ECE 331 Digital System Design Student:_____

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HOMEWORK 8 – due **Tuesday**, November 6th at **≤6pm**

1) Feedback (3pts) – to be completed after you finish.

- F1. If you worked on it with classmates and your solutions might be TOO similar, write their names here:_____
- F2. How long did it take you to work on the homework (don't count the reading assignment!)
  1h 2h 4h infinite hours
- F3. Do you have suggestions on how to improve it? (ideas for new problems?) Let us know here (and/or use your own homework sheets):

2) CMOS circuit design (20 pts)

Implement a two input XOR gate using PMOS and NMOS transistors.

3) Interfacing gates (30 pts)

(a) Determine the fanout limit when a **Texas Instruments** SN7400 (Quad 2-Input NAND) drives an **ON Semiconductor** SN74LS00 (Quad 2-Input NAND). For the SN74LS00, assume VIN=2.7 V when determining IIH, if needed.
(b) Determine the fanout limit when an **ON Semiconductor** SN74LS00 (Quad 2-Input NAND) drives a **Texas Instruments** SN7400 (Quad 2-Input NAND). For the SN74LS00, assume VIN=2.7 V when determining IIH, if needed.

4) Power dissipation (27 pts)

For each IC listed below, determine the quiescent power dissipation, dynamic power dissipation and total power dissipation when one gate from each IC drives a capacitive load of CL = 15 pF at switching frequencies of 100 kHz, 1 MHz and 10 MHz at VCC = 5 V. Assume the gate output is HIGH 3/4 of the time and LOW 1/4 of the time.

a) ON Semiconductor 74LS283
b) Philips 74F283
c) Philips 74HC283

5) Power dissipation again. (20)

For a CMOS inverter, assume that the load capacitance is C=150fF and Vcc=5V. The inverter is cycled through the low and high voltage levels at an average rate of f=75MHz.

(a) Calculate the dynamic power dissipated in the inverter.

(b) For a chip that contains the equivalent of 450,000 inverters, calculate the total dynamic power dissipated if 15 percent of the gates change values at any given time.

6) Extra credit (10pts: either 10 or 0, adding to a max of 100 as your final grade).

Define a Schmitt-trigger input. In particular, look at the SN74HC7002 (Texas Instruments), (a) identify the main difference between that chip and a non-Schmitt-trigger chip (write a couple of sentences!), (b) draw the symbol that identifies the Schmitt-trigger, and (c) present at least one application where that would be necessary. **http://focus.ti.com/lit/ds/symlink/sn74hc7002.pdf**