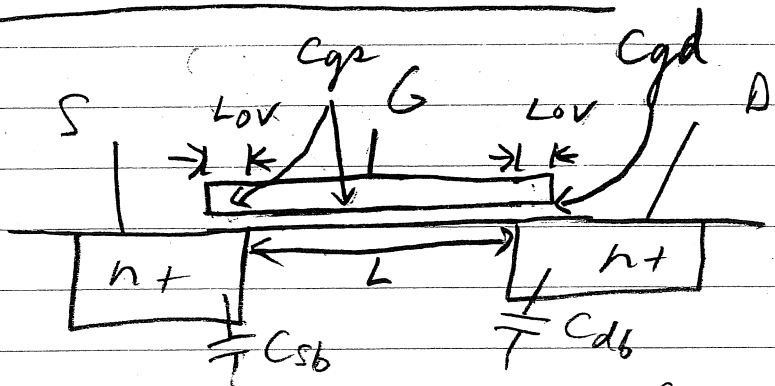
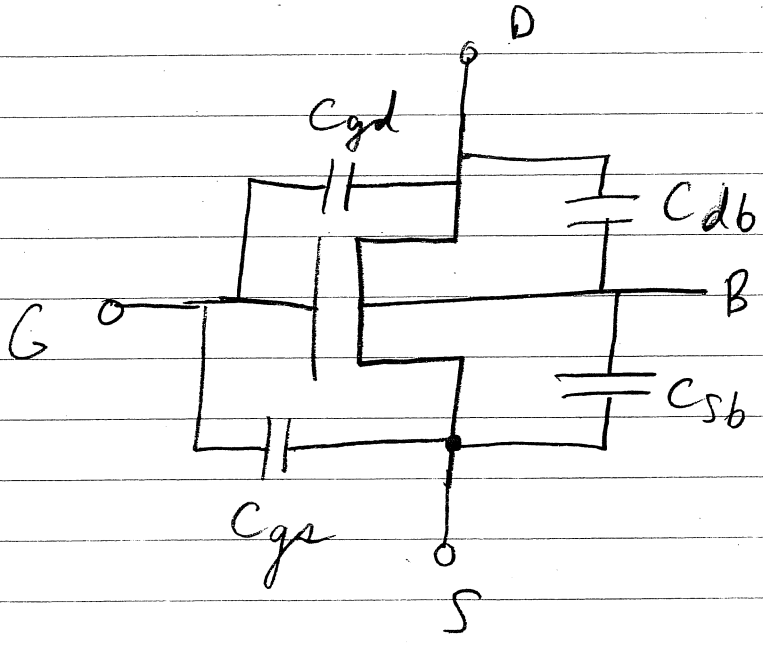
MC1

MOS CAPACITOR MODEL



WHEN ACTIVE



NORMALLY $V_B = V_S$ SO C_{sb} UNIMPORTANT

$$C_{gs} = \frac{2}{3} W L C_{ox} + W L_{ov} C_{ox}$$

$$C_{gd} = W L_{ov} C_{ox}$$

$$C_{db} = \frac{C_{db0}}{\sqrt{1 + \frac{V_{DB}}{V_0}}}$$

MC2

C_{ox} GATE CAPACITANCE PER UNIT AREA

$\frac{2}{3} WLC_{ox}$ IS GATE TO CHANNEL CAP WHEN DEVICE ACTIVE

CHANNEL IS CONNECTED TO SOURCE

$\frac{2}{3}$ FACTOR DUE TO CHANNEL SHAPE

$WL_{ov}C_{ox}$ IS GATE OVERLAP CAPACITANCE

L_{ov} IS OVERLAP LENGTH

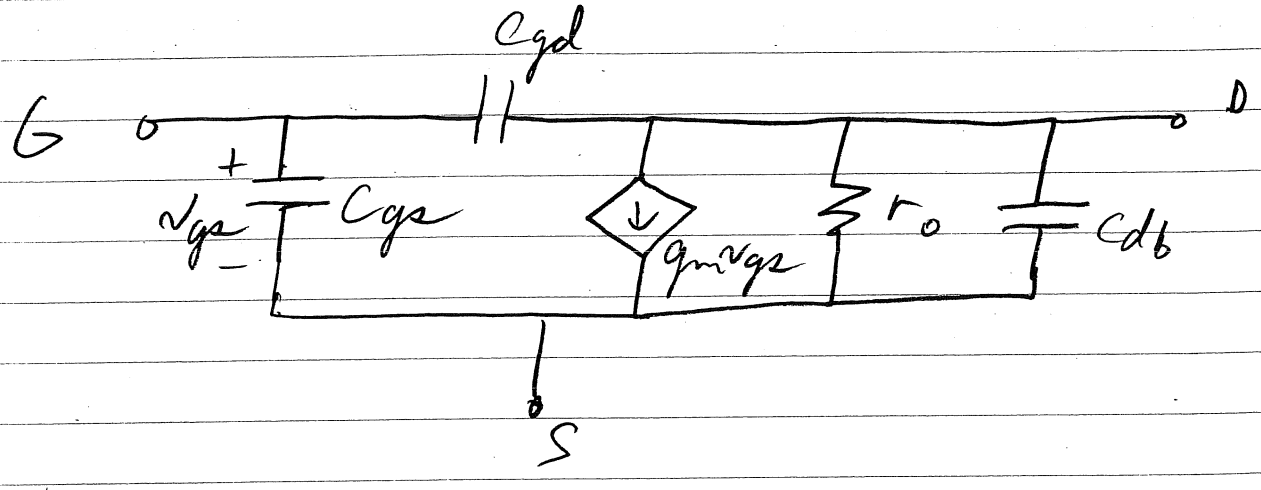
C_{dbo} IS DRAIN BODY CAPACITANCE WITH $V_{DB} = 0$

V_{DB} IS DRAIN BODY VOLTAGE (REVERSE BIAS VOLTAGE)

V_0 IS JUNCTION BUILT-IN VOLTAGE

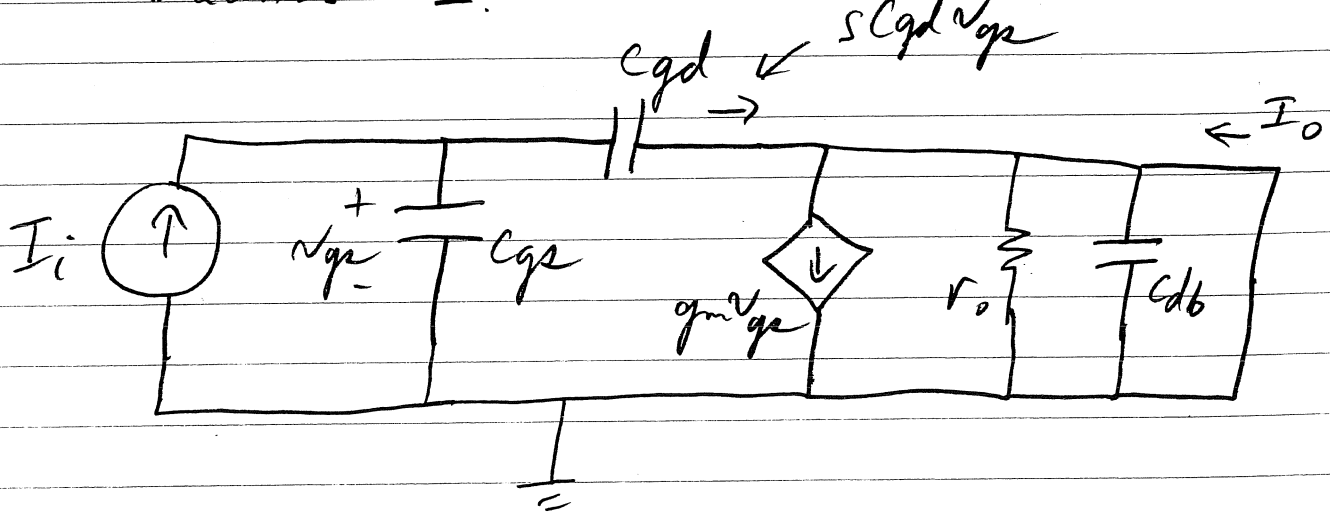
$V_0 \approx 0.7\ V$

MOSFET MODEL WHEN $V_{SB} = 0$



f_T MOSFET UNITY GAIN FREQ

FREQ WHERE SHORT-CIRCUIT CURRENT GAIN EQUALS 1.



$$I_o = g_m V_{gs} - sC_{gd} V_{gs}$$

CAN SHOW TYPICALLY $sC_{gd} V_{gs} \ll g_m V_{gs}$

$$I_o \approx g_m V_{gs} \quad (1)$$

$$V_{gs} = I_i / s(C_{gs}+C_{gd}) \quad (2)$$

$$(1)+(2) \Rightarrow \frac{I_o}{I_i} = \frac{g_m}{s(C_{gs}+C_{gd})} \quad (3)$$

LET (3) = 1 TO FIND WHEN $I_o = I_i$

LET $s = j\omega_T$

$$\left| \frac{g_m}{j\omega_T(C_{gs}+C_{gd})} \right| = 1 \Rightarrow \omega_T = \frac{g_m}{C_{gs}+C_{gd}}$$

$$\boxed{f_T = \frac{g_m}{2\pi(C_{gs}+C_{gd})}}$$

RECALL $g_m = \mu_n C_{ox}\left(\frac{W}{L}\right) V_{OV}$

& $C_{gs} = \frac{2}{3} WL C_{ox}$

ASSUMING $C_{gd} \ll C_{gs}$

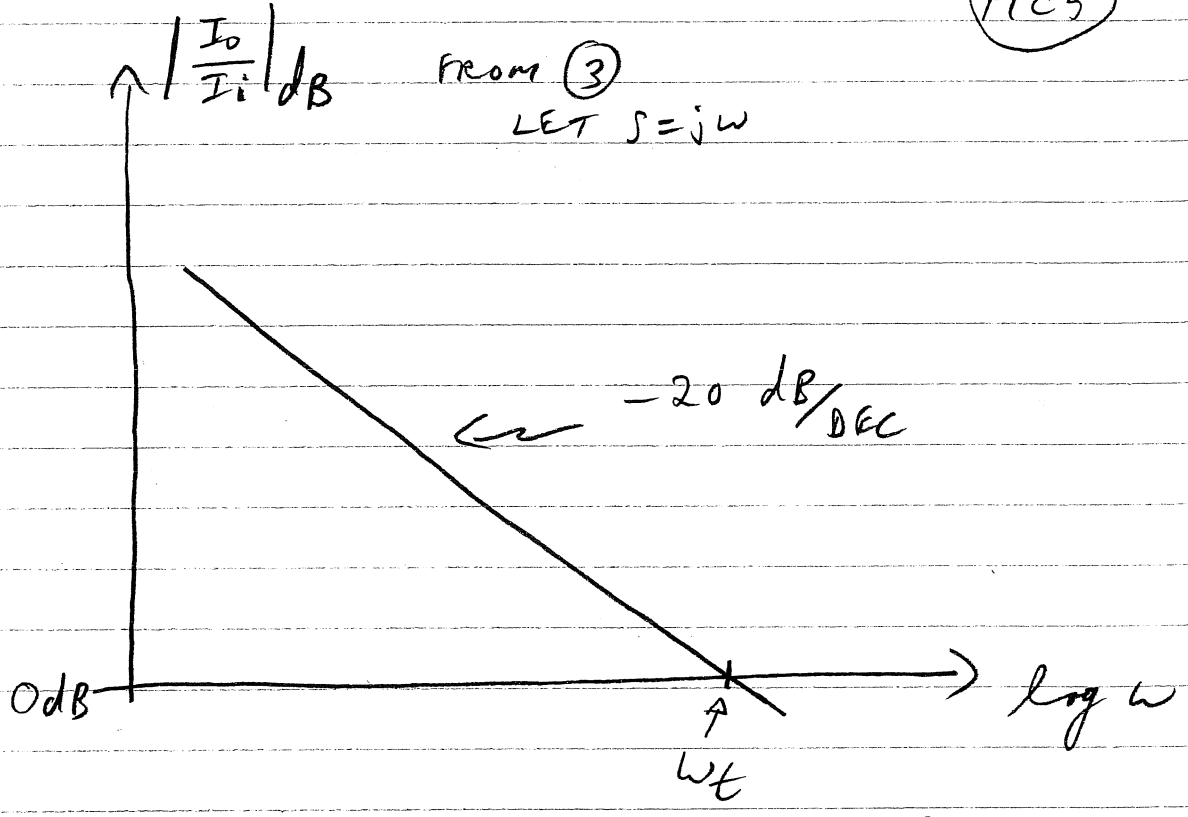
$$f_T = \frac{3\mu_n V_{OV}}{4\pi L^2}$$

INDEPENDENT OF W

PROPORTIONAL TO $\frac{1}{L^2}$

PROPORTIONAL TO V_{OV}

MC5



$w_t = 2\pi f_t$ $\qquad$ $w_t = \dfrac{g_m}{C_{gs} + C_{gd}}$