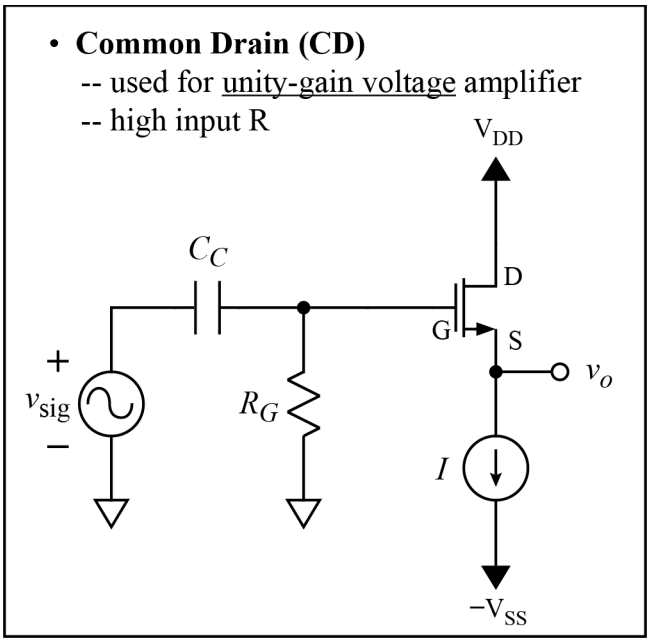
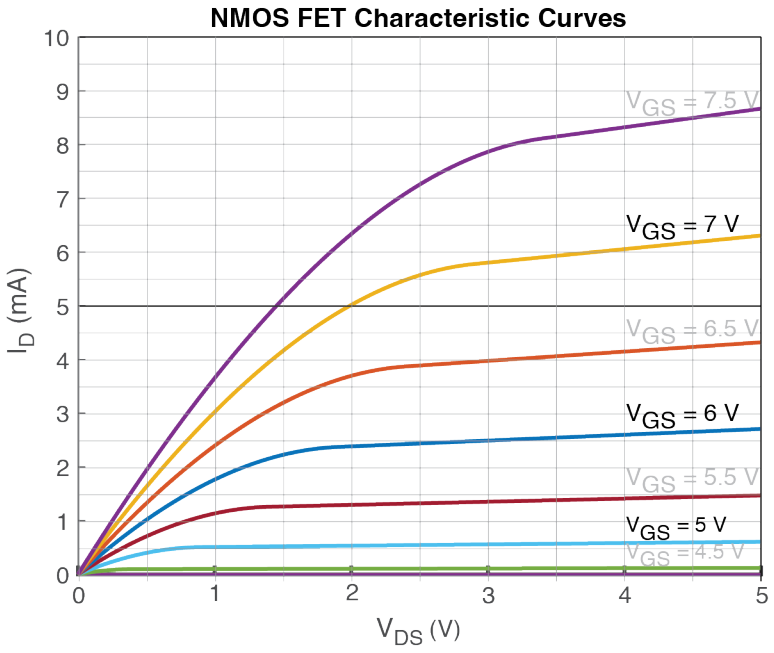
By: Arn Stolp and Neil E. Cotter

INFO:



PROB: Find the DC operating point of the circuit.

$V_{DD} = -1\text{V}, -V_{SS} = -8\text{V}, I = 1.5\text{mA}, R_G = 100\ \text{k}\Omega$



SOLN: The capacitor, C_C , acts like an open circuit for DC, so we may ignore the capacitor and v_{sig}. We have the following additional information:

$$V_{DD} = -1\text{V}, -V_{SS} = -8\text{V}, I = 1.5\text{mA}, R_G = 100\ \text{k}\Omega.$$

The current source dictates that $I_D = I = 1.5\,\text{mA}$. Since $V_{DD} = -1\,\text{V}$, we have

$$V_D = -1\,\text{V}.$$

Since no current flows in R_G, the gate voltage is $0\,\text{V}$.

$$V_G = 0\,\text{V}$$

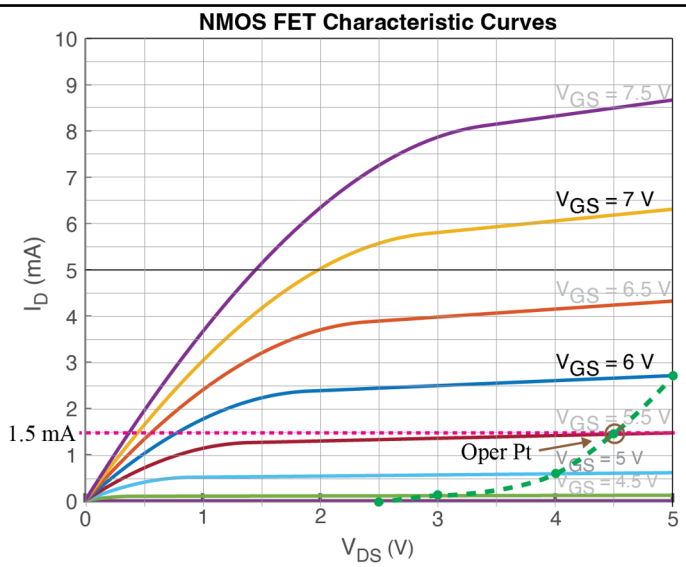
That means V_S will become whatever voltage is necessary to cause $I_D = I = 1.5\,\text{mA}$. The line for $I_D = I = 1.5\,\text{mA}$ is shown as a dashed line across the characteristic curves. The operating point must lie on this line.

Since we know V_G and V_D, and since V_S is the same for both, we can say that we have the following relationship between V_{GS} and V_{DS}:

$$V_G - V_D = 0\,\text{V} - -1\,\text{V} = 1\,\text{V} = V_{GS} - V_{DS}$$

Points on the characteristic curves where $V_{GS} - V_{DS} = 1\,\text{V}$,)i.e., V_{GS} is 1V higher than V_{DS}), are marked by green dots and heavier dashed line fit on the characteristic curves. The solution must also lie on this line.

The operating point is marked with a circle on the characteristic curves below.


NMOS FET Characteristic Curves
I_D (mA)
V_{DS} (V)
V_{GS} = 7.5 V
V_{GS} = 7 V
V_{GS} = 6.5 V
V_{GS} = 6 V
V_{GS} = 5.5 V
V_{GS} = 5 V
V_{GS} = 4.5 V
1.5 mA
Oper Pt
0
1
2
3
4
5
6
7
8
9
10