

## Additional Problems for HW#3:

1. Consider the structure shown in Figure 1. This two-transistor structure can be considered a new type of single device (the "Cal-sistor") with the drain, source, and gate nodes as given. For this problem, assume that  $\lambda=\gamma=0$ .

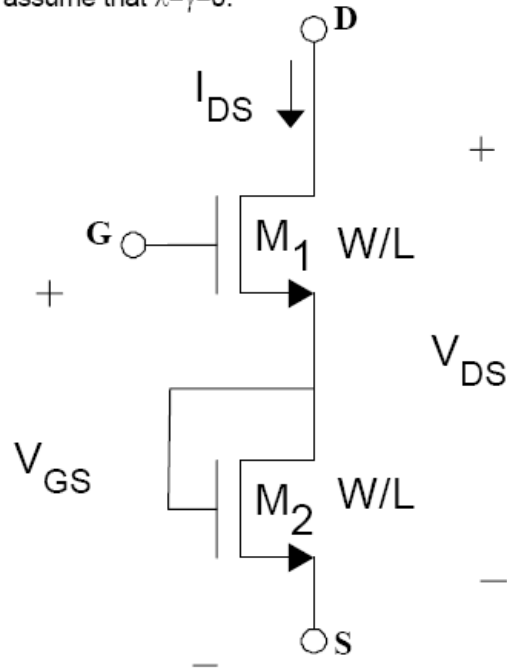


Figure 1

- a) Determine the  $V_{DS}$  and  $V_{GS}$  conditions for each of the 3 operating modes (cutoff, saturation, and linear) for the Cal-sistor.
- b) Determine  $I_{DS}$  as a function of  $V_{GS}$  and  $V_{DS}$  for each of these 3 modes.

2. For each of the two circuits in figure 2, perform the calculations for (a) and (b) by hand. Assume  $V_{T0}=0.5V$ ,  $k'W/L = 8mA/V^2$ ,  $\lambda=0.1V^{-1}$ ,  $\gamma=0.2V^{1/2}$ ,  $R_1=10k\Omega$ ,  $R_2=2k\Omega$ ,  $R_3=10k\Omega$ ,  $R_4=10k\Omega$ ,  $V_{DD}=3V$ .

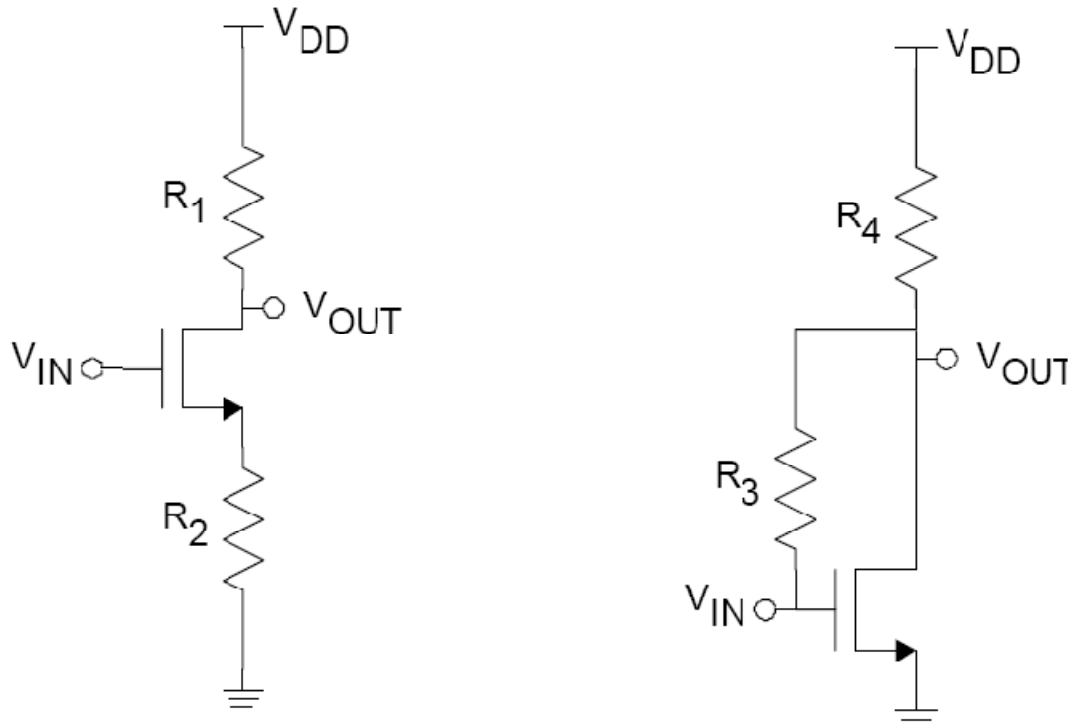


Figure 2

- Determine the dc voltage  $V_{IN}$  so that  $V_{OUT}$  is at 1.5V. Assume that  $V_{IN}$  is between 0 and  $V_{DD}$ .
- Calculate the operating point parameters  $I_{DS}$ ,  $V_T$  and  $V_{DSAT}$ , and the small signal-parameters  $g_m$ ,  $g_{mbs}$ , and  $r_o$ .