Test #1

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Electronic Circuits (II)

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Prob.1 (10)

We want to design the source follower shown in Fig. 1 to have voltage gain of 0.8. Using $\frac{\mathrm{W}}{\mathrm{L}} = \frac{30}{0.18}$, $\mu_{\mathrm{n}} C_{ox} = 200\mu A/V^2$, $\mathrm{V_{th}} = 0.4$ and $\lambda = 0$, determine the required gate bias voltage.

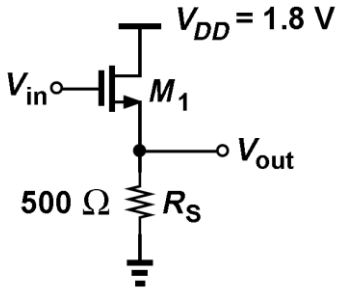
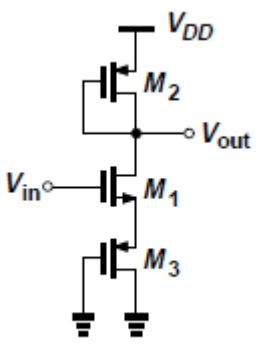


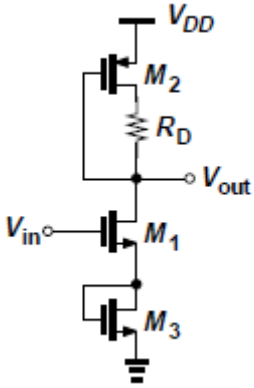
Fig. 1

Prob. 2 (20)

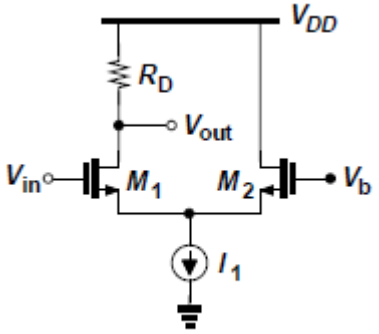
Determine the voltage gain of the following CS with source degeneration amplifiers shown in Fig. 2. Assume λ=0. Express your answers in terms of MOS transconductances and R_D. (4 points each)



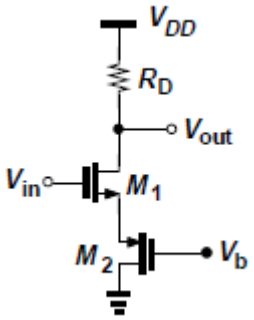
(a)



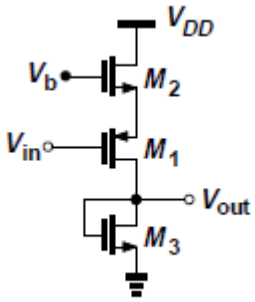
(b)



(c)



(d)

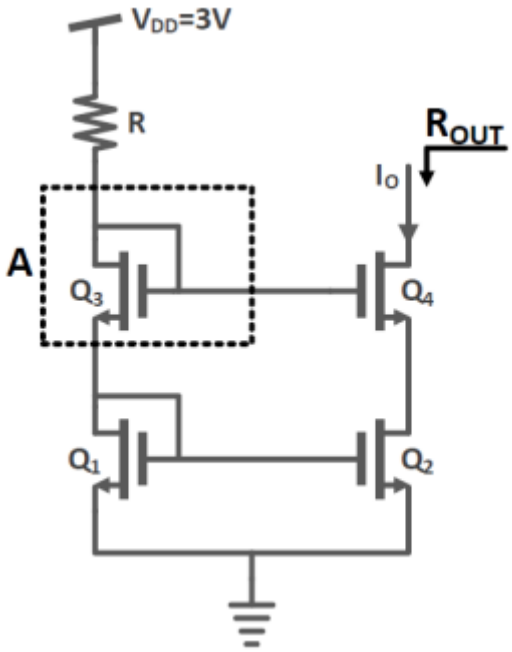


(e)

Fig. 2

Prob. 3 (30)

Current mirrors are often used as current sources. For better performing current sources, its output resistance should be as large as possible. In this problem, you are asked to determine the output resistance of a current-source circuit shown below. All MOS transistors are identical with $\frac{W}{L}$=100, V_{th}=0.7V, and $\mu_n C_{ox}$=200μA/V^2, r_o=200kΩ. Use V_{DD}=3V and assume all transistors are in saturation.



(a)(10) Determine the numerical value for R so that I_o=100μA. For this part, ignore the influence of r_o.

(b)(10) The small-signal model for Block A is a resistor. Determine the expression for its resistance, R_{eq}. Your answer should contain only g_m and r_o.

(c)(10) Determine the expression for output resistance, R_{out}. Use the result obtained in (b). Your answer should contain only g_m and r_o.

Prob. 4 (20)

Determine the expression for R_p in the circuit of Fig. 4 such that $I_1 = I_{REF}/2$. Your answer should contain only $\frac{W}{L}, I_{REF}, \beta = \mu_n C_{ox}$. Assume both MOS transistors are in saturation and λ=0.

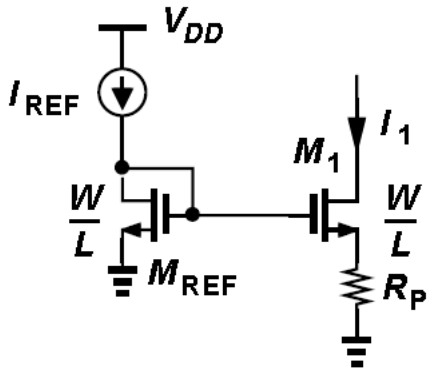
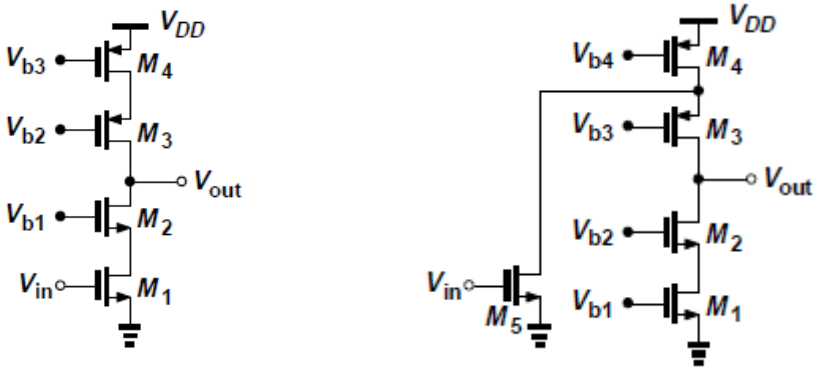


Fig. 4

Prob. 5 (20)



(a) (b)

Fig. 5

For each of cascade circuits shown in Fig. 5, (a) determine the output impedance, (b) voltage gain. Assume each transistor M_n has output impedance $r_{o,n}$, which is much larger than $1/g_{m,n}$ so that $g_{m,n}r_{o,n} >> 1$.