UNIT-II

MEASUREMENT OF LOW TEMPERATURE

ESSAY QUESTIONS

Q. 3. What is a Thermocouple and give its Working Principle & Applications?

The thermocouple can be defined as a kind of temperature *sensor* that is used to measure the temperature at one specific point in the form of the EMF or an electric current. This sensor comprises two dissimilar metal wires that are connected together at one junction. The temperature can be measured at this junction and the change in temperature of the metal wire stimulates the voltages.

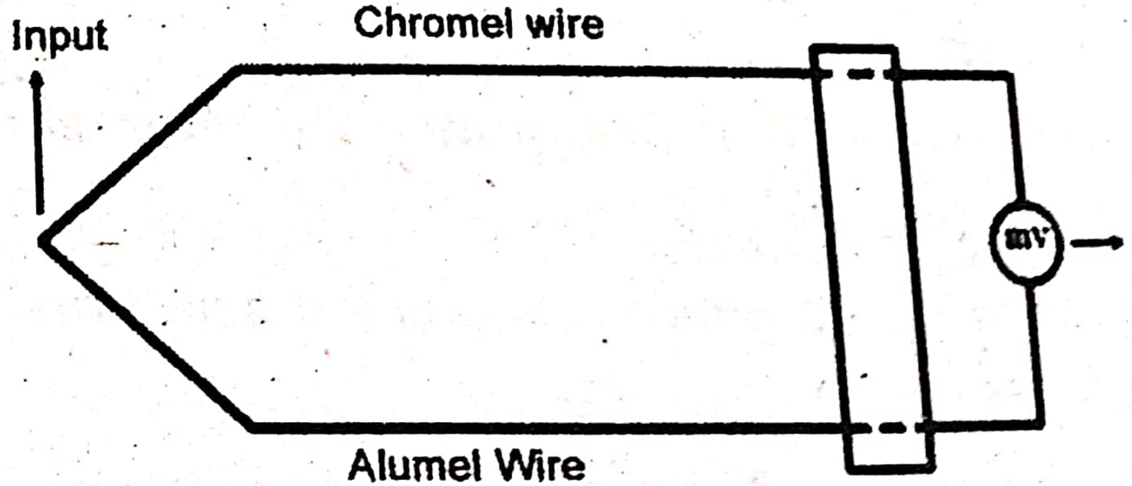

Fig : Thermocouple

The amount of EMF generated in the device is very minute (millivolts), so very sensitive devices must be utilized for calculating the e.m.f produced in the circuit. The common devices used to calculate the e.m.f are voltage balancing potentiometer and the ordinary galvanometer. From these two, a balancing potentiometer is utilized physically or mechanically.

Working of Thermocouple :

The **thermocouple diagram** is shown in the below picture. This circuit can be built with two different metals and they are coupled together by generating two junctions. The two metals are surrounded by the connection through welding.

In the above diagram, the junctions are denoted by P & Q and the temperatures are denoted by T1, & T2. When the temperature of the junction is dissimilar from each other, then the electromagnetic force generates in the circuit.

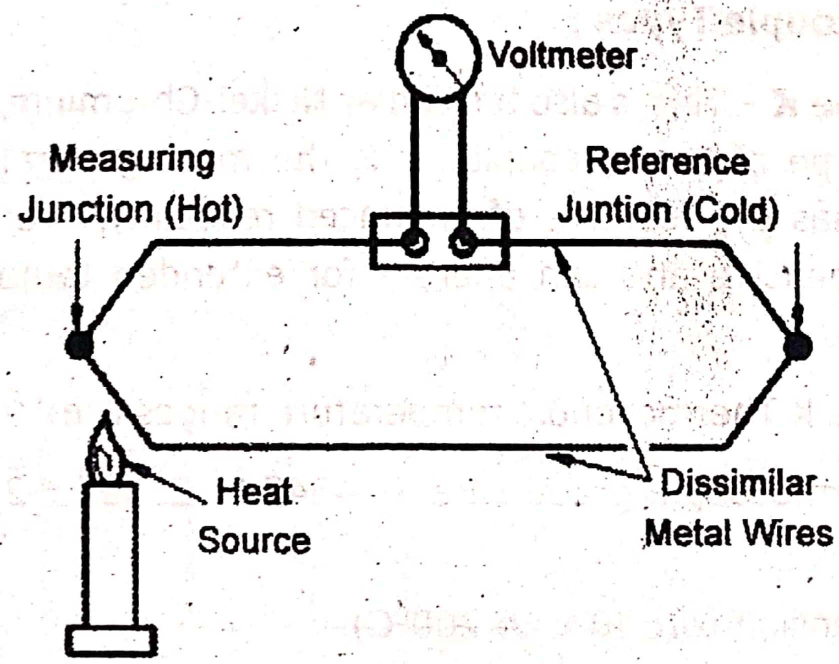

Fig : Thermocouple Circuit

If the temperate at the junction end turn into equivalent, then the equivalent, as well as reverse electromagnetic force, produces in the circuit and there is no flow of current through it. Similarly, the temperature at the junction end becomes imbalanced, then the potential variation induces in this circuit.

The magnitude of the electromagnetic force induces in the circuit relies on the sorts of material utilized for thermocouple making. The entire flow of current throughout the circuit is calculated by the measuring tools.

The electromagnetic force induced in the circuit is calculated by the following equation

$$E = a\,(\Delta\theta) + b\,(\Delta\theta)^2$$

Where $\Delta\theta$ is the temperature difference among the hot thermocouple junction end as well as the reference thermocouple junction end, a & b are constants.

SHORT ANSWER QUESTIONS

Q. 4. Explain the concepts of correction and calibration in gas thermometer.

Application of fundamentals discussed above to the calibration of specific temperature sending elements will vary somewhat, depending on the level of accuracy required. It is uneconomical and unnecessary to take the time and care needed for extremely precise calibration, when not required by the needs of the process being monitored, or when the sensor has substantial built-in inaccuracy. The important consideration is the amount of inaccuracy (or, more properly, the level of uncertainty) that is permissible. For convenience, we will discuss procedures for three levels of uncertainty: +/- 1.0 deg C, +/- 0.1 deg C, and +/- 0.01 deg C.

(A) Calibration within +/- 1.0 deg C uncertainty :

For many uses where an uncertainty of the order of +/- 1 deg C is acceptable,, thermometers and controllers are purchased having specifications that claim inaccuracies no greater than that amount. The instruments are then used for extended periods of time without calibration — often, in fact, until breakage or major malfunction occurs. If in fact, and accuracy of +/- 1 deg C is important, this is a dangerous practice, since few instruments will remain in calibration for extended periods unless specifically made for long-term stability. Even many glass thermometers, generally accepted as "correct unless broken," are no longer regularly made with the expensive glass annealing and aging steps that insure the necessary stability.

The simplest calibration procedure for such instruments is to make a periodic ice point check, if 0 deg C is included in the instrument range, and/or to compare desired readings with that of a high-quality mercury-in-glass thermometer such as the ASTM precision series, ASTM 62C through 70C (or F). These reference thermometers have scale graduations, in the moderate ranges, of +/- 0.1 deg C or +/- 0.2 deg F and hence are within the accuracy range (an order of magnitude more accurate than the instrument to be calibrated) needed for such service.

(B) Calibration within +/- 0. 1 deg C uncertainty:

In order to insure that routine temperature measurements with operating instruments are accurate to within +/-0. 5 deg C to +/-1. 0 deg C, it is necessary for the instrument itself to be calibrated to an uncertainty of no more than +/-0. 1 deg C. Since this is the accuracy range most commonly needed in industrial use, the calibration procedures will be described in more detail than those above.

VERY SHORT ANSWER QUESTIONS

Q. 4. What is the resistance temperature?

Resistance temperature devices (RTDs) provide accurate process temperature readings within thermal fluid systems. Typically made from platinum, RTDs use known mathematical relationships between resistance and temperature to measure a fluid's heat.

Q. 7. How does a magnetic thermometer work and what is used for?

Magnetic Thermometer continuously indicates the surface temperature of steel and other magnetic material. Magnetic Thermometer continuously indicates the surface temperature of steel and other magnetic material.