



ET CLASS MATERIAL

UNIT-2 -ECE A &B

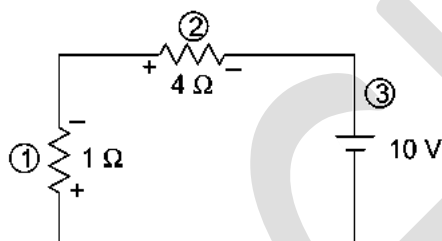
GV Raja sekhar

TELLEGEN'S THEOREM

Tellegen's theorem is valid for any lumped network which may be linear or nonlinear, passive or active, time-varying or time-invariant. This theorem states that in an arbitrary lumped network, the algebraic sum of the powers in all branches at any instant is zero. All branch currents and voltages in that network must satisfy Kirchhoff's laws. Otherwise, in a given network, *the algebraic sum of the powers delivered by all sources is equal to the algebraic sum of the powers absorbed by all elements*. This theorem is based on Kirchhoff's two laws, but not on the type of circuit elements. Consider two networks N1 and N2, having the same graph with different types of elements between the corresponding nodes.

$$\text{Then } \sum_{K=1}^b v_{1K} i_{2K} = 0$$

$$\text{and } \sum_{K=1}^b v_{2K} i_{1K} = 0$$

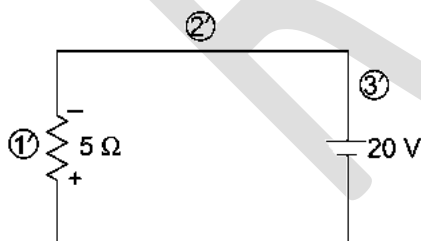


$$i_1 = i_2 = 2 \text{ A}; i_3 = 2 \text{ A}$$

$$\text{and } v_1 = -2 \text{ V}, v_2 = -8 \text{ V}, v_3 = 10 \text{ V}$$

$$\begin{aligned} \sum_{K=1}^3 v_K i_K^1 &= v_1 i_1^1 + v_2 i_2^1 + v_3 i_3^1 \\ &= (-2)(4) + (-8)(4) + (10)(4) = 0 \end{aligned}$$

$$\begin{aligned} \sum_{K=1}^3 v_K i_K &= v_1 i_1 + v_2 i_2 + v_3 i_3 \\ &= (-2)(2) + (-8)(2) + (10)(2) = 0 \end{aligned}$$



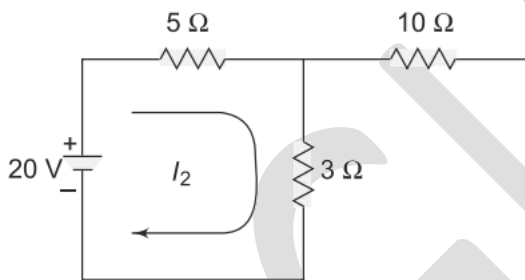
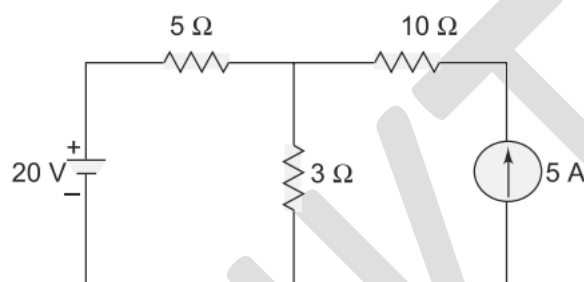
$$i_1^1 = i_2^1 = 4 \text{ A}; i_3^1 = 4 \text{ A}$$

$$\text{and } v_1^1 = -20 \text{ V}; v_2^1 = 0 \text{ V}; v_3^1 = 20 \text{ V}$$

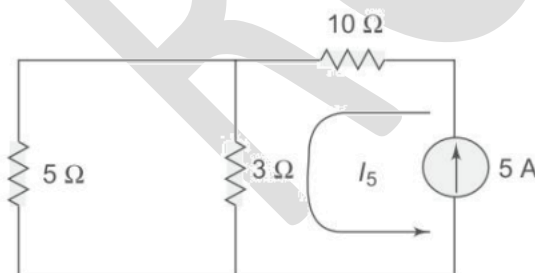
$$\begin{aligned} \sum_{K=1}^3 v_K^1 i_K &= v_1^1 i_1 + v_2^1 i_2 + v_3^1 i_3 \\ &= (-20)(2) + (0)(2) + (20)(2) = 0 \end{aligned}$$

$$\sum_{K=1}^3 v_K^1 i_K^1 = (-20)(4) + (0)(4) + (20)(4) = 0$$

The **SUPERPOSITION THEOREM** states that in any linear network containing two or more sources, the response in any element is equal to the algebraic sum of the responses caused by individual sources acting alone, while the other sources are non-operative; that is, while considering the effect of individual sources, other ideal voltage sources and ideal current sources in the network are replaced by short circuit and open circuit across their terminals. This theorem is valid only for linear systems.



the current I_2 due to the 20 V voltage source with 5 A source open circuited $= 20/(5 + 3) = 2.5$ A



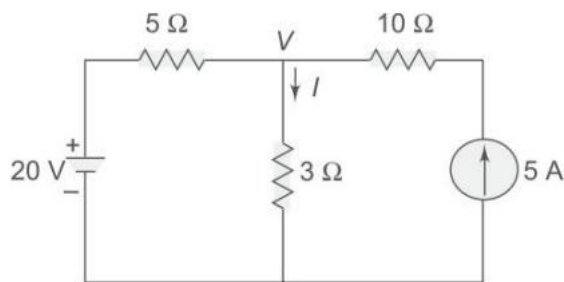
$$I_5 = 5 \times \frac{5}{(3+5)} = 3.125 \text{ A}$$

The total current passing through the 3 Ω resistor is

$$(2.5 + 3.125) = 5.625 \text{ A}$$

LECTURE NOTES

Compiled for the students of RGUKT



$$\frac{V-20}{5} + \frac{V}{3} = 5$$

$$V \left[\frac{1}{5} + \frac{1}{3} \right] = 5 + 4$$

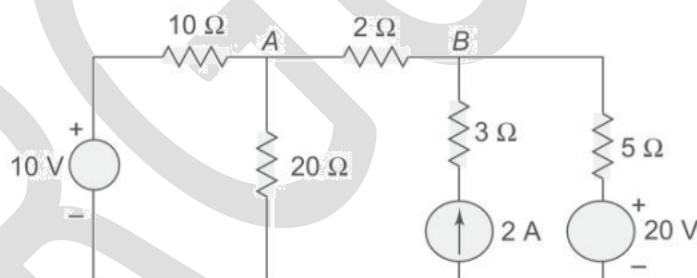
$$V = 9 \times \frac{15}{8} = 16.875 \text{ V}$$

The current passing through the 3 Ω resistor is equal to V/3,

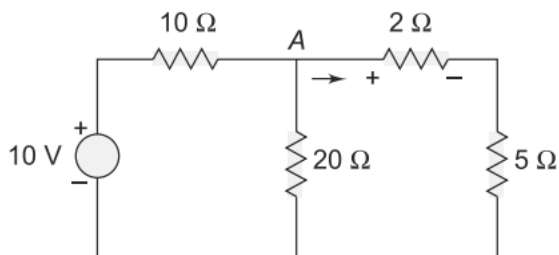
i.e. $I = \frac{16.875}{3} = 5.625 \text{ A}$

So the superposition theorem is verified.

Find the voltage across the 2ohm resistor in Fig



Step -1



Assuming a voltage V at the node 'A'

$$\frac{V-10}{10} + \frac{V}{20} + \frac{V}{7} = 0$$

$$V [0.1 + 0.05 + 0.143] = 1$$

or $V = 3.41 \text{ V}$

$$V_2 = \frac{V}{7} \times 2 = 0.97 \text{ V}$$

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

ELECTRICAL TECHNOLOGY

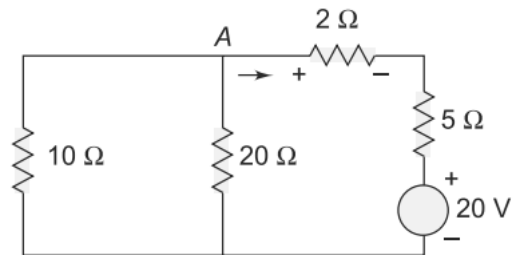
LECTURE NOTES

Compiled for the students of RGUKT

$$\frac{V-20}{7} + \frac{V}{20} + \frac{V}{10} = 0$$

$$V[0.143 + 0.05 + 0.1] = 2.86$$

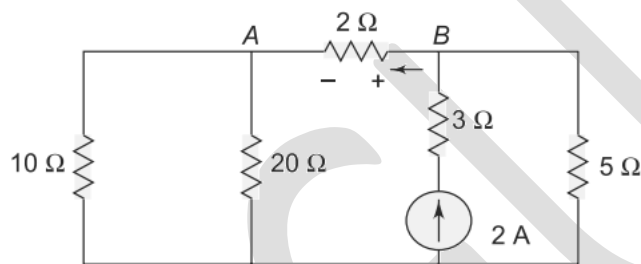
$$\text{or } V = \frac{2.86}{0.293} = 9.76 \text{ V}$$



step 2 :

$$V_2 = \left(\frac{V-20}{7} \right) \times 2 = -2.92 \text{ V}$$

Step 3



$$\begin{aligned} \text{The current in the } 2 \Omega \text{ resistor} &= 2 \times \frac{5}{5 + 8.67} \\ &= \frac{10}{13.67} = 0.73 \text{ A} \end{aligned}$$

The voltage across the 2Ω resistor = $0.73 \times 2 = 1.46 \text{ V}$

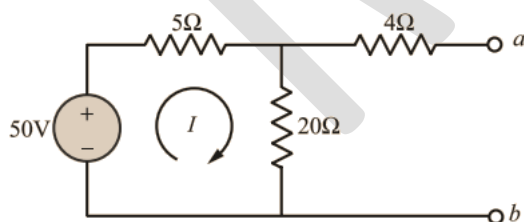
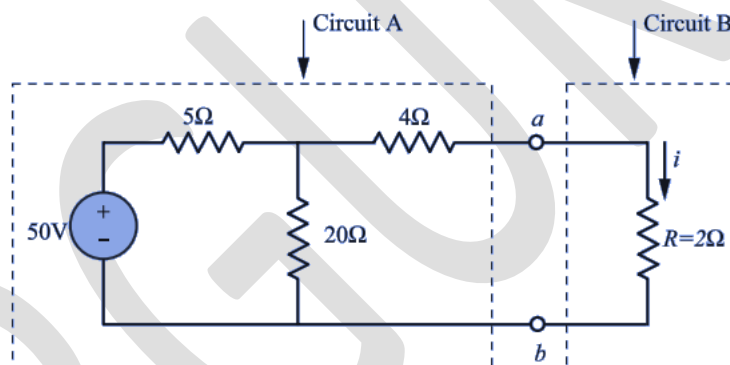
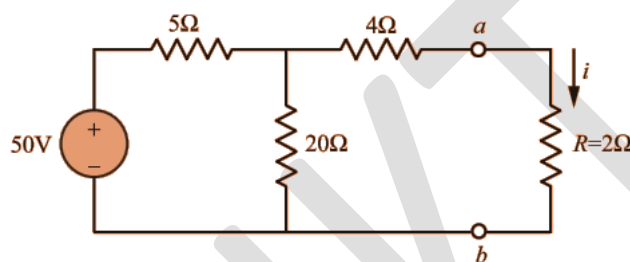
The algebraic sum of these voltages gives the total voltage across the 2Ω resistor in the network

$$V = 0.97 - 2.92 - 1.46 = -3.41 \text{ V}$$

LECTURE NOTES

Compiled for the students of RGUKT

Thevenin's theorem states that any two terminal linear network having a number of voltage current sources and resistances can be replaced by a simple equivalent circuit consisting of a single voltage source in series with a resistance, where the value of the voltage source is equal to the open-circuit voltage across the two terminals of the network, and resistance is equal to the equivalent resistance measured between the terminals with all the energy sources are replaced by their internal resistances.



$$-50 + 25I = 0 \Rightarrow I = 2A$$

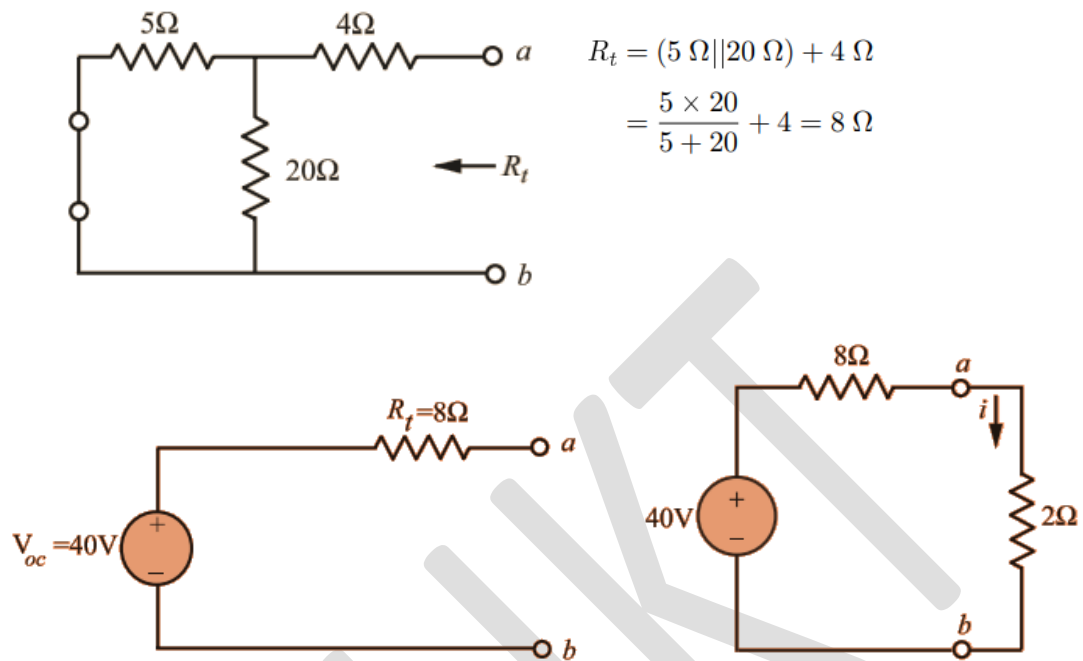
$$V_{ab} = V_{oc} = 20(I) = 40V$$

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

ELECTRICAL TECHNOLOGY

LECTURE NOTES

Compiled for the students of RGUKT



$$i = \frac{40}{2 + 8} = 4A$$

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

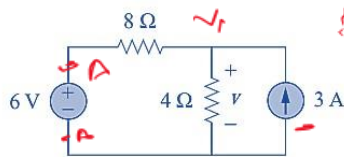
ELECTRICAL TECHNOLOGY

LECTURE NOTES

Compiled for the students of RGUKT

The superposition principle states that the voltage across (or current through) an element in a linear circuit is the algebraic sum of the voltages across (or currents through) that element due to each independent source acting alone

superposition helps us to analyze a linear circuit with more than one independent source by calculating the contribution of each independent source separately



$$V_{4\Omega} = V_1 + V_2$$

$$= 8 + 2 = 10V$$

Node

$$3 = \frac{V_1 - 6}{8} + \frac{V_1}{4}$$

$$3 = \frac{V_1}{4} + \frac{V_1}{8} - \frac{6}{8}$$

$$6 + \frac{3}{4} = V_1 \left(\frac{1}{4} + \frac{1}{8} \right)$$

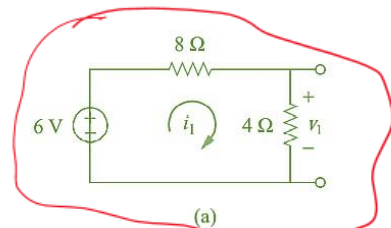
$$4 = 10$$

$$V_1 = 4 \times \frac{6}{12} = 2V$$

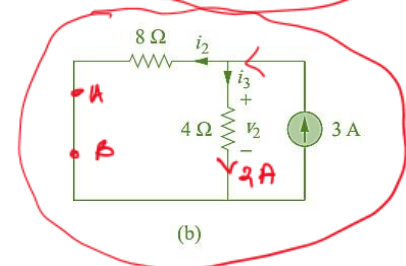
$$V_2 = 3 \times 4 = 8V$$

$$i_3 = 3 \times \frac{8}{8+4}$$

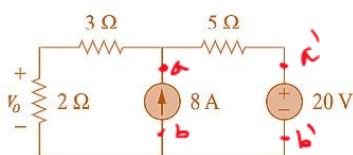
$$= 3 \times \frac{8}{12} = 2A$$



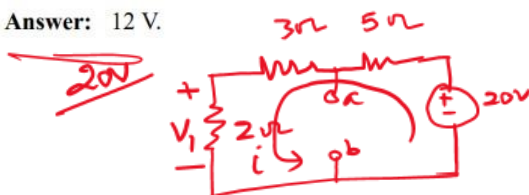
(a)



(b)



Answer: 12 V.



$$V_1 = i \times 2$$

$$= \frac{20}{10} \times 2$$

$$= 4V$$

V.S → short
C.S → open.

$$V_0 = V_1 + V_2 + V_3 + \dots$$



$$i_1 = 8 \times \frac{5}{5+5} = 4A$$

$$V_2 = 2 \times i_1$$

$$= 2 \times 4 = 8V$$

$$V_0 = V_1 + V_2 = 8 + 4 = 12V$$

LECTURE NOTES

Compiled for the students of RGUKT

$i_o = i_o' + i_o''$

$3(i_2 - i_1) + 1(i_2 - i_3) - 5i_o' + 2i_2 = 0$

$6i_2 - 3i_1 - i_3 = 5i_o'$

$i_1 = 4 \text{ A}$

For loop 2, KVL

$-3i_1 + 6i_2 - 1i_3 - 5i_o' = 0$ (1)

For loop 3,

$-5i_1 - 1i_2 + 10i_3 + 5i_o' = 0$ (2)

But at node 0,

$i_3 = i_1 - i_o' = 4 - i_o'$

$i = 4$

$3i_2 - 2i_o' = 8$

$i_2 + 5i_o' = 20$

$i_o' = \frac{52}{17} \text{ A}$

$i_o = -\frac{8}{17} = -0.4706 \text{ A}$

$i_o = i_o' + i_o''$

$= \frac{52}{17} - \frac{60}{17}$

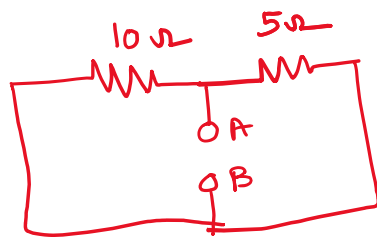
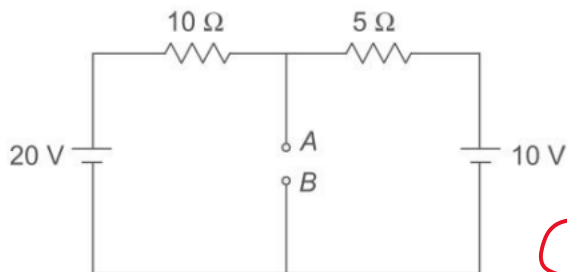
$= -\frac{8}{17} = -0.4706 \text{ A}$

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

ELECTRICAL TECHNOLOGY

LECTURE NOTES

Compiled for the students of RGUKT



Determine Norton Eq ckt.

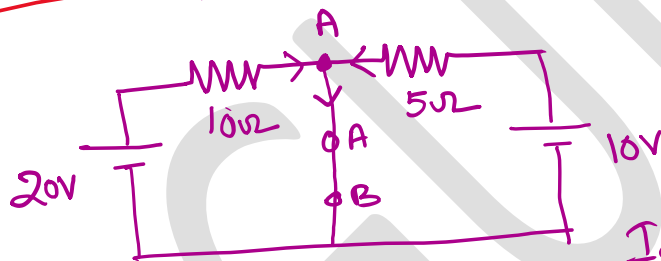
step-1

find R_N

(to find R_N short circuit the Voltage sources)

$$R_N = \frac{10 \times 5}{10 + 5} = \frac{10}{3} \Omega$$

Step-2 find $I_{sc} = I_N$

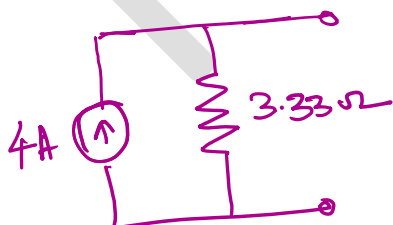


Apply KCL at Node A

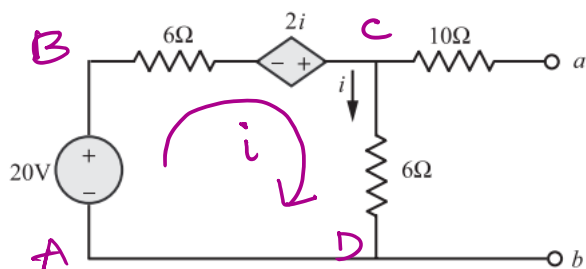
$$I_{sc} = \frac{V_A - 20}{10} + \frac{V_A - 10}{5}$$

$\therefore$ AB is short $V_A = 0$

$$\Rightarrow I_{sc} = \frac{-20}{10} - \frac{10}{5} = -4A$$



Norton Equivalent circuit.



find V_{th} and R_{th} .

apply KVL to the Loop

$$20 = 6i - 2i + 6i$$

$$20 = 10i$$

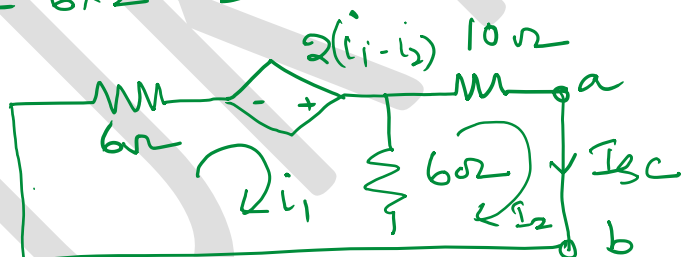
$$i = 2A$$

V_{th} = voltage across 6Ω resistance

$$V_{th} = 6 \times i = 6 \times 2 = 12V$$

to find R_{th}

$$R_{th} = \frac{V_{oc}}{I_{sc}}$$



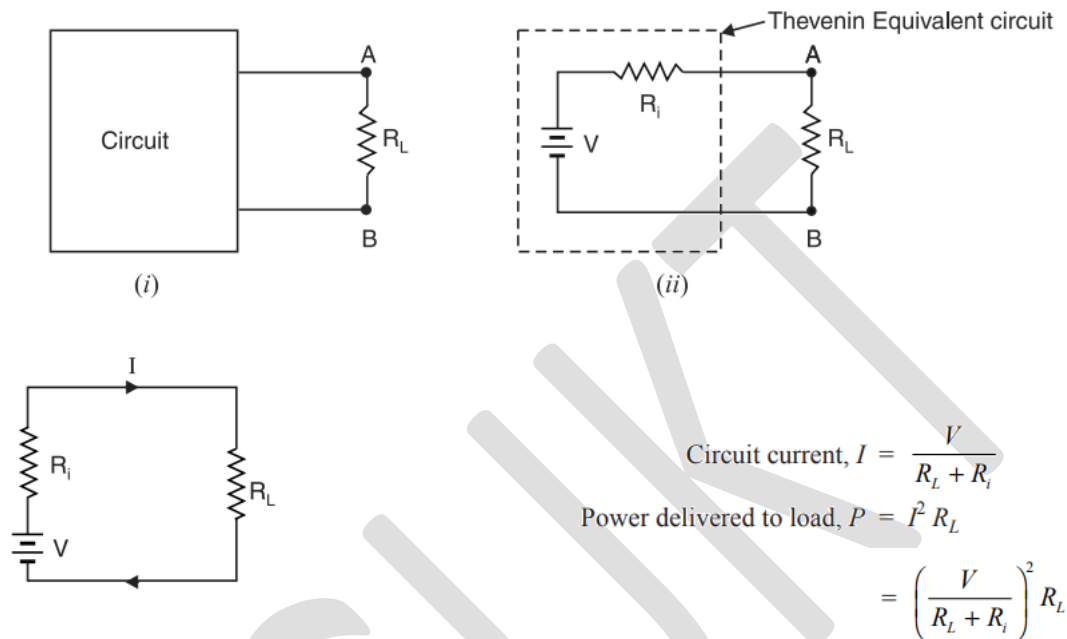
$$\begin{aligned} \text{Eq-1} \quad 2(i_1 - i_2) &= 6i_1 + 6i_1 - 6i_2 \\ 2i_1 - 2i_2 - 12i_1 + 6i_2 &= 0 \\ -10i_1 - 4i_2 &= 0 \quad \text{--- (1)} \end{aligned}$$

$$\begin{aligned} \text{Eq-2} \quad 6(i_2 - i_1) + 10I_2 &= 0 \\ -6i_1 + 16i_2 &= 0 \quad \text{--- (2)} \end{aligned}$$

$$\text{Solving} \quad i_2 = I_{sc} = \frac{120}{136}$$

$$R_{th} = \frac{12}{120/136} = 13.6\Omega$$

MAXIMUM POWER TRANSFER THEOREM This theorem deals with transfer of maximum power from a source to load and may be stated as under: In d.c. circuits, maximum power is transferred from a source to load when the load resistance is made equal to the internal resistance of the source as viewed from the load terminals with load removed and all e.m.f. sources replaced by their internal resistances



Thus,

$$\frac{dP}{dR_L} = V^2 \left[\frac{(R_L + R_i)^2 - 2R_L(R_L + R_i)}{(R_L + R_i)^4} \right] = 0$$

or $(R_L + R_i)^2 - 2R_L(R_L + R_i) = 0$

or $(R_L + R_i)(R_L + R_i - 2R_L) = 0$

or $(R_L + R_i)(R_i - R_L) = 0$

Since $R_L + R_i$ cannot be zero,

$\therefore R_i - R_L = 0$

or $R_L = R_i$

or **Load resistance = Internal resistance of the source**

The maximum power is obtained from a linear circuit at a given pair of terminals when terminals are loaded by Thevenin's resistance (R_{Th}) of the circuit. The above statement is obviously true because by Thevenin's theorem,

$$\begin{aligned} \text{Efficiency} &= \frac{\text{Output power}}{\text{Input power}} = \frac{I^2 R_L}{I^2 (R_L + R_i)} \\ &= \frac{R_L}{2R_L} = \frac{1}{2} = 50\% \end{aligned}$$

Under the conditions of maximum power transfer, the load voltage is one-half of the open circuited voltage at the load terminals.

$$\text{Load voltage} = I R_L = \left(\frac{V}{R_L + R_i} \right) R_L = \frac{V R_L}{2 R_L} = \frac{V}{2}$$
$$\text{Max. power transferred} = \left(\frac{V}{R_L + R_i} \right)^2 R_L = \left(\frac{V}{2 R_L} \right)^2 R_L = \frac{V^2}{4 R_L}$$

Applications of Maximum Power Transfer Theorem

This theorem is very useful in situations where transfer of maximum power is desirable. Two important applications are listed below:

- (i) In communication circuits, maximum power transfer is usually desirable. For instance, in a public address system, the circuit is adjusted for maximum power transfer by making load (i.e. speaker) resistance equal to source (i.e. amplifier) resistance. When source and load have the same resistance, they are said to be matched. In most practical situations, the internal resistance of the source is fixed. Also, the device that acts as a load has fixed resistance. In order to make $R_L = R_i$, we use a transformer. We can use the reflected-resistance characteristic of the transformer to make the load resistance appear to have the same value as the source resistance, thereby “fooling” the source into “thinking” that there is a match (i.e. $R_L = R_i$). This technique is called impedance matching.
- (ii) Another example of maximum power transfer is found in starting of a car engine. The power delivered to the starter motor of the car will depend upon the effective resistance of the motor and internal resistance of the battery. If the two resistances are equal (as is the case when battery is fully charged), maximum power will be transferred to the motor to turn on the engine. This is particularly desirable in winter when every watt that can be extracted from the battery is needed by the starter motor to turn on the cold engine. If the battery is weak, its internal resistance is high and the car does not start

Two identical cells connected in series deliver a maximum power of 1W to a resistance of 4 Ω . What is the internal resistance and e.m.f. of each cell ?

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

ELECTRICAL TECHNOLOGY

LECTURE NOTES

Compiled for the students of RGUKT

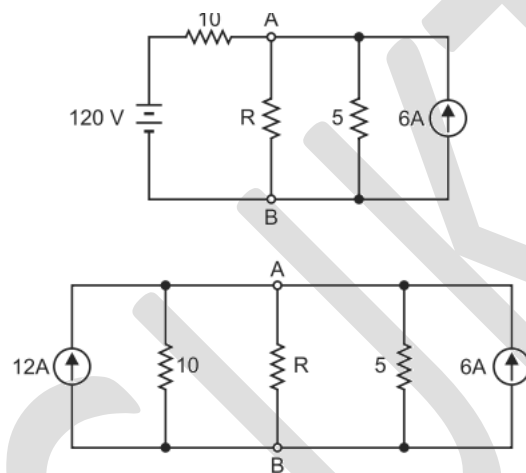
Let E and r be the e.m.f. and internal resistance of each cell. The total internal resistance of the battery is $2r$. For maximum power transfer,

$$2r = R_L = 4 \quad \therefore r = R_L/2 = 4/2 = 2 \Omega$$

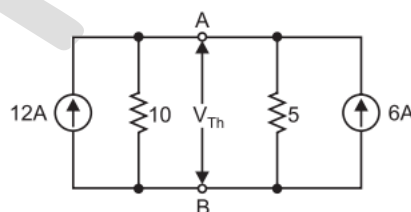
$$\text{Maximum power} = \frac{(2E)^2}{4R_L}$$

$$1 = \frac{4E^2}{4R_L} \quad \therefore E = \sqrt{R_L} = \sqrt{4} = 2 \text{ V}$$

Find the value of resistance R to have maximum power transfer in the circuit shown in Fig. 3.202 (i). Also obtain the amount of maximum power. All resistances are in ohms



To find the desired answers, we should find V_{Th} and R_{Th} at the load (i.e. R) terminals. For this purpose, we first convert 120V voltage source in series with 10Ω resistance into equivalent current source of $120/10 = 12A$ in parallel with 10Ω resistance. The circuit then becomes as shown in Fig.



$$\frac{V_{Th}}{10} + \frac{V_{Th}}{5} = 12 + 6 \quad \text{or} \quad V_{Th} = 60V$$

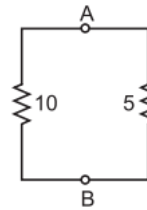
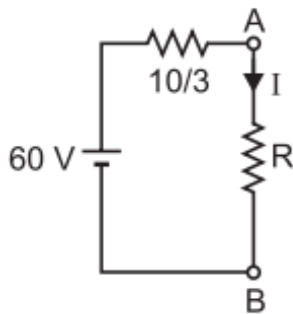
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

ELECTRICAL TECHNOLOGY

LECTURE NOTES

Compiled for the students of RGUKT

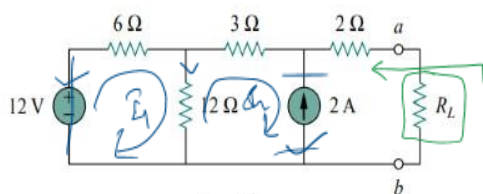
$$R_{Th} = 10\Omega \parallel 5\Omega = \frac{10 \times 5}{10 + 5} = \frac{10}{3}\Omega$$



For maximum power transfer, the condition is

$$R = R_{Th} = \frac{10}{3}\Omega$$

$$\text{Max. power transferred, } P_{max} = \frac{V_{Th}^2}{4R_L} = \frac{V_{Th}^2}{4R} = \frac{(60)^2}{4 \times (10/3)} = 270 \text{ W}$$



$$R_L =$$

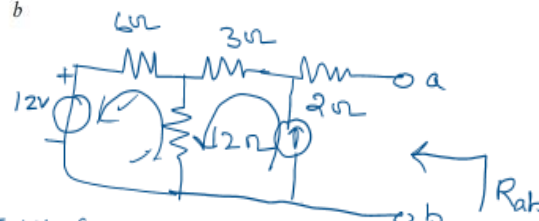
(Voltage source - s.c)
(Current source - o.c)

$$R_{eqs} = R_{Th}$$

$$R_{Th} = 2 + 3 + 6 \parallel 12 = 5 + \frac{6 \times 12}{18} = 9\Omega$$

$$-12 + 18i_1 - 12i_2 = 0, \quad i_2 = -2 \text{ A}$$

$$-12 + 6i_1 + 3i_2 + 2(0) + V_{Th} = 0 \Rightarrow V_{Th} = 22 \text{ V}$$



$$\frac{6 \times 12}{18} = 4\Omega$$

$$p_{max} = \frac{V_{Th}^2}{4R_{Th}}$$

$$-12 + 6I_1 + 12(I_1 - I_2) = 0$$

$$I_2 = -2 \text{ A}$$

$$-12 + 6I_1 + 12I_1 + 12(-2) = 0$$

$$R_{ab} = R_{Th} = 9\Omega$$

$$p_{max} = \frac{V_{Th}^2}{4R_L} = \frac{22^2}{4 \times 9} = 13.44 \text{ W}$$

$$24 + 48I_1 = 0$$

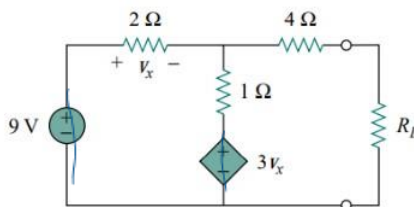
$$I_1 = \frac{-24}{48} = -\frac{1}{2}$$

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

ELECTRICAL TECHNOLOGY

LECTURE NOTES

Compiled for the students of RGUKT



Answer: 4.22 Ω, 2.901 W.



$$P = \frac{(7)^2}{4 \times 4.66} = 2.62 \text{ W}$$

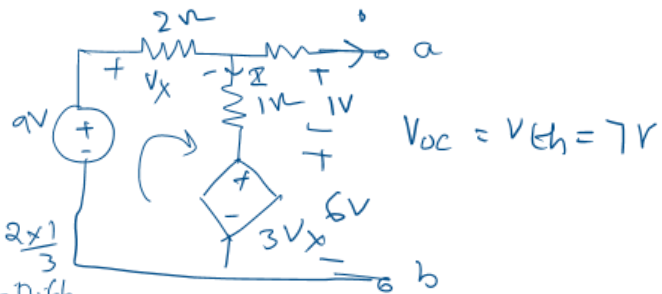
$$4 + \frac{2 \times 1}{3} = 4 + 0.66 = 4.66 \Omega$$

$$= 4.66 \Omega - 9 + V_x + 1 I_1 + 3 V_x = 0$$

$$-9 + I_1 \times 2 + I_1 + 3(2 I_1) = 0$$

$$9 = 9 I_1$$

$$I_1 = 1 \text{ A}$$



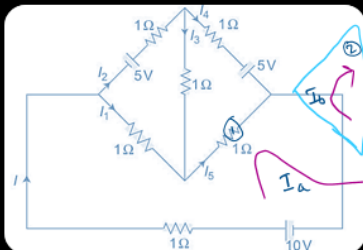
$$V_{oc} = V_{th} = 7 \text{ V}$$

$$V_x = I_1 \times 2$$

$$V_x = 2 \text{ V}$$

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ET – SPECIAL CLASS



find I_1 ?

No. of loops = 3

$$-10 + 1 I_a + (I_a - I_b)1 + (I_a - I_c)1 \Omega - (1)$$

$$-5 + 1 I_b + 1(I_b - I_c) + 1(I_b - I_a) - (2)$$

$$I_c - 5V + 1(I_c - I_a) + 1(I_c - I_b) - (3)$$

$$3 I_a - I_b - I_c = 10$$

$$-I_a + 3 I_b - I_c = 5$$

$$-I_a - I_b + 3 I_c = 5$$

$$\begin{bmatrix} 3 & -1 & -1 \\ -1 & 3 & -1 \\ -1 & -1 & 3 \end{bmatrix} \begin{bmatrix} I_a \\ I_b \\ I_c \end{bmatrix} = \begin{bmatrix} 10 \\ 5 \\ 5 \end{bmatrix}$$

$$\begin{bmatrix} I_a \\ I_b \\ I_c \end{bmatrix} = \begin{bmatrix} 10 \\ 5 \\ 5 \end{bmatrix} \begin{bmatrix} 3 & -1 & -1 \\ -1 & 3 & -1 \\ -1 & -1 & 3 \end{bmatrix}^{-1}$$

$$I_1 = I_a - I_b$$

$$I_2 = I_b$$

$$I_3 = I_c - I_a$$

$$I_4 = I_c$$

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

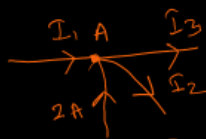
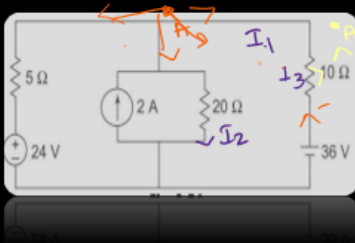
ELECTRICAL TECHNOLOGY

LECTURE NOTES

Compiled for the students of RGUKT

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ET – SPECIAL CLASS



$$I_1 + 2 = I_2 + I_3$$

Use nodal analysis and find current in 10Ω Resistor
No of nodes = 2 (one is ref)

at node A, Apply KCL

$$2 + I_1 = I_2 + I_3$$

$$2 + \frac{24 - V_A}{5} = \frac{V_A - 0}{20} + \frac{V_A - 36}{10} \quad \text{--- (1)}$$

$$\text{find } V_A = 29.7V$$



$$I_1 = \frac{24 - V_A}{5} = -1.14A$$

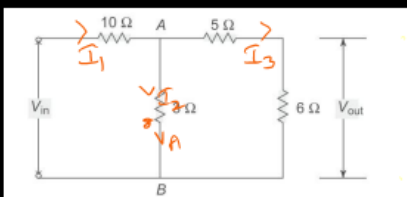
$$I_2 = \frac{V_A}{20} = 1.48$$

$$I_3 = \frac{29.7 - 36}{10} = -0.63$$

$$2 + I_3 = I_1 + I_2$$

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ET – SPECIAL CLASS



find V_{out}/V_{in}

No of Nodes = 2 - 1 = 1

$$I_1 = I_2 + I_3$$

$$\frac{V_{in} - V_A}{10} = \frac{V_A - 0}{5} + \frac{V_A - 0}{6}$$

$$\frac{V_{in} - V_A}{10} = \frac{V_A}{5} + \frac{V_A}{6} \quad \text{--- (1)}$$

$$V_A \left(\frac{1}{5} + \frac{1}{6} + \frac{1}{10} \right) = \frac{V_{in}}{10}$$

$$V_A = 0.18 V_{in}$$

$$V_{out} = V_A - I_3 \times 5$$

$$= V_A - \frac{V_A}{11} \times 5$$

$$V_{out} = V_A \left(1 - \frac{5}{11} \right) = V_A \frac{6}{11}$$

$$V_{out} = 0.18 V_{in} \times \frac{6}{11}$$

$$V_{out} = 0.098 V_{in}$$

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

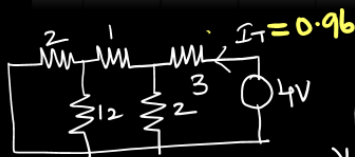
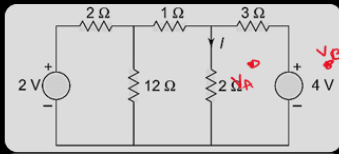
ELECTRICAL TECHNOLOGY

LECTURE NOTES

Compiled for the students of RGUKT

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ET – SPECIAL CLASS



$$I_T = \frac{2}{4.15} = 0.96 \text{ A}$$

$$I_T = \frac{V_T}{Z_T}$$

$$① \frac{2 \times 12}{2+12} = 1.714 \Omega$$

$$② 1 + 1.714 = 2.714$$

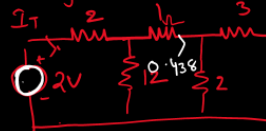
$$③ \frac{2.714 \times 2}{2.714 + 2} = 1.15 \Omega$$

$$④ 3 + 1.15 = 4.15 \Omega = Z_T$$

$$I_2 = I_{2V} + I_{4V}$$

$$= 0.262 + 0.55 = 0.812 \text{ A}$$

Using Super pos 1



Theorem find I

$$I_T = \frac{V}{Z_T} = \frac{2}{3.85} = 0.519 \text{ A}$$

$$\frac{3 \times 2}{5} = \frac{6}{5} = 1.2$$

$$12 + 1 = 13.2 \Omega$$

$$\frac{1}{13.2} = 0.0758$$

$$0.0758 \times 2 = 0.1516$$

$$0.1516 + 0.438 = 0.5896$$

$$I_{2V} = 0.438 \times \frac{3}{5}$$

$$= 0.262 \text{ A}$$

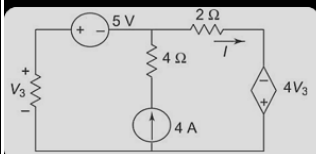
$$[2V \text{ Source}]$$

$$= 0.55 \text{ A}$$

$$[4V \text{ Source}]$$

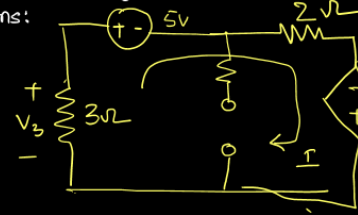
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ET – SPECIAL CLASS



Using Superposition theorem find I in 2Ω resistor?

Ans:



$$-I \cdot 3\Omega + 5V + 2I - 4V_3 = 0$$

$$-3I + 5 + 2I - 4(3I) = 0$$

$$5 - 12I = 0$$

$$I = \frac{5}{12} = 0.417 \text{ A}$$

$$I_T = 5.1 + 0.38 = 5.48 \text{ A}$$

$$I_2 = \frac{-1.5 - 1.11}{2} = -1.305 \text{ A}$$

$$I_2 = \frac{-3.4 - 4(-3.4)}{2}$$

$$= 5.1 \text{ A}$$

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

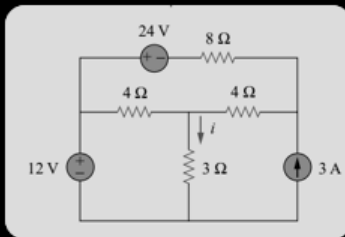
ELECTRICAL TECHNOLOGY

LECTURE NOTES

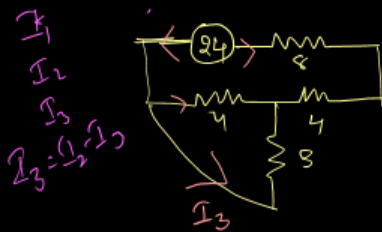
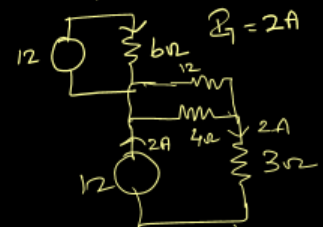
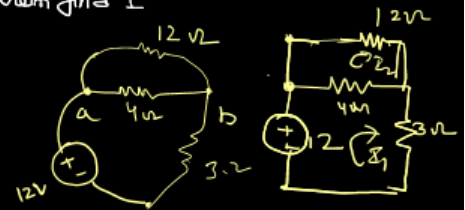
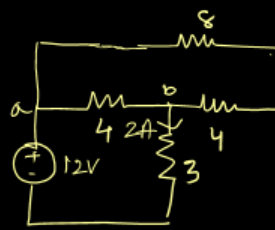
Compiled for the students of RGUKT

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ET – SPECIAL CLASS



Using Superposition theorem find I

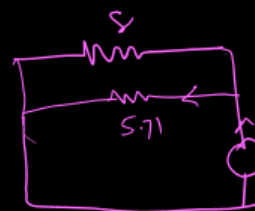
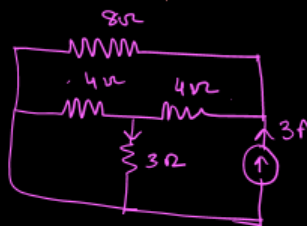
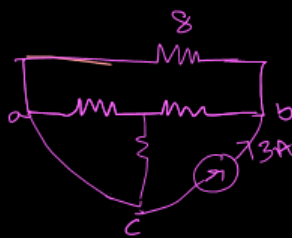


$$\frac{3 \times 4}{3 + 4} = \frac{12}{7} = 1.71 \Omega$$

$$R_T = 1.71 + 4 + 8 = 13.71 \Omega$$

$$I_T = \frac{24}{13.71} = 1.75 A$$

$$I_3 = 1.75 \times \frac{4}{7} = 1 A$$



$$3 \times \frac{4}{8 + 5.71} = 1.75$$

$$I_3 = 1.75 \times \frac{4}{7} = 1 A$$

$$I_{24V} + I_{12V} + I_{3A}$$

$$1 A + 2 A + 1 A = 4 A$$

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

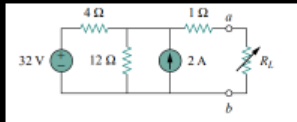
ELECTRICAL TECHNOLOGY

LECTURE NOTES

Compiled for the students of RGUKT

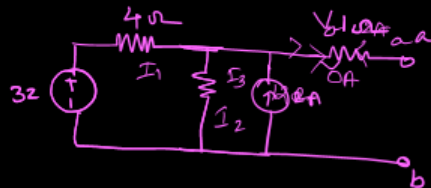
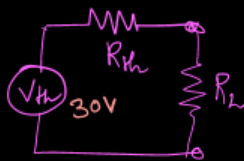
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ET – SPECIAL CLASS



- Using Thevenin's Theorem find the I in R_L if $R_L = 2\Omega$

- ① Disconnect R_L
- ② find V_{ab}
- ③ find R_{th} (S.C to V.S, O.C to C.S)



$$I_1 + I_3 = I_2$$

$$\frac{32 - V_a}{4} + 2 = \frac{V_a}{12}$$

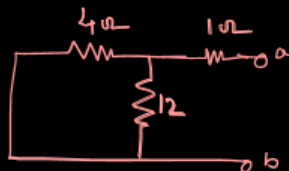
$$2 = \frac{V_a}{12} + \frac{32 - V_a}{4}$$

$$V_a = 30V$$

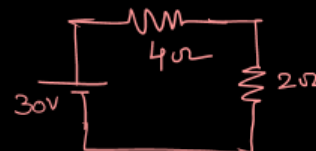
$$V_{ab} = V_a - V_b$$

$$= 30 - 0 = 30V$$

$$V_{th} = 30V$$



$$R_{th} = \frac{4 \times 12}{4 + 12} + 1 = 4\Omega$$

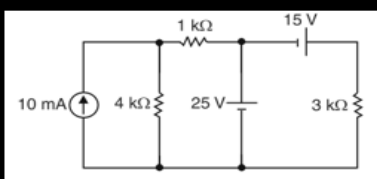


$$I = \frac{30}{4 + 2}$$

$$I_{R_L} = 5A$$

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ET – SPECIAL CLASS



Using Superposition theorem find the voltage across $1k\Omega$



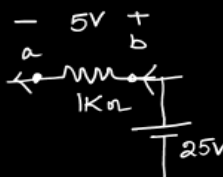
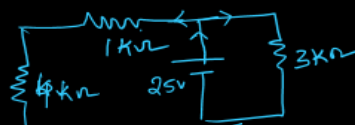
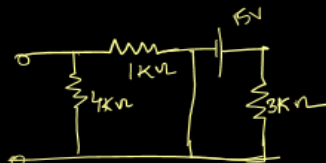
$$I_{1k\Omega} = 0 \quad V_{1k\Omega} = 0 \times 1 = 0V$$

$$I_{1k\Omega} = 10m \times \frac{4k}{5k} = 8mA$$

$$V_{1k\Omega} = 1k\Omega \times 8mA = 8V$$

$$I_{1k\Omega} = \frac{25}{5}m$$

$$V_{1k\Omega} = \frac{25}{5}m \times 1k = 5V$$



$$V_{10mA} = 8V$$

$$V_{25V} = -5V$$

$$V_{15V} = 0V$$

$$V_{1k\Omega} = V_{10mA} + V_{25V} + V_{15V}$$

$$V_{1k\Omega} = 8V + (-5V) + 0 = 3V$$

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

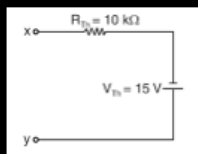
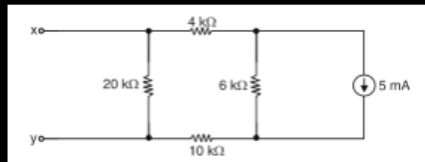
ELECTRICAL TECHNOLOGY

LECTURE NOTES

Compiled for the students of RGUKT

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ET – SPECIAL CLASS

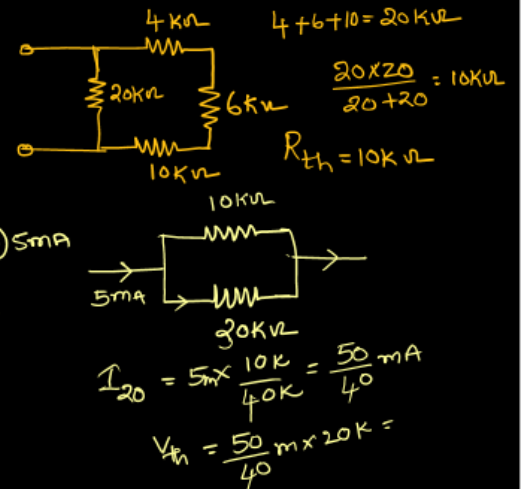
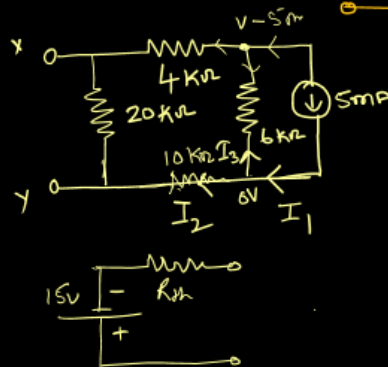


$$\frac{V-0}{6} + \frac{V}{34} = -5$$

$$V = -25.5$$

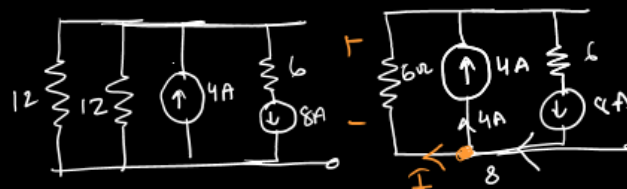
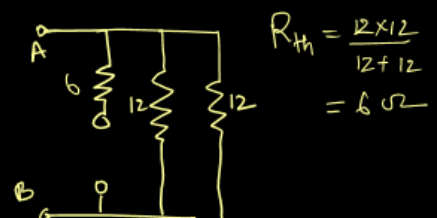
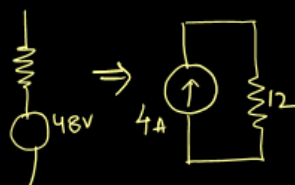
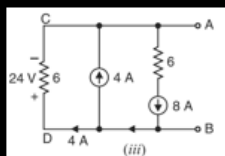
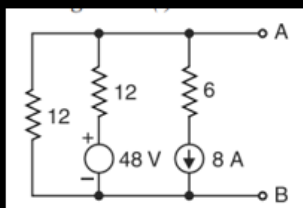
$$\frac{-25.5}{34} \times 20 = -15V$$

find V_{th} x R_{th}



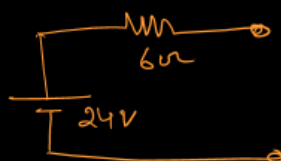
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ET – SPECIAL CLASS



$$I = 4$$

$$V_{th} = 6 \times 4 = 24V$$



DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

ELECTRICAL TECHNOLOGY

LECTURE NOTES

Compiled for the students of RGUKT

RGUKT