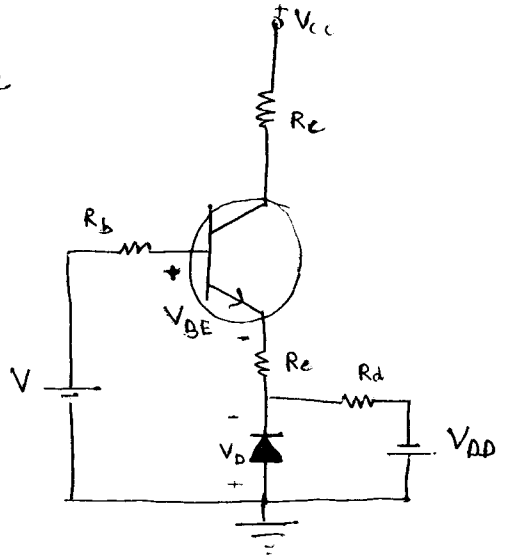
COMPENSATION TECHNIQUES :- Compensation technique refer to use of temperature sensitive devices such as diode, transistor, thermisters etc to compensate the variations in current In stability techniques the negative feedback reduces the gain and in some cases it becomes serious drawback in such cases this technique becomes suitable. Also sometime both techniques are used to give excellent bias and thermal stabelization.

The various compensation techniques are used

1) Diode Compensation for V_{BE} variation
2) Diode Compensation for I_{CO} variation
3) Thermistor Compensation
4) Sensistor Compensation

1) **Diode Compensation for V_{BE}:** A circuit utilizing the self bias stabelization technique and diode compensation is shown below. The diode is kept biased in forward direction by the source V_{DD} and resistance R_D (R_d). If the diode is of the same material and type of transistor the voltage V_D across the diode has same temperature coefficient (-2.5mV/C) as the Base to emitter V_{BE}.



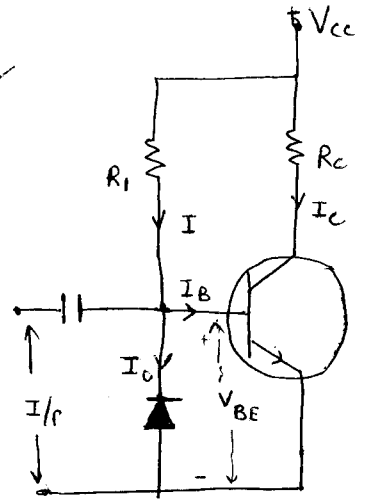
Applying KVL in base circuit

$$I_C = \frac{\beta [V - (V_{BE} - V_D)] + (R_b + R_e)(\beta + 1) I_{CO}}{R_b + R_e(1+\beta)} \quad \text{---- (1)}$$

Since Variation in V_{BE} with temperature is same as the variation in V_D with temperature, hence the quantity $(V_{BE} - V_D)$ remains constant in eq (1). So I_C becomes constant inspite of variations in V_{BE}.

2) Diode Compensation for I_{CO} Variation :-

For Germanium transistor changes in I_{CO} with temperature play more important role in collector current stability. The diode compensation circuit is shown below



This technique is often used for germanium transistors. If the diode and transistor are of the same type and material, the reverse saturation current I_o of the diode will increase with temperature at the same rate as the transistor collector saturation current I_{CO}.

$$I = \frac{V_{CC} - V_{BE}}{R_1} \approx \frac{V_{CC}}{R_1} \approx \text{Constant}$$

Since the diode is reverse biased by an amount $V_{BE} \approx 0.2\,V$ for germanium devices, it follows that the current through D is I_o. The Base current is $I_B = I - I_o$

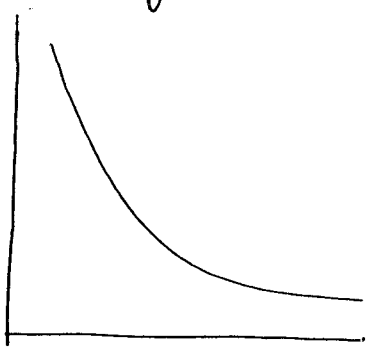
$$I_c = \beta I - \beta I_o + (1+\beta) I_{CO} \qquad \text{—(2)}$$

We see from eq(1) that $\beta >> 1$ and if I_o of D and I_{CO} of Q track each other over the desired temperature range, the I_c remains essentially constant.

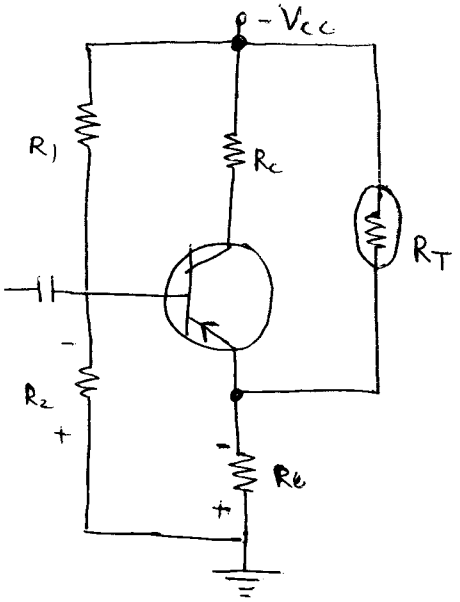
3 THERMISTOR COMPENSATION

The thermistor has a negative temperature coefficient, its resistance decreases exponentially with increasing T.

The circuit uses a thermistor R_T to minimize the collector current due to changes in I_{CO}, V_{BE} or β with T. As T rises, R_T decreases and current fed through R_T into R_E increases. Since the voltage drop across R_E is in the direction to reverse-bias the transistor, the temp. sensitivity of R_T acts so as to tend to compensate the increase in I_C due to T. The Reverse biasing reduces the EB junction forward Biasing thus reducing I_C.



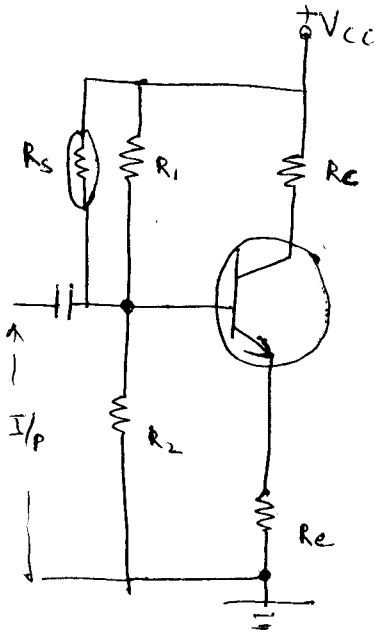
R Vs T Graph for Thermistor



An Alternate configuration using thermistor compensation is to move R_T from its position in above figure and place it across R_2. As temperature increases, the drop across R_T decreases - and hence the forward-biasing base voltage is reduced. This behaviour will tend to offset the increase in collector current with temperature

4) SENSISTOR COMPENSATION :-

Sensistor is a temperature sensitive resistor having positive temperature coefficient of resistance (of metals). It is a heavily doped semiconductor. The sensistor may be used either in parallel with R_1 or parallel with R_E, as shown below



As temperature increases the resistance of sensistor increases thus the resistance of parallel combination $R_1 // R_S$ increases. Now the voltage drop across R_2 decreases. Due to decrease of this voltage, the net forward emitter bias decreases. As a result I_C decreases. This reduced I_C compensate for the Increased I_C caused by the increases in I_{CO}, V_{BE}, or β due to temperature.