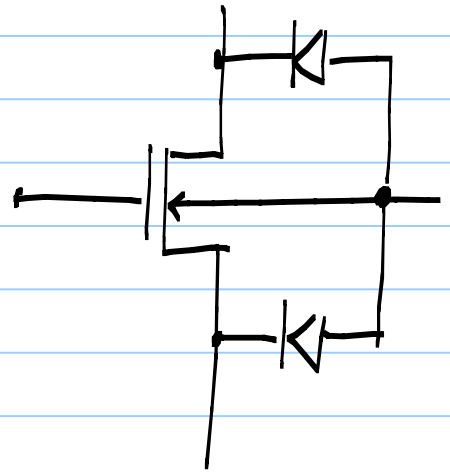
Lecture 7 20/1/2016

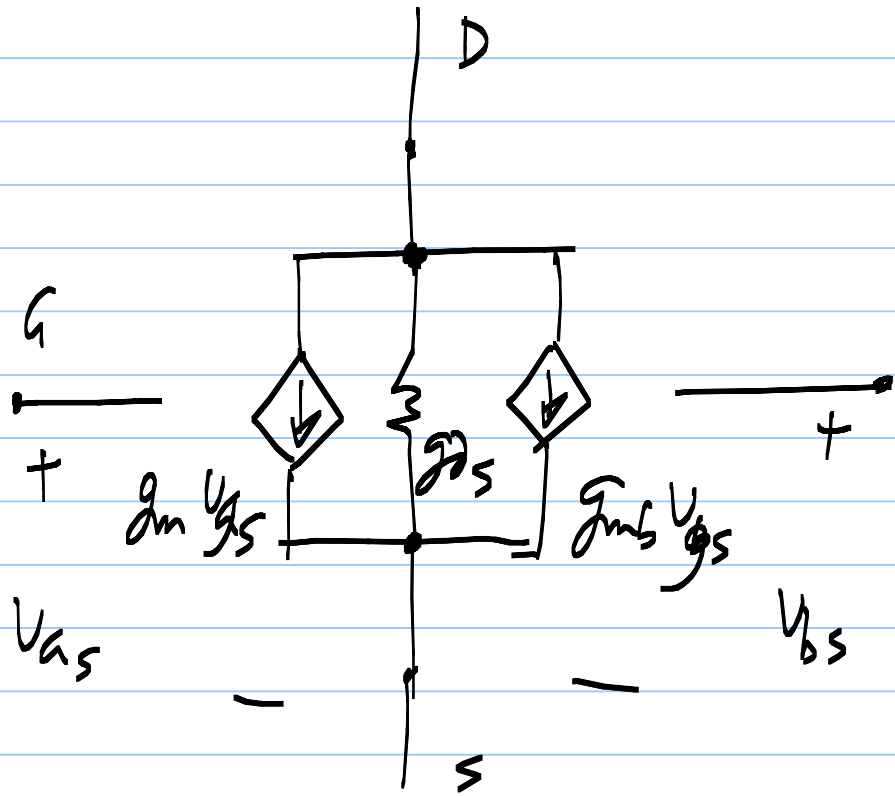


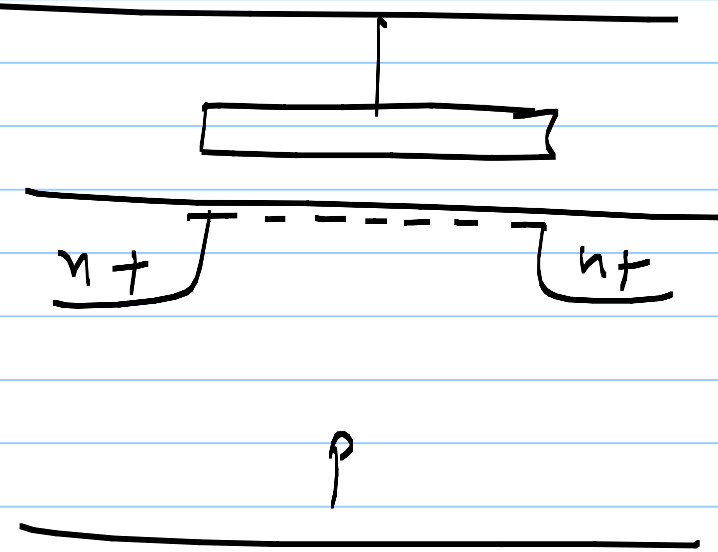
negative V_{SB} ($|V_{SB}| < 200mV$)

to reduce the threshold voltage

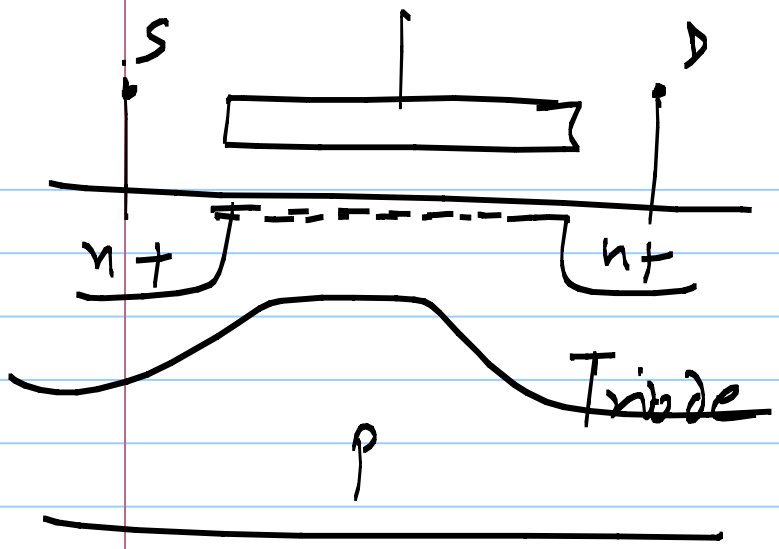
$$V_{T0} + \gamma \left(\sqrt{2\phi_F + V_{SB}} - \sqrt{2\phi_F} \right)$$

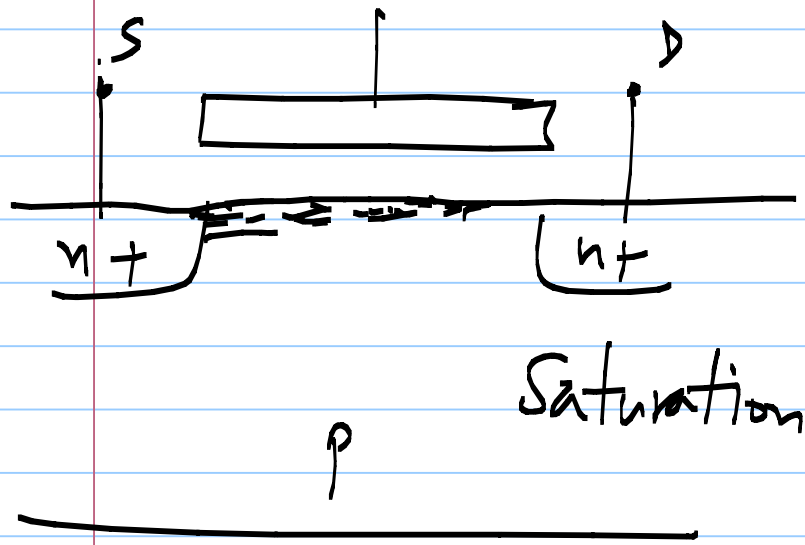
Small signal model of the MOS transistor





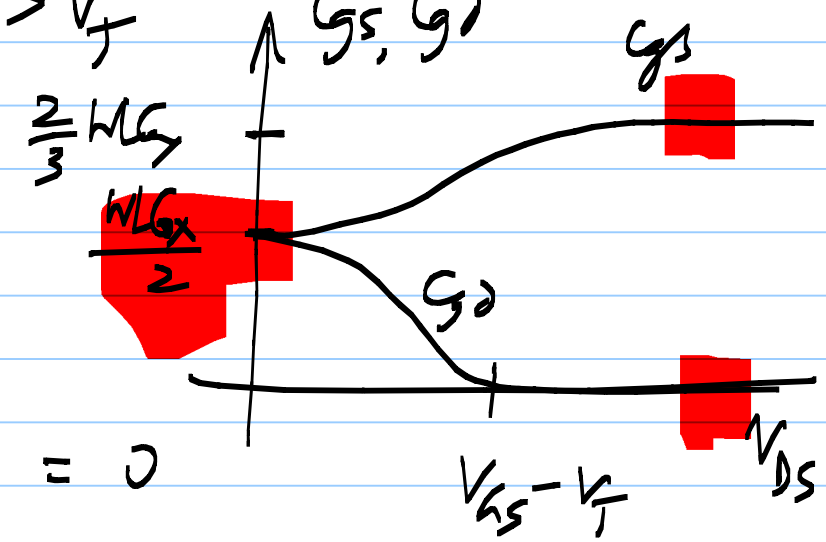
dc model of the MOS transistor





$$C_{gs} = C_{gd} = \frac{WLC_{ox}}{2}$$

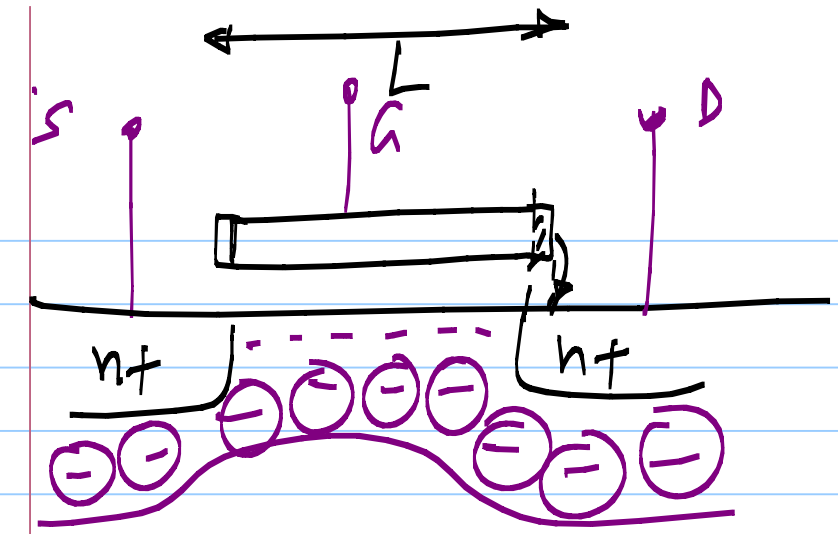
$V_{GS} > V_T$



$C_{gd} = 0$

$$C_{gs} = \frac{2}{3} WLC_{ox}$$

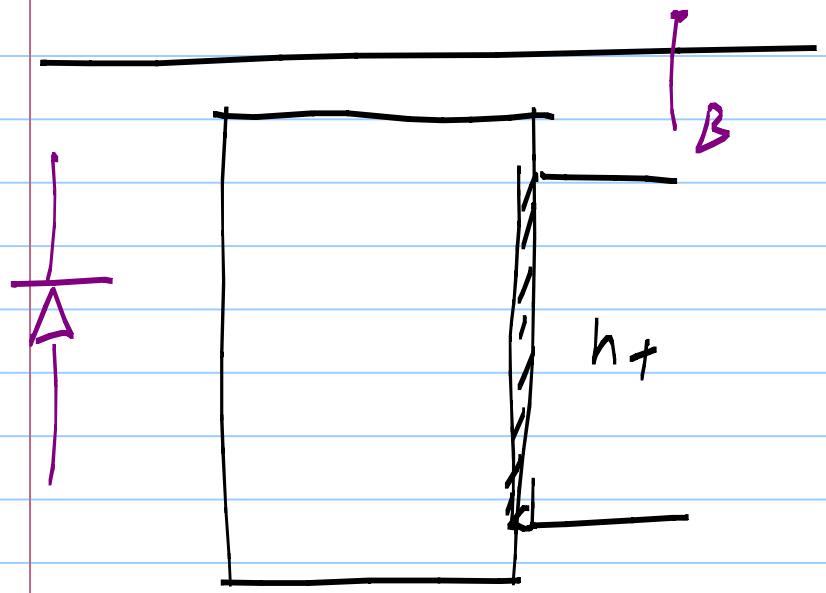
Intrinsic capacitors C_{gs}, C_{gd}

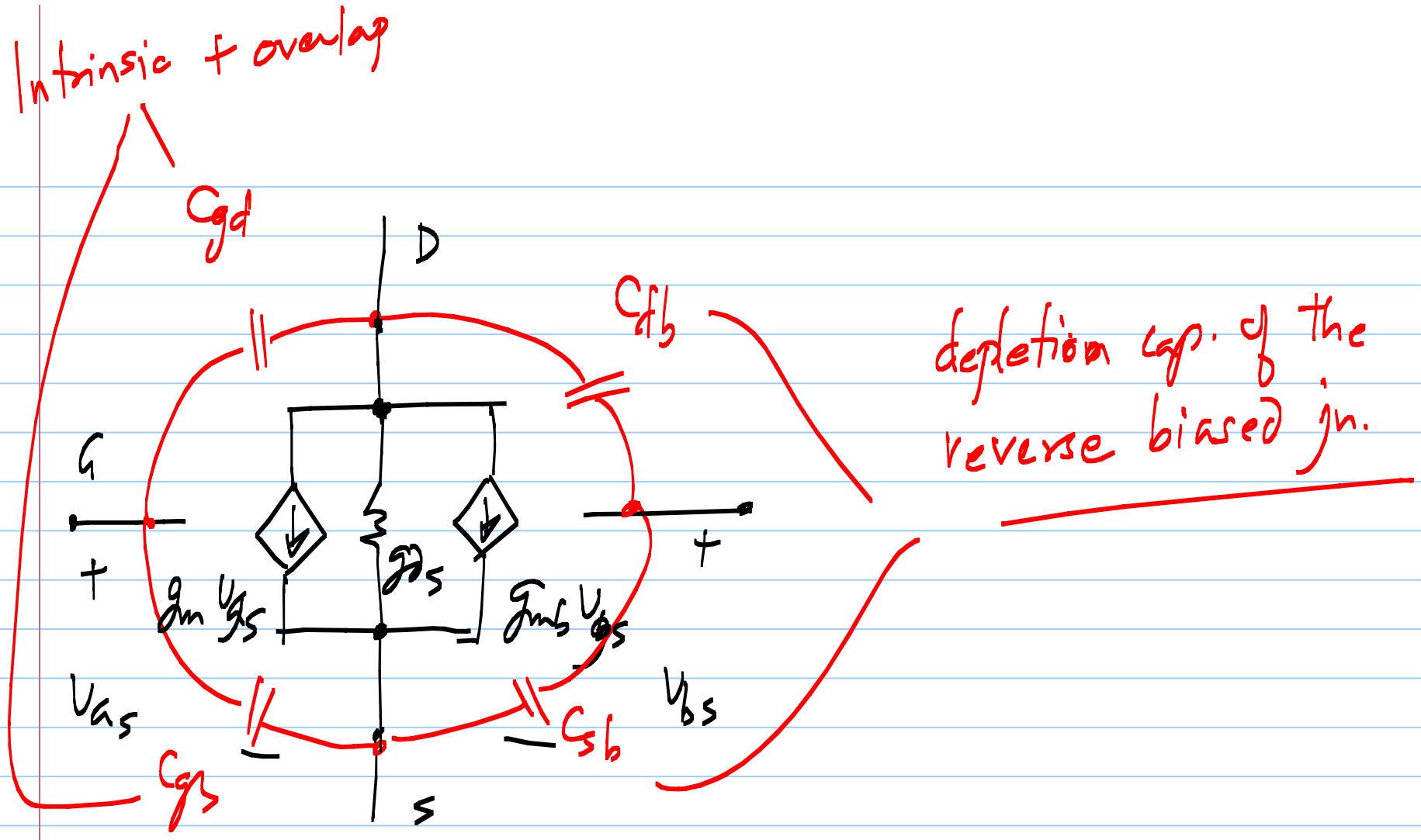


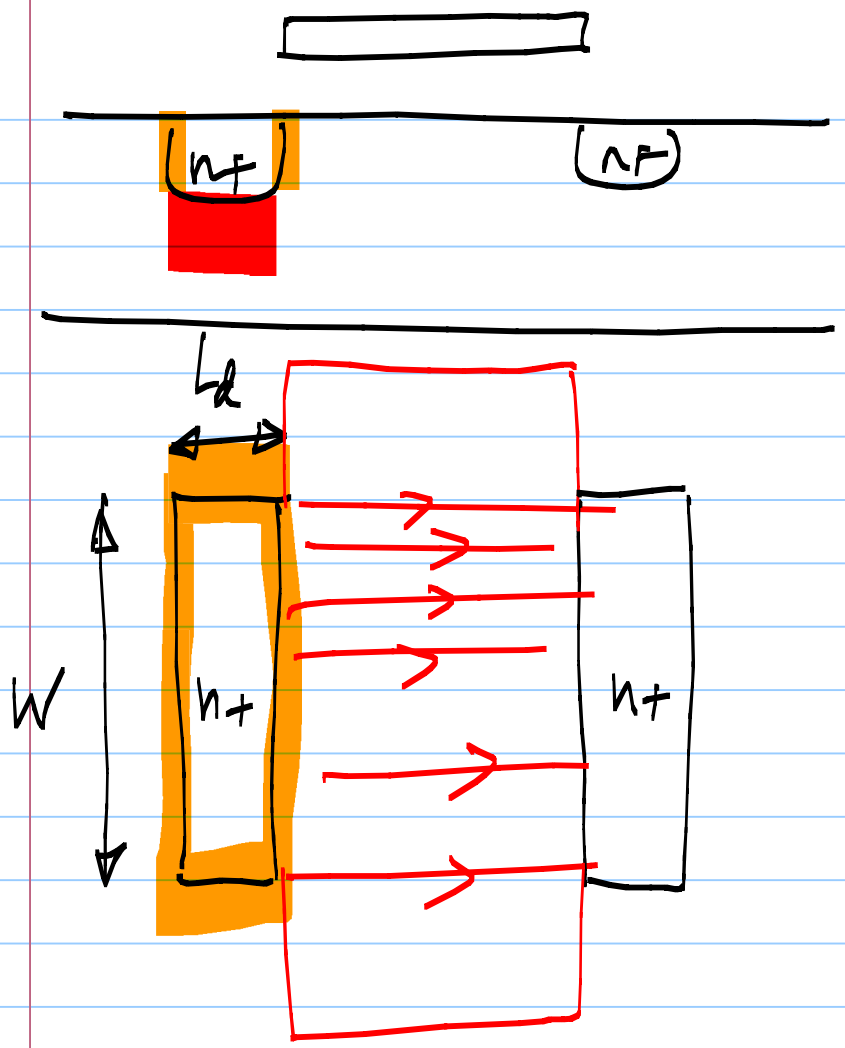
$$C_{gs} = C_{gs,i} + C_{ov}$$

$$C_{gd} = C_{gd,i} + C_{ov}$$

$C_{ov} = C'_{ov} \cdot W$



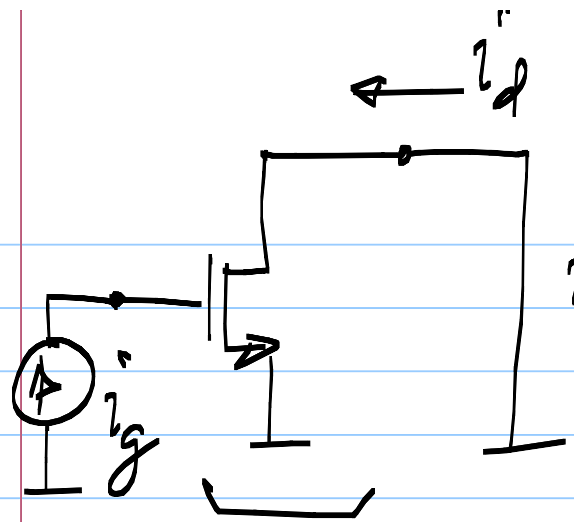

Intrinsic + overlap
C_{gd}
D
C_{db}
depletion cap. of the reverse biased jn.
G
+
+
$g_m V_{gs}$
g_{ds}
$g_{mb} V_{bs}$
V_{gs}
V_{bs}
C_{gs}
C_{sb}
S



$$C_{db}, C_{sb} = C_j' \cdot W L_d + C_j'' (2W + 2L_d)$$

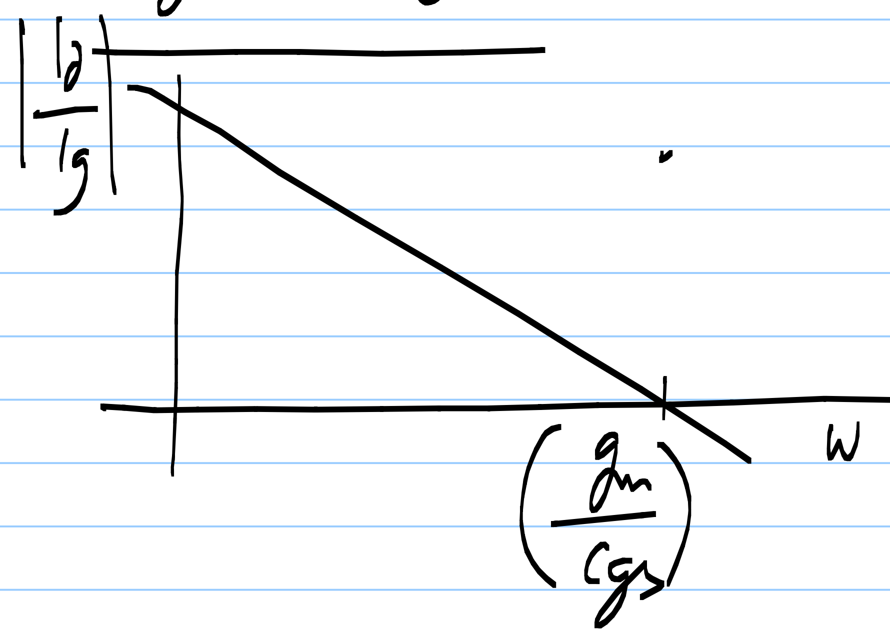
C_j': jn. cap / unit area

C_j'': jn. cap / unit length



incremental short

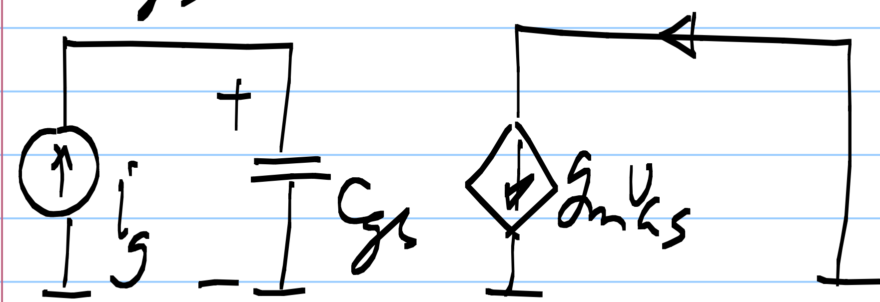
$$\frac{i_d}{i_g} \qquad \frac{I_d(s)}{I_g(s)} = \frac{g_m}{sC_{gs}}$$



Biased in saturation

$I_g / s \cdot C_{gs}$

$$I_g \cdot \frac{g_m}{sC_{gs}}$$



$$\omega_T = \frac{g_m}{C_{gs}} = \frac{\mu_n C_{ox} \frac{W}{L} (V_{GS} - V_T)}{\frac{2}{3} WL C_{ox}}$$

$$\omega_T = \frac{3}{2} \frac{\mu_n (V_{GS} - V_T)}{L^2}$$