

# COLLEGE OF ENGINEERING & TECHNOLOGY

Department: Electronics and Communications Engineering

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Course Title: Advanced Devices Fall 2014

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## MOSFET Scaling

For a certain NMOS technology, the device parameters are:

$\mu_0 = 1.35 \times 10^{-2} \text{ m}^2 \text{ V}^{-1} \text{ sec}^{-1}$ ,  $v_{\text{sat}} = 1.3 \times 10^5 \text{ m/sec}$ ,  $n = 2$  for mobility equation.

$t_{\text{ox}} = 3 \text{ nm}$ ,  $N_A = 9 \times 10^{17} \text{ cm}^{-3}$ ,  $x_j = 35 \text{ nm}$ , Gate workfunction = 4.05 eV.

Assume:  $L_{\text{metallurgical}} = L_{\text{gate}} - 2 \cdot 0.3 \cdot x_j$

### Question 1

- a) Scale the transistor from  $L_{\text{gate}}=200 \text{ nm}$  and  $V_{\text{ds}}=1.3 \text{ V}$  down to  $L_{\text{gate}}=150 \text{ nm}$ . Find the new device dimensions, doping, and maximum supply voltage
- b) Compare the following parameters with those of the initial device (found in sheet 5), using the new  $V_{\text{ds}}=V_{\text{gs}}$ 
  - i. Depletion widths at source, drain, and in the middle of the channel for a long channel transistor
  - ii. Long channel threshold voltage
  - iii. Short channel threshold voltage (using 2D model)
  - iv. Subthreshold current
  - v. Drain current
- c) Check if the parameters in 1b follows the ideal *Constant Field* scaling