**ECE 331 Spring 2013** **Homework 2**

Due Mon. Jan 21 at the beginning of class.

Show all your work and please try to be neat.

1. Complete the following exercises for the expression
   F = (A'+B'+C') (A'+B'+C) (A'+B+C') (A'+B+C) (A+B'+C)
   a. Write the PoS expression using Pi Notation
   b. Write the equivalent SoP expression in Sigma Notation.
   c. Write the SoP expression as an expanded logic expression, i.e., write F = *f*(A,B,C)
   d. Reduce the expression from (c) using K-Map.
   e. Reduce the expression from (c) using Boolean algebra, but keep your answer is a SoP form, i.e. using only terms containing ANDs that are ORed together. Does this agree with part (d)? If not, look for mistakes.
   f. Can your expression from (d) and (e) be minimized further to reduce the number of terms and/or operations? If so, write the minimized expressions.
   g. Draw the gate-level schematic for the minimized expression using any appropriate basic logic gate. Use only A , B , C as inputs –no complements.
   h. Draw the gate-level schematic using only NOR gates.
   i. Draw the gate-level schematic using only NAND gates.
2. Using only INV, 2-input NAND, and 3-input NAND gates, draw the schematic for a digital circuit that will implement the *2's complement overflow* (OV) function for an 8-bit ALU. . Assume the inputs are A ($A_7$ … $A_0$) and B ($B_7$ … $B_0$) and output (sum) is S ($S_7$ … $S_0$). Assume that only non-inverted inputs (i.e., X but not X') are available.

   HINT: You should be able to do this with 3 inverters and 3 NAND gates.

3. You can find a lot of useful information related to this course on the internet. To build your skills at using the web for professional purposes, use your favorite search tools to briefly reply to following. Include the URL you accessed for each part. You are welcome to type your response for Problem 3 so you can cut and paste URLs.
   a. Locate a fact related to the history of integrated circuits or microprocessors that was not covered in class or handout.
   b. Locate a good site to review the basics of Boolean logic and the operation of flip flops. Briefly describe what you like about this site.
   c. What is a popular microcontroller in use today (list manufacturer and part number/name)? List some of the basic features of the controller such as ALU bit width, # memory address bits, # of instructions it implements, nominal power supply voltage, # of I/O ports, etc.
   d. In this course, we will use the Freescale (formerly Motorola) 68HC12 (and 68HCS12) microcontroller as our main example to study architecture and assembly programming. Locate the instruction set for this controller and state where you found it.
   e. What microprocessor is currently considered the most advanced and/or powerful? List a few basic facts about this controller (number of transistors, chip size, fabrication technology, size of instruction set, etc.).
4. There are several logic gate simulators available on/through the internet, including a few linked on the class website. Locate one that looks interesting and use it to make a simple logic function. Briefly describe the simulator and what you like or do not like about it. List the URL.