EEE1024: Fundamentals of Electrical and Electronics Engineering

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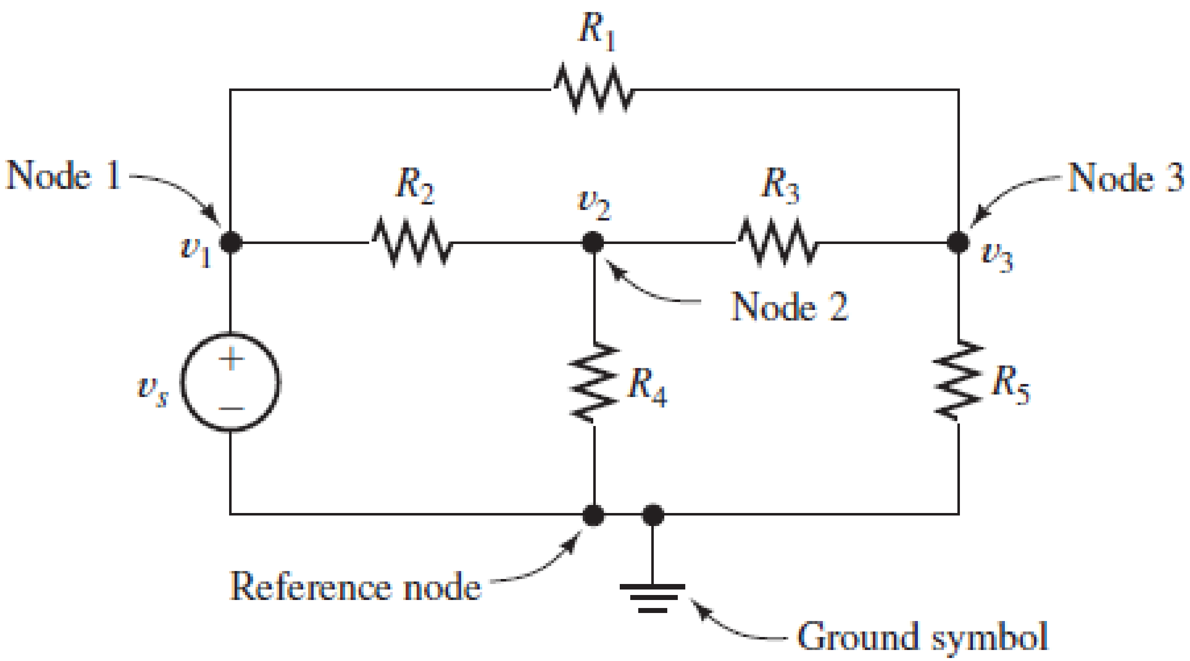
NODE VOLTAGE ANALYSIS

Node Voltage Analysis



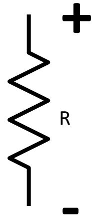
Series or parallel combinations – no use for this circuit!

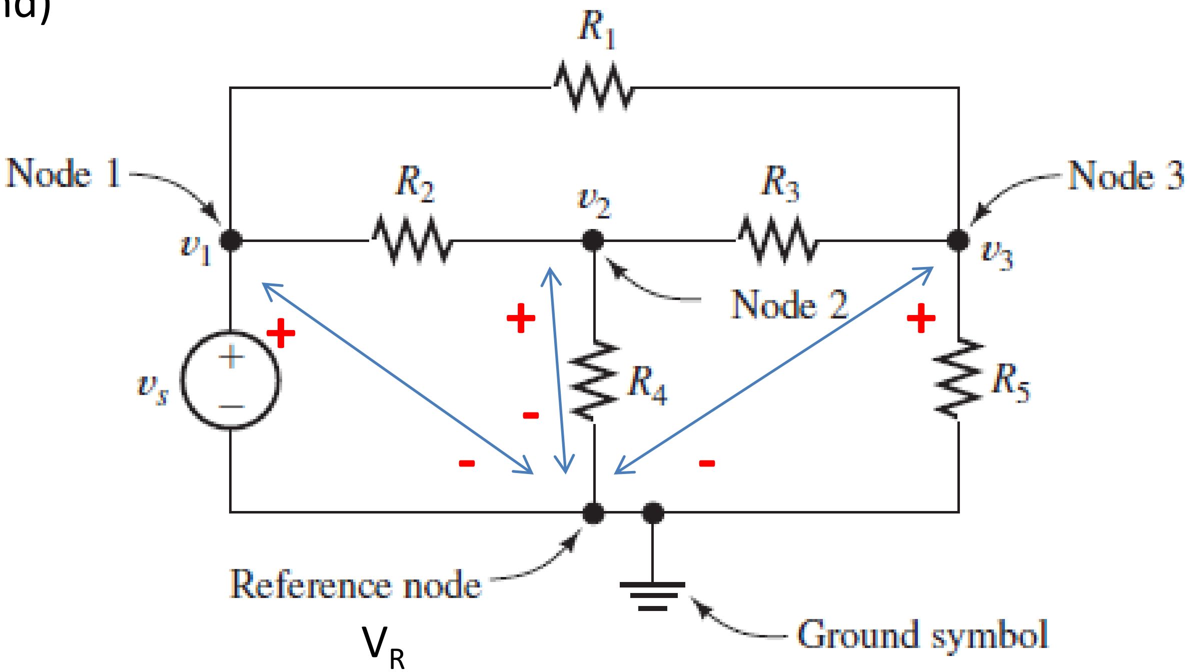
Node Voltage Analysis

Example 1:

1. Assign a Reference Node (Ground)

2. Assign **node voltage** names to remaining nodes.





3. Solve easy nodes first (which have a source connected to ref. node)

4. Write KCL for each node (ohm's law in mind)

5. Solve for all node voltages

Node Voltage Analysis - 1

Example 1:

@ Node 1, $v_1 = v_s$

KCL @ Node 3

$$\frac{(v_3 - v_1)}{R_1} + \frac{(v_3 - v_2)}{R_3} + \frac{(v_3 - 0)}{R_4} = 0$$

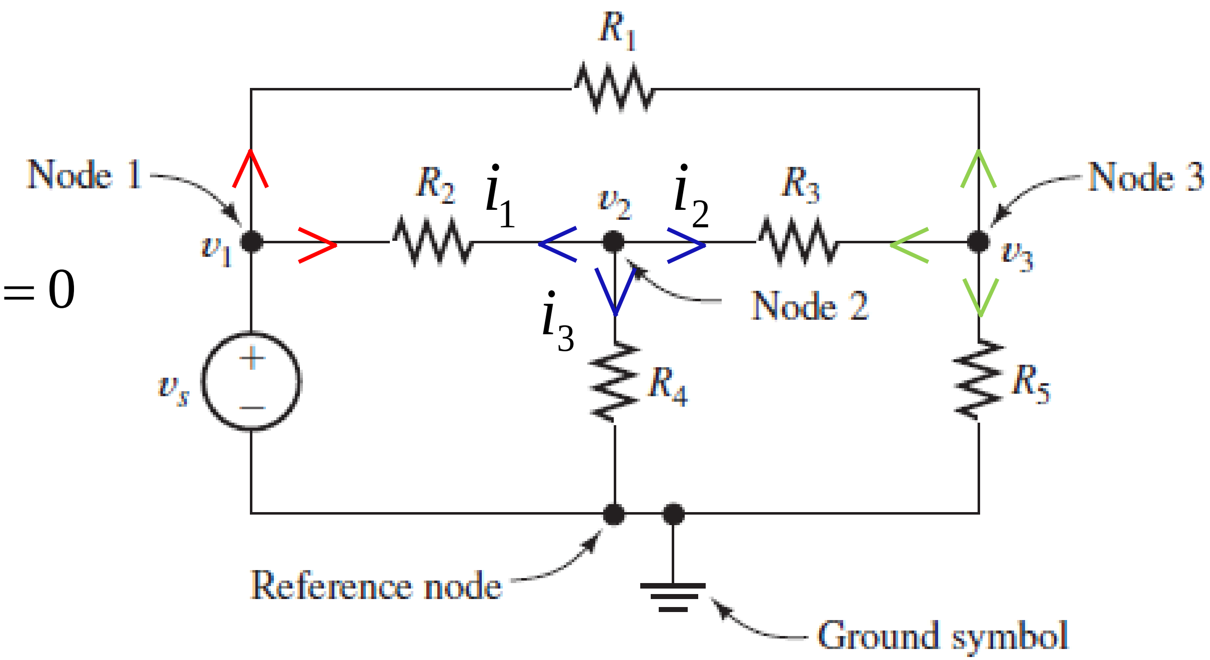
KCL @ Node 1

$$\frac{(v_1 - v_3)}{R_1} + \frac{(v_1 - v_2)}{R_2} = 0$$

KCL @ Node 2

$$i_1 + i_2 + i_3 = 0$$

$$\frac{(v_2 - v_1)}{R_2} + \frac{(v_2 - v_3)}{R_3} + \frac{(v_2 - 0)}{R_4} = 0$$



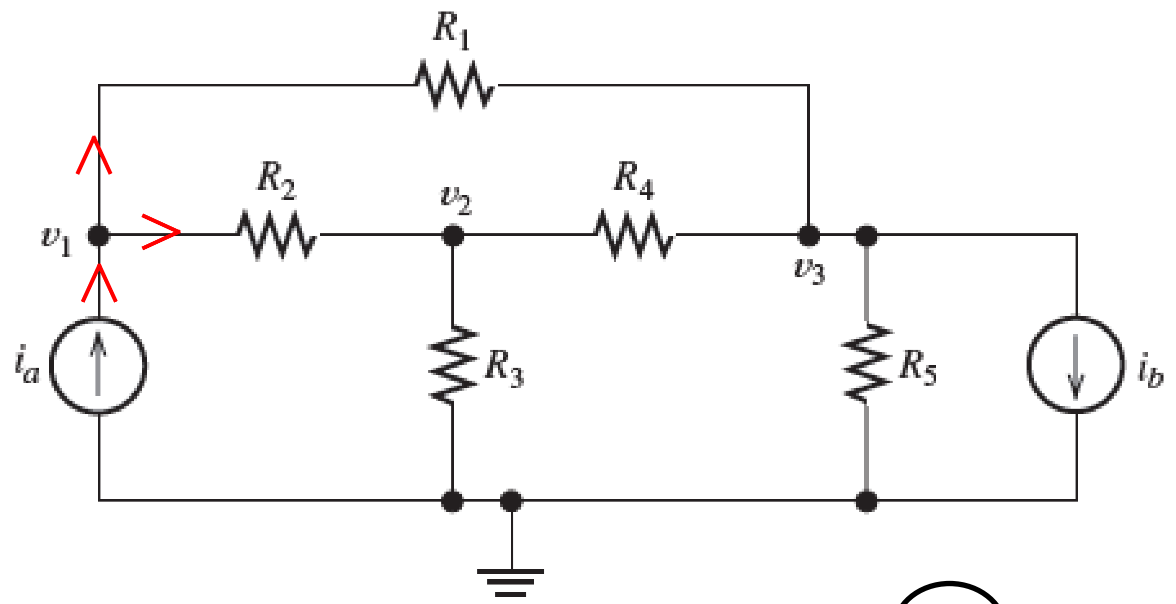
Add all currents leaving the node and set the sum to zero

– if there is a current source ???

Node Voltage Analysis - 2

Example 2:

Use KCL and find equations at each node



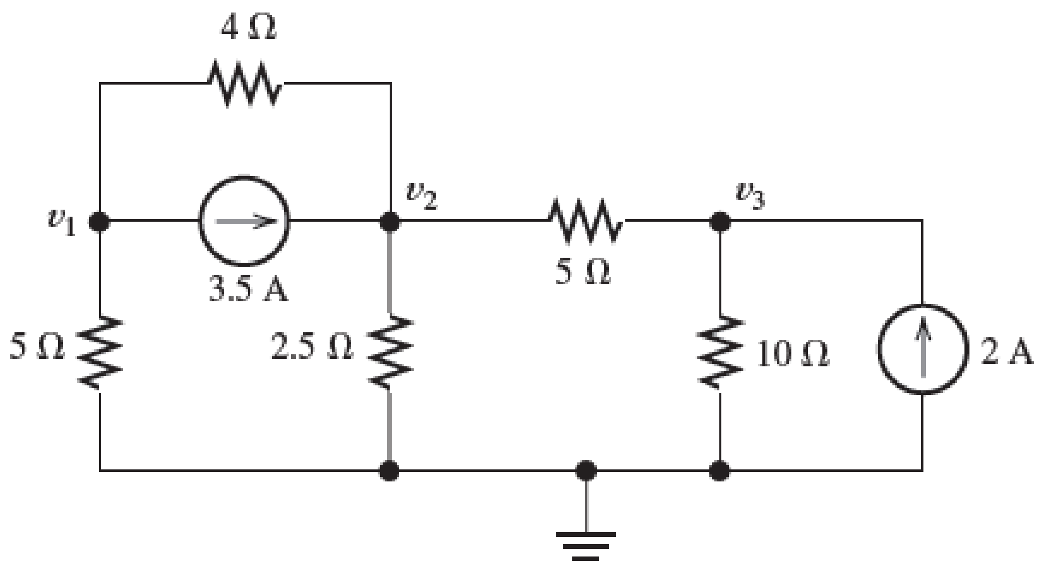
$$\frac{(v_1 - v_3)}{R_1} + \frac{(v_1 - v_2)}{R_2} = i_a \qquad (1)$$

$$\frac{(v_2 - v_1)}{R_2} + \frac{(v_2 - v_3)}{R_4} + \frac{v_2}{R_3} = 0 \qquad (2)$$

$$\frac{(v_3 - v_2)}{R_4} + \frac{(v_3 - v_1)}{R_1} + \frac{v_3}{R_5} + i_b = 0 \qquad (3)$$

Node Voltage Analysis - Practice

Q1:



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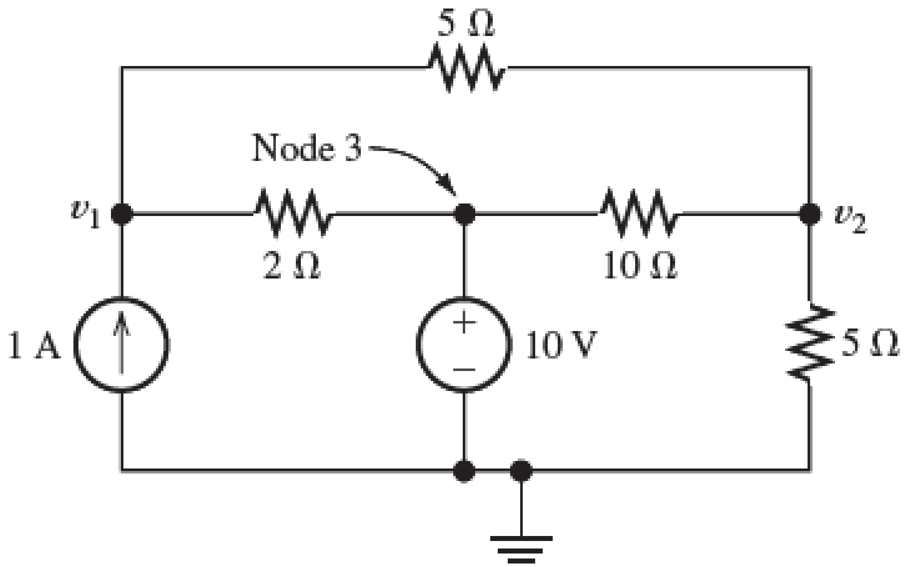
Node Voltage Analysis - Practice

Q 2:



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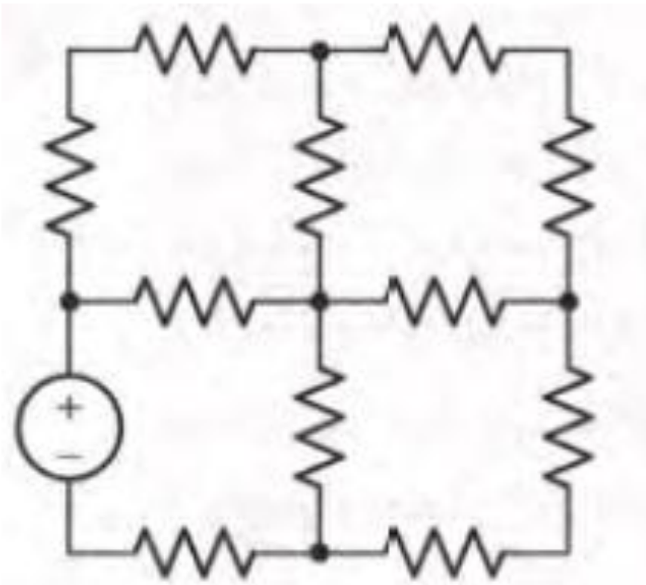
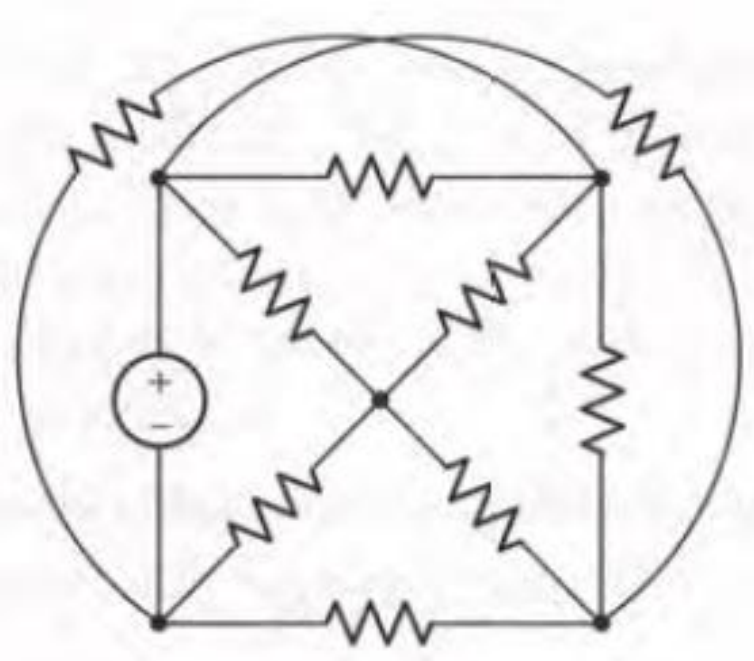
MESH CURRENT ANALYSIS

Mesh Current Analysis



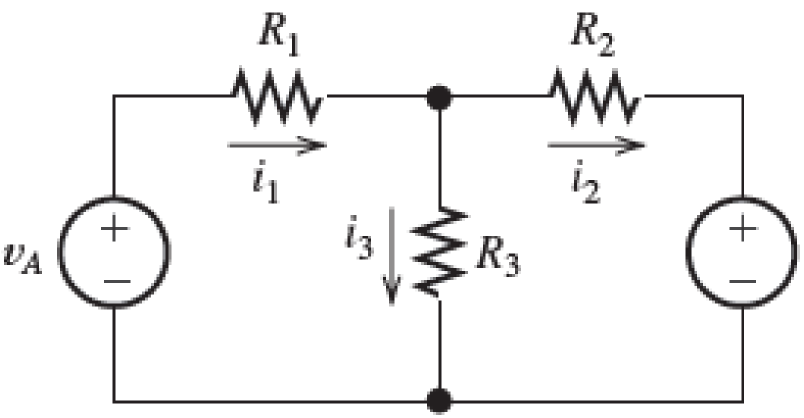
PLANAR Networks

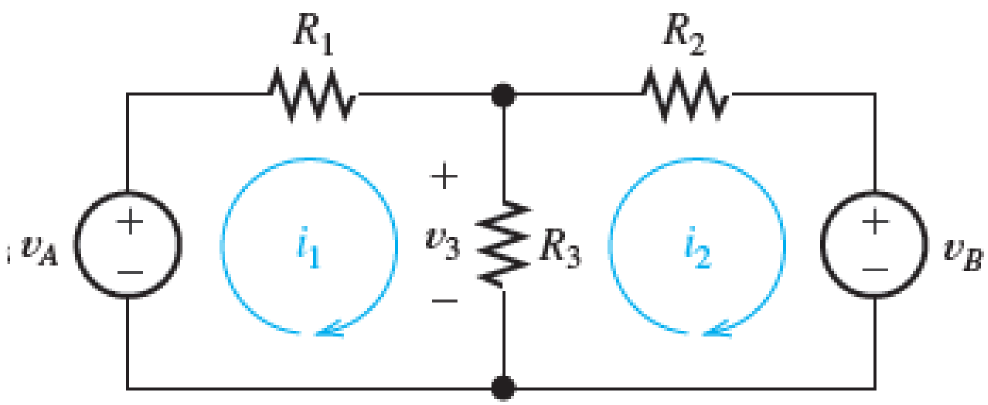


NON-PLANAR Networks

Mesh Current / Loop Current

Branch current Vs Mesh current

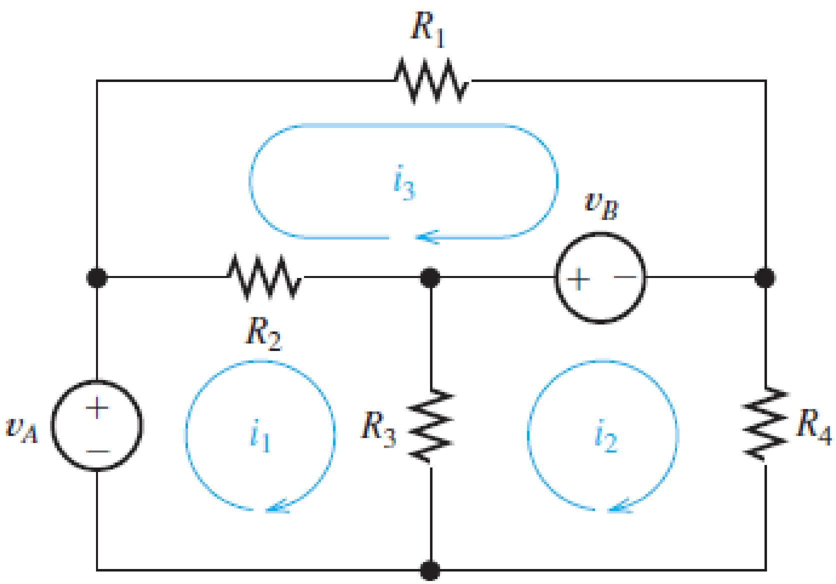


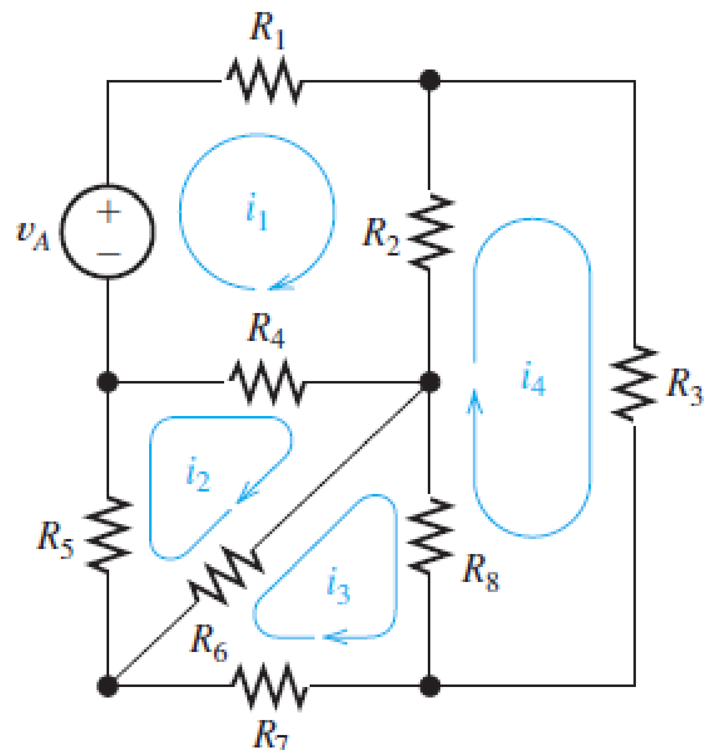


Branch currents – through elements

Mesh currents

How to choose the mesh currents?





In complicated circuits, this method comes in handy!

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