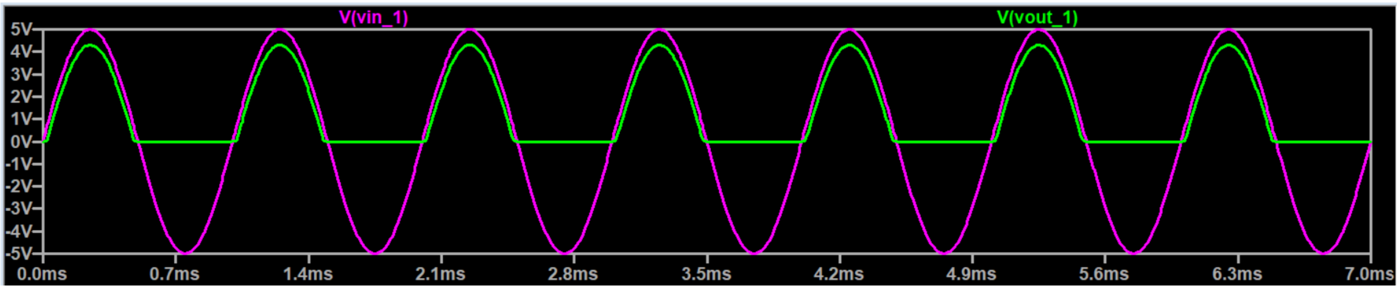
Diode Rectifier



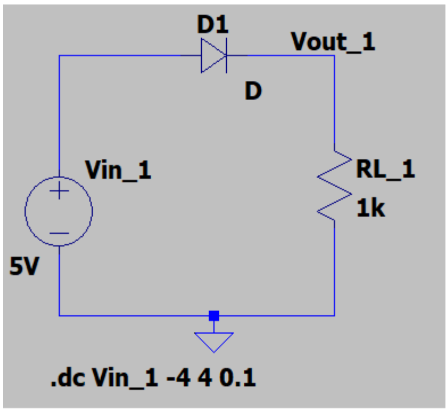
1. Construct the circuit of a **Half-wave rectifier** as shown in the figure above. Here, the input voltage, **Vin** is a **sine function** of **amplitude = 1v** and **frequency = 1 KHz**.
2. Use **"Transient Analysis"** simulation for this circuit. Use the following parameters.

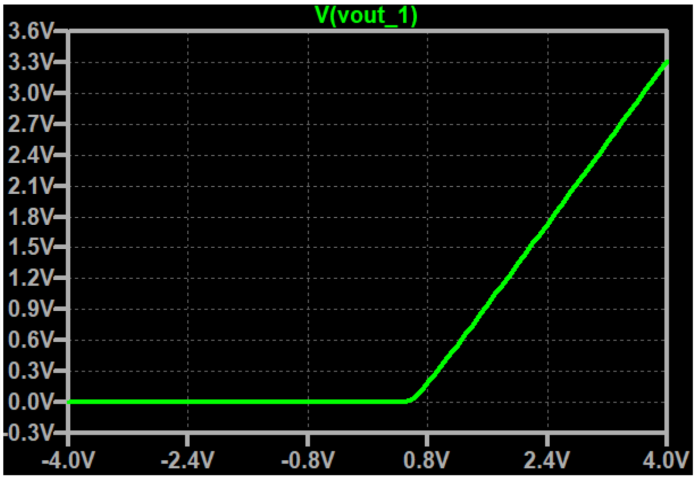


3. Run the simulation.
4. Plot ***V(vout_1)*** & ***V(vin)*** in the same graph. This should generate a graph like the following one. Take a screenshot of the graph.

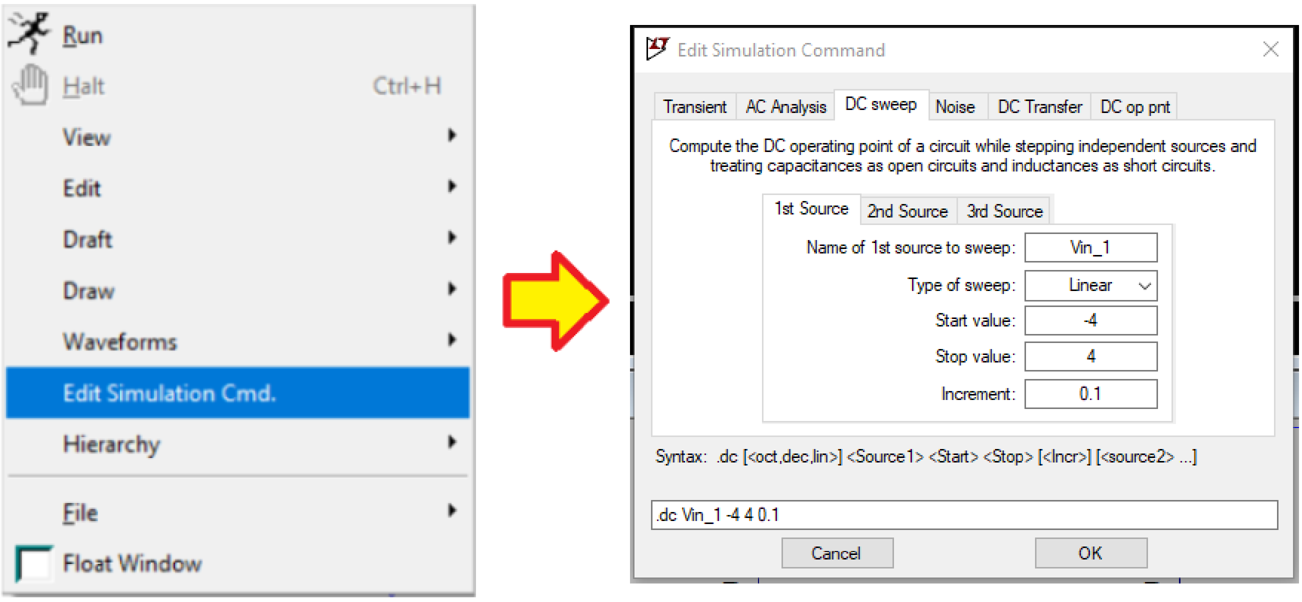


5. Now, <u>set the input voltage to any DC voltage</u>. Our aim is to generate the **Voltage-Transfer Characteristics** or **VTC** (right-figure) of the half-wave rectifier.



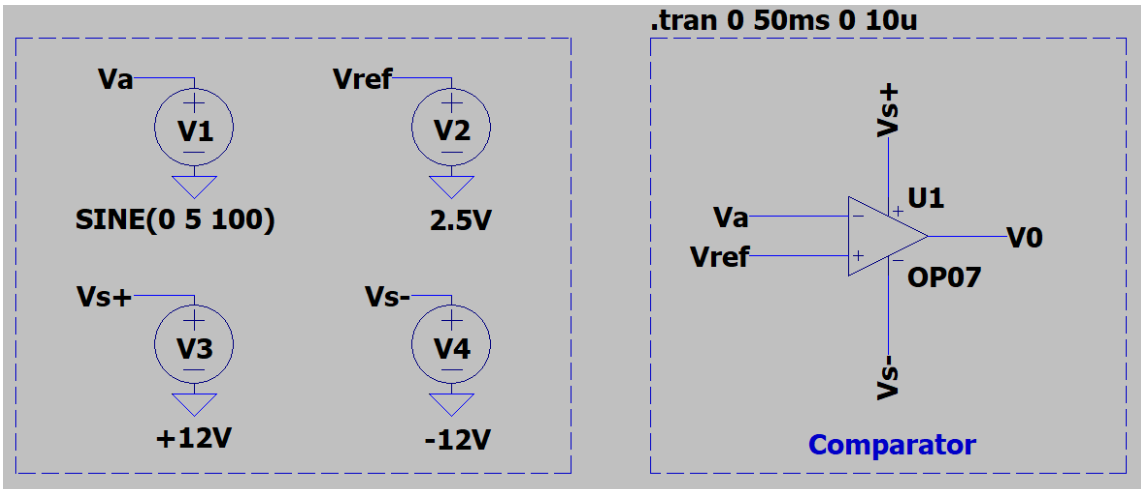


6. Perform "**DC Sweep**" on the voltage source **Vin_1** as shown below:

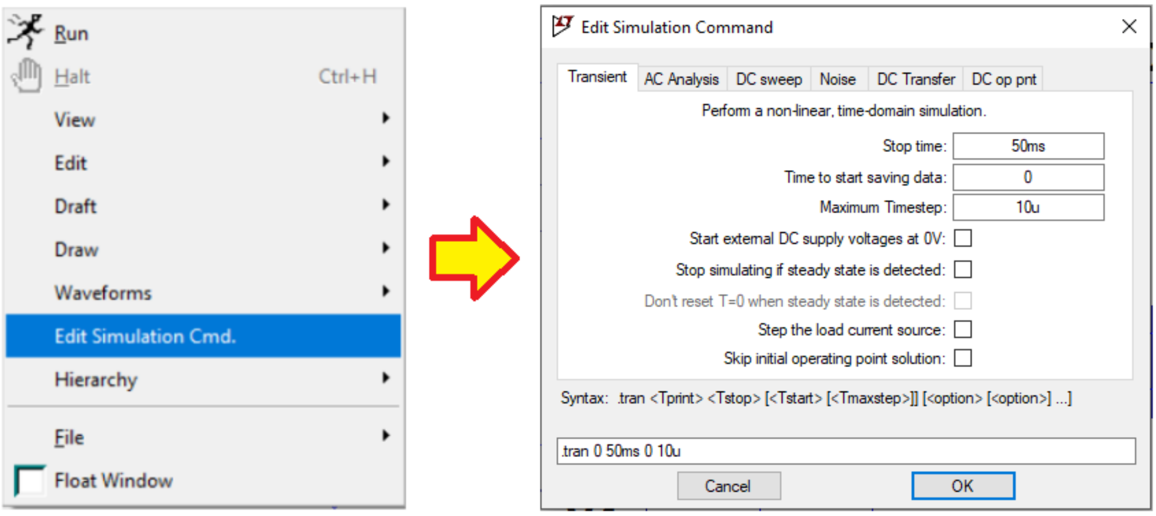


7. Run the simulation.
8. Add the ***V(vout_1)*** trace in the graph. Left-click on "***V(vout_1)***" to get the cursor.
9. ***Use the cursor to find the approximate*** V_{D0} ***of the diode.***
10. Take a screenshot of the graph.

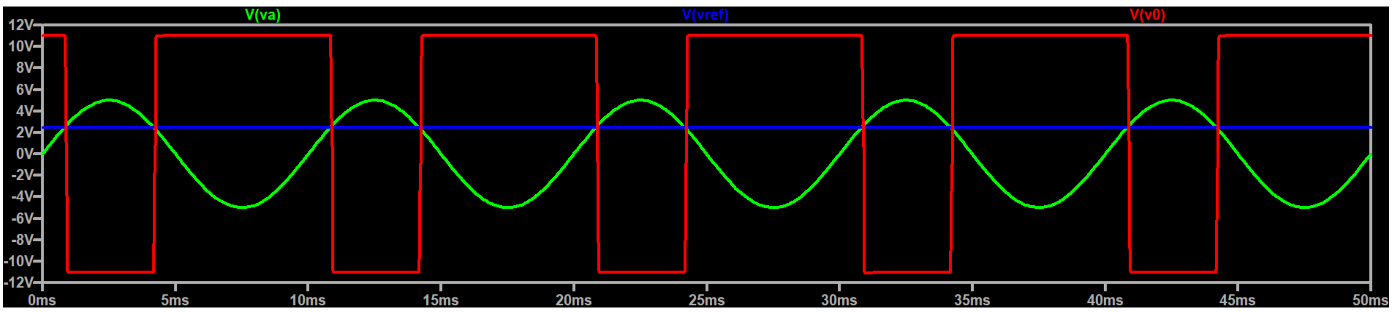
Op-Amp Comparator (Optional)



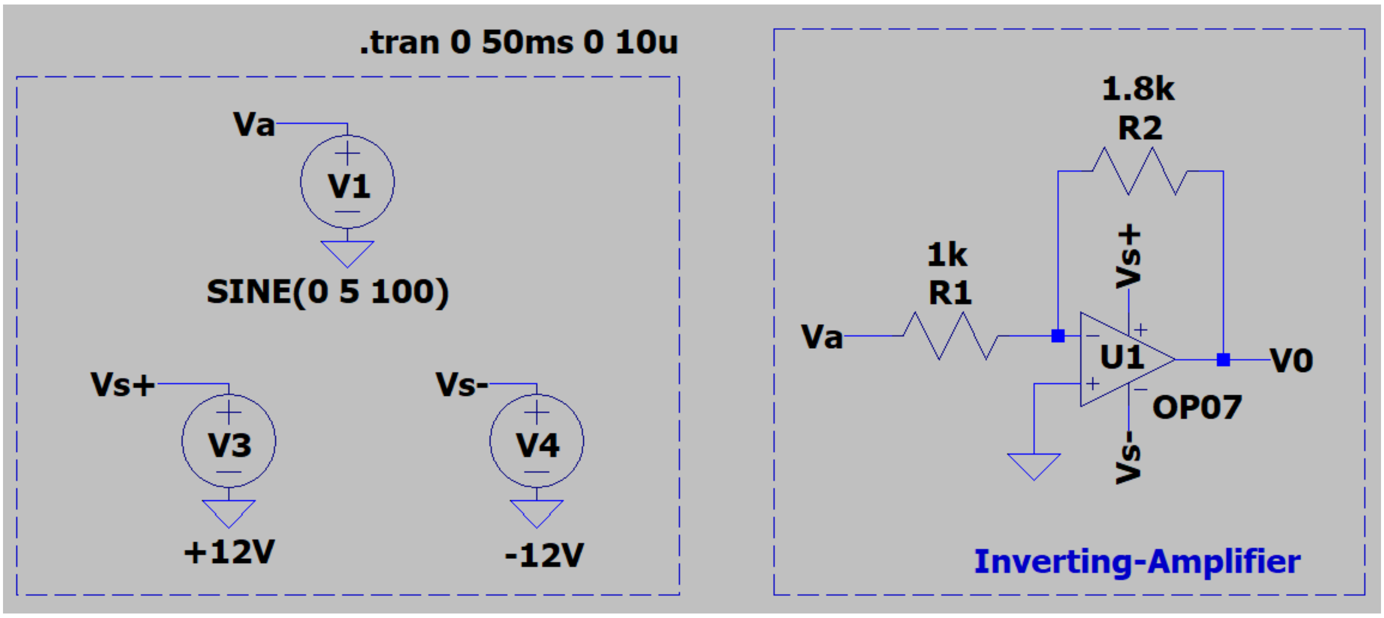
1. For an op-amp, use the component named ***OP07***.
2. Construct the circuit of **a comparator (inverting)** in a new schematic as shown above. The input voltage, **Va** is a **sine function** of **amplitude = 5v** and **frequency = 100 Hz**.
3. Use, **V_s+ = +12v** and **V_s- = -12v**.
4. Use **"Transient Analysis"** simulation for this circuit. Use the following parameters.



5. Run the simulation.
6. Plot ***V(va), V(vref)*** *and* ***V(v0)*** in the same graph. This should generate a graph like the following one demonstrating the cross-over points between the DC and AC signals.

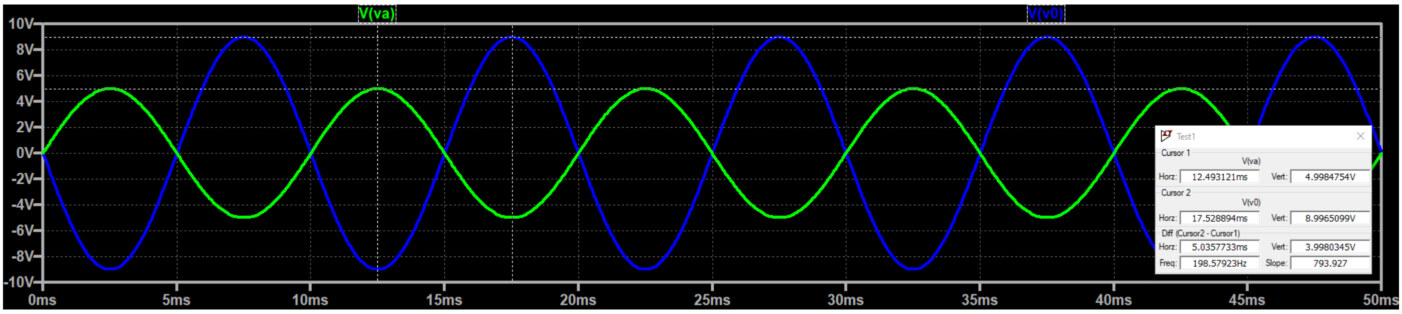


Inverting Amplifier

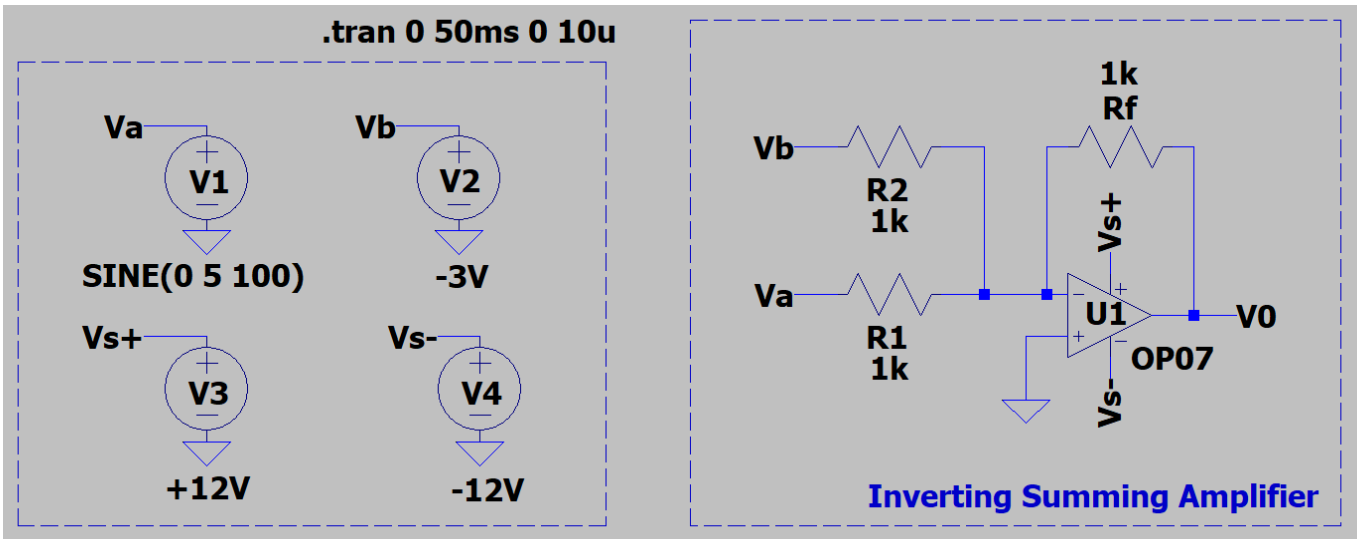


1. Construct the circuit of an **inverting-amplifier** as shown above. **Va** has the same parameters used in the "Comparator" task. Perform “**Transient Analysis**” with the same specifications as before.

2. Plot ***V(va)*** *and* ***V(v0)*** in the same graph. Observe whether the output signal is inverted and follows the known formula of, **V0 = -(R2/R1)*Va**.

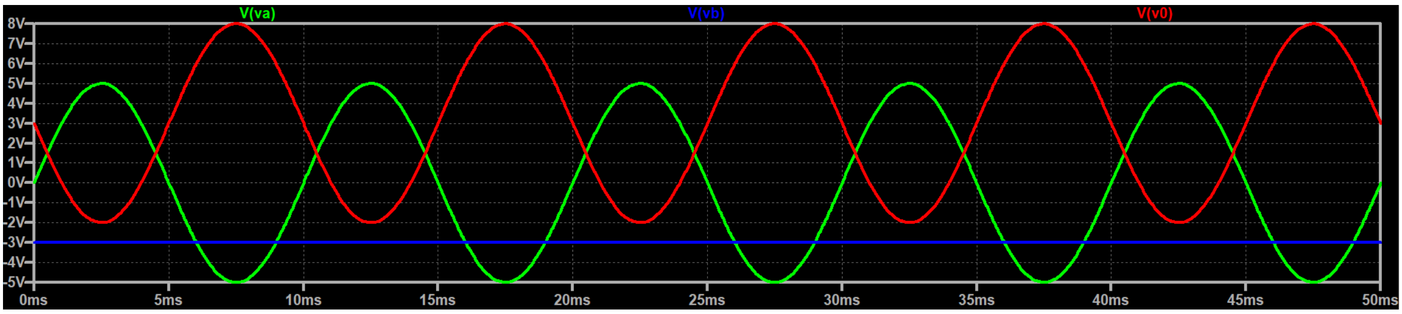


Inverting Summing Amplifier

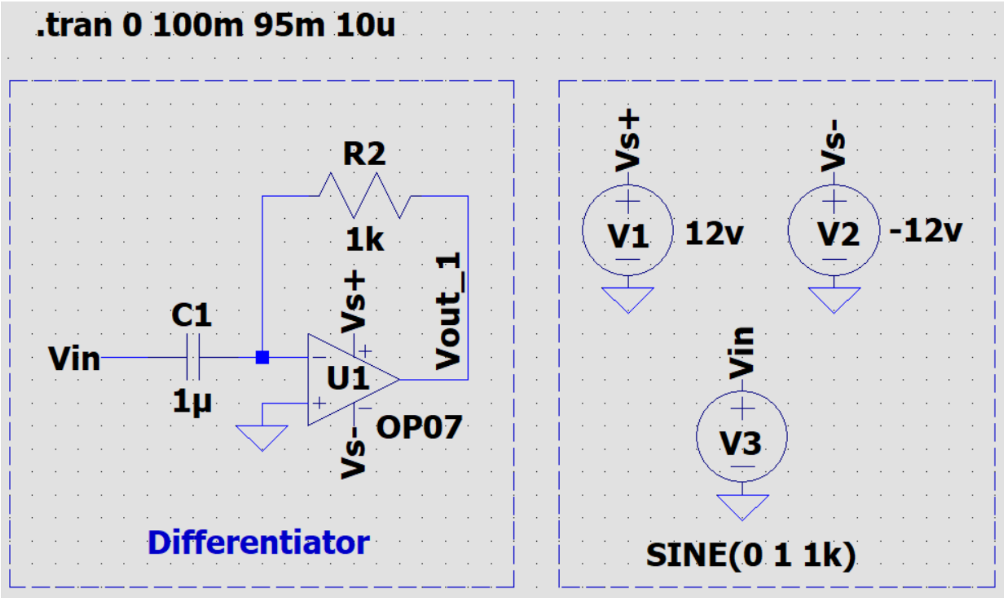


1. Construct the circuit of an **inverting-amplifier** as shown above. **Va** is a **sine wave (5V, 100Hz)** and **Vb** is a **-3v DC** source.

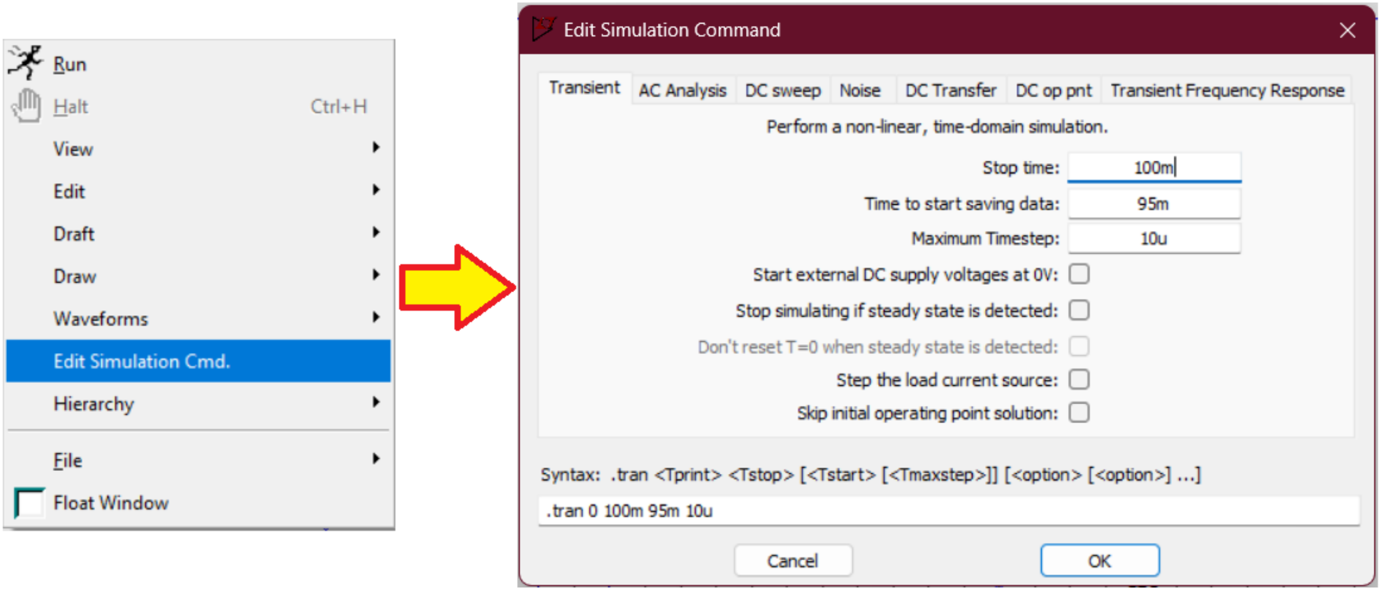
2. Perform "**Transient Analysis**". Plot ***V(va), V(vb)*** *and* ***V(v0)*** in the same graph. Observe if the output signal follows the known formula of: **V0 = -Rf*[Va/R1+Vb/R2]**



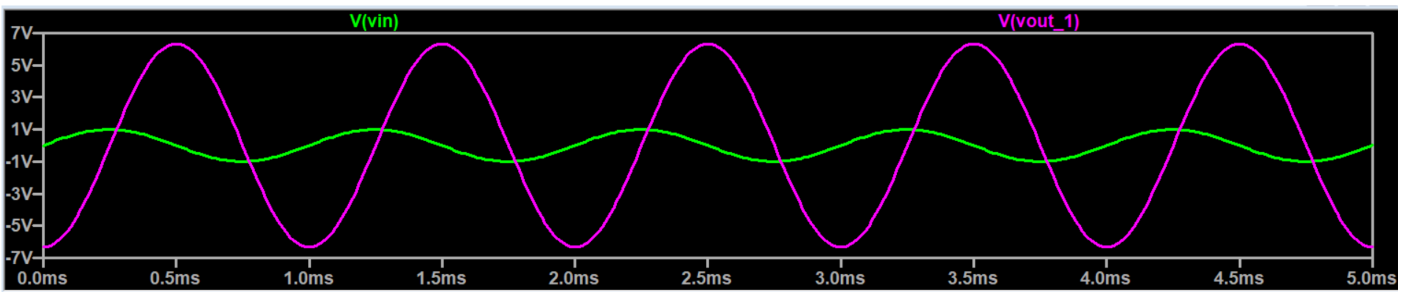
Op-Amp Differentiator



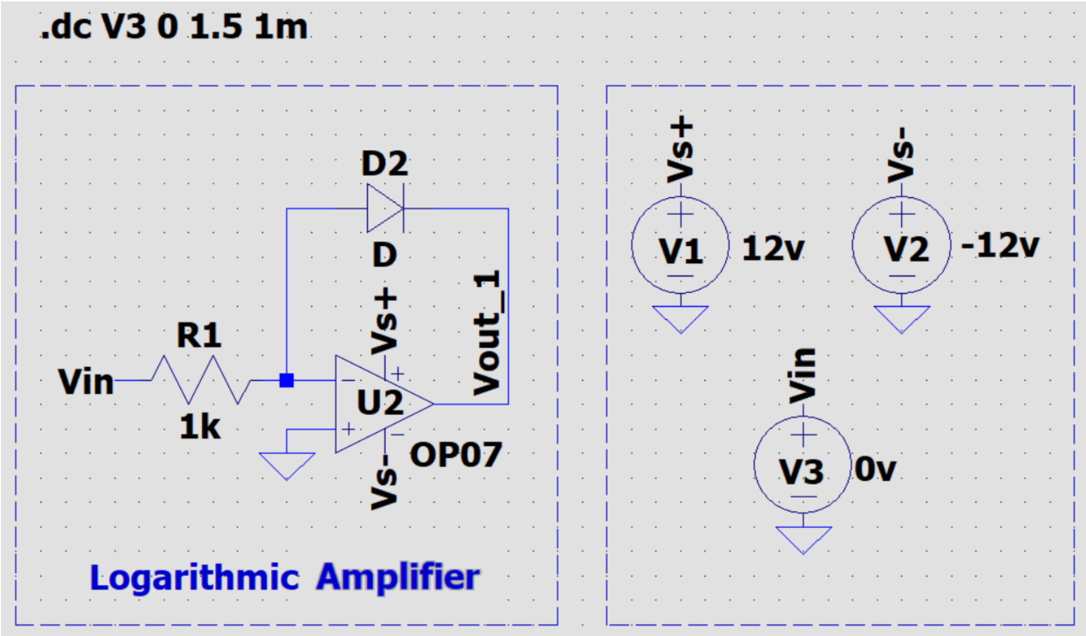
1. Construct the circuit of **a differentiator** in a new schematic as shown above. Here, the input voltage, **Vin** is a **sine function** of **amplitude = 1v** and **frequency = 1 KHz**.
2. Use, $\mathbf{V_s+ = +12v}$ and $\mathbf{V_s- = -12v}$.
3. Use **"Transient Analysis"** simulation for this circuit. Use the following parameters.



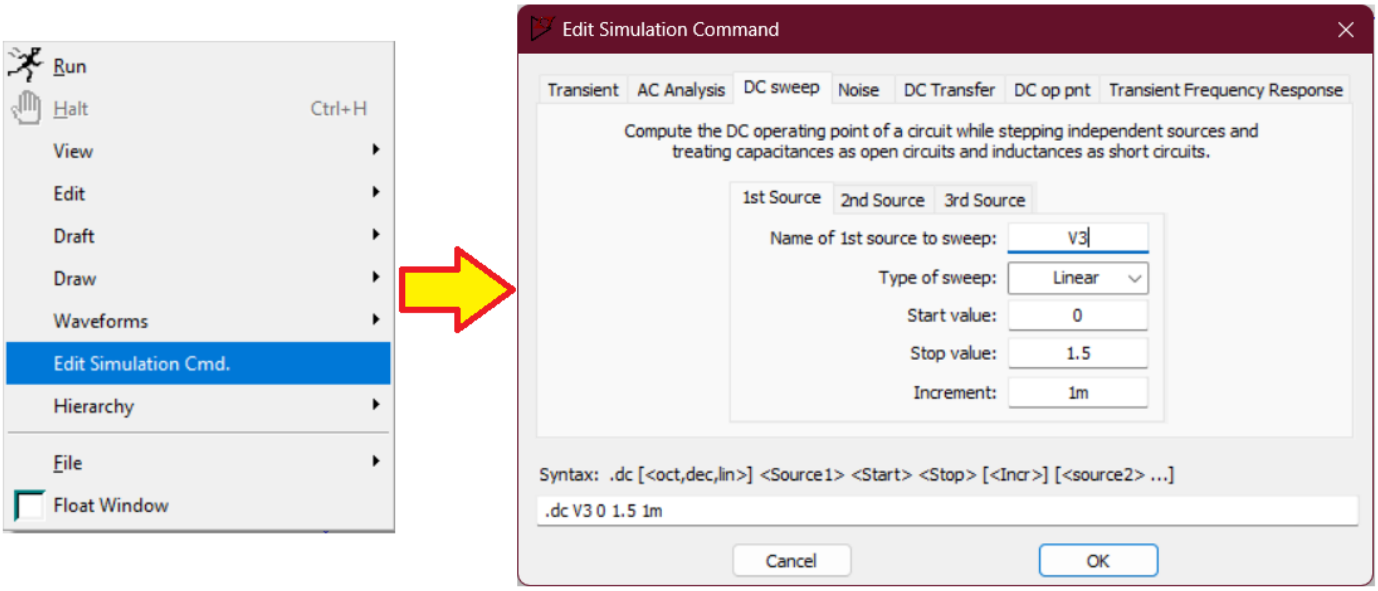
4. Run the simulation.
5. Plot ***V(vout_1)*** and ***V(vin)*** in the same graph. This should generate a graph like the following one demonstrating the differentiation operation on the input voltage.



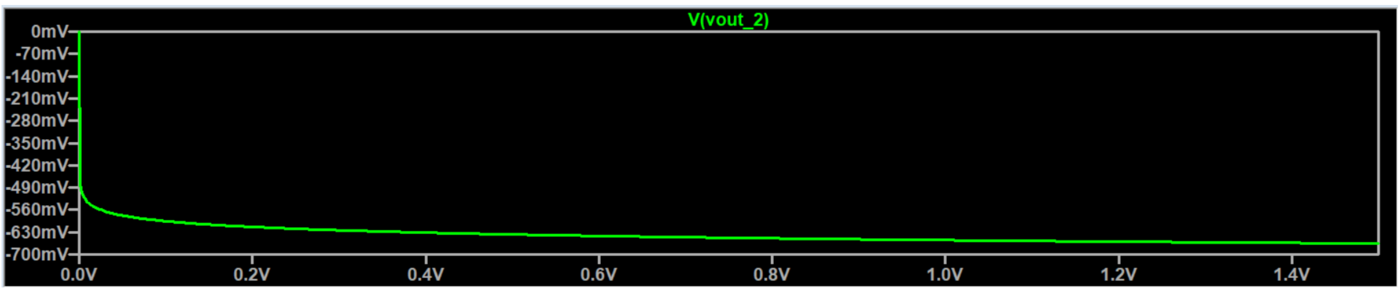
Logarithmic Amplifier



1. Construct the circuit of **a logarithmic amplifier** in a new schematic as shown above.
2. Use, **V_S+ = +12v** and **V_S- = -12v**.
3. Use **"DC Sweep"** simulation for this circuit. Use the following parameters.



4. Run the simulation.
5. Plot ***Vout_1 vs Vin***. This should generate a graph like the following one demonstrating the logarithmic relationship between the input and the output voltage.



Home Tasks

1. Simulate the circuit of a **Full-Wave Rectifier** to plot the **input voltage** and the **output voltage** in the same graph. Again, do necessary changes in the simulation to plot the **VTC** of it. Analyze the graphs and take screenshots of them.
   Caution: the output voltage should be taken across the terminals of the output resistance.
2. Build a **Non-Inverting Amplifier** with similar components used in the **Inverting Amplifier** circuit. Now plot the input and output and show their peak values. Analyze the graph and take a screenshot of it.
3. Revisit the task of the **Inverting Summing Amplifier**. Use the given **Va** in that task but change the value of **Vb** and **Rf** in such a way that the output **V0** swings between ***2.5V*** and ***0V***. Now plot ***V(va), V(vb)*** *and* ***V(v0)*** in the same graph. Analyze the graph and take a screenshot of it.
4. Build **an integrator** with similar components used in the **differentiator** circuit. Now plot the input and output voltage in the same graph. Analyze the graph and take a screenshot of it.
5. Build **an exponential amplifier** with similar components used in the **logarithmic amplifier** circuit. Now plot the input and output voltage in the same graph. Analyze the graph and take a screenshot of it.

Report

1. Attach cover page [include course code, course title, name, student ID, group, semester, date of performance, date of submission].
2. Attach all the screenshots of the tasks performed in the lab and comment on them.
3. Complete the home tasks.
4. Attach all the screenshots of the home tasks.
5. Your report should have a section containing all the analysis from the “Home Tasks'' section. You should include relevant comparisons if possible.
6. Did you face any challenges in simulation? If yes, explain briefly.
7. Add a brief Discussion at the end of the report.