- Homework #1 – Drop problems 2 and 4 and replace with Problems 4.52 and 5.47 of the text.
- Lecture notes may be downloaded in pdf at the website - http://users.ece.gatech.edu/~pallen/Academic/ECE3050/ece.htm

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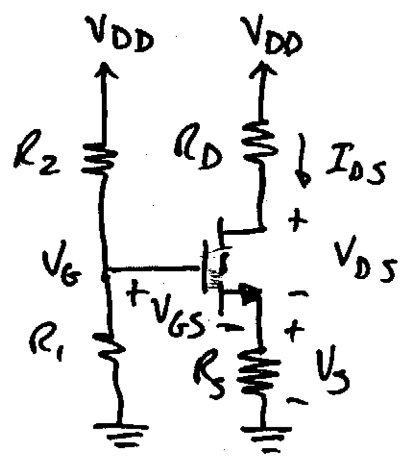
MOS Biasing Circuits

Biasing defines the dc operating point of a diode or transistor.

1.) Simple biasing ckt. (Last lecture)

2.) More stable biasing ckt.

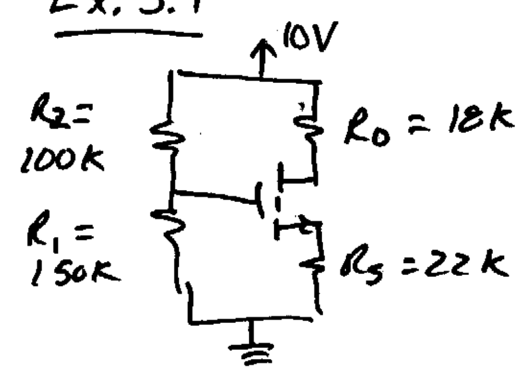


"Feedback"

① Suppose I_{DS} increases.
② V_S increases
③ V_G stays constant
④ $\therefore$ V_{GS} decreases

$$I_{DS} = \frac{K_n' W}{2L}\left(V_{GS} - V_{TN}\right)^2 \rightarrow \text{Decreases}$$

Ex. 3.1

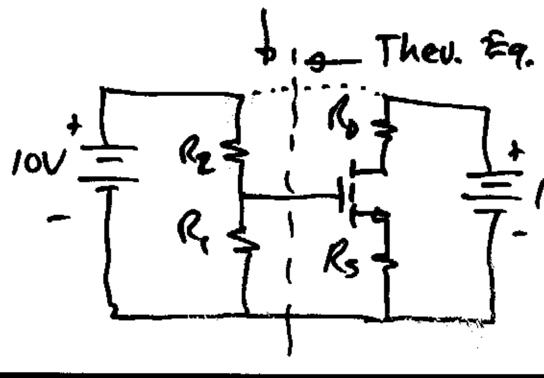


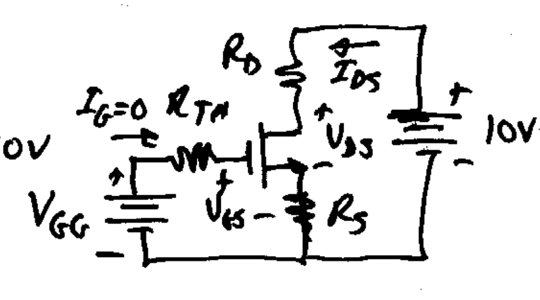
If $K_n' = 25\,\mu A/V^2$, $\frac{W}{L} = 10$, and $V_{TN} = 1\,V$, find Q point.
Find I_{DSQ}, V_{GSQ}, V_{DSQ}

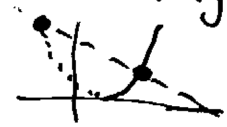
1.) $V_{TH} = V_{GG} = 10\,\frac{R_1}{R_1 + R_2} = 6V$

2.) $R_{TH} = R_1 \| R_2 = 60K$

Thev. Eq.







Ex. 3.1 – Cont'd

Gate loop: $V_{GG} = V_{GS} + I_{DS} R_S$ $\qquad I_{DS} = \frac{K_N}{2}(V_{GS} - V_{TN})^2$

Assume saturation

$$V_{GG} = V_{GS} + \frac{R_S K_N}{2}(V_{GS} - V_{TN})^2 \rightarrow 6 = V_{GS} + 2.75\,(V_{GS} - 1)^2$$

$$V_{GS} = 0.8182 \pm 1.361 \rightarrow \underline{\underline{V_{GSQ} = 2.179\text{V}}}$$

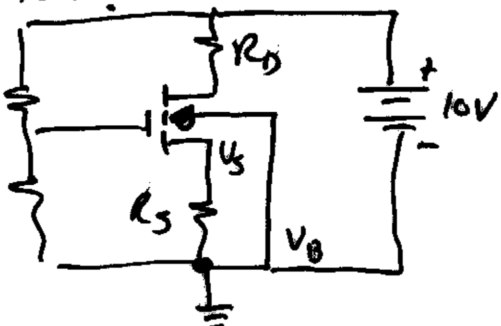
$$I_{DSQ} = \frac{25}{2} \cdot 10\,(2.179 - 1)^2\ \mu A = \underline{\underline{174\,\mu A}}$$

$$V_{DD} = I_{DSQ}(R_D + R_S) + V_{DSQ} \rightarrow V_{DSQ} = 10 - 174(0.04) = \underline{\underline{3.05\text{V}}}$$

Saturation occurs when $V_{DS} \geq V_{GS} - V_{TN}$

$$3.05 \overset{?}{\geq} 2.179 - 1 \quad \text{Yes}$$

Bulk effect?



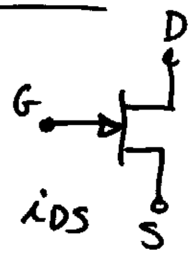
$V_{BS} = -V_S = -16k\,(174\mu A)$

$$V_{TN} = V_{TO} + \gamma\sqrt{2\phi_F - V_{BS}} - \gamma\sqrt{2\phi_F}$$

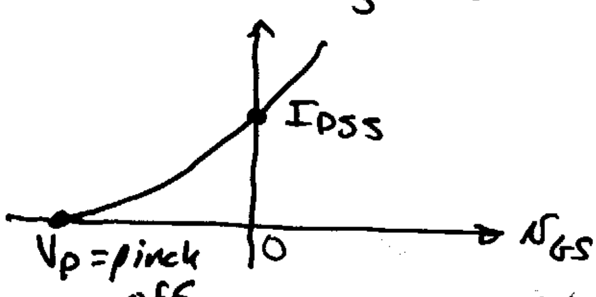
Parameters of the MOSFET Large Signal Models are

$$\boxed{K_N',\ V_{TO},\ \gamma,\ \lambda,\ 2\phi_F} \rightarrow K_N' \ \&\ V_{TN}$$

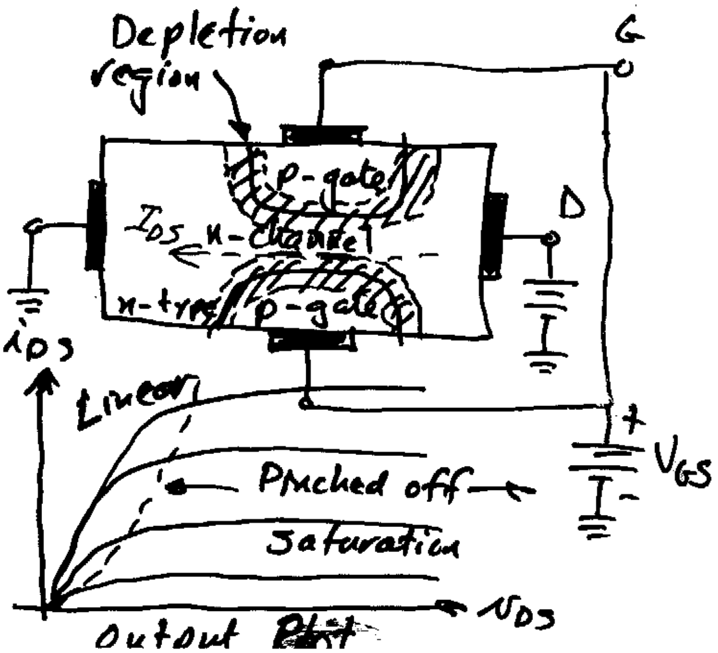
JFETs



n-channel JFET



Transconductance Plot.

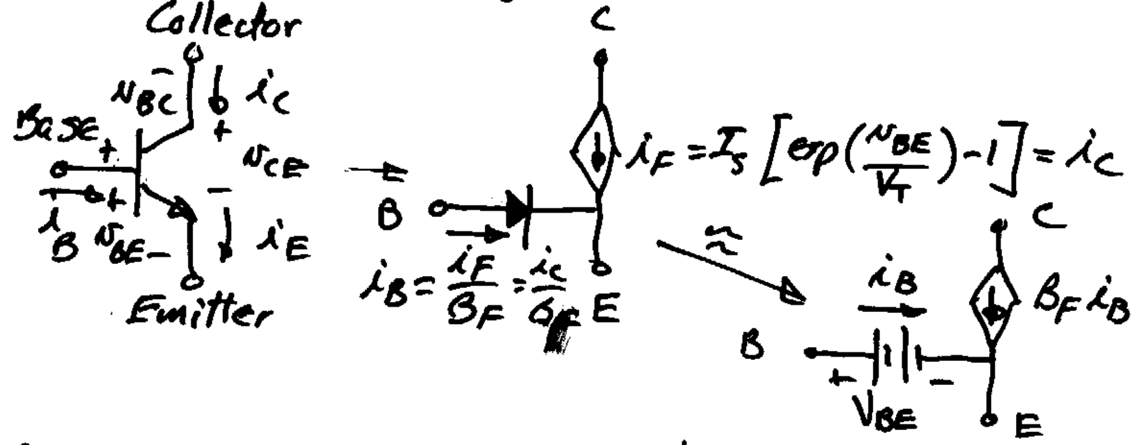


Output ~~Plot~~

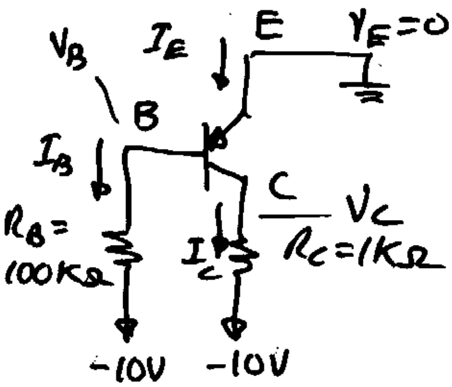
BJTs – Bipolar Junction Transistors

NPN Large Signal Model –

1.) Forward active region (BC is rev. biased, BE is fwd. biased)



2.) Ex. 3.2



If $\beta_F = 50$ find all dc currents and dc voltages.

Only good when i_B is mostly defined by the external circuit.

$$I_B = \frac{10 - V_{EB}}{100K} \approx \frac{10V}{100K} = 100\mu A$$

or can assume $V_{EB} \approx 0.7V$

$$\therefore I_B = \frac{10 - 0.7}{100K} = \underline{93\mu A}$$

$I_C = \beta_F I_B = 50 I_B = \underline{4.65mA}$

$I_E = I_C + I_B = \underline{4.74mA}$

$\underline{V_E = 0}$ $V_B \cong \underline{-0.7V}$ $V_C = -10 + I_C R_C = \underline{-5.35V}$

Next,