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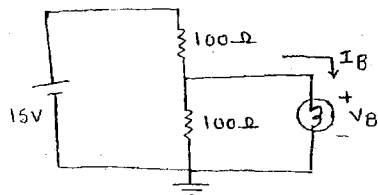
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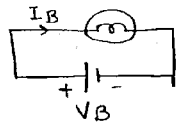
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Approach to start Analog:

Find the current through the light bulb and voltage across bulb

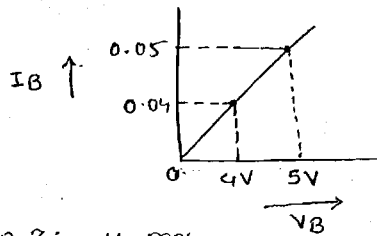


Step 1: Treat the Bulb as a Black box [lumped]



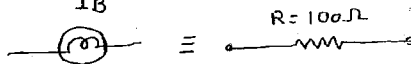
V_B	I_B
5V	0.05
6V	0.06
7V	0.07
4V	0.04

Step 2: Draw the characteristics of the bulb:

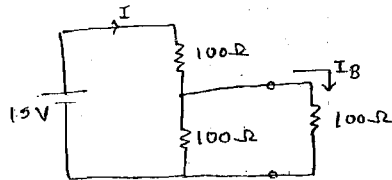


Step 3: $y = mx$

$$I_B = () V_B \rightarrow \frac{V_B}{I_B} = 100\Omega = \text{resistor}$$

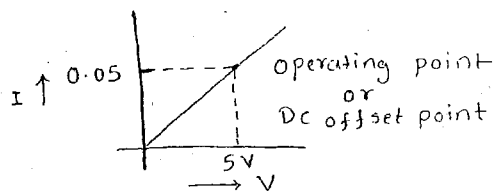


Step 4:



$$I = \frac{15}{100 + 100 \parallel 100} = 100\text{mA}$$

$$I_B = \frac{I}{2} = 50\text{mA}$$

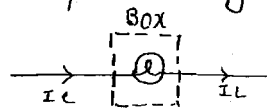


Note: In analog we deal with devices with peculiar V-I characteristics

- 1) Resistor (I is proportional to V)
- 2) Capacitor (I is proportional of rate of change of V)
- 3) Diode (I flows in one direction)
- 4) Thermistor (Temperature dependent resistor)
- 5) Photoresistor (Light dependent resistor).

* Lumped Circuit Constraints :

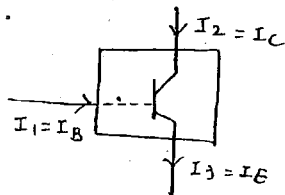
1) Choose the element boundaries in such a fashion that the rate of charge build up inside any device is zero for all time.



$$I_e - I_L = \frac{dq}{dt} = 0$$

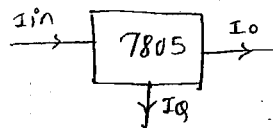
$$\therefore I_e = I_L \quad (\text{KCL})$$

e.g.



$$I_3 = I_1 + I_2$$

$$I_E = I_B + I_C$$

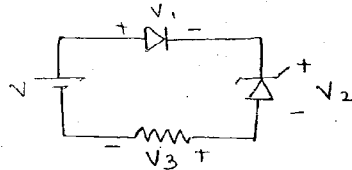


$$I_{in} = I_q + I_o$$

The idea behind this constrain is we allot a unique value of current entering & current leaving the terminal & not interested in the charge build up or depletion within the element.

- 2] Choose the element boundaries in such a fashion that the net change of flux outside the element in any close path is zero for all time.

The idea behind this constraint is we allot a unique value of voltage and that voltage does not change with time or path taken.



$$-V + V_1 + V_2 + V_3 = 0$$

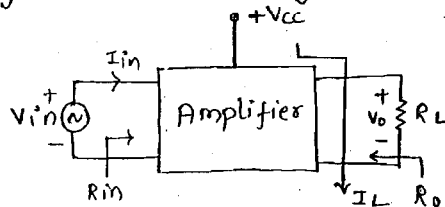
$$\rightarrow \boxed{V = V_1 + V_2 + V_3} \quad (\text{KVL})$$

- 3] The time scale of the input signal is much larger than the propagation delay of elements used.

* AMPLIFIER MODELLING *

Definition :-

An amplifier is a device which improves a strength of a signal. Strength means power gain.



$$\text{Voltage gain (AV)} = \frac{V_o}{V_{in}}$$

$$\text{Current gain (AI)} = \frac{I_L}{I_{in}}$$

$$\text{Power gain (AP)} = A_V \cdot A_I$$

$$\text{Gain}_{db} = 10 \log A_P$$

$$A_{Vdb} = 20 \log A_V$$