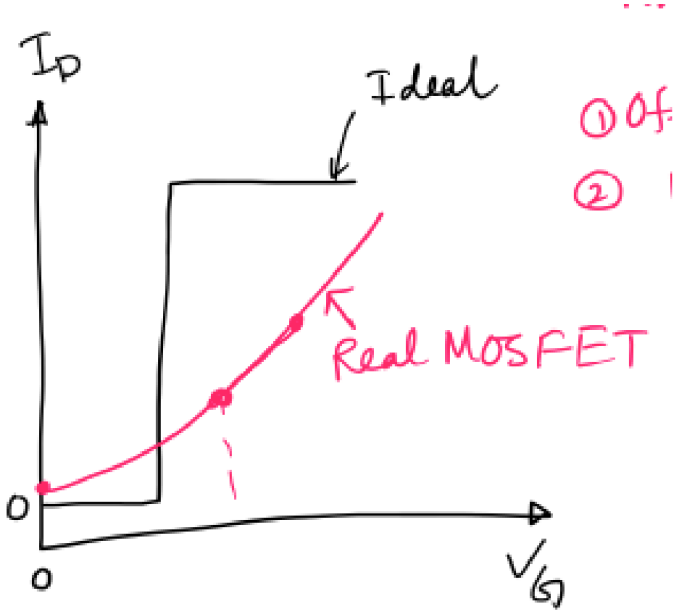
ECE 3030: Physical Foundations of Computer Engineering
Fall 2021
Homework 4—Total points 100
Due on Thursday 9/30/2021 at 11.59 am. In case of a late submission, you will be penalized by 50 points for each day after the submission deadline has passed. You will receive no score if you submit after the solution has been posted.

Q1 What are the two main differences between an ideal switch and a real MOSFET based switch? Explain with $I - D$-V_G characteristics. All variables have their usual meaning. [50 pts]

Solution to Q1:

(a) An ideal switch will have a zero off-state leakage current, while a MOSFET does not.

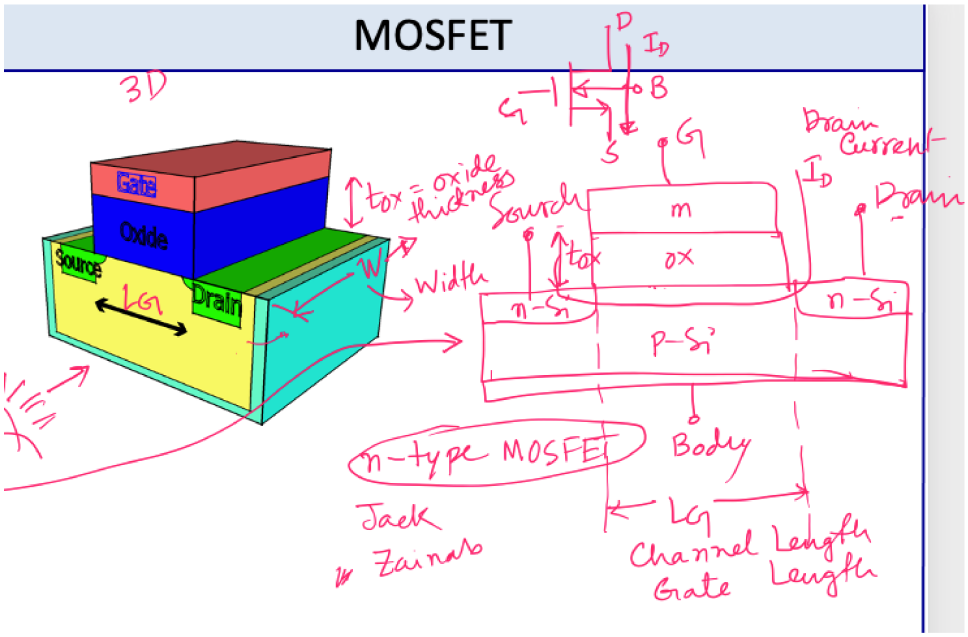
(b) An ideal switch have an abrupt on to off transition, while in a MOSFET the transition from the off-state to the on-state is diffuse.



Q2 Draw the 3-D schematic diagram of a MOSFET and the 2-D cross-section of the same, indicating all the relevant dimensions L_G, t_{ox} and W and the terminals. All variables have their usual meaning. [50 pts]

Solution to Q2:

L_G=Channel/gate length
t_{ox}=Oxide thickness
W=Width



Solution to Q3: The typical range of threshold voltage for a silicon MOSFET is approximately 0.5 to 1.5 volts.

Solution to Q4: Since $V_{GS} > V_{th}$ (3 volts > 0.8 volts), the MOSFET is in the enhancement mode.

Solution to Q5: Any answer is fine as it is opinion-based.