EGE-534 HW #2 *Dr. Izadi*

Name:____

Problem 1 (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 2 (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 3 (15 Points)
Design a self-dual of a full-adder circuit.

Problem 4 (10 Points)
Design a totally self-checking checker with 7 inputs.

Problem 5 (20 Points)
Consider a random-access memory that has an 8-bit data.

a) Determine the P matrix such that the error code computed by your Single Error Correcting Hamming code specifies the bit position of the error.
b) Design a circuit for such an encoder using basic gates.
c) How you would modify the SEC code you have defined above in order to obtain an SEC/DED code.

Problem 6 (10 Points)
Convert 0 to 15 to RNS using modules [3,5,7]. Within this range would you say a single fault is detectable or not. Justify your answer

Problem 7 (20 Points)

a. Using full adders and basic gates, design a 3N code encoder, where N is a 4-bit binary number.
b. Design a circuit to detect an error in the above 3N code.

Problem 8 (20 Points)

Consider a low-cost residue code based on module 7.

a. Show how do you obtain residue-7 check bits of $X_7 X_6 X_5 X_4 X_3 X_2 X_1 X_0$ using recursive addition technique?
b. What is the theoretical base for this easy encoding process?

Due 6/10/08