Measurement of temperature using R – type Thermocouple

Objective

I. To measure the flame temperature using R-type thermocouple.
II. To plot the flame temperature contour using MATLAB.

Theory

Thermocouples are most popular transducer for measurement of temperature. These are inexpensive, rugged device to measure temperatures over a wide range. A thermocouple operates on the principle that the junction of two dissimilar metals generates a voltage which is a function the temperature. This thermoelectric voltage is known as the Seebeck voltage, named after Thomas Seebeck, who discovered it in 1821. Here the heat energy is converted into electrical energy at the junction of two conductors as shown in figure 1. The voltage is nonlinear with respect to temperature. However, for *small changes in temperature*, the voltage is approximately linear (equation 1)

$$\Delta V = S\Delta T \qquad (1)$$

Where ΔV is the change in voltage, S is the Seebeck coefficient, and ΔT is the change in temperature.

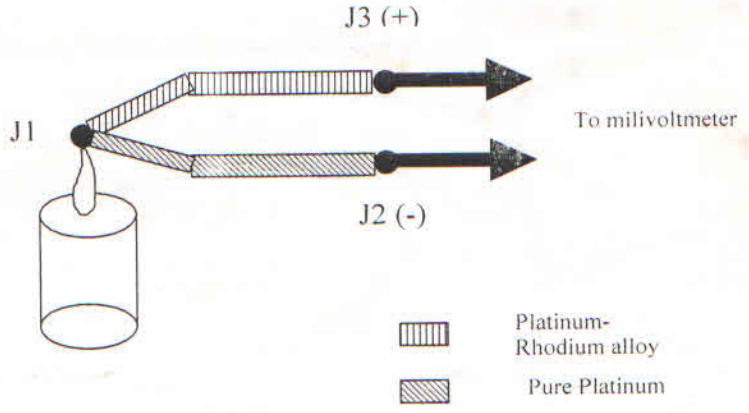


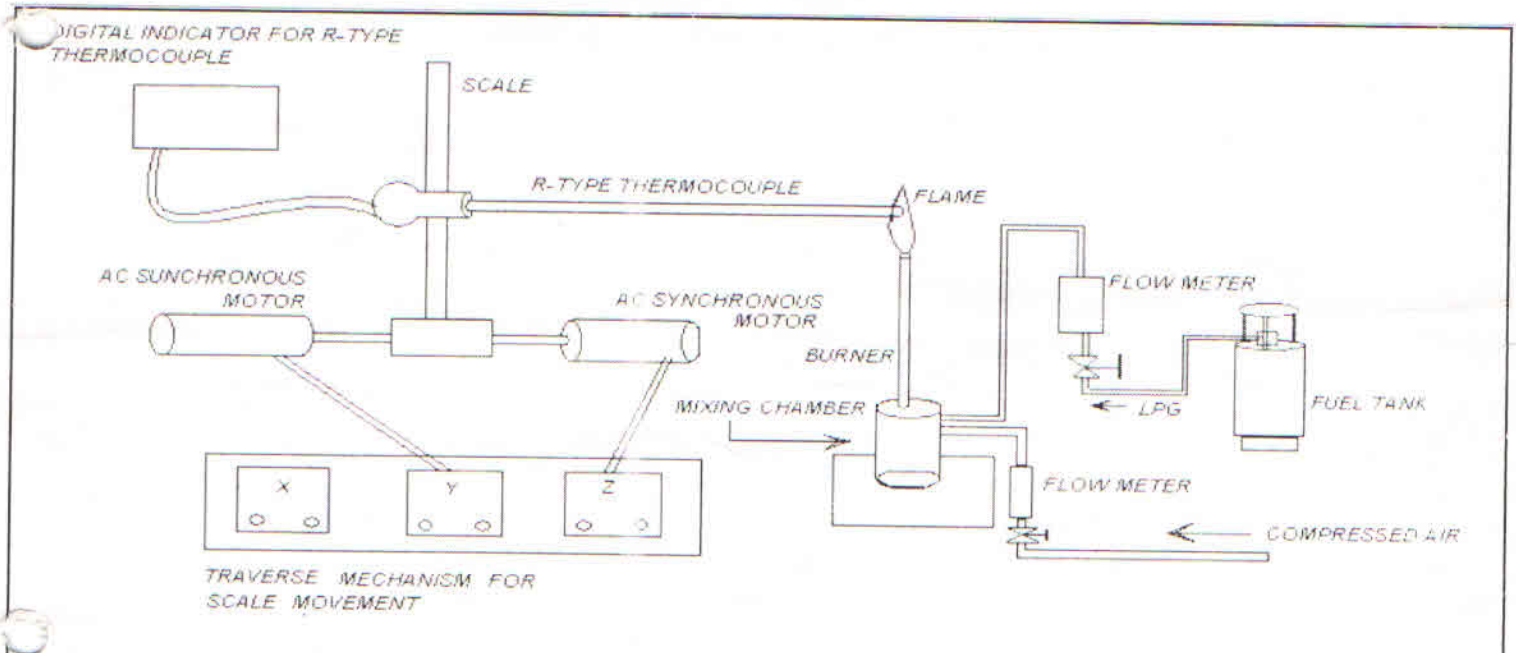
Figure1 R-Type thermocouple

An R-type thermocouple is shown in figure 1 using which the flame temperature will be measured. R-Type thermocouples are made up of a platinum–rhodium alloy containing 13% rhodium for positive conductor and pure platinum for the negative conductor. R-Type thermocouples are used for a temperature range of 0°C to 1600 °C. The thermocouple wires are connected to the copper leads of a data acquisition device. The

circuit contains three dissimilar metal junctions – J1, J2, and J3. The thermocouple junction J1 generates a Seebeck voltage proportional to the temperature of the candle flame. J2 and J3 each has its own Seebeck coefficient and generates its own thermoelectric voltage proportional to the temperature at the data acquisition terminals. To determine the voltage contribution from J1, the temperatures of junctions J2 and J3 as well as the voltage-to-temperature relationships for these junctions should be known. The contributions of the parasitic junctions at J2 and J3 can be subtracted from the measured value at J1.

Experimental set up

Make the connections as shown in figure 2 to measure the temperature using R-type thermocouple. Take the temperature readings at different points in the *y-z* plane. The thermocouple output is connected to a digital voltmeter.



Connection diagram of the experimental set up for temperature measurement.

Figure 2

Results

Take the reading of the digital voltmeter connected to the thermocouple output according table 1.

Table 1

Sl No.	Position along y-axis (mm)	Position along z-axis (mm)	Value of temperature of the flame (° C)

Discussions

1. Write down a MATLAB program to draw the temperature contour of the flame.
2. Explain the temperature contour plot.
3. How the cold junction compensation is done?
4. Write down the advantages and disadvantages of thermocouples.