EE111 - TEST I

NAME _____

Show all your work in the space provided. Answers with a simple "yes", "no", or a single number are incomplete and will not be given full credit. Answers in the form: ans = $\frac{a+sqrt(b)}{c}$ are fine where appropriate. Good English is required on essays.

Problem 1. (5 points) Derive the truth table for the following function:
$\mathbf{F} = (x + z')(y' + z)'$

Problem 2. (5 points) Give the binary equivalent of the following hexadecimal number: $14A0.2A_{16}$

Problem 3. (11 points) Perform binary subtraction of the following two's complement numbers by taking the two's complement of the subtrahend (be sure to indicate if an underflow or overflow occurs):

a) (5 points) $0101010 - 0110$ b) (5 points) $0111010 - 1010$

Problem 4. (7 points) Minimize the number of operators in the following Boolean expression: $x'y + x'z + y'z + x'y'z$.

Problem 5. (6 points) Evaluate the following, assuming unsigned binary numbers (be sure to indicate if an underflow or overflow occurs): $(101010 - 111)/101$

Problem 6. (5 points) Represent the following number in BCD: 5280_{10}.

Problem 7. (11 points) Perform binary multiplication with the following two's complement numbers:

a)
$$\begin{array}{r} 101010 \\ \text{X } 0101 \\ \hline \end{array}$$

b)
$$\begin{array}{r} 011010 \\ \text{X } 1110 \\ \hline \end{array}$$

Problem 8. (7 points) Using Truth-Tables, prove the following expressions are equivalent,

$$x' + y'z + yz' = (xy'z' + xyz)'$$

Problem 9. (7 points) Represent the following function in Canonical Form: $\mathbf{F} = x \oplus y \odot z$.

Problem 10. (5 points) Briefly explain what a behavioral representation is and why it is used.

Problem 11. (6 points) Convert the number **-42** to an 8-bit two's complement binary representation.

Problem 12. (8 points) Assume we are building a single-bit adder to add two unsigned 1-bit numbers. The result of the add will produce a sum-bit and a carry-bit. Form a logical expression for the carry-bit.

Problem 13. (5 points) Assume a code consists of the following code-words: {0000, 1010, 1001, 1111}. How many bit-errors could one detect if they were to use this code-set? Explain.

Problem 14. (5 points) If the unsigned binary number 0101110_2 is converted to base x, it becomes 42_x. What is x?

Problem 15. (7 points) Briefly explain in terms of Hamming distance, code-words, and non-code words, how a parity bit facilitates error detection. As part of your explanation, specify the number of errors that may be detected.