Branch Current Method (BCM) Analysis

1. Fundamental variables of the circuit

Branches (R): 10 | Nodes (N): 4 | Current Source (FC): 1

Number of different Mesh combinations:36

Number of independent Meshes that need to be defined: R - (N - 1) - FC = 10 - (4 - 1) - 1 = 6

2. Identification/direction of branch currents:

Branch 0 composed by: R8 | I0: A → B

Branch 1 composed by: R6 | I1: A → B

Branch 2 composed by: R1 | I2: B → gnd

Branch 3 composed by: R7 | I3: gnd → B

Branch 4 composed by: R4 | I4: C → gnd

Branch 5 composed by: R2 | I5: A → C

Branch 6 composed by: R5,V1 | I6: A → gnd

Branch 8 composed by: R9 | I8: A → B

Branch 9 composed by: R3 | I9: B → C

3. Node Equations:

Node B:

$$-I2 - I9 + I0 + I1 + I3 + I8 - \frac{1}{1000} = 0$$

Node A:

$$-I0 - I1 - I5 - I6 - I8 + \frac{1}{1000} = 0$$

Node C:

$$-I4 + I5 + I9 = 0$$

4. Identification/Direction of Meshes + Mesh Equations:

Mesh 0 composed by: R8,R7,V1,R5 | A → B ,starting on R8

$$-I3 \cdot R7 - I6 \cdot R5 + I0 \cdot R8 = V1$$

Mesh 1 composed by: R6,R9 | A → B ,starting on R6

$$-I8 \cdot R9 + I1 \cdot R6 = 0$$

Mesh 2 composed by: R8,R9 | A → B ,starting on R8

$$-I8 \cdot R9 + I0 \cdot R8 = 0$$

Mesh 3 composed by: R8,R1,V1,R5 | A → B ,starting on R8

$$-I6 \cdot R5 + I0 \cdot R8 + I2 \cdot R1 = V1$$

Mesh 4 composed by: R1,R4,R3 | B → gnd ,starting on R1

$$-I4 \cdot R4 - I9 \cdot R3 + I2 \cdot R1 = 0$$

Mesh 5 composed by: R6,R2,R3 | B → A ,starting on R6

$$-I1 \cdot R6 - I9 \cdot R3 + I5 \cdot R2 = 0$$

5. System of Equations:

Mesh 0: $-50 \cdot I3 - 50 \cdot I6 + 50 \cdot I0 - 1 = 0$
Mesh 1: $-50 \cdot I8 + 50 \cdot I1 = 0$
Mesh 2: $-50 \cdot I8 + 50 \cdot I0 = 0$
Mesh 3: $-50 \cdot I6 + 50 \cdot I0 + 50 \cdot I2 - 1 = 0$
Mesh 4: $-50 \cdot I4 - 50 \cdot I9 + 50 \cdot I2 = 0$
Mesh 5: $-50 \cdot I1 - 50 \cdot I9 + 50 \cdot I5 = 0$
Node B: $-I2 - I9 + I0 + I1 + I3 + I8 - \frac{1}{1000} = 0$
Node A: $-I0 - I1 - I5 - I6 - I8 + \frac{1}{1000} = 0$
Node C: $-I4 + I5 + I9 = 0$

6. Solution (of the system of equations):

$I0$ = 0,003 A
$I1$ = 0,003 A
$I2$ = 0,004 A
$I3$ = - 0,004 A
$I4$ = 0,004 A
$I5$ = 0,004 A
$I6$ = - 0,012 A
$I8$ = 0,003 A
$I9$ = 0,000 A