EE 16B DIS 204

Mon - Thu
7:00 PM.

1. Matrices.

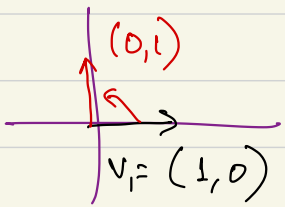
$$A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}_{2\times 2}$$

- Row rank.
- Column rank
- Rank.
- Row space, Column space.
- Eigen values
- Eigen vectors

$A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}_{2\times 2}$ ← transformation

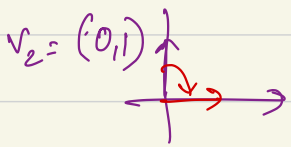
$\mathbb{R}^{(2)} \longrightarrow \mathbb{R}^{(2)}$

$\begin{bmatrix} a \\ b \end{bmatrix} \longrightarrow \begin{bmatrix} c \\ d \end{bmatrix}$



$A \cdot v_1 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

$= \begin{bmatrix} 0 \\ 1 \end{bmatrix}$



$Av_2 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

$= \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

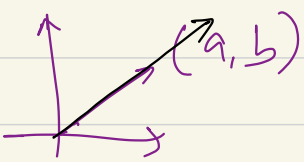
If a matrix is not full rank. (square)

$\exists x \neq 0$, s.t. $Ax = 0$

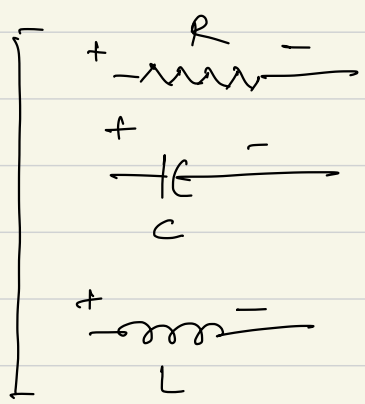
(Rank deficiency).

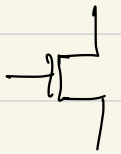
- Eigenvector.

v s.t. $Av = \lambda v$ (λ is a scalar)

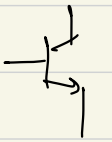


Circuits

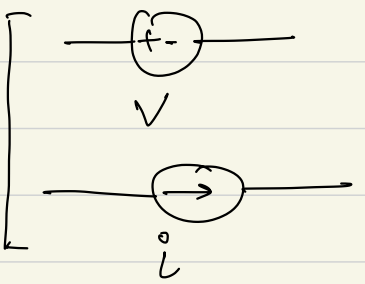


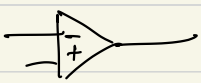


MOSFETS



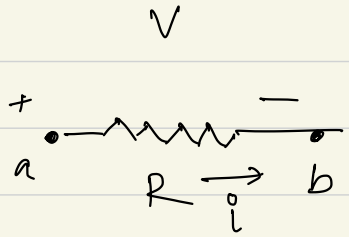
BJT (Bipolar junction transistors)





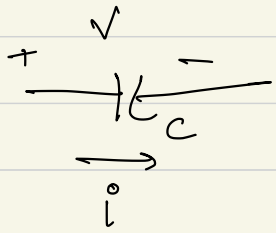
op-amps

Resistor



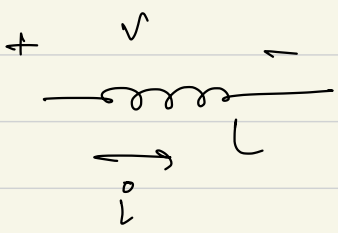
$$i = \frac{V}{R}$$

Capacitor



$$i = C\frac{dv}{dt}$$

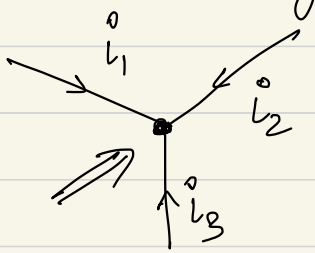
Inductor



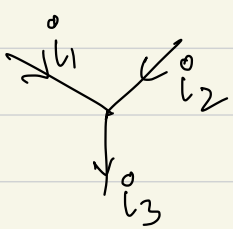
$$v = L\frac{di}{dt}$$

KCL and KVL → Kirchoff's voltage law. (conservation of energy)

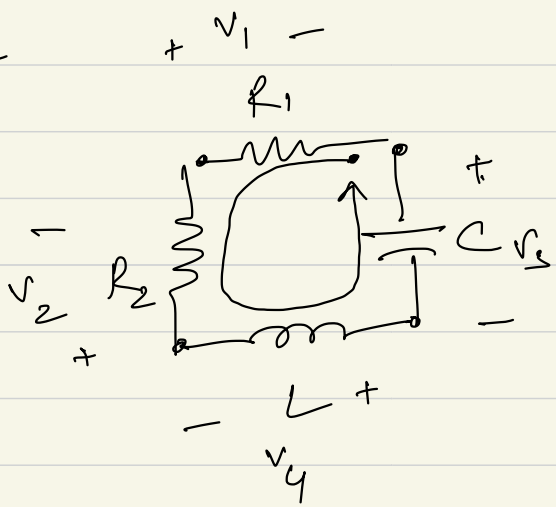
Kirchoff's Current Law. (conservation of charge)



$$i_1 + i_2 + i_3 = 0$$

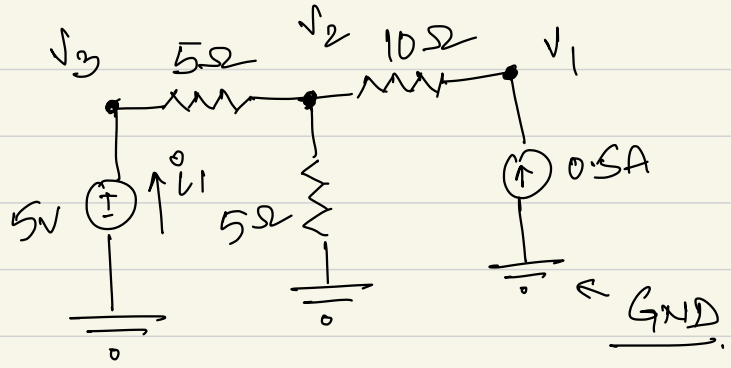


$$i_1 + i_2 - i_3 = 0$$



$$q(v_1 + v_2 + v_3 + v_4) = 0$$

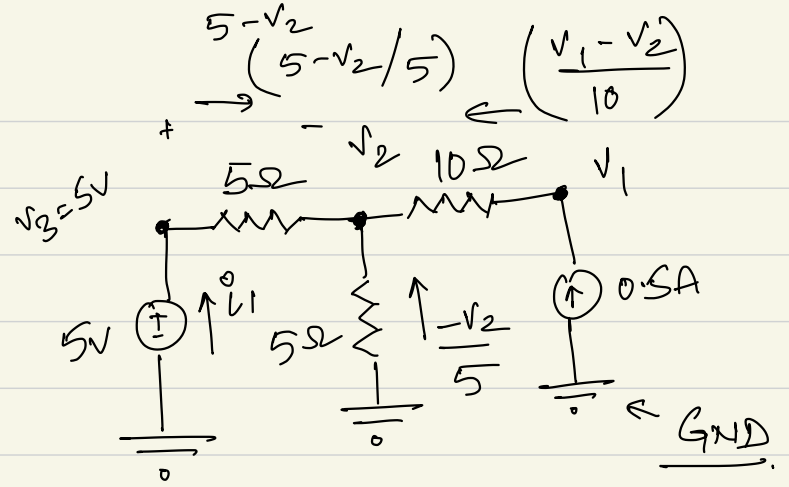
Circuit example



① Nodal analysis :+ KCL

② Mesh analysis. (KVL) + KCL.

- Mark out voltages across elements
- Write system of equations using KCL
- Try to solve for the unknowns.



$$\left(\frac{V_1-V_2}{10}\right) = 0.5 \quad (1)$$

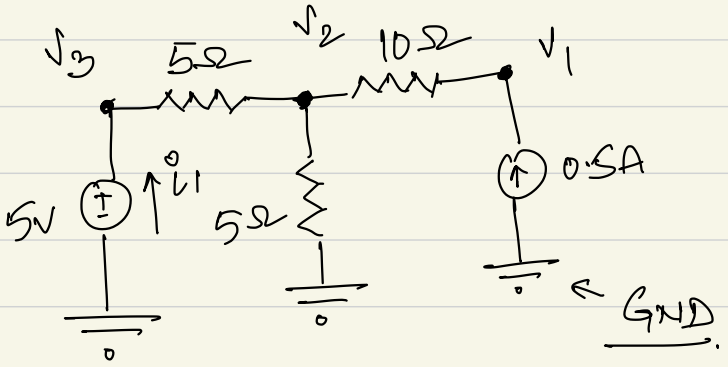
$$\left(\frac{5-V_2}{5}\right) + \left(\frac{-V_2}{5}\right) + \left(\frac{V_1-V_2}{10}\right) = 0 \quad (2)$$

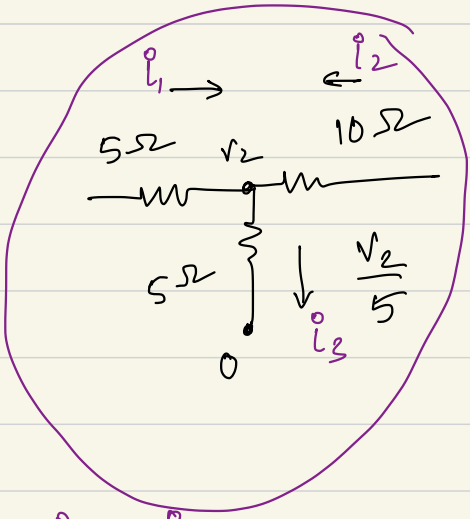
Substituting (1) in (2)

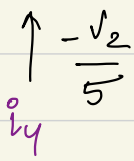
$$\left(\frac{5-V_2}{5}\right) + \left(\frac{-V_2}{5}\right) + 0.5 = 0$$

$$1 - \frac{2V_2}{5} + 0.5 = 0$$

$$V_2 = \frac{1.5 \times 5}{2} = 3.75V$$







$i_1 + i_2 - i_3 = 0$

$i_1 + i_2 + i_4 = 0$

$i_1 + i_2 - \frac{V_2}{5} = 0$

$i_1 + i_2 - \frac{V_2}{5} = 0$