Basic Electrical Engineering (TEE 101)

Lecture 9: Numerical Practice on Mesh Analysis

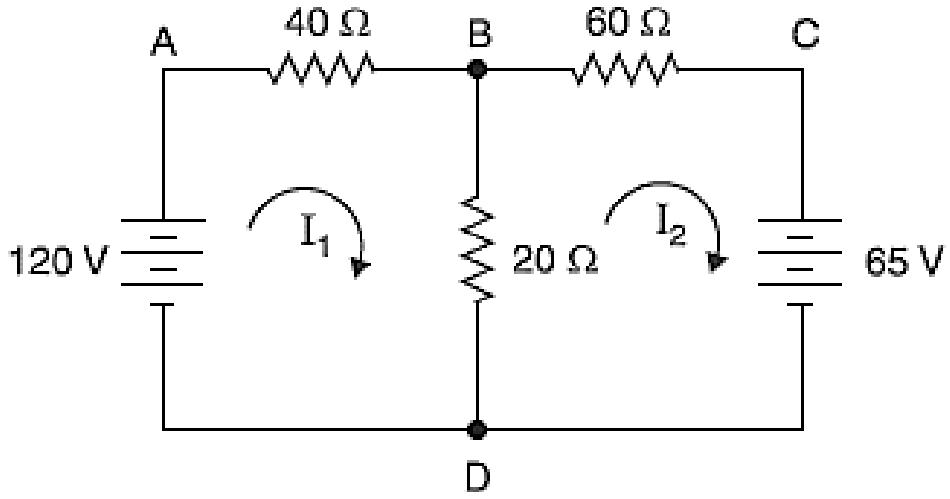
Content

This lecture covers the numerical practice on Mesh Analysis for the:

- **Circuit with two meshes**
- **Super mesh Case**

Case – 1: Circuit with 2 meshes and voltage sources

In the network shown in Figure below, find the magnitude of each branch current by mesh current method.



In this circuit, there are 02 meshes. Hence, there will be 02 mesh equations in this problem.

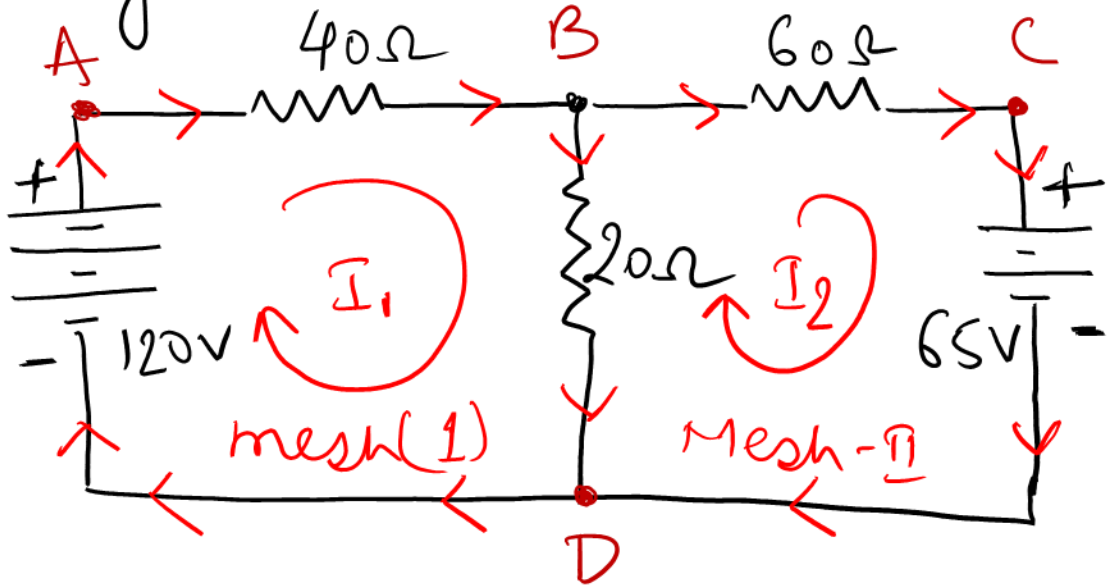
Step 1 :- Identify the number of meshes.

Step 2 :- Take current in each branch of the network and assume their direction. You can assume any direction of branch current in bilateral circuits

Step 3 :- Now, assume the current in each mesh. The direction of mesh currents can be taken either clockwise or anti-clockwise

Mark these mesh currents. Let these currents are I_1 and I_2 and are circulating in clockwise direction

Now, lets draw the circuit diagram



The KVL equation of mesh-I is :

$$120 + (-I_1 \times 40) - (I_1 - I_2) \times 20 = 0$$

$$120 - 40I_1 - 20I_1 + 20I_2 = 0$$

$$-60I_1 + 20I_2 = -120$$

$$\boxed{3I_1 - I_2 = 6} \quad \text{---------- (1)}$$

Similarly, apply KVL in mesh-II we get :

$$-60 \times I_2 - 65 - (I_2 - I_1) \times 20 = 0$$

$$-60I_2 - 65 - 20I_2 + 20I_1 = 0$$

$$20I_1 - 80I_2 = 65$$

$$4I_1 - 16I_2 = 13 \quad \text{——} (2)$$

We can solve eq^n (1) and (2) to calculate the mesh currents I_1 and I_2.

$$[3I_1 - I_2 = 6] \times 16$$
$$[4I_1 - 16I_2 = 13] \times 1$$

$$48I_1 - 16I_2 = 96$$
$$4I_1 - 16I_2 = 13$$
$$- \quad + \quad -$$
$$44I_1 = 83$$

$$I_1 = \frac{83}{44} = \boxed{1.886\,A} \quad \text{——} (3)$$

The value of I_2 can be calculated using the value of I_1 in either eq^n (1) or (2). So,

$$4 \times \left(\frac{83}{44}\right) - 16I_2 = 13$$

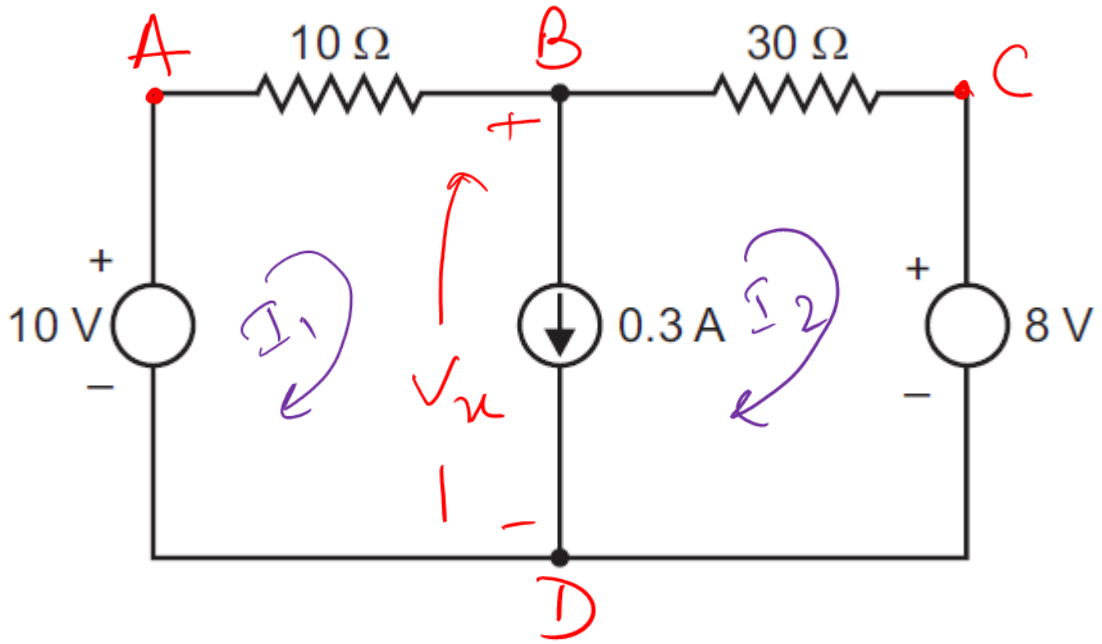
$$\boxed{I_2 = -0.341\ A} \quad \text{——} (4)$$

The current through branch BD is

$$I_1 - I_2 = 1.886 - (-0.341)$$
$$= \boxed{2.227\ A} \quad \text{——} (5)$$

Case -3: Super Mesh Case

Use mesh current method to determine currents through each of the resistance in the circuit shown in Figure below:



A super mesh take place when a current source is contained between two essential meshes. The circuit is first treated as if the current source is not there. This leads to one equation that incorporates two mesh currents.

Let us assume a voltage across the current source, which is (for example) V_x

Now apply KVL

$$10 - 10I_1 - V_x = 0 \quad \text{—(1)}$$

and

$$-30I_2 - 8 + V_x = 0 \quad \text{—(2)}$$

add eqn (1) and (2)

$(10 - 10I_1 - V_x) + (-30I_2 - 8 + V_x) = 0$

or, $10 - 8 - 10I_1 - 30I_2 = 0$

or, $-10I_1 - 30I_2 = -2$

or, $\boxed{5I_1 + 15I_2 = 1}$ — (3)

Now; The Current in the current Source can be written as:

$\boxed{I_1 - I_2 = 0.3}$ — (4)

Now, we can Solve eq^n. (3) and (4) to determine the values of I_1 and I_2.

$[5I_1 + 15I_2 = 1] \times 1$

$[I_1 - I_2 = 0.3] \times 5$

$5I_1 + 15I_2 = 1$

$5I_1 - 5I_2 = 1.5$

$-\quad\quad +\quad\quad -$

$20I_2 = -0.5$

$I_2 = \frac{-0.5}{20} = -0.025A$

Substitute this value of I_2 in any eqn (i.e either eqn ③ or eqn ④) we get

$$I_1 - (-0.025) = 0.3$$

or, $$I_1 + 0.025 = 0.3$$

$$I_1 = 0.3 - 0.025$$

$$\boxed{I_1 = 0.275\ A}$$

$$\boxed{I_2 = -0.025\ A}$$

⇒ Ans

The negative sign of I_2 indicates that the actual direction of flow of this current is opposite to that we assumed.

i.e the current is flowing from D → C → B and not from B → C → D as assumed

Thank You