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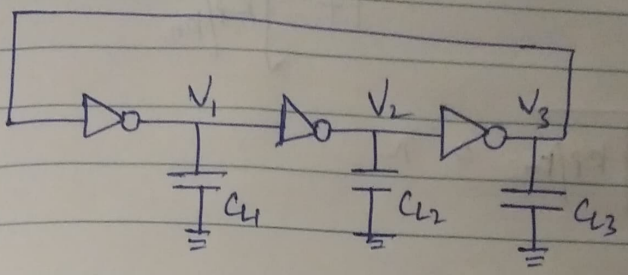
apsara

Date: / /

Assignment 10

Ans 1 :-)



each oscillator consist of N no. of rise delays (τ_r) & N no. of fall delays (τ_f)

total time : $(\tau_r + \tau_f)_1 + (\tau_r + \tau_f)_2 + \cdots + (\tau_r + \tau_f)_n$

if delay is same for each stage & transistor,

$$T = 2\tau_p N \quad \therefore \quad f = 1/T = 1/2\tau_p N$$

b.) if τ_p depends on W & L & both W & L are scaled by S.

$$W' \rightarrow W/S$$
$$L' \rightarrow L/S$$
$$W'/L' = \frac{W/S}{L/S} = W/L$$

τ_p remains same.

Ayush

Ans 2.)

$$V_t = 2.2 = \frac{V_{tn} + (V_{DD} - V_{tp})\sqrt{\frac{K_p}{K_n}}}{1 + \sqrt{K_p/K_n}}$$

Let $\sqrt{K_p/K_n} = x$

$$2.2 = \frac{0.8 + (5-1)x}{1+x}$$

$$2.2 + 2.2x = 0.8 + 4x \Rightarrow x = 0.77$$

$$\frac{\mu_n C_{ox} (W/L)_p}{\mu_n C_{ox} (W/L)_n} = \frac{20}{50} = \frac{3}{5} \rightarrow W_p = 1.5 W_n$$

$$I_{avg} = \frac{1}{2}\left[i_c(V_{in}=0, V_{out}=0.5) + i_c(V_{in}=0, V_{out}=4.5) \right]$$

$\rightarrow V_{SG} - V_{tp} \geq V_{SD}$

$V_{DD} - V_{tp} \geq V_{DD} - V_{out}$

$\rightarrow 4 < 5 - 0.5 \rightarrow$ lin

$\rightarrow 4 > 5 - 4.5 \rightarrow$ satn

$$I_{lin} = \frac{k_p}{2}\left[2(4)(0.5) - (0.5)^2\right] = 1.875\ k_p$$

$$I_{sat} = \frac{k_p}{2}\left[5-1\right]^2 = 8\ k_p$$

$$I_{avg} = 1/2\left[8 + 1.875\right] = \underline{4.94}$$

$$\therefore \quad k_p = 20 \times 10^{6} W_p$$

$$W_p = \frac{8 \times 10^{-12}}{5 \times 10^{-9} \times 4.94 \times 20 \times 10^{-6}} = \frac{8 \times 10 \times 10 \times 10}{5 \times 20 \times 4.94}$$

$$= \frac{80}{4.94} = \underline{16.19}$$

$$W_p = 1.5\, W_n \longrightarrow W_n = \frac{W_p}{1.5} = \frac{16.19}{1.5} = \underline{10.8}$$

agnish