To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT):

- **Introduction**: A Platinum Resistance Thermometer (PRT) exploits the nearly linear increase of platinum's electrical resistance with temperature. By precisely measuring resistance, one infers temperature with high accuracy over a wide range (−200 °C to +850 °C). The PRT is the cornerstone of the ITS-90 (International Temperature Scale of 1990) temperature scale and finds widespread use in meteorology, meteorological stations, process control, and scientific research.
  - Platinum's chemical inertness and mechanical stability make it ideal for repeatable, long-term measurements.
  - Electron–phonon scattering: As temperature rises, phonon density in the Pt lattice increases, impeding free-electron flow and raising resistance.

- **Theory**: For standard platinum wires, resistance $R(T)$ is related to temperature T by:

$$R(T) \approx R_0(1 + \alpha T)$$

Where, R_0 is the resistance at $0^{\circ}C$ and α is the temperature coefficient (note that at very high temperature this linear relationship may break leading to additional quadratic terms). Therefore, we can write,

$$R(T_1) = R_0(1 + \alpha T_1) \quad \text{and}$$
$$R(T_2) = R_0(1 + \alpha T_2).$$

Hence,

$$R(T_2) = \frac{R(T_1)}{(1 + \alpha T_1)}(1 + \alpha T_2)$$
$$\rightarrow R(T_2)(1 + \alpha T_1) = R(T_1)(1 + \alpha T_2)$$
$$\rightarrow \boldsymbol{\alpha} = \frac{\boldsymbol{R(T_2) - R(T_1)}}{\boldsymbol{R(T_1)T_2 - R(T_2)T_1}}.$$

- **Circuit**:

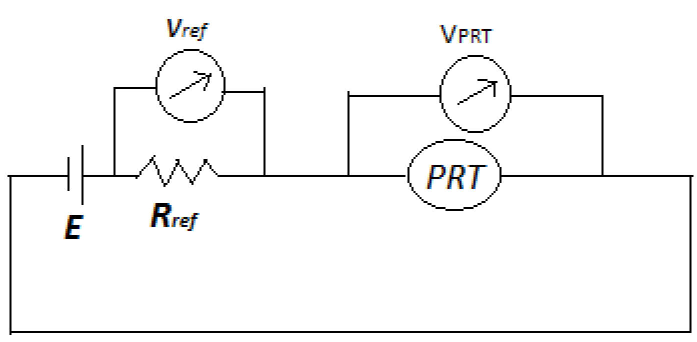

Figure 1: Circuit diagram. E is the source voltage, R_{ref} is the reference resistance. V_{ref} is the voltage drop across R_{ref} and V_{PRT} is the voltage drop across the PRT.

- **Procedure**:
  - The circuit should be constructed as Fig.1.
  - Place the **PRT** inside a water bath and place a **Thermometer** with its tip touching the PRT.
  - Insert a **heater rod** or use other means to **control the temperature** of water.
  - **Fix** the **source voltage** to around 2 volt (to maintain low current in the circuit to avoid joule heating) and $R_{ref} \approx 2 - 3\ \Omega$, (close to the typical resistance of PRT) for a temperature *T*, measure V_{ref} and V_{PRT} using two multimeters (well calibrated).
  - The current flowing in the circuit is $I_{ref} = \frac{V_{ref}}{R_{ref}}$ and the resistance of the PRT at that temperature is $R(T) = \frac{V_{PRT}}{I_{ref}}$.
  - Now vary the temperature *T* and repeat measurements.
  - Change water and take another set for averaging.
  - **Produce data for the below table 1** and **plot** *R(T) w.r.t. T* to check the linear relation as described in the theory section.
  - From two arbitrary points in the graph **calculate** α using the relation calculated in the theory section.

Table 1 (*Table to produce R(T) versus T graph*):

Temperature (T)	V_{ref} (mV)			V_{ref}^{avg} (mV)	$I_{ref} = \frac{V_{ref}^{avg}}{R_{ref}}$ (mA)	V_{PRT} (mV)			V_{PRT}^{avg} (mV)	$R(T) = \frac{V_{PRT}}{I_{ref}}\ \Omega$
	1st Set	2nd Set	3rd Set			1st Set	2nd Set	3rd Set		
Room Temp										
$+10°$										
$+10°$										
...	…	…	…	…	…	…	…	…	…	…