

EE230: Experiment No.9

Instrumentation amplifier on load cell Sensor

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1 Overview of the experiment

1.1 Aim of the experiment

The experiment aims at familiarizing the student with the implementation of an instrumentation amplifier to amplify output from a load cell sensor by creating the circuit on a breadboard and applying known weights to the weighing machine to generate inputs.

1.2 Methods

To attain the objectives listed, a circuit was developed on a breadboard using provided circuit diagrams which was hooked up to a weighing machine and known weights were applied to it to achieve required voltage values. Additionally gain in terms of mV/gm was computed to get a sense of the sensitivity of the amplifier.

2 Design

Due to the deformation in the load, the modified resistance values are :

$$R_a = R_g + \Delta R \quad (1)$$

$$R_b = R_g - \Delta R \quad (2)$$

Table 1: Circuit Parameter Values

R ₁	R ₂	R ₃	R ₄
1kΩ	4.7kΩ	330Ω	10kΩ

$$R_c = R_g - \Delta R \quad (3)$$

$$R_d = R_g + \Delta R \quad (4)$$

Due to this the output voltage of the load cell snesor is V_{out+} and V_{out-}

$$V_{out+} = (R_g + \Delta R) * (V_{in+} - V_{in-}) / (2R_g) \quad (5)$$

$$V_{out-} = (R_g - \Delta R) * (V_{in+} - V_{in-}) / (2R_g) \quad (6)$$

$$V_{out+} + V_{out-} = (\Delta R) * (V_{in+} - V_{in-}) / (2R_g) \quad (7)$$

2.1 Instrumentation Amplifier using TL084 IC

A Instrumentation Amplifier was designed using using TL084 IC. The amplifiers were run on $\pm 12V$ supply voltage. To obtain a gain of 300, the values of the resistances were chosen as follows:

$$A_v = R_4 / R_3 (1 + 2R_2 / R_1) \quad (8)$$

Furthermore the load cell sensor was set up for providing input to the 3 opamp Instrumentation Amplifier. A $\pm 5V$ supply and ground for bridge was given to the weighing machine and the raw load cell output was connected to the input of the instrumentation amplifier. The circuit diagram for the same has been attached below :

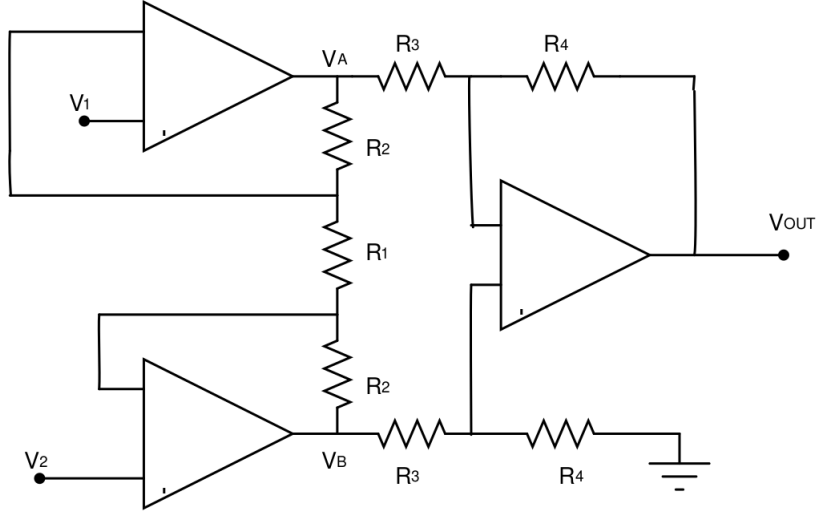
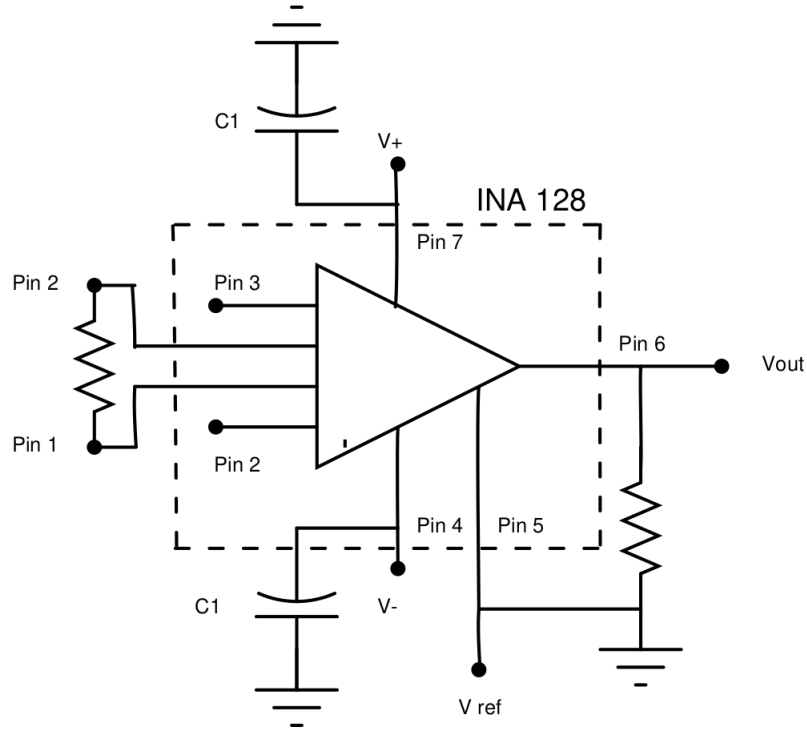


Table 2: Circuit Parameter Values

R_g	R_L	C_1
220 Ω	10k Ω	0.1 μ F

2.2 Instrumentation Amplifier using 1NA128 IC

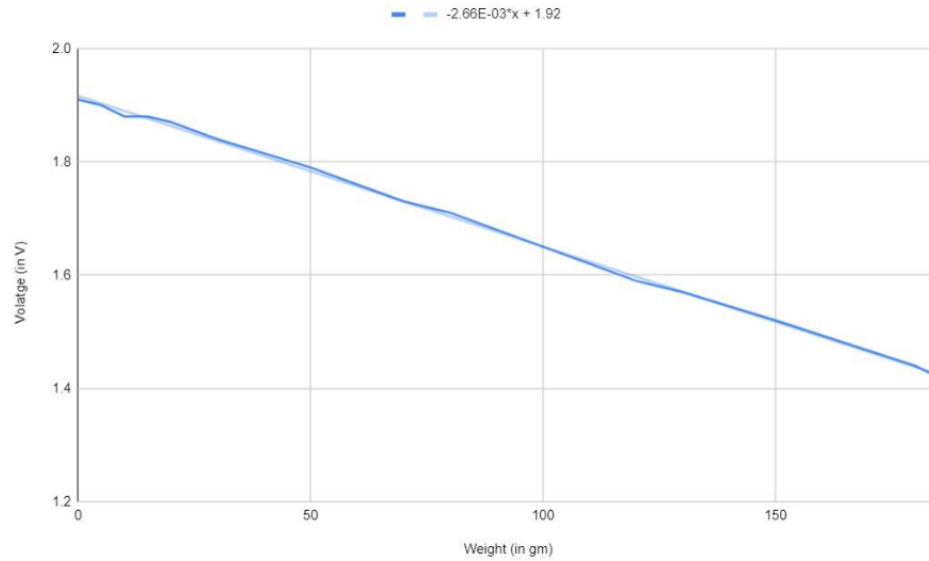
A Instrumentation Amplifier was designed using using INA128 Amplifier. The amplifiers were run on $\pm 12V$ supply voltage. The parameters of the circuit were : Furthermore the load cell sensor was set up for providing input to the 3 op-amp Instrumentation Amplifier. A $\pm 5V$ supply and ground for bridge was given to the weighing machine and the raw load cell output was connected to the input of the instrumentation amplifier. The circuit diagram for the same has been attached below :



3 Experimental results

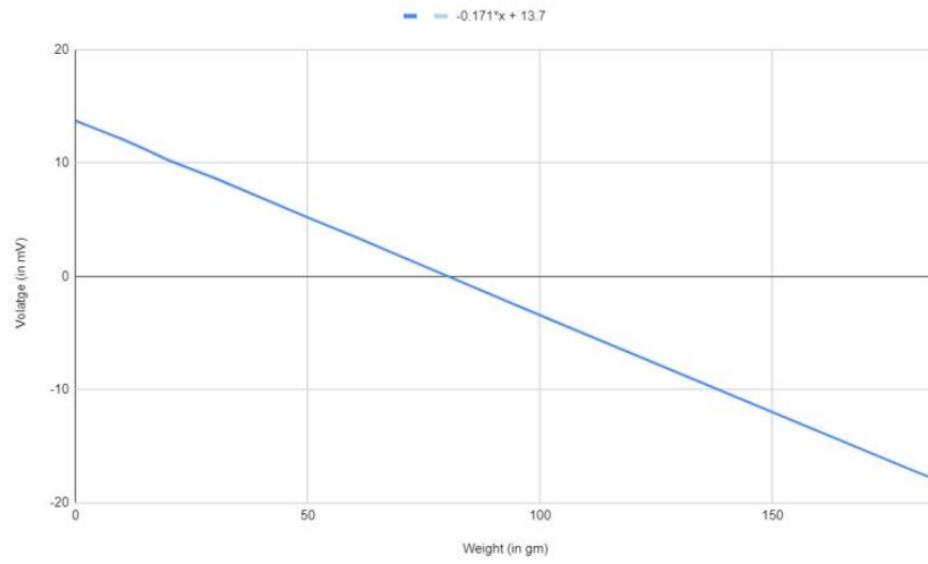
3.1 Instrumentation Amplifier using TL084 IC

The circuit was designed to provide a gain of 300. When the circuit was connected to the load cell sensor and the output was plotted for varying amount of weights, the relationship of V_{out} vs weight looked like : Based on readings obtained from graph, the obtained value of the sensitivity in mV/gm was 2.55.

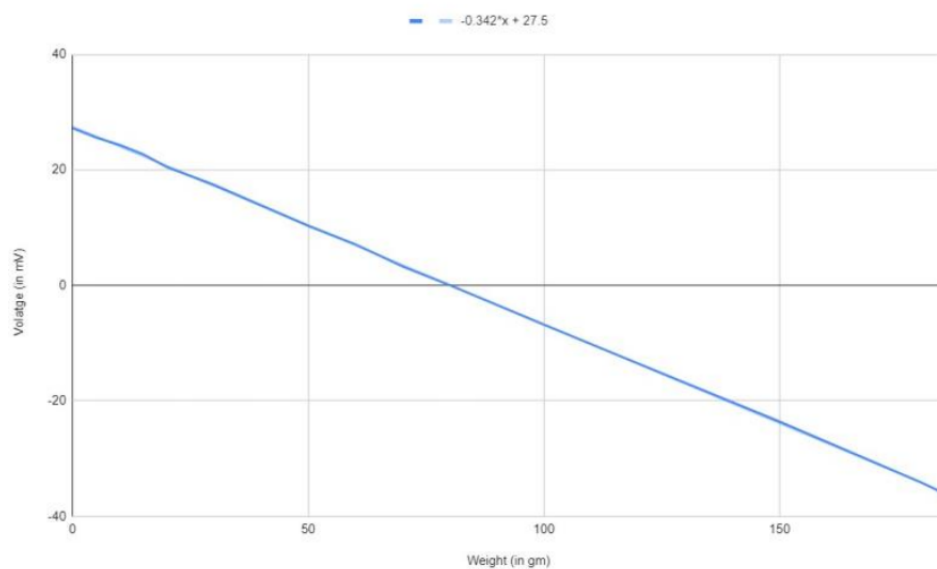


3.2 Instrumentation Amplifier using 1NA128 IC

When the circuit was connected to the load cell sensor and the output was plotted for varying amount of weights, the relationship of V_{out} vs weight looked like : Based on readings obtained from graph, the obtained value of the sensitivity in mV/gm was 0.171.



Upon halving the value of R_g to get double the sensitivity, the modified plot and sensitivity were 0.34.



4 Experiment completion status

I have completed all parts of the experiment in lab only.