

ShanghaiTech University  
School of Information Science and Technology

EE112 Analog Integrated Circuits I

**Homework 4**

**Due: Nov 4<sup>th</sup> before the recitation**

Read the chapter 5.

1. Calculate the total charge stored in the channel of an NMOS transistor having  $C_{ox} = 9 \text{ fF}/\mu\text{m}^2$ ,  $L = 0.36 \mu\text{m}$ , and  $W = 3.6 \mu\text{m}$ , and operated at  $V_{OV} = 0.2 \text{ V}$  and  $V_{DS} = 0 \text{ V}$ .
2. Design the circuit of Fig. 1 to establish a drain current of  $0.1 \text{ mA}$  and a drain voltage of  $+0.3 \text{ V}$ . The MOSFET has  $V_t = 0.5 \text{ V}$ ,  $\mu_n C_{ox} = 400 \mu\text{A}/\text{V}^2$ ,  $L = 0.4 \mu\text{m}$ , and  $W = 5 \mu\text{m}$ . Specify the required values for  $R_S$  and  $R_D$ .

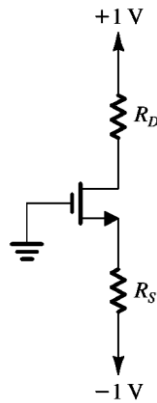


Figure 1

3. The NMOS transistors in the circuit of Fig. 2 have  $V_t = 0.5 \text{ V}$ ,  $\mu_n C_{ox} = 90 \mu\text{A}/\text{V}^2$ ,  $\lambda = 0$ , and  $L_1 = L_2 = L_3 = 0.5 \mu\text{m}$ . Find the required values of gate width for each of  $Q_1$ ,  $Q_2$ , and  $Q_3$  to obtain the voltage and current values indicated.

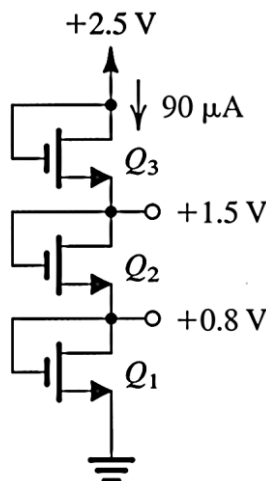


Figure 2

4. In the circuits shown in Fig. 3, transistors are characterized by  $|V_t| = 1\text{ V}$ ,  $k'W/L = 4\text{ mA/V}^2$ , and  $\lambda = 0$ .
- (a) Find the labeled voltages  $V_1$  through  $V_7$ .
- (b) In each of the circuits, replace the current source with a resistor. Select the resistor value to yield a current as close to that of the current source as possible, while using resistors specified in the 1% table provided in Appendix J.

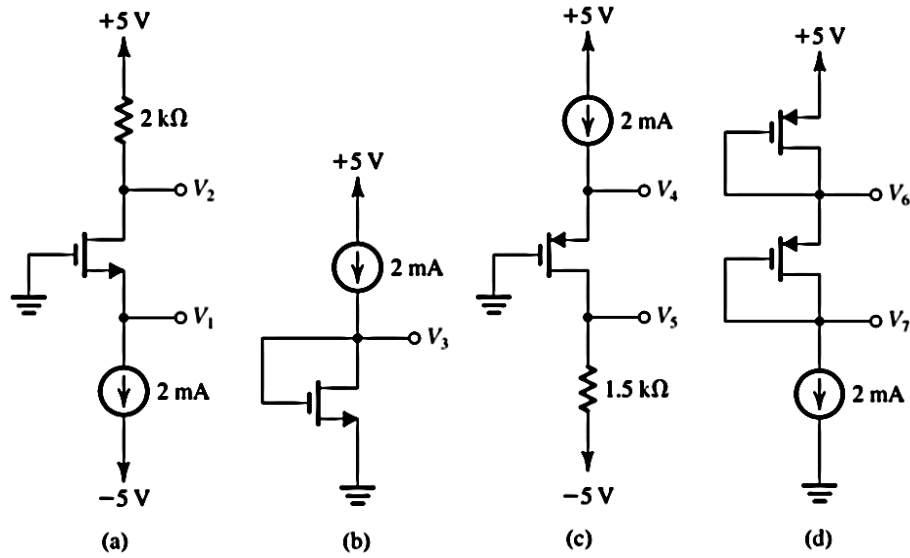


Figure 3