Problem Set 1: MOS (Biasing + Small-Signal Model)

Chapter 6 (MOS Device)

In the following problems, unless otherwise stated, assume $\mu_n C_{ox} = 200\ \mu\text{A/V}^2$, $\mu_p C_{ox} = 100\ \mu\text{A/V}^2$, and $V_{TH} = 0.4$ V for NMOS devices and -0.4 V for PMOS

Problem 6.24

In the Fig. 6.42 ,what is the minimum allowable value of V_{DD} if M_1 must not enter the triode region? Assume $\lambda = 0$.

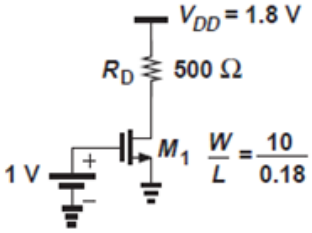


Figure 6.42

Problem 6.31

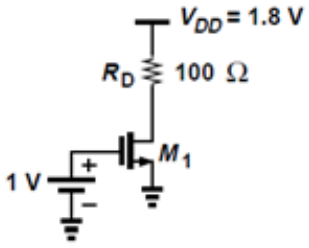
An NMOS device operating in saturation with $\lambda = 0$ must provide a transconductance of $1/(50\ \Omega)$

(a) Determine W/L if $I_D = 0.5$ mA.
(b) Determine W/L if $V_{GS} - V_{TH} = 0.5$ V.
(c) Determine I_D if $V_{GS} - V_{TH} = 0.5$ V.

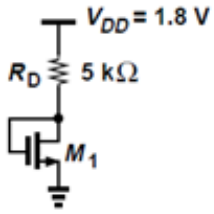
Problem 6.33 (b, d)

If $\lambda = 0.1\ \text{V}^{-1}$ and $W/L = 20/0.18$, construct the small-signal model of each of the circuits shown

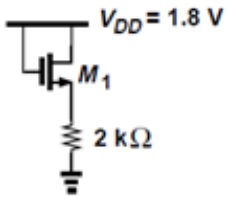
Solve the DC operating point



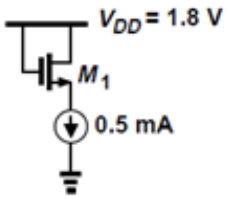
(a)



(b)



(c)

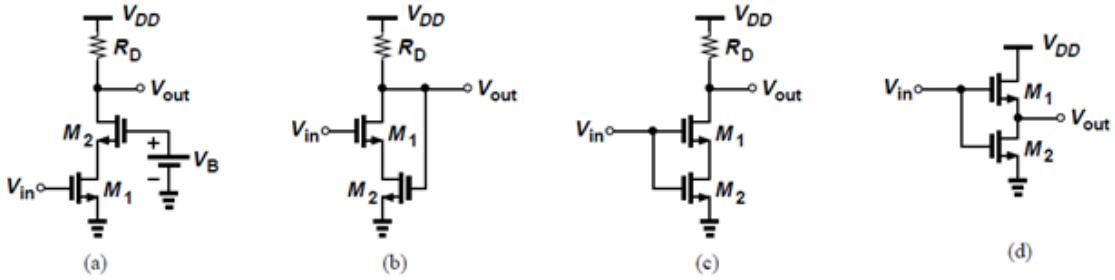


(d)

Problem 6.38 (d)

Construct the small-signal model of the circuits depicted in Fig. 6.50. Assume all transistors operate in saturation and $\lambda \neq 0$.

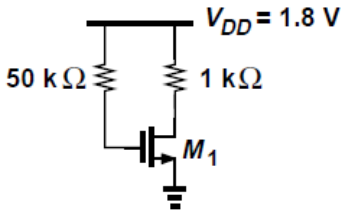
Find an expression for R_{in} and R_{out}



Chapter 7 (Biasing Techniques & Input / Output Impedance)

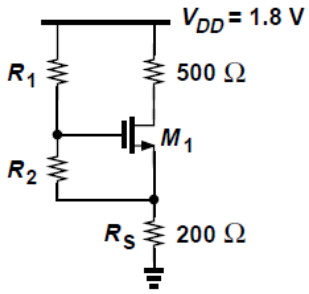
Problem 7.1

In the circuit of Fig. 7.39, determine the maximum allowable value of W/L if M_1 must remain in saturation. Assume $\lambda = 0$.



Problem 7.5

Consider the circuit depicted in Fig. 7.43, where $W/L = 20/0.18$. Assuming the current flowing through R_2 is one-tenth of I_{D1}, calculate the values of R_1 and R_2 so that $I_{D1} = 0.5\,\text{mA}$.



Problem 7.15

Consider the circuit shown in Fig. 7.52, where $(W/L)_1 = 10/0.18$ and $(W/L)_2 = 30/0.18$. if $\lambda = 0.1\ \mathrm{V}^{-1}$, calculate V_B