Experiment 7: Study and Observation of Different Types of Op-amp Model.

Theory:

Operational amplifiers, or op-amps, are essential components in electronic circuits, widely used for signal processing, amplification, and various other applications. Different types of op-amp models have been developed to meet specific design requirements and performance criteria. **Inverting Op-Amp:** In an inverting op-amp configuration, the input voltage is applied to the inverting terminal, and the output voltage is the inverted version of the input. The gain is determined by the ratio of feedback and input resistors.

Here, output voltage, $v_0 = -\frac{R_2}{R_1} v_i$ [figure-1]

Non-Inverting Op-Amp: In a non-inverting op-amp configuration, the input voltage is applied to the non-inverting terminal, and the output voltage is an amplified, non-inverted version of the input. The gain is determined by the ratio of feedback and input resistors.

Here, output voltage, $v_0 = (1 + \frac{R_2}{R_1}) v_i$ [figure-2]

Integrator and Differentiator Op-Amps: These op-amp configurations are used for mathematical operations. An integrator produces an output voltage proportional to the integral of the input voltage, while a differentiator produces an output voltage proportional to the derivative of the input voltage.

Here, for integrator, output voltage, $v_0 = -\frac{1}{RC} \int v_i dt$ [figure-3]

For differentiator, output voltage, $v_0 = -RC \frac{dv_i}{dt}$

Equipment and Software Requirements:

- Proteus simulation software
    - 741
    - Resistor (1k, 10k)
    - Oscilloscope
    - Power (-20, +20)
    - Alternator (1 v, 100 Hz)
- Computer with Proteus installed

Circuit Diagram:

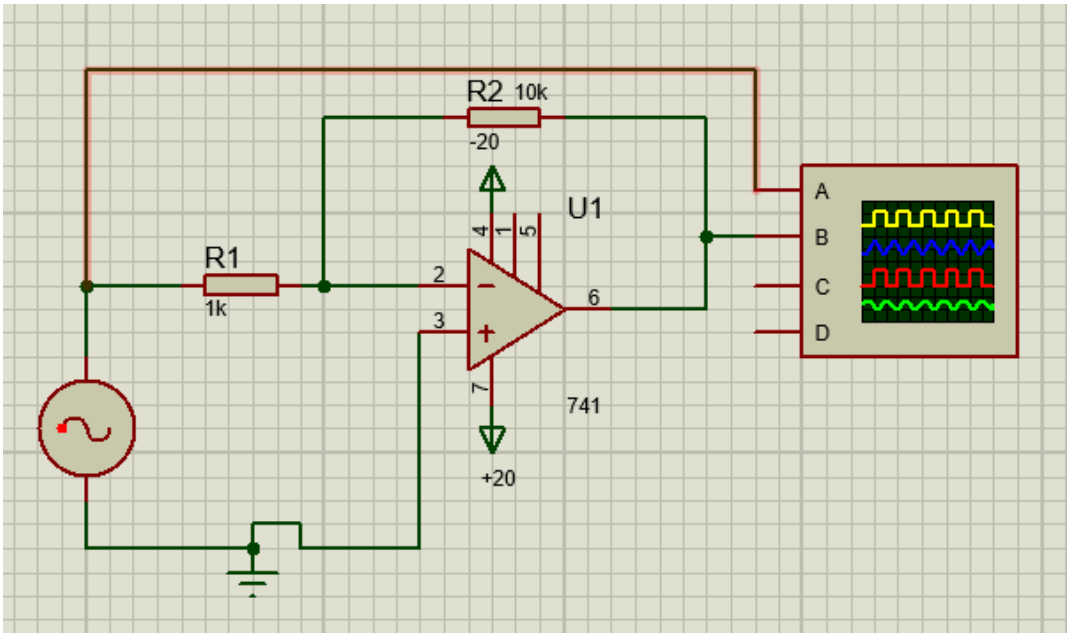

Figure-1: Inverting Op-amp

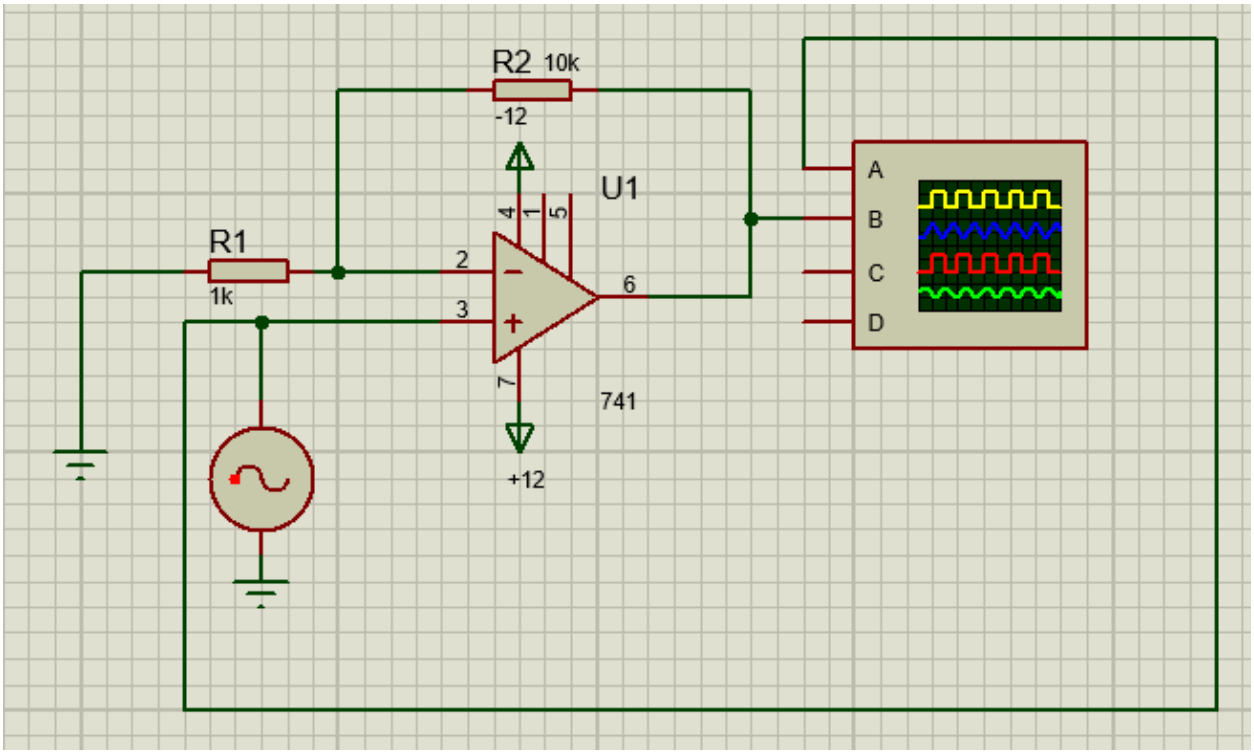

Figure-2: Non-inverting Op-amp

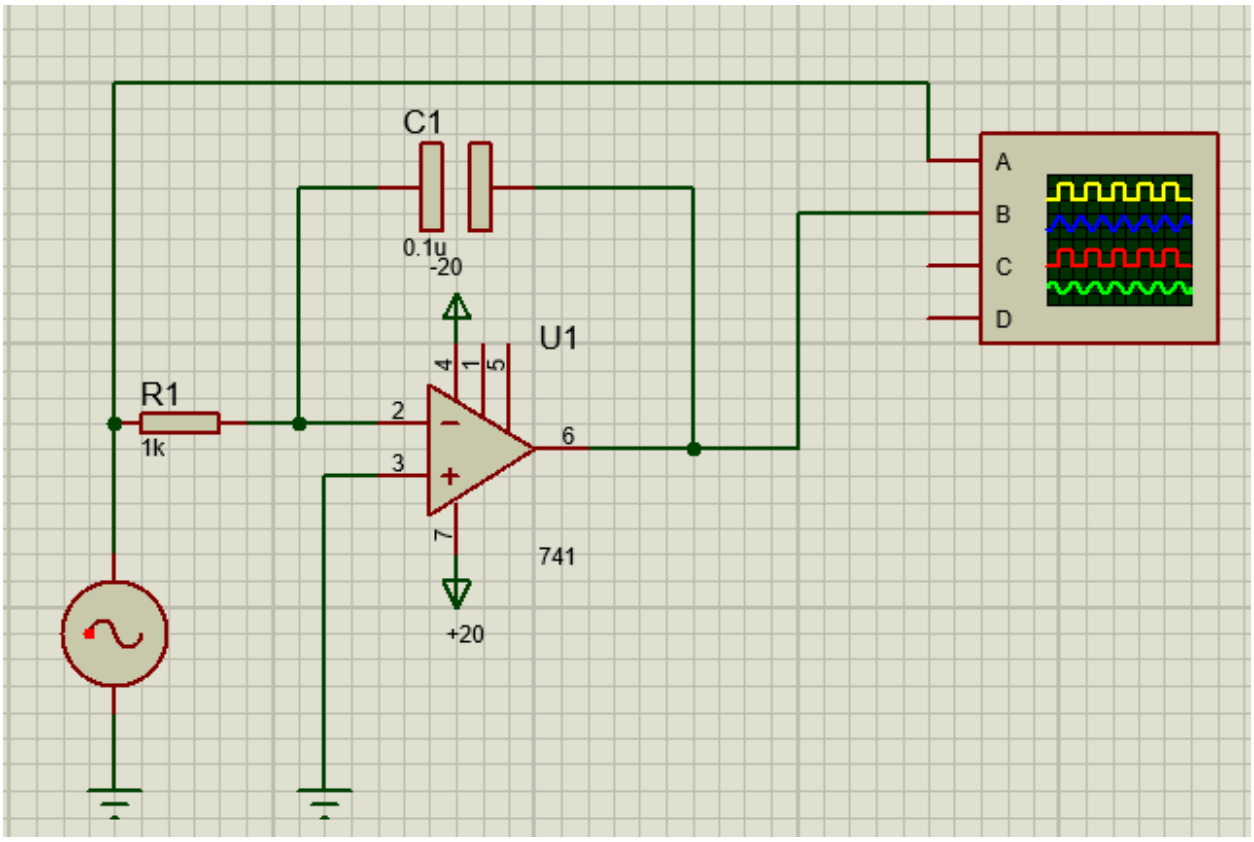

Figure-3: Integrator Circuit

Data Collection and Analysis:

- Observe the input and output waveshape from oscilloscope.
- Measure how much amplification is done.

Precautions:

- Ensure proper connections in the circuit.
- Use appropriate units and scales for measurements.
- Be cautious when using simulation software to avoid incorrect configurations.

Lab Task:

Repeat the experiment for differentiator, instrumentation, summing amplifier.

Questions and Exercises:

1. In your Proteus design of an inverting op-amp, what happens to the output voltage when you vary the input voltage?
2. In the integrator op-amp simulation, how does the output voltage change with time, and what does this represent in a real-world scenario?
3. How the voltage gain can be regulated?
4. In your instrumentation amplifier simulation, how well does it reject common-mode signals, and how stable is its performance?