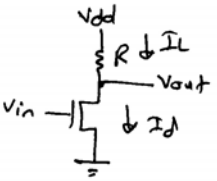
Name: Key **Id#**

COE 360, Principles of VLSI Design, Term 043
Quiz# 6

Date: Sunday, August 7

Q1. Design a **Resitive-load Inverter** with V_{OH}=5v, V_{OL}=0.2v, and Average DC power 250 µW. Assume that V_{tn}=1v and $\mu_n C_{ox}$=50.5 uA/V^2. Assume that the used technology is 0.5um.



By KCL, $I_L = I_d$

when $V_{in} = V_{OH}$, $V_{out} = V_{OL}$

$V_{gd} = V_{OH} - V_{OL} = 5 - 0.2 > V_t \Rightarrow$ transistor is in Linear mode.

$$\Rightarrow \frac{V_{dd} - V_{OL}}{R} = \frac{\beta_n}{2}\left[2(V_{DD} - V_t)V_{OL} - V_{OL}^2\right]$$

$$\Rightarrow \frac{5 - 0.2}{R} = \frac{\beta_n}{2}\left[2(5-1)0.2 - (0.2)^2\right]$$

$$\Rightarrow \frac{4.8}{R} = \frac{\beta_n}{2}\left[1.56\right]$$

$$\Rightarrow \beta_n = \frac{2 * 4.8}{1.56\ R} = \frac{6.154}{R}$$

$$\text{Average DC power} = \frac{V_{dd}}{2} \cdot I = \frac{V_{dd}}{2}\frac{(V_{dd} - V_{OL})}{R}$$

$$\Rightarrow 250\,mW = \frac{5}{2}\frac{4.8}{R}$$

$$\Rightarrow R = \frac{2.5 \times 4.8}{250\,\mu} = 48\,K\Omega$$

$$\Rightarrow \beta_n = \frac{6.154}{48K} = 128.2\ \mu\frac{A}{V^2}$$

$$\Rightarrow \mu_n C_{ox}\frac{W}{L} = 128.2\ \mu\frac{A}{V^2}$$

$$\Rightarrow \frac{W}{L} = \frac{128.2\,\mu}{50.5\,\mu} = 2.539$$

$$\Rightarrow L = 0.5\,\mu m \qquad W = L * 2.539 = 1.269\,\mu m$$