# CPE 316: Electrical Circuits and Electronic Design Laboratory.

**Lab 03**

**Op-Amp Integrator and Differentiator Circuits.**

**Submitted by**: **Dan Otieno.**

**Date of Experiment: 09/12/22.**

# INTRODUCTION:

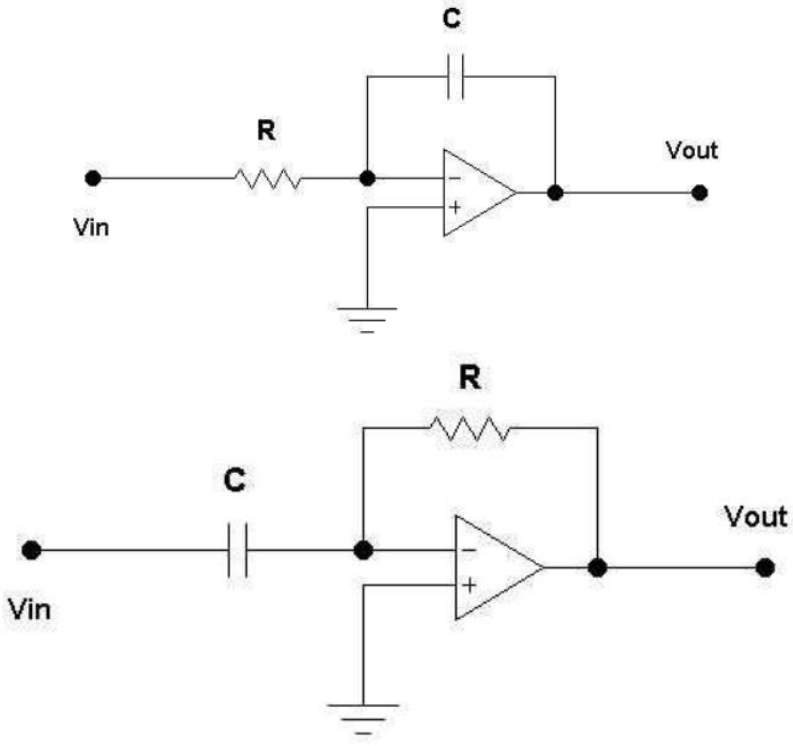
The purpose of this laboratory was to design and simulate Integrator and Differentiator op-amp circuits via Multisim and design the circuits in the lab using hardware. Once the two objectives were achieved, the secondary goal was to generate various waveforms associated with the circuits, both simulated and from electronic equipment in the laboratory.

## PART A:

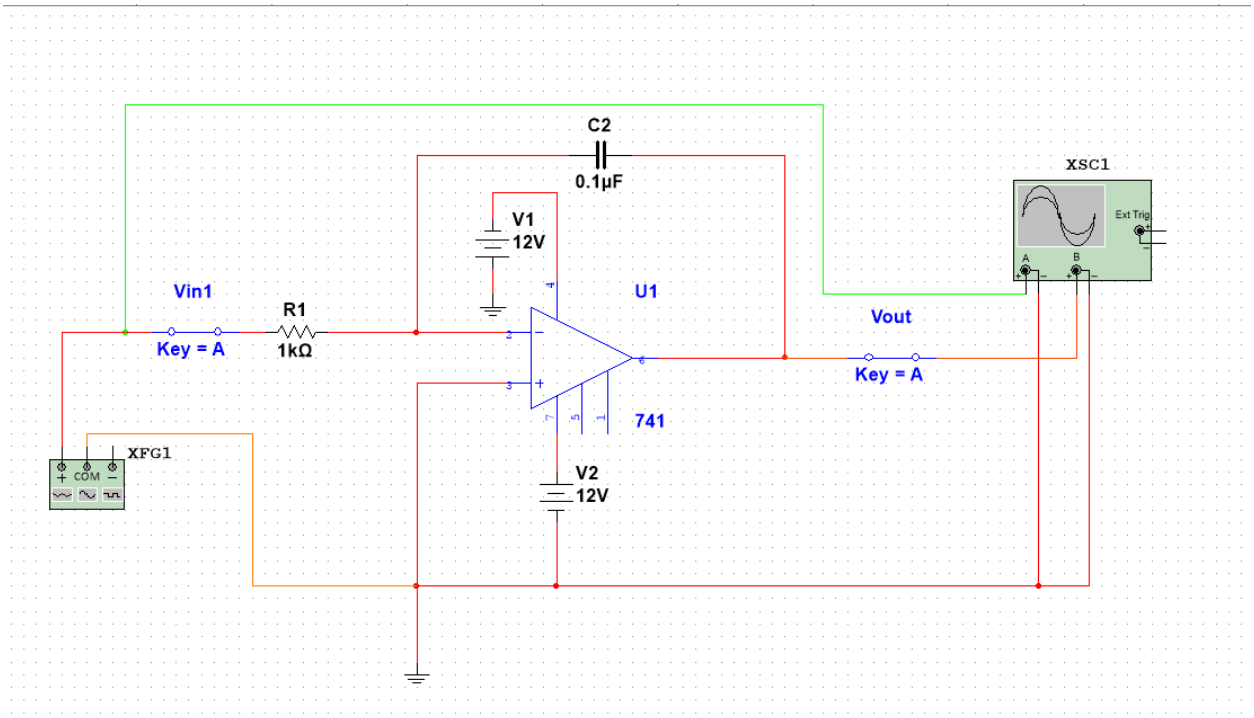
The first task in the lab was to digitally design the Integrator and Differentiator circuits as shown in the diagrams below, and with the following configurations:

R=1K Ohm, C=3.3 µF, f = 1K HZ, 15V to power the op-amps.
VIN = 1Vpp sinusoidal.
VIN = 1Vpp triangle.
VIN = 1Vpp square.

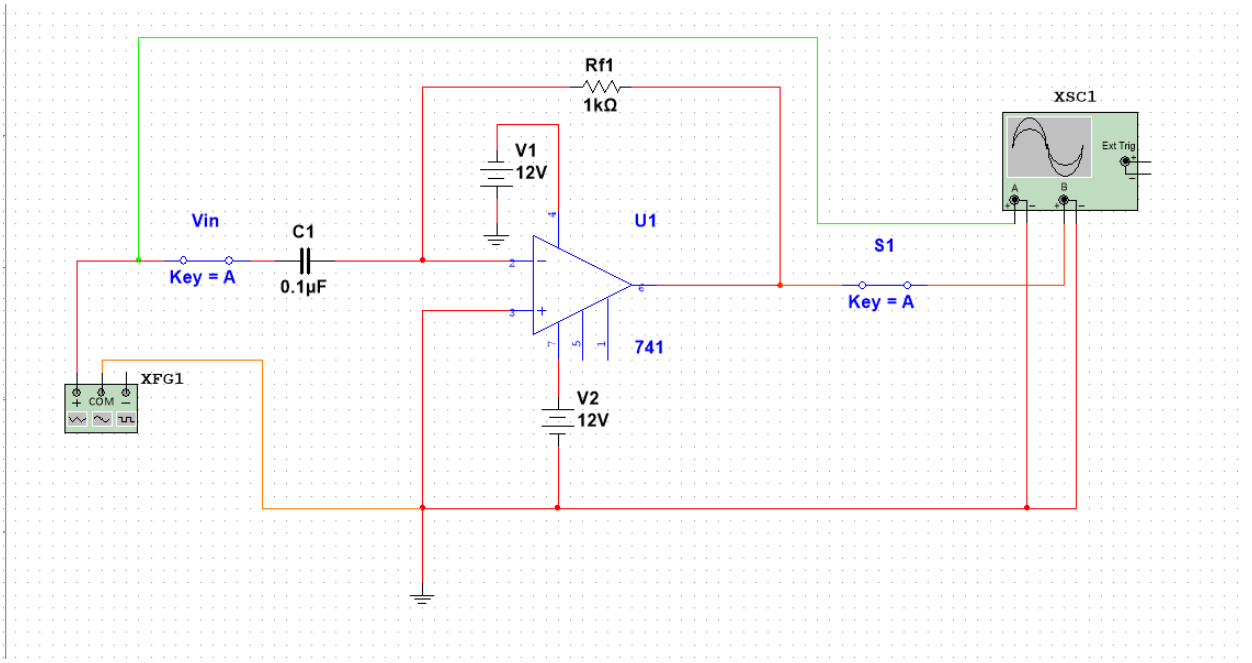
The first diagram below is an Integrator and the second diagram is a differentiator.




The design for the Integrator is shown below:

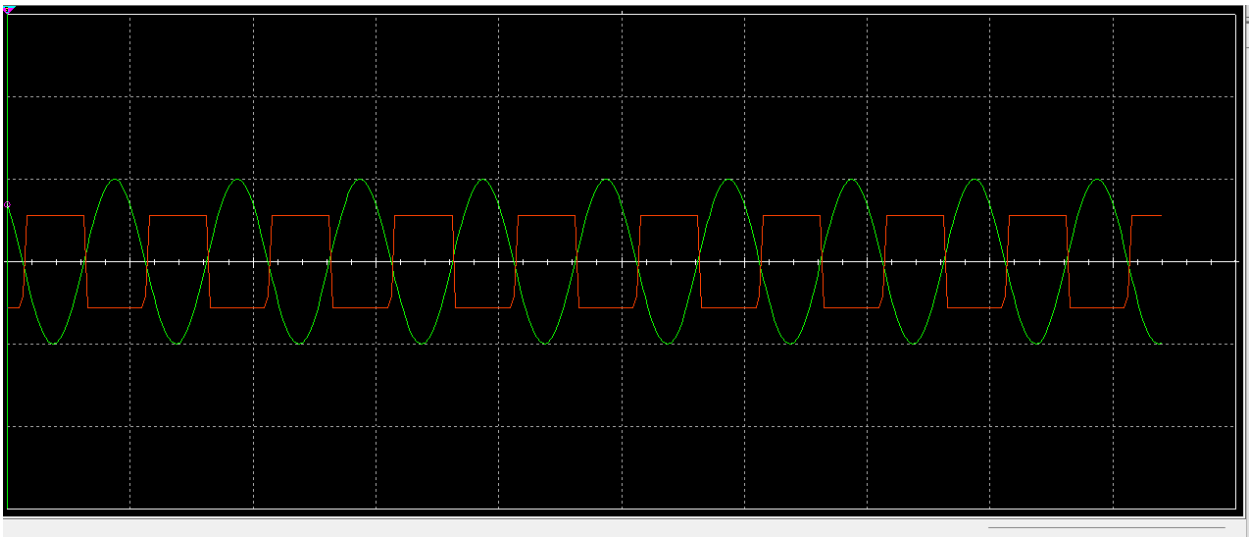


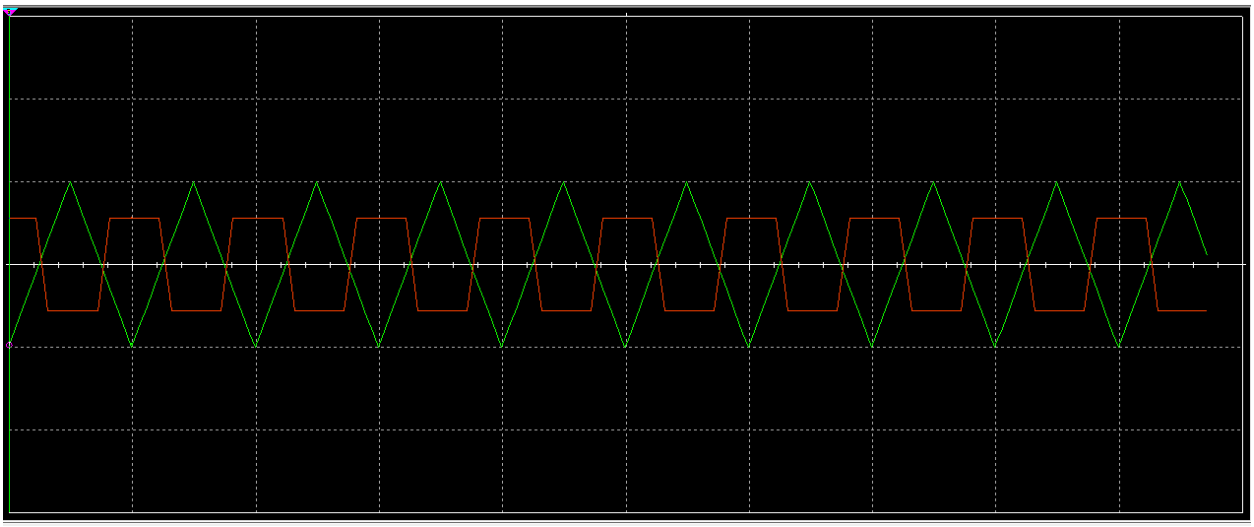

And the design for the Differentiator is as follows:

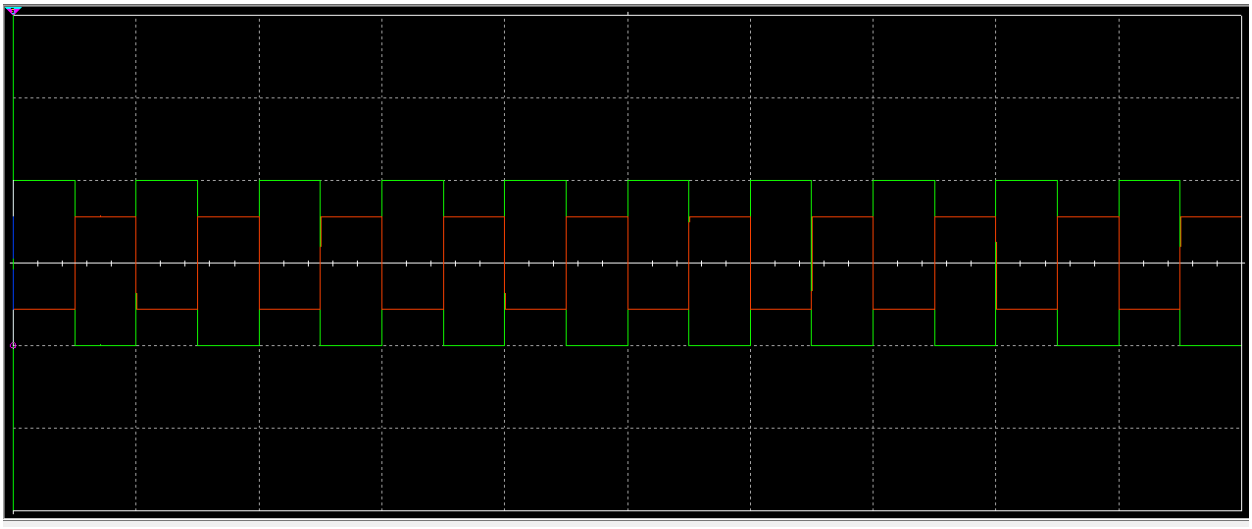



When the simulations were completed, the following outputs were achieved for Sinusoidal, Triangular and Square inputs.

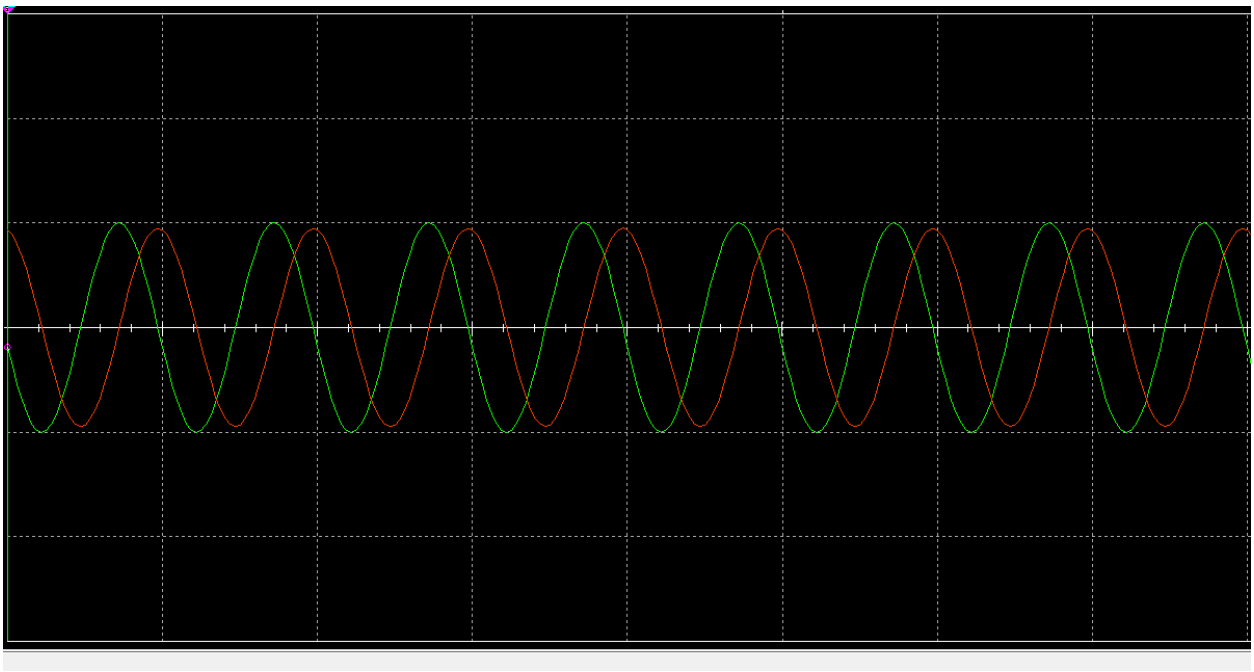
For Integrator simulations:

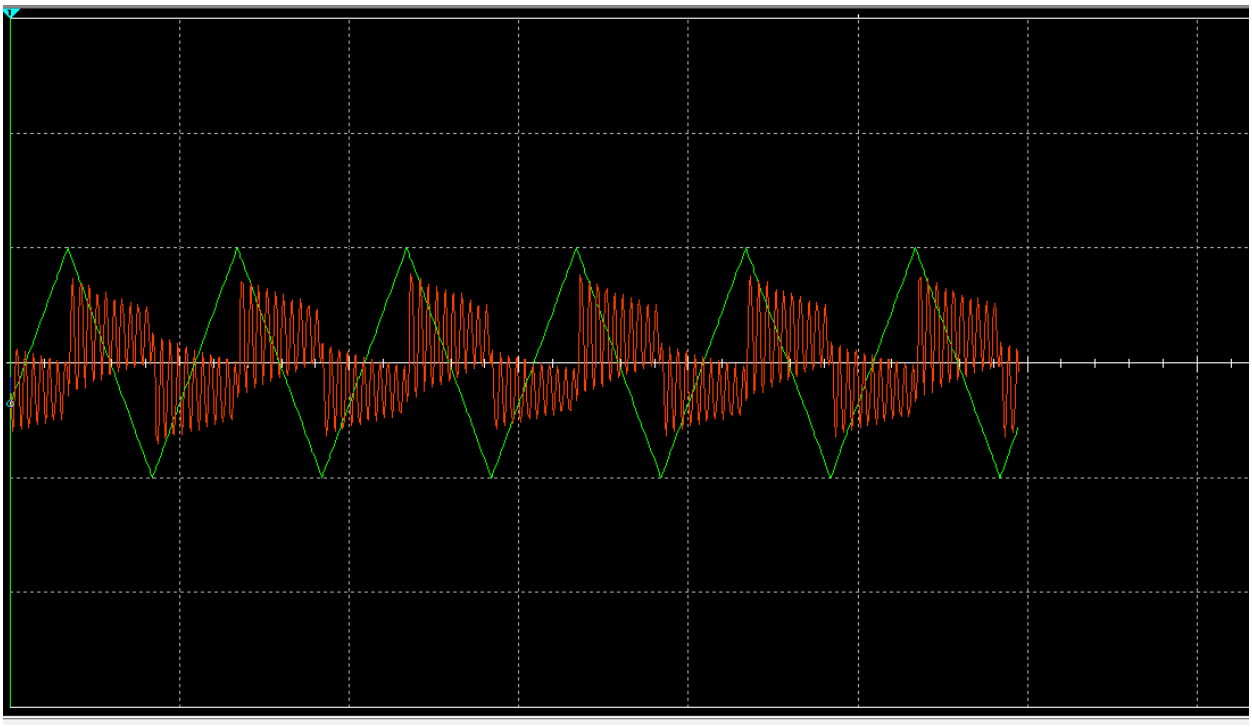


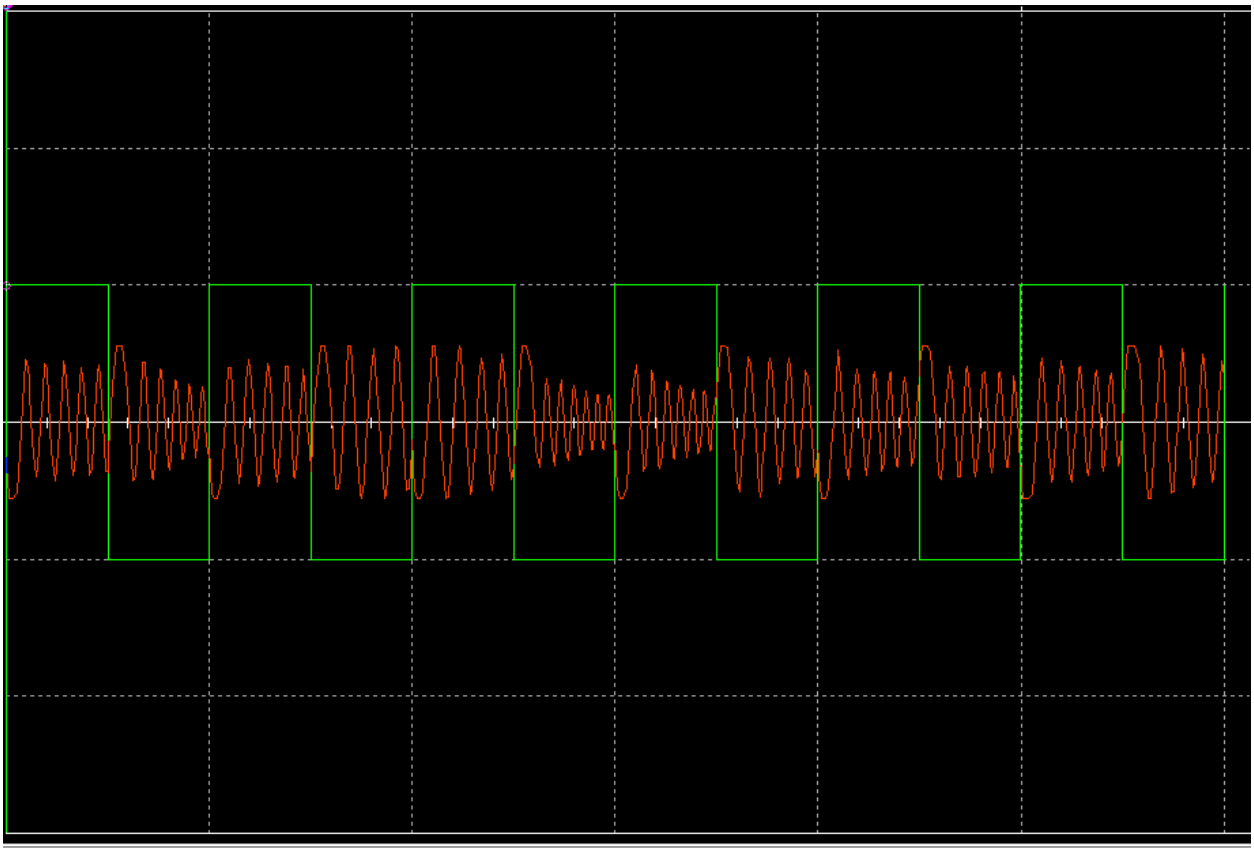




The following outputs were achieved for the Differentiator simulations with sinusoidal, square, and triangular input signals:



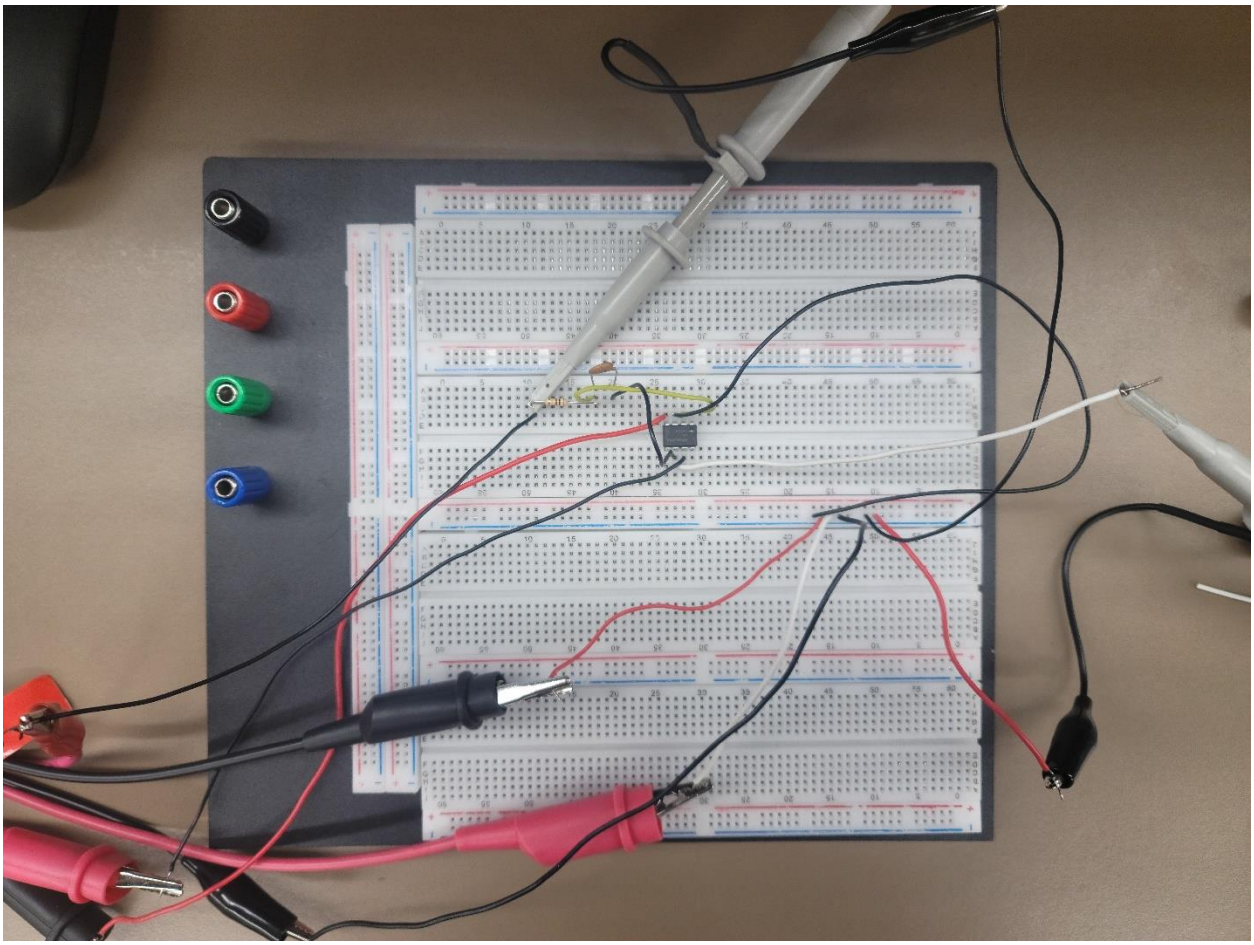




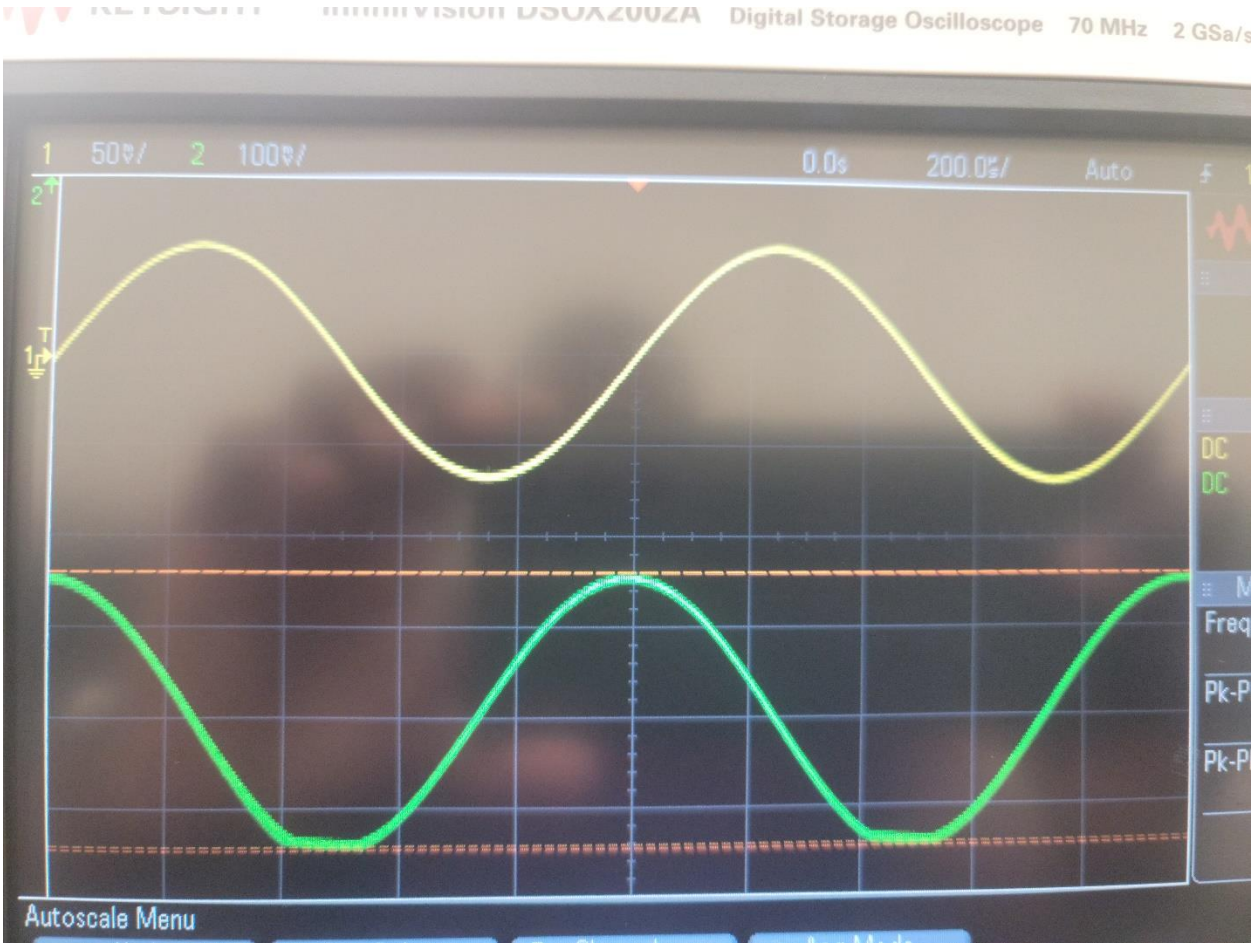
**PART B:**

This part involved reenacting the digital designs in the laboratory and testing outputs with square, triangle, and sine wave inputs. The following images below show the lab setup and various outputs from a connected Oscilloscope.

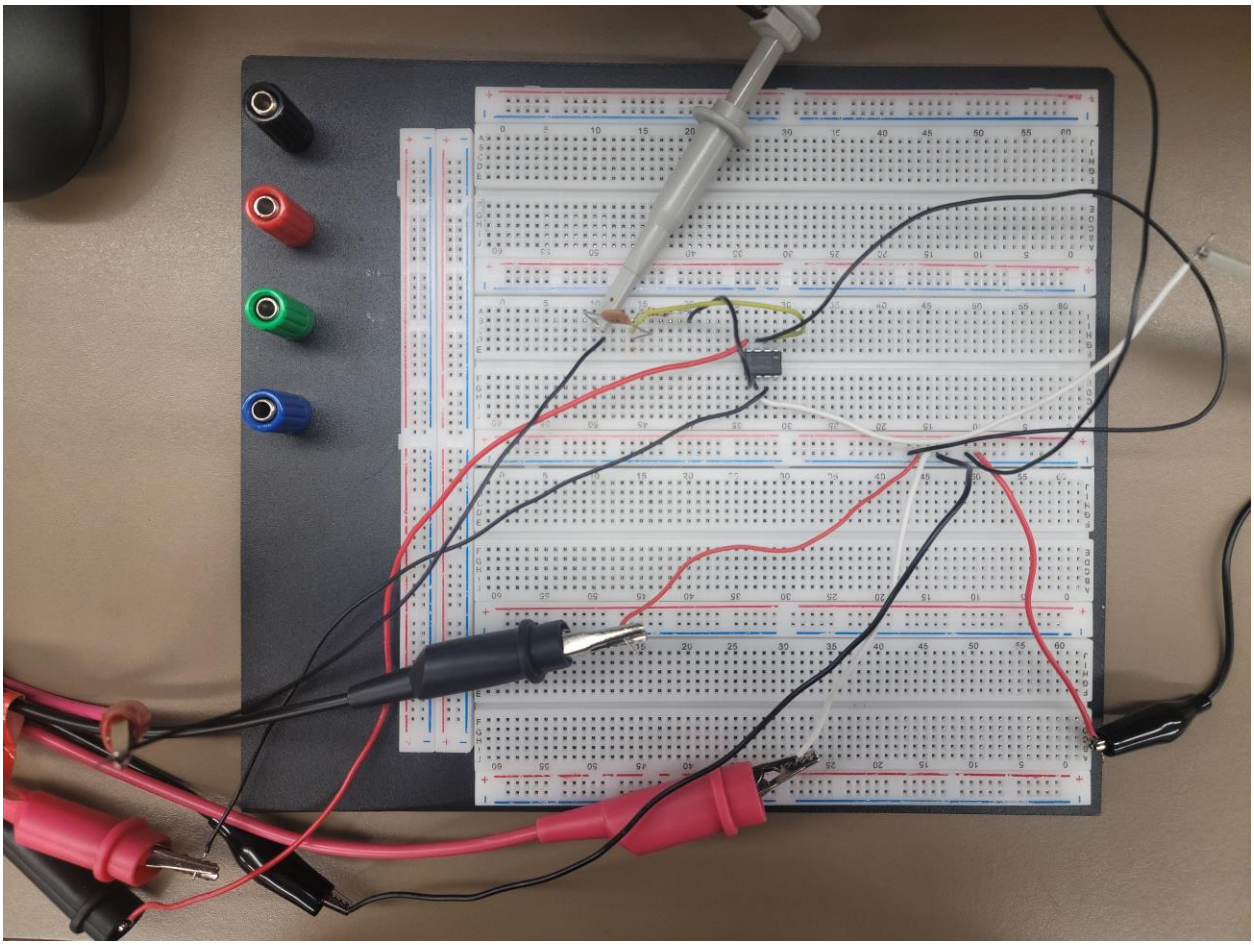
Integrator op-amp design and outputs:

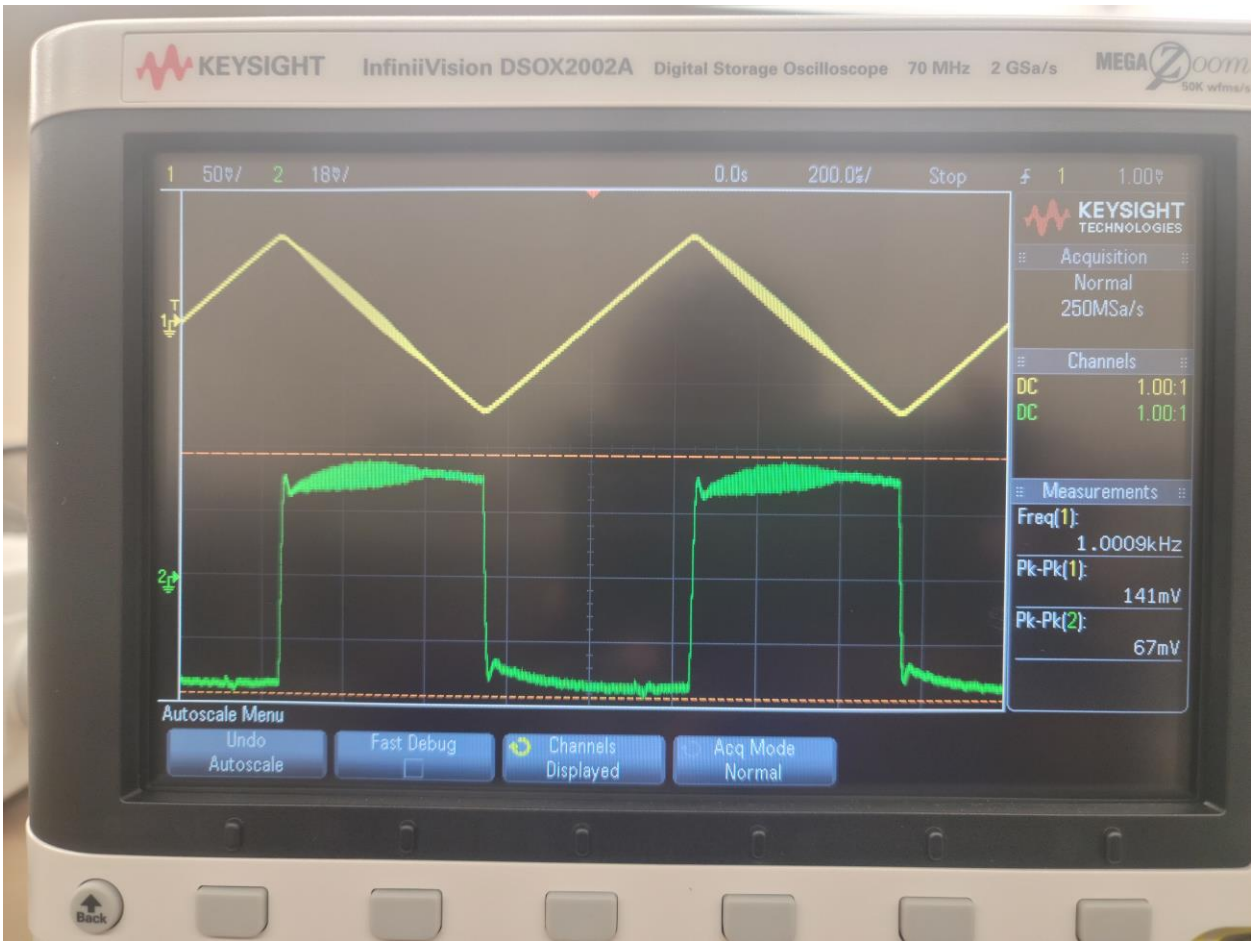


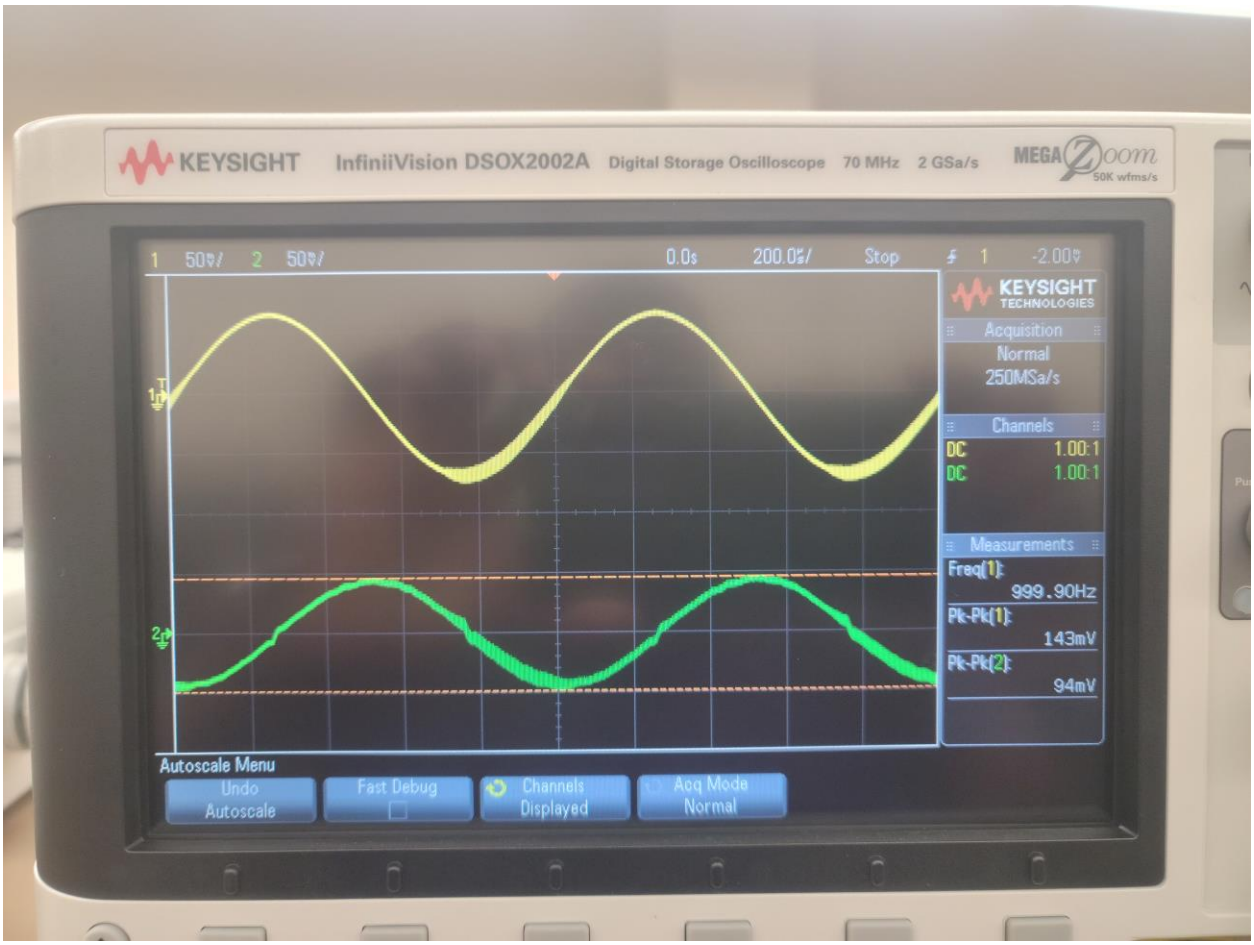

KEYSIGHT
InfiniiVision DSOX2002A
Digital Storage Oscilloscope
70 MHz
2 GSa/s
1 50V/
2 100V/
0.0s
200.0s/
Auto
DC
DC
Autoscale Menu
Undo Autoscale
Fast Debug
Channels Displayed
Acq Mode Normal


Digital Storage Oscilloscope 70 MHz 2 GSa/s
1 50mV/ 2 100mV/ 0.0s 200.0µs/ Auto
DC
DC
Freq
Pk-P
Pk-P
Autoscale Menu


Differentiator op-amp design and outputs:




KEYSIGHT
InfiniiVision DSOX2002A
Digital Storage Oscilloscope
70 MHz
2 GSa/s
MEGA Zoom
1 50mV/ 2 18mV/
0.0s
200.0ns/
Stop
1 1.00V
KEYSIGHT TECHNOLOGIES
Acquisition
Normal
250MSa/s
Channels
DC 1.00:1
DC 1.00:1
Measurements
Freq(1):
1.0009kHz
Pk-Pk(1):
141mV
Pk-Pk(2):
67mV
Autoscale Menu
Undo Autoscale
Fast Debug
Channels Displayed
Acq Mode Normal
Back


KEYSIGHT
InfiniiVision DSOX2002A
Digital Storage Oscilloscope
70 MHz
2 GSa/s
MEGA Zoom
50K wfms/s
1 50mV/ 2 50mV/
0.0s
200.0ns/
Stop
1 -2.00mV
KEYSIGHT TECHNOLOGIES
Acquisition
Normal
250MSa/s
Channels
DC 1.00:1
DC 1.00:1
Measurements
Freq(1):
999.90Hz
Pk-Pk(1):
143mV
Pk-Pk(2):
94mV
Autoscale Menu
Undo Autoscale
Fast Debug
Channels Displayed
Acq Mode Normal


In conclusion, this was an interesting lab and it was a great learning experience understanding the differences between the two circuit designs.