INSTRUMENTATION AMPLIFIER

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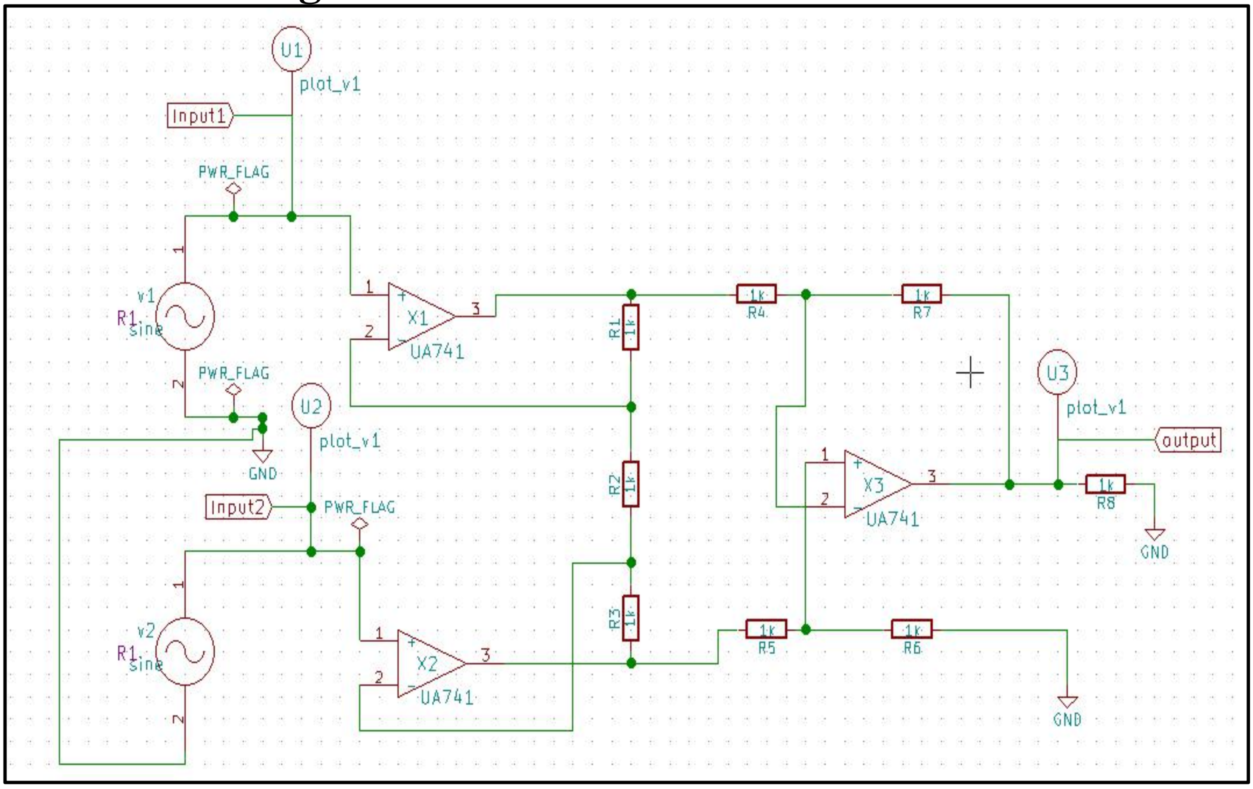
Introduction:

An instrumentation amplifier is a differential op-amp circuit providing high input impedance with ease of gain adjustment through the variation of a single resistor.It is a type of differential amplifier that has been outfitted with input buffer amplifiers, which eliminate the need for input impedance matching and thus make the amplifier particularly suitable for use in measurement and test equipment. Additional characteristics include very low DC offset, low drift, low noise, very high open-loop gain, very high common-mode rejection ratio, and very high input impedance.Always the input of an instrumentation amplifier is the output from the transducers and will a small signal.These are used where great accuracy and stability of the circuit are required for both short and long-term.

Schematic Diagram:



Transient Response Analysis:

- <u>Parameters</u>

All the resistors used in the circuit have a value = 1kΩ.
The input (voltage signal) V1 is set at 10mV at 100Hz.
The input (voltage signal) V2 is set at 20mV at 100Hz.
The output signal is observed across the load R8 (1kΩ).
The output (voltage signal) V0 is given by the,

- <u>General equation</u>

$$V0 = (V2 - V1) \times \left(1 + \frac{2 \times R1}{Rg}\right) \times \left(\frac{R3}{R2}\right)$$

In view of the schematic circuit :
R1=R1=1kΩ
Rg=R2=1kΩ
R3=R6=1kΩ
R2=R4=1kΩ

Substituting the parameter values in the general output equation, we have

$$V0 = (20 - 10) \times \left(1 + \frac{2 \times 1}{1}\right) \times \left(\frac{1}{1}\right)$$

V0=10×3

V0=<u>30mV at 100Hz.</u>

Simulation Output:

- <u>Ngspice Plot:</u>

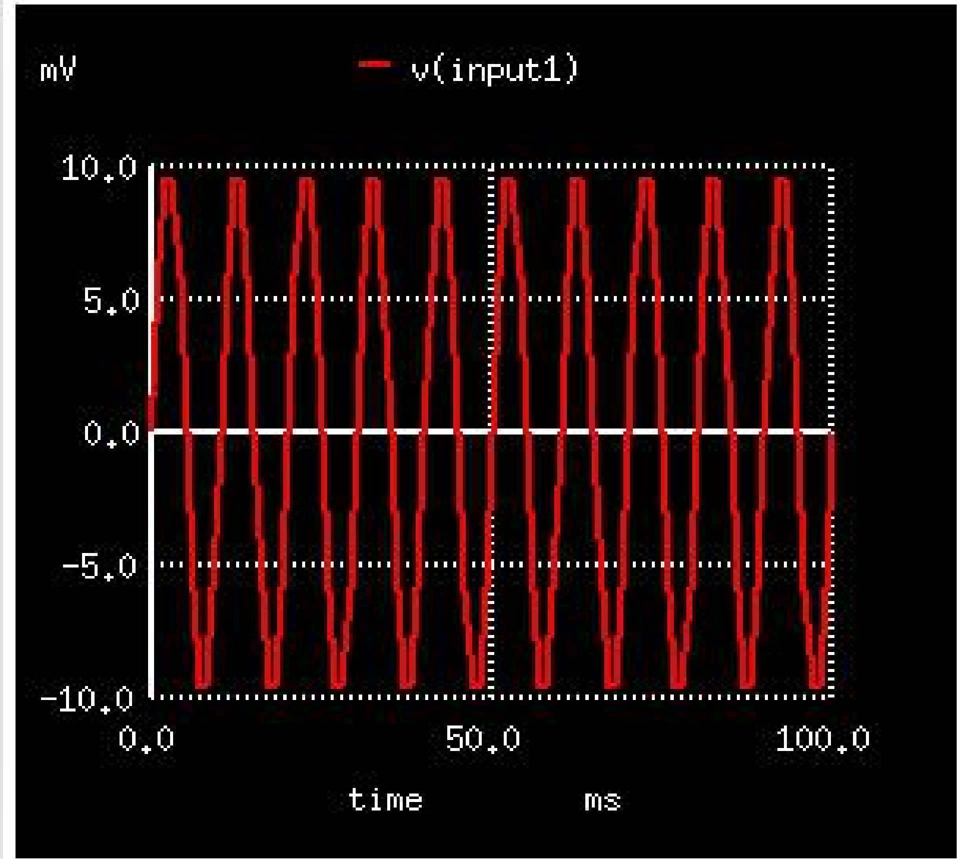


Figure1-input1 plot(10mv at 100Hz)

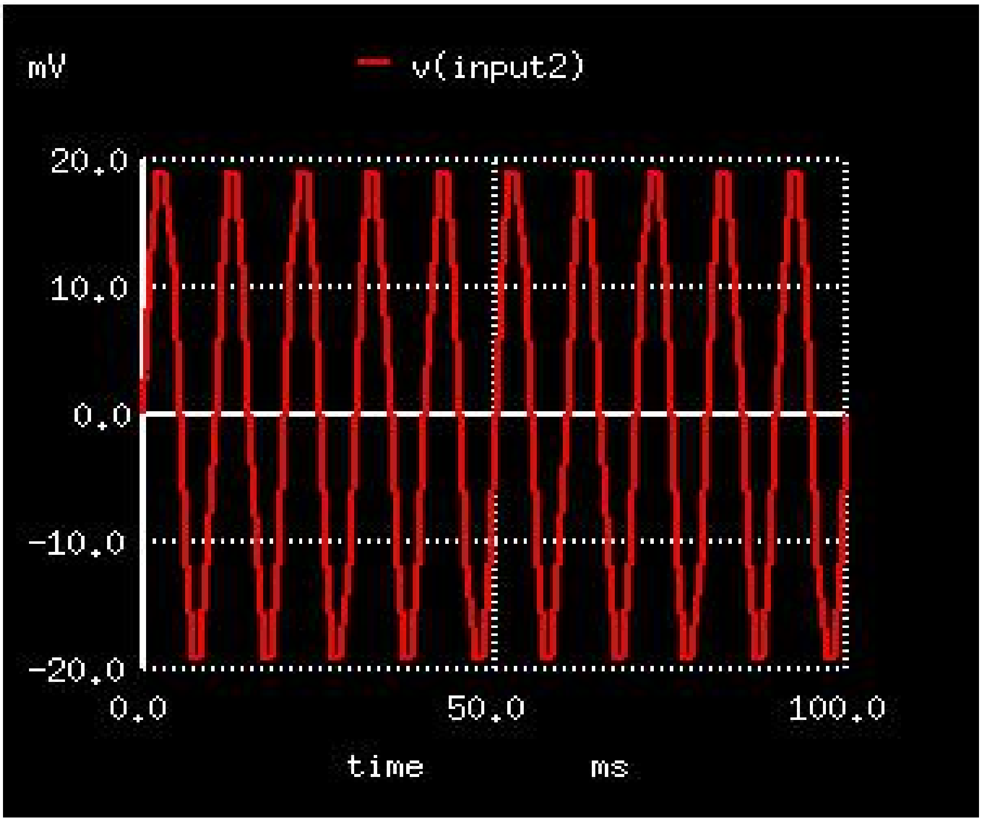


Figure2-input2 plot(20mv at 100Hz)

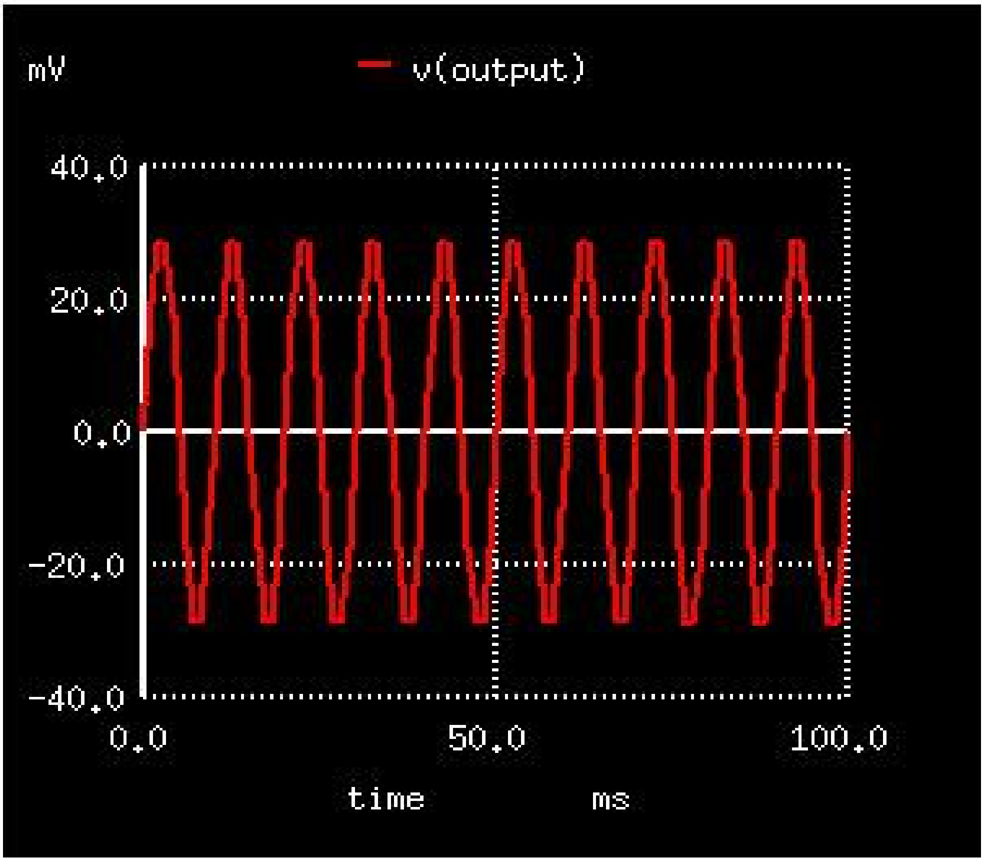


Figure3-output plot(30mv at 100Hz)

- Python Plot:

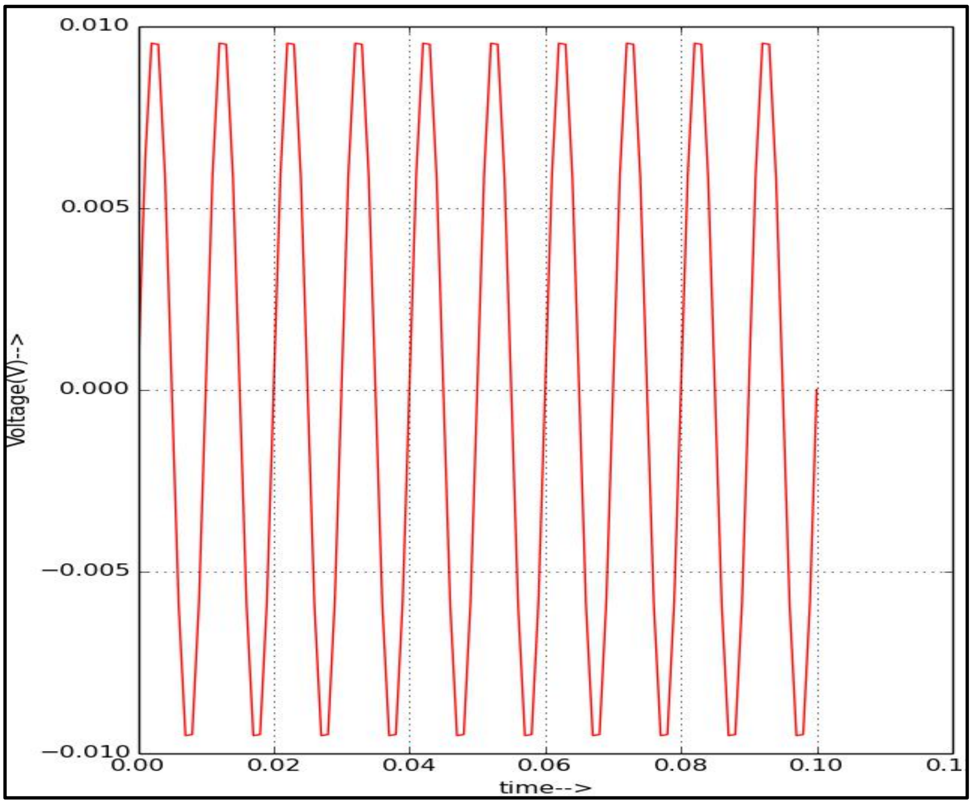


Figure4-input1 plot(10mv at 100Hz)

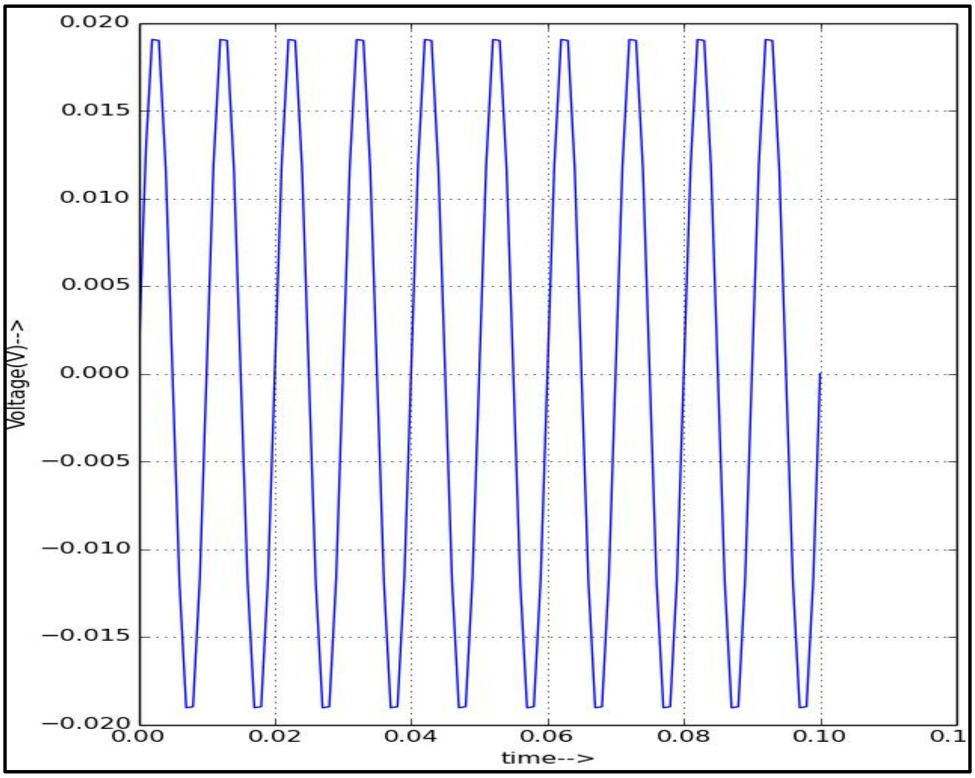


Figure5-input2 plot(20mv at 100Hz)

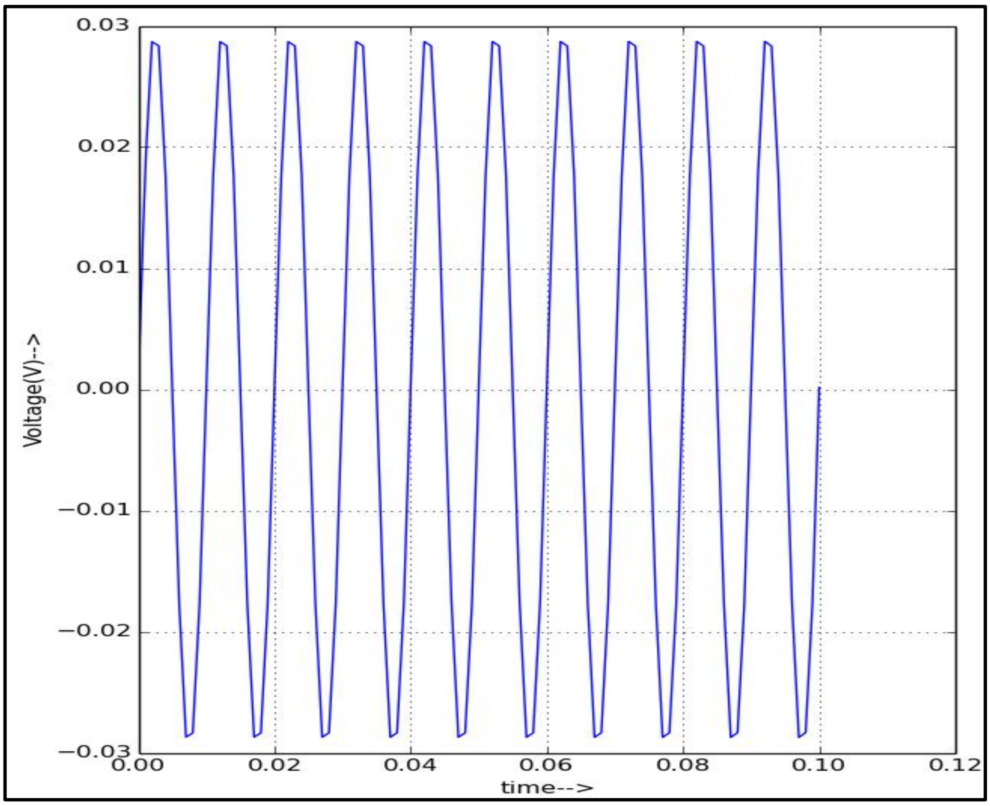


Figure6-output plot(30mv at 100Hz)

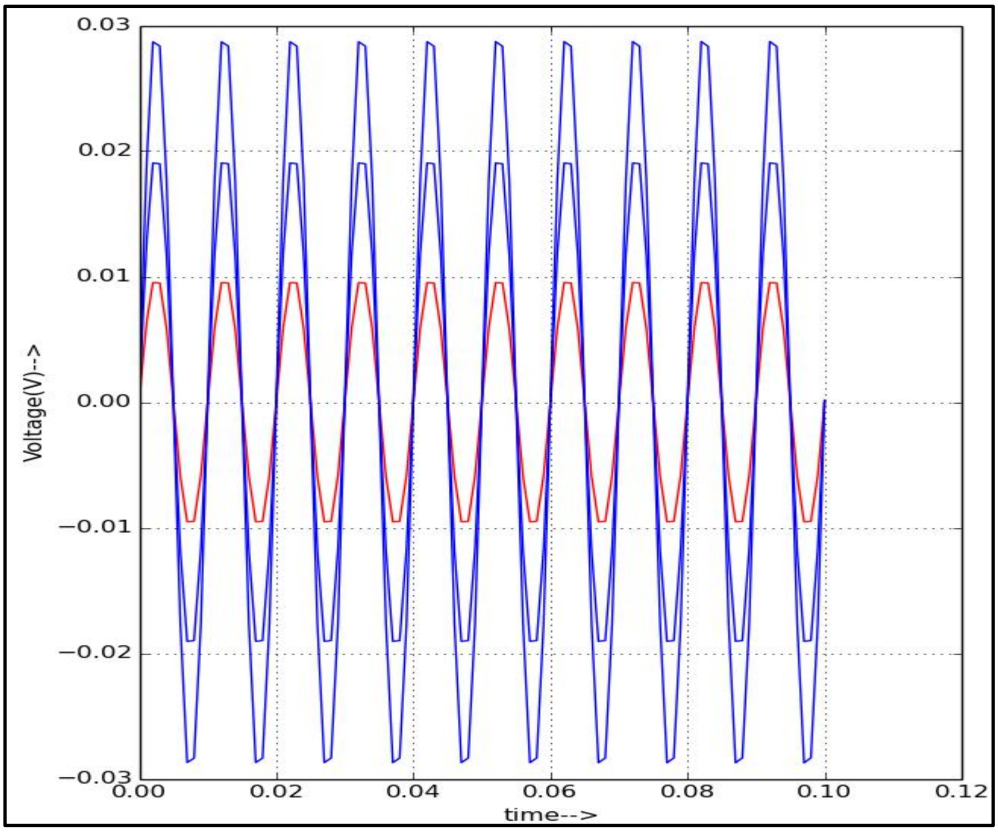


Figure7- plot shows the difference in inputs is amplified to obtain the output.

Conclusion:

Thus, the design of an instrumentation amplifier is understood and implemented to observe the appropriate input and output wave-forms.Instrumentation amplifiers don't need input impedance that makes this amplifier suits for measurement purposes.The importance of an instrumentation amplifier is that it can reduce unwanted noise that is picked up by the circuit.In industries, physical quantities are converted into electrical signals using transducers and the signal is amplified for signal processing. For this, an instrumentation amplifier is used instead of an Opamp.

Reference:

1. https://www.allaboutcircuits.com/textbook/semiconductors/chpt-8/the-instrumentation-amplifier/
2. http://www.circuitstoday.com/instrumentation-amplifier