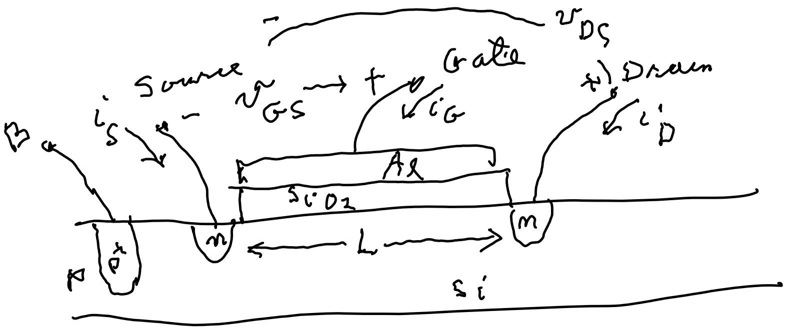
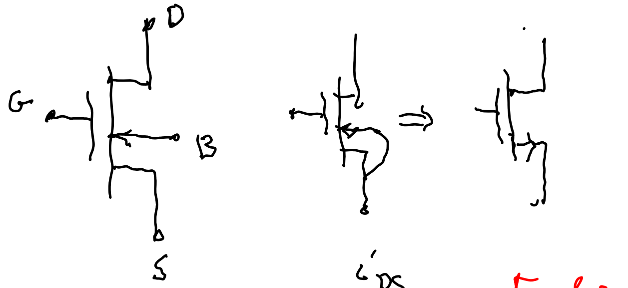
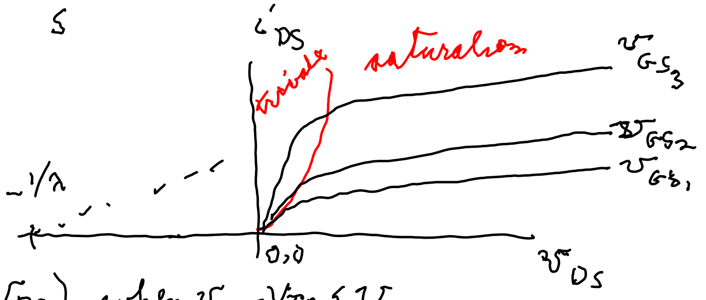
ENEE 303
02/05/19

Note Title 2/5/2019

N channel MOS







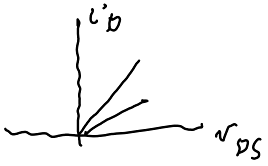
Eqs. 3 regions: off : $i_D = 0$ $v_{GS} < V_{TO}$ = turn on

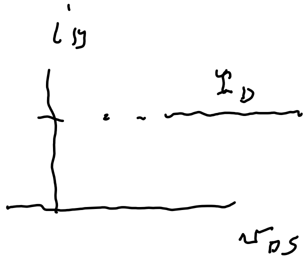
saturation; $i_D = \frac{k}{2} W/L (v_{GS} - V_{TO})^2 (1 + \lambda V_{DS})$ when $v_{GS} - V_{TO} \leq v_{DS}$ & $v_{GS} > V_{TO}$ (when $v_{SB} = 0$)

triode = ohmic: $i_D = \frac{kW}{L}\left((v_{GS} - V_{TO})(v_{DS} - \frac{1}{2} v_{DS}^2)\right)(1 + \lambda v_{DS})$ when $v_{GS} - V_{TO} \geq v_{DS}$

Table 5.1

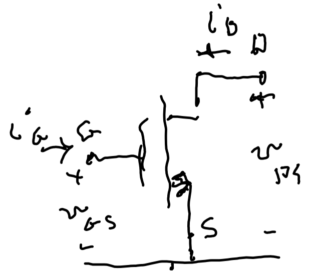
For small v_{DS} (in ohmic range) $i_D \simeq \frac{kW}{L}(v_{GS}-V_{TO})\,v_{DS} = g(v_{GS})\cdot v_{DS} \Rightarrow$ voltage variable resistor

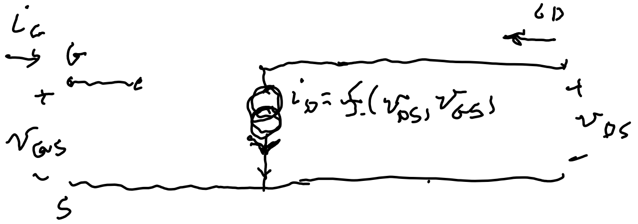




For large v_{DS} (in saturation)

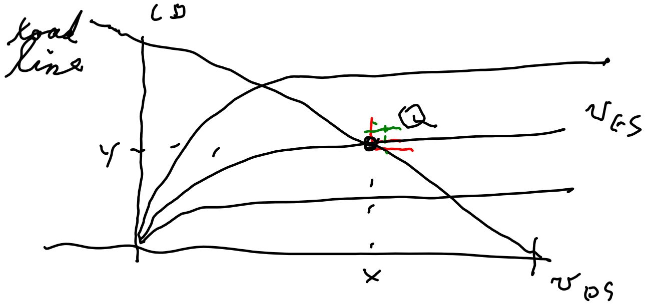
$$i_D \approx \frac{kW}{2L}(v_{GS}-V_{TO})^2 \Rightarrow \text{constant current (for fixed } v_{GS})$$
$$= I_D$$





VCCS
voltage
controlled
current
source

Chapter 7, p.380 ⇒ Q point = bias



Taylor series

$$f(\underset{\underset{v_{DS}}{\shortparallel}}{x}, \underset{\underset{v_{GS}}{\shortparallel}}{y}) = \underset{\underset{i_D}{\shortparallel}}{z} = f(X, Y) + \left.\frac{\partial f}{\partial x}\right|_{Q} (x - X) + \left.\frac{\partial f}{\partial y}\right|_{Q} (y - X) + \underbrace{\left\{ \frac{\partial^2 f}{x^2}, \frac{\partial^2 f}{\partial y^2}, \frac{\partial^2}{\partial x \partial y} \text{ etc} \right.}_{\text{ignore for small signal}}$$

Q $\shortparallel$

$v_{GS} = V_{GS}$

$v_{DS} = V_{DS}$

⇑

bias = DC values