Electrical Circuit-I

10th Lecture-Tutorial

MESH ANALYSIS

By:

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Ref: Robert L. Boylestad, *INTRODUCTORY CIRCUIT ANALYSIS*, Pearson Prentice Hall, Eleventh Edition, 2007

Example (6)

Write the mesh equations for the network in Fig. 6, and find the current I2 through the 7 Ω resistor

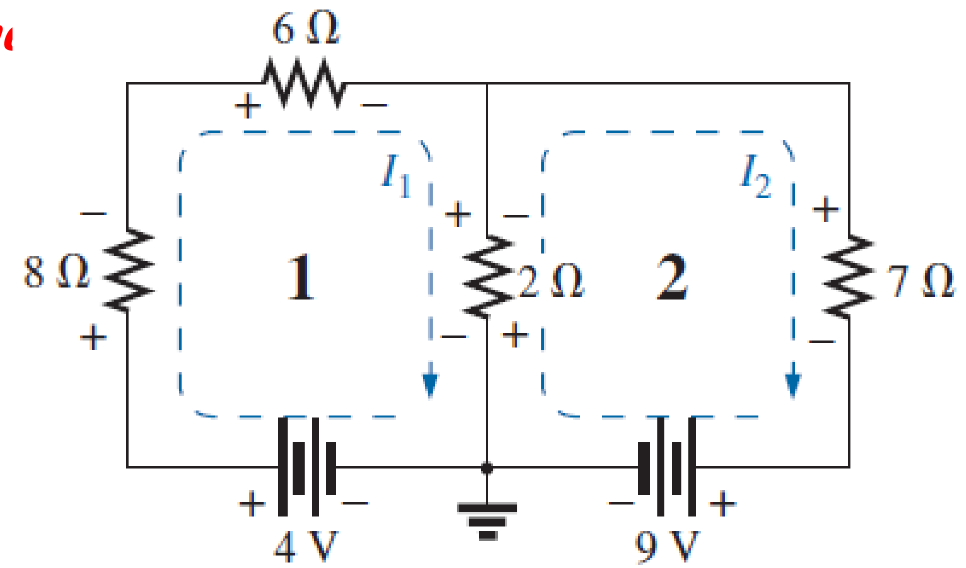

FIG. 6

Solution:

Step 1:

Step 1: As indicated in Fig. 6, each assigned loop current has a clockwise direction.

Steps 2 to 4:

$$I_1: \quad (8\ \Omega + 6\ \Omega + 2\ \Omega)I_1 - (2\ \Omega)I_2 = 4\ \text{V}$$
$$I_2: \quad (7\ \Omega + 2\ \Omega)I_2 - (2\ \Omega)I_1 = -9\ \text{V}$$

and

$$16I_1 - 2I_2 = 4$$
$$-2I_1 + 9I_2 = -9$$

which, for determinants, are

and

$$I_2 = I_{7\Omega} = \frac{\begin{vmatrix} 16 & 4 \\ -2 & -9 \end{vmatrix}}{\begin{vmatrix} 16 & -2 \\ -2 & 9 \end{vmatrix}} = \frac{-144 + 8}{144 - 4} = \frac{-136}{140}$$

$$= \mathbf{-0.97\ A}$$

Example (7)

Write the mesh equations fo the network in Fig. 7

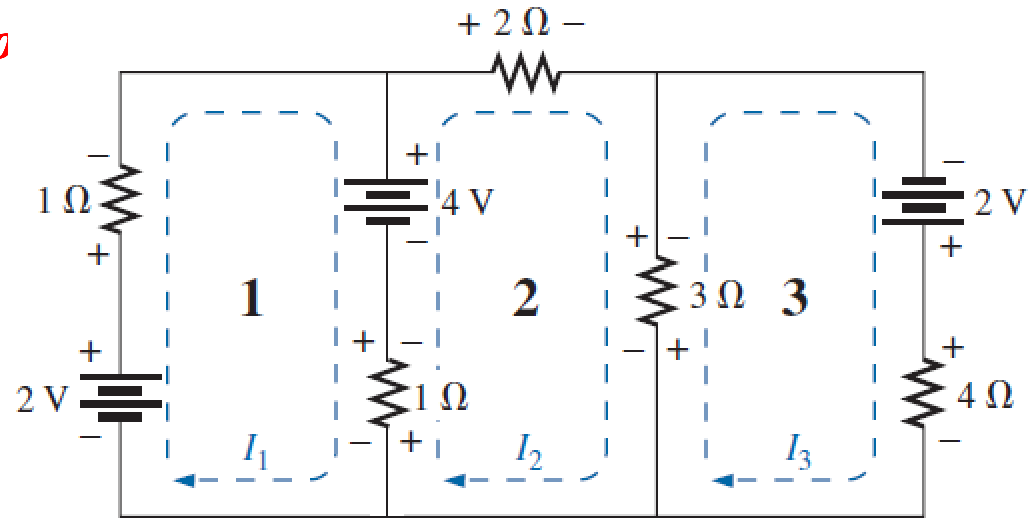

FIG. 7

Solution:

Each window is assigned a loop current in the clockwise direction:

I_1 does not pass through an element mutual with I_3.

$$I_1: \quad (1\,\Omega + 1\,\Omega)I_1 - (1\,\Omega)I_2 + 0 = 2\text{ V} - 4\text{ V}$$

$$I_2: \quad (1\,\Omega + 2\,\Omega + 3\,\Omega)I_2 - (1\,\Omega)I_1 - (3\,\Omega)I_3 = 4\text{ V}$$

$$I_3: \quad (3\,\Omega + 4\,\Omega)I_3 - (3\,\Omega)I_2 + 0 = 2\text{ V}$$

I_3 does not pass through an element mutual with I_1.

Summing terms yields :

$$2I_1 - I_2 + 0 = -2$$

$$6I_2 - I_1 - 3I_3 = 4$$

$$7I_3 - 3I_2 + 0 = 2$$

Example (8)

Write the mesh equations for the network in Fig. 8 and find the current I3 through the 10 Ω resistor

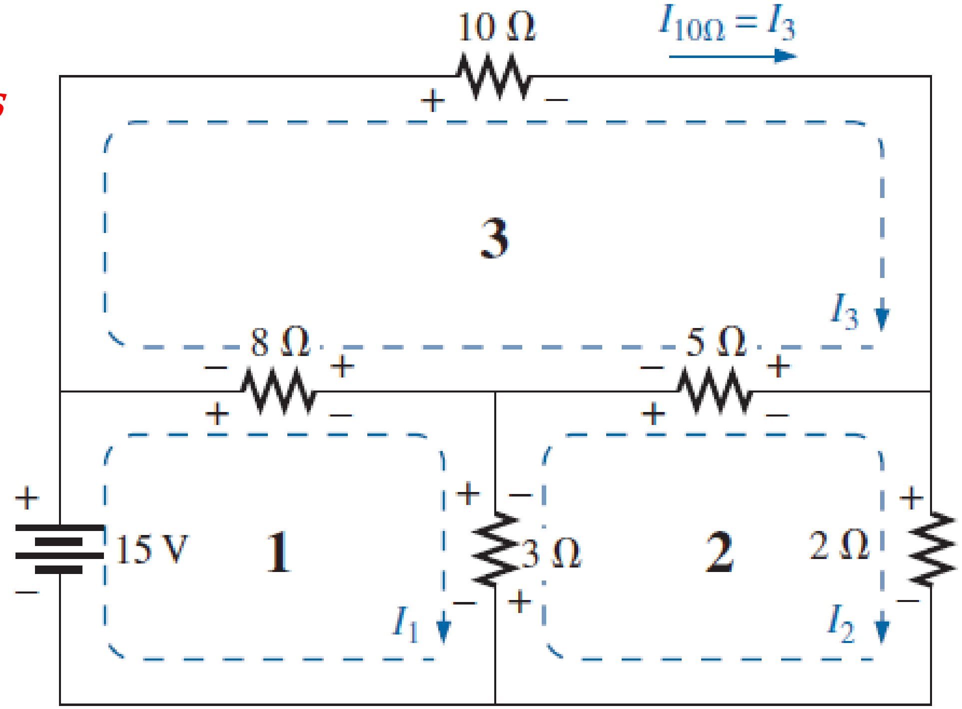

FIG. 8

Solution:

$$I_1: \quad (8\ \Omega + 3\ \Omega)I_1 - (8\ \Omega)I_3 - (3\ \Omega)I_2 = 15\ \text{V}$$
$$I_2: \quad (3\ \Omega + 5\ \Omega + 2\ \Omega)I_2 - (3\ \Omega)I_1 - (5\ \Omega)I_3 = 0$$
$$I_3: \quad (8\ \Omega + 10\ \Omega + 5\ \Omega)I_3 - (8\ \Omega)I_1 - (5\ \Omega)I_2 = 0$$

$$11I_1 - 8I_3 - 3I_2 = 15\ \text{V}$$
$$10I_2 - 3I_1 - 5I_3 = 0$$
$$23I_3 - 8I_1 - 5I_2 = 0$$

or

$$11I_1 - 3I_2 - 8I_3 = 15\ \text{V}$$
$$-3I_1 + 10I_2 - 5I_3 = 0$$
$$-8I_1 - 5I_2 + 23I_3 = 0$$

and $$I_3 = I_{10\Omega} = \frac{\begin{vmatrix} 11 & -3 & 15 \\ -3 & 10 & 0 \\ -8 & -5 & 0 \end{vmatrix}}{\begin{vmatrix} 11 & -3 & -8 \\ -3 & 10 & -5 \\ -8 & -5 & 23 \end{vmatrix}} = \mathbf{1.22\ A}$$