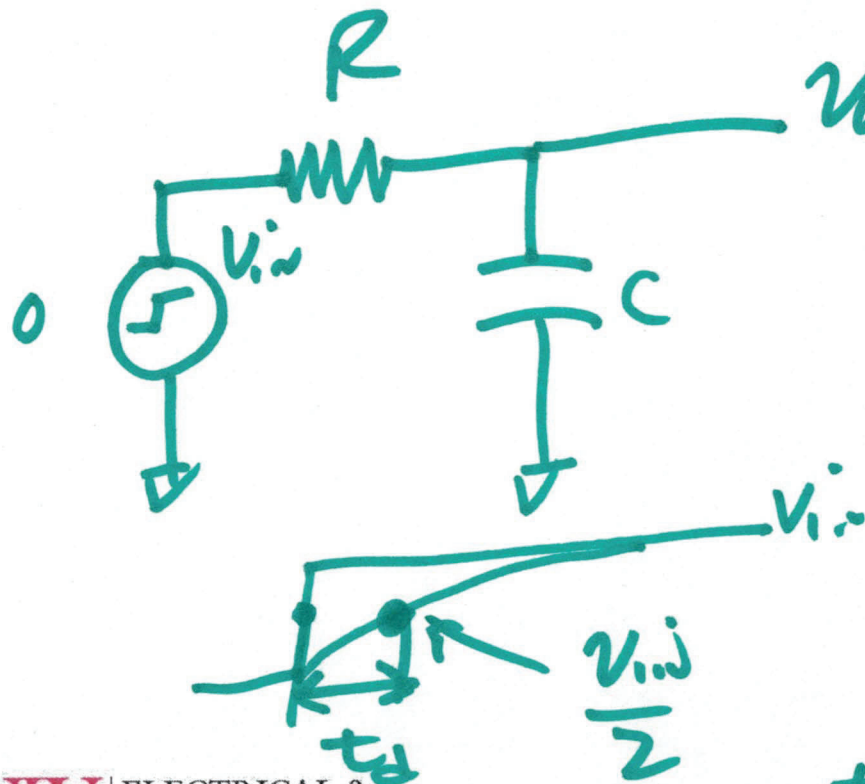


EE 421 / EEL 6621

Digital IC Design

Lecture 4

Sept. 2, 2020



$$V_{out} = V_{in} (1 - e^{-t/RC})$$

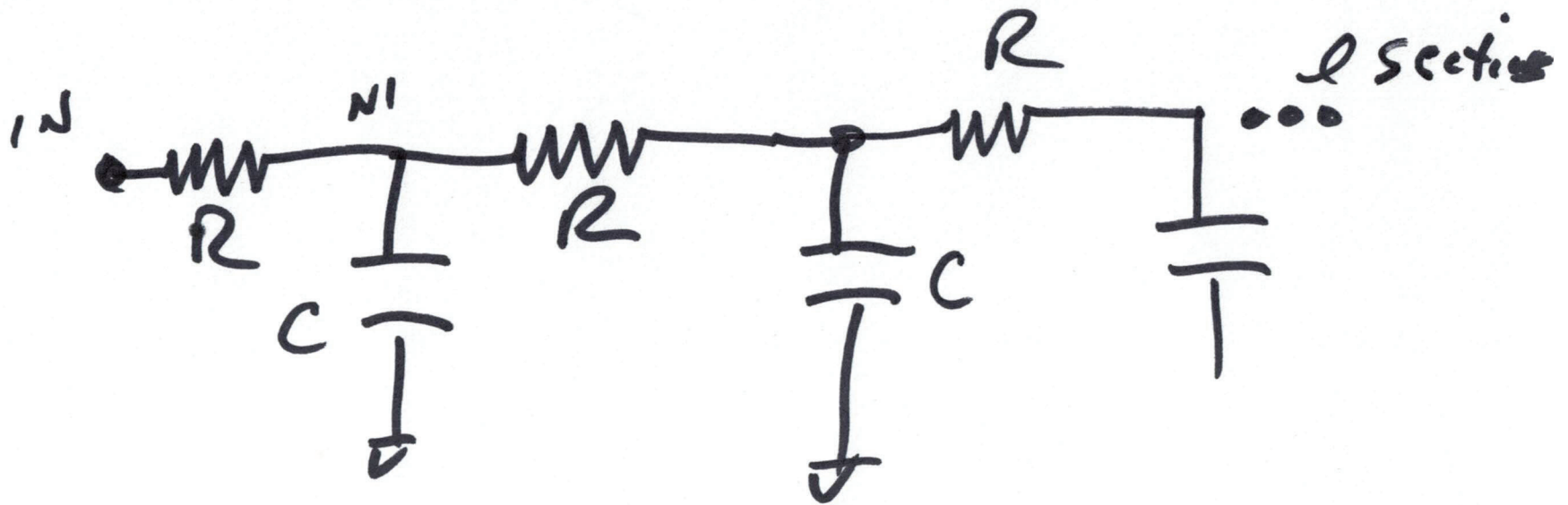
$$\frac{V_{in}}{2} = V_{in} (1 - e^{-t_d/RC})$$

$$-\frac{1}{2} = -e^{-t_d/RC}$$

$$t_d = RC (-\ln \frac{1}{2})$$

$$t_d = RC \ln 2 \approx \boxed{0.7 RC}$$

1)

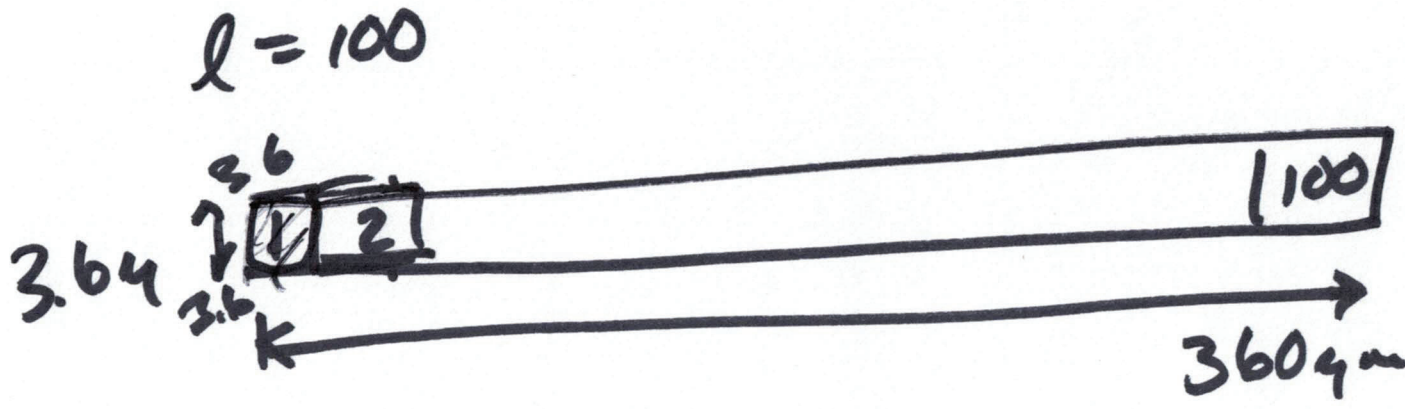


$$t_d = 0.7RC + 0.72RC + 0.73RC$$

$$t_d = 0.7RC (1 + 2 + 3 + 4 + \dots + l)$$

$$0.7RC \frac{l(l+1)}{2} \underset{l \rightarrow \text{big}}{\approx} 0.35RC l^2$$

2)



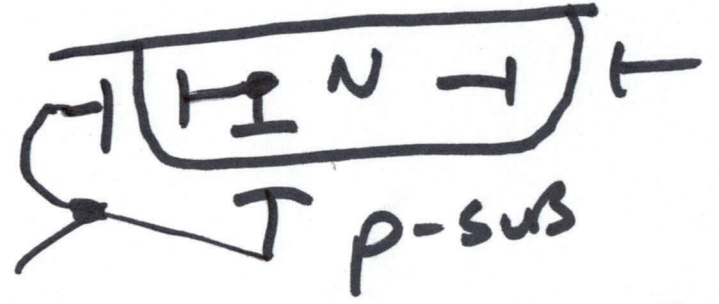
7nm
 0.007 μ
 1 micron =
 $10^{-6} \mu$

$$R_{\square} = 800 \Omega / \square$$

$$C_{b/A} = 50 \text{ aF} / \mu\text{m}^2$$

$$C_{sw/A} = 100 \text{ aF} / \mu\text{m}$$

$$R = 80 \text{ k}\Omega$$



$$C_b = 3.64 \times 3.64 \times \frac{50 \text{ aF}}{\mu\text{m}^2}$$

$$\approx 750 \text{ aF} / \square$$

$$R_D = 800$$

$$C_D = 750 \text{ aF} + 150 \text{ aF}$$

$$C_{sw} = (3.6 + 3.6) 100 \text{ aF}$$

$$900 \text{ aF} / \square \quad l = 100 \quad \approx 150 \text{ aF} / \square$$

3)

$$t_d = 0.35 r l^2 \cdot C$$

$$r = 800$$

$$C = 900 \text{ aF}$$

$$l = 100$$

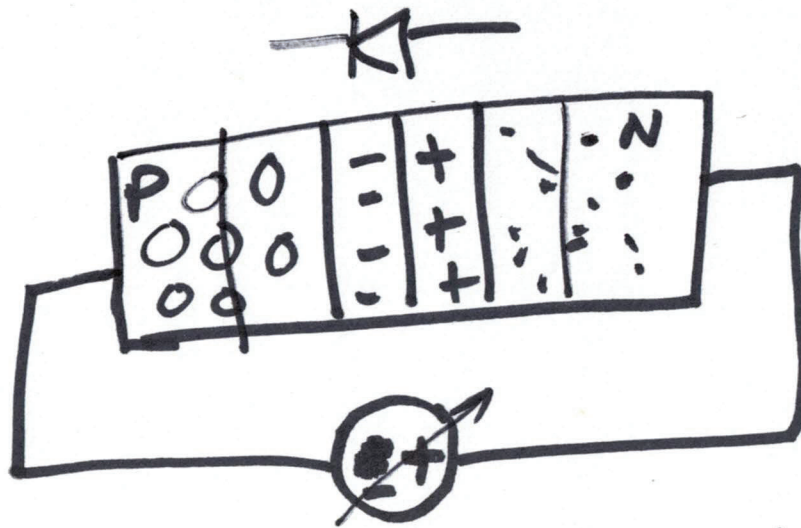
$$t_d = 0.35 \cdot 100^2 \cdot 800 \cdot 900 \text{ aF}$$

$$R_{TOT} = 100 \cdot 800 = 80k = 3500 \cdot 800 \cdot 900 \text{ aF}$$

$$C_{TOT} = 100 \cdot 900 \text{ aF} = 90 \text{ fF}$$

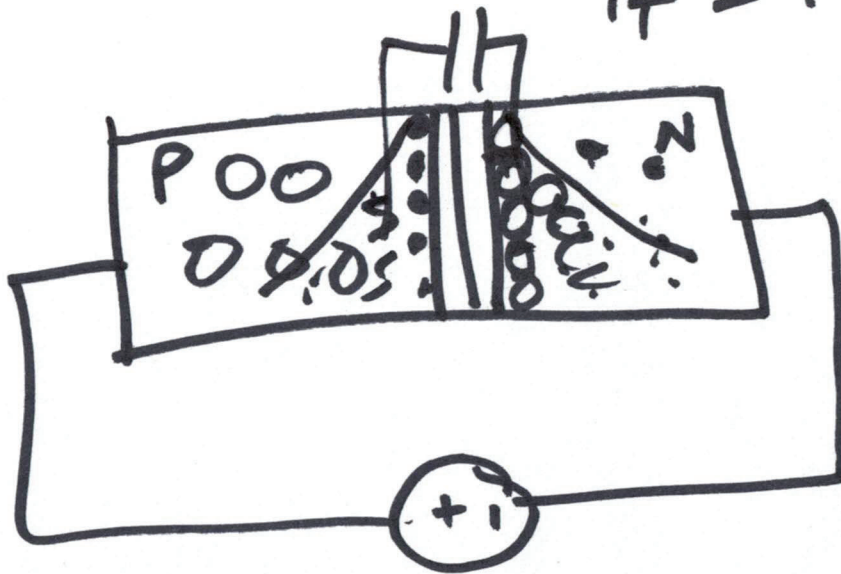
$$t_d = 2.52 \text{ ns}$$

Diode Reverse Recovery



$$C = e \cdot \frac{A}{t}$$

$\tau_T = \text{transit time} = +0.7 -$



5)