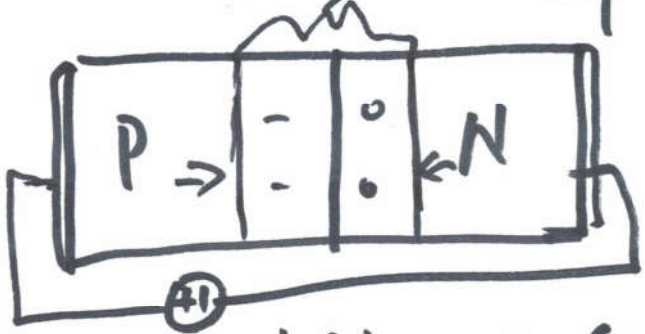
depletion region



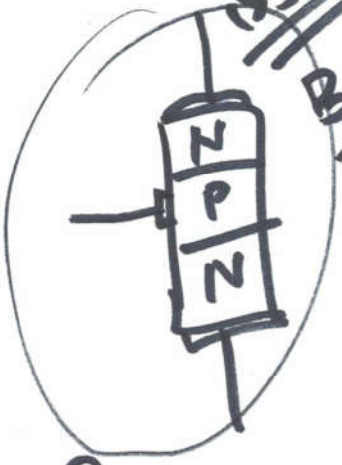
Forward Bias ⇒ C_j ↓

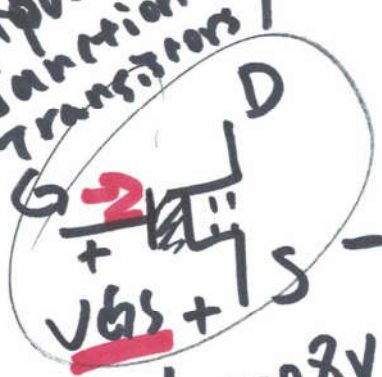
$C \uparrow \downarrow$

$C = \epsilon \frac{A}{d} \downarrow$

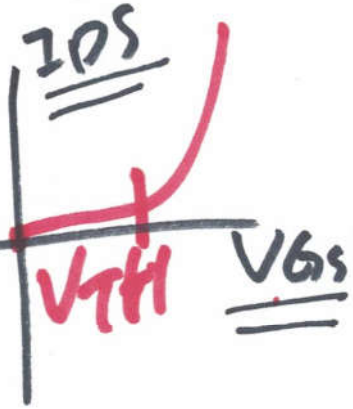
BJTs

Bipolar Junction Transistors

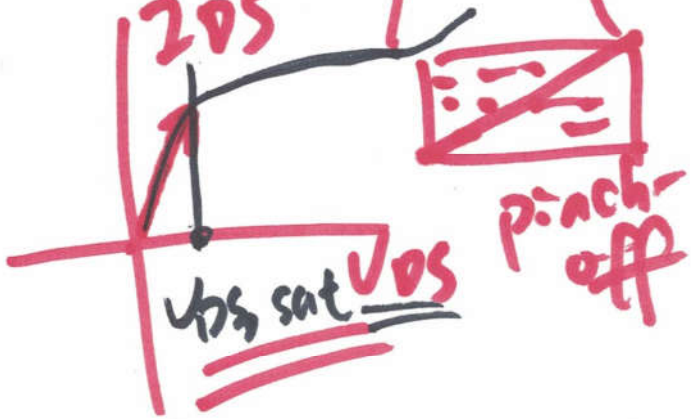


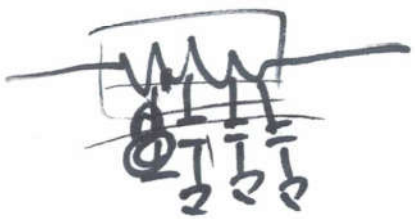


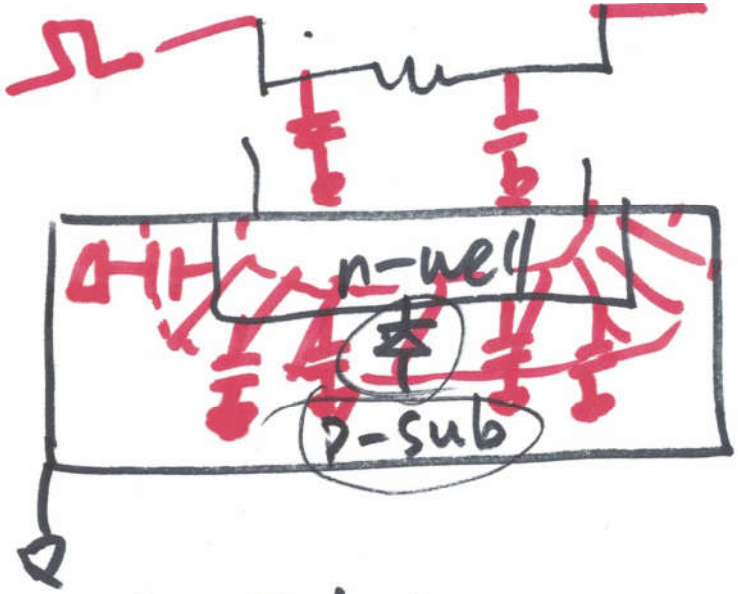
$\rightarrow V_{TH} = 0.8V$

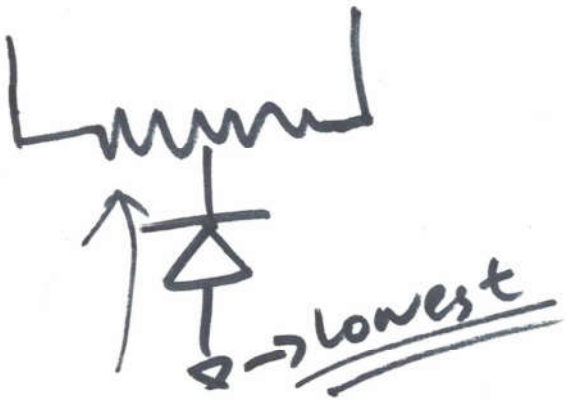


Zenerdiode

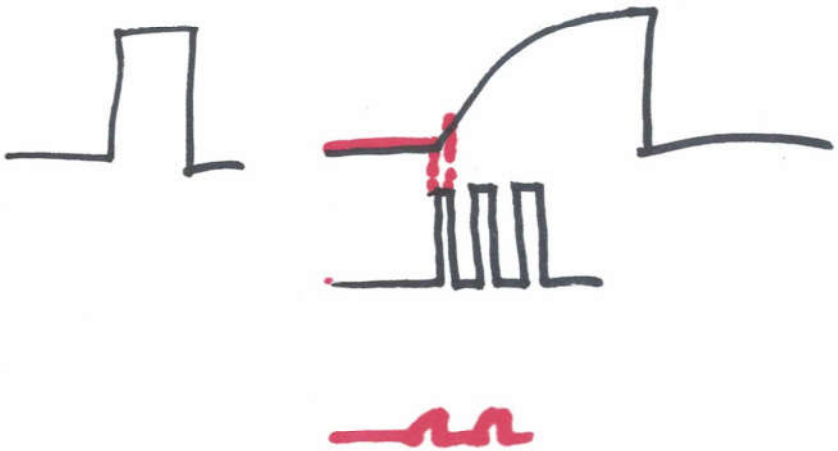


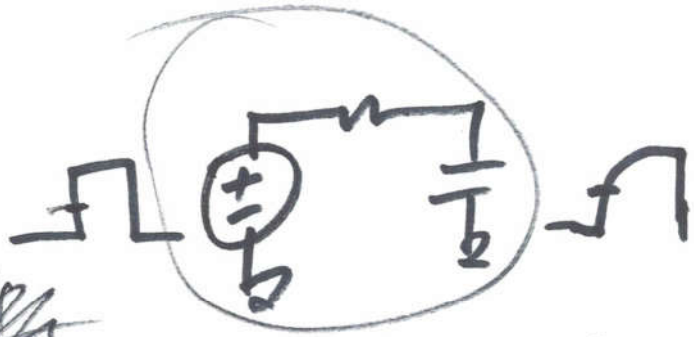






Distributed RC Delay





RC $\quad t_d = 0.7RC$

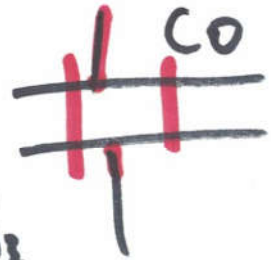
$$f = \frac{1}{2\pi RC}$$

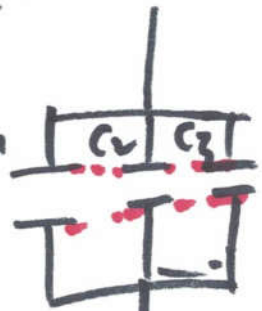
$$C = \varepsilon \frac{A}{d}$$

$$A_0 = A_1 + A_2 + A_3$$

$$C_0 = C_1 + C_2 + C_3$$

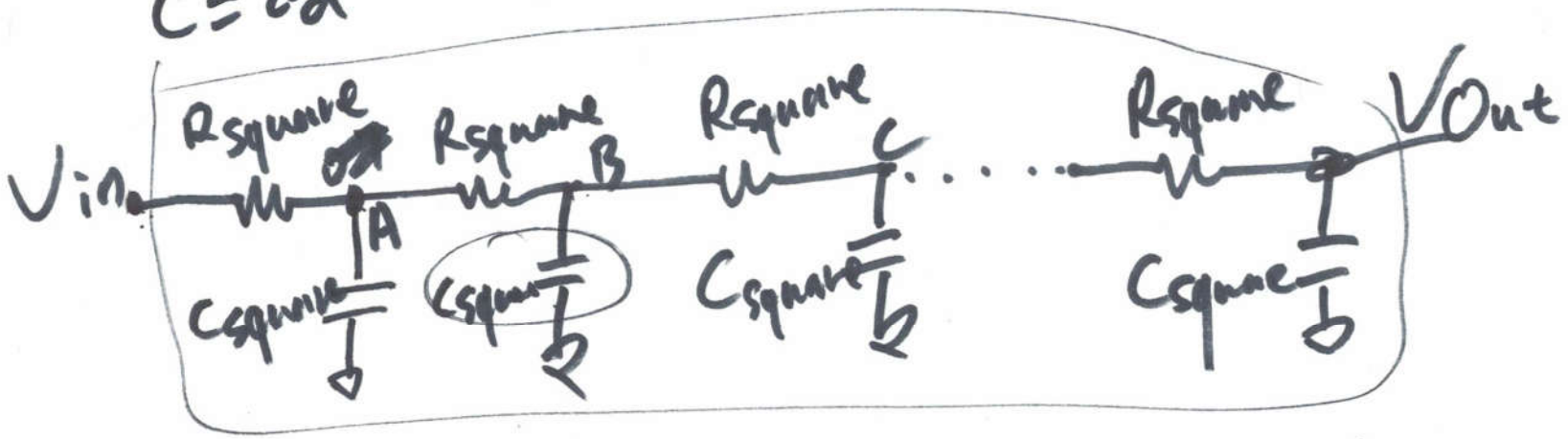
$$= \varepsilon \frac{A_1}{d} + \varepsilon \frac{A_2}{d} + \varepsilon \frac{A_3}{d}$$

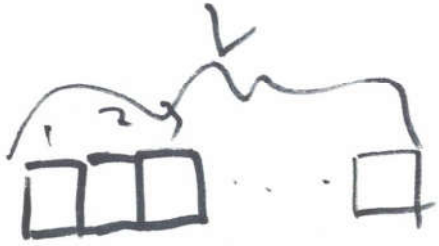




$C_0 = C_1 + C_2 + C_3$

W. L □ $C = \varepsilon \frac{A}{d}$





$$
\begin{cases}
t_{dA} = 0.7 R_{square} C_{square} \\
t_{dB} = 0.7 \cdot 2 R_{square} \cdot C_{square} \\
t_{dC} = 0.7 \cdot 3 \cdot R_{square} \cdot C_{square} \\
\quad \vdots \qquad \vdots \\
t_{dout} = 0.7 \cdot L \cdot R_{square} \cdot C_{square}
\end{cases}
$$

$$
t_d = t_{dA} + t_{dB} + t_{dC} + \cdots + t_{dout}
$$

$$
= 0.7 R_{square} C_{square} (1 + 2 + 3 + \cdots + L) = 0.7 R_{square} C_{square} \frac{L(L+1)}{2}
$$

$L(L+1) \approx L(L+1)$

$\frac{L(L+1)}{2}$

0.3^2

$= 0.7 R_{square} C_{square} \frac{L^2}{2}$

(3)

$$t_d = 0.35\, R_{square} C_{square} L^2$$

△ Example.

Estimate the time delay through 250 kΩ resistor made using an n-well with a width of 10 and length of 500. Assume a 10×10 square of n well has 5 fF of capacitance.

$$R_{square} = \frac{250\,k\Omega}{500/10} = 5\,k\Omega$$

Farad

$$t_d = \frac{0.35}{} \times 5 \times 10^{3}\,\Omega \times 5 \times 10^{-15}\,F \times 50^2$$

$$= 21.875\,ns = 21.875 \times 10^{-9}\,s$$

MOSIS 2018

NMOS N-111

MUSE

$6,500

TSMC 180nm → CS

Sun

Solaris 8