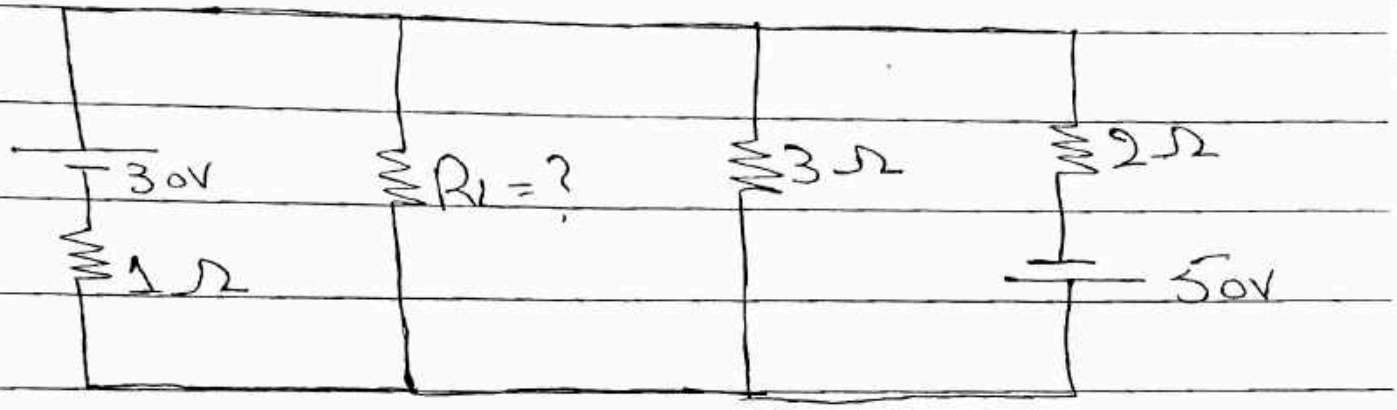
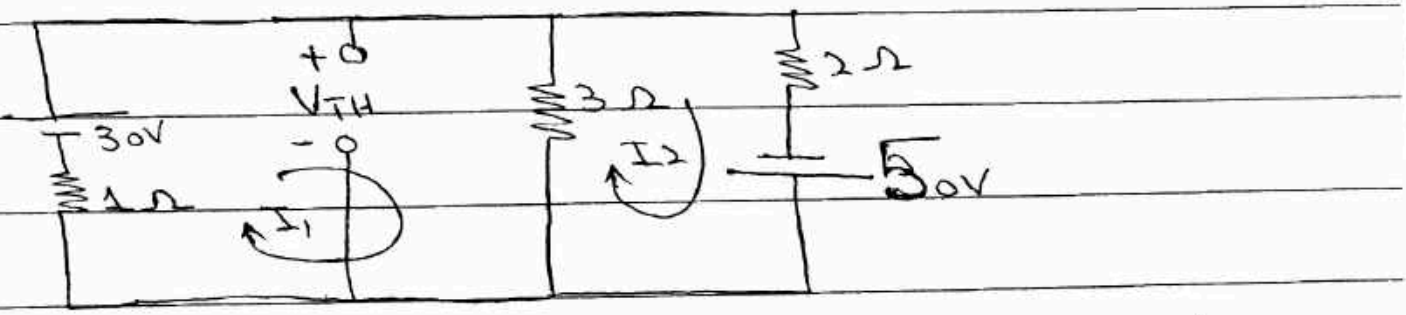
Q:- Find the value of resistance R_L for max power transfer. Also, calculate maximum power.



Step 1:-

Remove R_L and replace it by open ckt voltage V_{TH}. and find V_{TH}.



$30 - 3(I_1 - I_2) - 1I_1 = 0$ (KVL on loop ①)

$30 - 3I_1 + 3I_2 - I_1 = 0$

$-4I_1 + 3I_2 = -30$ or $4I_1 - 3I_2 = 30$ — ①

KVL on loop ②:- $-2I_2 + 50 - 3(I_2 - I_1) = 0$

$-2I_2 + 50 - 3I_2 + 3I_1 = 0$

$3I_1 - 5I_2 = -50$

or $-3I_1 + 5I_2 = 50$ — ②

By Solving eq① & ②

$\Rightarrow I_1 = 27.27A$ & $I_2 = 26.36A$

Now finding V_{TH}

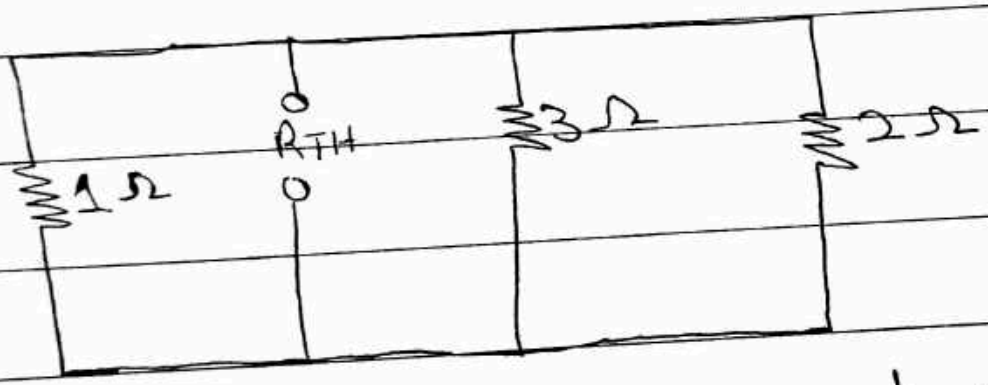
$30 - V_{TH} - 1I_1 = 0$

$V_{TH} = 30 - 27.27$

$\boxed{V_{TH} = 2.73V}$

Step 2:-

calculating R_{TH}.

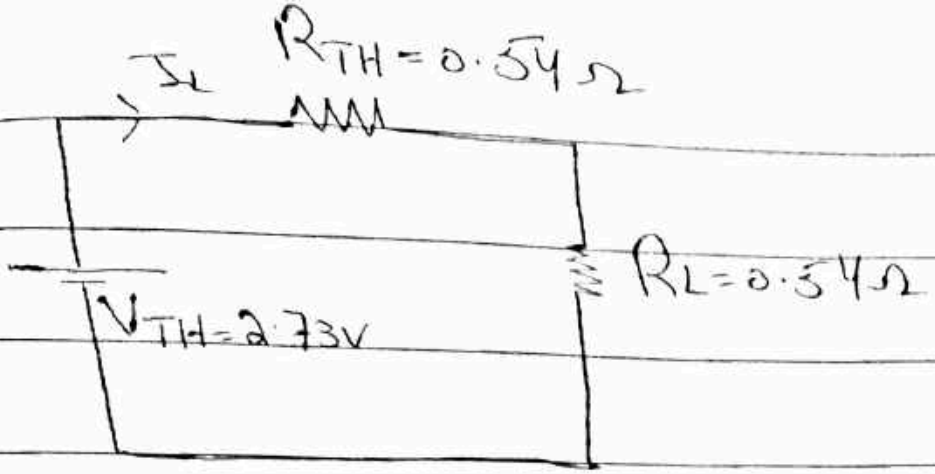


$\frac{1}{R_{TH}} = \frac{1}{1} + \frac{1}{3} + \frac{1}{2} \Rightarrow \frac{1}{R_{TH}} = \frac{1}{1.833}$

$\boxed{R_{TH} = 0.54\Omega}$

Step No 3:-

Calculating I_L & P_{max}.



$$I_L = \frac{2.73}{2(0.54)}$$

$$\boxed{I_L = 2.50A}$$

$$\text{Also } P_{max} = \frac{V_{TH}^2}{4R_{TH}}$$

$$= \frac{(2.73)^2}{4(0.54)}$$

$$\boxed{P_{max} = 3.42W}$$ Ans:-

Lab No 13

"To analyze a DC Circuit Using millman's Theorem"

Objective:-

The main objective of this lab is to simply a complex ckt consisting of various voltage sources and find the current through and voltage across a load resistance.

Theory:-

→ millman's theorem was named after famous electrical engineering professor Jacob millman.

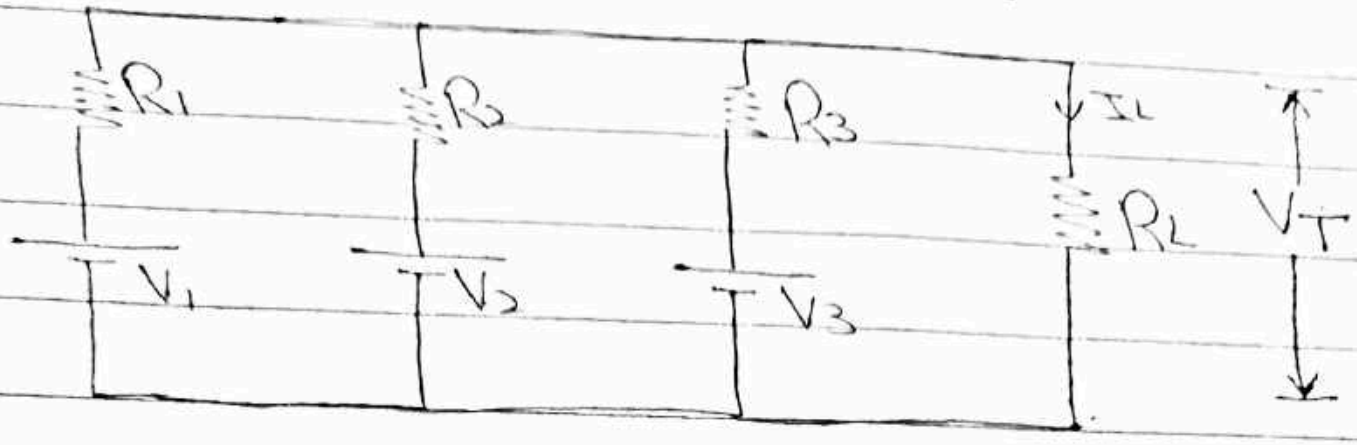
→ This theorem acts as a very strong tool in case of Simplyfying the special type of complex electrical circuit.

→ This theorem is very useful to find out voltage across the load and current through the load resistor.

→ This theorem is also called parallel generator theorem.

→ millman's theorem is applicable to a ckt which may contain only voltage sources in parallel or a combination of voltage and current sources connected in parallel.

→ In this lab, we will consider a ckt which consists of voltage sources only.



→ Here V_1, V_2 and V_3 are voltages of respective 1st, 2nd and 3rd branch

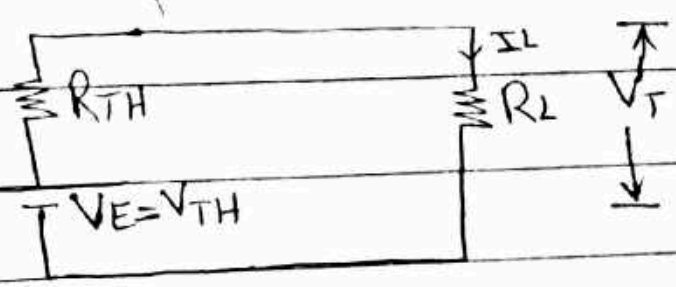
→ R_1, R_2 and R_3 are the respective resistances of the voltage sources.

→ I_L is the current passing through load resistor(R_L)

→ V_T is the voltage across R_L.

$\therefore V_T = I_L \times R_L$

→ Now this complex ckt can be reduced easily to a single equivalent voltage source with a series resistance with the help of millman's theorem as shown below:-



where VE is the equivalent voltage

To calculate V_E:

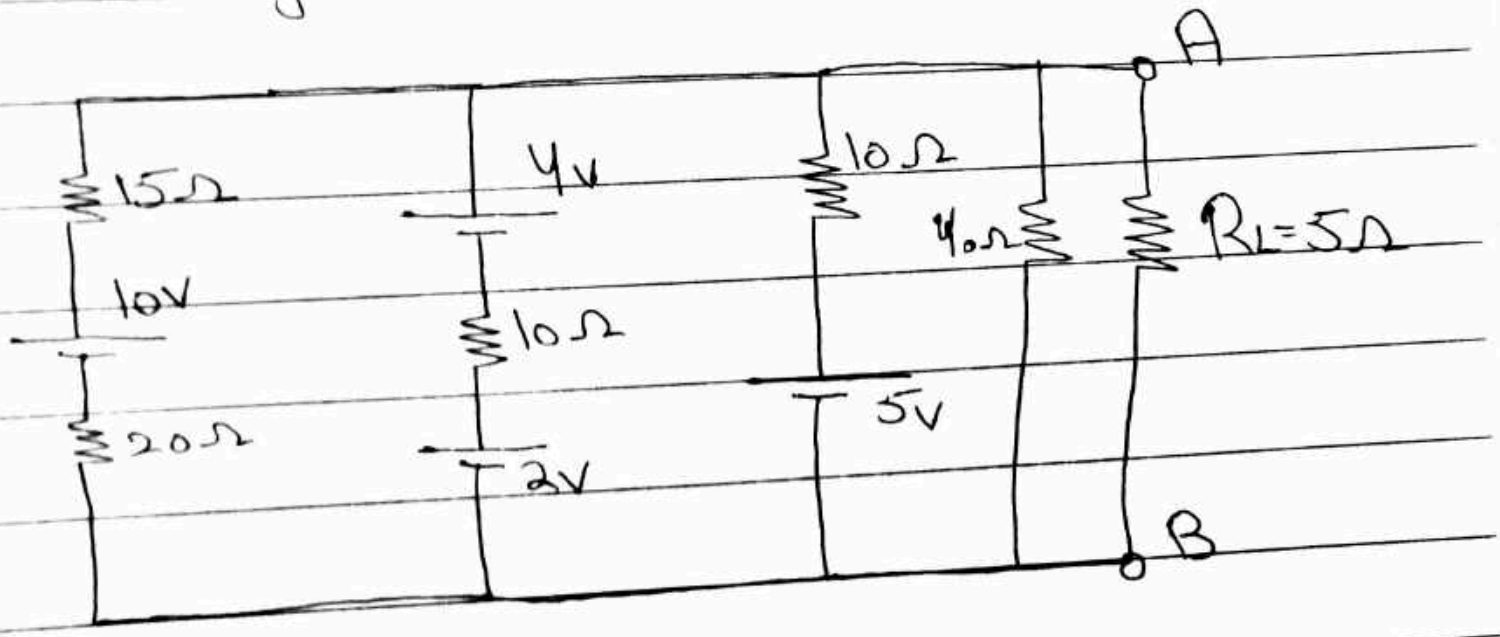
$$V_E = \frac{V_1/R_1 + V_2/R_2 + V_3/R_3}{1/R_1 + 1/R_2 + 1/R_3}$$

To calculate load current (I_L) and terminal voltage (V_T):

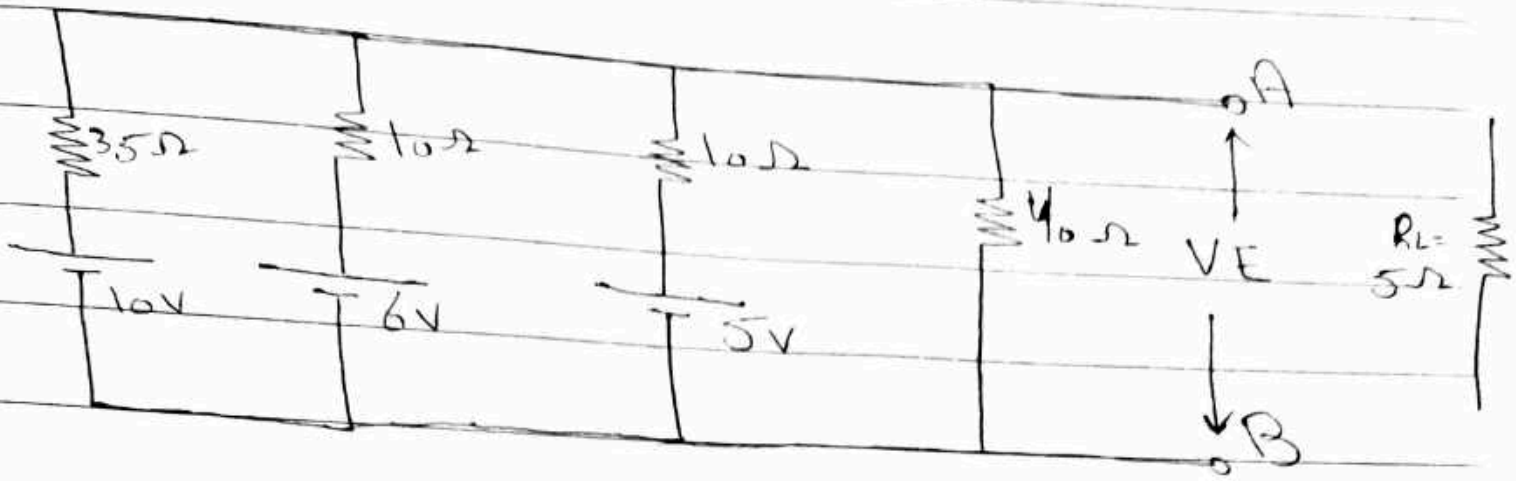
$$I_L = \frac{V_{TH}/V_E}{R_L + R_{TH}} \quad \text{or} \quad \text{Eq. } V_T = I_L \times R_L$$

Circuit Diagram:-

Using Millman's Theorem, calculate the current through and voltage across 5Ω resistor in the ckt shown below:-



Simplifying the circuit:-



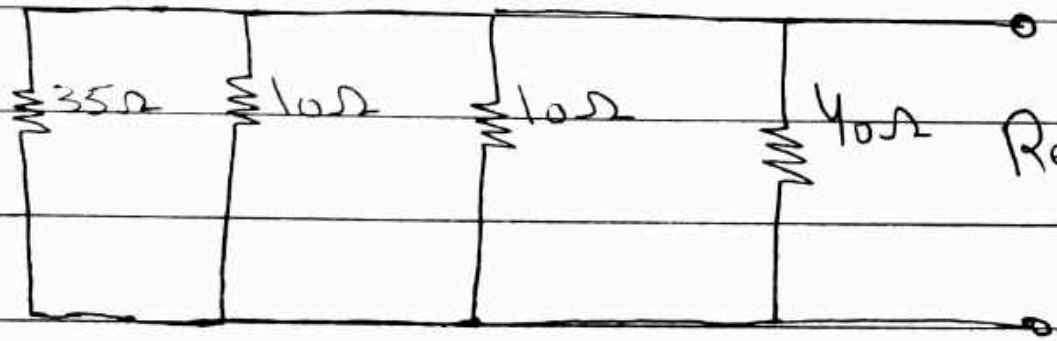
$$V_E = \frac{V_1/R_1 + V_2/R_2 + V_3/R_3 + V_4/R_4}{1/R_1 + 1/R_2 + 1/R_3 + 1/R_4}$$

$$= \frac{10/35 + 6/10 + 5/10 + 0/40}{1/35 + 1/10 + 1/10 + 1/40}$$

$$= \frac{1.3857}{0.253}$$

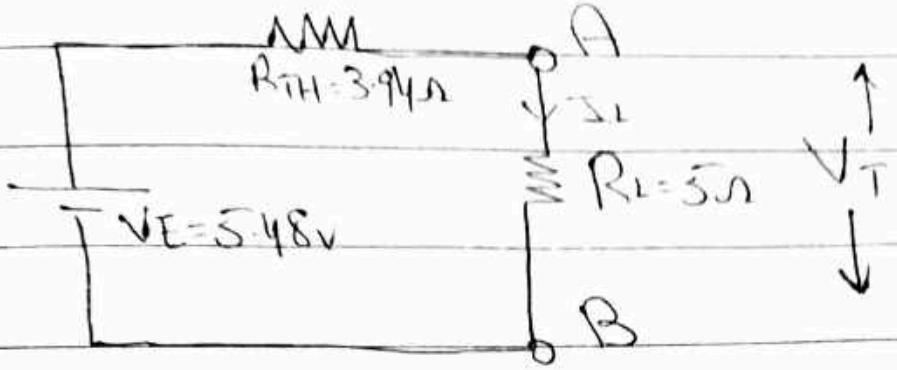
$$\boxed{V_E \text{ or } V_{TH} = 5.48V}$$

Now calculating R_{TH}.



$$\frac{1}{R_{eq}} = \frac{1}{35} + \frac{1}{10} + \frac{1}{10} + \frac{1}{40} \Rightarrow \boxed{R_{eq} = 3.94\Omega}$$

The Simplified CKT will be:-



$$I_L = \frac{V_E}{R_{TH}+R_L} = \frac{5.48}{3.94+5} = \boxed{0.61A}$$

also $V_T = I_L \times R_L$

$= 0.61 \times 5$

$$\boxed{V_T = 3.05V}$$