EECS 105 – Microelectronic Devices and Circuits

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Homework Assignment # 14, Due May 4, 2001

MOS Device Data

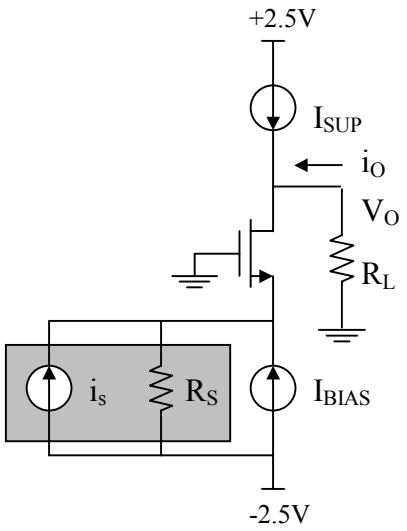
$V_{Tn} = -V_{Tp} = 1V$, $\mu_n C_{ox} = 50\mu A/V^2$, $\mu_p C_{ox} = 25\mu A/V^2$, $-2\phi_p = 2\phi_n = 0.8V$,
$\lambda_n = \lambda_p = 0.05V^{-1}$ @ $L=2\mu m$, $C_{ox}=2.3fF/\mu m^2$, $C_{jn}=0.1fF/\mu m^2$, $C_{jp}=0.3fF/\mu m^2$,
$C_{jswn}=0.5fF/\mu m$, $C_{jswp}=0.35fF/\mu m$, $C_{ovn}=0.5fF/\mu m$, $C_{ovp}=0.5fF/\mu m$, $L_{diffn} = L_{diffp} = 6\mu m$

$R_{oc}=\infty$ for all current sources

14.1 Frequency Response of Common-Gate Amplifier

Given an NMOS common-gate amplifier with a current source supply as shown in the figure (The bulk node of the NMOS transistor is tied to its source). Assume that I_{BIAS} is set such that $i_O=0A$, $I_{SUP}=200\mu A$, $W/L=100\mu m/2\mu m$. Find the low frequency current gain and ω_{3dB} for

(1) $Rs=100\Omega$ and $R_L=10k\Omega$
(2) $Rs=1k\Omega$ and $R_L=100k\Omega$
(3) $Rs=500\Omega$ and $R_L=5k\Omega$



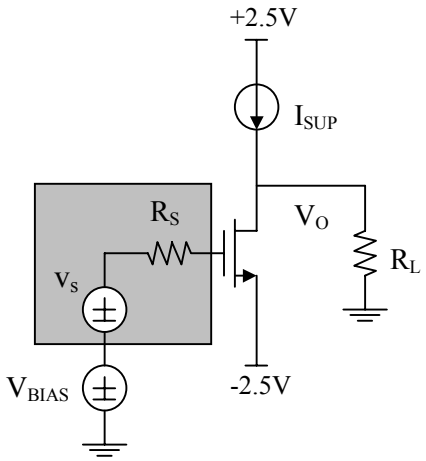
14.2 Frequency Response of Common-Source Voltage Amplifier

You are given an NMOS common-source voltage amplifier with a current source supply with I_{SUP}=100μA. The NMOS device has a W/L=40μm/2μm. The source resistance R_S=10kΩ and the load resistance $R_L \rightarrow \infty$. Assume the NMOS device is operating in saturation region.

(1) Calculate the open-circuit voltage gain at low frequency.

(2) Calculate ω_{3dB} using the Miller Approximation and considering only C_{gs} and C_{gd} of the NMOS device

(3) Repeat (2) using the open-circuit time-constant method



14.3 Frequency Response of Cascode Amplifier

Repeat 14.2 using the cascode amplifier shown in the figure below. W/L=40μm/2μm and the bulk node is tied to its source for both NMOS devices.

(1) Calculate the open-circuit voltage gain at low frequency.

(2) Calculate ω_{3dB} using the open-circuit time-constant method