ENEE 303
03/26/19

Note Title 3/26/2019

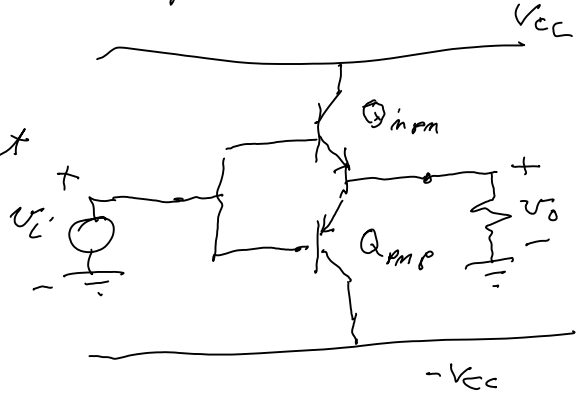
push pull, p. 929, Fig. 12.5

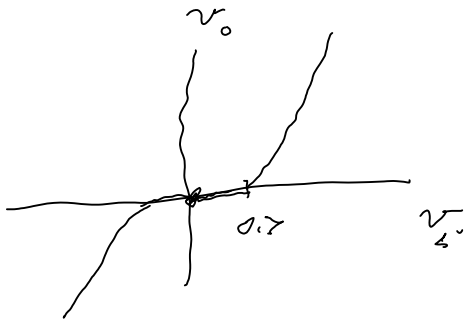
Miller effect, p. 725, Eq. (10.45)

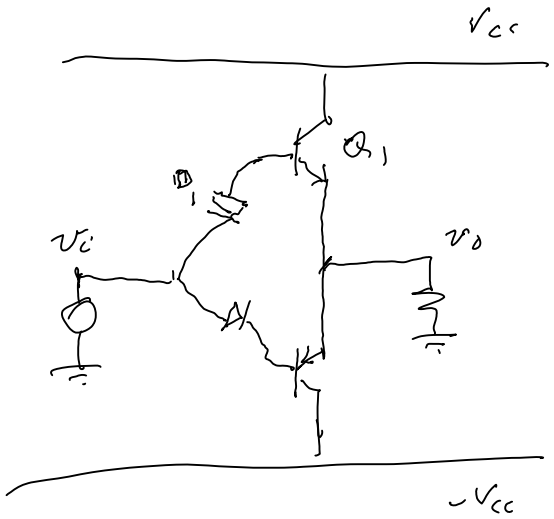
Body effect, p. 288, eq. (5.30)

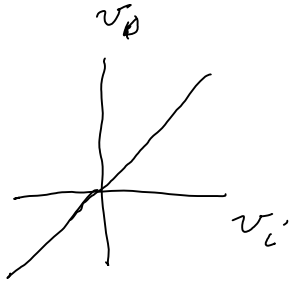
Exam a week from Th

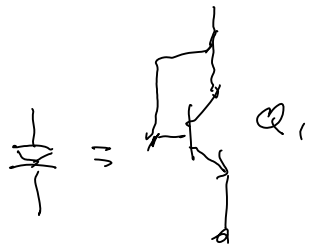
class B
for power output stages



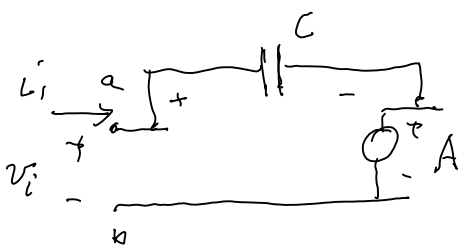




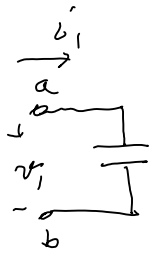




Miller effect



$\Rightarrow$

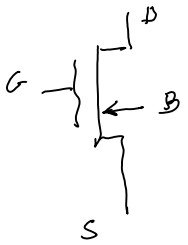


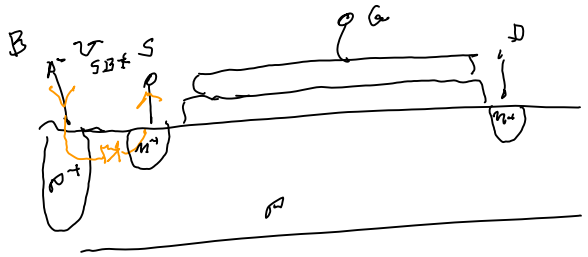
$C_{eq} = C_{miller} = C(1 - A_v)$

$$i_1 = \alpha C (v_i - v_o)$$
$$= \alpha C (v_i - A_v \cdot v_i) = \alpha C (1 - A_v) v_i = \alpha C_{eq} \cdot v_i$$

normally $A_v \simeq -g_m R_L \Rightarrow C_{miller} = C(1 + g_m R_L) > C$

Body effect:





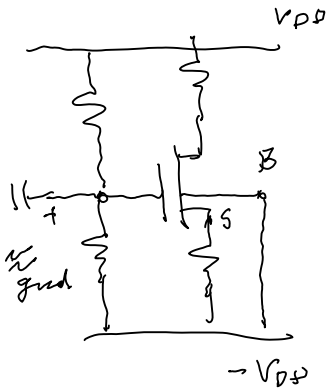
$$v_{th} = V_{TO} + \gamma\left(\sqrt{2\phi_f + v_{SB}} - \sqrt{2\phi_f}\right)$$

v_{th} = threshold voltage increases if $v_{SB} > 0$

if $v_{SB} > 0$ diode S-B is turned off

but if $v_{SB} < 0.6$ V then this diode is on

∴ tie the bulk to lowest potential



gives $v_{SB} \simeq V_{DD}$

if in saturation

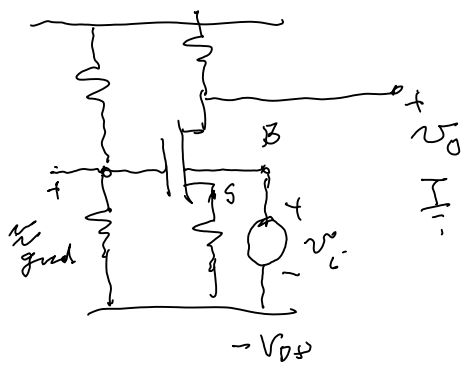
$$i_D = k\left(v_{GS} - v_{th}\right)^2$$

4.00
−0.64
3.36

Ex: $V_{TO} \approx 1$ V, $\gamma = 1/2$, $2\phi_f \approx 0.64$, $\sqrt{2\phi_f} = 0.8$, $V_{DD} = 3.36$

Then $\gamma\left(\sqrt{2\phi_f + v_{SB}} - \sqrt{2\phi_f}\right) = \frac{1}{2}\left(\sqrt{4} - \sqrt{0.64}\right) \simeq \frac{1}{2}\left(2 - 0.8\right) = 1 - 0.4 = 0.6$

V_{TO} changes to V_{th}, from 1 to 1.6 V ⇐ a big change. here $v_{SB} = V_{SB}$ as bias



$$g_{mb} = \frac{\partial i_D}{\partial v_i = v_{BS}} \quad ; \quad i_D = k\left(v_{SG} - V_{th}(v_{SB})\right)^2$$

$$\frac{\partial i_D}{\partial v_{BS}} = \frac{\partial i_D}{\partial v_{th}} \cdot \frac{\partial v_{th}}{\partial v_{BS}} = -k \cdot 2\left(v_{SG} - V_{th}(v_{SB})\right) \cdot \frac{1}{2} \frac{1}{\sqrt{2\phi_f + v_{SB}}} \cdot (-1) \Big|_{@Q}$$

$$\frac{\partial v_{th}}{\partial v_{SB}} = \gamma \cdot \frac{1}{2} \cdot \frac{1}{\sqrt{2\phi_f + v_{SB}}}$$

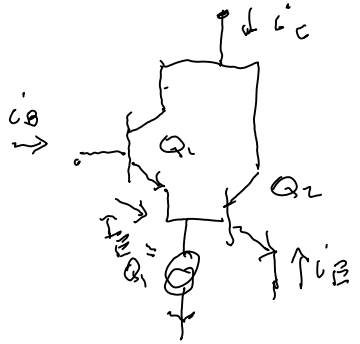
$$g_{mb} = k \cdot \frac{I_D}{(V_{ov})} \cdot \frac{1}{\sqrt{0.6 + V_{SB}}}$$

$$\| \quad V_{GS} - V_{th}$$

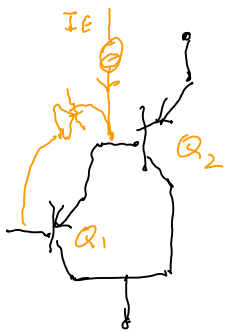
$\therefore$ we can use this as another type of amplifier

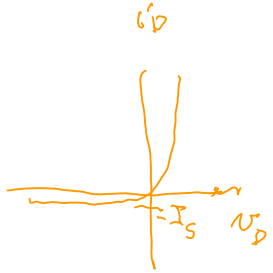
if $V_{SB} = -0.4$ get $\frac{1}{\sqrt{0.2}} > 1$

Darlington bias



& in LM139

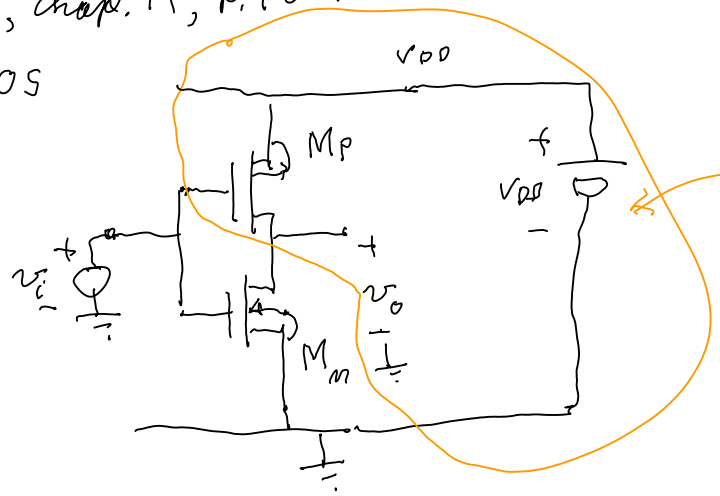




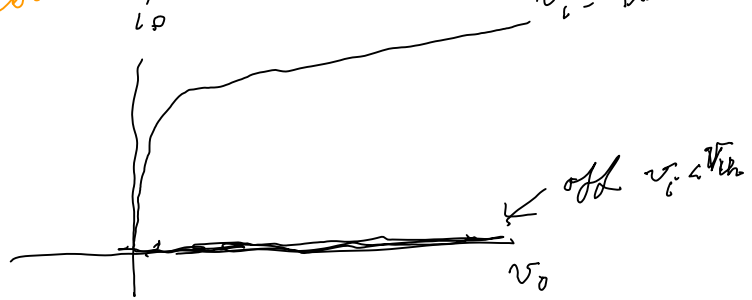
allows base & emitter currents for Q_1 when the base is open circuit

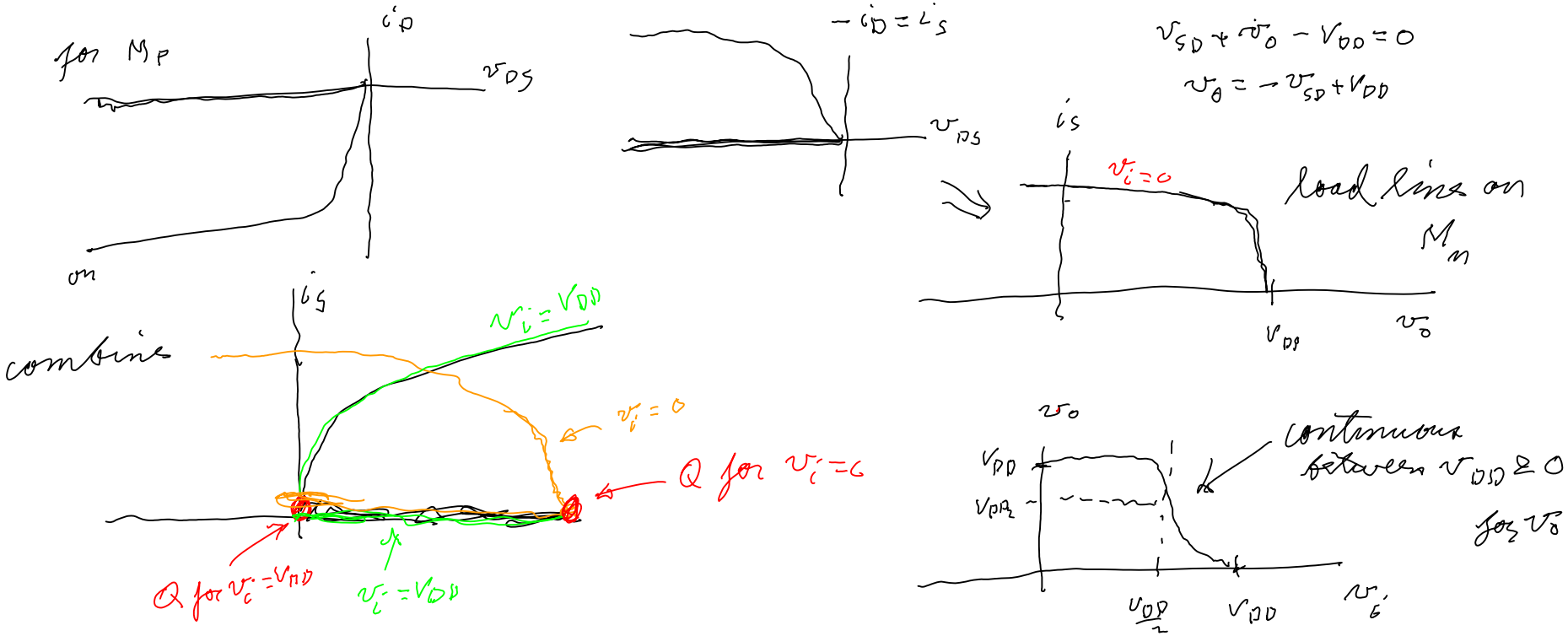
inverters, chap. 14, p. 1091

CMOS



acts as a load on M_n




for M_p
i_D
v_{DS}
on
i_S
combine
$v_i = V_{DD}$
$v_i = 0$
Q for $v_i = 0$
Q for $v_i = V_{DD}$
$v_i = V_{DD}$
$-i_D = i_S$
v_{SD}
$v_{SD} + v_o - V_{DD} = 0$
$v_o = -v_{SD} + V_{DD}$
i_S
$v_i = 0$
load line on M_n
V_{DD}
v_o
v_o
V_{DD}
$V_{DD} - V_{tp}$
continuous between $v_{DS} \geq 0$ for v_o
$\frac{V_{DD}}{2}$
V_{DD}
v_i