UNIVERSITY OF CALIFORNIA
College of Engineering
Department of Electrical Engineering and Computer Sciences

EE 130/230A — Prof. Liu
Fall 2013

Homework Assignment #13

Due at the beginning of class on **Tuesday, 11/26/13**

Problem 1: Advanced MOSFET structures

(a) Why are thin-body MOSFET structures advantageous for channel-length (L) scaling as well as supply-voltage (V_{DD}) scaling? (Hint: Note that the drain-to-body pn junction capacitance is significantly reduced.)

(b) The thin-body MOSFET structure (T_{Si} < 10 nm) is often referred to as a "fully depleted" MOSFET. Why is this the case? (Hint: The dopant concentration in the body region typically is less than 10^{18} cm^{-3}.)

(c) What is the primary advantage of a multiple-gate (double-gate or tri-gate) thin-body MOSFET structure over a single-gate thin-body MOSFET structure?

Problem 2: Qualitative BJT Questions

(a) Draw the energy-band diagrams for a Si NPN BJT in forward-active and saturation modes of operation.

(b) Draw a family of common-emitter output characteristics (I_C *vs.* V_{CE} curves for different values of V_{BE}). On your plot, indicate the saturation region and forward active region.

(c) Suppose the minority-carrier lifetime in the base were drastically reduced somehow. How would the following device parameters be affected, and why?

i. transport factor α_T
ii. emitter efficiency γ
iii. common-emitter dc current gain β_{dc}