Measurement and Instrumentation Laboratory (EE3P005)

EXPERIMENT-5

Resistance Temperature Detector

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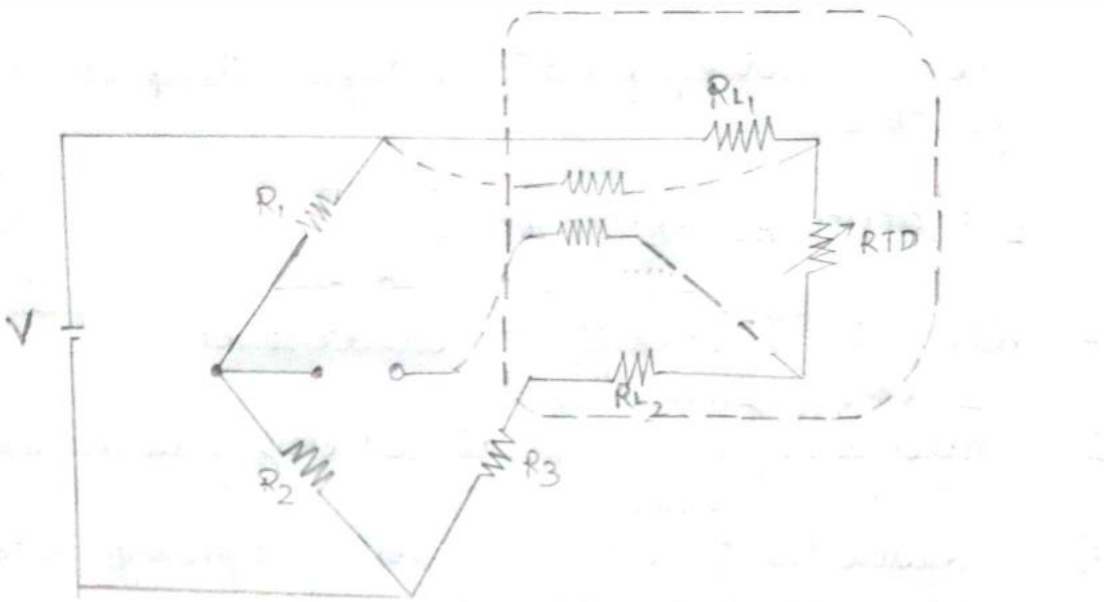
AIM OF THE EXPERIMENT:

To study the working of a Resistance temperature Detector.

APPARATUS REQUIRED:

- Resistance Temperature Detector
- Digital Multimeter
- Beaker
- Water
- Submersible Water Heater

CIRCUIT DIAGRAM:



R_T = Resistance at temperature T
R_0 = nominal Resistance

$$R_T = R_0 [1 + \alpha t + \beta t^2]$$

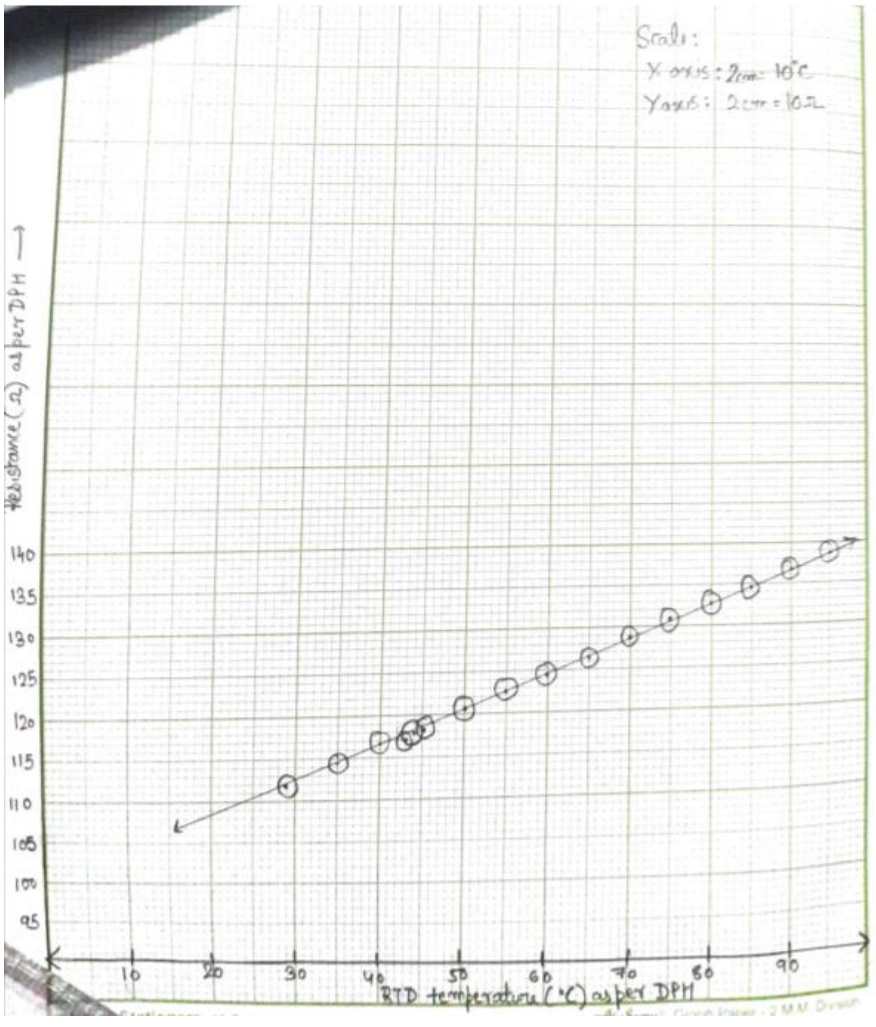
α, β = coefficient ~~of~~ ~~depends on~~ Resistance that depends on temperature

$\alpha = 0.00385 \ /^\circ C$ (For Pt)

OBSERVATION:

Thermometer in °C room temperature (water temp)	RTD temperature in °C as per DPM	Resistance as per DPM (Ω)
28	29	111.8
35	35	114.2
43	44	117.9
40	40	116.5
42	43	117.0
45	45	118.0
49	50	120.5
55	55	122.6
60	60	124.4
64	65	126.2
68	70	128.7
75	75	130.8
79	80	132.7
85	85	134.6
89	90	136.7
95	95	138.1

GRAPH:



CONCLUSIONS

Thus, we have successfully studied the characteristic of Pt 100 RTD device by heating water from room temperature to 95 degrees Celsius and plotting R versus T graph.

DISCUSSION

1. What is the objective of this experiment?

The objective of this experiment is to observe the resistance-temperature characteristics of the Pt100 RTD material. We expected the characteristics to be linear, and the final plot did show us that the characteristic is indeed quite linear.

2. Briefly explain operation of RTD, with mathematical equation and different types of materials used for RTD?

The main principle behind the RTDs working is, the resistance of metallic conductors, changes with the temperature. In case of metallic conductors, it increases with temperature. Both the quantities vary according to the following relation:

$Rt = R0\ [1+ \alpha(t-t0) + \beta(t-t0)2\ldots\ldots]$

Where Rt and R0 are the resistances at the temperatures t0C and t00C. Whereas α, β etc. are constants that depend on the material. For sufficiently small range of temperatures, where the relationship between the resistance and the temperature is almost linear, we can fairly assume that:

$Rt = R0\ [1+ \alpha(t-t0)]$

This relation helps us in measuring the temperature, from the values of the resistances. We can also understand that if the material we choose has a large range of linearity, it will be a good one for the measurement purposes.

Selection Criteria for the materials used in RTD:

- The material must be malleable to be formed into small wires.
- The materiel must have its resistance vs temperature characteristics to be repeatable and

stable slope or curve

- The material should also be resistant to corrosion, inert at high temperatures also.

Temperature sensitive materials like platinum, nickel, and copper are used in the construction of RTD. Platinum is the most commonly used material in the construction of RTD because it has linear change in temperature over a wide range of temperature compared to other materials.