# PART 4

## Linear - Nonlinear Applications of Op-Amp

1. Analyzing Operational Amplifier Operating As Comparator (2.1)
2. Analyzing Operational Amplifier Operating As Comparator (2.2)
3. Analyzing Operational Amplifier Operating As Logarithmic Amplifier (2.7)
4. Analyzing Operational Amplifier Operating As Instrumentation Amplifier (2.8)

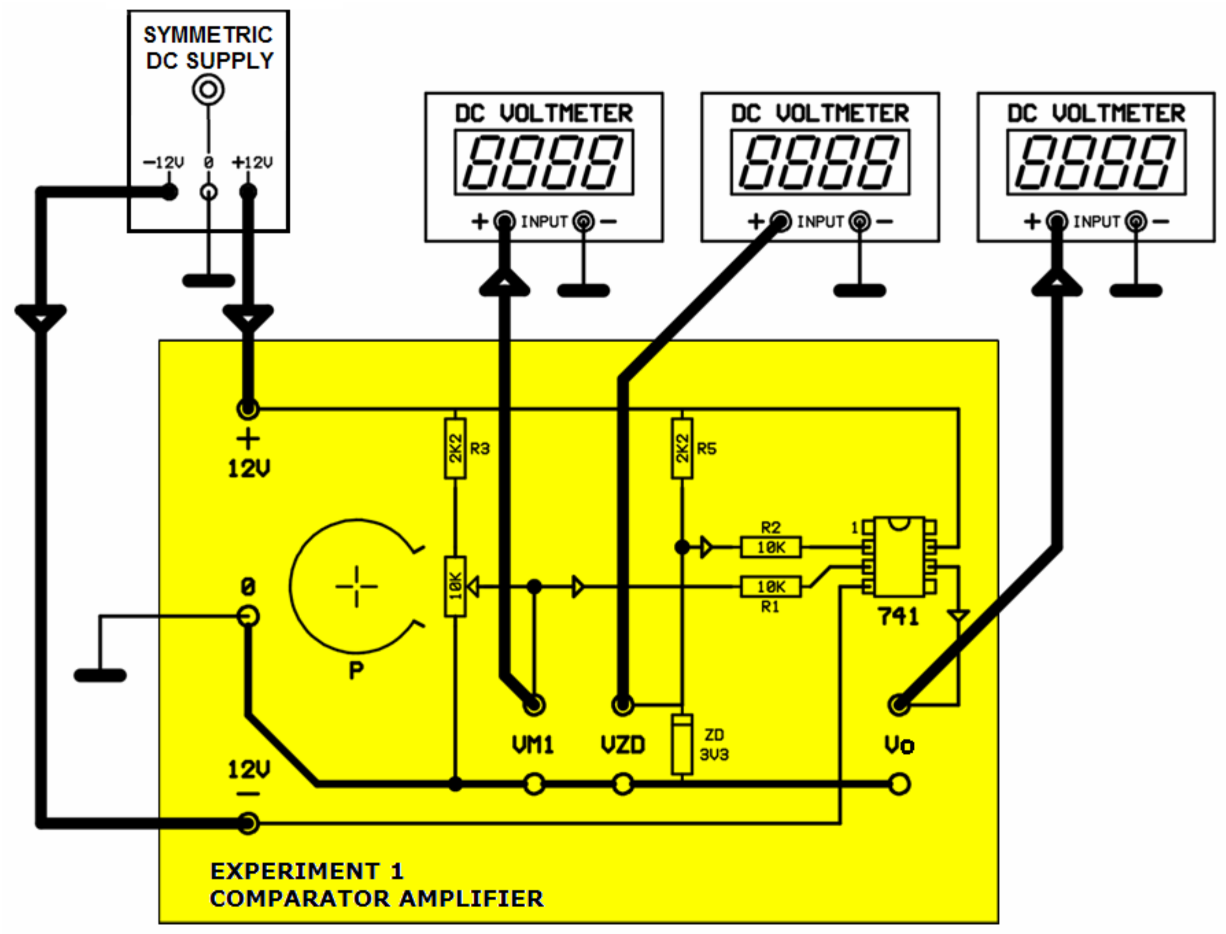
**MODULE Y-0014/02**

**EXPERIMENT: 2.1**

**ANALYZING OPERATIONAL AMPLIFIER OPERATING AS COMPARATOR**

**EXPERIMENTAL PROCEDURE:**

Connect the circuit as shown in the figure.




**1-** Apply power to the circuit. Measure the voltage (**VZD**) across the terminals of the zener diode connected to the circuit. What is that voltage called?

**2-** By adjusting the potentiometer P, satisfy the condition VM1=VZD. Measure the output voltage when that equality is satisfied. Explain the reason.

**3-** Take note of the reference voltage in each step on Table 1. Adjust the voltage V1 to the values given in the table by using potentiometer P for each step. Take note of the output voltage.

**Table 1**

| **V1** (**Volt**) | **VZD** (**Volt**) | **Vo** (**Volt**) |
|---|---|---|
| 1 | | |
| 2 | | |
| 4 | | |
| 5 | | |

**4-** Does the comparator circuit operate similar to the non-inverting amplifier? Why?

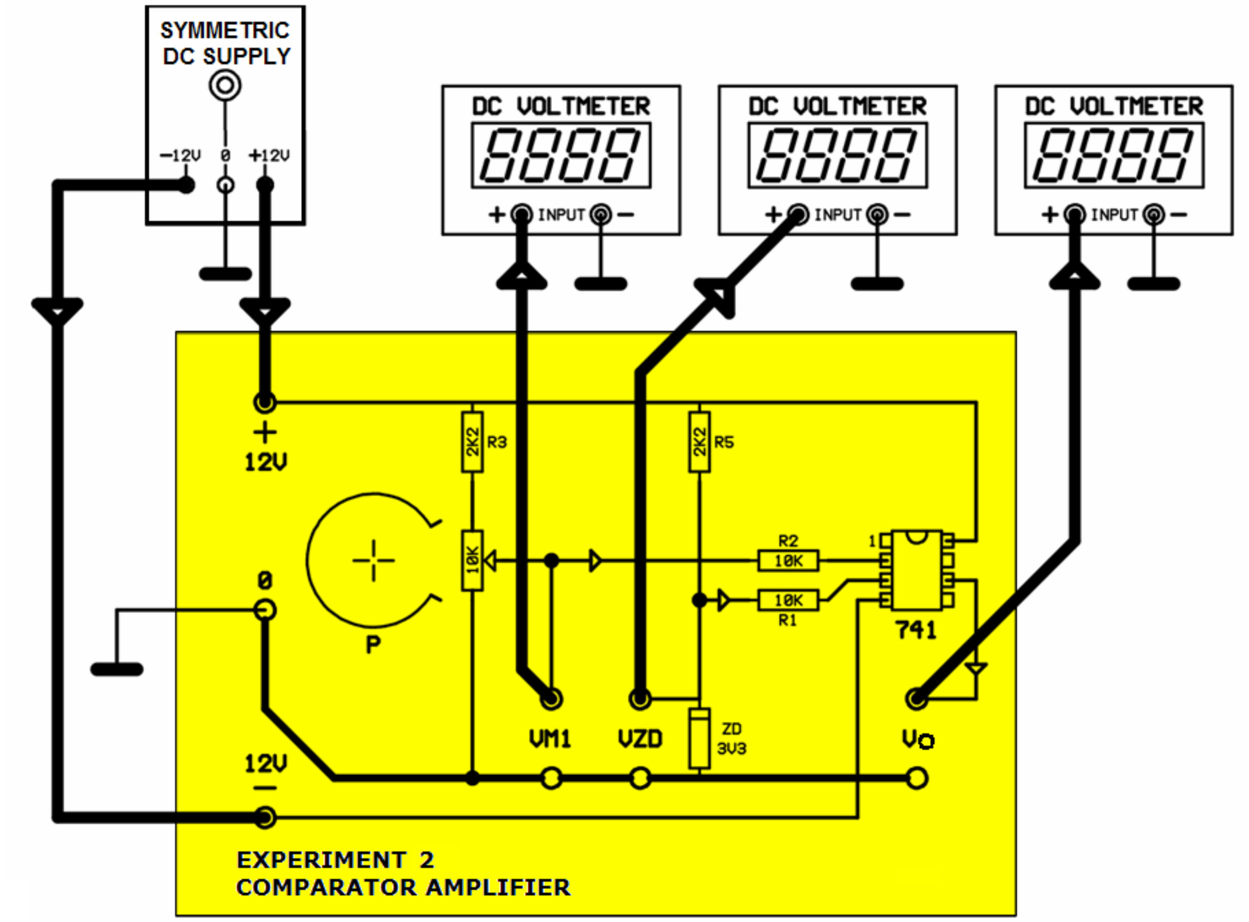
**EXPERIMENT: 2.2**

**ANALYZING OPERATIONAL AMPLIFIER OPERATING AS COMPARATOR**

**NOTE: The preparation information is given in experiment 2.1.**

**EXPERIMENTAL PROCEDURE:**

Connect the circuit as shown in the figure.




**1-** Apply power to the circuit. Measure the voltage (**VZD**) across the terminals of the zener diode (between the points A-O) connected to the circuit. What is that voltage called?

**2-** By adjusting the potentiometer P, satisfy the condition VM1=VZD. Measure the output voltage when that equality is satisfied. Explain the reason.

**3-** Take note of the reference voltage in each step on table 1. Adjust the voltage V1 to the values given in the table by using potentiometer P for each step. Take note of the output voltage.

**Table 1**

| **V1** (**Volt**) | **VZD** (**Volt**) | **Vo** (**Volt**) |
|---|---|---|
| 1 | 1 | |
| 2 | 2 | |
| 4 | 4 | |
| 5 | 5 | |

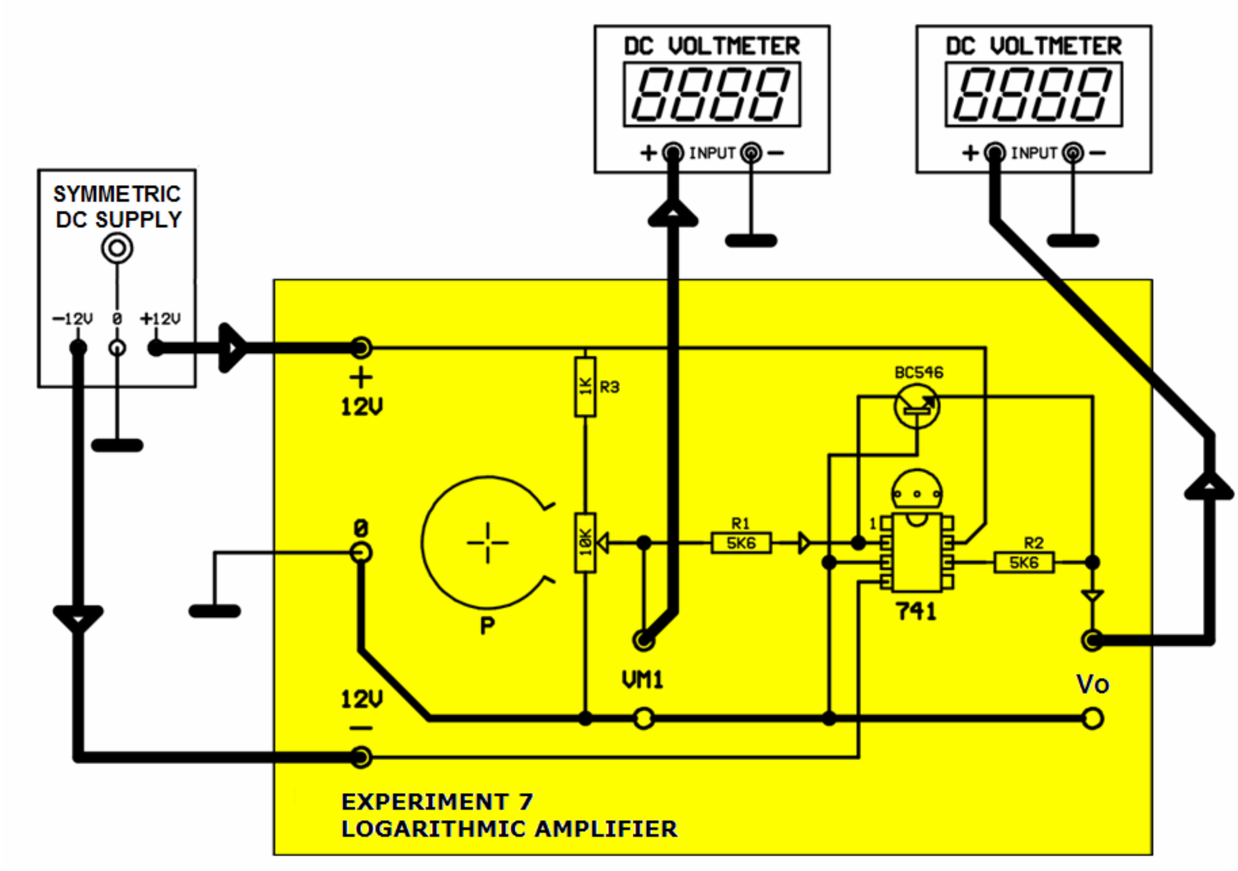
**4-** Does the comparator circuit operate similar to the inverting amplifier? Why?

**EXPERIMENT: 2.7**

**ANALYZING OPERATIONAL AMPLIFIER OPERATING AS LOGARITHMIC AMPLIFIER**

**EXPERIMENTAL PROCEDURE:**

Connect the circuit as shown in the following figure.




**1-** Apply power to the circuit. Adjust the input voltage V1 to the values given in table 1 by using the potentiometer P. Take note of the output voltage in each step.

**Table 1**

| V1 | Vo |
|---|---|
| 50 mV | |
| 500 mV | |
| 5 V | |

**2-** Why is the output voltage negative?

**3-** If the input voltage is made V1=250mV, how much the output voltage increases?

*When* ***V1=*** *50mV,* ***Vo=****- .*

***V1=*** *250mV →*

***Vo=*** *60mV.*$\log_{10} X$

***Vo=***

**4-** If the input voltage, V1, is 2,5V, how much the output voltage increases?

*When* ***V1=*** *500mV,* ***Vo=*** *.*

***V1*** ***=*** *2,5V →*

*The resulting increase at the output is;*

***VO=*** *60mV.*$\log_{10} X$

***VO=***

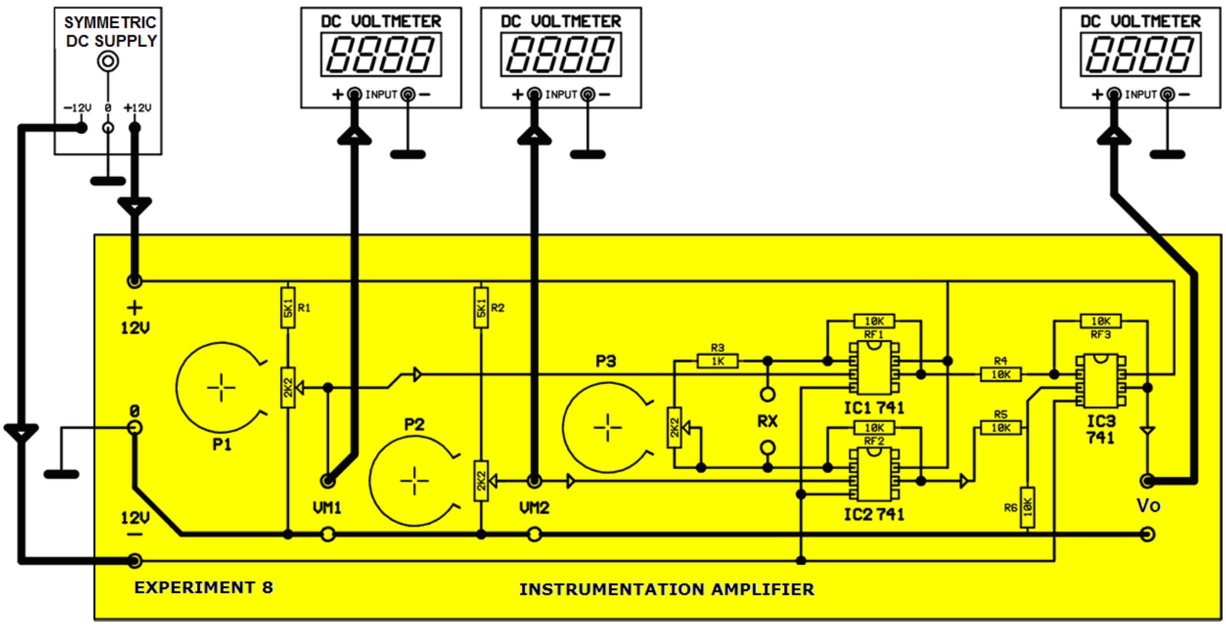
**5-** Is the increase at the output logarithmic? Why?

**EXPERIMENT: 2.8**

**ANALYZING OPERATIONAL AMPLIFIERS OPERATING AS INSTRUMENTATION AMPLIFIER**

## EXPERIMENTAL PROCEDURE:

Connect the circuit as shown in the figure.




**NOTE: In the circuit, RX=R3+P3. If the variable resistance P3 is set to zero;**

**RX=** R3+P3=1K+0=1K.

If the variable resistance P3 is set to its maximum value;

**RX=** R3+P3=1K+2K2=3K2.

All the resistances in the circuit are 10K.

**1-** Apply power to the circuit. Adjust the input voltage (**V1**) of the instrumentation amplifier to 0,8Volts by using the potentiometer P1 and adjust the input voltage (**V2**) of the instrumentation amplifier to 0,5Volts by using the potentiometer P2.

**2-** Take note of the output voltage on table 1 when the resistance RX is 1K and 2K.

**Note:** Measure RX using ohmmeter to set the given values.

**Table 1**

| **RX** (**K**) | **Vo** (**Volt**) |
|---|---|
| 1K | |
| 2K | |

**3-** What is the relation between the resistance RX and the gain of the circuit?

**4-** Why is the output signal negative?

**5-** Calculate the output voltage (**Vo**) when the resistance RX is 1K and 2K. Compare with the experimental results.

*When* ***RX=*** *1K;*

***VO=*** *- (V1-V2).* $\left[1+\frac{2R}{RX}\right]$

***VO=***

*When* ***RX=*** *2K;*

***VO=*** *-(V1-V2).* $\left[1+\frac{2R}{RX}\right]$

***VO =***

*Comments:*