MASSACHVSETTS INSTITVTE OF TECHNOLOGY
Department of Electrical Engineering and Computer Science

6.002 - Electronic Circuits
Fall 2000

Homework #7
Handout F00-036

Issued 10/19/2000 - Due 10/27/2000

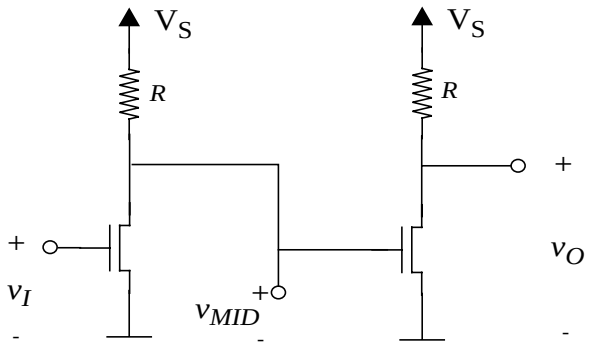
Reading: 9.2, Chapter 11, 12.1

Exercise 7.1: a) Exercise 1, Chapter 11.
b) Repeat part (a) with capacitors replaced by inductors. Take the value of each inductor in mH to be numerically equal to the value of the capacitor it replaces in μF.

Exercise 7.2: Exercise 16, Chapter 12.

Exercise 7.3: Exercise 22, Chapter 12.

Problem 7.1:



The two-stage non-inverting MOSFET amplifier shown above is the same as the one examined in Problem 6.2 except that it is biased differently. In this problem, V_I is chosen such that $V_I = V_{MID} = V_O$.

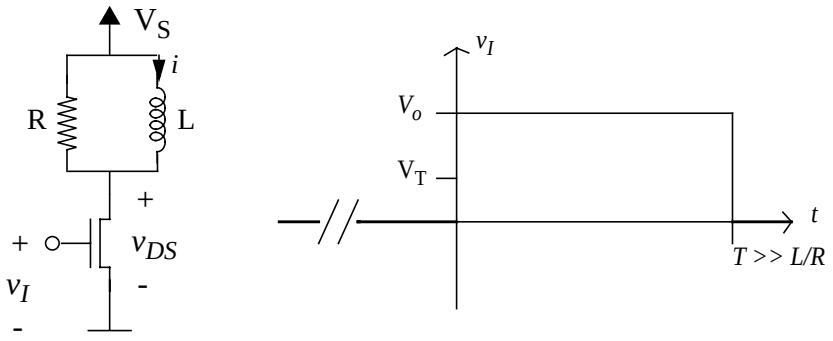
a) Show that the input bias V_I for which $V_I = V_{MID} = V_O$ is given by

$$V_I = V_T + \frac{-1 + \sqrt{1 + 2KR(V_S - V_T)}}{KR}.$$

b) Draw the small-signal circuit for the amplifier and use it to determine the small-signal gain $G = \frac{v_{out}}{v_{in}}$. Express G as a function of K, V_T, V_I, and R.

Problem 7.2: Problem 22, Chapter 12.

Problem 7.3:



$i_{DS} = \frac{K}{2}(v_{GS} - V_T)^2$

The circuit shown is used to pulse the current in the coil of a relay. The design is such that the relay contacts close when the current reaches 70% of its steady-state value (i.e. the value reached at the time $T \gg \frac{L}{R}$).

a) Assume that the MOSFET operates in the saturation region for $0 < t < T$. Determine and sketch $i(t)$ and $v_{DS}(t)$, indicating clearly the waveforms for $t < 0$, $0 < t < T$, and $T < t$.

b) For the case examined in part (a), what limit must be placed on the *maximum* coil current if the MOSFET is required to stay in the saturation region for $0 < t < T$? Express the answer in terms of V_S, R, K, V_T, and V_o.

c) For the case examined in part (a), what limit must be placed on the coil current if the maximum value of v_{DS} is limited to $1.5V_s$?