Design of RTD Signal Conditioning Circuit

GROUP1

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Objective

- To design a signal conditioning circuit for RTD.
  - Task 1 – For 0 C output is 0V and for 100 C output is 5V
  - Task 2 – For 25 C output is 0V and for 100 C output is 5V

Individual Problem Statement

- Varad Kajarekar – Worked on Task 1
- Yogesh Kadam - Worked on Task 1
- Krunal Kale - Calculation work
- Shubhankar Joshi - Worked on Task 2
- Jayesh Kamane - Worked on Task 2

Introduction

- RTDs, or resistance temperature detectors, are sensors used to measure temperature.

- These sensors are the among the most accurate temperature sensors available, covering large temperature ranges.

The variation of resistance of the metal with the variation of the temperature is given as,

$$RT = Rref\,[1 + \alpha\,(T - Tref)]$$

- Where, R_t and R_0 are the resistance values at t^oC and $t_0{}^oC$ temperatures. α and β are the constants depends on the metals.

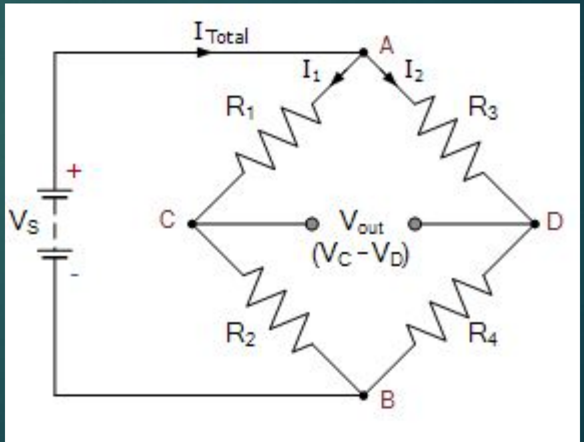
Wheatstone Bridge

- The Wheatstone Bridge diamond shaped circuit who's concept was developed by Charles Wheatstone can be used to accurately measure unknown resistance values, or as a means of calibrating measuring instruments, voltmeters, ammeters, etc, by the use of a variable resistance and a simple mathematical formula.

$$V_C = \frac{R_2}{(R_1 + R_2)} \times V_S$$

$$V_D = \frac{R_4}{(R_3 + R_4)} \times V_S$$

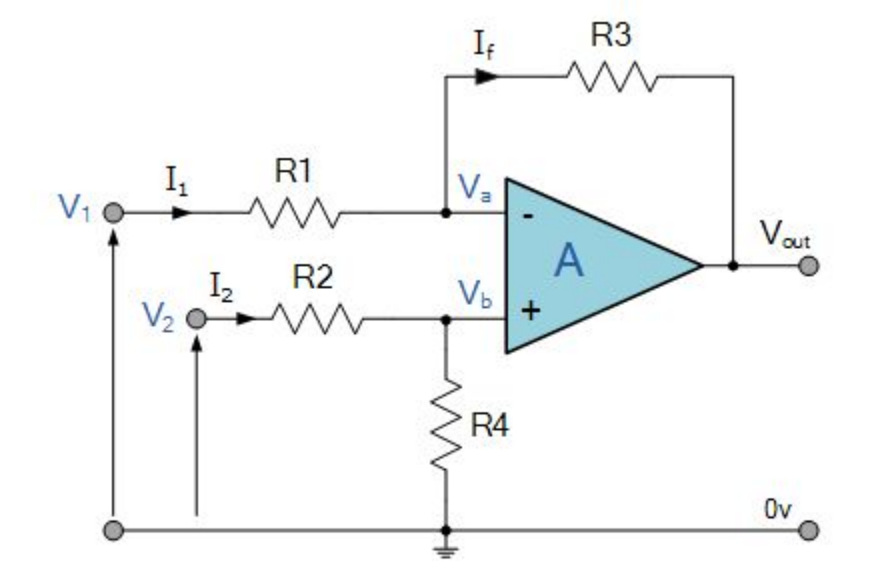
$$V_{OUT} = V_C - V_D$$



Differential Amplifier

- A differential amplifier is a type of electronic amplifier that amplifies the difference between two input voltages but suppresses any voltage common to the two inputs

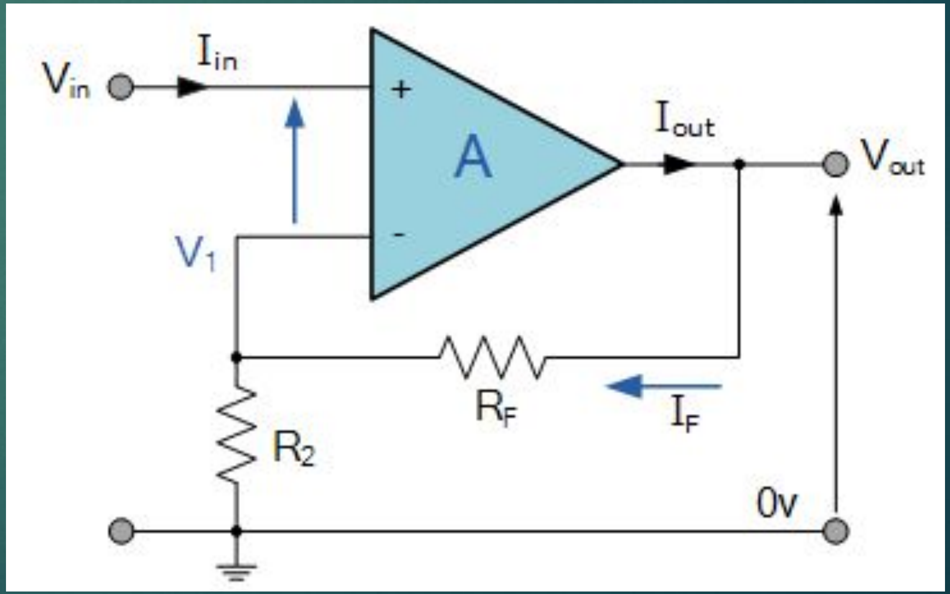
$$V_{OUT} = \frac{R_3}{R_1}\left(V_2 - V_1\right)$$



Non-Inverting Opamp

- A non-inverting op amp is **an operational amplifier circuit with an output voltage that is in phase with the input voltage**.

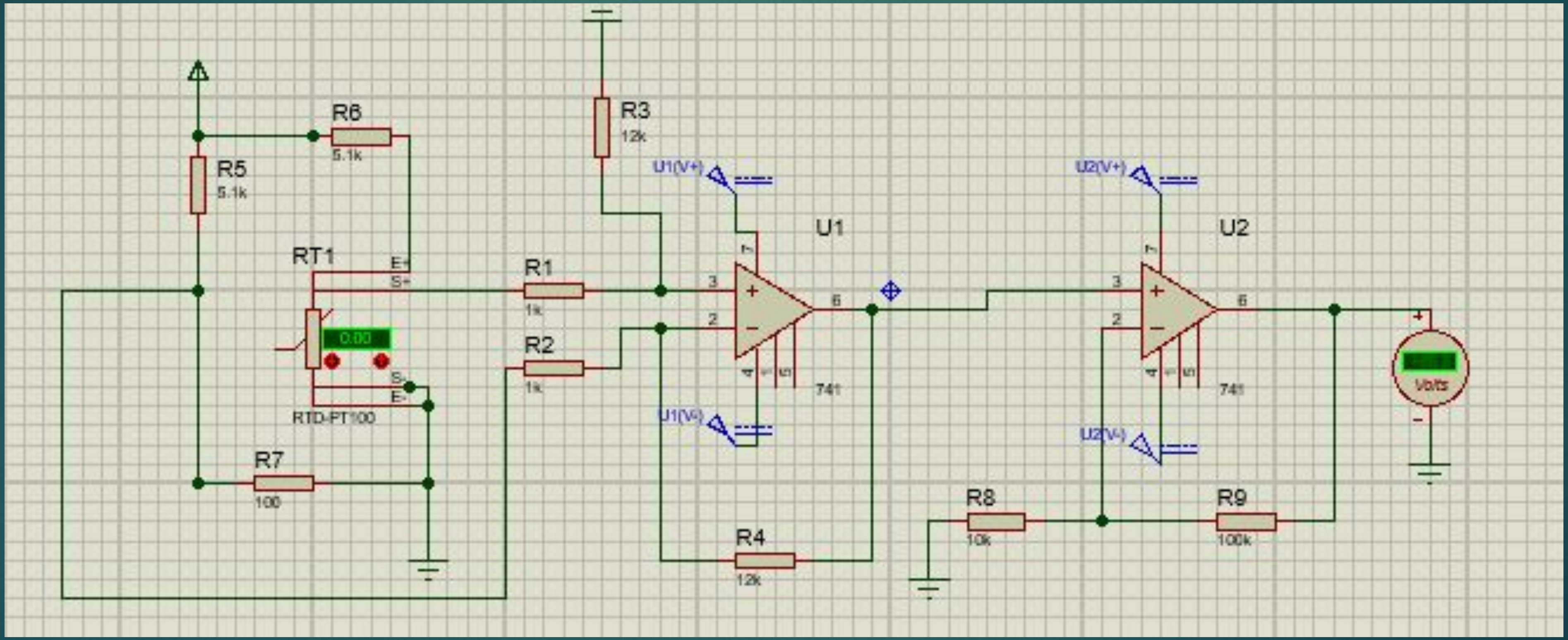
$$A_{(v)} = 1 + \frac{R_F}{R_2}$$



Circuit Diagram

$$V_{OUT} = \frac{R_3}{R_1}(V_2 - V_1)$$

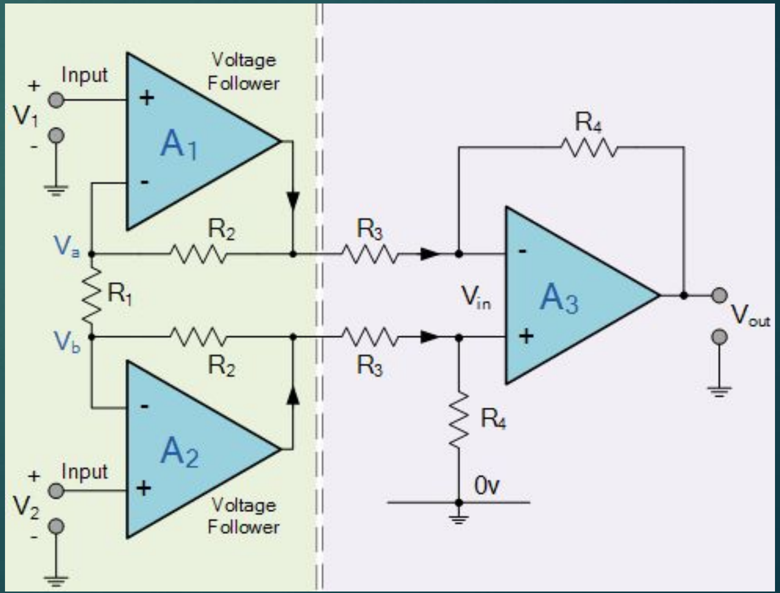
$$A_{(v)} = 1 + \frac{R_F}{R_2}$$



Instrumentation Amplifier

- Instrumentation Amplifiers (in-amps) are very high gain differential amplifiers which have a high input impedance and a single ended output. Instrumentation amplifiers are mainly used to amplify very small differential signals from strain gauges, thermocouples or current sensing devices in motor control systems.

$$V_{OUT} = (V_2 - V_1)\left[1 + \frac{2R_2}{R_1}\right]\left(\frac{R_4}{R_3}\right)$$



Circuit diagram