Khwaja Yunus Ali University

Lab Report -05

Name of the Department: Computer Science and Engineering

Course Code: CSE 0713-1105

Course Title: Electrical Circuit Lab

Experiment No.: 05

Name of the Experiment: Verification of Nodal Analysis Using Hardware and Digital Simulation

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Instructor Signature & Date

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Name of the Experiment:

Verification of Nodal Analysis Using Hardware and Digital Simulation

Objectives

To verify Nodal Analysis using hardware and digital simulation.

Theory:

Nodal Analysis is a method used to determine the voltage at different nodes in an electrical circuit using Kirchhoff's Current Law (KCL). It helps simplify circuit analysis by using node voltages instead of current equations.

Circuit Diagram:

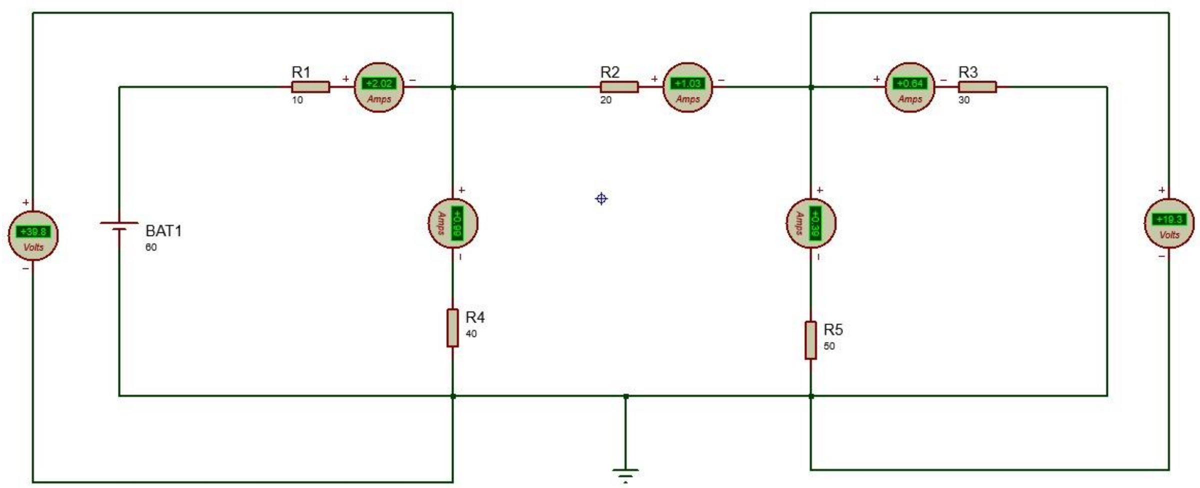

Fig . (1) Nodal Analysi

Apparatus:

- Software used: Proteus 8 Professional
- Voltmeter
- Resistor
- Power Supply
- Connecting Wires

Working Procedure:

1. Constructed the circuit as per the diagram in Proteus 8 Professional.
2. Identified the principal nodes and selected a reference (ground) node.
3. Applied Kirchhoff's Current Law (KCL) to each non-reference node.
4. Solved the equations to determine node voltages.
5. Measured the voltage at each node using simulation.
6. Compared the theoretical and simulated values.

Calculations:

Given Values:

- Voltage Source (V_s): 60V
- Resistor:

$$R_1 = 10\Omega, R_2 = 20\Omega, R_3 = 30\Omega, R_4 = 40\Omega, R_5 = 50\Omega$$

At Node 1(V_1) :

$$\frac{V_1 - V_s}{R_1} + \frac{V_1}{R_4} + \frac{V_1 - V_2}{R_2} = 0$$

Substituting values:

$$\frac{V_1 - 60}{10} + \frac{V_1}{40} + \frac{V_1 - V_2}{20} = 0$$

Multiply by 40 (LCM):

$$4(V_1 - 60) + V_1 + 2(V_1 - V_2) = 0 \Longrightarrow 7V_1 - 2V_2 = 240 \text{ (Equation 1)}$$

At Node 2(V_2) :

$$\frac{V_2 - V_1}{R_2} + \frac{V_2}{R_3} + \frac{V_2}{R_5} = 0$$

Substituting values:

$$\frac{V_2 - V_1}{20} + \frac{V_2}{30} + \frac{V_2}{50} = 0$$

Multiply by 300 (LCM):

$$15(V_2 - V_1) + 10V_2 + 6V_2 = 0 \Longrightarrow -15V_1 + 31V_2 = 0 \text{ (Equation 2)}$$

Solving Equations:

From Equation 2:

$$V_1 = \frac{31}{15}V_2$$

Substitute V_1 into Equation 1:

$$7\left(\frac{31}{15}V_2\right) - 2V_2 = 240 \Longrightarrow \frac{217V_2}{15} - 2V_2 = 240 \Longrightarrow \frac{187V_2}{15} = 240$$

$$V_2 = \frac{240 \times 15}{187} \approx 19.25 \text{ V}$$

$$V_1 = \frac{31}{15} \times 19.25 \approx 39.8 \text{ V}$$

Observation Table:

SL No	Input Voltage (V)	V1 (Simulated)	V2 (Simulated)	V1 (Calculated)	V2 (Calculated)
1	60	39.8	19.3	39.8	19.25
2	55	36.5	17.5	36.4	17.4
3	50	33.2	15.8	33.1	15.7
4	45	29.9	14.1	29.8	14.0

Result and Discussion:

- The calculated node voltages closely match the theoretical values.
- Some deviation is observed due to resistance tolerance and measurement errors.
- The experiment successfully verifies Nodal Analysis.

Conclusion:

Using Nodal Analysis, we determined the voltages at different nodes using Kirchhoff's Current Law (KCL). The experiment verified that the sum of currents at each node is zero, confirming the accuracy of Nodal Analysis.