LAB REPORT NO 8

Spring 2020

CS-II lab

Submitted by: **Muhammad Ali**
Registration No: **19PWCSE1801**
Class Section: A

Submitted to:

Engr. Faiz ullah

(08,02, 2020)

Department of Computer Systems Engineering
University of Engineering and Technology, Peshawar

Lab 8

Operational Amplifier Applications-Inverting Summing Amplifier and Difference Amplifier

OBJECTIVES:

To demonstrate the use of Operational Amplifier for performing mathematical operations of summation and difference.

EQUIPMENT:

1. DC Power Supply
2. Oscilloscope
3. Function Generator

Components

1. LM 741 Op-amp
2. 47kΩ
3. 100kΩ

Part A

Inverting Summing Amplifier

Theory Overview

Figure 1 shows an example of how an operational amplifier is connected to perform voltage summation. In this figure, an ac and a dc voltage are summed. In general,

$$V_O = -\left(\frac{R_f}{R_1}V_1 + \frac{R_f}{R_2}V_2 + \ldots\ldots\text{etc.}\right)$$

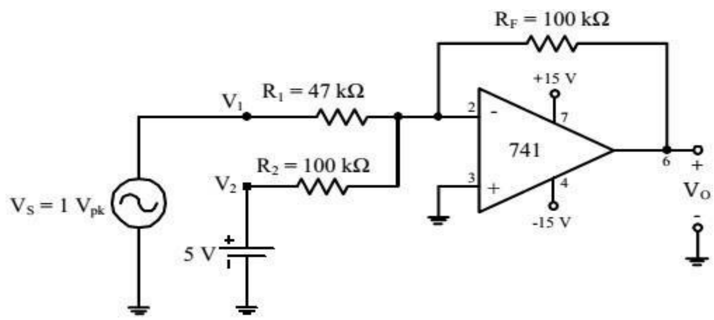


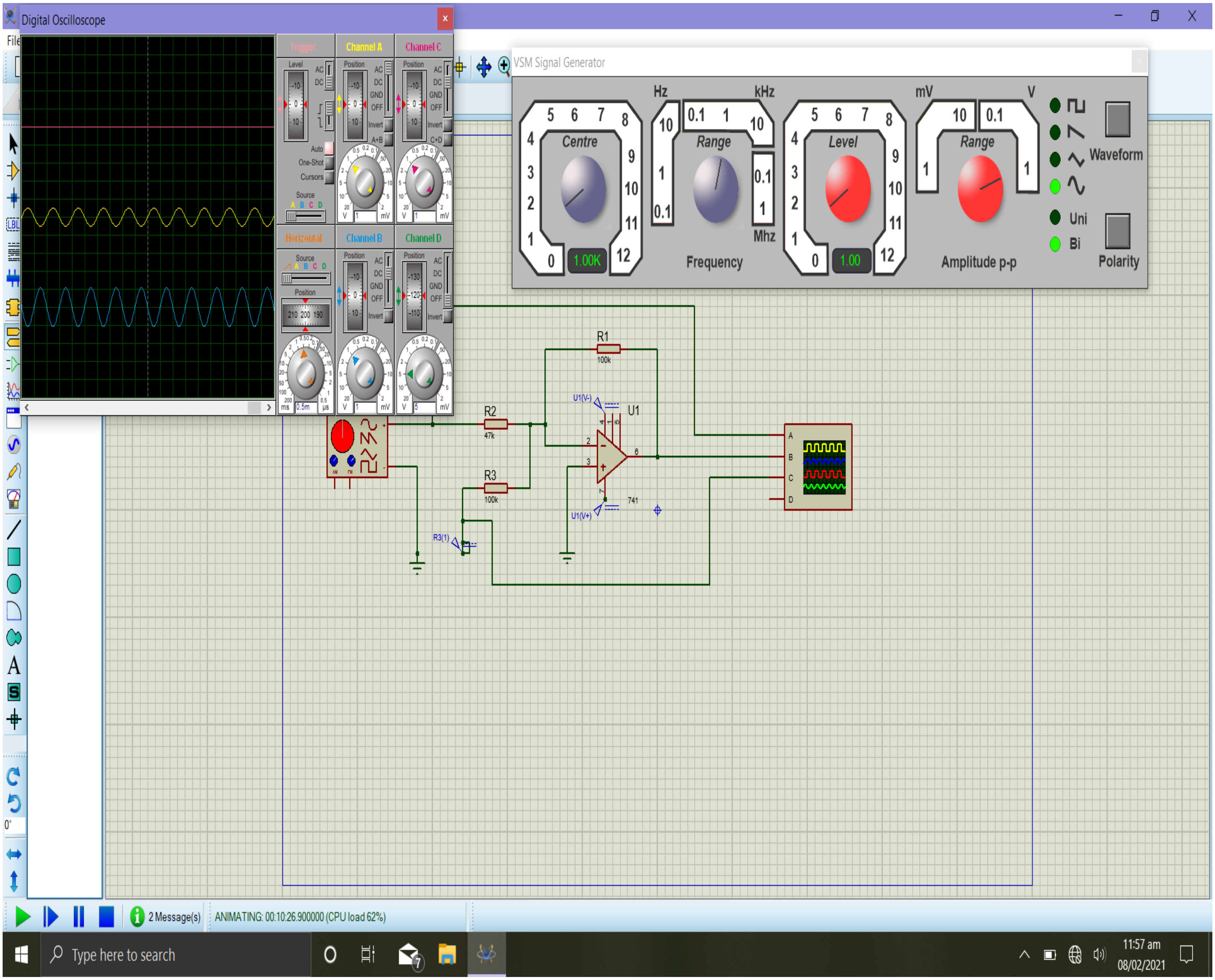
Figure 1

Procedure

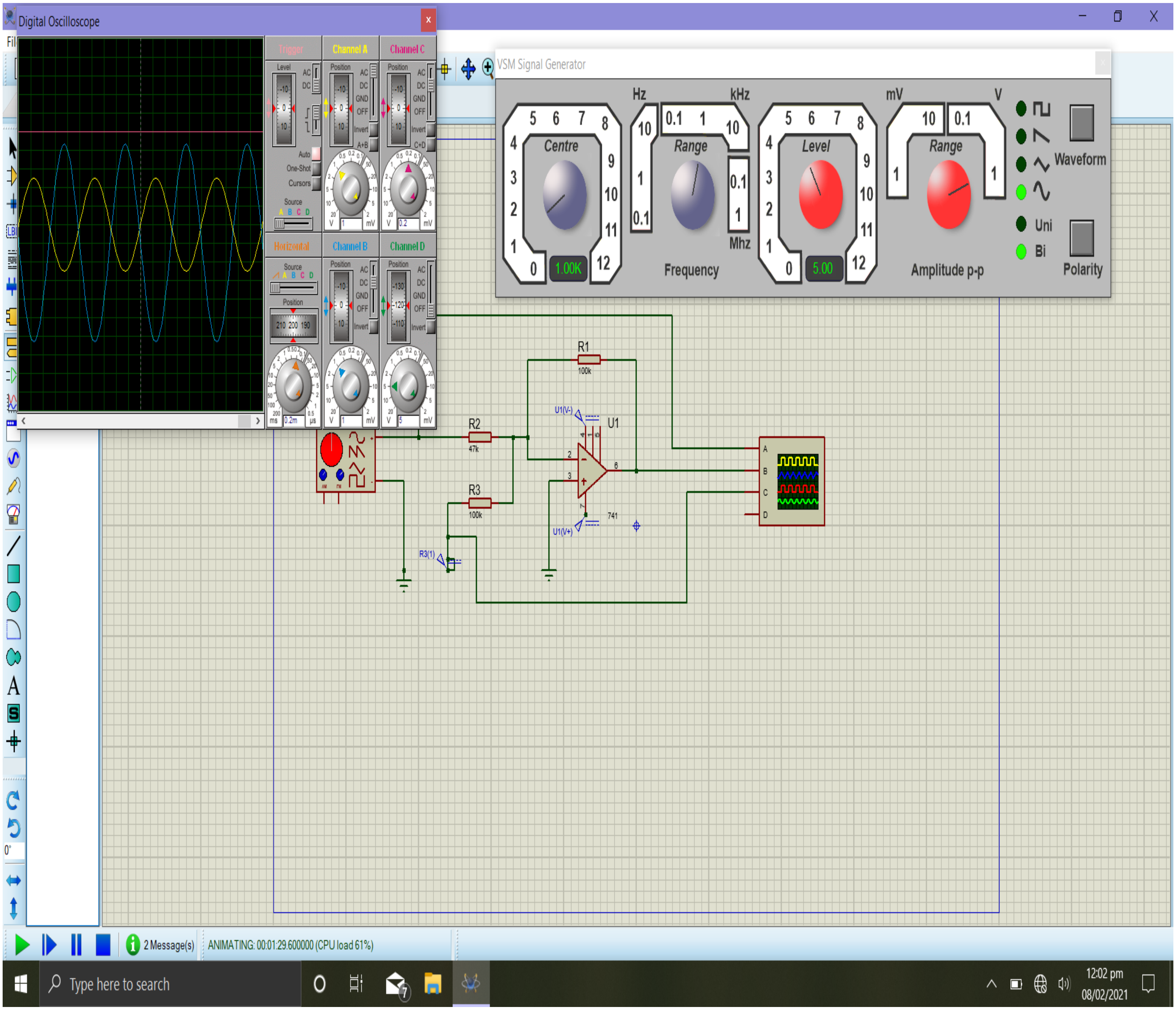
1. To demonstrate the use of an operational amplifier as a summing amplifier, connect the circuit of Figure 1.
2. With V_S adjusted to produce a 1 V peak sine wave at 1 kHz, observe the output voltage V_O (and V_S to note the phase relationship) on an oscilloscope set to dc input coupling.
3. Sketch the output voltage waveform. Be sure to note the dc level in the output.
4. Interchange the 5 V dc power supply and the 1 V peak signal generator.
5. Repeat procedure step 2 and observe the change in output waveform.

Proteus pictures output:-

Channel A is at origin: Means channel B(output) signal is move 5 division down and channel C(dc source) move upward 5 division but channel A is at origin.



When Source are interchange between Ac and Dc:-



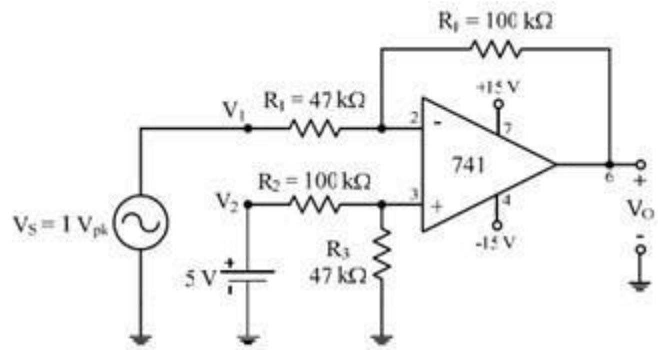
Theoretical output, V_0 =-(2.12 (at angle of 0 degree) + 5)

Part B

Difference Amplifier

Theory Overview

A difference amplifier has two inputs and the output voltage is proportional to the voltage difference of the input voltages. In fact, the (open-loop) Op-Amp itself is a difference amplifier, except that the gain is ideally infinity. Here we want a difference amplifier with finite gain. One such circuit using a single OpAmp is shown in Figure 4. It can be shown that the gain of the difference amplifier can be calculated using the following:



$$V_O = \left(V_2 \left(1 + \frac{R_f}{R_1} \right) \left(\frac{R_3}{R_2 + R_3} \right) \right) - \left(\frac{R_f}{R_1} V_1 \right)$$

Figure 2

This equation can be simplified by making $R_3 = R_f = R_1 = R_2$, yielding a simple differential amplifier with unity gain:

$$V_0 = V_2 - V_1$$

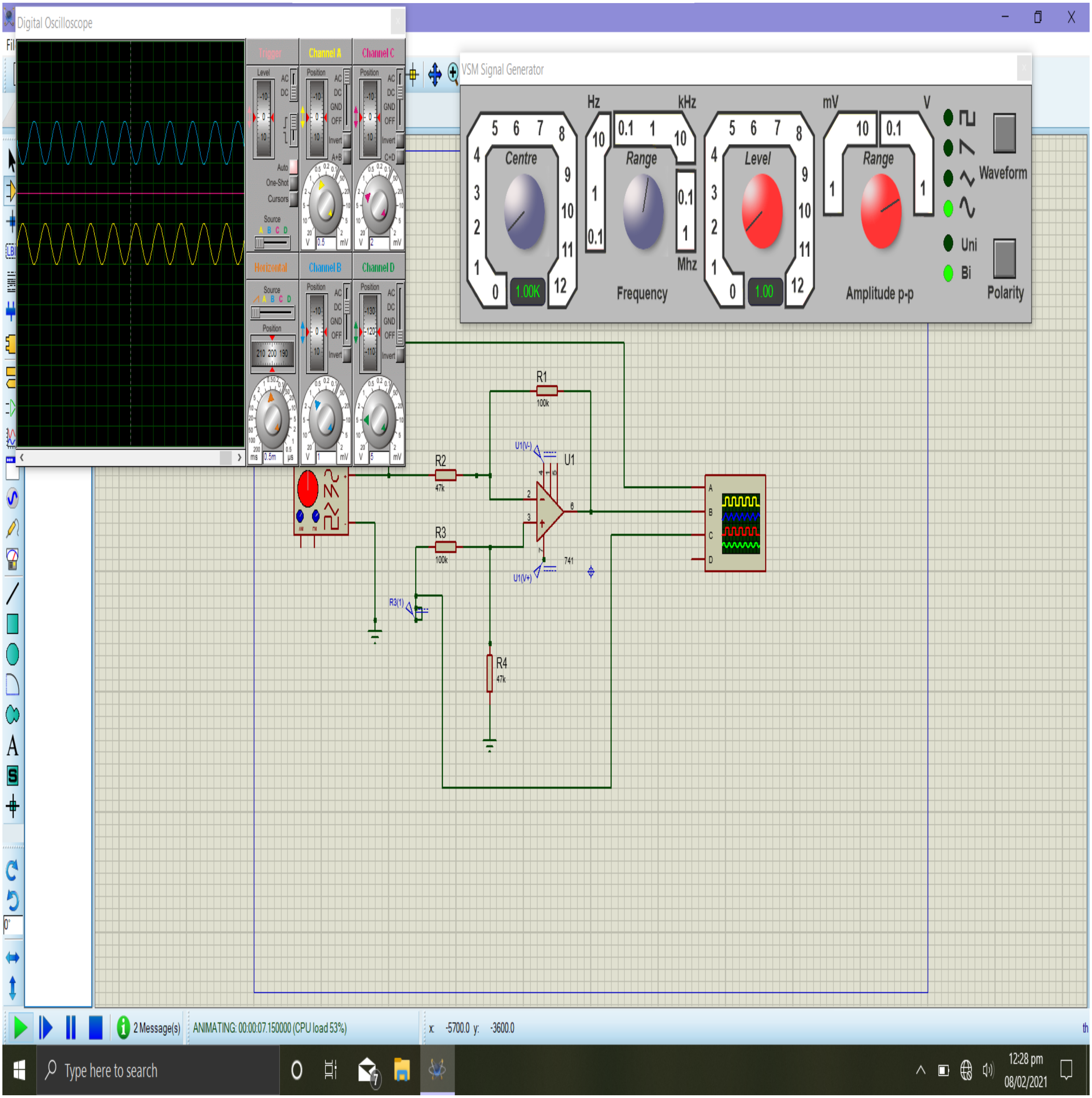
Procedure

1. To investigate the use of an operational amplifier in a difference amplifier configuration, connect the circuit of Figure 2.
2. With V_S adjusted to produce a 1 V peak sine wave at 1 kHz, observe the output voltage V_O(and V_S to note the phase relationship) on an oscilloscope set to dc input coupling.
3. Sketch the output voltage waveform. Be sure to note the dc level in the output.
4. Interchange the 5 V dc power supply and the 1 V peak signal generator.
5. Repeat procedure step 2 and observe the change in output waveform.

Part B:-

According to formula ,$V_{0=(10.6k-2.12)}$

$$V_o = \left\{V_2\left(1+\frac{R_f}{R_1}\right)\left(\frac{R_3}{R_2+R_3}\right)\right\} - \left(\frac{R_f}{R_1}V_1\right)$$



When R1=R2=R3=Rf:-