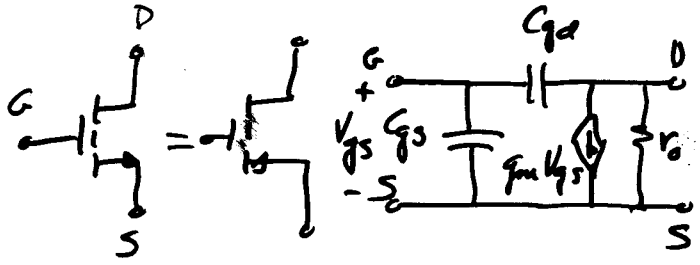
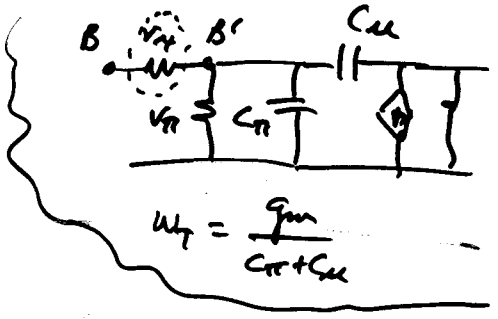
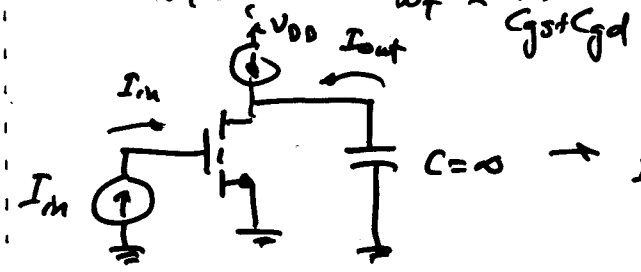
High-Frequency MOSFET Model



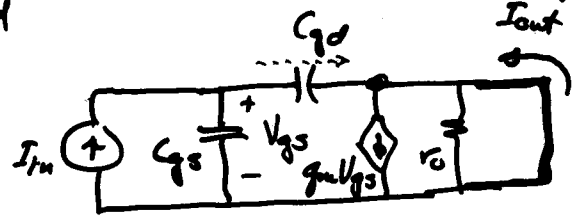


$$\omega_T = \frac{g_m}{C_\pi + C_\mu}$$

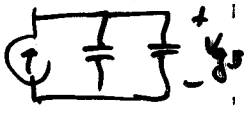
$\omega_T = ?$ $\quad \omega_T \approx \frac{g_m}{C_{gs}+C_{gd}}$



$I_{cgd} + I_{out} = g_m V_{gs}$



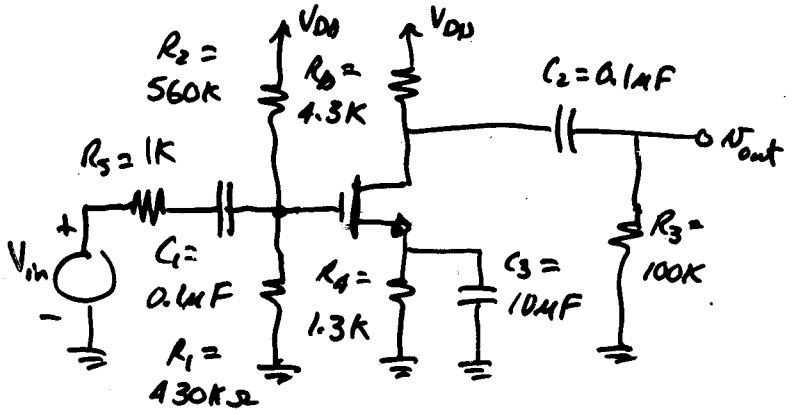
$$I_{out} \cong g_m V_{gs} \quad \& \quad V_{gs} = I_{in}\left[\frac{1}{s(C_{gs}+C_{gd})}\right]$$



$$\frac{I_{out}}{I_{in}} = \frac{g_m}{s(C_{gs}+C_{gd})} \rightarrow \frac{I_{out}(j\omega)}{I_{in}(j\omega)} = \frac{g_m}{j\omega(C_{gs}+C_{gd})}$$

$$\left|\frac{I_{out}(j\omega)}{I_{in}(j\omega)}\right| = 1 \quad \text{where } \omega \equiv \omega_T \rightarrow \boxed{\omega_T = \frac{g_m}{C_{gs}+C_{gd}}}$$

MOSFET Example – Cont'd

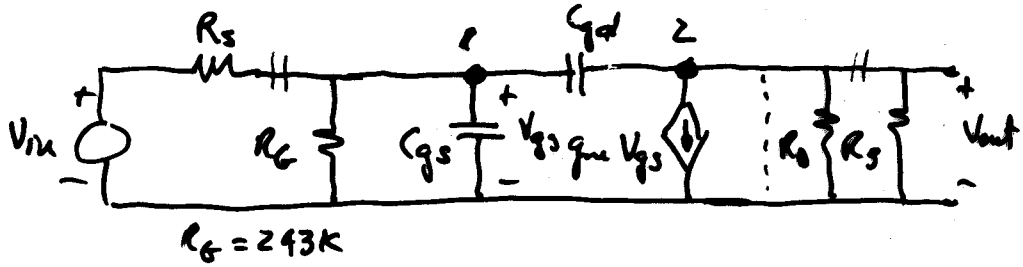


Find f_H.

$X_c = \frac{1}{\omega C}$

$g_m = 1.23mS \quad C_{gs} = 10pF \quad C_{gd} = 2pF$

S.S. Model –



$\omega >> \omega_L$

$R_G = 243K$

Direct analysis –

Nodal equations

$$\left(\frac{1}{R_s} + \frac{1}{R_G} + sC_{gs} + sC_{gd}\right)V_{gs} - sC_{gd}V_{out} = \frac{V_{in}}{R_s} \quad (1)$$

$$sC_{gd}(V_{out} - V_{gs}) + g_m V_{gs} + V_{out}\left(\frac{1}{R_D} + \frac{1}{R_s}\right) = 0 \quad (2)$$