ELEMENTS OF ELECTRICAL ENGINEERING

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Mesh Analysis in the networks with Current Sources

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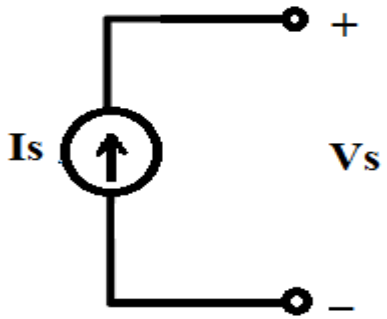
Mesh Analysis in the networks with current sources

- We cannot write a KVL in the mesh containing current sources.
- Voltage across an ideal current source is unknown.



- Hence, there is a slight change in the procedure when applying Mesh Analysis in such cases.

Mesh Analysis in the networks with current sources - Procedure

Step 1: Identify the number of meshes in the network.

Step 2: Assign one mesh current in each mesh preferably in the same direction.

Step 3: Write KVL in the meshes without current sources. Write Current Equation in the Meshes with current sources.

Step 4: Solve simultaneous equations to obtain Mesh currents.

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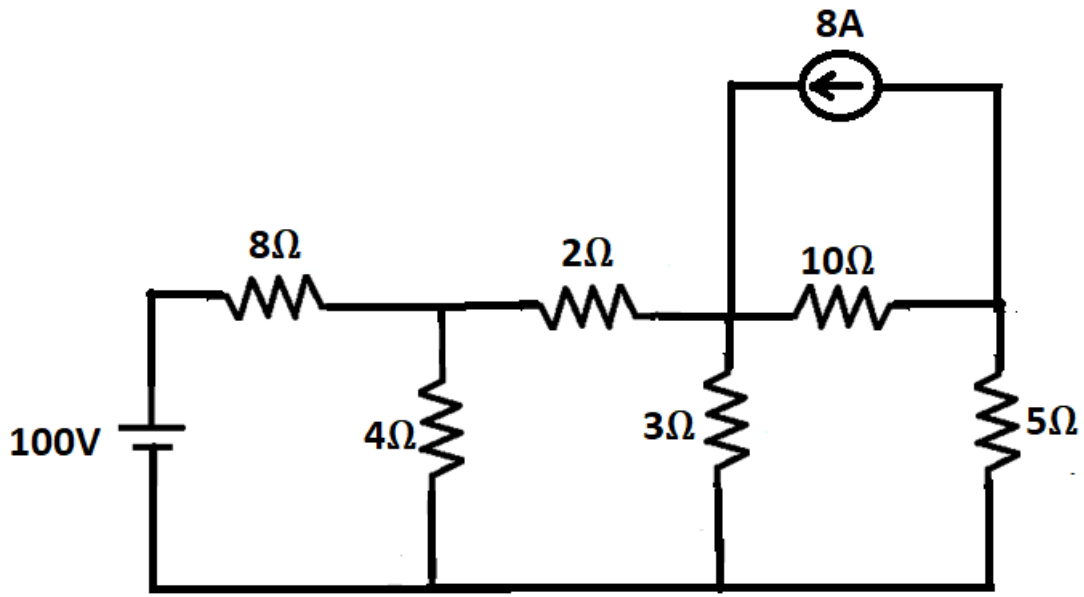
Numerical Example 1

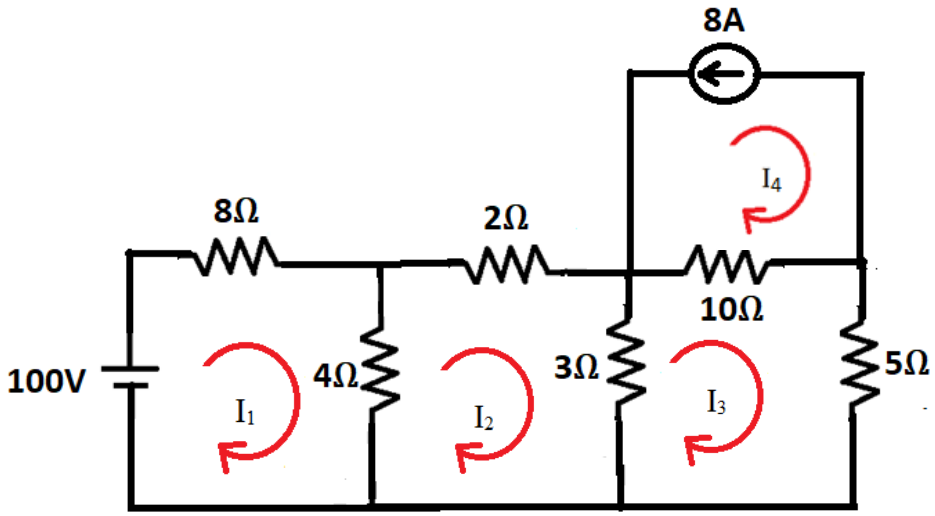
Question:

Obtain current through 4Ω resistor using Mesh Analysis.



Numerical Example 1

Solution:



Number of Meshes = 4

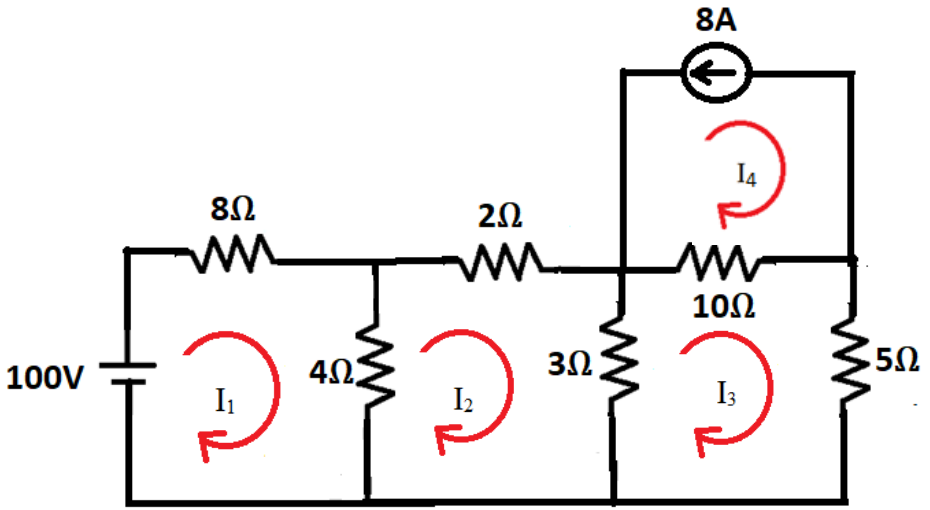
KVL (Mesh 1) : $-8I_1-4(I_1-I_2)+100 = 0$

i.e., $12I_1-4I_2-0I_3-0I_4 = 100$ ---- (1)

KVL (Mesh 2) : $-4I_1+9I_2-3I_3-0I_4 = 0$ ---- (2)

Numerical Example 1

Solution (Continued..):



KVL (Mesh 3) : $0I_1-3I_2+18I_3-10I_4 = 0$ ---- (3)

Current Equation (Mesh 4) : $I_4 = -8$ ---- (4)

Solving (1), (2), (3) & (4), $I_1 = 9.26A$; $I_2 = 2.79A$; $I_3 = -3.97A$

Current through 4Ω resistor = $(I_1 \sim I_2) = (I_1-I_2) = 6.47A$

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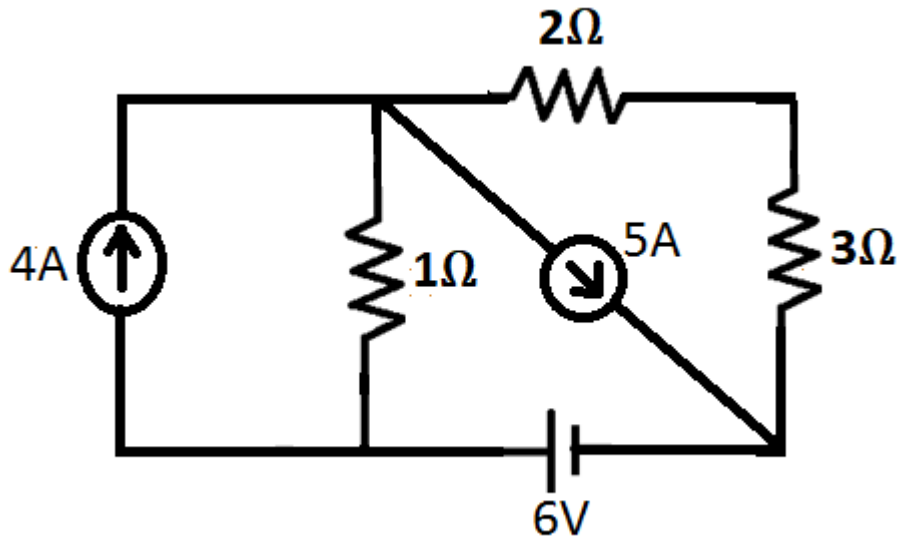
Numerical Example 2

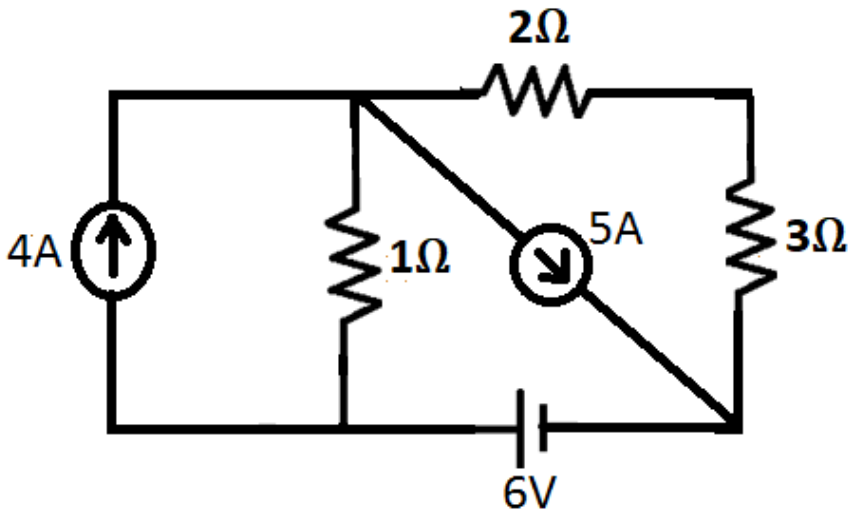
Question:

Obtain voltage across 3Ω resistor using Mesh Analysis.



Numerical Example 2

Solution:



- Whenever a current source is common to two meshes, it creates a supermesh.
- In Such networks, either supermesh technique is applied (or) network is rearranged to confine that common current source to any one mesh.

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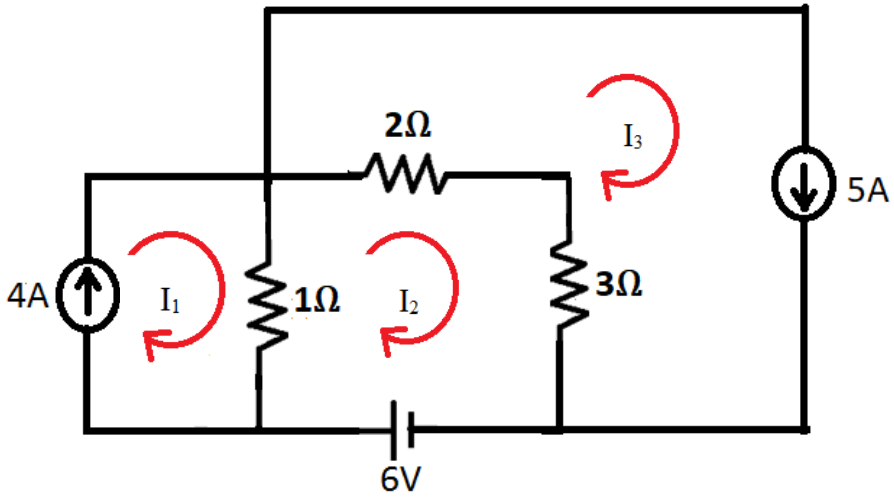
Numerical Example 2

Solution (Continued) :



Current Equation (Mesh 1) : $I_1 = 4$ ---- (1)

KVL (Mesh 2) : $-I_1+6I_2-5I_3 = 6$ ---- (2)

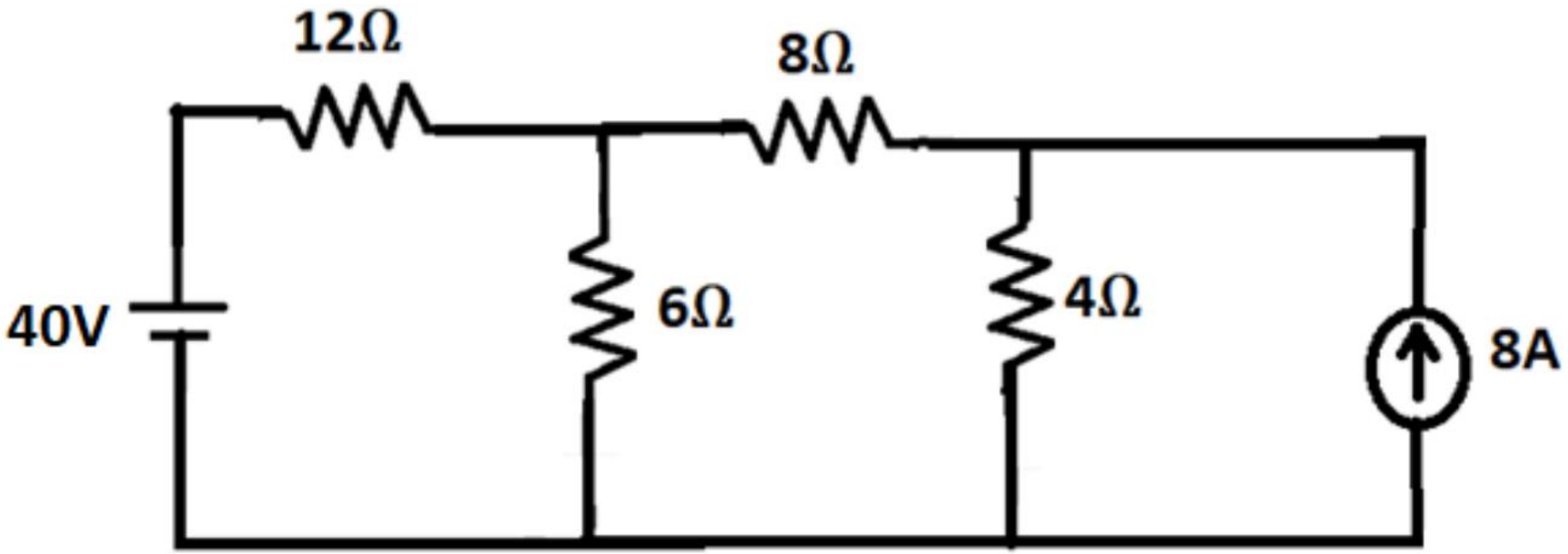
Current Equation (Mesh 3) : $I_3 = 5$ ---- (3)

Solving (1), (2) & (3), $I_2 = 5.83A$

Current through 3Ω resistor = $(I_2 \sim I_3) = (I_2-I_3) = 0.83A$

Voltage across 3Ω resistor = 2.49V

Q. Find the current through the 6Ω resistor



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Text Book & References

Text Book:

1. "Basic Electrical Engineering" S.K Bhattacharya, 1st Edition Pearson India Education Services Pvt. Ltd., 2017
2. "Basic Electrical Engineering", D. C. Kulshreshta, 2nd Edition, McGraw-Hill. 2019
3. "Special Electrical Machines" E G Janardanan, PHI Learning Pvt. Ltd., 2014

Reference Books:

1. "Engineering Circuit Analysis" William Hayt, Jack Kemmerly, Jamie Phillips and Steven Durbin, 10th Edition McGraw Hill, 2023

2. "Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 12th Edition, Pearson Education, 2016.

THANK YOU

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