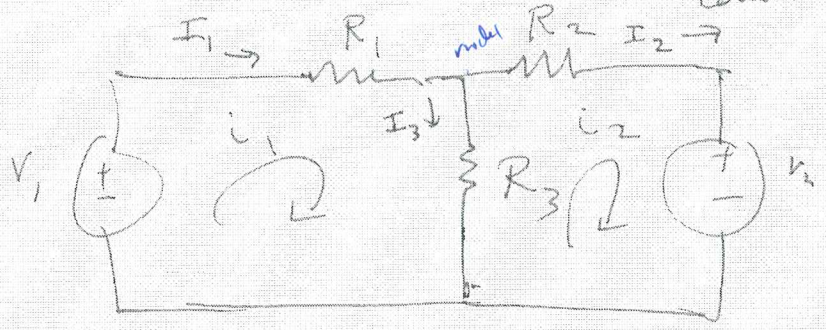
Mesh Analysis

Mesh: Closed loop that does not contain any other loops within it.



Unknowns I_1 I_2 I_3 V_{node} — 4

Mesh analysis

1) Assign mesh currents $i_1, i_2 \ldots i_n$
2) Apply KVL to each mesh.
3) Solve eqns. for $i_1 \ldots i_n$

$$-V_1 + R_1 i_1 + R_3 (i_1 - i_2) = 0$$

$$R_2 i_2 + V_2 + R_3 (i_2 - i_1) = 0$$

2 eqns. 2 unknowns i_1, i_2

Solve.

Nodal Anal vs Mesh Anal:

Depends on particular problem.

Chapter 3, Problem 73.

Write the mesh-current equations for the circuit in Fig. 3.117.

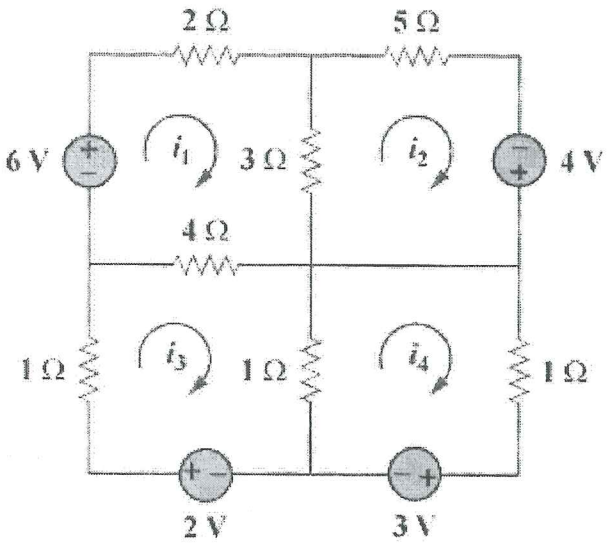


Figure 3.117

Unknowns
Unknowns
Current thru each ~~res~~ component
= 11
Voltage @ each node (not ref)
(8-1)
Σ = 18

1) Assign mesh currents
i_1, i_2, i_3, i_4

2) KVL

Mesh: 4 mesh currents

~~$-6 + 2i_1 + 3i_1 +$~~

① $-6 + 2i_1 + (i_1 - i_2)3 + (i_1 - i_3)4 = 0$

② $(i_2 - i_1)3 + i_2 5 - 4 = 0$

③ $i_3 \cdot 1 + (i_3 - i_1)4 + (i_3 - i_4)1 - 2 = 0$

④ $(i_4 - i_3)\cdot 1 + i_4 \cdot 1 + 3 = 0$

④ eqn ④ unknowns. solve.

If mesh has current source, "supermesh", discussed in text. lecture, time permitting.

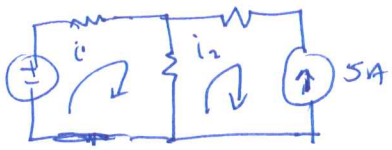
Bad news @ Mesh:

If current source present:

Case 1 In only 1 mesh, easy: Determining current of that mesh.

~~Case 2 In 2 meshes~~

E.g.



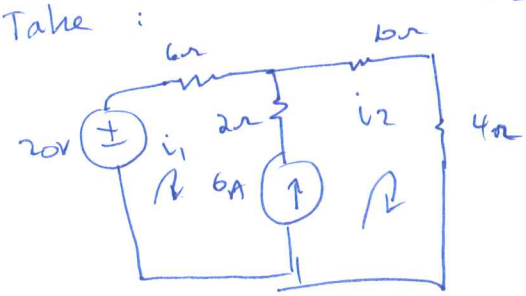
$i_2 = -5\ A$

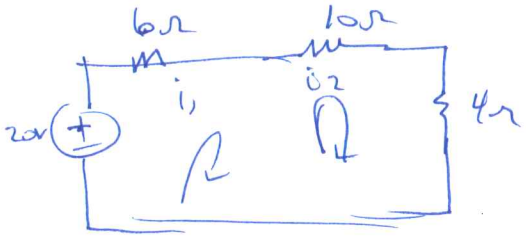
Case 2 In 2 meshes:

"Supermesh"

remove current source

Take:





Replace:

New rules:

KVL to each mesh as usual

$6i_1 + 14i_2 = 20$

* New: KCL $i_1 + 6 = i_2$ to the mesh

Solve for ints.

Chapter 3, Problem 44.

Use mesh analysis to obtain i_o in the circuit of Fig. 3.90.

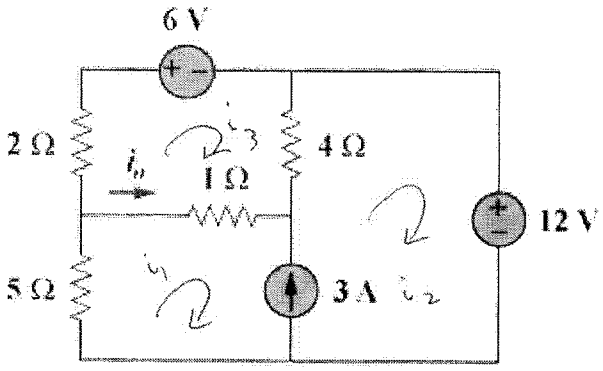


Figure 3.90

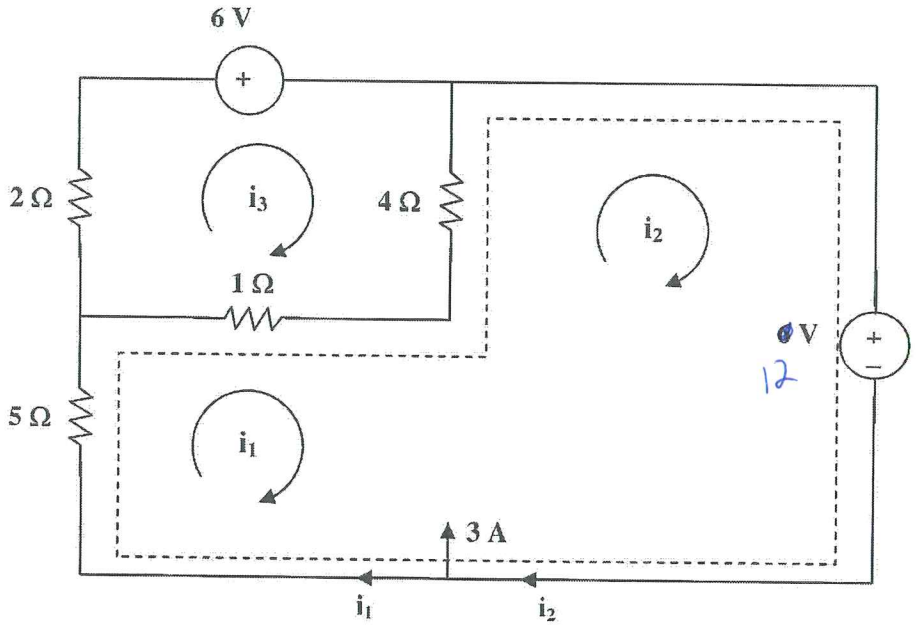
Supermesh: 1) Assign mesh currents

2) Remove current source.

3) Apply KVL for enclosed ~~circuit~~ loop

4) Solve i_1 ... i_n

Chapter 3, Solution 44.



Loop 1 and 2 form a supermesh. For the supermesh,

$$6i_1 + 4i_2 - 5i_3 + 12 = 0 \quad (1)$$

For loop 3, $$-i_1 - 4i_2 + 7i_3 + 6 = 0 \quad (2)$$

Also, $$i_2 = 3 + i_1 \quad (3)$$

Solving (1) to (3), $i_1 = -3.067$, $i_3 = -1.3333$; $i_o = i_1 - i_3 =$ **-1.7333 A**

Chapter 3, Problem 3.

Find the currents i_1 through i_4 and the voltage v_o in the circuit in Fig. 3.52.

Recall Nodal Unknowns. But Nodal => only 1 eq.. to solve

Try mesh.

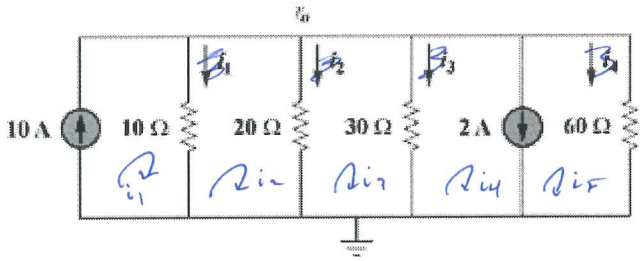


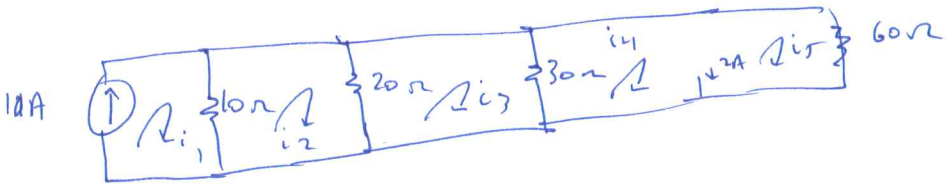
Figure 3.52

Mesh 5 unknowns $i_1 - i_5$

$i_1 = 10$ A

$i_2 10 + (i_2 - i_3) 20 = 0$

$i_3 30 - (i_3 - i_4) 30 = 0$



KVL @ Supermesh $i_4 30 - i_5 60 = 0$

KCL @ Supermesh $i_4 + 2A - i_5 = 0$

5 eqns. 5 unknowns solve.

Nodal a little approach for this prob.

Chapter 3, Problem 73.

Write the mesh-current equations for the circuit in Fig. 3.117.

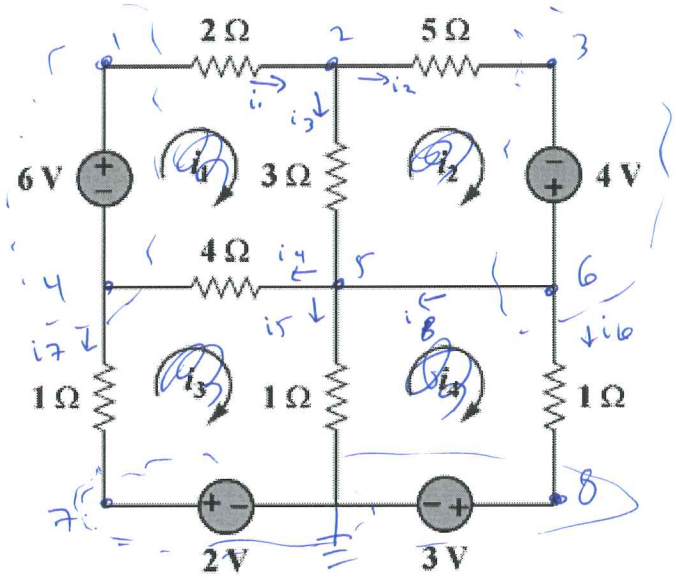


Figure 3.117

Unknowns 14

$v_1 - v_2$

$i_1 - i_8$

Tiny nodal:

$V_8 = 3V$

$V_7 = 2V$

KCL @ N2 $i_1 = i_2 + i_3$

N3 ...

SN $i_4 = i_1 + i_7$

SN $i_2 = i_6 + i_8$

N5 $i_8 + i_3 = i_4 + i_5$

SN $i_7 + i_5 + i_6 = 0$

KVL @ loop containing source (4x)

$-6V + i_1 2 + i_3 3 + i_4 4 = 0$

$-i_3 3 + i_2 5 - 4 = 0$

$-i_7 1 - i_4 4 + i_5 1 - 2 = 0$

$-i_5 1 + i_6 1 + 3 = 0$

Sub.

$i_1 = \frac{v_1 - v_2}{2}$ $i_2 = \frac{v_2 - v_3}{5}$ etc.

Solve 7 eqns. 7 unknowns (V_s).

Complicated.