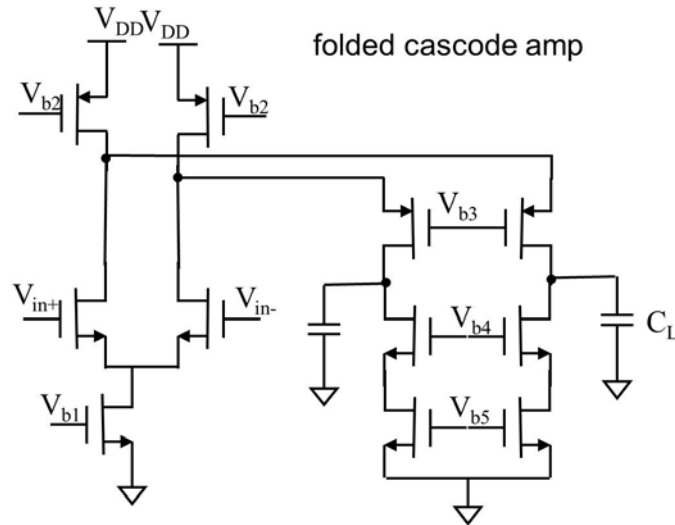


### HW 3

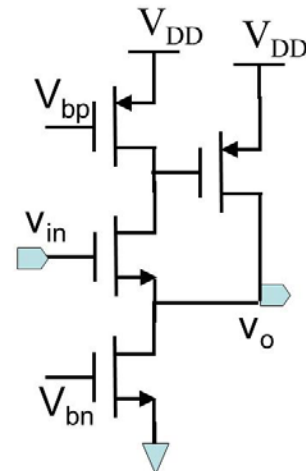
- Shown below is a generic fully differential folded cascode amplifier. Suppose all transistors are reasonably well designed. The two transistors in each pair are identical.  $V_{b1}$ ,  $V_{b5}$ , and  $V_{b2}$  are appropriately selected so that total current at the bottom is equal to the total current at the top. All transistors are supposed to be in strong inversion with  $V_{eff}$  in the 0.1 to 0.4 V range, and all need to be in saturation.

- Find conditions on  $V_{b3}$  and  $V_{b4}$ .
- Find output swing range for  $V_{o+}$ ,  $V_{o-}$ , and  $V_{od}$ , first in terms of  $V_{b3}$  and  $V_{b4}$ , and then the largest possible range.
- Find the input common mode range.
- Find the positive and negative slew rate for  $V_{o+}$ ,  $V_{o-}$ , and  $V_{od}$ .



- For the circuit shown to the right. Suppose the two PMOST have the same size and the two NMOT have the same size.  $V_{bn}$  and  $V_{bp}$  are well selected.

- Find the  $I_{DQ}$  relationships and  $V_{eff}$  relationships among all transistors.
- Find  $V_{in}$  range and  $V_o$  range. (notice that their difference is about fixed)
- Find  $r_{in}$ ,  $r_o$ , and  $A_v(0)$ .



- 4.4
- 4.8 (assume constant numerator)
- 4.12 a. but use MOSIS 0.5um parameters
- 4.14 a. but use MOSIS 0.5um parameters
- 4.20
- 4.21
- 4.26
- 4.27