

# **PR291: GROUP PROJECT : GROUP 6**

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Department of Electronics and Communication  
Engineering

SUBJECT CODE : PR291



TOPIC: Design of subtractor circuit using OP-AMP

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## ❖ INTRODUCTION :

An operational amplifier (often op-amp or opamp) is a DC-coupled high-gain electronic voltage amplifier with a differential input and, usually, a single-ended output. In this configuration, an op-amp produces an output potential (relative to circuit ground) that is typically hundreds of thousands of times larger than the potential difference between its input terminals. Operational amplifiers had their origins in analog computers, where they were used to perform mathematical operations in many linear, non-linear and frequency-dependent circuits. The popularity of the op-amp as a building block in analog circuits is due to its versatility. Due to negative feedback, the characteristics of an op-amp circuit, its gain, input and output impedance, bandwidth etc. are determined by external components and have little dependence on temperature coefficients or manufacturing variations in the op-amp itself.

## ❖ APPARATUS REQUIRED :

- IC-741
- Resistors (1 k ohm)-4
- Function power supply
- Multimeter

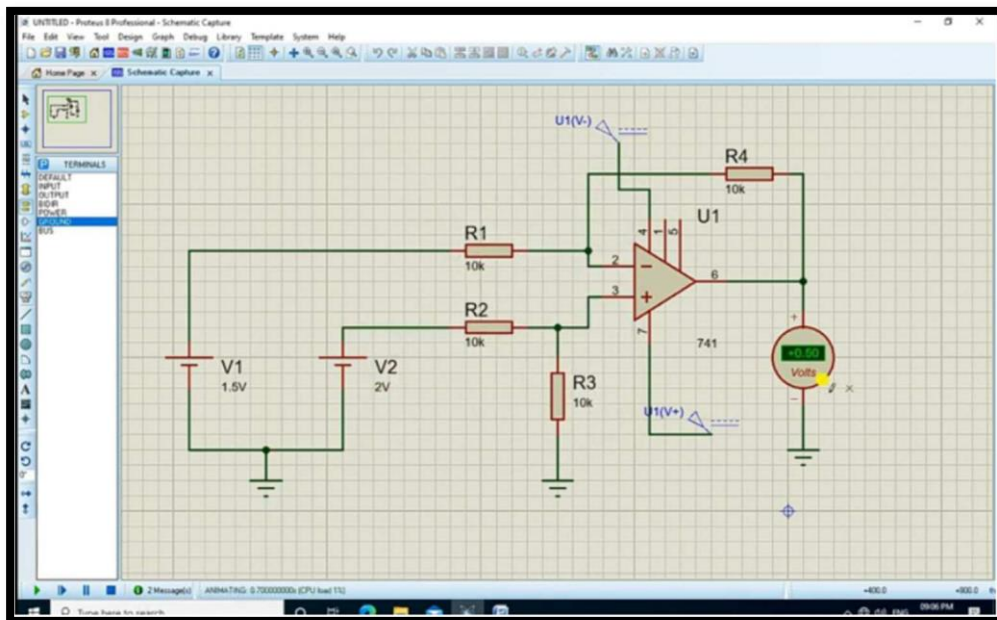
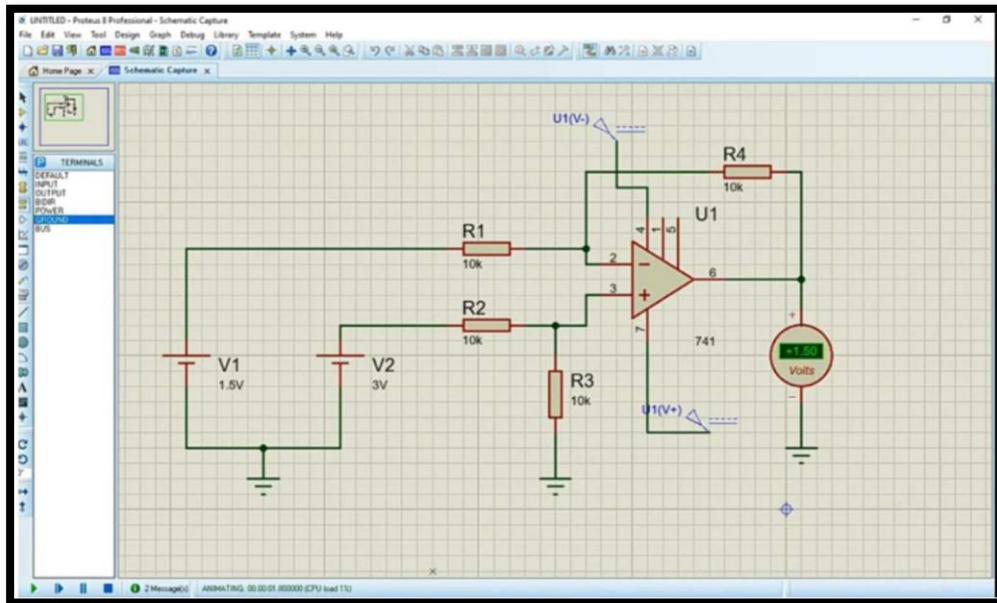
## ❖ SOFTWARE USED :

### Proteus Design Suite

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.

It was developed in Yorkshire, England by Labcenter Electronics Ltd and is available in English, French, Spanish and Chinese languages.

## ❖ CIRCUIT DIAGRAM :-



## ❖ CONCLUSION: -

The subtractor circuit, input signals can be scaled to the desired values by selecting appropriate values for the resistors. When this is done, the circuit is referred to as scaling amplifier. However, in this circuit all external resistors are equal in value. So, the gain of amplifier is equal to one. The output voltage  $V_{o}$  is equal to the voltage applied to the non-inverting terminal minus the voltage applied to the inverting terminal; hence the circuit is called a subtractor.

## ❖ RESULT: -

Each resistance is of 10k $\Omega$

Now the input voltage for the inverting circuit is +1.5V

& The input voltage for the non-inverting circuit is + 0.50V

Theoretically output voltage should be

$$= - (\text{Inverting input voltage} - \text{Non inverting input voltage})$$

$$= - (1.5 - 0.50) \text{ V}$$

$$= - 1.0 \text{ V}$$

Now from the circuit we get

$V_{out}$  for the source  $V_1$

$$V_{1 \text{ output}} = - \frac{R_2}{R_1} V_1$$

$V_{out}$  for the source  $V_2$

$$V_{2 \text{ output}} = \left(1 + \frac{R_2}{R_1}\right) \frac{R_2}{R_2 + R_1} V_2$$

$$V_{2 \text{ output}} = \frac{R_2}{R_1} V_2$$

According to super position theorem,

$$V_{out} = V_{1 \text{ output}} + V_{2 \text{ output}}$$

$$\begin{aligned}
\text{or, } V_{out} &= -\frac{R_2}{R_1} V_1 + \frac{R_2}{R_1} V_2 \\
&= \frac{R_2}{R_1} (V_2 \text{ output} - V_1 \text{ output}) \\
&= -\frac{R_2}{R_1} (V_1 \text{ output} - V_2 \text{ output}) \\
&= -\frac{10}{10} (1.50 - 0.50) \\
&= -1.0V
\end{aligned}$$

Hence the circuit is verified.

❖ **Precaution: -**

1. Make sure adjustment before applying the input signal.
2. Maintain proper  $V_{cc}$  levels.

❖ **Source: -**

1. [https://www.tutorialspoint.com/linear\\_integrated\\_circuits\\_applications/linear\\_integrated\\_circuits\\_applications\\_arithmetic\\_circuits.htm#:~:text=An%20op%2Damp%20based%20subtractor,output%20is%20an%20amplified%20one.](https://www.tutorialspoint.com/linear_integrated_circuits_applications/linear_integrated_circuits_applications_arithmetic_circuits.htm#:~:text=An%20op%2Damp%20based%20subtractor,output%20is%20an%20amplified%20one.)
2. <https://www.electronics-tutorial.net/analog-integrated-circuits/subtractordifference-amplifier/>
3. [https://www.electronicstutorials.ws/opamp/opamp\\_5.html](https://www.electronicstutorials.ws/opamp/opamp_5.html)