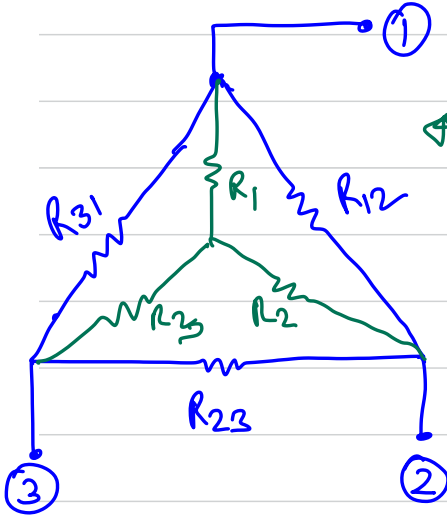
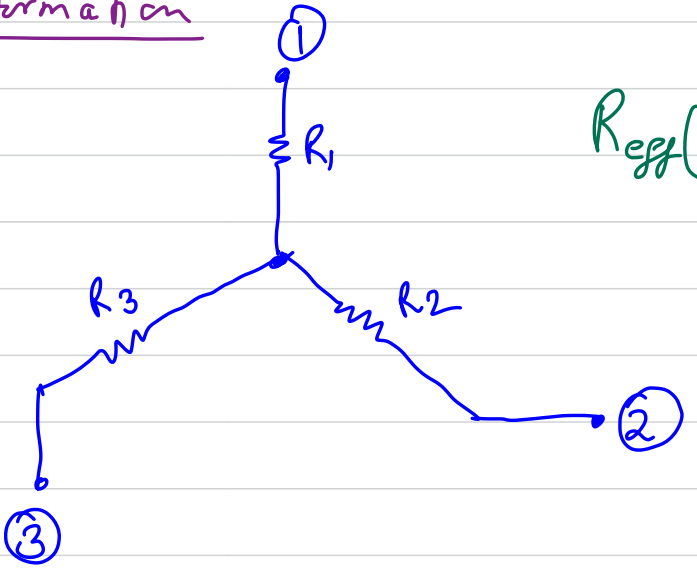
Lecture 6

Star – Delta transformation



R_{eff} 1&2



$R_{eff}(1,2)$

$$R_{12} \,||\, (R_{31} + R_{23}) = (R_1 + R_2) \qquad R_{eff(1,2)}$$

$$R_{23} \,||\, (R_{31} + R_{12}) = (R_3 + R_2) \qquad R_{eff(2,3)}$$

$$R_{31} \,||\, (R_2 + R_{23}) = (R_1 + R_3) \qquad R_{eff(1,3)}$$

$$R_1 = \frac{R_{31} R_{12}}{R_{12} + R_{23} + R_{31}} \qquad R_2 = \frac{R_{12} R_{23}}{R_{12} + R_{23} + R_{31}} \qquad R_3 = \frac{R_{eff} R_{31}}{R_{12} + R_{23} + R_{31}}$$

$$R_{12} = R_1 + R_2 + \frac{R_1 R_2}{R_3} \qquad R_{23} = R_2 + R_3 + \frac{R_2 R_3}{R_1}$$

$$R_{31} = R_1 + R_3 + \frac{R_1 R_3}{R_2}$$

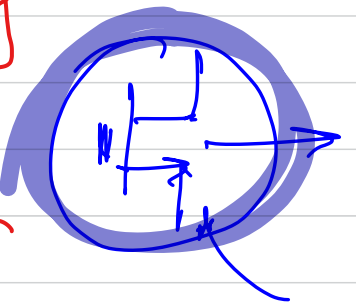
"Controlled Sources"

→ Voltage Controlled voltage Source (VCVS) e

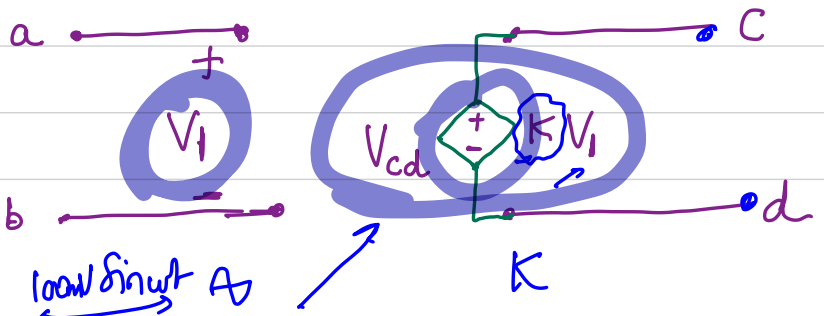
→ Voltage Controlled Current Source (VCCS) g

→ Current Controlled voltage Source (CCVS) h

→ Current Controlled current Source (CCCS) f

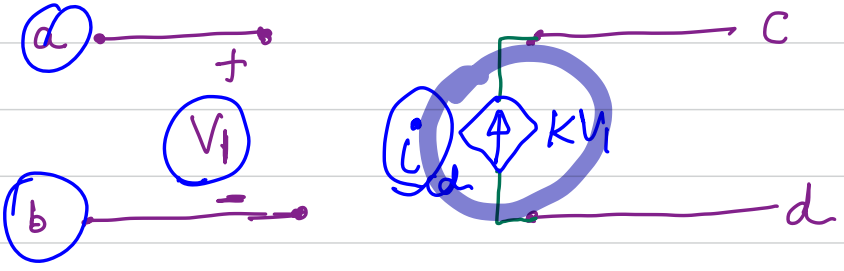


VCVS



$$V_{cd} = K V_{ab}$$

VCCS



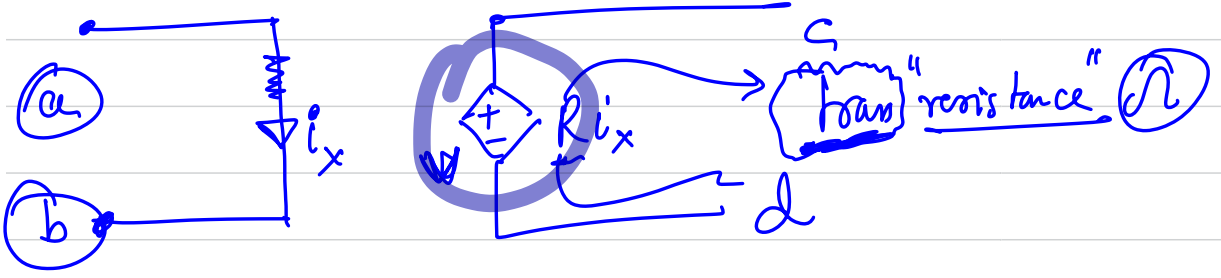
$i_{cd} = K V_{ab}$

trans — Conductance

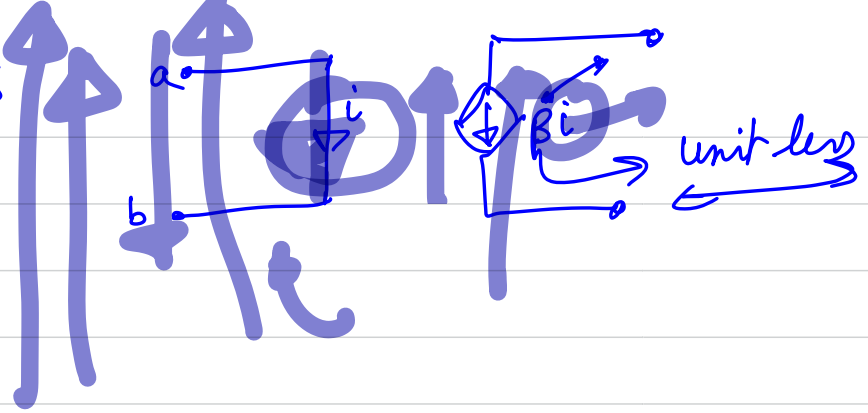
transfer

$R \rightarrow G = \frac{1}{R}$

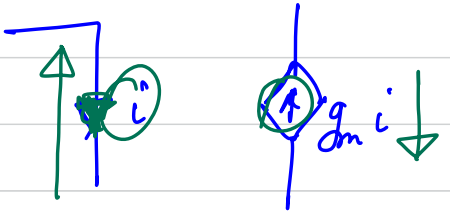
CCVS

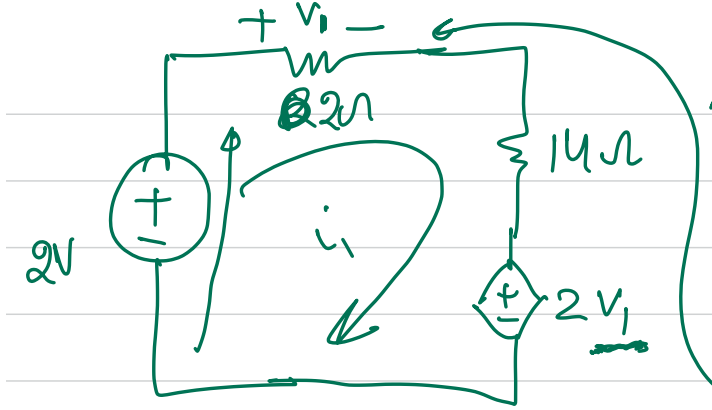


CC CS



Q

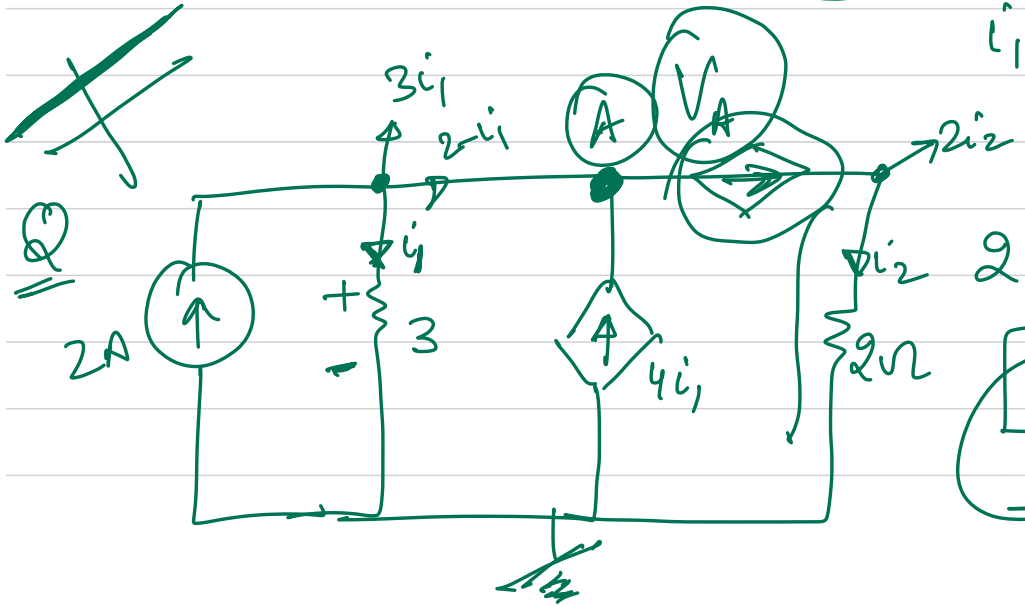




$\rightarrow 2 - 2 \times i_1 - 14\, i_1 - 2v_1 = 0$

$v_1 = 2 i_1$

$i_1 = ?$ 0.1 Amp



$2A + 4i_1 = i_1 + i_2$

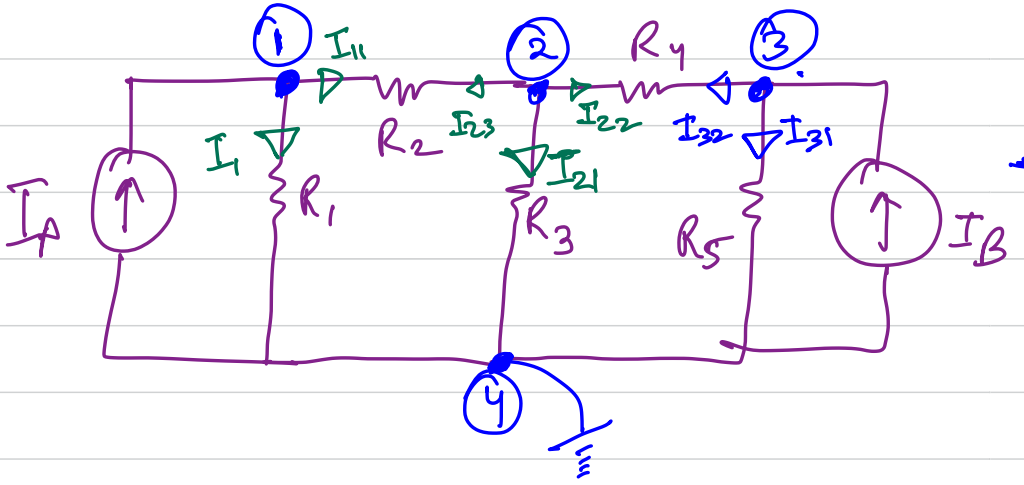
$2 + 3i_1 = i_2$

$3i_1 = 2i_2$ $\quad i_2 = -2A$

$i_1 = -4$

Nodal Analysis → "KCL" ⟷

Circuits resistors current source.



$I_B = I_{31} + I_{32}$

$V_3 G_5 + (V_3 - V_2) G_4 = I_B$

$+ V_1 \cdot 0 - V_2 G_4 + V_3 (G_5 + G_4) = I_B.$

$I_1 + I_{11} = I_A$

$\frac{V_1}{R_1} + \frac{V_1 - V_2}{R_2} = I_A \rightarrow$

$V_1 G_1 + (V_1 - V_2) G_2 = I_A$

$V_1 (G_1 + G_2) - V_2 G_2 = I_A \rightarrow (1)$

$I_{21} + I_{22} + I_{23} = 0$ $\quad V_2 G_3 + (V_2 - V_3) G_4 + (V_2 - V_1) G_2 = 0$

$$-V_1 G_2 + V_2 (G_3 + G_4 + G_2) - V_3 G_4 = 0 \quad (2)$$

$V_1 (G_1 + G_2) - V_2 G_2 + V_3 \cdot 0 = I_A \longrightarrow$ node 1

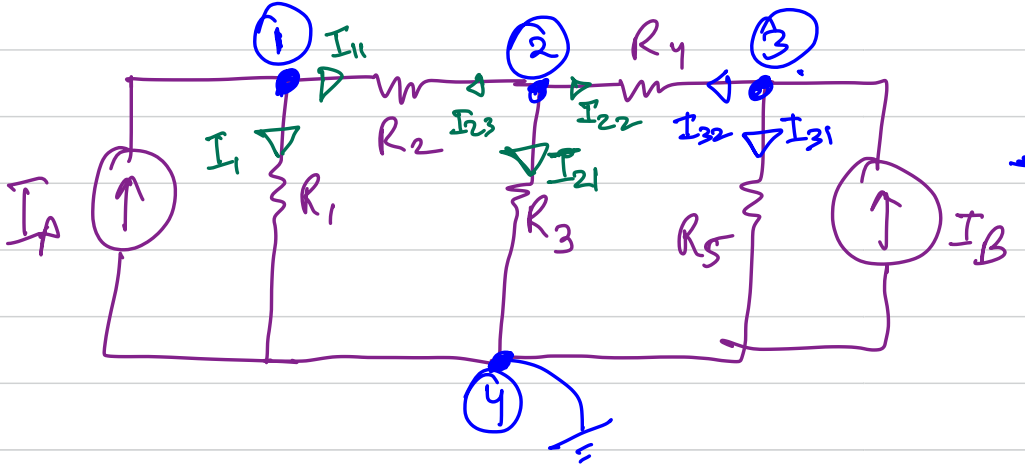
$-V_1 (G_2) + V_2 (G_2 + G_3 + G_4) - V_3 G_4 = 0 \longrightarrow$ node 2

$V_1 \cdot 0 - V_2 G_4 + V_3 (G_5 + G_4) = I_B \longrightarrow$ node 3.

$$\begin{bmatrix} G_1+G_2 & -G_2 & 0 \\ -G_2 & G_2+G_3+G_4 & -G_4 \\ 0 & -G_4 & G_5+G_4 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} I_A \\ 0 \\ I_B \end{bmatrix}$$

Conductance Matrix — Unknown variable — "Current source" / voltage source

$$G\,V = I$$



$$V = G^{-1} I$$

$$\begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix} = \begin{matrix} 1 \\ 2 \\ 3 \end{matrix}$$