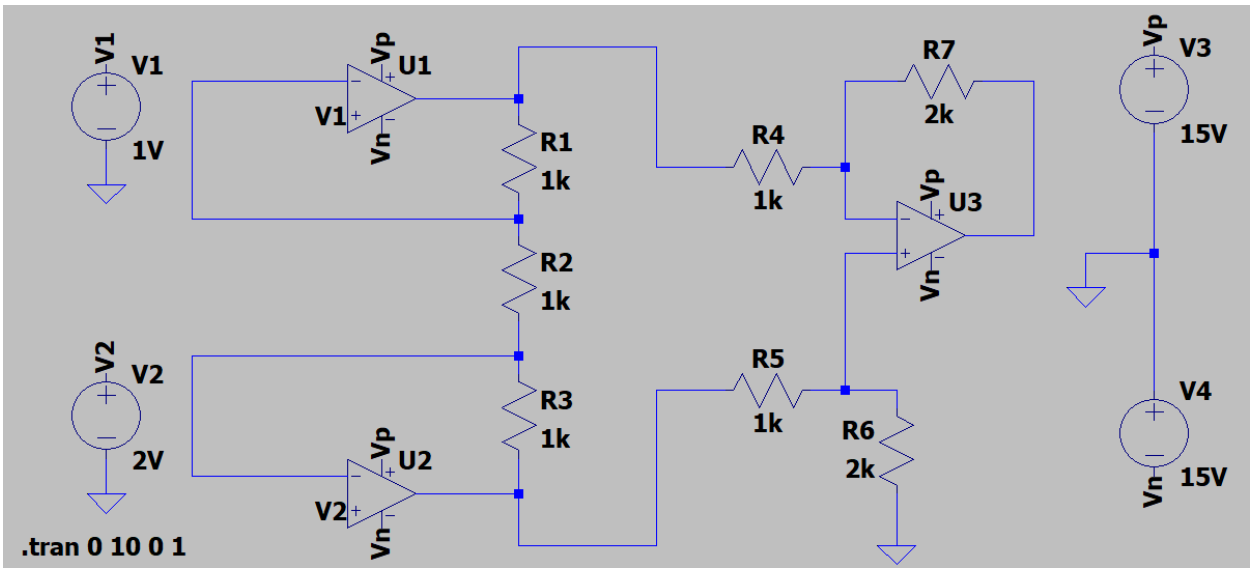
EXPERIMENT NO. 3

AIM: To simulate and determine voltage gain of three Op-amp instrumentation amplifier using LTspice.

Software Required: Ltspice

Circuit diagram:



Introduction:

The commonly used Instrumentation Amplifier circuit is one using three op amps. This Three Op Amp Instrumentation Amplifier circuit provides high input resistance for accurate measurement of signals from transducers. In this circuit, a noninverting amplifier is added to each of the basic difference amplifier inputs.

The op-amps U1 and U2 are the noninverting amplifiers forming the input or first stage of the instrumentation amplifier. The op-amp U3 is the normal difference amplifier forming an output stage of the amplifier. In many industrial applications it is necessary to measure various physical quantities such as temperature, humidity, water flow etc. These are measured by transducers. The output of transducer is required to be amplified for which instrumentation amplifier is used.

The output voltage is given as:

$$v_{out} = \frac{R_7}{R_4}\left(\frac{2R_1}{R_2} + 1\right) \times (v_A - v_B)$$

The total differential-mode gain of the circuit is:

$$A_d = \frac{R_7}{R_4}\left(\frac{2R_1}{R_2} + 1\right)$$

Experiment Procedure:

1) Open New Schematics, Use the components icon to enter the components menu and select a component/device. Place the component/device on your schematics
2) Place all the required component/device on your schematics, assign value and names by double click. Click on wire icon to connect the components.
3) Set input dc signal with 1V and 1.5V.
4) Now go to Edit Simulation cmd and select transient with stop time as 10, start at 0 and maximum time step as 1.
5) Save the schematics in the desired folder and click on Run icon to stimulate the circuit.
6) A new output window will pop out. Click on output and check the output voltage of stage 2, i.e. Vout.
7) Now calculate practical gain and compare it with theoretical gain.

CALCULATIONS:

For $v_A = 1$ V and $v_B = 2$ V,

Sr. No.	Parameter	Theoretical value	Practical value
1	v_{out}	6	6
2	A_d	6	6

OBSERVATION:

The output of stage 1 i.e. Vout 1 is 3V. Thus the practical gain is same as the theoretical gain of instrumentation amplifier.

CONCLUSION:

The overall voltage gain of an instrumentation amplifier can be controlled by adjusting the value of resistor R_2

Result:

Finding amplitude of output voltage Vout to calculate A_d