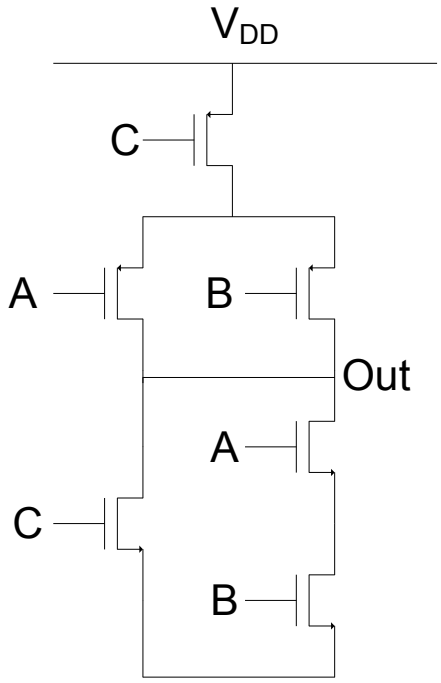
EE40/42/100 Practice MOSFET Problems

(Problems 4 ~ 6 are for EE40 only, though EE42/100 students may want to try to find the Q-point for each of these questions)

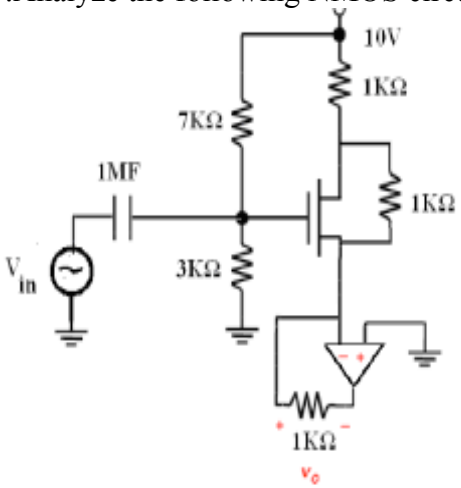
1.



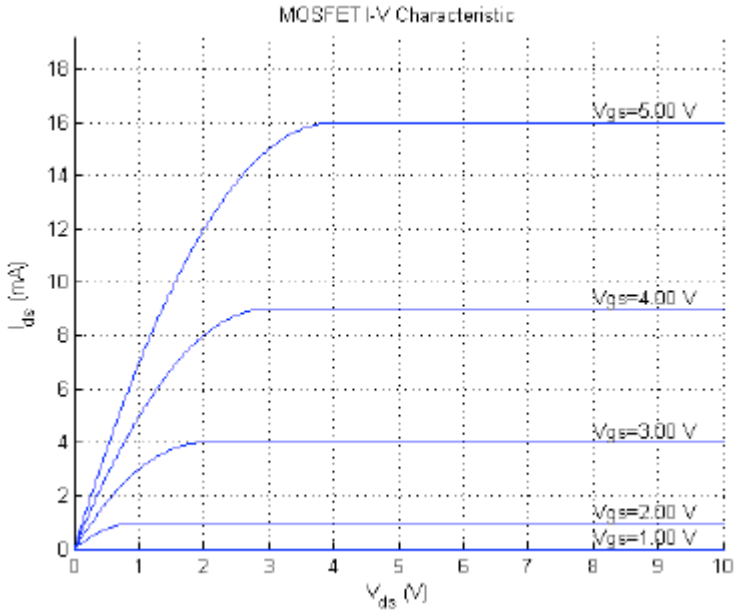
What logic function does this CMOS gate perform? (Draw a truth table, and write an expression in sum-of-products form.)

2. Draw a CMOS circuit for the function: Out = (AB)' +A'C
Where X' means the inversion of X.

3.Analyze the following NMOS circuit. K = 1mA/V^2 and V_{to} = 1V

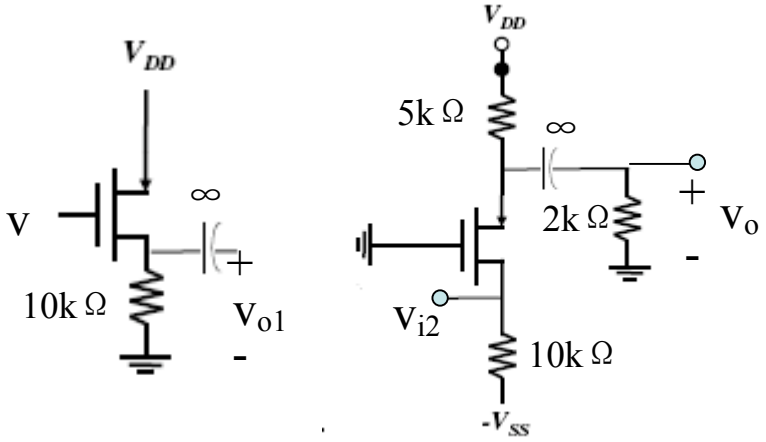


a. Using KVL, write the equation of I_{ds} as a function of V_{ds}.
b. Draw the load line on the following diagram:



c. Using equations for a NMOS transistor, find V_{GSQ}, I_{DSQ}, and V_{DSQ}. Confirm answers through the load line above.

4. (a) The NMOS transistor in the source follower circuit of Fig(a) has gm=5mA/V and rd is infinity. Find the open-circuit voltage gain and the output resistance.
(b) The NMOS transistor in the common-gate amplifier of Fig(b) has gm=5mA/V and rd is infinity. Find the input resistance and voltage gain.
(c) If the output of the source follower in (a) is connected to the input of the common-gate amplifier in (b), use the results of (a) and (b) to obtain the over all voltage gain. (Hint: Voltage gain is affected by the load resistance. Consider the load effect for cascaded circuits.)



Fig(a) Fig(b)

5 Hambley, P12.48

6 Hambley, P12.45. But use 10M Ω for both R1 and R2, and 20k Ω for R_L. r_d is not equal to infinity anymore. Do consider the effect caused by r_d.
(Hint: The transistor might not operated in the saturaion regime. Think about how you can find out r_d from the definition(eq. 12.31).