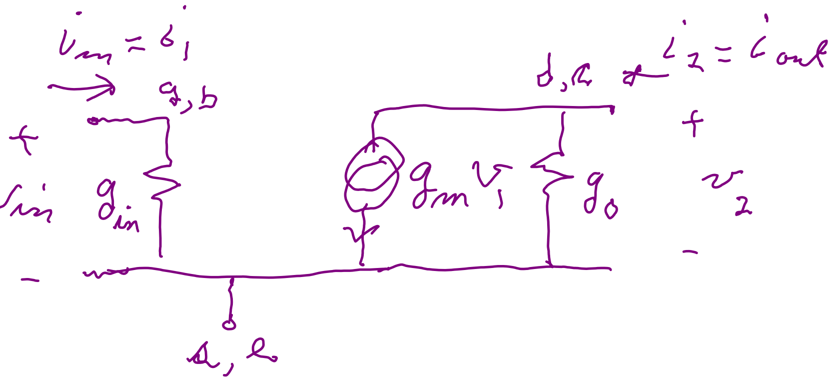
ENEE 303
02/19/19

Note Title 2/19/2019

Bias for BJT



$g_{in} \approx 0$ MOS

$g_\pi = \frac{1}{\beta}\frac{I_c}{V_T}$ BJT

$g_o = I_D/V_A = \lambda I_D$ MOS

$g_o = I_c/V_A$ BJT

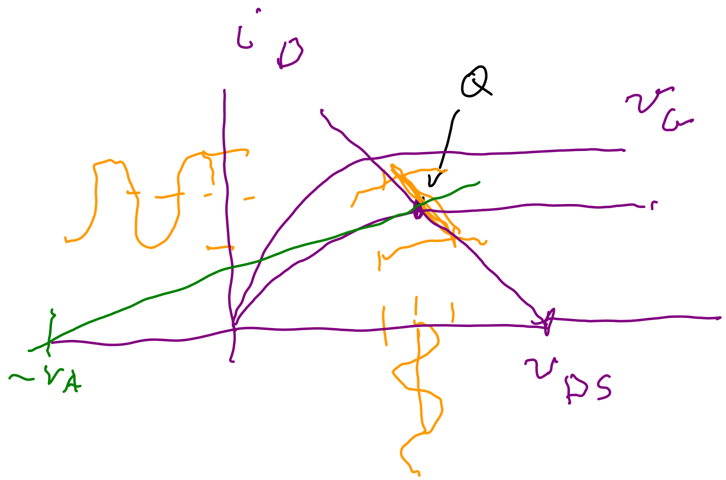
$g_m \simeq I_D/V_{OD}$ MOS

$g_m = \frac{I_c}{V_T}$ BJT

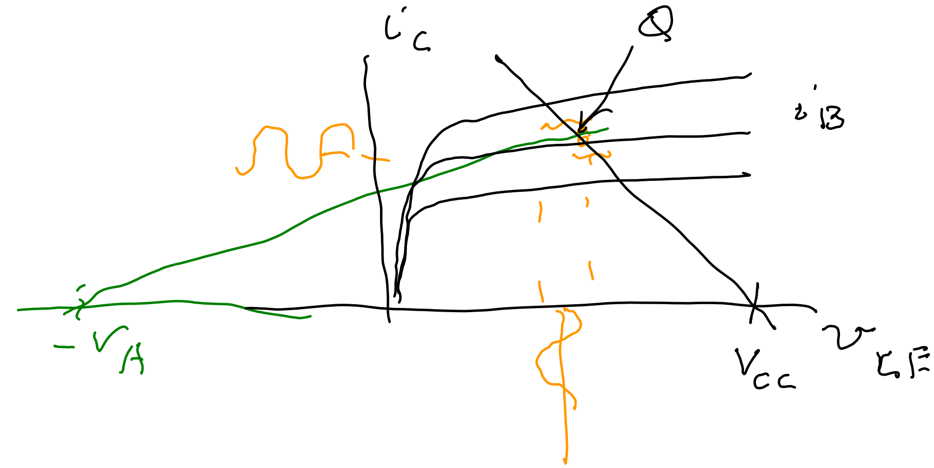
V_{OD} = overdrive $= V_{GS} - V_{TO}$

$V_T = \frac{KT}{|q|}$

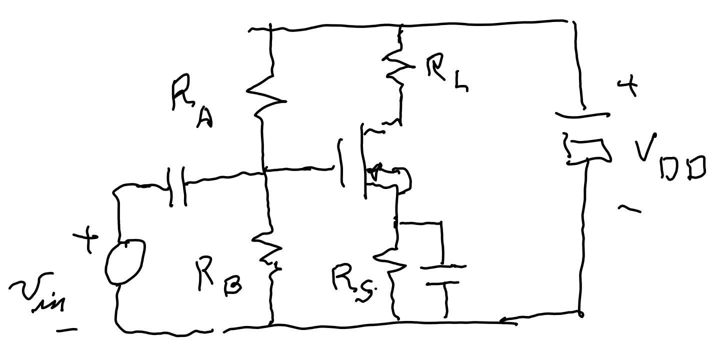
$\frac{1}{\lambda} = V_A$ = Early voltage



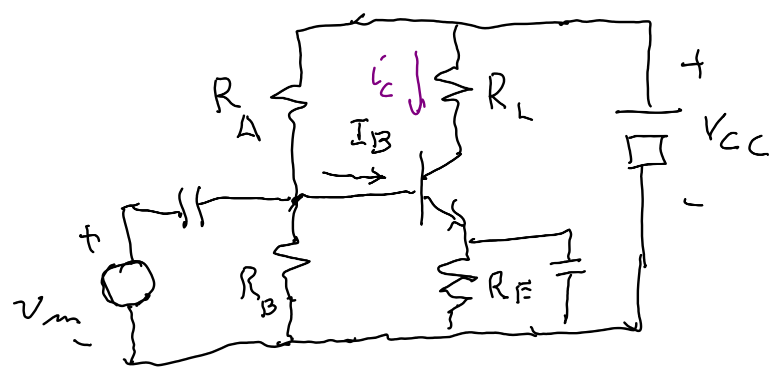
i_D
Q
v_G
$\sim v_A$
v_{DS}



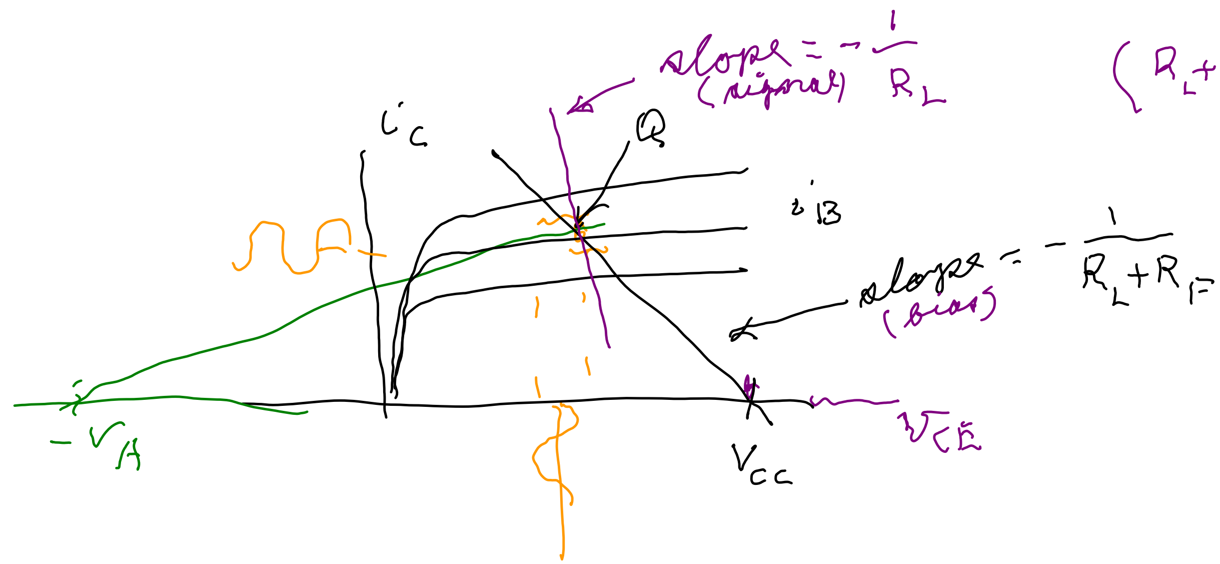
i_C
Q
i_B
$-v_A$
V_{CC}
v_{CE}



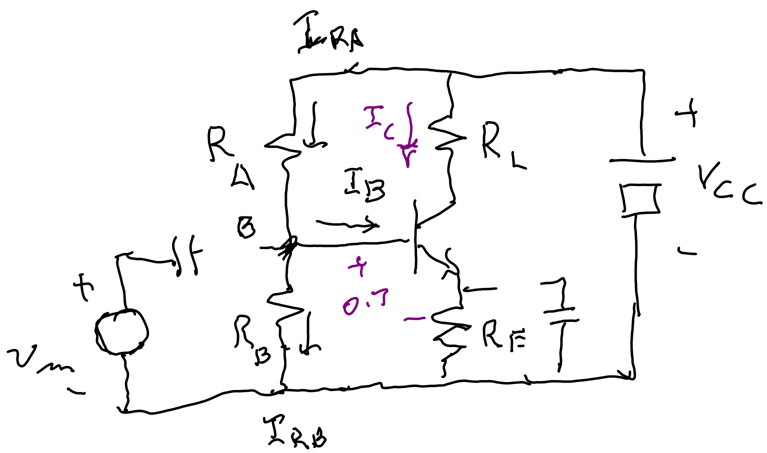
R_A
R_L
+
V_{DD}
-
+
v_{in}
-
R_B
R_S



R_A
i_C
R_L
+
V_{CC}
I_B
-
+
v_{in}
-
R_B
R_E



$(R_L + R_E) i_C = V_{CC} - V_{CE}$



decide R_A & R_B to give Q point

$V_{BE} \approx 0.7$

Know I_C by Q point

β from transistor data

choose R_E & know V_{CC}

@ B: KCL $\Rightarrow 0 = I_{R_A} - I_B - I_{R_B}$ (1)

$I_B = I_C / \beta$

on R_B, $V_{R_B} \approx R_B I_{R_B} = 0.7 + R_E \cdot \frac{I_C}{\alpha}$ (2)

on R_A & R_B, $V_{CC} = R_A I_{R_A} + R_B I_{R_B}$ (3)

$(\hat{1})$: $I_{R_A} = I_B + I_{RB} \Rightarrow \times R_A \Rightarrow R_A I_{R_A} = R_A \frac{I_C}{\beta} + R_A I_{RB}$ $(\hat{1})$

into (3): $V_{CC} = R_A \frac{I_C}{\beta} + R_A I_{RB} + R_B I_{RB} = R_A \frac{I_C}{\beta} + (R_A + R_B) I_{RB}$ $(\hat{3})$

from (2): $I_{RB} = G_{RB}(0.7 + R_E I_C/\alpha)$ $G_{RB} = 1/R_{RB}$

into $(\hat{3})$ $V_{CC} = R_A \frac{I_C}{\beta} + (R_A + R_B) G_{RB} (0.7 + R_E I_C/\alpha) = R_A \frac{I_C}{\beta} + \left(\frac{R_A}{R_B} + 1\right)\left(0.7 + R_E \frac{I_C}{\alpha}\right)$

$\frac{R_A}{R_B} = k_{AB}$ unset

R_A: unknown

can set $\frac{R_A}{R_B} = k_{AB}$ & solve for R_A