Electrical Resistor network node voltage solver

* Objective : Use Kirchhoff current law to form linear equations for a multi node DC circuit and compute unknown voltages.

* What is Node Voltage Method ?

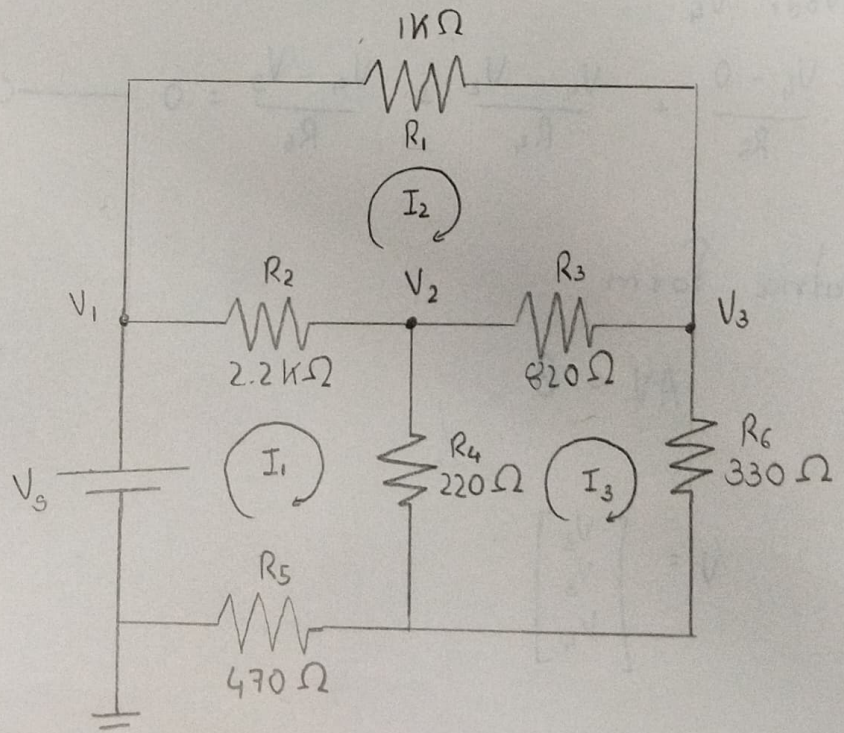
- The node voltage method is a systematic technique used to determine unknown voltages in an electrical circuit by applying
  (i) Kirchhoff's Current Law
  (ii) Ohm's Law

- At each node :

$$\Sigma I = 0$$

The algebraic sum of currents entering or leaving a node must be zero

* Problem



- Given :

$R_1 = 1K\Omega$
$R_2 = 2.2K\Omega$
$R_3 = 820\ \Omega$
$R_4 = 220\ \Omega$
$R_5 = 470\ \Omega$
$R_6 = 330\ \Omega$
$V_5 = 8V$
Ground = 0V

- Since V_1 is connected directly to the source

$$V_1 = V_5 = 8V$$

- Node V_2

$$\frac{V_2 - V_1}{R_2} + \frac{V_2 - V_3}{R_3} + \frac{V_2 - V_4}{R_4} = 0 \quad \text{——— (i)}$$

- Node V_3

$$\frac{V_3 - V_1}{R_1} + \frac{V_3 - V_2}{R_3} + \frac{V_3 - V_4}{R_6} = 0 \quad \text{——— (ii)}$$

- Node V_4

$$\frac{V_4 - 0}{R_5} + \frac{V_4 - V_2}{R_4} + \frac{V_4 - V_3}{R_6} = 0 \quad \text{——— (iii)}$$

* Matrix form

$$AV = B$$

where

$$V = \begin{bmatrix} V_2 \\ V_3 \\ V_4 \end{bmatrix}$$

$$A = \begin{bmatrix} \left(\frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}\right) & -\frac{1}{R_3} & -\frac{1}{R_4} \\ -\frac{1}{R_3} & \left(\frac{1}{R_1} + \frac{1}{R_3} + \frac{1}{R_6}\right) & -\frac{1}{R_6} \\ -\frac{1}{R_4} & -\frac{1}{R_6} & \left(\frac{1}{R_4} + \frac{1}{R_5} + \frac{1}{R_6}\right) \end{bmatrix}$$

$$B = \begin{bmatrix} \frac{V_s}{R_2} \\ \frac{V_s}{R_1} \\ 0 \end{bmatrix}$$