EE 212 (Electronic Devices Lab)

Experiment-6

Basic Operational Amplifier circuits

Group Info:

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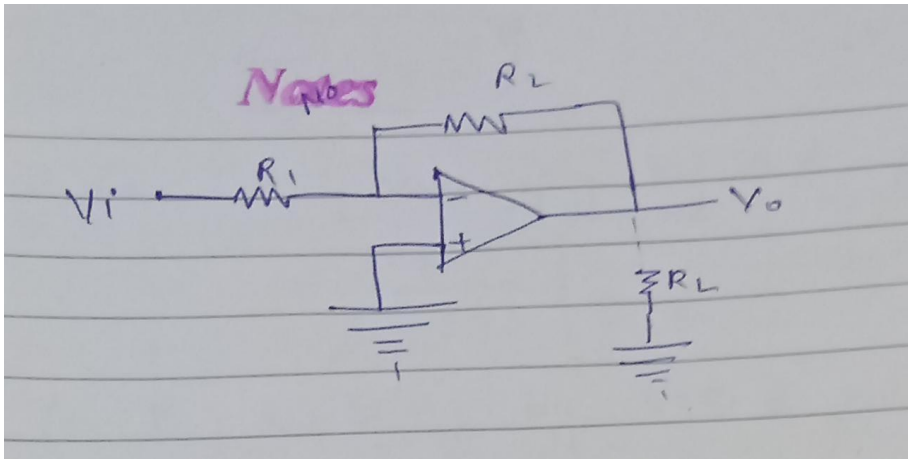
Objectives: To build inverting amplifier, non-inverting amplifier, differentiator and integrator using Op-Amps

Equipment/Components Required:
1. OP-Amp μA 741
2. Resistors of suitable values
3. Capacitors of suitable values
4. Regulated power supply
5. Arbitrary Function Generator
6. Digital Storage Oscilloscope

R1=1k
R2=10k
Rl=10k
C=0.01 * 10^-6 F
R'=470K
R'= 500 k pot

Steps:
Inverting Amplifier

1. First, we wired the amplifier circuit according to the circuit diagram given. We applied a sinusoidal input with a peak of 0.1V and frequency 1 kHz. We observed Vi and Vo on the oscilloscope.



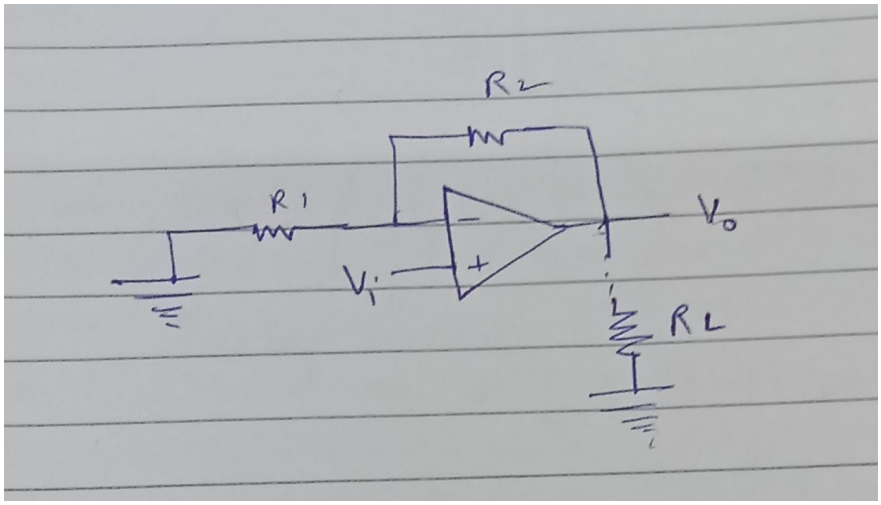
2. We increased the input amplitude from 0.1V to 2 V, and observed the output waveform. Explain your observation.

3. We kept the input amplitude at 0.5 V, and increased the frequency until the output waveform became triangular.
From the waveform, we calculate the slew rate.

4. We recorded the gain of the amplifier versus frequency for 100 Hz < f < 1MHz.
5. We recorded the frequency response for R1 =1 k, R2 =100 k. We plotted the frequency response for R2 =10 k and that for R2 =100 k together.

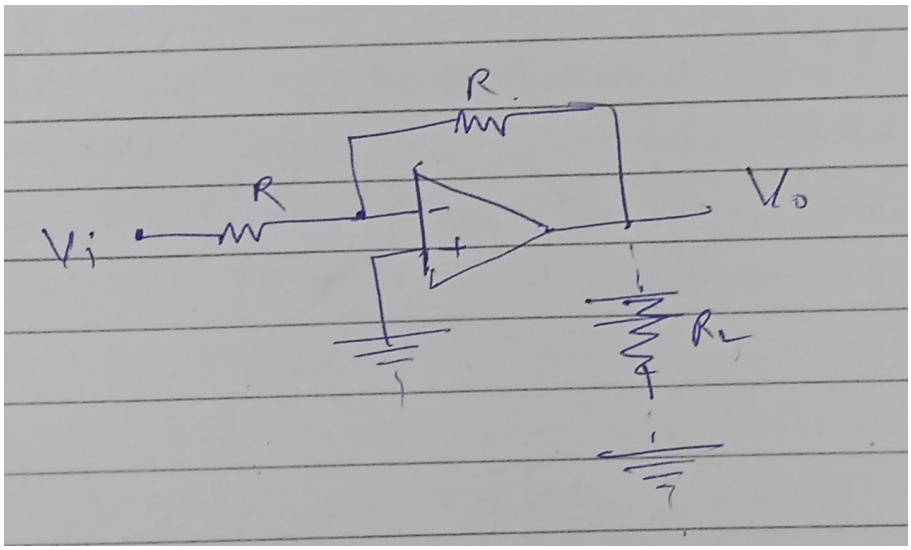
Non Inverting Amplifier

We repeated all the steps as we did for the inverting amplifier for the new circuit diagram.



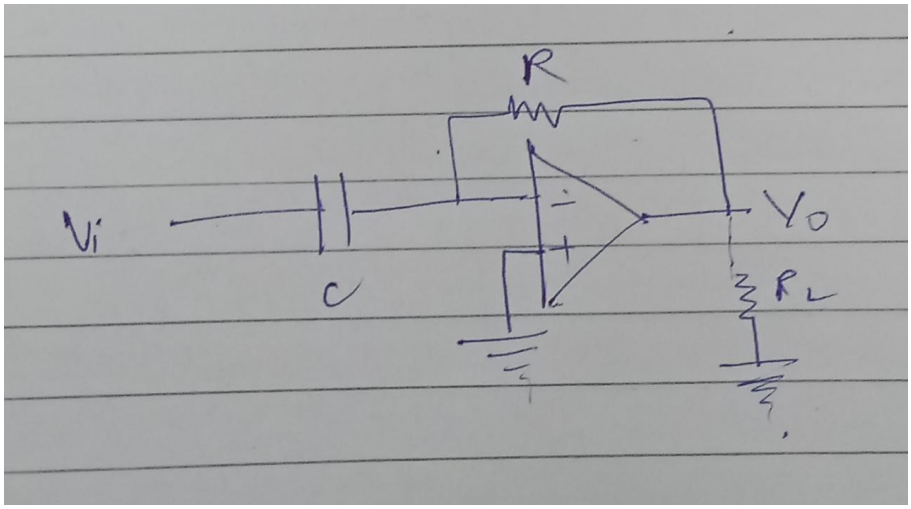
Integrator

1. We wired up the integrator circuit as given in the figure.We gave a square wave input (±2 V, 1 kHz).
2. We computed the frequency at which an input square wave of ±2V produces an output voltage going from −2V to +2 V.
3. We replaced R′ with a 500 k pot. Then we changed the pot from minimum to maximum to observe its effect on the output waveform.



Differentiator

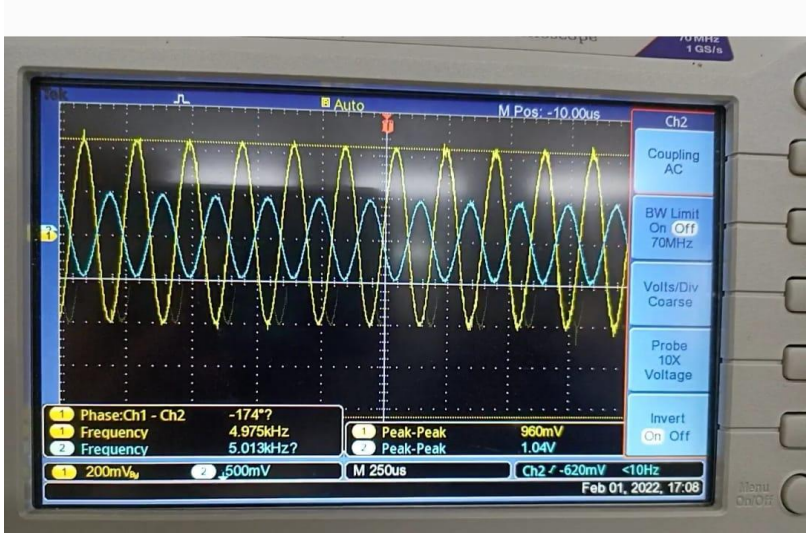
1. We arranged the circuit as shown in the figure with a triangular wave input (±2 V, 2.5 kHz). We observed Vo(t).
2. We connected a small capacitor C′ =0.001 μF in parallel with R, then observed Vo(t).



Observation

Inverting Amplifier

1. We observed that the magnitude and phase of Vo was what we theoretically calculated.



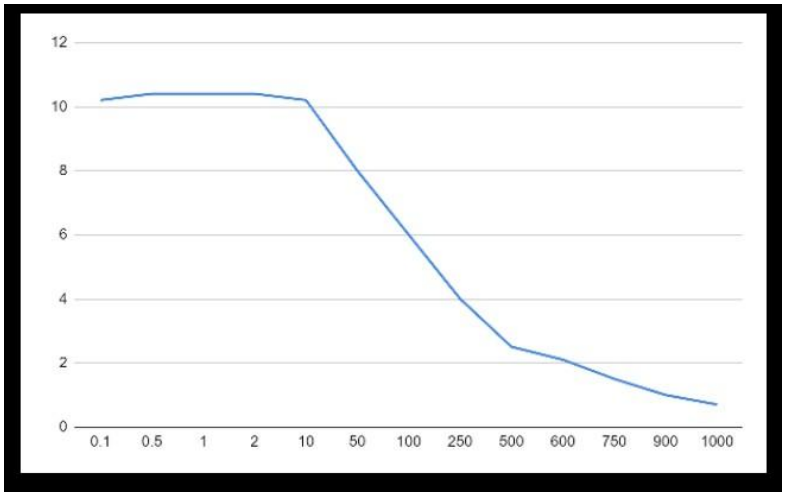
Slew rate:

Slew Rate= dV/dt = 2*pi*V/(1/f) = 1.7/175k= 0.56V/s

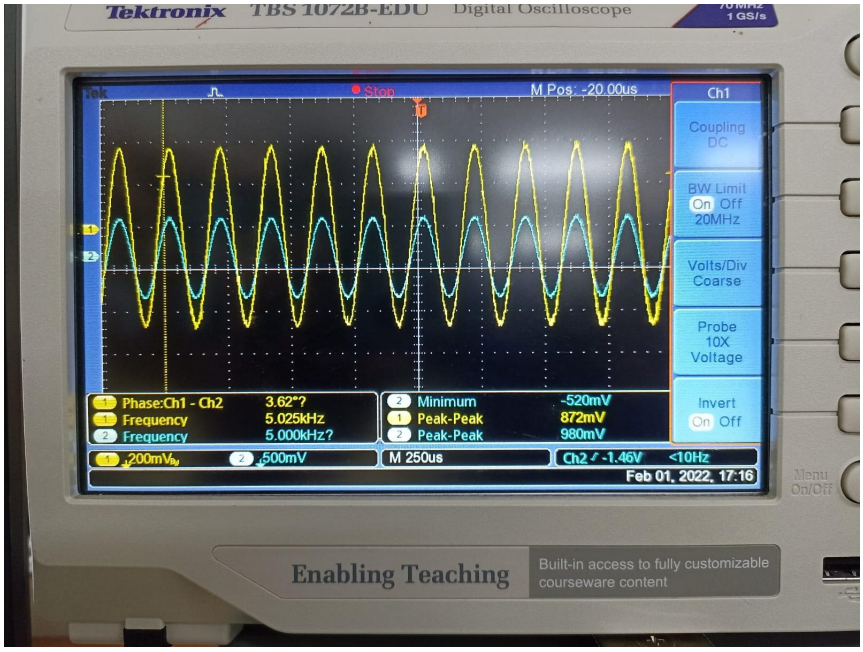
Observation Table:

Frequency(in kHz)	Vin	Vout	Gain
0.01	0.5	0.6	1.2
0.02	0.5	1	2
0.05	0.5	2	4
0.1	0.5	3.5	7
0.5	0.5	5.9	11.8
1	0.5	5.95	11.9
2	0.5	5.98	11.96
10	0.5	5.8	11.6
50	0.5	4.3	8.6
100	0.5	2.5	5
250	0.5	1.5	3
500	0.5	0.9	2.5
600	0.5	0.6	2.1
750	0.5	0.5	1.5
900	0.5	0.4	1
1000	0.5	0.35	0.7

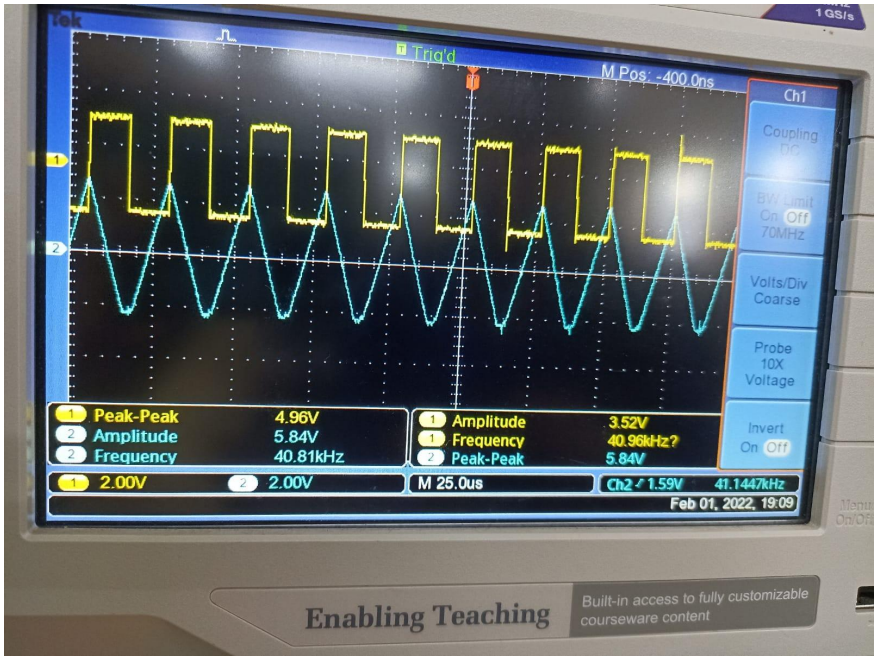
Frequency range: 100 Hz to 1 MHz



2.



3. We got a triangular output for square wave input.
   Required frequency:


1 GS/s
Trig'd
M Pos: -400.0ns
Ch1
Coupling
DC
BW Limit
On Off
70MHz
Volts/Div
Coarse
Probe
10X
Voltage
Invert
On Off
Peak-Peak 4.96V
Amplitude 5.84V
Frequency 40.81kHz
Amplitude 3.52V
Frequency 40.96kHz?
Peak-Peak 5.84V
2.00V
2.00V
M 25.0us
Ch2 1.59V
41.1447kHz
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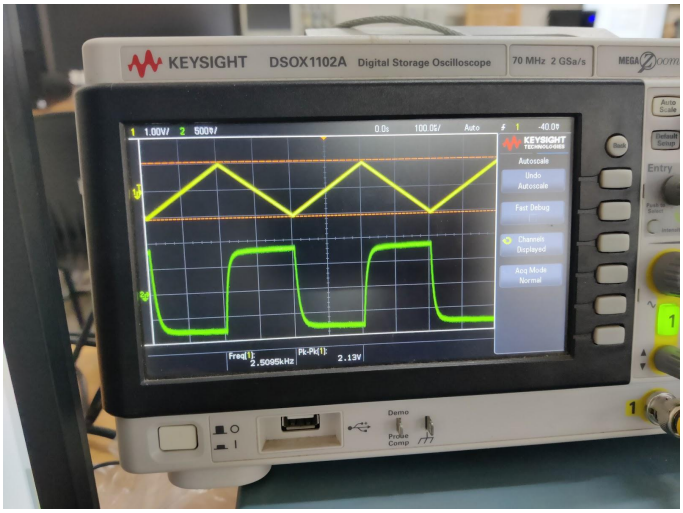
Enabling Teaching
Built-in access to fully customizable courseware content

4.


KEYSIGHT
DSOX1102A
Digital Storage Oscilloscope
70 MHz 2 GSa/s
Autoscale
Undo Autoscale
Fast Debug
Channels Displayed
Acq Mode Normal
Freq(1) 2.5095kHz
Pk-Pk(1) 2.13V

Discussion:

Manvi: We learnt to make circuits of integrator, differentiator, etc for the first time. We even learnt to check a faulty breadboard. We mde proper circuits and observed the expected results. It was so informative experience.

Shashi:We learnt how to build inverting amplifier, Non-inverting amplifier, differentiator, integrator using Op-amps practically. And while doing experiment we got the input and output graphs, slew rate, gain of amplifiers as we studied theoretically. With the help of prof. Ruma ma'am we learnt how to check shorted breadboard and grounding wire. Overall it was a nice experiment and we learned a lot through the experiment.