# Paper 1, TDC Part-1
# Problem Discussion

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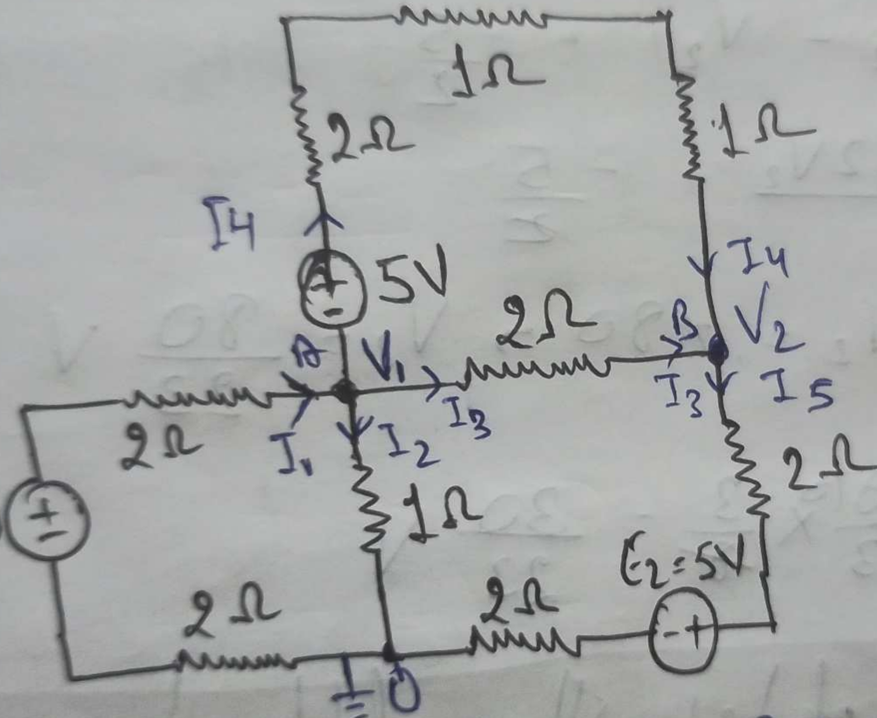
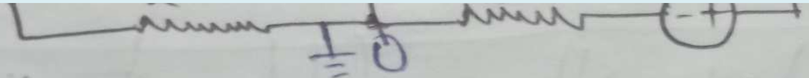
# Mesh and Nodal Analysis in Passive Circuits

Q1) Using Nodal Method, find the battery current in the circuit shown below.




Soln. There are 3 nodes A, B & 0 where 0 is reference node and is grounded. Let voltages ... are $V_1$ & $V_2$ resp.

# Mesh and Nodal Analysis in Passive Circuits




There are 3 nodes A, B, & O where O is reference node and is grounded. Let voltages at A & B are $V_1$ & $V_2$ resp.

Also let different branch currents are $I_1$, $I_1$, $I_3$, $I_4$ & $I_5$ as shown in figure.

Then applying KCL at node A, we have

$$I_1 = I_2 + I_3 + I_4$$

or, $$\frac{E_1 - V_1}{4} = \frac{V_1}{1} + \frac{V_1 - V_2}{2} + \frac{V_1 + 5 - V_2}{4}$$

or, $$\frac{5}{4} = V_1\left(\frac{1}{4} + \frac{1}{4} + \frac{1}{2} + 1\right) - V_2\left(\frac{1}{2} + \frac{1}{4}\right) + \frac{5}{4}$$

or, $$0 = 2V_1 - \frac{3}{4}V_2 \Rightarrow 8V_1 - 3V_2 = 0$$

or $$V_1 = \frac{3}{8}V_2$$ -

# Mesh and Nodal Analysis in Passive Circuits

Now, applying KCL at node B, we have

$$I_3 + I_4 = I_5$$

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

or $V_1\left(\frac{1}{2} + \frac{1}{4}\right) - V_2\left(\frac{1}{2} + \frac{1}{4} + \frac{1}{4}\right) = -\frac{5}{4} - \frac{5}{4} = -\frac{5}{2}$

or $\frac{3}{4} V_1 - V_2 = \frac{-5}{2}$

or $\frac{3}{4} \times \frac{3}{8} V_2 - V_2 = -\frac{5}{2}$

or $\frac{9V_2 - 32V_2}{\cancel{32}\ 16} = -\frac{5}{\cancel{2}}$

or $+23V_2 = +80 \Rightarrow V_2 = \frac{80}{23}\ V$

# Mesh and Nodal Analysis in Passive Circuits

$$V_1 = \frac{80}{23} \times \frac{3}{8} = \frac{30}{23}\ \text{V}$$

So, we can obtain the different current now,

$$I_1 = \frac{5 - 30/23}{4} = 0.92\ \text{A}$$

$$I_2 = \frac{V_2}{1} \Rightarrow \frac{80}{23}\ \text{A} = 3.5\ \text{A}$$

$$I_3 = \frac{\frac{30}{23} - \frac{80}{23}}{2} = \frac{-50}{46} \approx -1.0\ \text{A}$$

$$I_4 = I_1 - I_2 - I_3 = 0.92 + 1 - 3.5$$
$$= -1.58\ \text{A}$$

$$I_5 = \frac{\frac{80}{23} - 5}{4} = \frac{-1.52}{4} = -0.38\ \text{A}$$

# Mesh and Nodal Analysis in Passive Circuits

1) Two wires A and B are connected in series at 0°c and resistance of B is 3.5 times that of A. The resistance temperature co-efficient of A is 0.4%. and that of the combination is is 0.1%. Find the resistance temperature co-efficient of B.

Soln:

$$\frac{R_B}{R_A} = 3.5 \quad \text{———— (i)}$$

# Mesh and Nodal Analysis in Passive Circuits

As per ratio & proportion

| A | | B |
|---|---|---|
| 0.004 | | $\alpha_B$ |
| | 0.001 | |
| $(0.001 - \alpha_B)$ | | 0.003 |

$$\Rightarrow \frac{R_B}{R_A} = \frac{0.003}{(0.001 - \alpha_B)}$$

or, $3.5 = \dfrac{0.003}{(0.001 - \alpha_B)}$

or, $3.5 \times 10^{-3} - 3.5\alpha_B = 3 \times 10^{-3}$

or, $3.5\alpha_B = (3.5 - 3) \times 10^{-3}$

$$\alpha_B = \frac{0.5}{3.5} \times 10^{-3}$$

$= 0.00014\ ^\circ C^{-1}$

$= 0.014\ \%$

## Mesh and Nodal Analysis in Passive Circuits

For any query contact- 9771474020

# Thank You