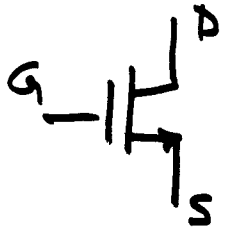
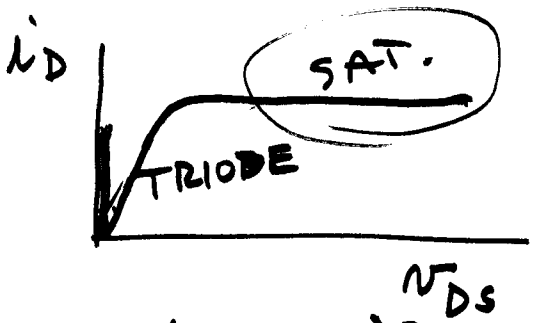
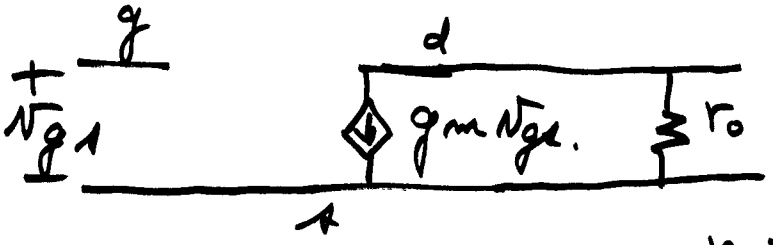
MOSFET DIFFERENTIAL AMP.





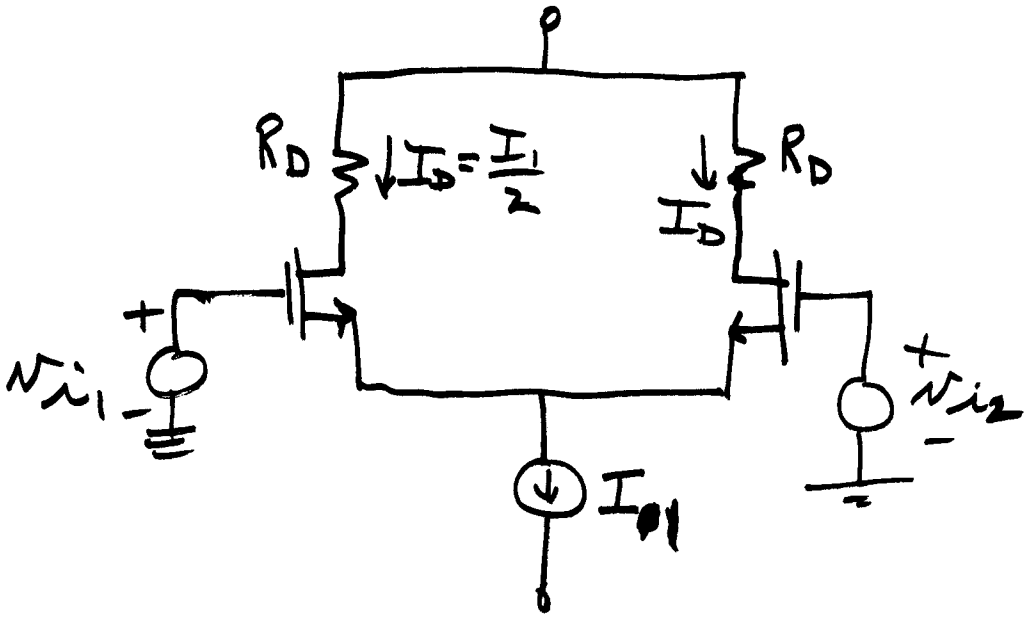
$$i_D = K_n (v_{GS} - V_{TN})^2 (1 + \lambda v_{DS})$$

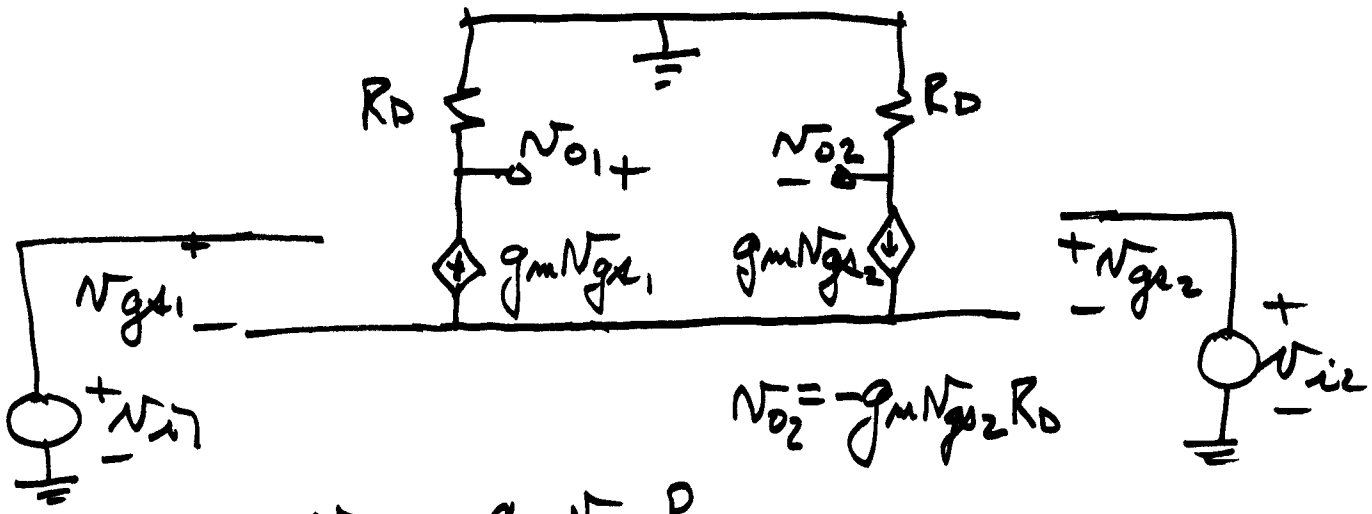


$$r_o = \frac{V_A}{I_{DQ}} = \frac{1}{\lambda I_{DQ}}$$

$$g_m = 2\sqrt{K_n I_{DQ}}$$

$$K_n = \left(\frac{W}{L}\right)\frac{k'_n}{2}$$





$$v_{o2} = -g_m v_{gs2} R_D$$

$$v_{o1} = -g_m v_{gs1} R_D$$

$$v_{o1} - v_{o2} = -g_m v_{gs1} R_D + g_m v_{gs2} R_D$$

$$= -g_m R_D \left(v_{gs1} - v_{gs2} \right)$$

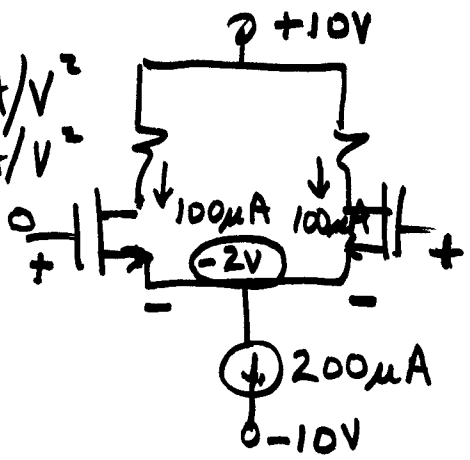
$$-v_{i1} + v_{gs1} - v_{gs2} + v_{i2} = 0$$

$$v_{gs1} - v_{gs2} = v_{i1} - v_{i2}$$

$$\boxed{\frac{v_{o1} - v_{o2}}{v_{i1} - v_{i2}} = -g_m R_D}$$

$K_n = 0.1 mA/V^2$
$= 100 \mu A/V^2$

$V_T = 1V.$



$$I_D = K_n (V_{GS} - V_{TN})^2$$

$$V_{GS} = \sqrt{\frac{I_D}{K_n}} + V_{TN}$$

$$V_{GS} = \sqrt{\frac{100\mu}{100\mu}} + 1$$

$$V_{GS} = 2V$$

For saturation $V_{DS} > V_{GS} - V_T = 2 - 1 = 1V.$

LET $V_{DS} = 4\ V. \Rightarrow V_D = 2V.$

$$V_D = 10 - I_D R_D = 2$$

$$I_D R_D = 8V.$$

$$R_D = \frac{8V}{100\mu A} = 80K$$

$$g_m = 2\sqrt{K_n I_D} = 2\sqrt{100\mu\ 100\mu} = 200\mu A/V$$
$$.2 mA/V$$

$$A_V = -g_m R_D = -(.2m)(80K)$$

$$= -16$$

CURRENT MIRROR - NEXT CLASS