EGE -534 HW #2 Dr. Izadi

Name: _____

Problem 1 (25 Points)

a. Three fundamental terms used in this course are *fault, error,* and, *failure.* In one to three sentences, clearly distinguish these terms from each other.
b. What is the difference between a *permanent fault,* an *intermittent fault,* and a *transient fault* in term of fault duration?
c. Comment on the following statement with justification. Single faults can cause multiple bit errors and multiple faults can cause single error.
d. Comment on the following statement with justification. A fault-tolerant system necessarily has a high reliability.
e. Define the following: *reliability, availability, safety,* and *performability*. Does a system with a high availability necessarily have a high reliability?

Problem 2 (15 Points)

Design a one bit 5MR voter.

Problem 3 (30 Points)

A 2M X 16 memory system is design using 1 M X 4 chips. Assume chip failure modes are single-bit cell (50%), single-row all-0's (20%), single-column all-0's (20%), 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 (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 5 (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 6 (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: Feb. 20, 2009