Points missed: _____ Student's Name: ___________________________________

Total score: _____ /100 points

East Tennessee State University – Department of Computer and Information Sciences
CSCI 2150 (Tarnoff) – Computer Organization
TEST 1 for Spring Semester, 2005

Read this before starting!

- The total possible score for this test is 100 points.
- This test is ***closed book and closed notes***
- You may ***NOT*** use a calculator. Leave all numeric answers in the form of a formula.
- You may use one sheet of scrap paper that you must turn in with your test.
- All answers must have a box drawn around them. This is to aid the grader (who might not be me!) Failure to do so might result in no credit for answer. Example:

$$\boxed{32F1_{16}}$$

- **1 point will be deducted** per answer for missing or incorrect units when required. **No** assumptions will be made for hexadecimal versus decimal, so you should always include the base in your answer.
- If you perform work on the back of a page in this test, indicate that you have done so in case the need arises for partial credit to be determined.
- Statement regarding academic misconduct from Section 5.7 of the East Tennessee State University Faculty Handbook, June 1, 2001:

  "Academic misconduct will be subject to disciplinary action. Any act of dishonesty in academic work constitutes academic misconduct. This includes plagiarism, the changing of falsifying of any academic documents or materials, cheating, and the giving or receiving of unauthorized aid in tests, examinations, or other assigned school work. Penalties for academic misconduct will vary with the seriousness of the offense and may include, but are not limited to: a grade of 'F' on the work in question, a grade of 'F' of the course, reprimand, probation, suspension, and expulsion. For a second academic offense the penalty is permanent expulsion."

Basic Rules of Boolean Algebra:

1. $A + 0 = A$	**7.** $A \cdot A = A$
2. $A + 1 = 1$	**8.** $A \cdot \overline{A} = 0$
3. $A \cdot 0 = 0$	**9.** $\overline{\overline{A}} = A$
4. $A \cdot 1 = A$	**10.** $A + AB = A$
5. $A + A = A$	**11.** $A + \overline{A}B = A + B$
6. $A + \overline{A} = 1$	**12.** $(A + B)(A + C) = A + BC$

DeMorgan's Theorem: $\overline{(AB)} = (\overline{A} + \overline{B})$ $\qquad \overline{(A + B)} = (\overline{A} \bullet \overline{B})$

Short-ish Answer (2 points each unless otherwise noted)

1. Calculate the period of a periodic pulse train with a frequency of 2 Gigahertz (2×10^9 Hertz). ***Be sure to include your units!***

2. The AND operation in boolean algebra is analogous to what mathematical algebraic operation?

   a.) addition b.) multiplicative inverse c.) negation
   d.) multiplication e.) subtracting 1 f.) division

3. True or False: A signal with a 50% duty cycle has the same pulse width (duration of a logic one during a single cycle) regardless of the signal's frequency.

4. How many combinations of 1's and 0's can a 6-bit number (i.e., 6 binary variables) have?

   a.) 2^{6-1} b.) $2^6 - 1$ c.) 2^{6+1} d.) 2^6 e.) $2^{6-1} - 1$ f.) None of the above

5. For each of the following binary representations, give the decimal expression for the smallest/lowest value that can be represented using 9 bits. (2 points each)

   a.) unsigned binary:

   b.) 2's complement:

   c.) signed magnitude:

6. What is the **minimum** number of bits needed to represent 132_{10} in signed magnitude representation?

   a.) 6 b.) 7 c.) 8 d.) 9 e.) 10 f.) None of the above

7. True or False: The number 001001000110001010001 1 is a valid BCD number.

8. True or False: The 8-bit value 10110110_2 represents the same value in both signed magnitude and 2's complement form.

9. Write the complete truth table for a 2-input NOR gate.

A	B	X

The following two questions are based on the 8-bit binary addition shown below.

```
 01100011
+00110110
---------
 10011001
```

10. True or False: If the addition above is considered 8-bit 2's complement, an overflow has occurred.

11. True or False: If the addition above is considered 8-bit unsigned, an overflow has occurred.

12. How many positions and in what direction (left or right) must the number 00011000_2 be shifted in order to effectively divide it by 8? (3 points)

Number of positions to shift: ________________ Direction to shift: __________________

13. Circle the function that would first be performed in the following expression.

$$A \cdot (B + F + (C \cdot D + E))$$

14. True or False: The two circuits below are equal.

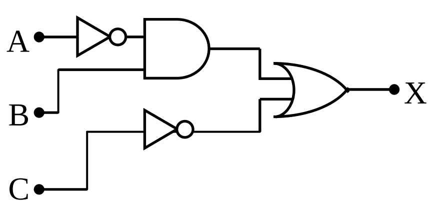
Medium-ish Answer (4 points each)

15. Convert the floating-point number 11011000111010011000000000000000 to its binary exponential format, e.g., 1.1010110×2^{-12}, (which, by the way, is not even close to the right answer).

16. Convert 1100**.**0101 to decimal. (Leave your answer in expanded form.)

17. Draw the circuit ***exactly*** as it is represented by the Boolean expression $\overline{A \bullet B} + C \bullet \overline{B}$.

18. In the space to the right, create the truth table for the circuit shown below.



A	B	C	

19. Write the Boolean expression for the circuit shown in the previous problem. ***Do not simplify!***

20. Convert 1101001010101101010010_2 to hexadecimal.

21. List two benefits of a digital circuit that uses fewer gates.

22. Use any method you wish to prove $A + \overline{A} \bullet B = A + B$.

23. If an 8-bit binary number is used to represent an analog value in the range from –10 to 145, what is the accuracy of the system? In other words, if the binary number is incremented by one, how much change in the analog range is represented? (Leave your answer in the form of a fraction.)

24. Use DeMorgan's Theorem to distribute the inverse of the expression $\overline{A + B + C \bullet D}$ to the individual terms. ***Do not simplify!***

Longer Answers (Points vary per problem)

25. Mark each boolean expression as ***true*** or ***false*** depending on whether the right and left sides of the equal sign are equivalent. Show all of your work to receive partial credit for incorrect answers. (3 points each)

a.) $A + \overline{(A + B)} + B = A$ Answer: ___________

b.) $AB(A + \overline{B}) = AB$ Answer: ___________

(25 continued…)

c.) $A + \overline{B} + C + \overline{(AB)} = 1$ Answer: ___________

26. Fill in the blank cells of the table below with the correct numeric format. ***For cells representing binary values, only 8-bit values are allowed!*** If a value for a cell is invalid or cannot be represented in that format, write "X". Use your scrap paper to do your work. (2 points per cell)

Decimal	2's complement binary	Signed magnitude binary	Unsigned binary
	01101010		
–128			
		11001000	