CSE-250

Assignment-02

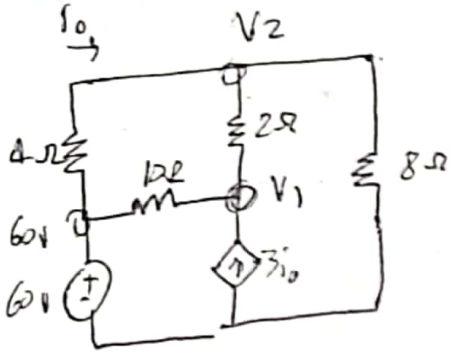
Name: MD Ikramul Kayes

ID : 21301576

Sec : 07

Slide-5

Problem-5



For V_1 node,

$$V_1\left(\frac{1}{10}+\frac{1}{2}\right)-3i_o-\frac{60}{10}-\frac{V_2}{2}=0$$

$$\Rightarrow \frac{3}{5}V_1-\frac{V_2}{2}-3\frac{60-V_2}{4}=6$$

$$\Rightarrow \frac{3}{5}V_1+\frac{V_2}{4}=51 \quad -(i)$$

For V_2 node,

$$V_2\left(\frac{1}{4}+\frac{1}{2}+\frac{1}{8}\right)-\frac{60}{4}-\frac{V_1}{2}=0$$

$$\Rightarrow -\frac{V_1}{2}+\frac{7}{8}V_2=15 \quad -(ii)$$

After solving eq (i), (ii) we get,

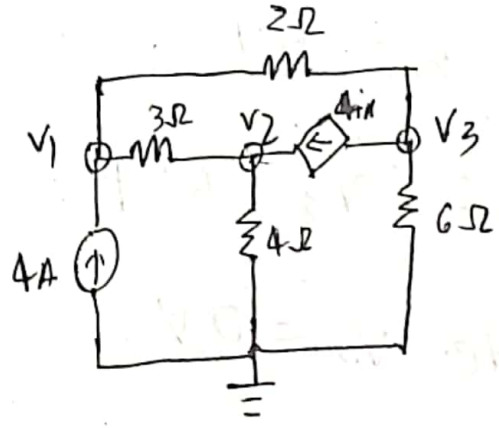
$$V_1=62.88$$

$$V_2=53.07$$

$$i_o=\frac{60-V_2}{4}=\frac{60-53.07}{4}=1.730\,A$$

(Ans)

Problem 6



$$i_n = \frac{V_2}{4}$$

For V_1 node,

$$V_1\left(\frac{1}{3}+\frac{1}{2}\right) - 4 - \frac{V_2}{3} - \frac{V_3}{2} = 0$$

$$\Rightarrow \frac{5}{6}V_1 - \frac{V_2}{3} - \frac{V_3}{2} = 4 \quad \text{—— (I)}$$

~~$V_2\left(\frac{1}{3}+\frac{1}{4}\right) - 4i_n - \frac{V_1}{3} = 0$~~

For V_2 node,

$$V_2\left(\frac{1}{3}+\frac{1}{4}\right) - 4i_n - \frac{V_1}{3} = 0$$

$$\Rightarrow \frac{7}{12}V_2 - V_2 - \frac{V_1}{3} = 0$$

$$\Rightarrow -\frac{V_1}{3} - \frac{5}{12}V_2 = 0 \quad \text{—— (II)}$$

For V_3 node,

$$V_3\left(\frac{1}{6}+\frac{1}{2}\right) + \frac{V_2}{4} \times 4 - \frac{V_1}{2} = 0$$

$$\Rightarrow \frac{V_1}{2} + V_2 + \frac{2}{3}V_3 = 0 \quad \text{—— (III)}$$

By solving eq ①, ⑫, ⑪ we get,

$V_1 = 32V$ $V_2 = -25.6$, $V_3 = 62.4$

And the ground node $V_0 = 0V$

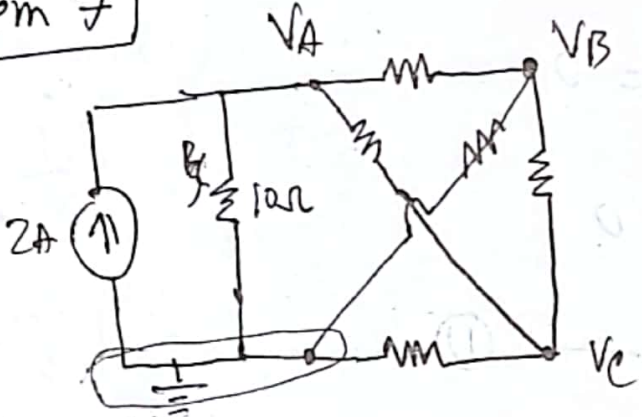
$\therefore V_1 = 32V$

$V_2 = -25.6\ V$

$V_3 = 62.4\ V$

$V_0 = 0V$

Problem 7)



For node V_A

$$V_A\left(\frac{1}{10}+\frac{1}{10}+\frac{1}{20}\right) - \frac{V_c}{10} - \frac{V_B}{20} - 2 = 0$$

$$\Rightarrow \frac{V_A}{4} - \frac{V_B}{20} - \frac{V_c}{10} = 2 \quad \text{---} ①$$

For node V_B,

$$V_B\left(\frac{1}{20}+\frac{1}{10}+\frac{1}{20}\right) - \frac{V_A}{20} - \frac{V_c}{20} = 0$$

$$\Rightarrow -\frac{V_A}{20} + \frac{V_B}{5} - \frac{V_c}{20} = 0 \quad \text{---} ⑪$$

For node V_e,

$$V_e\left(\frac{1}{20}+\frac{1}{10}+\frac{1}{20}\right)-\frac{V_A}{10}-\frac{V_B}{20}=0$$

$$\Rightarrow -\frac{V_A}{10}-\frac{V_B}{20}+\frac{1}{5}V_e=0 \quad \text{---(III)}$$

By solving eq (I), (II), (III) we get,

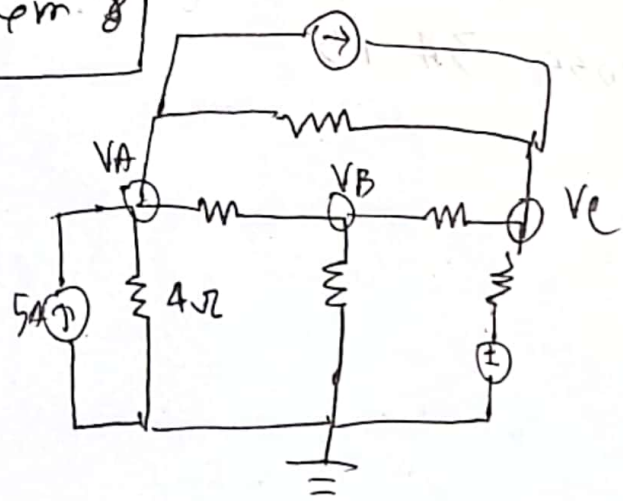
$V_A = 11.76$

$V_B = 4.705$

$V_e = 7.058$

$$I_5=\frac{V_A-0}{10}=\frac{11.76-0}{10}=1.18\,A$$

Problem 8



For V_A node,

$$V_A\left(\frac{1}{4}+\frac{1}{8}+\frac{1}{2}\right)-\frac{V_B}{8}-\frac{V_e}{2}-5+3=0$$

$$\Rightarrow \frac{7}{8}V_A-\frac{V_B}{8}-\frac{V_e}{2}=2 \quad \text{---(I)}$$

For V_B node

$$V_B\left(\frac{1}{2}+\frac{1}{8}+\frac{1}{4}\right)-\frac{V_A}{8}-\frac{V_e}{4}=0$$

$$\Rightarrow -\frac{V_A}{8}+\frac{7}{8}V_B-\frac{V_e}{4}=0 \quad \text{---} \quad (II)$$

For V_e node,

$$V_e\left(\frac{1}{8}+\frac{1}{4}+\frac{1}{2}\right)-\frac{12}{8}-\frac{V_B}{4}-\frac{V_A}{2}-3=0$$

$$\Rightarrow -\frac{V_A}{2}-\frac{V_B}{4}+\frac{7}{8}V_e=-\frac{3}{2} \quad \text{---} \quad (III)$$

By solving eq (I), (II), (III) we get,

$V_A = 10$, $V_B = 4.93$, $V_e = 12.267$

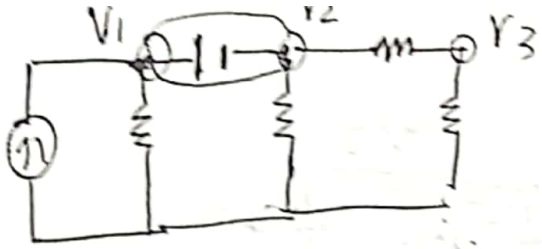
Voltage ~~across~~ across 3A is

$$V = |V_e - V_A|$$

$$= \pm|12.267 - 10|$$

$$= \pm 2.267$$

Problem - 2



Super node

$$\frac{V_1}{5} - 5 + \rightarrow V_2\left(\frac{1}{10} + \frac{1}{2}\right) = 0$$

$$\Rightarrow \frac{V_1}{5} + \frac{3}{5}V_2 - \frac{V_3}{2} = 5 \quad \text{---} \quad (1)$$

$$V_1 - V_2 = 20 \quad \text{---} \quad (11)$$

For V_3 node

$$V_3\left(\frac{1}{2} + \frac{1}{8}\right) - \frac{V_2}{2} = 0$$

$$\Rightarrow -\frac{V_2}{2} + \frac{5}{8}V_3 = 0 \quad \text{---} \quad (111)$$

By solving eq (1), (11), (111) we get,

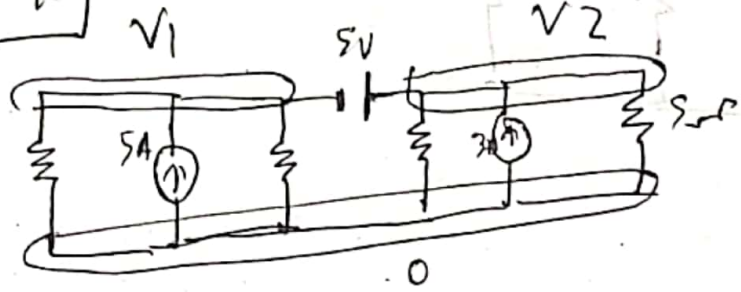
$V_1 = 22.5\,V$

$V_2 = 2.5\,V$

$V_3 = 2\,V$

Here voltage across current source is $V_1 = 22.5\,V$ and voltage across 8Ω is $V_3 = 2\,V$

Problem 10]



For supernode,

$$V_1\left(\frac{1}{6}+\frac{1}{3}\right)-5+V_2\left(\frac{1}{7}+\frac{1}{5}\right)-3=0$$

$$\Rightarrow \frac{1}{2}V_1+\frac{12}{35}V_2=8 \quad \text{---} \quad (1)$$

$$V_2-V_1=5$$

$$\therefore -V_1+V_2=5 \quad \text{---} \quad (11)$$

After solving eq (1), (11) we get,

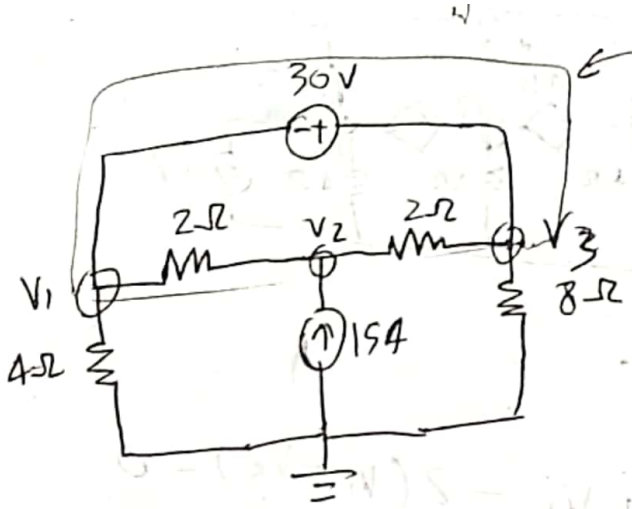
$$V_1=7.45\,V, \quad V_2=12.45\,V$$

As $i_o=\frac{V_2}{7}=\frac{12.45}{7}$

$$\therefore i_o=1.78\,A$$

(Ans)

Problem 11



For supernode

$$V_1\left(\frac{1}{2}+\frac{1}{4}\right) - \frac{V_2}{2} + \frac{V_3}{8}\left(\frac{1}{8}+\frac{1}{2}\right) - \frac{V_2}{2} = 6$$

$$\Rightarrow \frac{3}{4}V_1 - V_2 + \frac{5}{8}V_3 = 0 \quad \text{---} \quad (i)$$

$$V_3 - V_1 = 30 \quad \text{---} \quad (ii)$$

$$V_2\left(\frac{1}{2}+\frac{1}{2}\right) - \frac{V_1}{2} - \frac{V_3}{2} = 15$$

$$\Rightarrow -\frac{V_1}{2} + \frac{V_2}{1} - \frac{V_3}{2} = 15 \quad \text{---} \quad (iii)$$

By solving eq (i), (ii), (iii) we get

$V_1 = 30\,V$

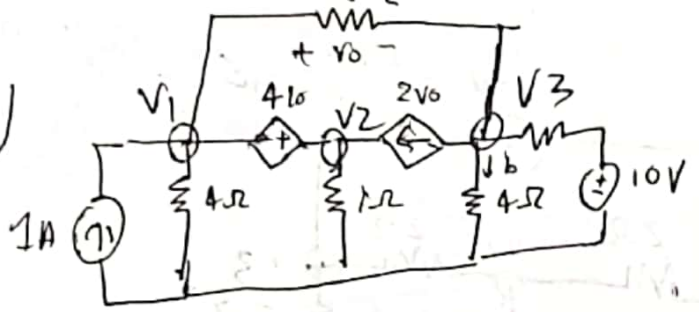
$V_2 = 60\,V$

$V_3 = 60\,V$

As we know, the current through 2Ω resistor is $i = \frac{V_3 - V_2}{2} = \frac{60-60}{2} = 0\,A$

(Ans)

Problem 12)



For super node,

$$V_1\left(\frac{1}{4}+\frac{1}{1}\right)-1+V_2-2(V_1-V_3)=0$$

$$\Rightarrow \frac{5}{4}V_1+V_2-2V_1+V_3=1$$

$$\Rightarrow -\frac{3}{4}V_1+V_2+V_3=1 \quad \text{—— (I)}$$

$$V_2-V_1=\frac{V_3}{4}$$

$$\Rightarrow -V_1+V_2-V_3=0 \quad \text{—— (II)}$$

For V_3 node,

$$V_3\left(\frac{1}{4}+\frac{1}{2}+1\right)+2(V_1-V_3)-\frac{10}{2}-\frac{V_3}{1}=0$$

$$\Rightarrow V_1-\frac{1}{4}V_3=5 \quad \text{—— (III)}$$

By solving eq (I), (II), (III) we get,

$V_1 = 4.97 V_0$ V

$V_2 = 4.85$ V

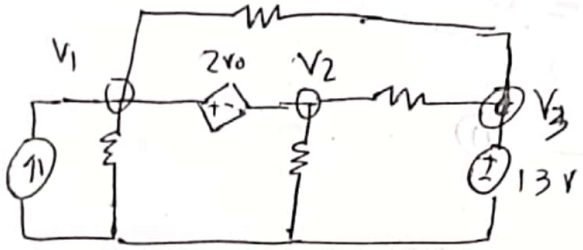
$V_3 = -0.12$ V

Current through $4I_o$ $\rightarrow$ $i = 4.97 \times (\frac{1}{4} + 1) - 1$

$= 5.33\ A$

(Ans)

Problem 13



$V_3 = 13$

For supernode,

$$V_1\left(\frac{1}{2} + 1\right) - 2 - \frac{13}{2} + V_2\left(\frac{1}{8} + \frac{1}{4}\right) - \frac{13}{8}$$

$$\Rightarrow \frac{3}{2}V_1 + \frac{3}{8}V_2 = \frac{81}{8} \quad \text{— (1)}$$

$V_1 - V_2 = 2v_o$ $2V_2$

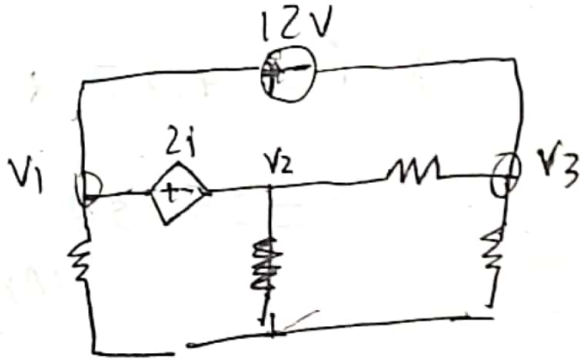
$\Rightarrow V_1 - 3V_2 = 0$

$\therefore V_1 = 6.23\ V$

$V_2 = 2.07\ V$

$V_3 = 13\ V$

Problem 14)



· For super node,

$$\frac{V_1}{4} + \frac{V_2}{1} + \frac{V_3}{4} = 0 \quad \text{— (I)}$$

$$V_1 - V_3 = 12 \quad \text{— (II)}$$

$$V_1 - V_2 = 2\,\frac{V_3}{4}$$

$$\Rightarrow V_1 - V_2 - \frac{V_3}{2} = 0 \quad \text{— (III)}$$

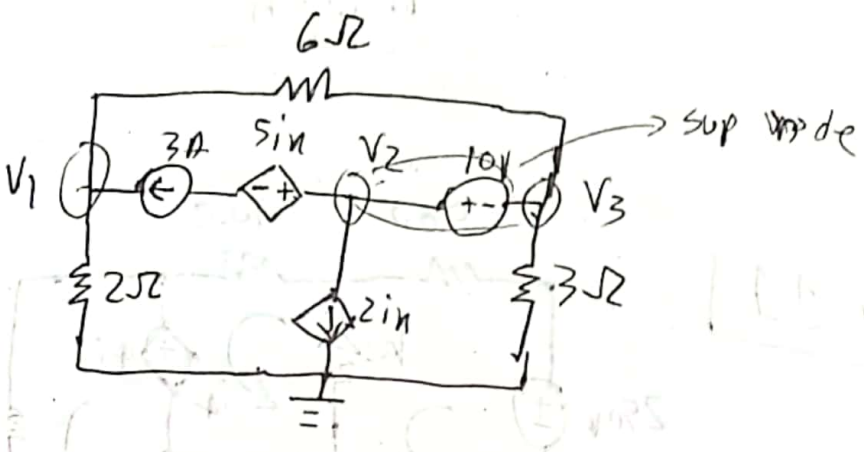
By solving eq (I), (II), (III) we get,

$V_1 = -3\ V$

$V_2 = 4.5\ V$

$V_3 = -15\ V$

Problem 15)



~~For super node,~~
For V_1,

$$V_1\left(\frac{1}{2}+\frac{1}{6}\right)-\frac{V_3}{6}-3=0$$

$$\Rightarrow \frac{2}{3}V_1-\frac{V_3}{6}=3 \quad \text{— (i)}$$

$$i_n=\frac{V_1}{2}$$

$$2i_n=V_1$$

For super node,

$$V_1+3+V_3\left(\frac{1}{3}+\frac{1}{6}\right)-\frac{V_1}{6}=0$$

$$\Rightarrow \frac{5}{6}V_1+\frac{1}{2}V_3=-3 \quad \text{— (ii)}$$

$$V_2-V_3=10 \quad \text{— (iii)}$$

By solving eq (i), (ii), (iii) we get,

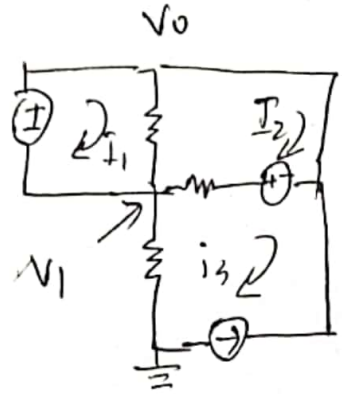
$V_1=2.11\ V$, $V_2=0.47\ V$, $V_3=-9.52V$

As, $i_n=\frac{V_1}{2}=\frac{2.11}{2}=1.055A$

(Ans)

Slide-6

P-3]



$$-400 + 10(i_1 - i_2) + 10i_1 = 0 \quad \text{---} \quad (I)$$

$$10(i_2 - i_1) - 100 + 10(i_2 + 10) = 0 \quad \text{---} \quad (II)$$

$\Rightarrow$ (I) can be written as,

$$20i_1 - 10i_2 - 400 = 0$$

(II) can be written as

$$-10i_1 + 20i_2 = 0$$

$$i_1 = \frac{80}{3} \;,\; i_2 = \frac{40}{3}$$

$\Rightarrow$ we can write,

$$\frac{0 - V_1}{10} = -10$$

$\therefore V_1 = 100V$

Now,

V_0

$$\frac{V_1 - V_0}{10} = i_2 - i_1$$

$$V_1 - V_0 = 10\left(\frac{40}{3} - \frac{80}{3}\right)$$

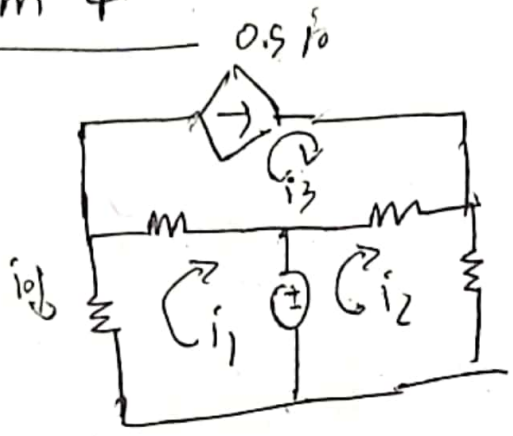
$$V_1 - V_0 = -\frac{400}{3}$$

$$\Rightarrow V_0 = V_1 + \frac{400}{3}$$

$$= 100 + \frac{400}{3}$$

$$= ~~166.67~~ \; 233.333 V$$

Problem 4



$\therefore i_1 = -i_0$

$\therefore 0.5\, i_0 = -0.5\, i_1$

$\therefore i_3 = -0.5\, i_1$

Loop 1

$i_1 + 4(i_1 - i_3) + 280 = 0$

$\Rightarrow i_1 + 4(i_1 + 0.5\, i_1) + 280 = 0$

$\Rightarrow 5 i_1 = -280$

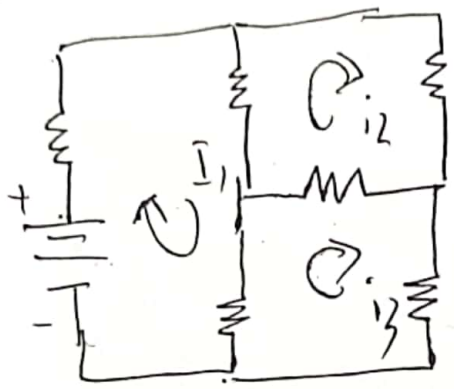
$\therefore i_1 = -40\text{A}$

$i_0 = -i_1$

$= 40\text{A}$

(Ans)

Problem 5)



Loop 1

$$-10 + i_1 + 2(i_1 - i_2) + 2(i_1 - i_3) = 0$$

$$\Rightarrow 5i_1 - 2i_2 - 2i_3 = 10 \quad \text{---} \quad (I)$$

Loop 2

$$2i_2 + 2(i_2 - i_3) + 2(i_2 - i_1) = 0$$

$$\Rightarrow -2i_1 + 6i_2 - 2i_3 = 0 \quad \text{---} \quad (II)$$

Loop 3

$$2i_3 + 2(i_3 - i_1) + 2(i_3 - i_2) = 0$$

$$\Rightarrow -2i_1 - 2i_2 + 6i_3 = 0 \quad \text{---} \quad (III)$$

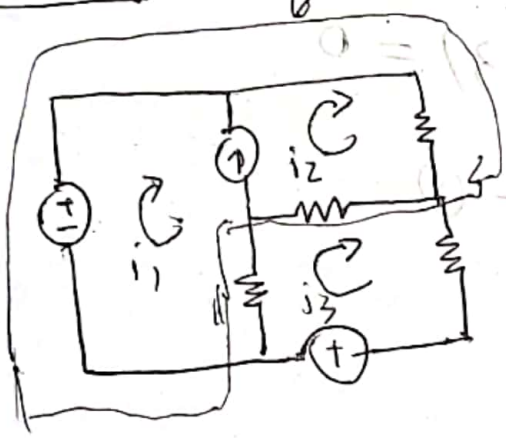
By solving eq (I), (II), (III) we get,

$i_1 = 3.33\text{mA}$, $i_2 = 1.67\text{mA}$, $i_3 = 1.67\text{mA}$

As, $i_5 = i_1$

$\therefore i_5 = 3.33\ mA$

Problem 6



Loop ② (super mesh)

$-400 + 100 i_2 + 50(i_2 - i_3) + 50(i_1 - i_3) = 0$

$\Rightarrow 50 i_1 + 150 i_2 - 100 i_3 = 400$ — ①

$i_2 - i_1 = 4$ — ②

Loop 3

$-50 + 50(i_3 - i_1) + 50(i_3 - i_2) + 100 i_3 = 0$

$\Rightarrow -50 i_1 - 50 i_2 + 200 i_3 = 50$ — ③

By solving eq ①, ②, ③ we get,

$i_1 = -0.5$, $i_2 = 3.5$, $i_3 = 1$

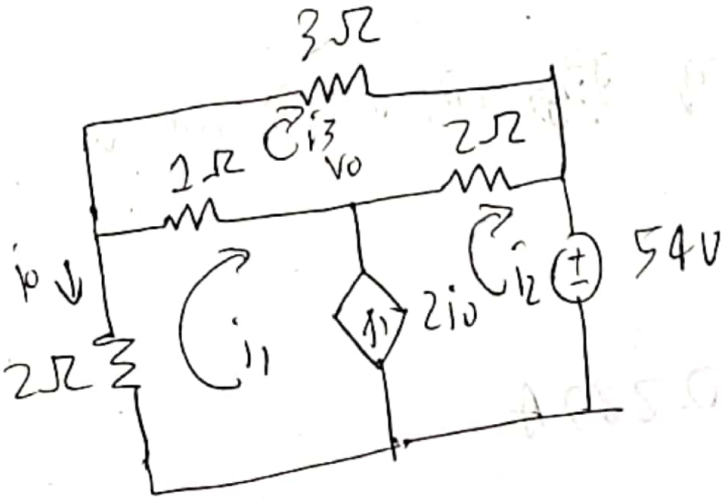
As $i_0 = i_3 - i_1$ [From the circuit]

$= 1 - 3.5$

$= -2.5$

$\therefore i_0 = -2.5$

Problem 7



super mesh 1

$2i_1 + 1(i_1 - i_3) + 2(i_2 - i_3) + 54 = 0$

$\Rightarrow 3i_1 + 2i_2 - 3i_3 = -54$ — (I)

$i_2 - i_1 = -2i_1$

$\Rightarrow i_1 + i_2 = 0$ — (II)

loop 3

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

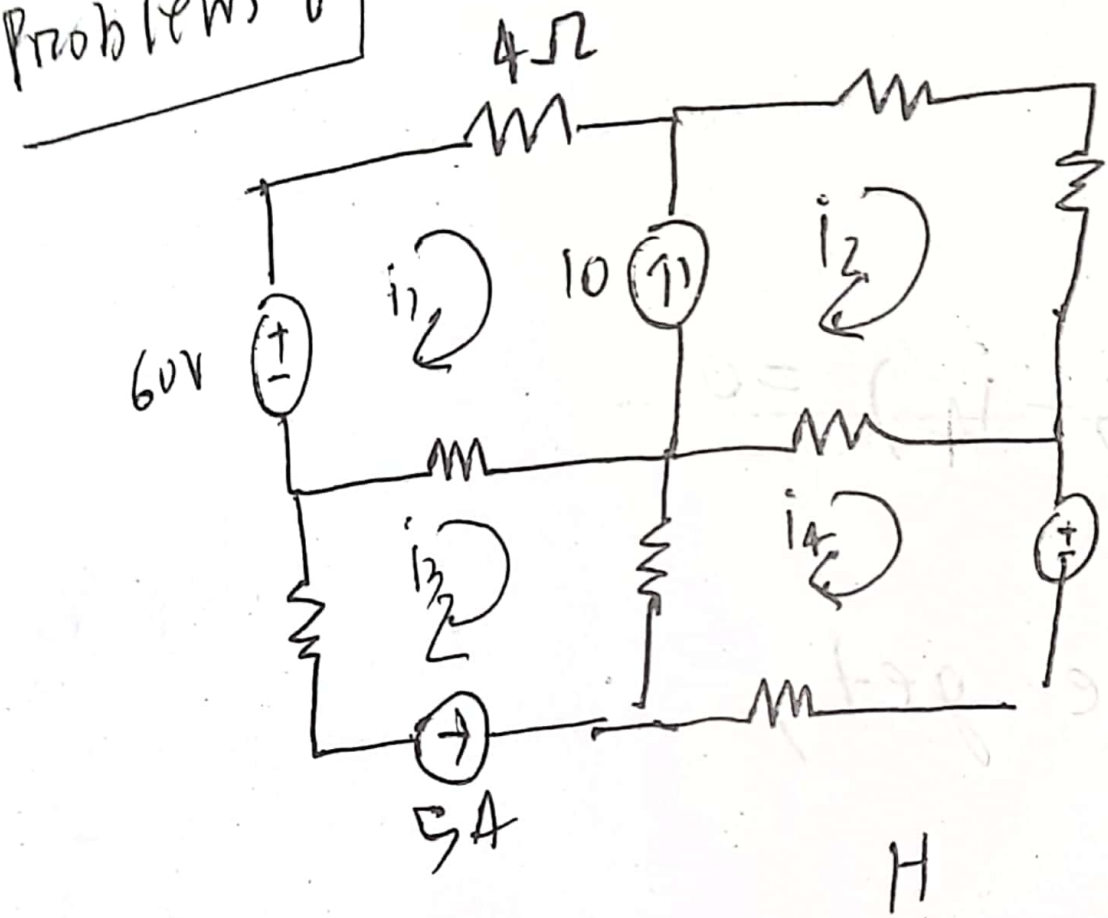
$\Rightarrow -i_1 - 2i_2 + 6i_3 = 0$

By solving eq (I), (II), (III) we get

$i_1 = -36\ A$, $i_2 = 36\ A$, $i_3 = 6\ A$

$i_0 = -i_1 = 36\ A$ (Ans)

Problem 8



~~For super mesh~~

Here, $i_3 = -5$

For super mesh i_1, i_2,

$$\Rightarrow -60 + 4i_1 + 3i_2 + i_2 + 2(i_2 - i_4) + 2(i_1 + 5) = 0$$

$$\Rightarrow 6i_1 + 6i_2 - 2i_3 = 50 \quad \text{— (I)}$$

$$\Rightarrow i_2 - i_1 = 10 \quad \text{— (II)}$$

Loop 4

$$\Rightarrow 22.5 + 4i_4 + 1(i_4 + 5) + 2(i_4 - i_2) = 0$$

$$\Rightarrow -2i_2 + 7i_4 = -27.5 \quad \text{— (III)}$$

~~Loop 3~~

~~$\Rightarrow -5 + 2(5 - i_1) + 1(5 - i_4) = 0$~~

Solving eq (I), (II), (III) we get,

$i_1 = -1.063$

$i_2 = 8.938$

$i_4 = -1.375$

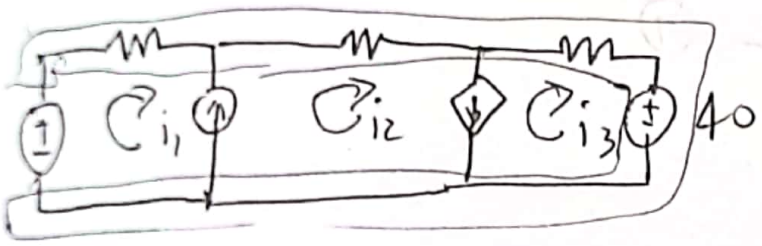
As, $i_3 = i_3 - i_4$

$= -5 - (-1.375)$

$= -3.62\ A$

(Ans)

Problem 9)



$-100 + 4i_1 + 8i_2 + 2i_3 + 40 = 0$ — (i)

$i_2 - i_1 = 4\,mA$ — (ii)

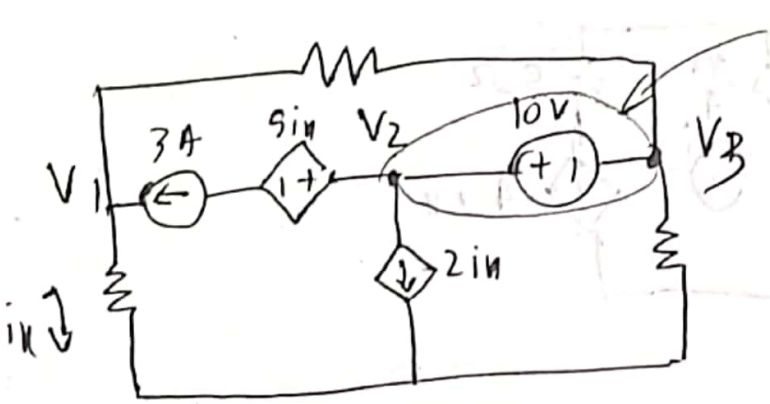
$i_2 - i_3 = 2i_1$ — (iii)

~~$\therefore i_1 = 2,\ i_2 = 6$~~

$\therefore$ By solving eq (i), (ii), (iii) we get,

$i_1 = 2\,mA$, $i_2 = 6\,mA$, $i_3 = 2\,mA$

Problem 10) ~~Mesh~~ ① Nodal.



$$i_N = \frac{V_1}{2}$$

For V_1,

$$V_1\left(\frac{1}{6}+\frac{1}{2}\right) - 3 - \frac{V_3}{6} = 0$$

$$\Rightarrow \frac{2}{3}V_1 - \frac{V_3}{6} = 3 \quad \text{—} \quad (i)$$

For ~~V2~~ super node,

$$V_1 + 3 + V_3\left(\frac{1}{3}+\frac{1}{6}\right) - \frac{1}{6}V_1 = 0$$

$$\Rightarrow \frac{5}{6}V_1 + \frac{1}{2}V_3 = -3 \quad \text{—} \quad (ii)$$

$$V_2 - V_3 = 10 \quad \text{—} \quad (iii)$$

By solving eq (i), (ii), (iii) we get,

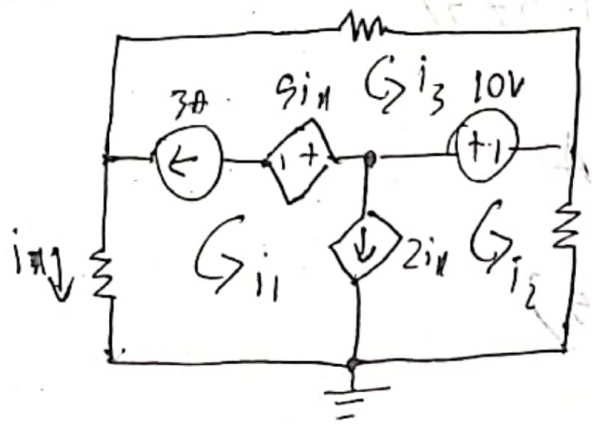
$$V_1 = 2.117, \quad V_2 = 0.47, \quad V_3 = -9.529$$

$$i_N = \frac{V_1}{2} = \frac{2.117}{2} = 1.059\,A$$

(Ans)

P-10

Problem 10 (11) Mesh →



Super mesh

$2i_1 + 3i_2 + 6i_3 = 0$ — (I)

$i_2 - i_1 = 2i_1 = 0$

$\Rightarrow i_2 - 3i_1 = 0$ — (II)

$i_1 - i_3 = 3$ — (III)

By solving eq (I), (II), (III) we get,

$i_1 = 1.058$

$i_2 = 3.1764$

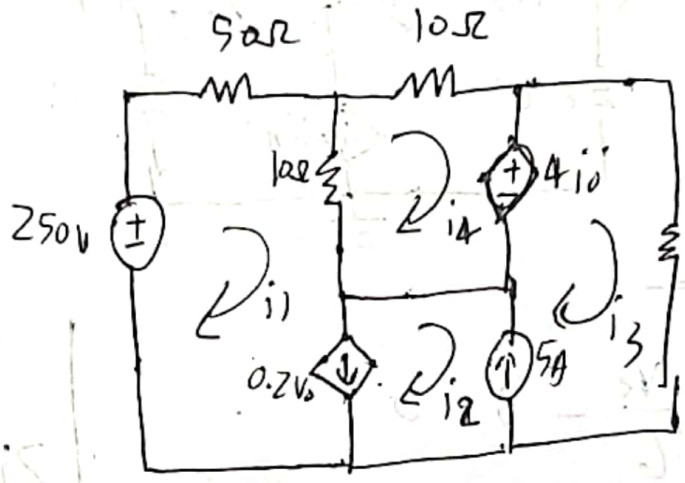
$i_3 = -1.941$

As, $i_x = i_1$ $\therefore i_x = 1.058$ A

(Ans)

Mesh

Problem 11



For supermesh

$$-250 + 50i_1 + 10(i_1 - i_4) - 4(i_1 - i_2) + 40i_3 = 0$$

$$\Rightarrow 56i_1 + 40i_3 - 14i_4 = 250 \quad \text{---} \quad (1)$$

$$i_1 - i_2 = 0.2 \times 10i_4$$

$$\Rightarrow i_1 - i_2 - 2i_4 = 0 \quad \text{---} \quad (11)$$

$$i_3 - i_2 = 5$$

$$\therefore -i_2 + i_3 = 5 \quad \text{---} \quad (111)$$

$$4(i_1 - i_4) + 10(i_4 - i_1) + 10i_4 = 0$$

$$\Rightarrow -6i_1 + 16i_4 = 0 \quad \text{---} \quad (IV)$$

By solving eq (i), (ii), (iii), (iv) we get

$i_1 = 0.784\,A$

$i_2 = 0.196\,A$

$i_3 = 5.196\,A$

$i_4 = 0.294\,A$

$V_0 = 10 \times i_4 = 2.94\,V$

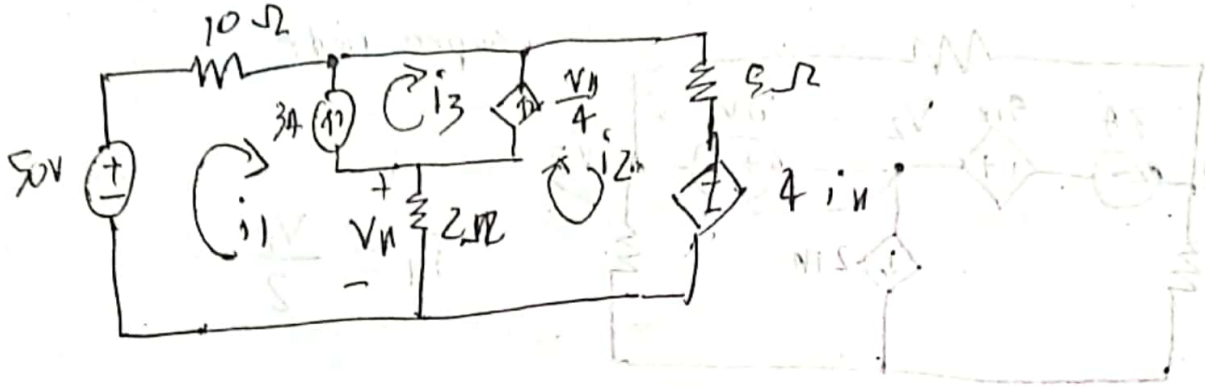
$i_0 = i_1 - i_4$

$= 0.784 - 0.294$

$= 0.49\,A$

(Ans)

Problem-12



$$V_n = 2(i_1 - i_2)$$

Super mesh :

$$-50 + 10i_1 + 5i_2 + 4i_1 = 0$$

$$\Rightarrow 14i_1 + 5i_2 = 50 \quad \text{—— (i)}$$

$$i_3 - i_1 = 3$$

$$\Rightarrow -i_1 + i_3 = 3 \quad \text{—— (ii)}$$

$$i_2 - i_3 = \frac{V_n}{4}$$

$$\Rightarrow i_2 - i_3 = \frac{i_1 - i_2}{2}$$

$$\Rightarrow 2i_2 - 2i_3 = i_1 - i_2$$

$$\Rightarrow -i_1 + 3i_2 - 2i_3 = 0 \quad \text{—— (iii)}$$

∴ By solving eq ① ② ③ we get,

$i_1 = 2.105\ A$

$i_2 = 4.105\ A$

$i_3 = 5.105\ A$

As $i_N = i_1$

$\therefore i_N = 2.105\ A$

$V_N = 2(i_1 - i_2)$

$= 2(2.105 - 4.105)$

$= -4\ V$