

Practical No.26: Measure temperature of liquid using thermocouple.

I Practical Significance:

Thermocouple is the active temperature transducer based on Seebeck and Peltier effect. Since it is active transducer, designing of signal conditioner is easy. This is mostly used to measure the temperature above 300°C . This practical will help students to use thermocouple for measuring the temperature of the given liquid.

II Industry/Employer Expected Outcome(s):

In the industry environment it is expected to handle various transducers for measurement of process parameters such as temperature, pressure, level, flow, displacement etc. It is necessary to measure the high value temperature in various industries. Employee should be able to select, test and use appropriate thermocouple.

III Course Level Learning Outcome(s):

Use various types of sensors and transducers.

IV Laboratory Learning Outcome(s):

Use active transducer (thermocouple) for measurement of temperature.

V Relevant Affective Domain related outcome(s):

1. Follow safe practices.
2. Demonstrate working as a leader/a team member.
3. Maintain tools and equipment.

VI Relevant Theoretical Background (With diagrams if required):

A thermocouple is a device made by two different metals joined to form two junctions. The two wires are called thermo elements or legs of the thermocouple. One end of thermocouple is called as measuring end and the other end of the thermocouple is called reference end, The measuring end is immersed in the environment whose temperature T_2 is to be measured, which can be for instance the temperature of a furnace at about 500°C , while the reference end is held at a different temperature T_1 , e.g. at ambient temperature.

Thermocouples will cause an electric current to flow in the attached circuit when subjected to changes in temperature. The amount of current that will be produced is dependent on the temperature difference between the measurement and reference junction, the characteristics of the two metals used and the characteristics of the attached circuit.

VIII Required Resources/apparatus/equipment with specification:

Sr. No.	Particulars	Specification	Quantity
1	Thermocouple	Thermocouple K type: Temp range 0-200 ⁰ c	01
2	Temp bath	2KW,230V AC	01
3	Digital temperature indication	0 ⁰ c to 200 ⁰ c ,accuracy of +/- 1%	01
4	Digital Multimeter	0-200mV	01
5	Mercury Thermometer	0 to 300 ⁰ c	01
6	Compensating cable	2 wire,0.5mm ²	01

IX Precautions to be followed:

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used
3. Ensure the power switch is in off condition initially.

X Procedure:

1. Identify the component of given setup diagram.
2. Connect set up for temperature measurement with thermocouple.
3. Place the thermocouple, thermometer, immersion heater in temperature bath.
4. Record the room temp. with mercury thermometer
5. Record the output voltage with multimeter for room temperature.
6. Switch on the power supply of heater.
7. Note down the temperature for every 10 degree temperature rise.
8. Record the temperature using mercury thermometer.
9. Record the output voltage using multimeter.
10. Repeat the steps 7 to 9 for 10 readings.
11. Plot the temperature Vs voltage graph

XI Required Resources/apparatus/equipment with specifications:

S. No	Instruments/ Components	Suggested specification	Quantity
1	Temp bath	2KW, 230V AC	01
2	Digital multimeter	0-200 mV	01
3	mercury thermometer	0 to 300 ⁰ c	01
4	Compensating cable	2 wire 10.5mm ²	01

XII Actual procedure followed:

1. Identify the component of given setup dia
2. Connect setup temperature measurement with thermocouple.
3. place the thermocouple thermometer heater in temperature bath.

XIII Observations and Calculations:

SR. NO.	Temperature °C	Voltage (mv)
1	30 °C	0.39
2	35 °C	0.43
3	40 °C	0.49
4	45 °C	0.57
5	50 °C	0.63

XIV Results:

Hence, we have studied the measure temperature of liquid using thermocouple.

XV Interpretation of Results:

we have successfully implemented the measure temperature of liquid using thermocouple.

XVI Conclusions & Recommendations:

thermocouple is the active temperature transducer based on seebeck emf relation effect.

XVII Practical Related Questions:

1. State the output voltage when two terminals are short of thermocouple.
2. State the practical reason to cover thermocouple with metal case.
3. State the output voltage at room temperature.
4. State the different types of thermocouple.

[Space for Answers]

1. When two terminals of a thermocouple are shorted, the output voltage is zero millivolts. This is because the cold junction temperature, the standard reference for thermocouple, at room temperature corresponds to 0 mV.

2. Thermocouples are often encased in metal for protection against harsh environments, mechanical damage, and to ensure proper electrical insulation & signal integrity.

3. At room temperature approximately 20°C or 293.15 K . Room temperature is often considered to be around 20°C or 293.15 K .

4. The main types of thermocouple distinguished by their alloy combinations and temperature range include:

Type K, Type T, Type N, Type E, Type R, Type S, Type B.

XVIII References/ suggestions for further reading ; includes websites:

1. Laboratory Manual for Introductory Electronics Practicals, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi: ISBN: 9780852265543
2. APPLICATION NOTES-PRACTICAL TEMPERATURE MEASUREMENTS from OMEGA
3. <https://youtube/WmIgusHZyPc?t=42>