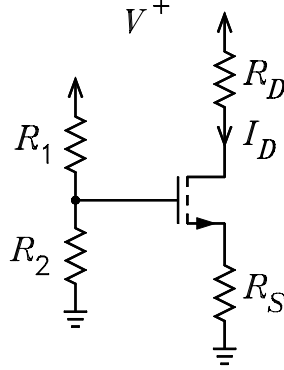


ECE3050 Homework Set 5

1. For $K = 1.78 \text{ mA/V}^2$, $V_{TO} = 1.5 \text{ V}$, $V^+ = 18 \text{ V}$, $R_1 = 110 \text{ k}\Omega$, $R_2 = 68 \text{ k}\Omega$, $R_D = 0$, and $R_S = 1 \text{ k}\Omega$, write the bias equation, solve for I_D , and verify that the MOSFET is biased in the saturation region, i.e. its active mode. [$I_D = 3.897 \text{ mA}$, $V_{DS} = 14.10 \text{ V}$, $V_{GS} - V_{TO} = 1.480 \text{ V}$]



2. Add a resistor R_3 from gate to source for the circuit in problem 1. (a) Show that

$$V_{GG} = V^+ \frac{R_2 \parallel (R_3 + R_S)}{R_1 + R_2 \parallel (R_3 + R_S)} + I_S \frac{R_S}{R_S + R_3 + R_1 \parallel R_2} \times R_1 \parallel R_2$$

$$R_{GG} = R_1 \parallel R_2 \parallel (R_3 + R_S)$$

$$V_{SS} = \frac{V^+}{R_1 + R_2 \parallel (R_3 + R_S)} \times \frac{R_2}{R_2 + R_3 + R_S} \times R_S$$

$$R_{SS} = (R_1 \parallel R_2 \parallel R_3) \parallel R_S$$

- (b) For $R_3 = 20 \text{ k}\Omega$, write the bias equation, solve for I_D , and verify that the MOSFET is biased in the saturation region. [$I_D = 0.492 \text{ mA}$, $V_{DS} = 17.41 \text{ V}$, $V_{GS} - V_{TO} = 0.526 \text{ V}$]

3. Add a resistor R_4 from drain to source for the circuit in problem 1. Show that

$$V_{SS} = V^+ \frac{R_S}{R_D + R_4 + R_S} - I_D \frac{R_D}{R_D + R_4 + R_S} R_S$$

$$R_{SS} = R_S \parallel (R_4 + R_D)$$

$$V_{DD} = V^+ \frac{R_4 + R_S}{R_D + R_4 + R_S} + I_S \frac{R_S}{R_D + R_4 + R_S} R_D$$

$$R_{DD} = R_D \parallel (R_4 + R_S)$$