

UNIVERSITY OF CALIFORNIA AT BERKELEY
College of Engineering
Department of Electrical Engineering and Computer Science

R.W. Brodersen
Jianhui Zhang

Homework #5
Due 10/01/03

EECS 140
Fall 2003

.model nmos

+ **nmos level=1 tox=2.6n vt0=0.3 gamma=0.2 phi=0.6 u0=250 ld=0.025u**
+ **capop=0 acm=3 ldif=0 hdif=0.2u cj=8e-4 cjsw=8e-12 cjgate=8e-11**
+ **lambda=0.2**

.model pmos

+ **pmos level=1 tox=2.6n vt0=-0.3 gamma=0.2 phi=0.6 u0=100 ld=0.025u**
+ **capop=0 acm=3 ldif=0 hdif=0.2u cj=8e-4 cjsw=8e-12 cjgate=8e-11**
+ **lambda=0.15**

When using the above models, remember to use W/L_{eff} in your calculations, where $L_{eff}=L-2*L_d$ and $L_d=0.025\mu m$. You can calculate k' directly from the SPICE model parameters u_0 and tox .

1. For the circuit (Fig.1) shown on the next page, assume $V_{DD}=1.2v$, $(W/L)_1=(W/L)_2=(W/L)_3=(W/L)_4=(W/L)_5=(W/L)_7=4\mu/0.13\mu$, $(W/L)_6=16\mu/0.13\mu$, $(W/L)_8=(W/L)_9=8\mu/0.13\mu$, $(W/L)_{1s}=5\mu/0.13\mu$, $(W/L)_{2s}=0.13\mu/1\mu$. $R_s=380\Omega$, $R_{ref}=1K\Omega$, $R_D=10K\Omega$. $V_{ic}=0.9v$ and $V_{id}=0v$. Ignore the body effect. Ignore the channel length modulation in hand calculation.

- a) What is the purpose of the transistor M_{1s} , M_{2s} and R_s in this circuit? What is the approximate current flow through M_{2s} ?
- b) Calculate g_{m5} .
- c) Calculate A_{dm} .
- d) Verify part b & c in SPICE.

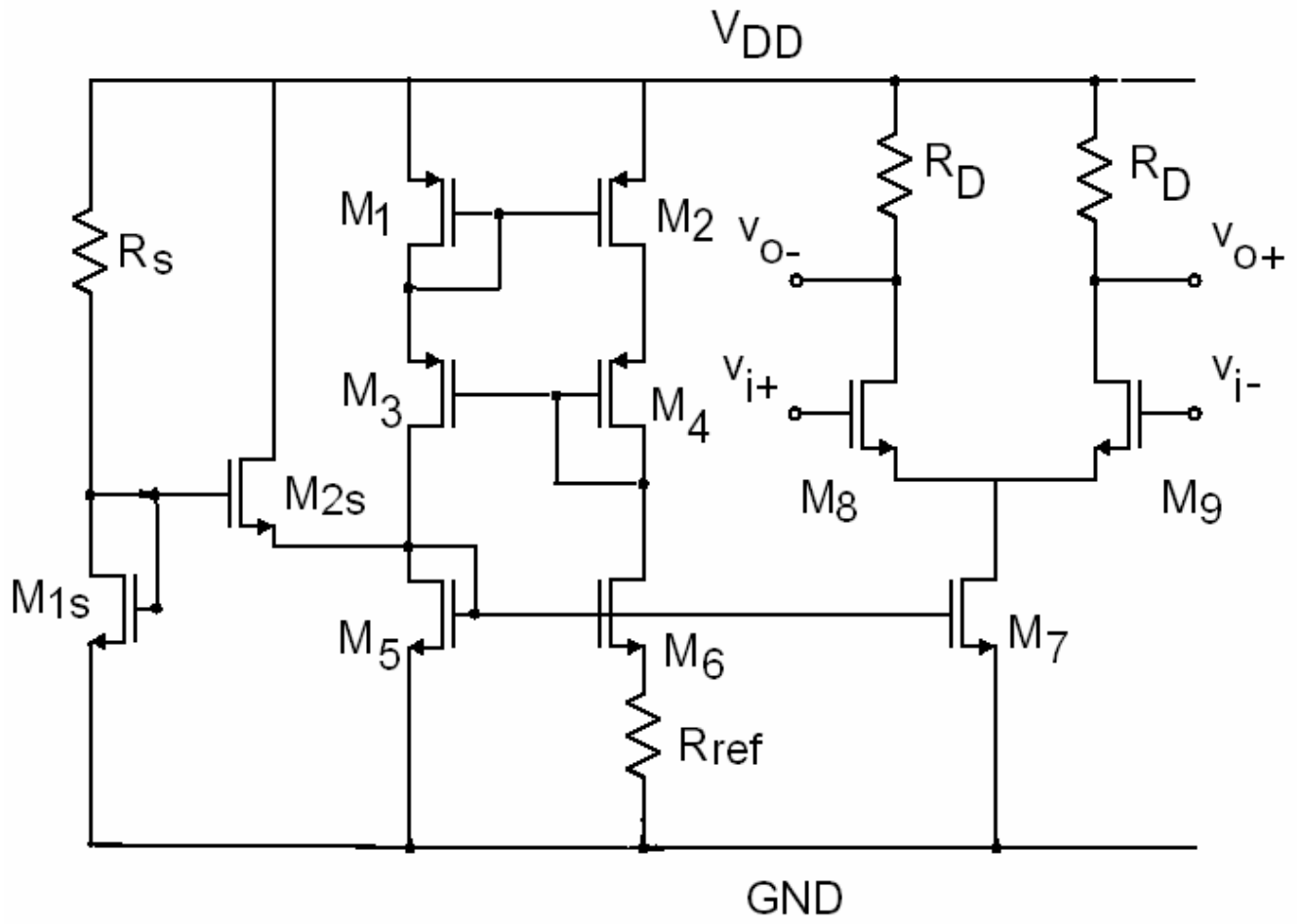


Fig.1

2. For the circuit (Fig.2) shown below, calculate the small signal gain V_o/V_i in terms of small signal parameters g_m and r_o of M1-M5. Ignore the body effect and assume $\lambda \neq 0$. Assume the W/L of M1-M3 are same.

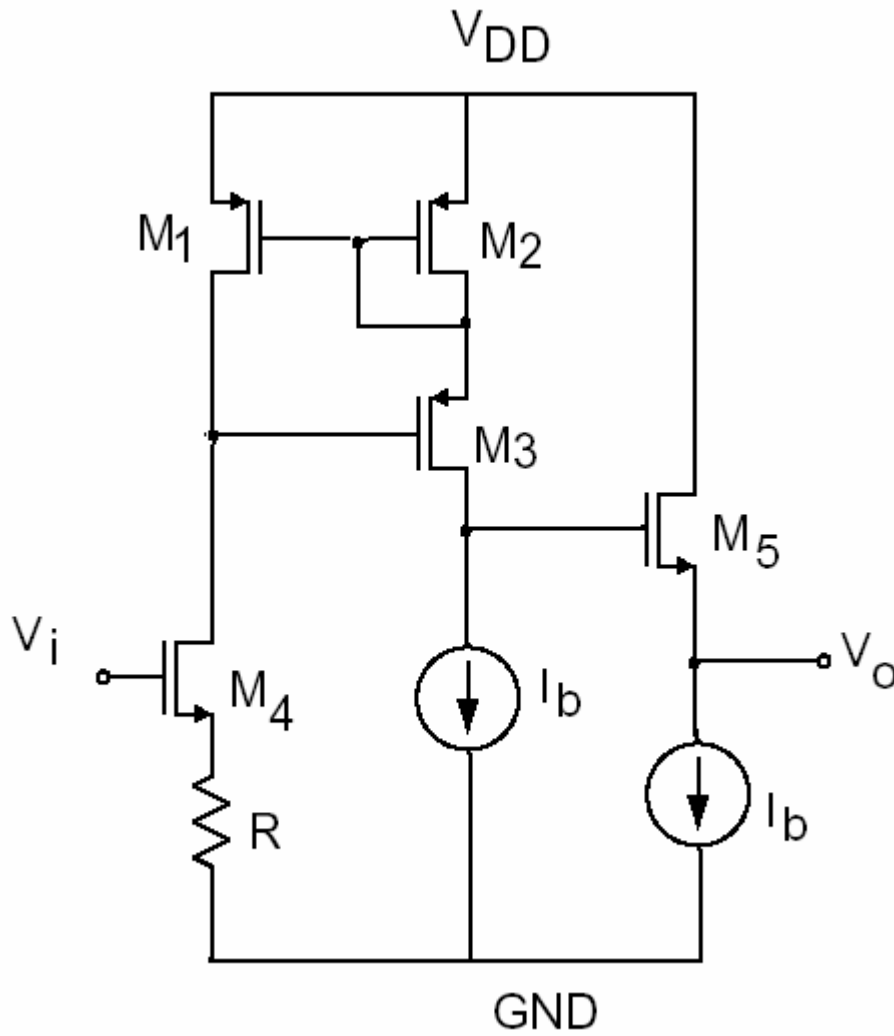


Fig. 2