Lab 1: Introduction to EE 281 Lab

Name: _____ Lab Partner:_____

Answers to pre-lab questions and a design of any circuits you will build or experiments you will perform must be turned in at the beginning of your lab period. You may want to make a copy of the pre-lab for reference while you do the lab because you will not have the copy you turn in at the beginning. Make sure all the work you turn in is your own. I.E., do not copy other student's work (This applies to lab reports as well as pre-labs).

For this lab, design of your circuits will consist of a schematic diagram, for each of the circuits you will build. The schematic should be annotated with pin numbers and chip names and have a table listing the part number and name of each chip.

Pre-lab Questions

1. Derive a minimum cost circuit using NAND gates (no fan-in constraints) for

   $f(W,X,Y,Z) = \Sigma\, m(4,5,7,12,13,15)$

2. Now derive the minimum cost Product of Sums solution using NOR gates for

   $f(W,X,Y,Z) = \Sigma\, m(4,5,7,12,13,15)$

3. Derive a minimum cost circuit using NAND gates (fan-in of 2 like you were using 7400 NAND chips) for

   $f(W,X,Y,Z) = \Sigma\, m(0,2,4,7)$

Experiments

Generic Logic

Design and build a logic circuit that implements the following using only TTL NAND gates. (Hint: you should be able to do this with parts in your kit.) Use the switches and LED's on the protoboards in the lab for inputs and outputs. Test your circuit by hand and demonstrate it to your TA when you are sure it is working.

$f(W, X,Y,Z) = \Sigma\, m(0,2,4)$
TA signature for this circuit: _____

Now implement a second equation only using two input NAND gates.

$f(X,Y,Z) = \Sigma\, m(0,2,4,7)$

TA signature for this circuit: _____

Infrared Heat Oven Alarm Logic

Consider an Infrared Industrial Oven that has three Infrared Heating Elements arranged in a circle. The oven is designed that some heating elements are allowed to fail and the system will still perform adequately. There is also a fan that circulates the heated air within the Oven. If the fan fails then this is considered a system failure.

We assume that there are four input variables (the heating elements -H1, H2, H3, and the fan – F1) that each output a 1 if it is associated heating/fan element is functioning and a 0 if it is not functioning (i.e. an error condition). You are to design a simple combinational logic circuit using only NAND gates(2 input – 7400) and one inverter chip (7404) that outputs a 1 (which indicates an oven fault) if any of following conditions is met (and a 0 otherwise).

1. H1=0 and H2 = 0
2. H2= 0 and H3 = 0
3. H1=0 and H3 = 0
4. F1 = 0

In other words, if any two adjacent heating elements or if the fan has failed then the circuit will output a one.

In the lab, implement this circuit using any gates you choose. Use the switches and LED's on the proto boards in the lab for inputs and outputs. Test your circuit by hand and demonstrate it to your TA when you are sure it is working.

TA signature for this circuit: _____

Now that your circuit is working, determine the average power consumption of the TTL portion of your circuit using the multi-meter function from the explorer board (P=V*I, find Voltage and Current).

TA signature for this circuit: _____