SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution

Coimbatore-35

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

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

What is Nodal Analysis?

- Nodal analysis is used for solving any electrical network, and it is defined as
- The mathematical method for calculating the voltage distribution between the circuit nodes.
- This method is also known as the node-voltage method since the node voltages are with respect to the ground.

Nodal Analysis

Features of Nodal Analysis

- Nodal analysis is an application of Kirchhoff's current law.
- When there are 'n' nodes in a given electrical circuit, there will be 'n-1' simultaneous equations to be solved.
- To obtain all the node voltages, 'n-1' should be solved.
- The number of non-reference nodes and the number of nodal equations obtained are equal.

Nodal Analysis

Procedure of Nodal Analysis

The following steps are to be followed while solving any electrical circuit using nodal analysis:

Step 1:

To identify the principal nodes and select one of them as a reference node.

This reference node will be treated as the ground.

Nodal Analysis

Step 2:

All the node voltages with respect to the ground from all the principal nodes should be labelled except the reference node.

Step 3:

The nodal equations at all the principal nodes except the reference node should have a nodal equation. The nodal equation is obtained from Kirchhoff's current law and then from Ohm's law.

Nodal Analysis

Step 4:

To obtain the node voltages, the nodal equations can be determined by following Step

3.

Types of Nodes in Nodal Analysis

There are two types of nodes in nodal analysis:

- Non-reference node
- Reference node

Nodal Analysis

Non-Reference Node

The node with a definite node voltage is a non-reference node.

Reference Node

The node that acts as a reference point to all the other nodes is known as the reference node, which is also known as the datum node.

There are two types of reference nodes, and they are:

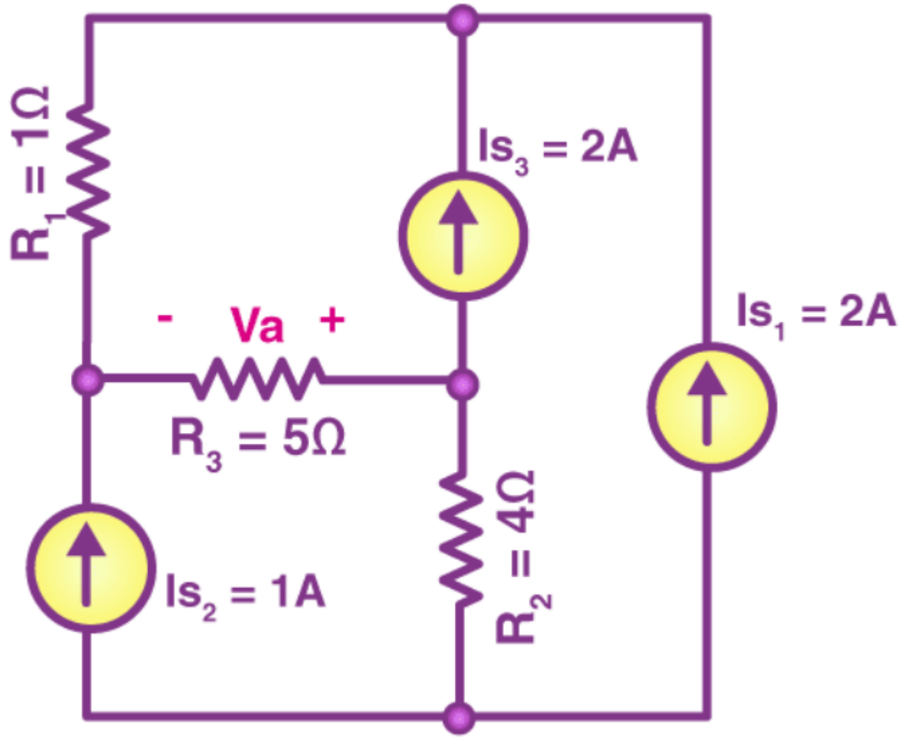
•Chassis ground

A reference node that acts as a common node for more than one circuit is called chassis ground.

Nodal Analysis

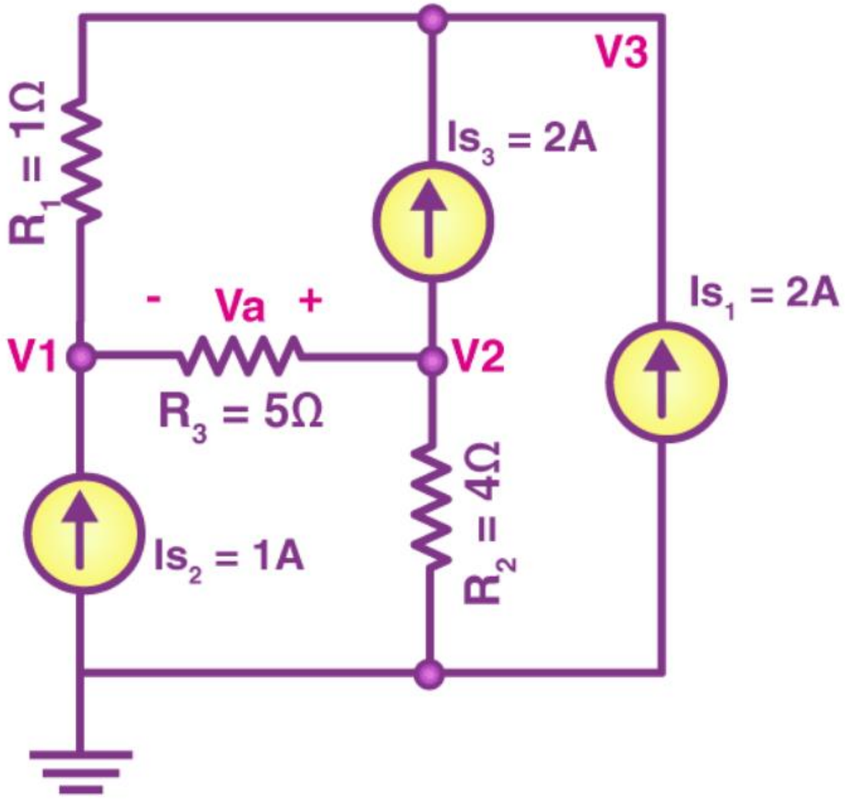
Example 1:

For the following circuit, find V_a by nodal analysis.



Nodal Analysis

Step 1: To select a reference node and label the node voltages



Step 2: Apply Kirchhoff's current law to all the nodes

Node 1:

$-I_{s_2} + \frac{V_1 - V_2}{R_3} + \frac{V_1 - V_3}{R_1} = 0 \Rightarrow 6V_1 - V_2 - 5V_3 = 5$

(eq.1)

Node 2:

$I_{s_3} + \frac{V_2 - V_1}{R_3} + \frac{V_2}{R_2} = 0 \Rightarrow -4V_1 + 9V_2 = -40$

(eq.2)

Node 3:

$-I_{s_1} - I_{s_3} + \frac{V_3 - V_1}{R_1} = 0 \Rightarrow V_3 - V_1 = 4$

(eq.3)

From eq.1,2,3 we know that

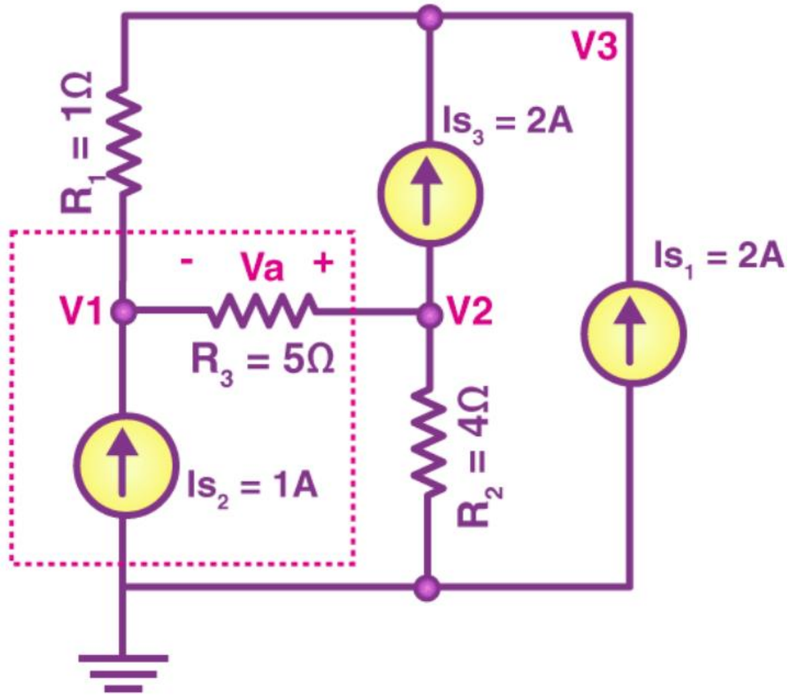
V_1 = 37v

V_2 = 12v

V_3 = 41

Nodal Analysis

Step 3: To find the required quantities



Applying Kirchhoff's voltage law in the above loop, we get

$-V_1 - V_a + V_2 = 0$

$V_a = -25v$

THANK YOU