CSE-40534 HW #1 *Dr. Izadi*

In doing your homework, please make sure you follow the following guidelines. Failure to follow them, will result in 0 grade:

- *Only write on one side of your paper.*
- *Problem solutions must follow in order i.e. Start with Problem 1, then Problem 2 and etc. The solutions to each section must also be in order.*
- *Unless explicitly specified, you should not explain your solution – just provide your solution.*
- *Make sure that the papers are stapled and your name is on the paper.*

Problem 1 (10 Points)
Design a one-bit 5MR voter using basic gates.

Problem 2 (20 Points)
A cyclic code is to be based on the Generator polynomial $X^7 + X^6 + X^5 + X^2 + 1$.

a. Generate a codeword for the input data 10111.
b. Using logic gates, design an appropriate encoder and decoder the given generator.

Problem 3 (20 Points)
A 2M X 16 memory system is design using 1 M X 4 chips. Assume chip failure modes are single-bit cell (45%), single-row all-0's (30%), single-column all-0's (15%), and whole-chip all-0's (10%). Also, assume 0 and 1 values are equally likely. Compare and comment on relative performance (single-error-detection coverage) and overhead of the following approaches.

a. Bit per chip
b. Bit per multiple chips
c. Duplication
d. Single precision checksum (one sum for the entire memory).

Problem 4 (15 Points)
Design a self-dual of a full-adder circuit.

Problem 5 (10 Points)
Design a totally self-checking checker with 8 inputs.

Problem 6 (20 Points)
Consider a random-access memory that has a word format $X_5\, X_4\, X_3\, X_2\, X_1\, X_0$ of size 6 bits. We can use Hamming code to correct any single bit in this memory.

a) Determine the H (or P) matrix such that the syndromes s_i computed by your SEC Hamming code specifies that the single-bit error is at position *i*. Also, give the error-free syndrome s^*.
b) How you would modify the SEC code you have defined above in order to obtain an SEC/DED code.

Problem 7(20 Points)
Using the combinatorial model, determine the reliability of a simplex, TMR, and 5MR systems as a function of reliability of a simplex system, R(t) . You may assume a fault-free voter. Using MathLab, plot the reliability of the three systems versus R(t) and comment on their relative reliabilities.

Problem (25 Points)
Using Markov model, determine the discrete solution for the reliability of a 3MR system with λ failure rate and μ repair rate. You may assume that the system initially is fault free. Using MathLab, plot R(t) from 0 to 5 hours using

a. $\Delta t = 0.01$, $\lambda = .0001$ and $\mu. = .01$
b. $\Delta t = 0.01$, $\lambda = .001$ and $\mu. = .01$
c. $\Delta t = 0.01$, $\lambda = .0001$ and $\mu. = .001$

Due 10/23/06