Introduction to Analog Integrated Circuits (111), DECE, NTUST

Homework 4 (Due date: 10/25)

HW4.1: (20 points)

Using a long-channel model, **prove** that, in strong inversion, the transistor M_R behaves like a resistor ($R_{on,R}$) with its resistance,

$$R_{on,R} = \frac{(W/L)_C}{(W/L)_R}\frac{1}{g_{m,C}}$$

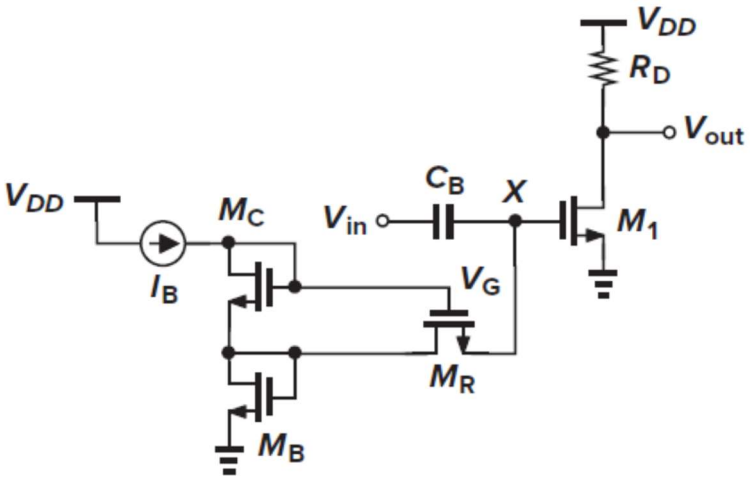

Fig. 4.1

HW4.2: (30 points)

The circuit of Fig. 4.2 is designed with $(W/L)_{1,2} = 8/2$, $(W/L)_{3,0} = 8/2$, and $I_{REF} = 100\ \mu A$. Assume $\mu_n C_{ox}$=800μA/V^2, VDD=3V and γ=0. V_{TH}=0.7V

(a) Determine V_X and the acceptable range of V_b.

(b) Estimate the deviation of I_{out} from 100 μA if the drain voltage of M_3 is higher than V_X by 1 V, if λ=0.1V^{-1}.

(c) How to design V_b to have a minimum drain voltage of M_3?

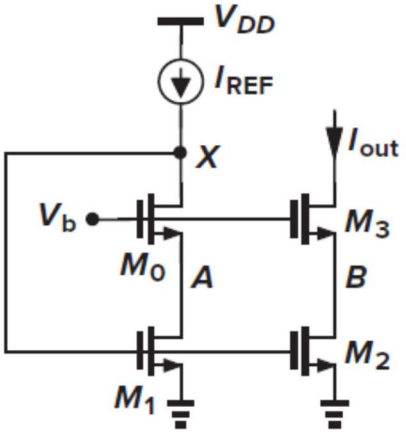

Fig. 4.2

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HW4.3 (30 points)

In the circuit shown in Fig. 4.3, a source follower using a wide transistor and a small bias current is inserted in series with the gate of M_3 so as to bias M_2 at the edge of saturation. Assuming M_0–M_3 are identical and $\lambda \neq 0$, estimate the mismatch between I_{out} and I_{REF} if (a) $\gamma = 0$, (b) $\gamma \neq 0$.

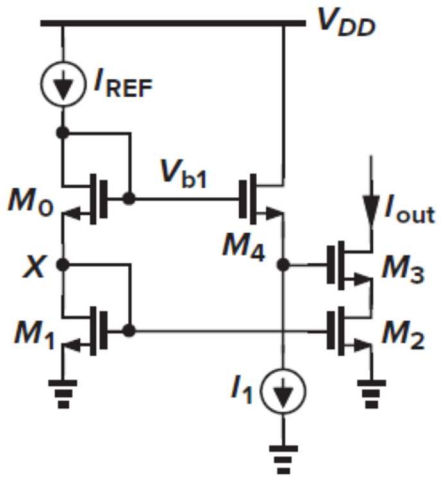

Fig. 4.3

HW4.4: (20 points)

The circuit shown in Fig. 4.4 exhibits a *negative* input inductance. Calculate the input impedance of the circuit and identify the inductive component.

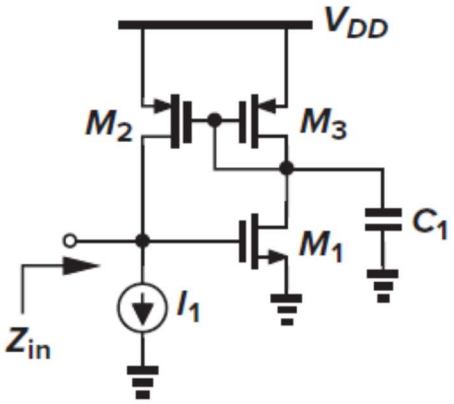

Fig. 4.4