EEE1024: Fundamentals of Electrical and Electronics Engineering

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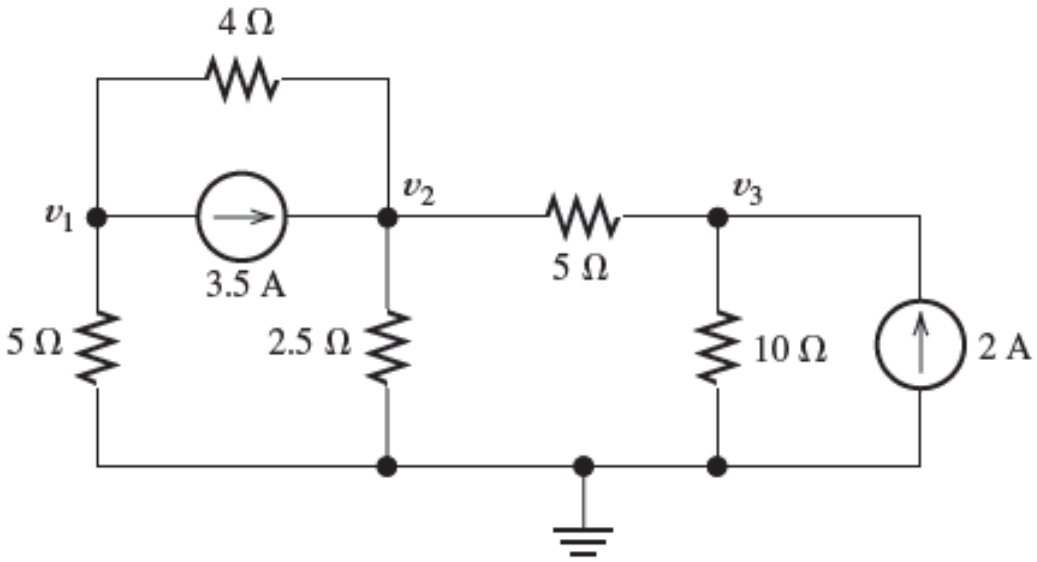
Node Voltage Analysis - Practice

Q1:



$$\frac{v_1}{5} + \frac{v_1 - v_2}{4} + 3.5 = 0$$

@1

$$0.45v_1 - 0.25v_2 = -3.5$$

$$\frac{v_2 - v_1}{4} + \frac{v_2}{2.5} + \frac{v_2 - v_3}{5} = 3.5$$

@2

$$-0.25v_1 + 0.85v_2 - 0.2v_3 = 3.5$$

$$\frac{v_3 - v_2}{5} + \frac{v_3}{10} = 2$$

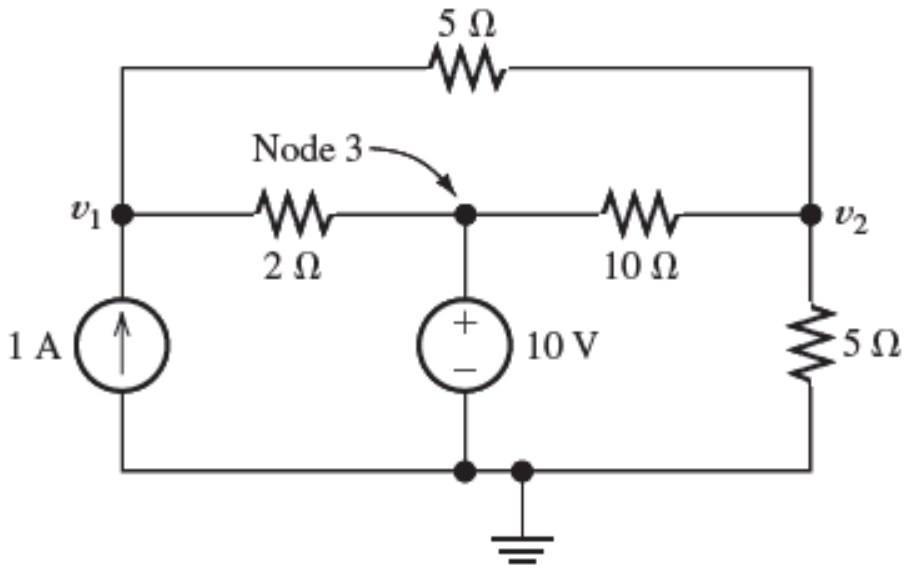
@3

$$-0.2v_2 + 0.35v_3 = 2$$

$V_1 = -5V$ $V_2 = 5V$ $V_3 = 10V$

Node Voltage Analysis - Practice

Q 2:



$$\frac{v_1 - v_2}{5} + \frac{v_1 - 10}{2} = 1$$

@1

$$0.7v_1 - 0.2v_2 = 6$$

$$\frac{v_2}{5} + \frac{v_2 - 10}{10} + \frac{v_2 - v_1}{5} = 0$$

@2

$$-0.2v_1 + 0.5v_2 = 1$$

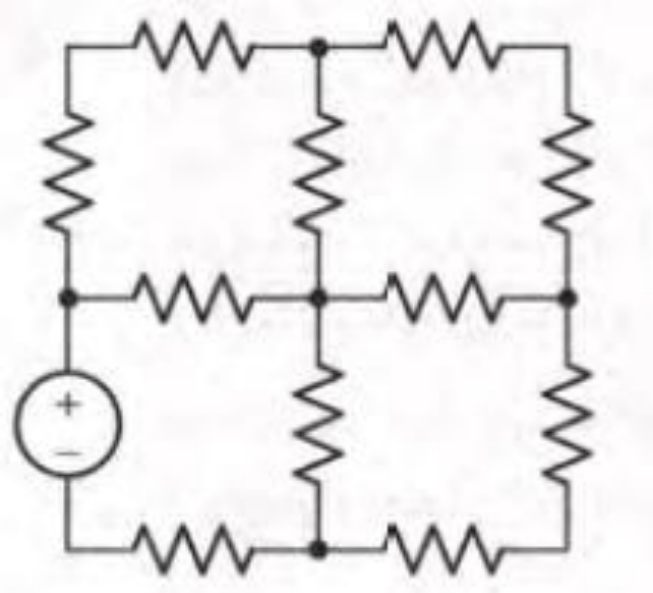
V_1 = 10.32V

V_3 = 10 V

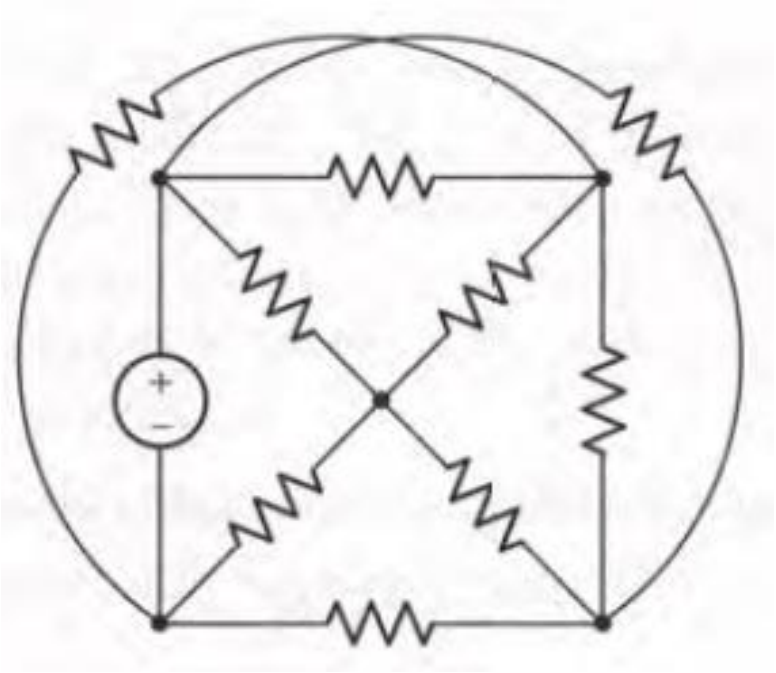
V_2 = 6.129V

MESH CURRENT ANALYSIS

Mesh Current Analysis



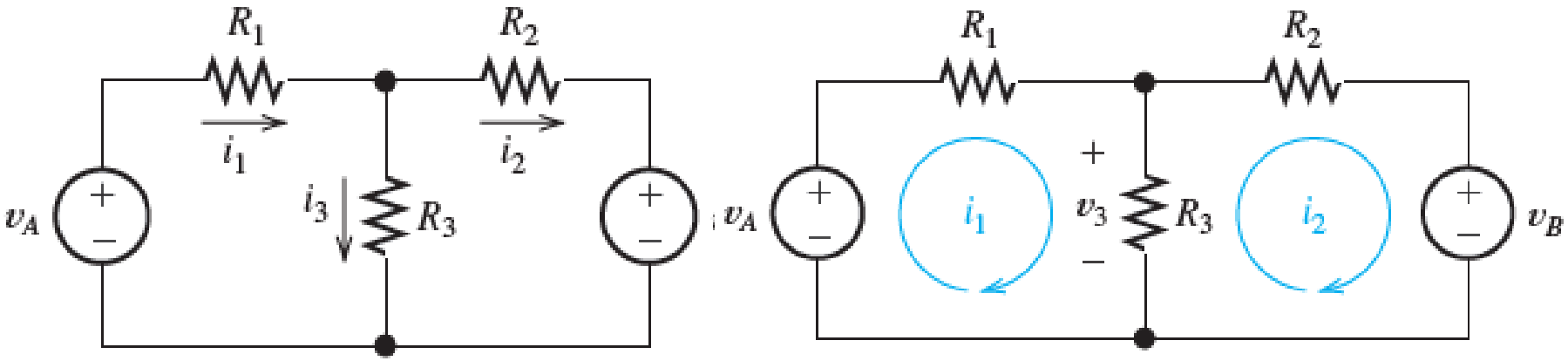
PLANAR Networks



NON-PLANAR Networks

Mesh Current / Loop Current

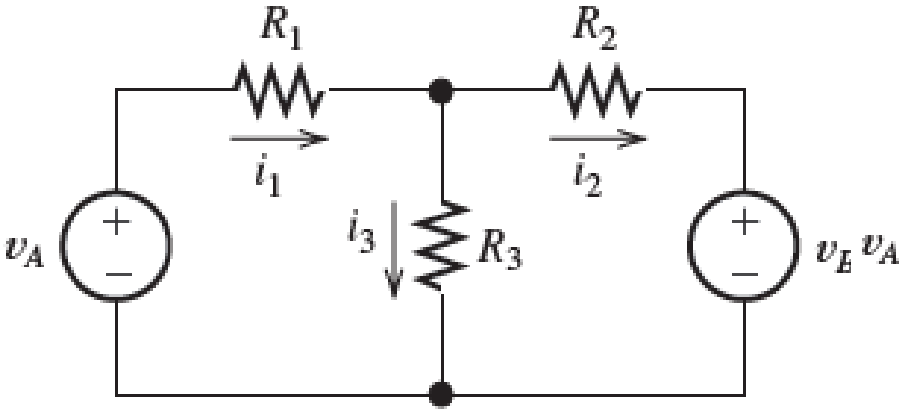
Branch current Vs Mesh current

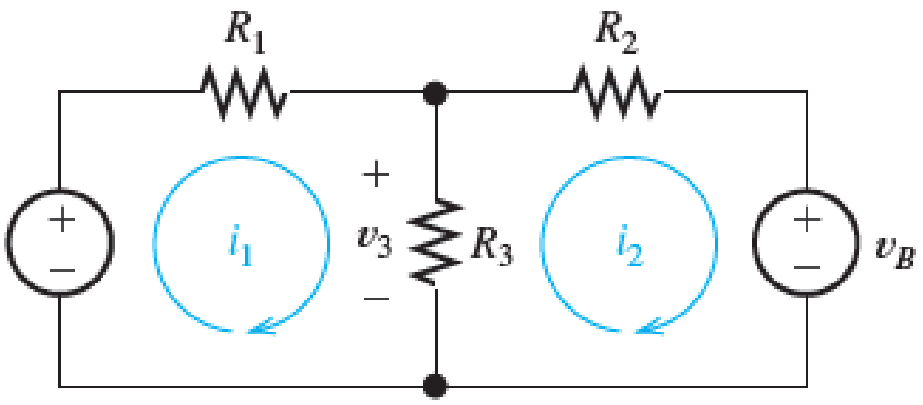


Branch currents – through elements

Mesh currents

Advantage of Mesh Current Analysis





$$R_1 i_1 + R_3 i_3 = v_A$$

$$-R_3 i_3 + R_2 i_2 = -v_B$$

} **KVL**

$$i_1 = i_2 + i_3$$

} **KCL**

Substitute for i_3

$$R_1 i_1 + R_3(i_1 - i_2) = v_A$$

$$-R_3(i_1 - i_2) + R_2 i_2 = -v_B$$

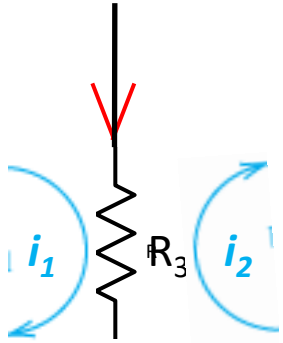
Branch currents – i_1, i_2, i_3

1. Draw meshes
2. Solve easy ones
3. Write KVL for the rest
4. Solve

Apply KVL to each mesh

$$R_1 i_1 + R_3(i_1 - i_2) = v_A$$

$$-R_3(i_1 - i_2) + R_2 i_2 = -v_B$$



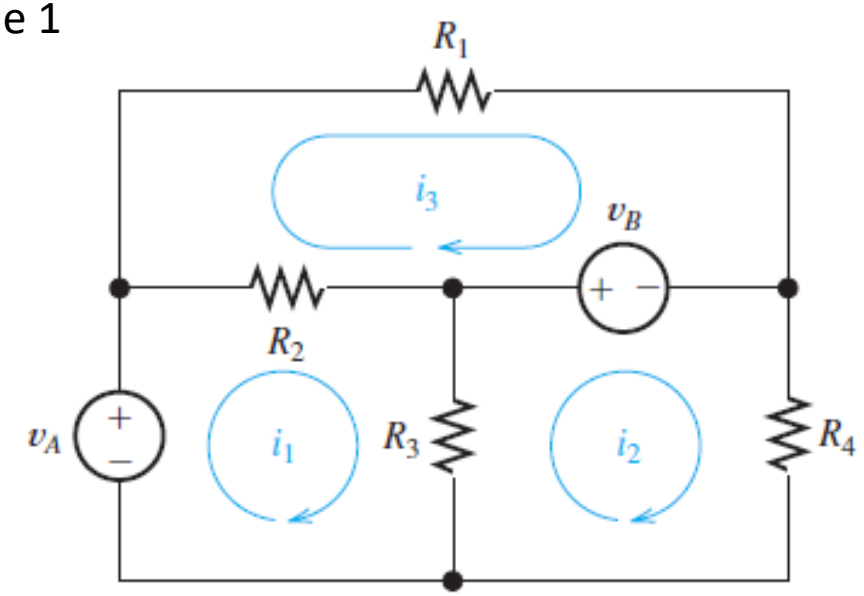
$i_{R3} = i_1 - i_2$

Mesh currents - i_1, i_2

Save 2 steps!!!

Mesh current method

Example 1



$$(R_2 + R_3)i_1 - R_3i_2 - R_2i_3 = v_A$$
$$-R_3i_1 + (R_3 + R_4)i_2 = -v_B$$
$$-R_2i_1 + (R_1 + R_2)i_3 = v_B$$

Apply KVL to each mesh, starting with Mesh 1

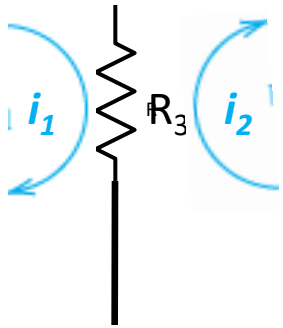
$$R_2(i_1 - i_3) + R_3(i_1 - i_2) - v_A = 0$$

KVL @ Mesh 2

$$R_3(i_2 - i_1) + R_4i_2 + v_B = 0$$

KVL @ Mesh 3

$$R_2(i_3 - i_1) + R_1i_3 - v_B = 0$$



R times current in the mesh under consideration minus the adjacent mesh!

Acknowledgements

1. H. Hayt, J.E. Kemmerly and S. M. Durbin, ‘Engineering Circuit Analysis’, 6/e, Tata McGraw Hill, New Delhi, 2011
2. Allan R. Hambley, ‘Electrical Engineering - Principles & Applications, Pearson Education, First Impression, 6/e, 2013