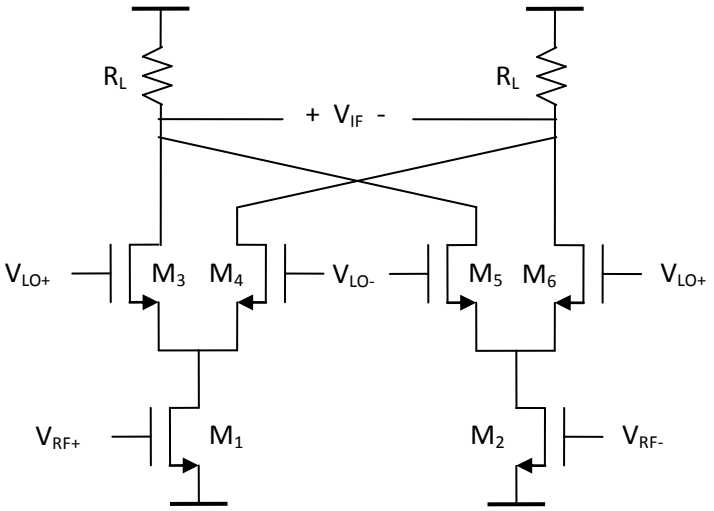
Handin Exercise 3, Mixers

This exercise deals with mixers and is a preparation for lab 3. An active mixer shown in the figure below is to be designed. You will need to refer to the data sheet of the 130nm CMOS process. The following requirements and information is provided:

- Supply voltage = 1.2V
- Voltage gain = 6dB
- LO frequency = 2GHz
- RF frequency = 1.8GHz
- R_L=300Ω
- L=0.25um for all transistors
- $V_{ov1,2}$ = 200mV
- Disregard bulk effects



1. Calculate the transconductance (g_m) required of M_1 and M_2 to make the voltage conversion gain equal to 6dB, under the assumption of ideal current switching in M_3-M_6.
2. Calculate width and bias current of M_1 and M_2.
3. Assume the width of the switch transistors (M_3 to M_6) to equal the width of M_1 and M_2. Calculate the minimum amplitude required of a square wave LO to accomplish perfect switching.
4. Calculate bias voltages at all gates, so that $V_{DS1,2}$ is 0.2V above $V_{DSsat1,2}$.
5. Will the maximum signal amplitude be limited by the input or the output, if the limit is when devices either cut-off or go into triode region? Assume only the IF signal to be present at the output, and all higher frequencies to be filtered off by C_L (not shown in figure).