

First Name: \_\_\_\_\_ Last Name: \_\_\_\_\_

*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. Make sure your name appears exactly as shown on your registration.*

Problem 1 (10 Points)

Design a one-bit 5MR voter using basic gates.

Problem 2 (10 Points)

Is  $F = \overline{A}B + C$  a self-dual circuit? If not, transform it with the additional input D.

Problem 3 (10 Points)

Is full adder a self-dual circuit? If not, transform it with the additional input D.

Problem 4 (20 Points)

A 4G X 16 memory system is design using 1 G 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.

- Bit per chip
- Bit per multiple chips
- Duplication
- Single precision checksum (one sum for the entire memory).

Problem 5 (10 Points)

Show that the code distance of a 4bit data with a single even parity is adequate to make it candidate for a single error detection.

Problem 6 (30 Points)

Consider a random-access memory that has an 7-bit data.

- a) Determine the H matrix such that the error code computed by your Single Error Correcting Hamming code specifies the bit position of the error.
- b) Show a block diagram of your data bus, memory, and various stages of parity generation and error correction mechanism.
- c) Design the detailed design of parity generation, syndrome generation and error correction circuitry using basic gates.
- d) How you would modify the SEC code you have defined above in order to obtain an SEC/DED code.

Due 2/11/10