Paper 1, TDC Part-1
Chapter– 3, Mesh and Node Analysis

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Mesh and Nodal Analysis in Passive Circuits

Nodal Analysis

This is another methods for analysing circuits.
This method is based on 'KCL'.

What is node?

→ It is a point in a circuit where terminals (ends) of two or more circuit elements meet.

In nodal analysis method we consider (take) those node of a circuit where at least 3 or more circuit elements meet.

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In a complex circuit the number of nodes increases. Let the circuits have 'N' nodes in all. One of these nodes is chosen as the reference (datum) node. The voltages of remaining (N-1) nodes with respect to the reference node form an independent set of variables that implicitly satisfies KVL equations.

(N-1) KCL equations are written down at the nodes.

For a resistive network this step results in (N-1) simultaneous algebraic equations in (N-1) nodal voltages. Once the nodal

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voltages are obtained, any voltage and current in the network can be obtained from these.

For demonstration, consider the following circuit discussed below.

Q 1)

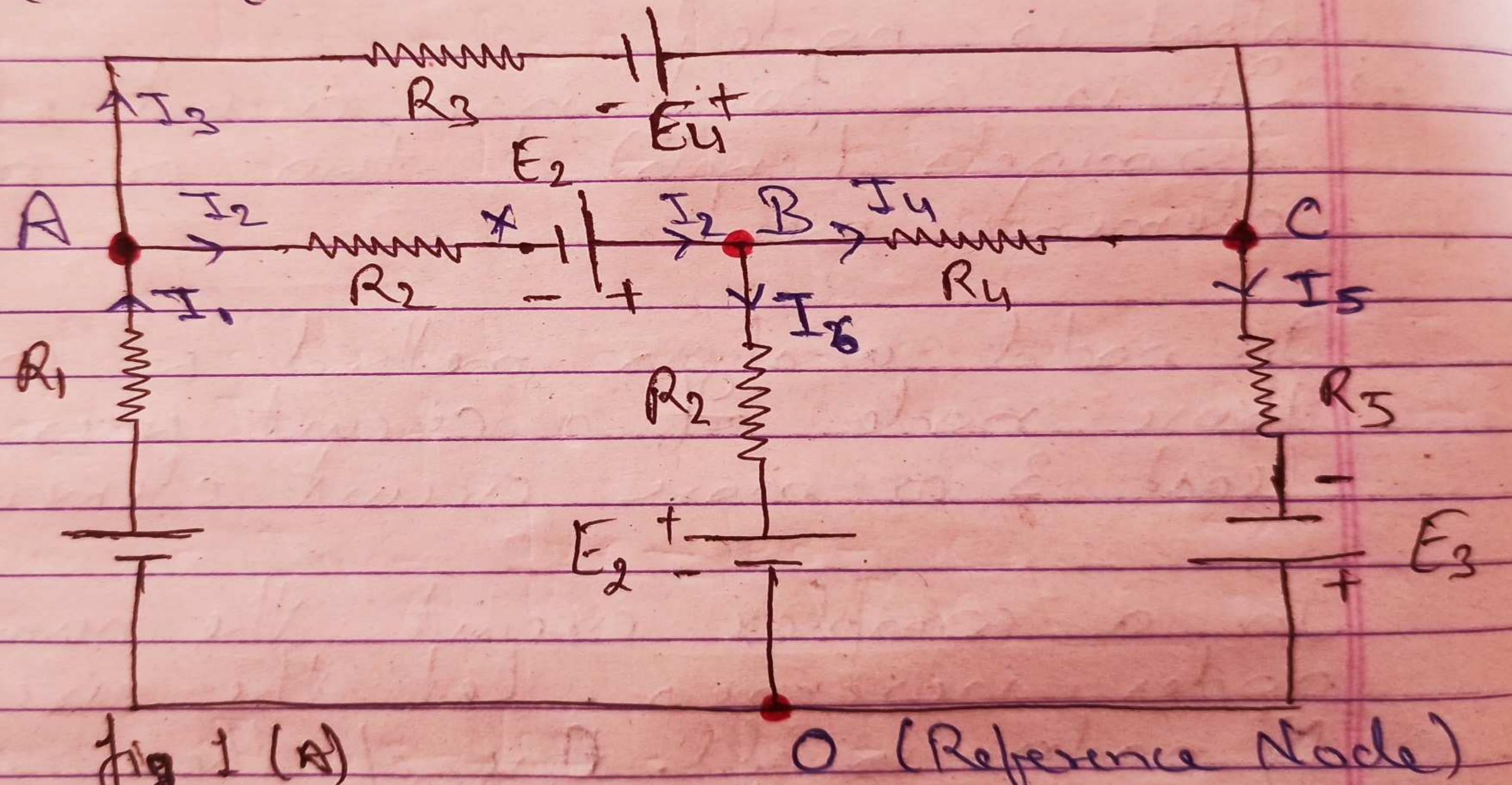

fig 1 (A)

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Fig 1 (A)　　　　O (Reference Node)

Find the current in each branch of the circuit, shown in figure 1 (A).

Soln: First of all in nodal analysis method we identify the **nodes** (i.e. those point where more than 2 branch elements ends are joined) in a circuit and name those ~~nodes~~ identified **nodes** as A, B, C & O.

So there are 4 nodes i.e. $n = 4$

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Now choose a reference node. Let the reference node be 'O'. (A reference node can be any node and a reference node is a node with respect to that potential of other nodes calculated.

So here we get V_{AO}, V_{BO}, V_{CO}

[If C is our reference node then we calculate V_{AC}, V_{BC}, & V_{OC}]

V_{AO} → It is the potential of node A with respect to node O.

Similarly for V_{BO} & V_{CO}

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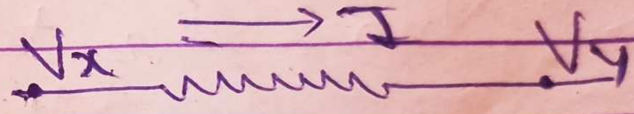
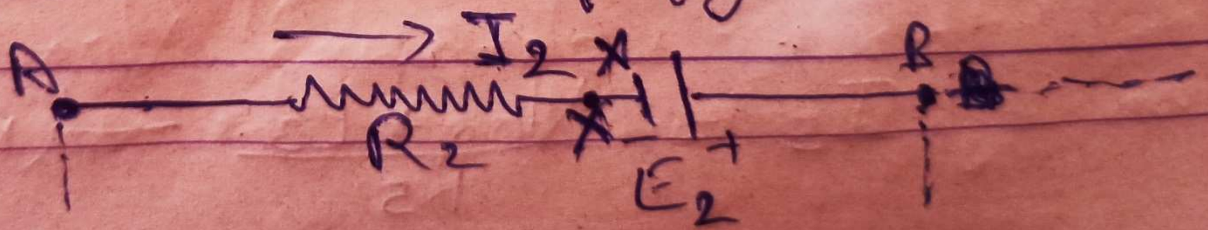
Now, if some how we find the value of V_{AO}, V_{BO} & V_{CO} then we can find ~~the~~ all of the branch current as ~~now~~ we know that

$$I = \frac{V_{xy}}{R} = \frac{V_x - V_y}{R}$$



So if the potential at the nodes ~~of~~ are known then we can find the branch current.

Consider branch AB of figure 1(A).



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Let the current I_2 flows the branch AB i.e. through the resistor R_2

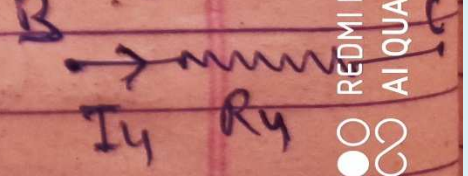
then $I_2 = \dfrac{V_{AX}}{R_2} = \dfrac{V_{AO} - V_{XO}}{R_2}$

and $V_{XO} = -E_2 + V_{BO}$

So, $I_2 = \dfrac{V_{AO} - V_{BO} + E_2}{R_2}$ —— (i)

Let the different branch currents are I_1, I_2, I_3, I_4, I_5 & I_6 as shown in figure 1(a).

the current $I_4 = \dfrac{V_{BC}}{R_4} = \dfrac{V_{BO} - V_{CO}}{R_4}$ —— (ii)



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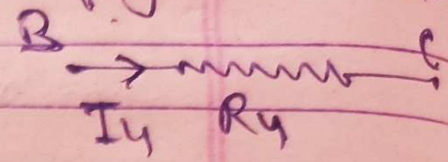
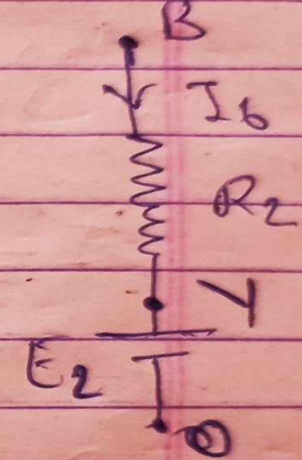


the current $I_4 = \frac{V_{BC}}{R_4} = \frac{V_{BO} - V_{CO}}{R_4}$ → (ii)

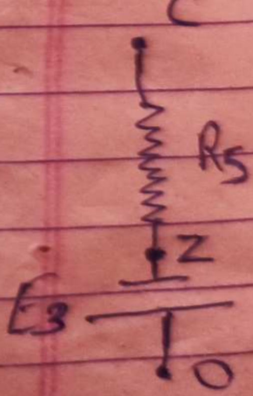


current $I_6 = \frac{V_{BY}}{R_2} = \frac{V_{BO} - V_{YO}}{R_2}$

and $V_{YO} = E_2 + V_O = E_2$

$V_O = 0$

So $I_6 = \frac{V_{BO} - E_2}{R_2}$ —— (iii)



Illy $I_5 = \frac{V_{CZ}}{R_5} = \frac{V_{CO} - V_{ZO}}{R_5}$

and $V_{ZO} = -E_3$

$I_5 = \frac{V_{CO} + E_3}{R_5}$ —— (iv)

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Illy, $I_3 = \frac{V_{AC}}{R_3} = \frac{V_{AO} - (-E_4 + V_{CO})}{R_3}$

$= \frac{V_{AO} + E_4 - V_{CO}}{R_3}$ ——(v)

and at last Illy $I_1 = \frac{E_1 - V_{AO}}{R_1}$ —(vi)

So if the potentials of all the nodes A, B & C are known then we can find the branch currents, I_1, I_2, I_3, I_4, I_5 & I_6.

Now to solve for V_{AO}, V_{BO} & V_{CO} we will write KCL at nodes A, B, & C respectively.

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For any query contact- 9771474020

Thank You