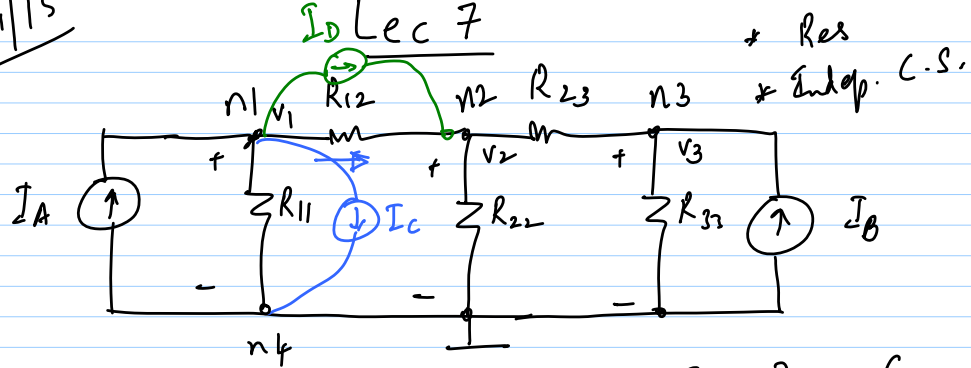


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Lec 7

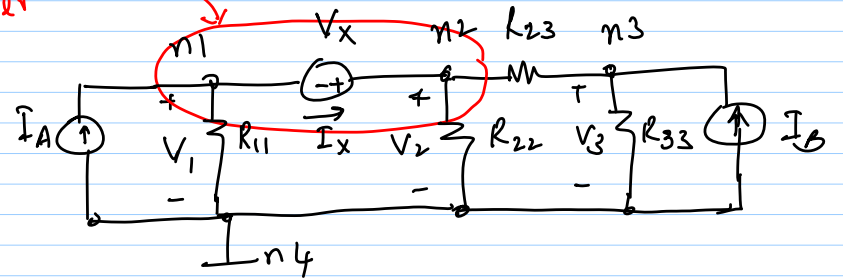


$$\begin{matrix} n1 \rightarrow \\ n2 \rightarrow \\ n3 \rightarrow \end{matrix} \begin{bmatrix} G_{11} + G_{12} & -G_{12} & 0 \\ -G_{12} & G_{12} + G_{22} + G_{23} & -G_{23} \\ 0 & -G_{23} & G_{23} + G_{33} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} I_A \\ 0 \\ I_B \end{bmatrix}$$

$$[G] \cdot \bar{v} = \bar{I}$$

$$\bar{v} = [G]^{-1} \cdot \bar{I} \quad \checkmark$$

"Supernode"



$$\text{KCL @ } n1: G_{11} \cdot V_1 + I_x = I_A$$

$$\text{KCL @ } n1: G_{11} \cdot V_1 + I_x = I_A$$

$$\text{@ } n2: (G_{22} + G_{23})V_2 - G_{23}V_3 - I_x = 0$$

$$\left. \begin{matrix} \text{KCL for} \\ \text{supernode (1,2)} \end{matrix} \right\} \Rightarrow G_{11} \cdot V_1 + (G_{22} + G_{23})V_2 - G_{23}V_3 = I_A$$

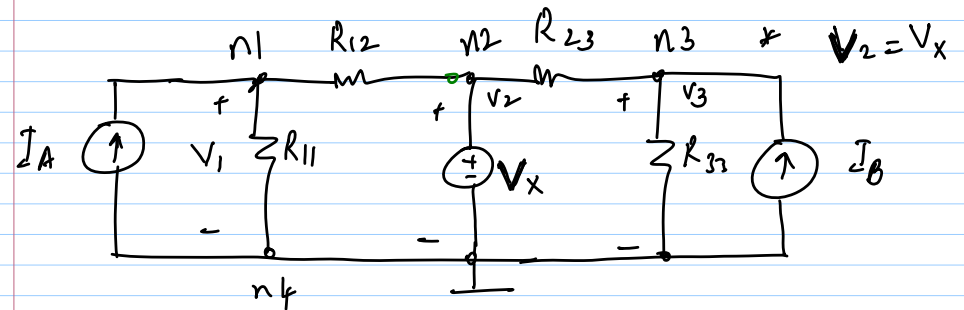
$$-V_1 + V_2 = V_x$$

$$\begin{bmatrix} a/- \end{bmatrix} \begin{bmatrix} v \end{bmatrix} = \begin{bmatrix} I/v \end{bmatrix}$$

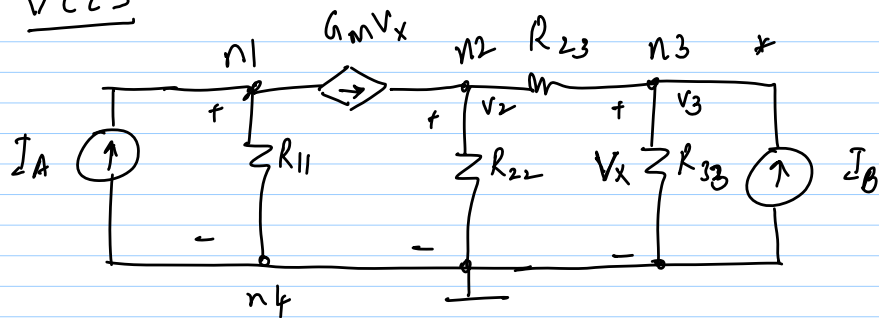
\* Construct "supernode"

\* KCL for supernode, other nodes

\* Voltage constraints inside supernode



VCCS



KCL @ n1

$$G_{11}V_1 + G_m V_3 = I_A$$

@ n2

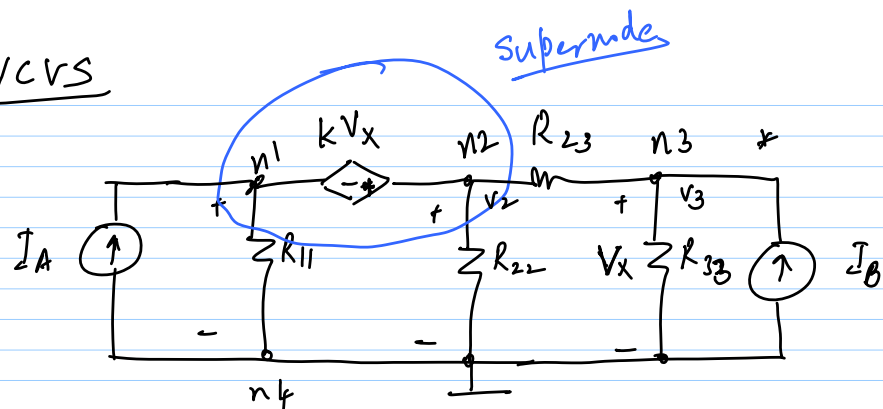
$$(G_{22} + G_{23})V_2 - (G_{23} + G_m)V_3 = 0$$

@ n3

$$-G_{23}V_2 + (G_{23} + G_{33})V_3 = I_B$$

$$\begin{bmatrix} G_{11} & 0 & G_m \\ 0 & G_{22} + G_{23} & -(G_{23} + G_m) \\ 0 & -G_{23} & G_{23} + G_{33} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} I_A \\ 0 \\ I_B \end{bmatrix}$$

VCVS

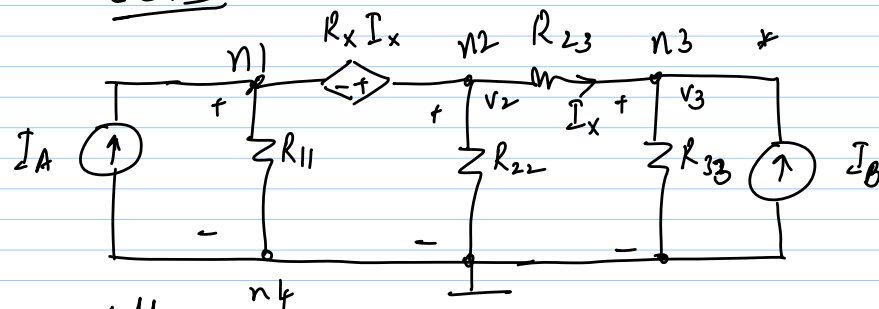


additional eq.

$$V_2 - V_1 = kV_3$$

$$\Rightarrow -V_1 + V_2 - kV_3 = 0$$

CCVS



addl. eq.

$$\begin{aligned} V_2 - V_1 &= R_x I_x \\ &= R_x \cdot \frac{V_2 - V_3}{R_{23}} \end{aligned}$$

$$-V_1 + \left(1 - \frac{R_x}{R_{23}}\right)V_2 + \frac{R_x}{R_{23}}V_3 = 0$$