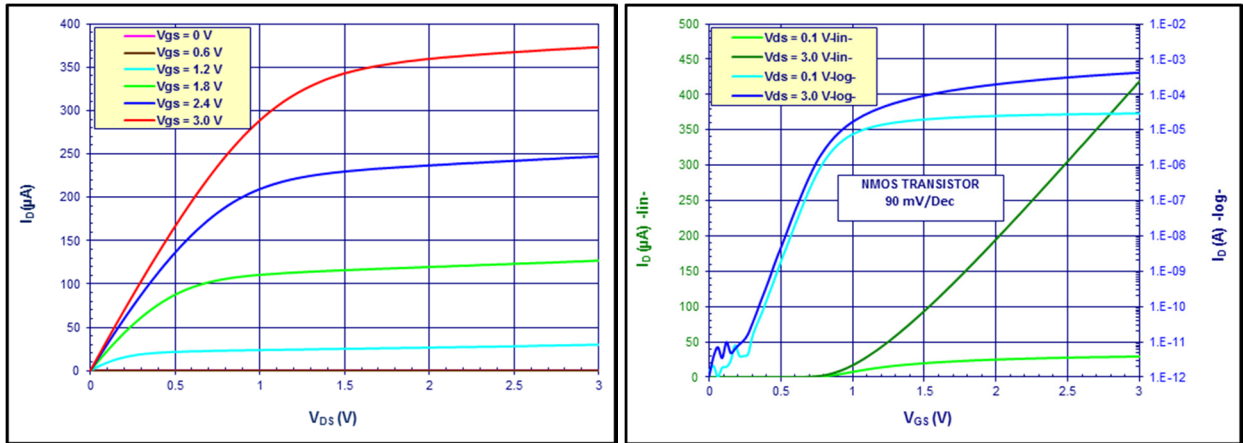# ECE 305 – Spring 2018

Homework 11 – Due Tuesday, April 17, 2018 at 12:00 PM in class (or in EE 326B)

1. Consider the input-output relation (left) and transfer characteristics (right) for an NMOS field-effect transistor depicted below. Assume the power supply voltage V_{DD}=1.8 V and R_s= R_D=1 kΩ.

   a. What is the on and off current for this transistor?
   b. What is the threshold current and threshold voltage for this transistor?
   c. What is the inversion layer charge density for this transistor? Assume C_{ox}=3 μF/cm².

2. Using the same parameters as in Problem 1, please calculate the following additional quantities.

   a. What is the average velocity of electrons at the source end of the channel, if calculated using the on current, while correcting for the effects of series resistance?
   b. What is the effective mobility of this MOSFET, as estimated from the linear region of operation? Assume that the channel length is 14 nm, and the width is 1 μm.
   c. Assuming the square law holds, i.e., $I_D/W = (\overline{\mu_n}C_{ox}/L)[(V_G - V_T)V_D - V_D^2/2]$, calculate the electric field as a function of position along the channel in the linear region of operation.