Arab Academy *F*or *S*cience & *T*echnology& *M*aritime *T*ransport *C*ollege of *E*ngineering & *T*echnology

EC332: Electronic Devices (2).

SHEET (4)

[1] Consider the circuit shown of the figure 1, I_{DQ1} of 80 uA , V_t = 0.6V, $\mu_n C_{ox}$ = 200 $\mu A/V^2$, L = 0.8 μm and W = 4 μm , the drain voltage of Q_1 designed to be 1V and applied to the gate of Q_2, assume the two transistors are identical (Assume $\lambda = 0$).

Find:

a) The drain current of Q_2.
b) The drain voltage of Q_2.

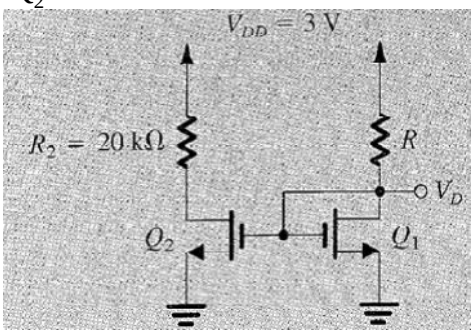

Figure 1

[2] Using two transistors Q_1 and Q_2 having equal length but widths related by $W_2/W_1 = 5$, Design the circuit shown on figure 2 to obtain I = 0.5 mA. Let $V_{DD} = V_{SS} = 5$, $(\mu_n C_{ox} W/L)_{Q1} = 0.8$ mA/V^2, $V_t = 1$V and $\lambda = 0$.

a) Find the required value for R.
b) What is the voltage at the gates of Q_1 and Q_2?
c) What is the lowest voltage allowed at the drain of Q_2 while Q_2 remains in the saturation region?

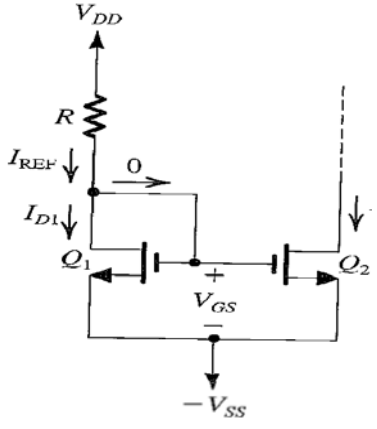

Figure 2

[3] Consider the circuit shown in Figure 3. Using a 15v supply, $V_t = 1.2$ v , $\lambda = 0$, K_n'=80 $\mu A/V^2$, W = 240 μm and L = 6 μm . Arrange that the drain current is 2 mA , with about one third of the supply voltage across R_S and R_D. Use 22 MΩ for the larger of R_{G1} and R_{G2}. What are the values of R_{G1}, R_{G2}, R_S and R_D that you have chosen? Specify them to two significant digits. For your design, how far is the drain voltage from the edge of Saturation?

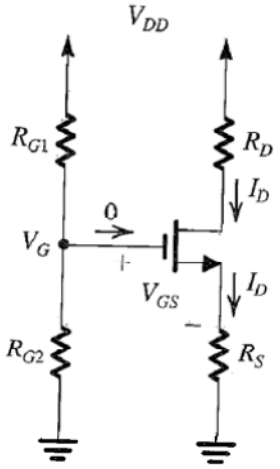

Figure 3

[4] For the circuit shown in figure 4 with I=1mA, R_G=0, R_D=5k and V_{DD}=10V, consider the behavior in each following two cases. In each case, find the voltages V_S, V_D and V_{DS} that results for each cases:

a) V_t=1V K_n'(W/L)=0.5mA/V^2.
b) V_t=2V K_n'(W/L)=1.25mA/V^2.

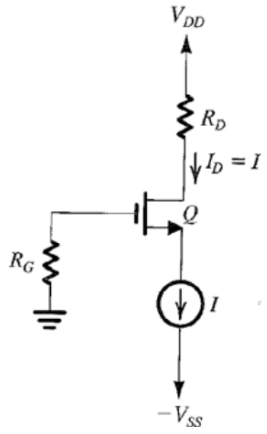

Figure 4

[5] As shown in figure 6, using a 6V supply with an NMOS transistor for which V_t=1.2V, K_n'(W/L)=3.2mA/V^2 and λ=0, provide a design which biases the transistor at I_D=2mA with V_{DS} larger enough to allow saturation operation for a -2V negative signal swing at the drain. Use 22MΩ as the largest resistor in the feedback bias network. What values of R_D, R_{G1} and R_{G2} have you chosen? Specify all resistors to two significant digits.

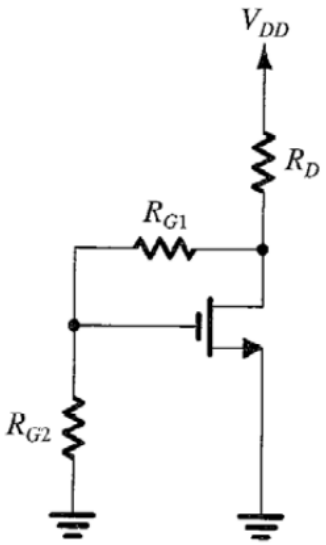

Figure 5