Paper 1, TDC Part-1
Chapter– 3, Mesh and Node Analysis
Nodal Analysis - 6

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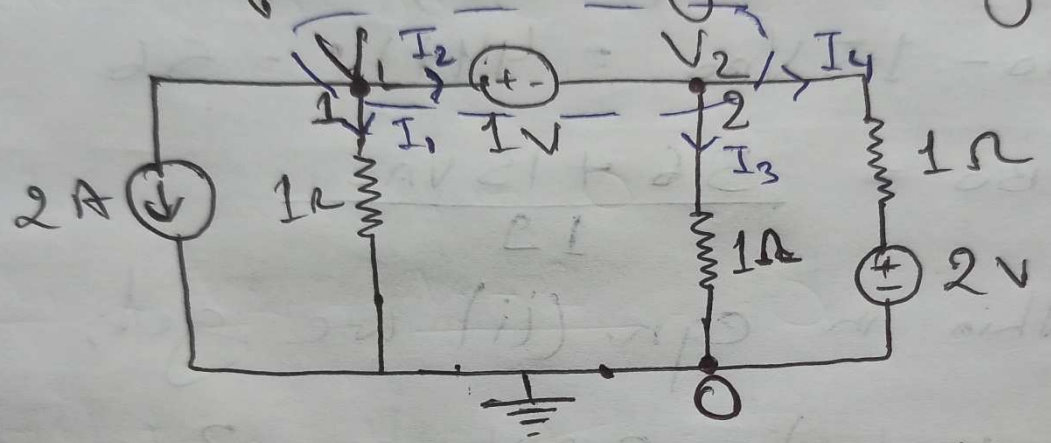
Mesh and Nodal Analysis in Passive Circuits

Q1) Find V_1 and V_2 and also different branch currents of the ckt given using super node meth



Sol:- In the given problem let us first name the nodes which we consider for nodal analysis. Let the nodes are 1, 2 and 0. Where 0 is reference node.

Let the different branch currents are I_1, I_2, I_3 & I_4 as shown in the ckt. diagram.

Since there is only voltage source between the nodes 1 and 2

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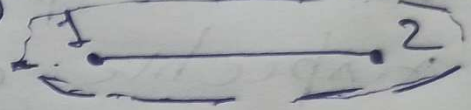
Since there is only voltage source between the nodes 1 and 2 so we will consider super node 1-2 (i.e. node 1, 2 and voltage source 1V are



then we have

$$V_1 - V_2 = 1 \quad \text{——}$$

$$\text{or, } V_1 = 1 + V_2 \quad \text{——} \quad (i)$$

Now applying KCL at supernode (1-2) we get at node 1 there is no incoming currents only outgoing currents 2A, I_1 and at node 2 also there is no incoming currents, we have only outgoing currents I_3 & I_4 so KCL at supernode (1-2).

$$2 + I_1 + I_3 + I_4 = 0$$

$$\frac{V_1}{1} + \frac{V_2}{1} + \frac{V_2 - 2}{1} = 0$$

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or, ~~2 +~~ $V_1 + V_2 + V_2$ ~~-2~~ $= 0$

putting $V_1 = 1 + V_2$ from eqn (i) we get,

$1 + V_2 + V_2 + V_2 = 0 \Rightarrow V_2 = -1/3$ V

then, $V_1 = 1 - \frac{1}{3} = \frac{2}{3}$ V

So the branch currents are,

$I_1 = \frac{V_1}{1} = \frac{\frac{2}{3}}{1}$ A, $I_3 = \frac{-\frac{1}{3}}{1}$ A $= -\frac{1}{3}$ A

$I_4 = \frac{-\frac{1}{3} - 2}{1} = -\frac{7}{3}$ A

Apply KCL at node 1,

$2 + I_1 + I_2 = 0$

or, $I_2 = -\left(2 + \frac{2}{3}\right) = -\frac{8}{3}$ A

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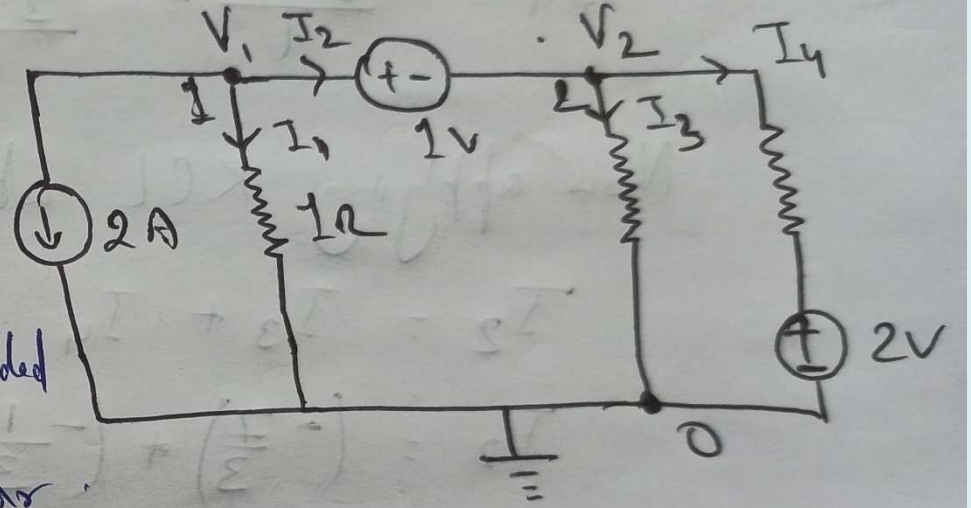
Now let us discuss this problem by another method where we consider node 2 as reference node

In this method again first we identify the nodes that 1, 2 and 0 where node 0 is grounded



Here we consider V_2 as our reference node. Let the different branch currents are I_1, I_2, I_3 & I_4 as shown in figure.

Since node 2 is our reference node so,

$V_1 - V_2 = 1$

$V_1 = 1 + V_2$ —— (i)

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As we get V_1 so no need to write KCL for V_1
Now our other node is 0. So applying KCL at 0. we get,

$$2 + I_1 + I_3 + I_4 = 0$$

$$2 + \frac{V_1}{1} + \frac{V_2}{1} + \frac{V_2 - 2}{1} = 0$$

$$2 + (V_2 + 1) + V_2 + V_2 - 2 = 0 \quad \text{[Putting } V_1 = V_2 + 1 \text{ from eqn (1)]}$$

$$3V_2 + 1 = 0$$

$$V_2 = -1/3$$

then $V_1 = 1 - \frac{1}{3} = 2/3$

So the different branch currents are

$$I_1 = \frac{V_1}{1} = \frac{\frac{2}{3}}{1} = \frac{2}{3} \text{ A},$$

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So the different branch currents are

$$I_1 = \frac{V_1}{1} = \frac{\frac{2}{3}}{1} = \frac{2}{3}\ A,$$

$$I_3 = \frac{V_2}{1} = \frac{-\frac{1}{3}}{1} = -\frac{1}{3}\ A$$

$$I_4 = \frac{V_2 - 2}{1} = \frac{-\frac{1}{3} - 2}{1} = -\frac{7}{3}\ A$$

Now applying KCL at node 2, we have.

$$I_2 = I_3 + I_4$$

$$I_2 = \left(-\frac{7}{3}\right) + \left(-\frac{1}{3}\right) = -\frac{8}{3}\ A$$

So I_2 is going ~~out~~ from node 2 to 1.

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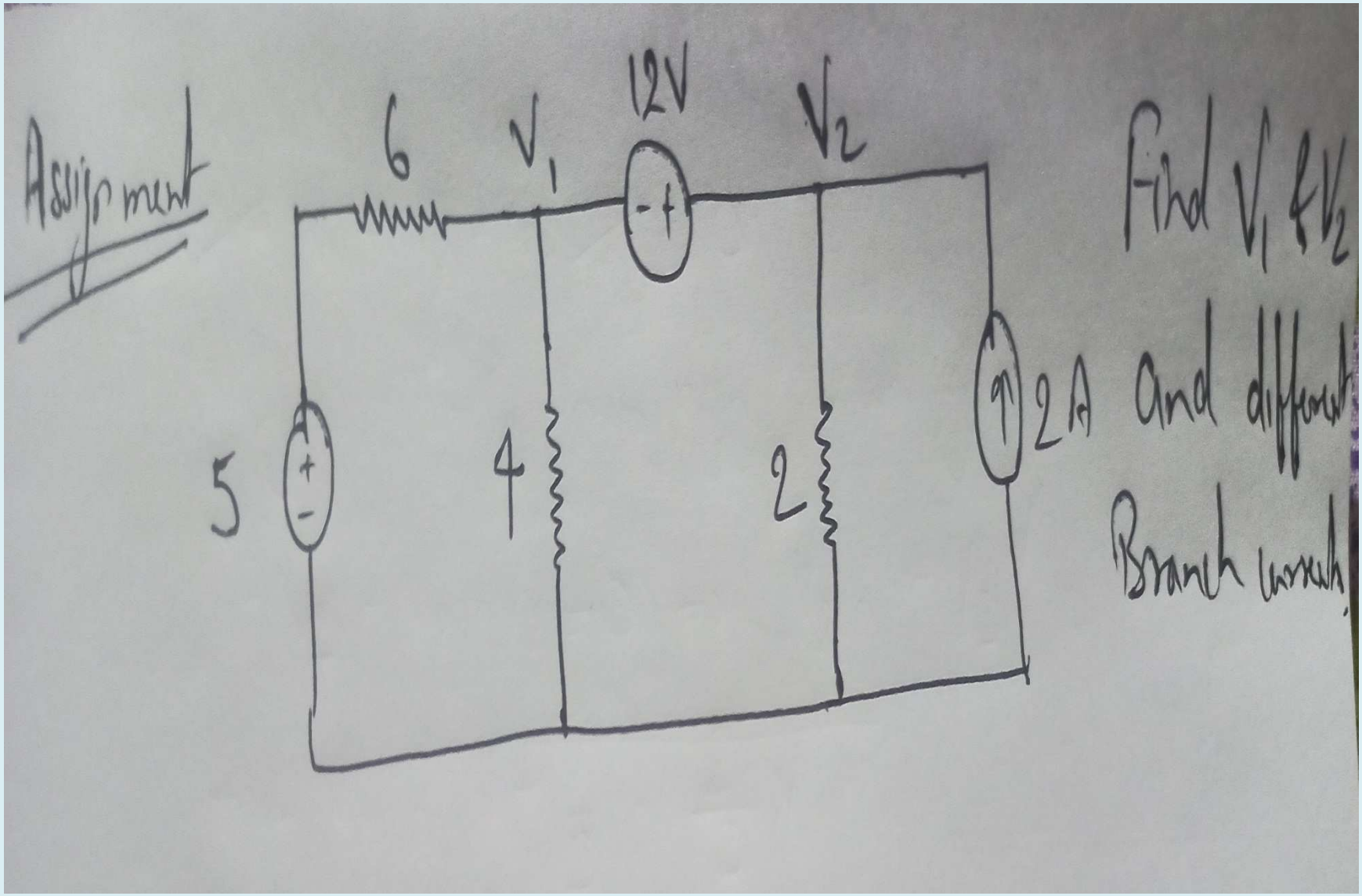

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For any query contact- 9771474020

Thank You