EE5311

MODULE – 4 – COMBINATIONAL CIRCUITS

RATIO'ED CIRCUIT / PSEUDO NMOS LOGIC

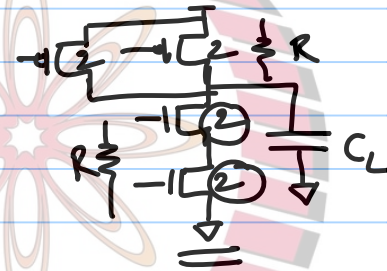$Y = V_{OL} > 0$

$< V_{IL}$

$$V_{OL} \propto \frac{W_p}{W_n} \quad ; \quad \text{Let } \frac{W_p}{W_n} = \alpha < 1$$

UNIT INVERTER

$$\tau = \frac{3}{4}\frac{V_{DD}}{I} \times 0.693 \cdot C$$

$$\boxed{\tau = \frac{C \, \Delta V}{I}}$$
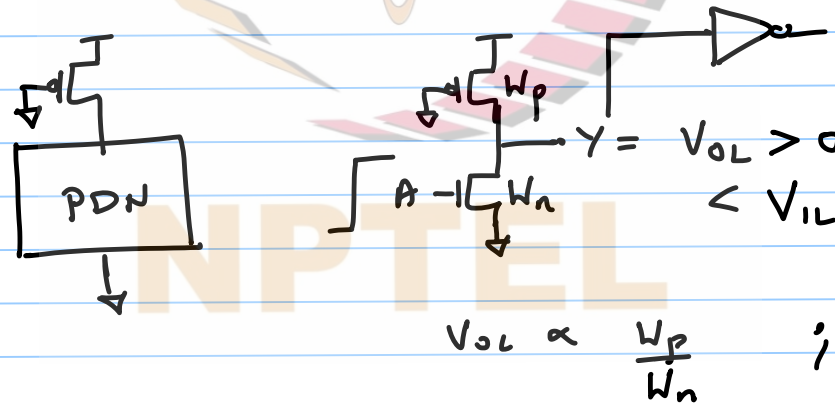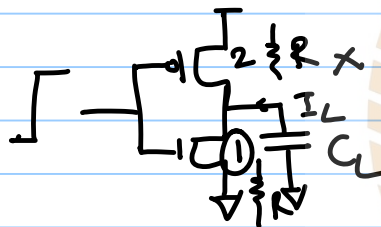
VNIT INV

PULL UP / DOWN RES = R
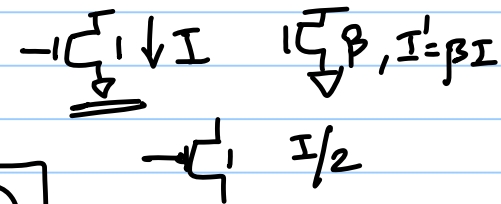
$I_L = |I_n|$
or
$I_L = |I_p|$

Let $W_n = \beta$

$\Rightarrow W_p = \alpha\beta$

$\beta = 1$??

$\boxed{I_n = I_p + I_L}$

$I_n = \beta I$
$I_p = (\alpha\beta/2)\, I$

$I' = \beta I$

$I/2$

$\alpha\beta \downarrow I_p =$

A

$\downarrow I_n$

$$\beta \cancel{t} = \frac{\alpha\beta}{2}\cancel{t} + \cancel{t}$$
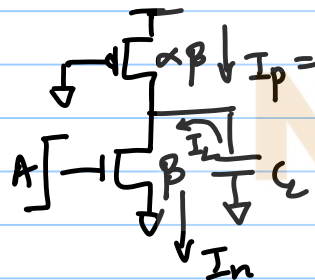
$$\Rightarrow \quad \beta(1 - \alpha/2) = 1$$

$$\therefore \quad \beta = \frac{1}{(1 - \alpha/2)}$$
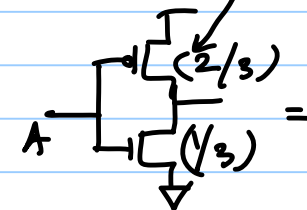
$$\alpha = \tfrac{1}{2}$$

$$\Rightarrow \quad \beta = 4/3$$

UNIT INV: (PSEUDO NMOS)
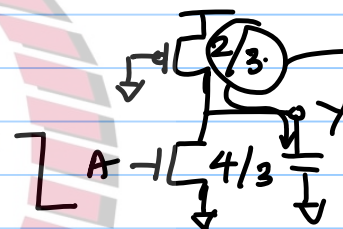
$$C_A = \frac{4}{3} C$$

PULL UP:
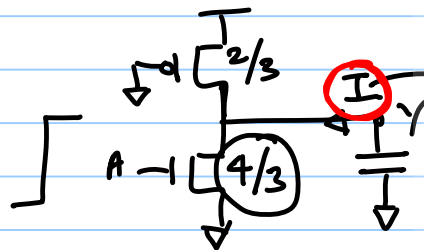

$$C_A = C$$

$$\therefore \quad g_{pu} = 4/3 > 1$$

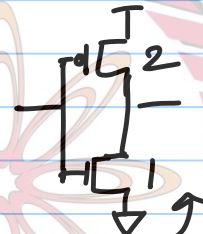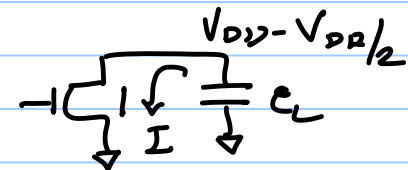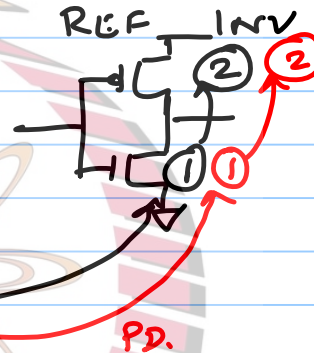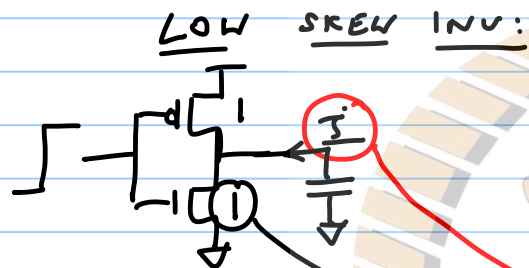## PULL DOWN:

$$C_A = \frac{4}{3}C$$

REF INV:

$$C_A = 3 \cdot C$$

$$\therefore \quad g_{pd} = 4/9 \quad < 1$$

LOW SKEW INV:

REF INV

I

② ②

① ①

PD.

$V_{DD} - V_{DD}/2$

I C_L

I

PSEUDO NMOS: PULL UP

$2/3$ $I_p = $ $I/3$

A $4/3$ $I_L = $ $I/3$

C_L

$(2/3)$

$(1/3)$

$I_L = I_p$
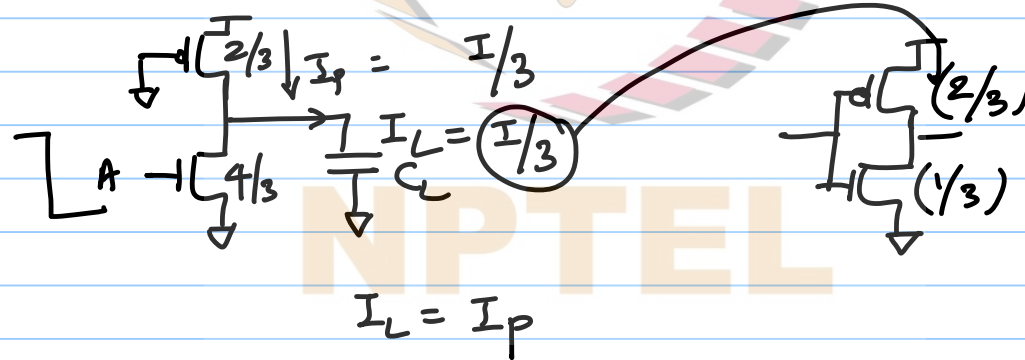
NAND-2 (PSEUDO NMOS)

$C_A = C_B = \dfrac{8}{3} C$

$\therefore \quad \overline{g_u = \dfrac{8}{3}}$

$g_d = \dfrac{8}{9}$

PU

PD
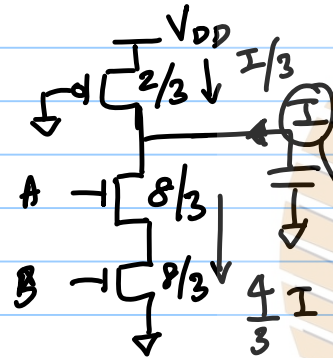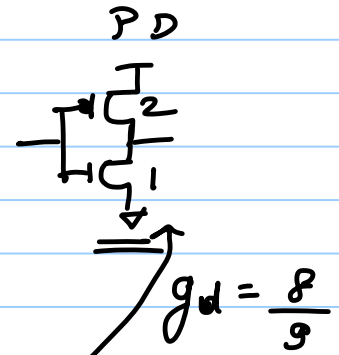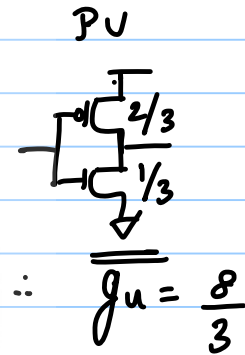
NOR3
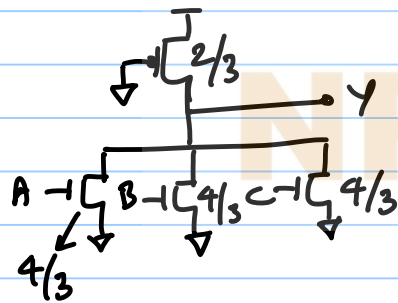
$g_u = 4/3$

$g_d = 4/9$

Cascode Voltage Switch Logic

Inverter

$V_{DD} \leftarrow \overline{Y}$ P1 N1 A

P2 → Cut off

Y → V_{OL}

N2 A

NAND 2

A

B

$(\overline{AB})$

$\overline{A}$ $\overline{B}$

$\overline{\overline{A} + \overline{B}} = AB$

A_1 A_2 A_N F

$\overline{F}$ $\overline{A_1}$ $\overline{A_2}$ $\overline{A_N}$