SNS COLLEGE OF TECHNOLOGY
Coimbatore-35
An Autonomous Institution

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

23ECB101 – CIRCUIT ANALYSIS AND DEVICES

I YEAR/ II SEMESTER

UNIT 1 – MESH AND NODE ANALYSIS OF ELECTRIC CIRCUITS

TOPIC - Nodal Analysis

Nodal Analysis

- There are two basic methods that are used for solving any electrical network: **Nodal analysis** and **Mesh analysis**.

- In Nodal analysis, we will consider the node voltages with respect to Ground. Hence, Nodal analysis is also called as **Node-voltage method**.

- Follow these steps while solving any electrical network or circuit using **Nodal analysis**.

- **Step 1** − Identify the **principal nodes** and choose one of them as **reference node**. We will treat that reference node as the Ground.

- **Step 2** − Label the **node voltages** with respect to Ground from all the principal nodes except the reference node.

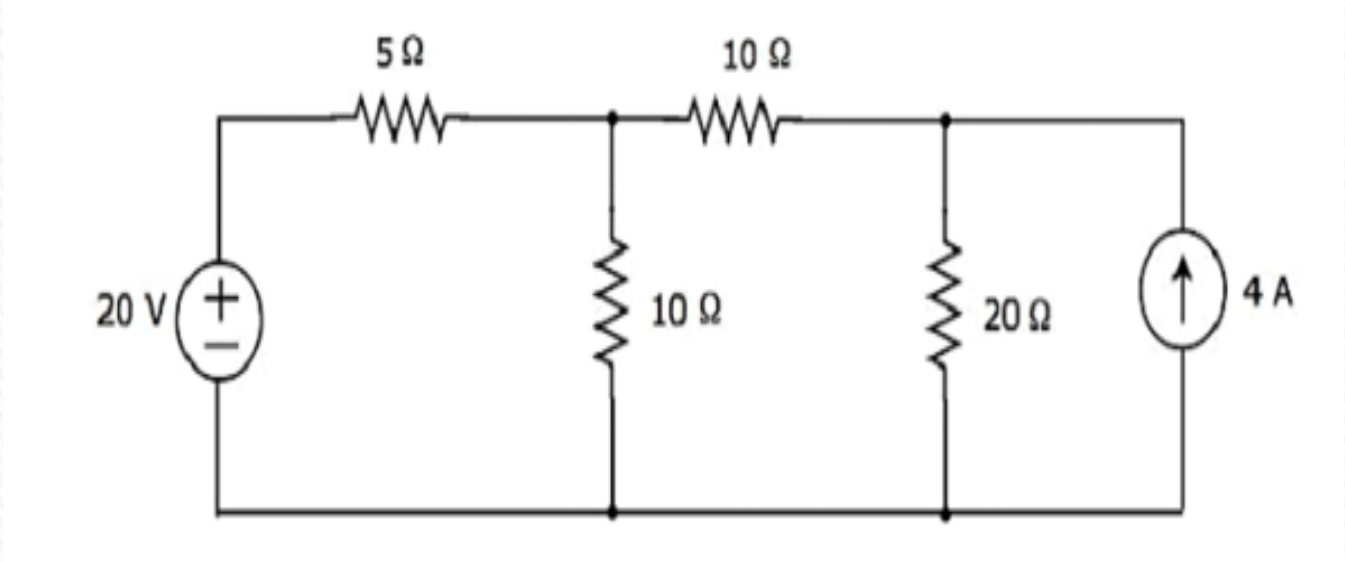
- **Step 3 −** Write **nodal equations** at all the principal nodes except the reference node. Nodal equation is obtained by applying KCL first and then Ohm's law.

- **Step 4 −** Solve the nodal equations obtained in Step 3 in order to get the node voltages.

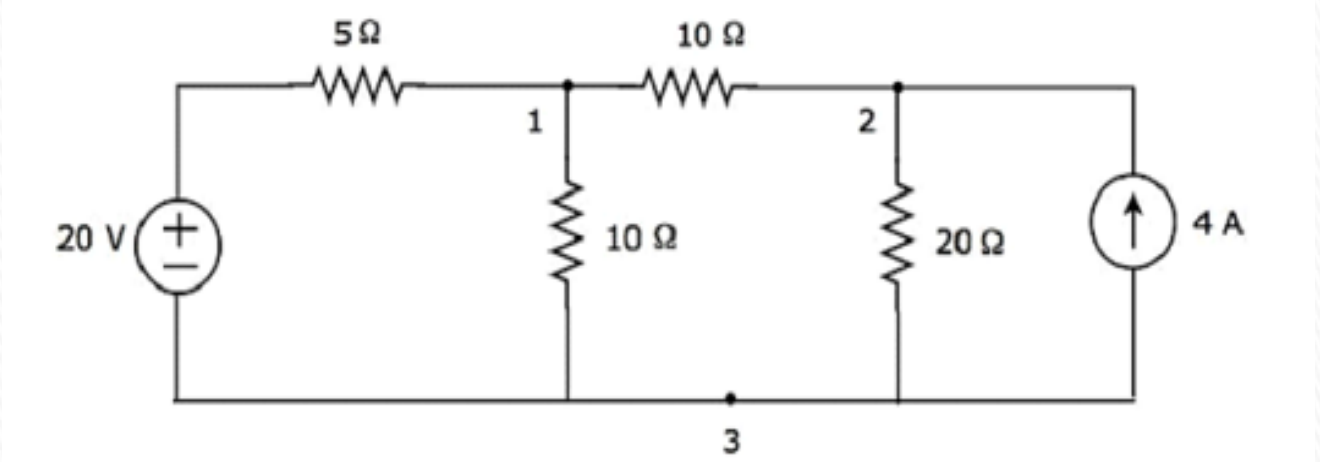
- Now, we can find the current flowing through any element and the voltage across any element that is present in the given network by using node voltages.

Example

- Find the current flowing through 20 Ω resistor of the following circuit using **Nodal analysis**.

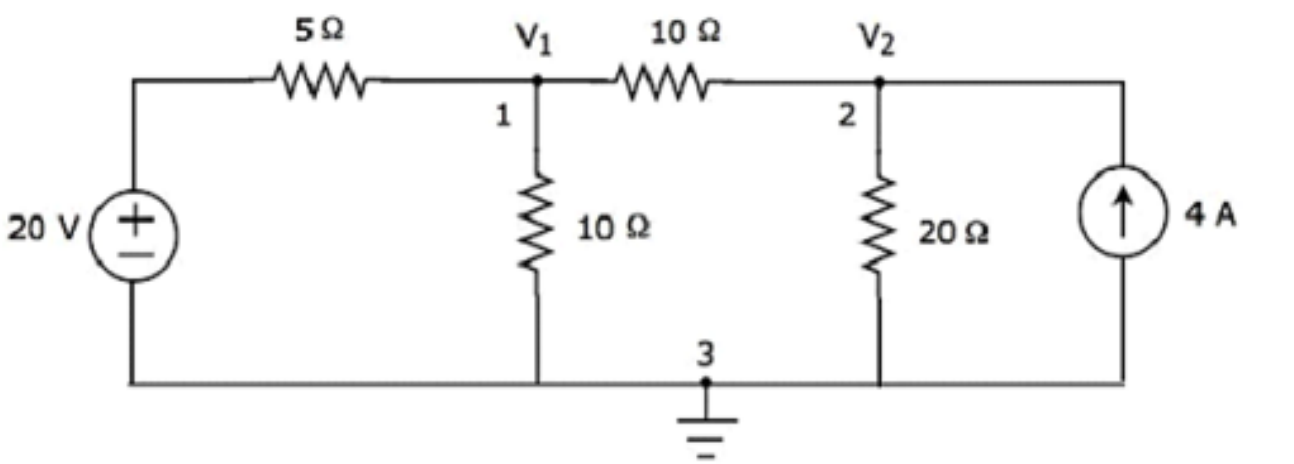


- **Step 1** – There are **three principle nodes** in the above circuit. Those are labelled as 1, 2, and 3 in the following figure.



In the above figure, consider **node 3** as reference node (Ground).

tep 2 − The node voltages, V_1 and V_2, are labelled in the following figure.



In the above figure, V_1 is the voltage from node 1 with respect to ground and V_2 is the voltage from node 2 with respect to ground.

Step 3 : The **nodal equation** at node 1 is

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$$\frac{V_1 - 20}{5} + \frac{V_1}{10} + \frac{V_1 - V_2}{10} = 0$$

$$\Rightarrow \frac{2V_1 - 40 + V_1 + V_1 - V_2}{10} = 0$$

$$\Rightarrow 4V_1 - 40 - V_2 = 0$$

$$\Rightarrow V_2 = 4V_1 - 40 \qquad \textbf{Equation 1}$$

The **nodal equation** at node 2 is

$$-4 + \frac{V_2}{20} + \frac{V_2 - V_1}{10} = 0$$

$$\Rightarrow \frac{-80 + V_2 + 2V_2 - 2V_2}{20} = 0$$

$$\Rightarrow 3V_2 - 2V_1 = 80 \qquad \textbf{Equation 2}$$

Step 4 − Finding node voltages, V_1 and V_2 by solving Equation 1 and Equation 2. substitute Equation 1 in Equation 2.

$$3(4V_1 - 40) - 2V_1 = 80$$

$$\Rightarrow 12V_1 - 120 - 2V_1 = 80$$

$$\Rightarrow 10V_1 = 200$$

$$\Rightarrow V_1 = 20V$$

Substitute V_1 = 20 V in Equation1.

$$V_2 = 4(20) - 40$$

$$\Rightarrow V_2 = 40V$$

- **Step 5** − The voltage across 20 Ω resistor is nothing but the node voltage V_2 and it is equal to 40 V. Now, we can find the current flowing through 20 Ω resistor by using Ohm's law.

- $I20\Omega = V2/R$

- Substitute the values of V_2 and R in the above equation.

- $I20\Omega = 40/20 \quad \Rightarrow I20\Omega = 2A$

Assessment

1. Nodal analysis is generally used to determine_____

a) Voltage

b) Current

c) Resistance

d) Power

2. If there are 10 nodes in a circuit, how many equations do we get?

a) 10

b) 9

c) 8

d) 7

3. How many nodes are taken as reference nodes in a nodal analysis?

a) 1

b) 2

c) 3

d) 4

THANK YOU