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Control systems lab
Experiment (1)
Analogue computing and integrators

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Objective:

*Investigating the function of a potentiometer and summing amplifier.

*To understand the function of integration and know how it is performed by integrator.

Part A: The Potentiometer

Q 1.1) How far does the knob has to move to change the voltage reading by 4v ? 40%

Part B: The summing amplifier

To calculate the out put voltages I use : Vo=-(V1+V2)

Input Voltages		Output Voltage	Output Voltage
V_1	V_2	$V_{o(measured)}$	$V_{o(calculated)}$
+5	+3	-8.04V	-8.0V
-5	+9	-4.1V	-4 V
-5	+5	0V	0V
-5	0	5V	5V

Q 1.2) What is the relationship exists between the output of the amplifier and its input?

The output of the amplifier is equal to the summation of the inputs voltages

Q 1.3) What is the value of the voltage at the input junction of the summing amplifier? Why?

The value of the input junction of the summing amplifier is equal to Zero ; Because there is no current passing through the op amp ,and that mean there is no voltage different between the positive and negative terminals of the amplifier. ((voltage at the input junction is virtual grounded))

Part C :

**In this part we connect V2 with 20KΩ resistor*

What is the value of the summing coefficient?

Rf/R2=10*K Ω /20K Ω =1/2=0.5*

Input Voltages		Output Voltage	Output Voltage
V_1	V_2	$V_{o(measured)}$	$V_{o(calculated)}$
+5	+3	-6.6V	-6.5V
-5	+9	0.62V	0.5 V
-5	+5	2.4V	2.5V
-5	0	5.1V	5V

Part D :The integrator

What does the meter indicate?

It's indicate a rapidly decreasing voltages

What is the saturation voltage?

-12.69V(on the DMM)

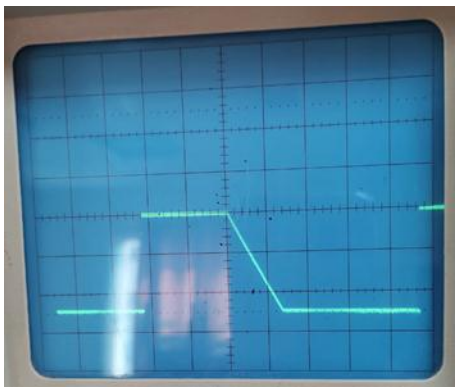
Q1.5 a) Switch the capacitor to 0.1µF, What do you notice? It shows a decreasing curve with respect to time, started from the reference (zero)and stopped at the saturation voltage which is equal to -12.5V

b) Measure and calculate how many second does it take to reach the saturation voltage?

$\mathcal{T}$=R*C=1M*0.1µ=0.1sec (time required for 1V)

The time required to reach the saturation voltage =12.69*0.1=1.269sec(this voltage taken from the DMM)

6) Connect the oscilloscope to the output of the integrator, switch to (compute) and sketch the output displayed on the oscilloscope.



7) Measure: The saturation voltage

Saturation voltage = -2.5 *5=-12.5V

*Oscilloscope division :
vertical 5V/div
Time 1sec/div

The time needed to reach the saturation voltage

Time=0.75 sec(calculated time=0.1*12.5=1.25sec)

Part E: Integrator with initial value

INITIAL VALUE= -5v

4) Display the output on the oscilloscope, Switch to (compute), what do you notice?

When we add negative initial voltage (-5) to the operational amplifier the curve does not start from reference (0), it started from +5V

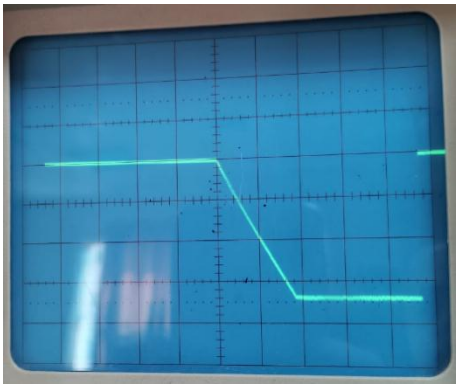
Q1.6 a) Using the oscilloscope, Measure the saturation voltage and the time needed to reach the saturation point?

**Oscilloscope division :*
vertical 5V/div
Time 1sec/div

Saturation voltage = -3.5 *5=-17.5V

Measured time=1.8 sec(calculated time=0.1*17.5=1.75sec)

b) Sketch the output?



Integrator output initial value=-5V

Part E: Integrator with initial value

INITIAL VALUE= +5v

4) Display the output on the oscilloscope, Switch to (compute), what do you notice?

When we add positive initial voltage (+5) to the operational amplifier the curve does not start from reference (0), it started from -5V

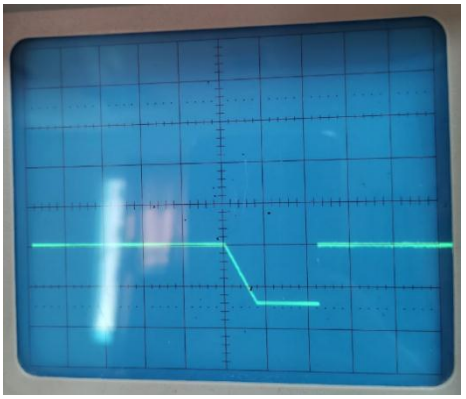
Q1.7 a) Using the oscilloscope, Measure the saturation voltage and the time needed to reach the saturation point?

**Oscilloscope division :*
vertical 5V/div
Time 1sec/div

Saturation voltage = -1.5 *5=-7.5V

Time=0.75 sec(calculated time=0.1*7.5=0.75sec)

b) Sketch the output?



Integrator output initial value=+5V

conclusion:

In this experiment we use analogue computing module ACM 349 to connect summing and integrating circuits, we adjusted the potentiometer to get various values of the inputs voltages , we used the DMM to measure the values of the input and output voltages of the op amps , we also used the oscilloscope to show the output voltage of the integrator.

I learned many things from this experiment , like connecting the op amps circuits over the kit board , and adjusting the potentiometer and connect it to the input, using DMM to measure voltages values and reading the saturation voltage and the time required to reach it from the oscilloscope.