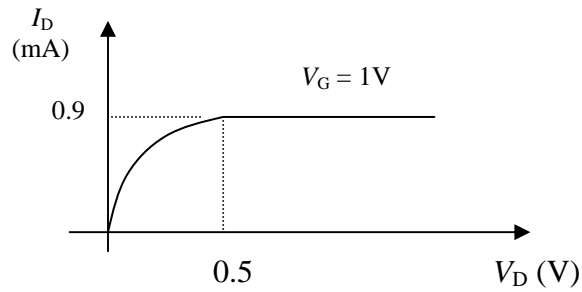


**ECSE-2210 Microelectronics Technology**  
**Fall 2005**  
**Class Activity 29**

1. An n-channel MOS transistor has a threshold voltage of 2 V and the following parameters:  
 $\epsilon_{Si} = 3 \epsilon_{ox} = 1 \times 10^{-12} \text{ F/cm}$ ;  $\mu_n = 1000 \text{ cm}^2/\text{Vs}$   $x_{ox} = 500 \text{ \AA}$   $Z = 15 \text{ }\mu\text{m}$ ,  $L = 1 \text{ }\mu\text{m}$ .  
For a gate voltage  $V_G = 4 \text{ V}$  calculate the following:
  - a. The resistance between the drain and source in the linear region of operation for small values of  $V_D$  (i.e.,  $V_D = 0$ ).
  - b. The drain to source current when the device is in saturation.
  - c. The drain voltage that should be applied for the device to be in saturation.
  - d. Transconductance and drain-to-source conductance under saturation.
  - e. Draw the equivalent circuit under saturation.
  - f. Calculate the cut-off frequency.

2. The figure below shows the drain current ( $I_D$ ) versus drain voltage ( $V_D$ ) of a silicon MOS transistor as a function of gate voltage ( $V_G$ ). The gate capacitance ( $C_{ox}$ ) of the device is  $1 \times 10^{-12}$  F.



- Is this an n-channel or p-channel device?
- Is this an enhancement or depletion mode device?

For a gate voltage,  $V_G = 3$  V:

- What is the drain voltage for saturation?
- What is the drain current in saturation?
- What is the small-signal trans-conductance in saturation?