UNC Charlotte – Spring 2006 - Exam 1 – February 14, 2006

Name: ________________________  Student MOSAIC ID: ____________________

<table>
<thead>
<tr>
<th>Question</th>
<th>1-4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>Total</th>
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<tbody>
<tr>
<td>Score</td>
<td>/40</td>
<td>/20</td>
<td>/15</td>
<td>/15</td>
<td>/20</td>
<td>/40</td>
<td>/150</td>
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You are permitted 80 minutes to take this test, no more. Put your answers on the supplied paper. This is an open book test. However, it is not open notes. You are allowed the following item for the test: Walker’s book, pencils, and erasers. You are not permitted to have any of the following on your desk during the test: notes, old assignments, calculators, other books, or other electronic assistance. Failure to abide by this policy will result in a zero for the test and a visit to the UNCC judicial board.

Please read and sign this statement: I have not received from anyone nor assisted others while taking this test. I have also notified the test proctor of any of these violations noted above.

Signature: ___________________________

Note: A and A' are equivalent

Short Answers

1) (30 points) Convert -500_{10} to hexadecimal (16 bits two’s complement notation) by hand. Show your work below.

Answer:

2) (5 points) Show the binary bit stream if I send the eight-bit data 0x45 via RS-232 communications with the appropriate start bits, one stop bit, and even parity.

Answer:

0x4E0C

11000
3) (10 points) What is the range of numbers which can be represented by 12 bits if we are representing two's complement integers? (express as the formula and as decimal numbers)

<table>
<thead>
<tr>
<th>Formula:</th>
<th>Decimal:</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2^{11} \rightarrow 2^{-1} \rightarrow -1$</td>
<td>$-2^{10} \rightarrow 2^{-10} \rightarrow 2^{10}$</td>
</tr>
</tbody>
</table>

4) (15 points) Perform the operation 0x5F2 divided by 0x24. Show your result in binary (hint: Perform the division in binary). Show your work below.

Answer:

```
10 0 1 0
1 0 1 0
```

```
/ 1 0 0 1 0 0
/ 1 0 0 1 0 0
/ 1 0 1 1 1 0 0 1 0
/ 1 0 0 1 0 0
  1 0 0 1 0 0
  1 0 1 0 0
  1 0 1 0
```
5) (20 points) Draw a Transistor-Level Schematic Diagram of a three-input OR Gate, similar to what was done in the homework assignment.

Spts P-channel at top, Serves
Spts n-channel at bottom parallel
Spts inverter at end
Spts labeled correctly
6) (15 pts.) Combinational Circuit Analysis. Write a logic expression for the output $F$ of the circuit below as a function of the circuit inputs ($W$, $X$, $Y$, and $Z$). Derive the expression directly from the structure of the circuit; do not simplify.

$$F = \overline{W}X + WYZ + \overline{Z}W + \overline{W}XZ$$

7) (15 pts.) Complete the Truth Table for the following function: $F = \Sigma(0,1,5,7)$ and give the Canonical Sum representation.

<table>
<thead>
<tr>
<th>Row</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>F</th>
<th>Minterm</th>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>1</td>
<td>$\overline{ABC}$ or $\overline{ABC}$</td>
</tr>
</tbody>
</table>

$$F = A\overline{B}C' + A\overline{B}C + AB'C + ABC$$
8) (20 pts.) Combinational Circuit Minimization. Using a Karnaugh map, find a minimal sum of products expression for the function from the previous question: \( F = \Sigma A, B, C(0, 1, 5, 7) \). Show all of your work (draw and label the entire table).

\[ F = \overline{A}B + AC \]

9) (40 pts.) Combinational Circuit Minimization. Fill in the Karnaugh map and find a minimal sum of products expression for the function:

\( F = \sum_{X, Y, Z(0, 2, 8, 9, 10, 12, 16, 22, 24, 25, 26, 28, 29)} + \sum_{4, 5, 6, 7, 13, 18, 20} \).

\[ F = \overline{W}Y + \overline{WZ} + \overline{XZ} \]