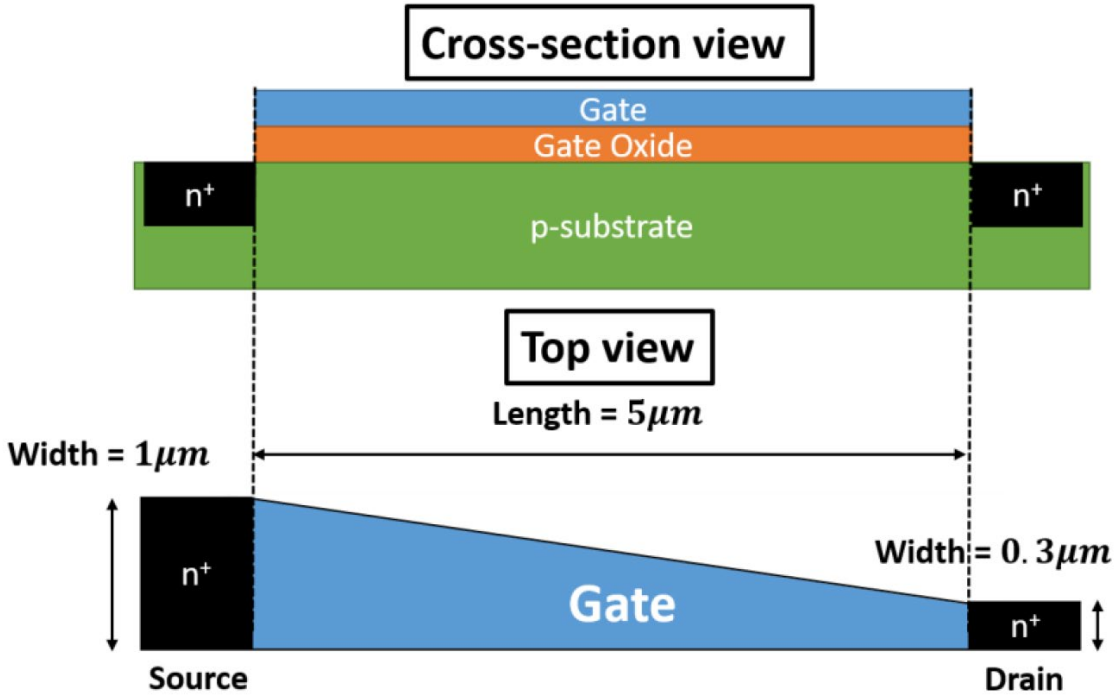
PROBLEM SET #6

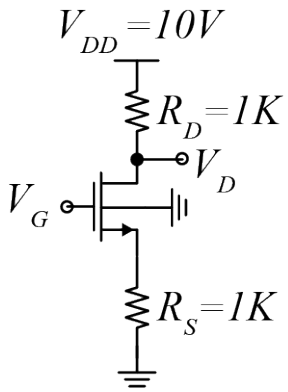
Issued: Friday, October 4, 2019

Due: Friday, October 18, 2019, 12:00 noon via **Gradescope**.

1. Sedra & Smith, Problem 5.49
2. Sedra & Smith, Problem 5.50
3. The cross-section and top-view of an NMOS transistor are shown below. The length of the channel is $5\mu m$. The width of the channel changes linearly from $1\mu m$ at the source to $0.3\mu m$ at the drain. Derive the expression for the device current when operating in the saturation region as a function of μ_n, C_{ox}, V_{GS}, V_{DS} and V_{th}. Assume $\lambda=0$.



4. In the following circuit, find V_G to set $V_D=8V$. Device parameters: $K'=100\mu A/V^2$, $V_T=0.7V$, $2\varphi_F=0.6V$, $\gamma=0.75\sqrt{V}$.



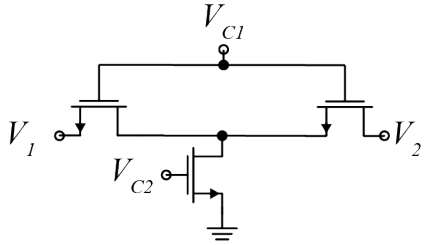
5. (a) Calculate the on-resistance for an NMOS transistor having W/L = 100/1 and operating with $VGS = 5V$ and $VTN = 0.75V$. (b) Repeat for a similar PMOS transistor with $VGS = -5V$ and $VTP = -0.75V$. (c) What W/L is required for the PMOS transistor to have the same R_{on} as the NMOS transistor in (a)?

6. What is the impedance between V_1 and V_2 under following conditions. Device parameters: $K' = 100\mu A/V^2$, $V_T = 0.7V$.

(a) $V_1 = 0V$, $V_{C1} = 5V$, $V_{C2} = 0V$.

(b) $V_1 = 2.5V$, $V_{C1} = 5V$, $V_{C2} = 1V$.

(c) $V_1 = 2.5V$, $V_{C1} = 2.5V$, $V_{C2} = 5V$.



7. Indicate the region of operation for an npn transistor biased as follows:

(a) $V_{BE} = -5.0V$, $V_{BC} = 0.7V$.

(b) $V_{BE} = -5.0V$, $V_{BC} = -5.0V$.

(c) $V_{BE} = 0.7V$, $V_{BC} = 0.7V$.

(d) $V_{BE} = 0.7V$, $V_{BC} = -5.0V$.

8. Indicate the region of operation for a pnp transistor biased as follows:

(a) $V_{EB} = 0.7V$, $V_{CB} = 0.7V$.

(b) $V_{EB} = 0.7V$, $V_{CB} = -0.65$.

(c) $V_{EB} = -0.65V$, $V_{CB} = 0.7V$.

(d) $V_{EB} = -0.65V$, $V_{CB} = -0.65V$.

9. Sedra & Smith, Problem 6.28

10. Sedra & Smith, Problem 6.56

11. Find the transistor operating points, V_C, and V_E in the following circuits. β=50, V_{BE}=0.7V.