Node Voltage Method – Nodal Analysis

The Node Voltage Method, also referred to as Nodal Analysis, is the systematic application of KCL to solve for the voltages across all circuit elements.

Definitions:

Node (N): An electrical juncture connecting two or more circuit elements.

Essential Node (EN): An electrical juncture connecting three or more circuit elements.

Super Node (SN): A composite node consisting of a collection of two or more ENs connected by a branch containing only independent and/or dependent voltage sources.

Nodal Analysis:

1. Identify and label all the Essential Nodes - assume there are "n" ENs.

2. Choose and label one EN as the reference node - call this reference node ground (zero Volts).

3. Identify and label all Super Nodes - assume a SN consists of "m" ENs.

4. Generate one KCL equation at each EN except at the reference node and at any EN which is part of a SN.

5. Generate "m-1" constraint equations for each SN in terms of the voltages at the ENs.

6. Generate one KCL equation for each SN which does not contain the reference node.

7. Generate one constraint equation for each dependent voltage source and dependent current source in terms of the voltages at the ENs - assume there are "d" dependent sources.

8. This process will generate a linear system of "d+n-1" equations with "d+n-1" unknowns. Solve the system of equations to determine the voltages at the ENs and the values of the dependent sources.

9. Use the calculated values of the voltages from step 8 to solve for the voltage across and the current through each circuit element.