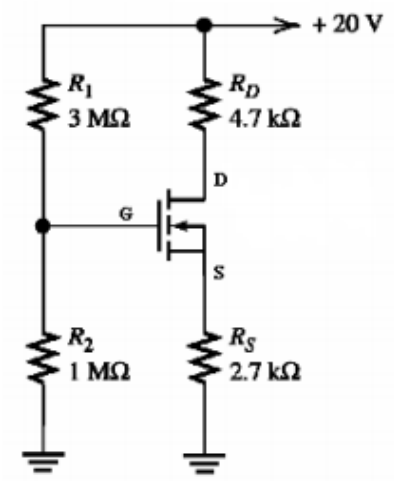
EE2032 Electronics Quiz#7

2. The n-channel MOSFET in the circuit has the following parameters:

$K = 1\ mA/V^2$,
$V_{GS(Th)} = 2\ V$.

Find I_D and V_{DS}.



Answer:

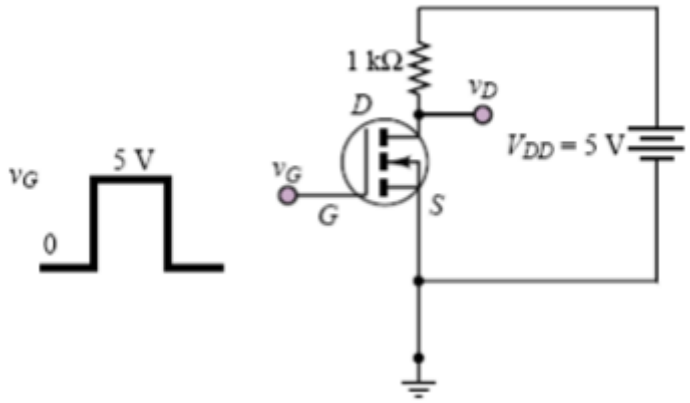
V_G=1/(1+3)*20 = 5 Volts

Assuming saturation:
I_D=1*(VGS-2)^2
V_{GS}+2.7*I_D=5

Here we find: V_{GS}=2.88 V, and, I_D=0.78 mA.
And for these values we find
V_{DS}=20-(4.7+2.7)*I_D = 14.2 V.

Since V_{GS}- V_T = 0.88, and V_{DS}>0.88, the assumption was correct.

4) The NMOS transistor shown in the figure has $V_T = 1.5$ V, $k = 0.4$ mA/V^2. If v_G is a pulse with 0 V to 5 V, find the voltage levels of the pulse signal at the drain output.
(That is; find v_D for $v_G = 0$ and for $v_G = 5$ V)



Answer:

When VGS=0:
ID=0, and therefore **VD=5** V

When VGS=5V:

Assuming saturation:
ID=0.4*(5-1.5)^2 = 4.9 mA ➔ VDS=0.1
But VDS must have been greater than 5-1.5=3.5 V for the saturation.

Therefore we need to check Triode region:

VDS=5-1*ID
ID=0.4*[2*(5-1.5)*VDS-VDS^2]

We find:
VDS=1.58 V
ID= 3.42 mA

Therefore, **VD= 1.58** V for 5V input.