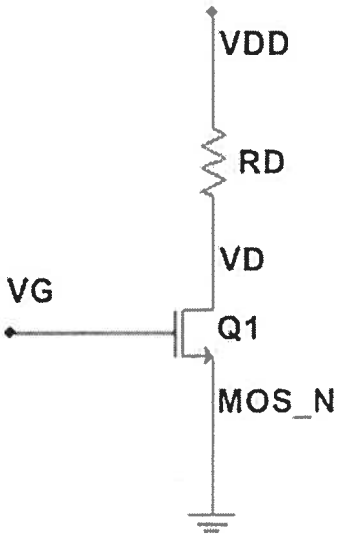
Week 6 Quiz Solutions

1. In the n-channel MOSFET circuit, $R_D = 12k\Omega$, and the supply voltage $V_{DD} = 10V$. The transistor has the parameters $K = 1.56mA/V^2$ and $V_{TO} = 1.4V$.

   What must the gate voltage V_G be to set the drain voltage V_D to $5V$?

   Enter your answer in volts to two decimal places.



$$V_D = V_{DD} - I_D R_D$$

$$\Rightarrow I_D = \frac{V_{DD} - V_D}{R_D} = 4.167 \times 10^{-4} A$$

$$I_D = K(V_{GS} - V_{TO})^2$$

$$\Rightarrow V_{GS} = \sqrt{\frac{I_D}{K}} + V_{TO}$$

$V_{GS} = 1.907 V$

$V_{GS} = V_G - V_S$

$V_S = 0$

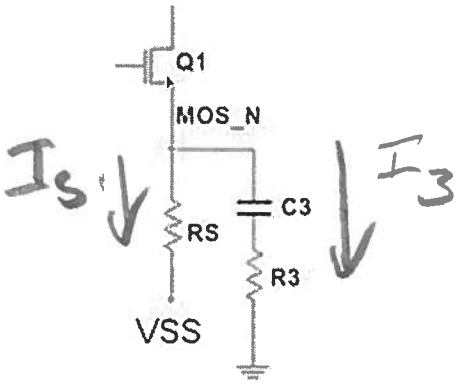
$\Rightarrow V_G = V_{GS} = 1.92 V$

$V_{DS} > V_{GS} - V_{TO}$
So Saturation Reg: ON

$V_{GS} > V_{TO}$ So ON

2. A portion of a common source amplifier is shown in the figure. It is given that the source voltage $V_s = -4V, V_{ss} = -12V, R_s = 2k\Omega$, and $R_2 = 91\Omega$.

Determine the dc bias current through R_3. (in mA to one decimal place)



C_3 is an open circuit to dc current

$\Rightarrow I_3 = 0$

3. For the partial CS amplifier circuit of problem 2,

Determine the dc bias current through R_s. (in mA to one decimal place)

$$I_s = \frac{V_s - V_{ss}}{R_s} = \frac{-4 - -12}{2} = \frac{8}{2} = 4mA$$

$$= 4.0\,mA$$

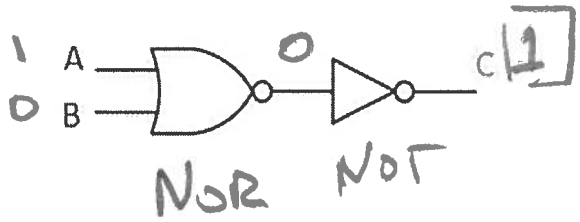
4. For the partial CS amplifier circuit of problem 2,

Determine the dc bias current of the transistor I_D. (in mA to one decimal place)

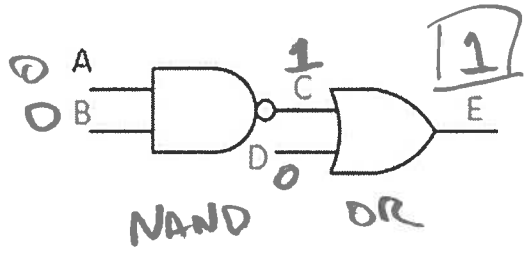
$I_D = I_s = 4.0mA$

5.

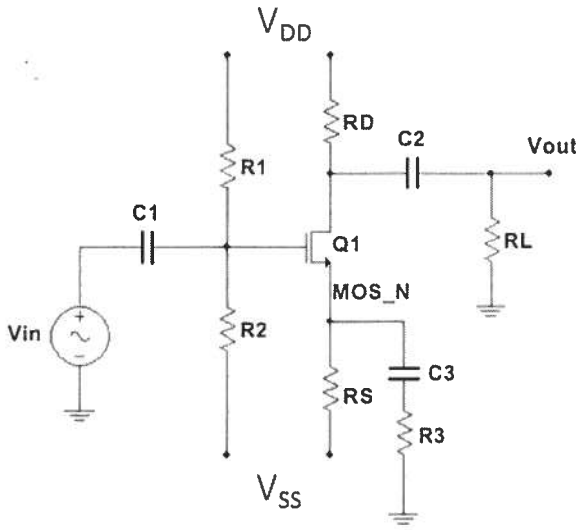
The binary inputs to the circuit below are A = 1, B = 0. Enter the corresponding value of C.



6. The binary inputs to the circuit below are A = 0, B = 0, D = 0. Enter the corresponding value of E.



7.



For the CS amplifier shown, $V_{DD} = 15V$, $V_{SS} = -15V$, $K = 1.1mA/V$, $V_{TO} = 2V$, $R1 = 150k\Omega$, $R2 = 110k\Omega$, $RD = 10k\Omega$, $RS = 5k\Omega$, $R3 = 200\Omega$, and $RL = 10k\Omega$.

What is the dc gate voltage to two decimal places?

$$V_G = V_{DD}\frac{R_2}{R_1+R_2} + V_{SS}\frac{R_1}{R_1+R_2}$$, by superposition

$$V_G = -2.308V$$

8. For the CS amplifier of problem 11, what is the MOSFET drain current in mA to two decimal places?

$$V_1 = V_G - V_{SS} - V_{TO}$$

$$I_D = \left(\frac{\sqrt{1+4KV_1R_S} - 1}{2\sqrt{K}R_S}\right)^2 = 1.877mA$$

9. For the CS amplifier of problem 11, what is the dc drain voltage V_D?

$$V_D = V_{DD} - I_D R_D = -3.\overline{M}2\,V$$

10. For the CS amplifier of problem 11, what is the magnitude of the ac midband gain to two decimal places?

$$g_m = 2\sqrt{KI_D} = 2.874 \times 10^{-3}$$

$$r_s = \frac{1}{g_m} = 347.952$$

$$A = \frac{-R_D \| R_L}{r_s + R_S \| R_3} = \frac{-5000}{540.260} = -9.255$$