SAMPLE PROBLEMS FROM EXAM 2, FALL 2008

Question 1 (10 points):

Answer the following questions regarding decoders.

a) Fill out the truth table for a 1-to-2 line decoder with input *I* and enable signal *En* (asserted high) and outputs F_0, F_1. (3 points)

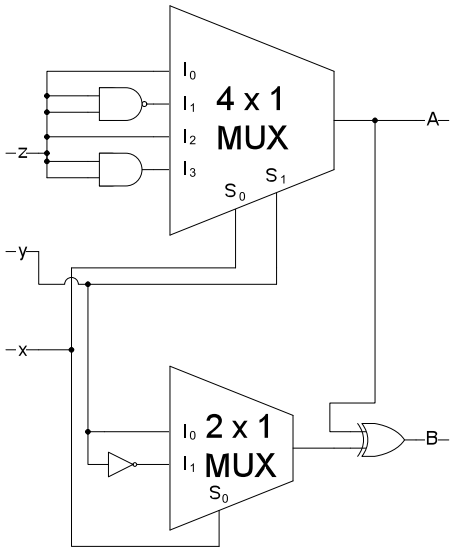
b) Draw the circuit (gate-level) diagram for this decoder. (2 points)

c) Using multiple 1-to-2-line decoders from part (a) design a 2-to-4-line decoder (with no enable) with inputs A_0, A_1 and outputs D_0, D_1, D_2, D_3. Show the block diagram only, with no internal circuit diagram of the decoders. (5 points)

Question 2 (15 points):

Analyze the following combinational logic circuit.

a) Determine the outputs functions A and B as sums of minterms. You may use any process to determine the result, but show your work. (10 points)



b) Implement the same circuit using a decoder circuit and external logic gates. Show the block-level diagram of your design (5 points)

Question 3 (15 points):

Design a combinational circuit with three binary inputs: *H, S, I* and three binary outputs: *x, y, z*. Each input represents and item that a person may order at a fast food place:

- *H* stands for hot dog, cost = $3
- *S* stands for soda, cost = $1
- *I* stands for ice cream, cost = $2

Each input can only be 0 or 1, which means that a customer can order each item only once (or none at all, for *H=0, S=0, I=0*).
The outputs *x,y,z* represent a 3-bit encoding $(xyz)_2$ of the total cost of the order. For example, for *H=1, S=0, I=0* (which evaluates to $3*)*, the output should be *x=0, y=1, z=1*.

a) Show the truth table for this combinational circuit. (10 points)

b) Determine the minimized functions *x, y, z* in a sum of products form. (5 points)

Question 4 (10 points):
Answer the following questions regarding latches.

a) Draw the circuit of a NAND-based SR latch.
Fill in the function table below that shows the value of the outputs for different combinations of inputs S and R. (5 points)

R	S	Q	Q'

b) Draw the circuit of a D-latch using the SR latch designed in problem (a) (5 points).
(Hint: provide the D and EN inputs, properly wiring them to the S, R inputs)

EN	D	Q