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Homework #8
(Due 11/06/02)

EECS 140
Fall 2002

- 1) For the circuit shown in figure 1, and for each of the two limiting cases given below, calculate the poles and zeros of the transfer function $A(f) = v_{out}/v_{in}$ and draw the piece-wise linear approximation of the Bode plot.

Ignore all other capacitances besides the capacitances drawn explicitly in figure 1.
 Assume $M_{1a} = M_{1b}$, $M_{2a} = M_{2b}$, $M_{3a} = M_{3b}$.

- a) $C_2 \ll C_1 / (g_m(r_{o,1} \parallel r_{o,2}))$
 b) $C_2 \gg C_1 / (g_m(r_{o,1} \parallel r_{o,2}))$

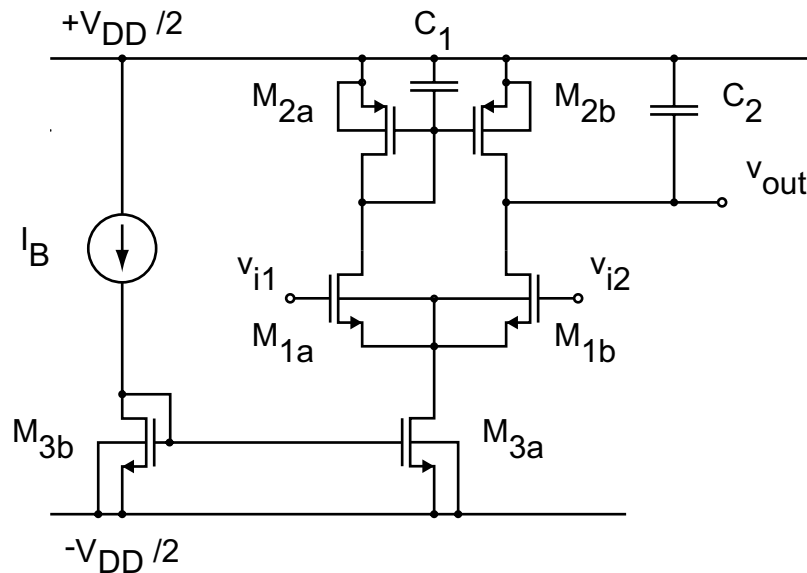


Figure 1.

SPICE Models

```
.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
```

SPICE Hints

- .pz analysis: pole-zero analysis

An analysis statement like `‘.pz v(out) vin’` will print all the poles and zeros of the transfer function from the *independent source* `vin` to the *output voltage* `v(out)` (similar to a `.tf` analysis)

A pole and zero (or pole-pair and zero-pair) very close to each other, might indicate a numerical artifact, rather than an actual pole and zero.

- .ac analysis: small signal analysis as a function of frequency

An analysis statement like `‘.ac dec 10 1M 1T’` will do an `.ac` analysis from 1 MHz to 1 THz with 10 points per decade of frequency.

You have to specify at least one independent small signal source, by adding an `‘ac’` option to a small signal source: `‘vin in gnd dc=0.5 ac=1’`. The `.ac` analysis will then calculate the small signal voltage on every single node.