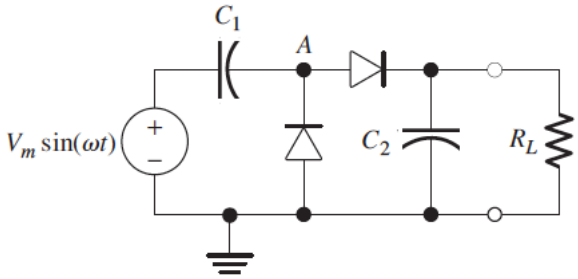
ECE100
Homework-8

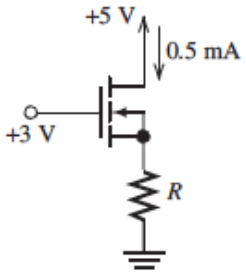
Total Points: 100

Submit your work in a pdf file electronically in the CCLE website before May 30th 11:59 pm. Late homework will not get credit!

1. Consider the circuit of Figure. The capacitors are very large, so they discharge only a very small amount per cycle. Sketch the voltage at point A versus time. Find the voltage across the load. Why is this called a voltage doubler? What is the peak inverse voltage across each diode? (10 points)

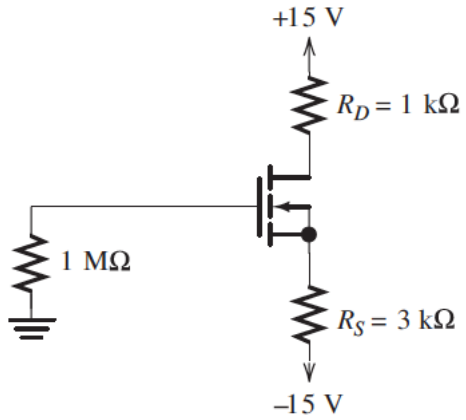


2. Two points in the saturation region of a certain NMOS transistor are (v_{GS} = 2 V, i_D = 0.2mA) and (v_{GS} = 3 V, i_D = 1.8 mA). Determine the values of V_{to} and K for this transistor. (10 points)
3. Given that the enhancement transistor shown in Figure P12.14 has V_{to} = 1 V and K = 0.5 mA/V^2, find the value of the resistance R. (10 points)

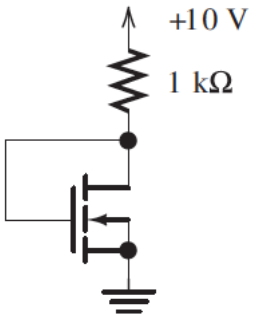


4. A p-channel enhancement MOSFET has V_{to} = - 0.5 V and K = 0.2 mA/V^2. Assuming operation in the saturation region, what value of v_{GS} is required for i_D = 0.8 mA? (10 points)

5. Find I_{DQ} and V_{DSQ} for the circuit shown in Figure. The MOSFET has V_{to} = 1V and K = 0.25 mA/V^2. (10 points)

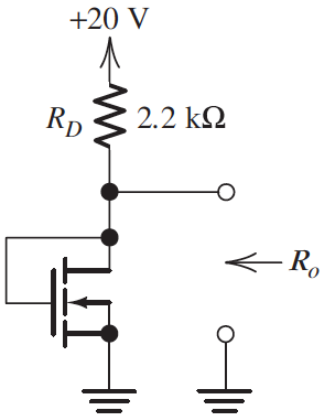


6. Find I_{DQ} and V_{DSQ} for the circuit shown in Figure. The MOSFET has Vto = 1V and K = 0.25 mA/V^2. (10 points)



7. In transistor small signal analysis, give definitions of g_m and r_d as partial derivatives. (5 points)
8. Suppose that we have an unusual type of FET for which $i_D = 3\ v_{GS}^3 + 0.1 v_{DS}$

   Here, i_D is in mA, v_{GS} is in volts, and v_{DS} is in volts. Determine the values of g_m and r_d for a Q point of V_{GSQ} = 1 V and V_{DSQ} = 10V. (10 points)
9. Draw the circuit diagram of a two-input CMOS AND gate. (Hint: Use a two-input NAND followed by an inverter.) (10 points)
10. Find V_{DSQ} and I_{DQ} for the FET shown in Figure, given V_{to} = 3 V and K = 0.5 mA/V^2. Find the value of g_m at the operating point. Draw the small-signal equivalent circuit, assuming that $r_d = \infty$. Derive an expression for the resistance R_o in terms of R_D and g_m. Evaluate the expression for the values given. (15 points)


+20 V
R_D
2.2 kΩ
R_o