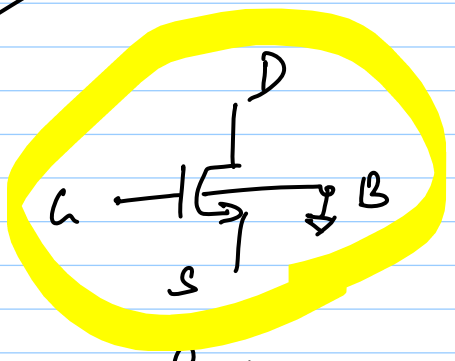
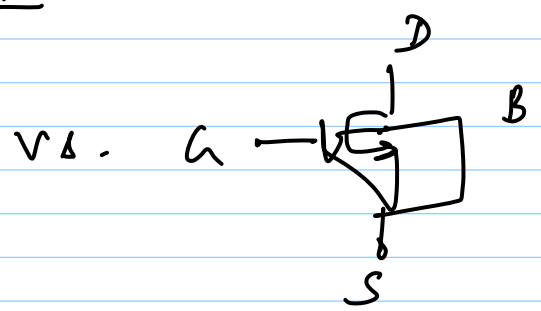
21-1-13

Lec 4



vs.



g_{mbs}

$V_T = V_{T0}$

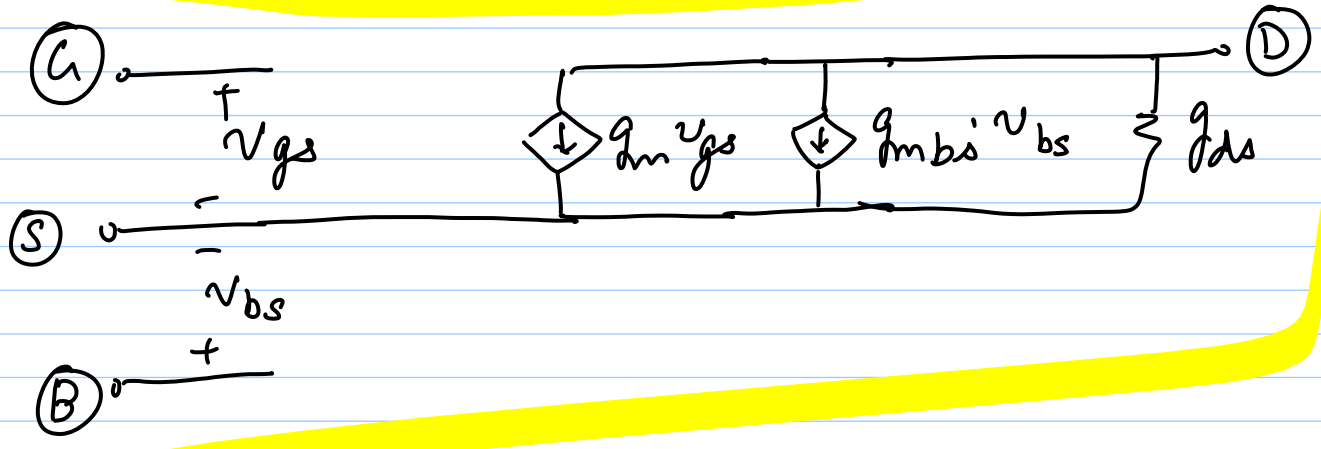
$$V_T = V_{T_0} + \gamma \left[\sqrt{2\phi_F + V_{SB}} - \sqrt{2\phi_F} \right]$$

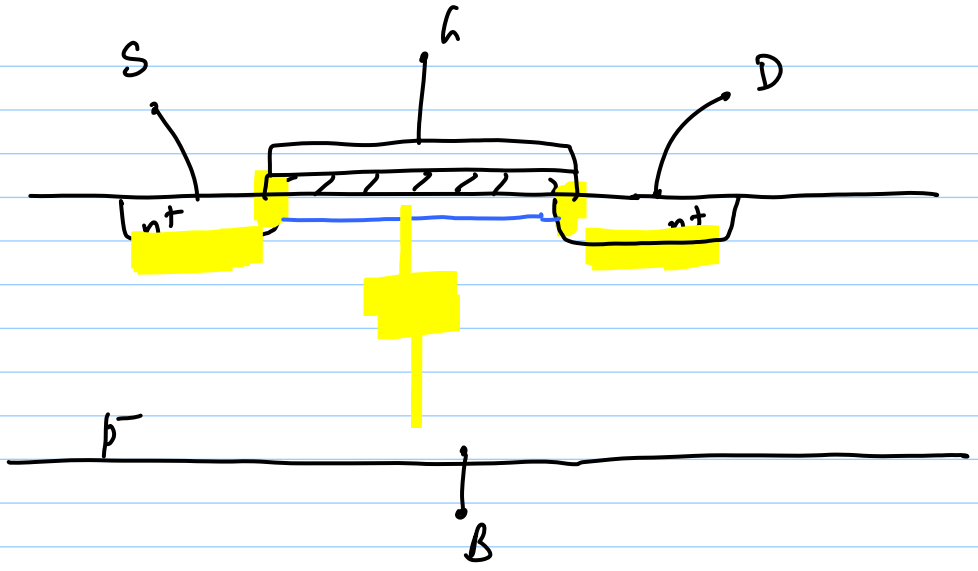
$$g_{mb} = \left. \frac{\partial I_D}{\partial V_{SB}} \right|_{V_{DS}, V_{GS} = \text{constant}}$$

$$= \frac{\partial I_D}{\partial V_T} \cdot \frac{\partial V_T}{\partial V_{SB}} = -\frac{\partial I_D}{\partial V_{GS}} \cdot \frac{\partial V_T}{\partial V_{SB}}$$

$$= -g_m \cdot \frac{\gamma}{2\sqrt{2\phi_F + V_{SB}}} = -\eta g_m$$

$\eta \sim 0.1$





$C_{ov} = W L_D C_{ox}$; L_D = overlap

$C_{gc} = WLC_{ox}$

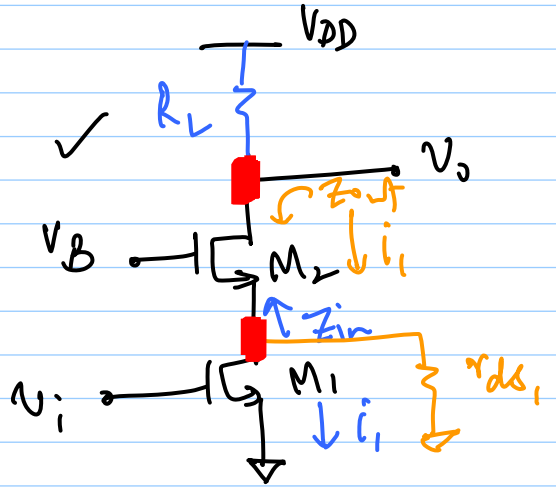
cap	OFF	TRIODE	SAT
C_{gs}	C_{ov}	$C_{ov} + C_{gc}/2$	$C_{ov} + \frac{2}{3} WLC_{ox}$
C_{gd}	C_{ov}	$C_{ov} + C_{gc}/2$	C_{ov}
C_{gb}	range of values	0	0
C_{sb}	C_{jsb}	$C_{jsb} + C_{cb}/2$	$C_{jsb} + \frac{2}{3} C_{cb}$
C_{db}	C_{jdb}	$C_{jdb} + C_{cb}/2$	C_{jdb}

Simple Amplifier Ckt analysis

1) Visualize the propagation of V & I signals through the ckt.
2) Develop insight into ckt performance based on (1)
3) Identify relative impedance levels at all nodes in the signal path
4) Freq. response: identify relative position of poles & zeroes based on (3) and caps.
5) VTC — info on voltage swings.

$g_m >> g_{mbs} >> g_{ds}$

Cascode C.S. Amp: (✓)



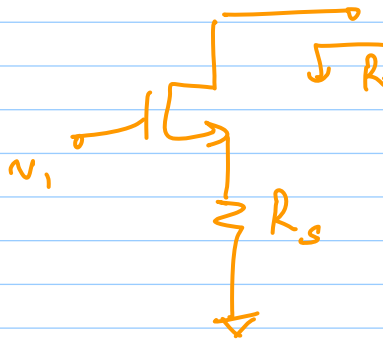
gain

$Z_{in} \approx 1/g_{m_2}$

$i_1 = g_{m_1} \cdot v_i$

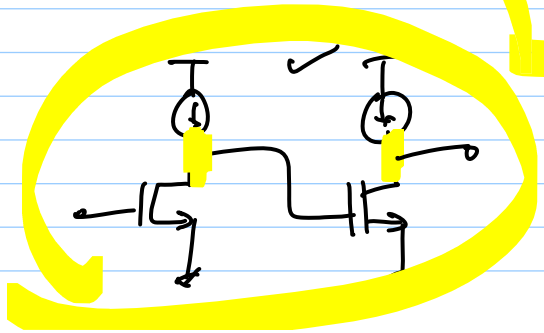
$R_{out} = (g_{m_2} r_{ds_2}) \cdot r_{ds_1}$

$a_v = -g_{m_1} \cdot [R_L \| R_{out}]$



as $R_L \to \infty \Rightarrow a_v \to -g_{m_1} R_{out}$

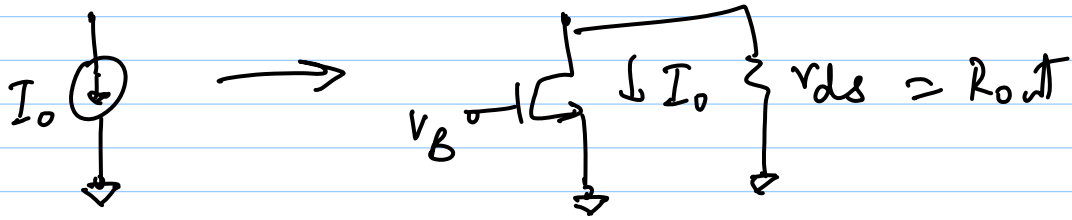
$$a_v = -(g_{m_1} r_{ds_1})(g_{m_2} r_{ds_2})$$

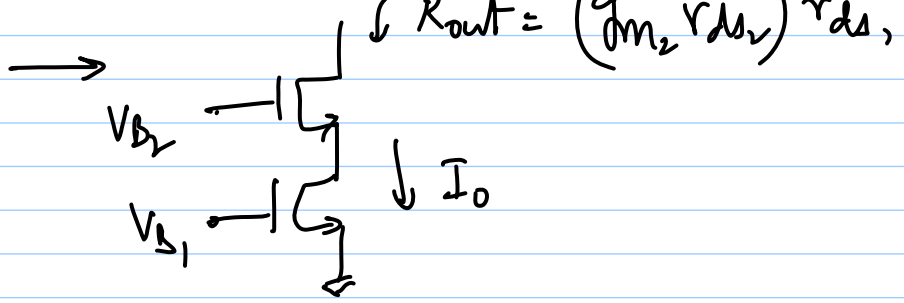


cascade

Advantage

1) V_{tc} as an ideal Current source





2) Cascade — 2 dominant poles
Cascode — 1 " "

3) Power consumption