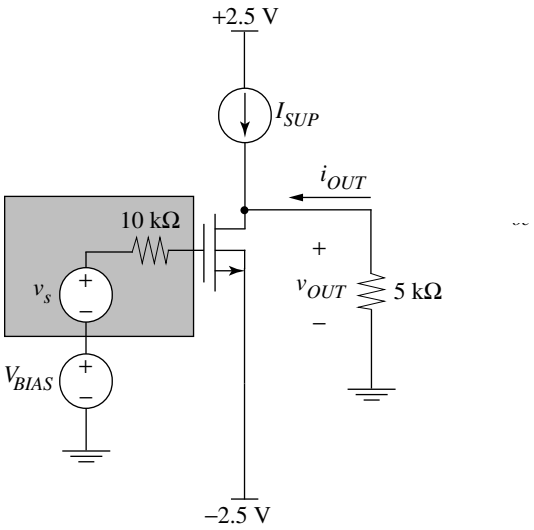
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Electrical Engineering and Computer Science

6.012
Microelectronic Devices and Circuits

Fall 1999
November 16, 1999 - Homework 8
Due November 24, 1999

Reading: Chapter 10 Section 10.1 – 10.6

You are given a CS amplifier and NMOS device parameters shown below. The current source supply provides 250μA and has an infinite output resistance, (i.e. I_{SUP} = 250 μA and r_{oc} ----> ∞). The current source supply must have at least 0.5 V across it in order to maintain the high output resistance.



W/L = 150/1.5
V_{Tn} = 0.7 V
$\mu_n C_{ox}$ = 50 μA/V^2
t_{ox} = 15 nm
λ_n = 0.067 V^{-1} @ L = 1.5 μm
C_{jn} = 0.1 fF/μm^2
C_{jswn} = 0.5 fF/μm
C_{ov} = 1fF/μm
L_{diff} = 6 μm

a) Calculate V_{BIAS} such that V_{OUT} = 0 V.

b) Draw the two-port model and calculate the two-port parameters R_{in}, R_{out}, and A_v.

c) Calculate the overall voltage gain v_{out}/v_s.

d) Calculate ω_{3dB}. Which capacitance is dominating the frequency response?

e) Calculate the output voltage swing.

f) Run a DC SWEEP in SPICE to find the value of V_{BIAS} necessary to operate in the middle of the high gain region and the output voltage swing.

g) Use the value of V_{BIAS} found in (f) to perform an AC analysis of the amplifier including the source and load resistors and report A_v. and $\omega_{3dB.}$