Lecture 5: Nodal & Mesh Analysis (Supplementary Slides)

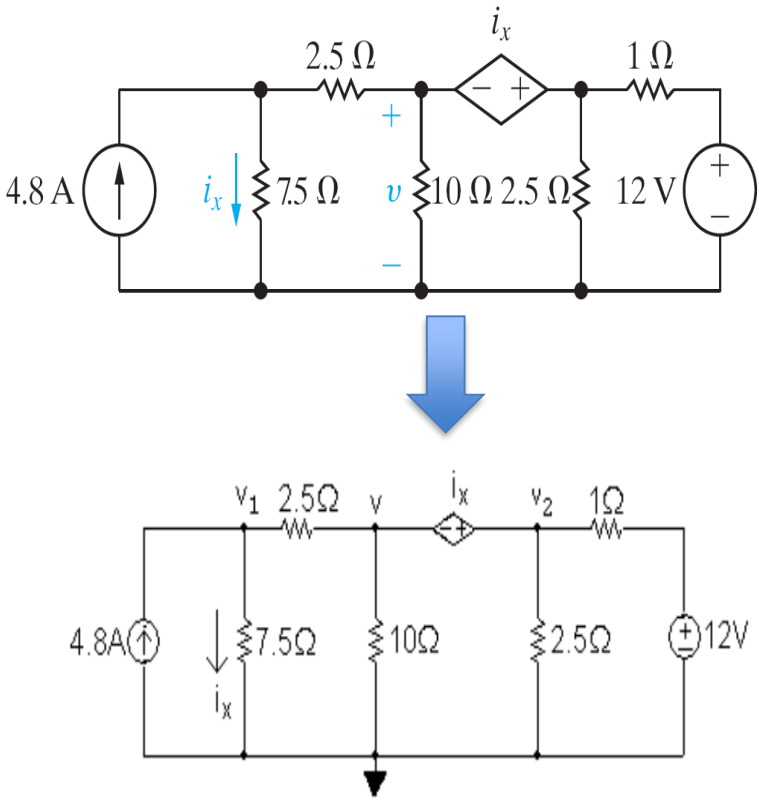
Instructors: Ogbonnaya Bassey &

Dr. Karen Butler-Purry

ECEN 214 – Electrical Circuit Theory (Spring 2020)

Example 2 (Assessment Problem 4.5)

Use the node-voltage method (that is nodal analysis) to find v in the circuit on the top right

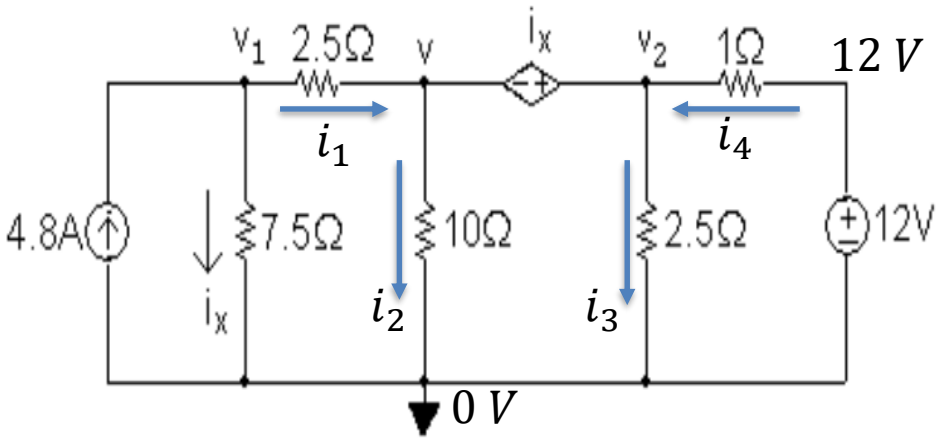


Choose a reference node, specify the nodal voltage variables at the remaining essential nodes

Note that v and v_2 nodes form a super node

Example 2 (Assessment Problem 4.5)

The current directions have been assigned arbitrarily



KCL at v_1 node (eq 1):

$i_1 + i_x = 4.8 \rightarrow \frac{v_1 - v}{2.5} + \frac{v_1}{7.5} = 4.8$

$\rightarrow 4v_1 - 3v = 36 \quad (1)$

KCL at the supernode (eq 2):

$$i_1 + i_4 = i_2 + i_3 \rightarrow \frac{v_1 - v}{2.5} + \frac{12 - v_2}{1} = \frac{v}{10} + \frac{v_2}{2.5}$$

$-0.4v_1 + 1.4v_2 + 0.5v = 12 \quad (2)$

Constraint equation due to supernode (eq 3):

$v_2 - v = i_x \rightarrow v_2 - v = \frac{v_1}{7.5}$

$\rightarrow v_1 - 7.5v_2 + 7.5v = 0 \quad (3)$

Example 2 (Assessment Problem 4.5)

In matrix form

$$\begin{bmatrix} 4 & 0 & -3 \\ -0.4 & 1.4 & 0.5 \\ 1 & -7.5 & 7.5 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v \end{bmatrix} = \begin{bmatrix} 36 \\ 12 \\ 0 \end{bmatrix}$$

Solving the matrix equation gives,

$v_1 = 15\,V, v_2 = 10\,V, v = 8\,V$