EXAMINATION I

1. [10] If the contents of register $t0$ are $0x00010001$ and you issue the two address command mult $t0,$t0. Exactly what registers are changed and to what?

\[
\begin{array}{c}
00010001 \\
00010001 \\
10000000 \\
10000001 \\
\end{array}
\]

Answer(s): \[HI \leftarrow 1, \ LO \leftarrow 20001_{\text{HEX}}\]

2. [10] Convert the two's complement hex number FFFFFE0A_{16} to decimal

\[
\begin{array}{ll}
0 & +1 \\
1x & +1 & 1 & 256 & 11/11/1100001010_2 \\
1x & +1 & 3 & 128 & 64 \\
3x & +1 & 7 & 64 & 32 \\
7x & +1 & 15 & 32 & 16 \\
15x & +1 & 31 & 16 & 4 \\
31x & +1 & 62 & 4 & 2 \\
62x & +1 & 125 & 2 \\
125x & +1 & 251 & 2 \\
251x & +1 & 302 & 2 \\
\end{array}
\]

Answer: \[\text{-502}_{\text{DEC}}\]

3. [10] Convert the decimal number -100_{10} to (32-bit) 2's-complement binary shown in hex:

\[
\begin{array}{c}
+100 = 64 + 32 + 4 \\
000001100100 \\
\text{LSB: } 1110011001 (1) \\
\end{array}
\]

Answer: \[\text{FFFFF9C}_{\text{HEX}}\]

Honor Code: I have neither given nor received help on this examination.

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4. [5] If the (8-bit) ASCII value for ‘A’ is 41<sub>HEX</sub> = 65<sub>DEC</sub> = 01000001<sub>BIN</sub> and the value for ‘a’ is 61<sub>HEX</sub> = 97<sub>DEC</sub> = 01100001<sub>BIN</sub>, give in hex the string which corresponds to the character string “Help”.

```
HELP
8 5 12 16
```

Answer = 04<sub>HEX</sub> 65<sub>HEX</sub> 6C<sub>HEX</sub> 70<sub>HEX</sub> or

```
48 65 6C 70 <= ASCII
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5. [15] Given the function f(w,x,y,z) = \sum m(0,1,2,3,8,9,10). Draw the Karnaugh map for it and simplify so as to give a minimal SoP form and draw the circuit for that form.

```
\[ w'z'x'y' + w'x'y + w'z'x + wz'x' = \text{SoP} \]

Note: \( \overline{w + y + z} \) is not in SoP form

Circuit:

6. [15] Suppose we are given the Boolean expression

\[ \overline{A \cdot B} + \overline{B \cdot C} = Y \]

with inputs A, B, and C; output Y. If we find our supplies only include 7432IC’s (4-two input OR’s) and 7404IC’s (6-NOT’s or inverters), we will have to use some Boolean Algebra to convert that expression into one involving only OR’s and NOT’s [Hint: DeMorgan’s Laws and Double Negation are all you need]. Convert it and then draw the circuit for your result.

```
\[ \overline{A \cdot B} + \overline{B \cdot C} \]
```

Circuit:
7. [20] Here is a snapshot of MIPS registers, SPIM memory dump, and the result of some data declarations. Answer the following questions concerning the results of certain instructions assuming each question refers to the same starting condition shown.

a) Where is the next instruction to be executed?

PC = 00400098 depending on time, could be next instruction at 0040009C

b) \textit{add} $t1, $a0, $t2$ changes what register to what (hex)? $a = 10$ $10 + 9 = 19 = 16 + 3$

$\textbf{t1} \leftarrow 0 \times 13$

c) If a \textit{syscall} were issued now, what would happen? [Remember: code 1 is \textit{print_int} and code 4 is \textit{print_str}]

\textbf{Prints "10"}

d) If we did a \textit{li} $s0, 0.4$ followed by \textit{sla} $s0, array$ (where ‘array’ is the label at the beginning of our \textit{.data} segment), how many bytes would be printed by a \textit{syscall}?

31 bytes the other 2 bytes would give 28
8. [15] Here is a Karnaugh map with some “Don’t Cares” in it (‘x’) for output $f$. Simplify it in the usual way and show the resultant Boolean expression and circuit.

Be careful not to write $\overline{x} \overline{z}$ instead of $x \overline{z}$.

Boolean expression:

$$f = w + y + xz + \overline{x} \overline{z}$$

Circuit:

Note: Poorly designed questions about all “don’t cares”.

End of Test!