

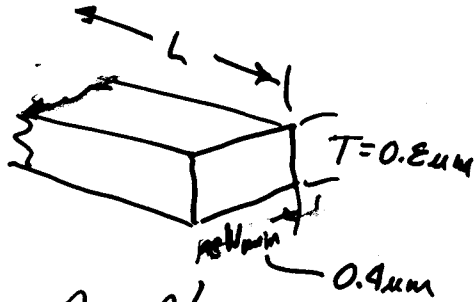
Final Exam Problem Session

7 problems

1 - required } work 5  
 6 - optional }

Problem 10.1

0.18 μm 20 μm = 20,000 μm



0.13 μm (Metal E) - 20 μm

$$R = \frac{\rho L}{A}$$

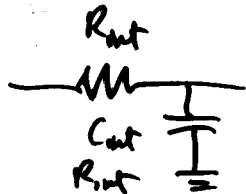
1 μm = 10<sup>-4</sup> cm

$$R_{int} = (1.7 \times 10^{-6} \Omega \cdot \text{cm}) \frac{20,000 \times 10^{-4} \text{ cm}}{T \times W}$$

$$T = 0.8 \times 10^{-4} \quad W = 0.4 \times 10^{-4}$$

$$= 1.7 \times 10^{-6} \Omega \cdot \text{cm} \frac{2 \text{ cm}}{(0.8)(0.4) \times 10^{-8} \text{ cm}^2} = \frac{3.4 \times 10^2}{.32} \approx 1000 \Omega$$

Delay

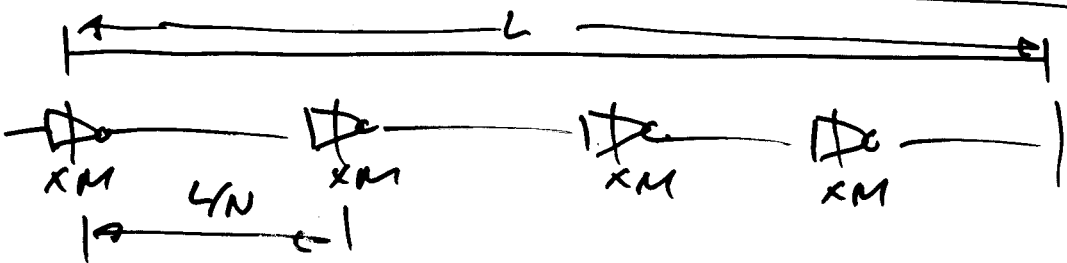
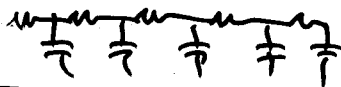


$$C_{int} = 0.1 \frac{\text{fF}}{\mu\text{m}} \times 20,000 \mu\text{m} = 2 \text{ pF}$$

Pi



$$\text{Delay} = \frac{1}{2} R_{int} C_{int} = 0.38 R_{int} C_{int}$$



Prob. 10.11

0.18 μm Top Level

$$R_{sq} = 27 \text{ m}\Omega/\square$$

$$W = 0.4 \mu\text{m}$$

$$L = 10 \text{ mm}$$

$$R_{int} = R_{sq} \frac{L}{W} = 27 \text{ m}\Omega \left( \frac{10 \text{ mm}}{0.4 \mu\text{m}} \right)$$

$$= 27 \text{ m}\Omega \left( \frac{10^7}{0.4} \right) = 27 \times 2.5 \times 10^8 \times 10^{-3}$$

$$= 67.5 \text{ m}\Omega/\mu\text{m}$$

$$C_{int} = 0.2 \text{ fF}/\mu\text{m} \text{ (closely spaced)}$$

$$N = \sqrt{\frac{A_{wire}}{F_{01}}}$$

$C_{eff} W$

PMOS to NMOS

$$R_{eqn} \left( \frac{1}{g} + G_c \right) (1+B)$$

$$\frac{0.18 \mu\text{m}}{0.4 \mu\text{m}}$$

$C_{self} W$

$$0.13 \mu\text{m}$$

$$N \approx 5.47 \approx 5$$

$$N = 9.67 \approx 10$$

Exam 1, Prob. 3

$$C_g = C_{ox} L \approx \frac{1.212 \text{ fF}}{.6 \mu\text{m}} \approx 2 \text{ fF}/\mu\text{m}$$