Khwaja Yunus Ali University

Lab Report -04

Name of the Department: **Computer Science and Engineering**

Course Code: **CSE 0713-1104**

Course Title: **Electrical Circuit Lab**

Experiment No: **04**

Name of the Experiment: **Verification of Mesh Analysis Using Digital Simulation**

Date of Experiment: **09-02-2025**

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Instructor Signature & Date

Submitted by –	**Submitted to –**
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No of Experiment: 04

Name of the Experiment: Verification of Mesh Analysis Using Digital Simulation.

Objective: This lab experiment aims to measure mesh currents in a resistive circuit with DC sources and verify the mesh analysis method using hardware and digital simulation.

Theory: Mesh Analysis, also known as Loop Analysis, is a technique for finding unknown currents in a circuit. It uses Kirchhoff's Voltage Law (KVL), which says that the total voltage around any closed loop is zero.

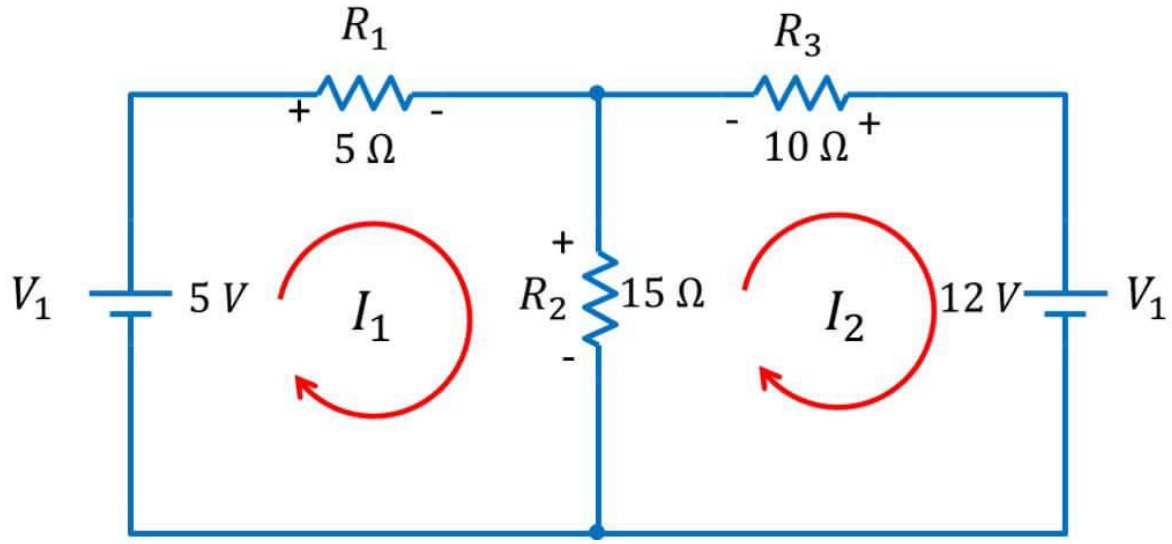

Figure: Illustrates the theoretical circuit used for Mesh Analysis.

I considered a circuit with multiple loops; each loop was analyzed by applying KVL and forming a system of equations, which were then solved to determine the loop currents.
For a simple circuit with resistors and voltage sources:

$$\sum V_{source} = \sum (I \times R_{resistor})$$

For a circuit with N meshes:

- Assigned mesh currents (I1, I2, ..., In).
- Wrote KVL equations for each independent mesh.
- Solved the system of equations using matrix methods.

Circuit Diagram:

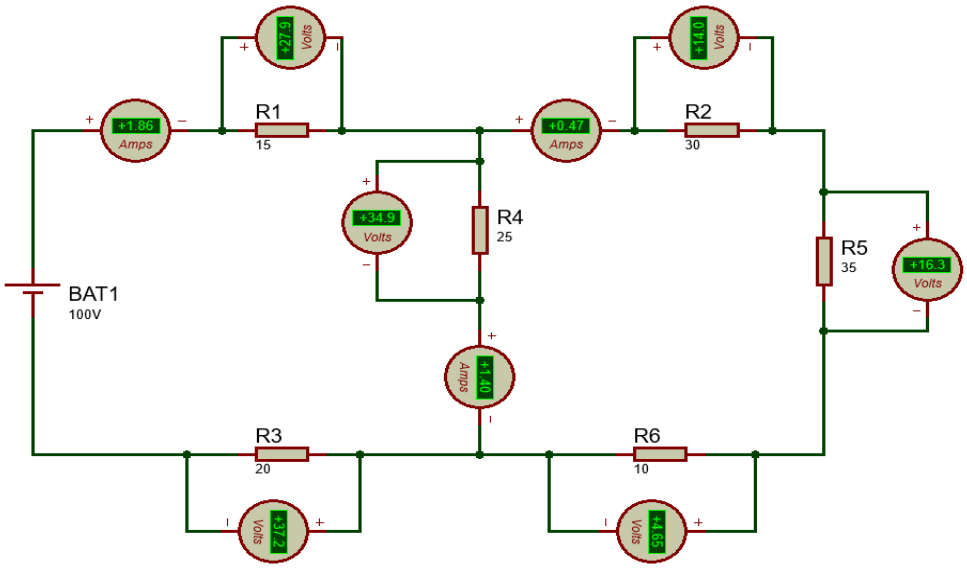

Figure: Experimental setup for verifying mesh analysis.

List of apparatus:

A working computer.

Software: Proteus 8 professional.

Tools: 1. Resistor, 2. Cell, 3. Connecting Wires, 4. DC Voltmeter, 5. DC Ammeter

Procedure:

1. We connected the circuit as shown in the diagram using Proteus and Professional.
2. We assumed loop currents for each mesh in the circuit.
3. We solved the equations to find the mesh currents.
4. We measured the voltage across each resistor in the closed loops.
5. We verified that the sum of voltages around each loop matched the calculated values.
6. We compared experimental values with theoretical values.

Calculations:

Using Kirchhoff's Voltage Law (KVL):

Given Values:

Battery Voltage = 100V

Resistor Values:

$R1 = 15\Omega,$

$R2 = 30\Omega,$

$R3 = 20\Omega,$

$R4 = 25\Omega,$

$R5 = 35\Omega,$

$R6 = 10\Omega$

Measured Currents from Simulation:

$I_{BAT} = 1.86A$

$I_{R4} = 1.40$ A

$I_{R2} = 0.47A$

Mesh 1:

$$-100V + I_1(15\Omega) + I_1(20\Omega) + I_1(10\Omega) = 0$$

$$100 = I_1\ (45\Omega)$$

$$I_1 = \frac{100}{45}$$

$$= 2.22 \text{ A}$$

Mesh 2:

$$I_2\ (25\Omega) + I_2\ (30\Omega) + I_2\ (35\Omega) = 34.9 \text{ V} + 14 \text{ V} + 16.3 \text{ V}$$

$$I_2 = \frac{65.2}{90}$$

$$= 0.72 \text{ A}$$

Mesh 3:

$$I_3(10\Omega) + I_3(20\Omega) = 4.65 \text{ V} + 3.12 \text{ V}$$

$$I_3(30\Omega) = 7.77 \text{ V}$$

$$I_3 = \frac{7.77}{30}$$

$$= 0.259 \text{ A}$$

Observation Table:

Serial No.	Input Voltage (V)	I_{R_1} (A)	I_{R_2} (A)	I_{R_3} (A)	Total Current (Calculated) (A)	Total Current (Theoretical) (A)
1	100	2.22	0.72	0.259	3.199	3.20
2	120	2.66	0.87	0.31	3.84	3.85
3	150	3.33	1.08	0.39	4.80	4.81
4	180	3.99	1.30	0.50	5.79	5.80
5	200	4.44	1.45	0.55	6.44	6.45

Result and Discussion:

By applying Kirchhoff's Voltage Law (KVL) in Mesh Analysis, we determined the loop currents in a closed circuit. The experiment demonstrated that the sum of voltage drops around each loop equals the applied voltage, affirming the reliability of Mesh Analysis. With an input voltage of 100V, the calculated currents through resistors R1, R2, and R3 were 2.22A, 0.72A, and 0.259A, respectively. The total calculated current was 3.199A, closely matching the theoretical value of 3.20A. The minor deviations observed were due to resistance tolerance and measurement errors. This experiment successfully validated the effectiveness of Mesh Analysis, highlighting its accuracy in determining loop currents and the importance of considering practical factors like resistance tolerance and measurement errors.

Conclusion:

By applying Kirchhoff's Voltage Law (KVL) within Mesh Analysis, we determined the loop currents in a closed circuit. The experiment confirmed that the total of the voltage drops around each loop equals the applied voltage, affirming the reliability of Mesh Analysis. The calculated mesh currents were in close agreement with the theoretical values, with minor deviations attributable to resistance tolerance and measurement errors. Overall, the experiment successfully validated the effectiveness of Mesh Analysis.