**FIRST EXAM**
ECEN 2120
October 3, 2008

This exam is closed book, closed notes and no calculators.

Write your name on every page. Read through the entire exam, and then answer all the questions. Do all your work on the exam itself -- if necessary, turn the page over or use the back of the previous page. If an answer is multiple choice, clearly circle the correct answer. All essay-type questions can be answered with one or two sentences. You may remove the last page of the exam if it is more convenient for you. You have 50 minutes. **Good Luck!**

**Question 1.** (15 points) For this question, use the register values given in the table below. All the values in the table are in HEX (assume any leading digits are zero). Your answers should also be HEX.

<table>
<thead>
<tr>
<th>D0</th>
<th>CA48</th>
<th>D1</th>
<th>9325</th>
<th>D2</th>
<th>0040</th>
<th>D3</th>
<th>0348</th>
<th>PC</th>
<th>AC12</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>0040</td>
<td>A1</td>
<td>0200</td>
<td>A2</td>
<td>2430</td>
<td>A6</td>
<td>4050</td>
<td>A7</td>
<td>8200</td>
</tr>
</tbody>
</table>

Use the letters (A) through (K) to refer to the addressing modes listed below:

(A) Data register direct  
(B) Address register direct  
(C) Address register indirect  
(D) Address register indirect with predecrement  
(E) Address register indirect with postincrement  
(F) Address register indirect with displacement  
(G) Address register indirect with index  
(H) Absolute  
(I) Program Counter with displacement  
(J) Program Counter with index  
(K) Immediate

For each of the following instructions, indicate which addressing mode is being used and the value of the effective address.

<table>
<thead>
<tr>
<th>Addr. Mode</th>
<th>Effective Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLR.L -(A1)</td>
<td></td>
</tr>
<tr>
<td>NOT.B (SP,D1)</td>
<td></td>
</tr>
<tr>
<td>JMP 28(A0)</td>
<td></td>
</tr>
</tbody>
</table>
Question 2. (5 points) The decimal value -97 is to be stored in a word using 2’s complement representation. What hexadecimal constant would be used in a DC.W directive to represent this value?

Question 3. (5 points) For the instruction: MOVE.W $10F0F0,D6 how many times is the 68000’s data bus used to fetch and execute this instruction?

Question 4. (3 points) A block of 32 bytes of storage is to be reserved. Which of the following assembler directives would accomplish this?
   (a) DC.B %1000
   (b) DC.B 32
   (c) DS.B $20
   (d) DCB.B 0 $32
   (e) None of the above.

Question 5. (5 points) Assume the following section definition:
   
<table>
<thead>
<tr>
<th>SECTION</th>
<th>vars,,D</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>DC.W $0AA</td>
</tr>
<tr>
<td>B</td>
<td>DC.W $0BB</td>
</tr>
<tr>
<td>C</td>
<td>DC.W $0CC</td>
</tr>
<tr>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>

   Assuming that the register D1 has been previously cleared, what are the contents of D1 after the instruction MOVE.L B,D1 is executed? (The answers are in HEX.)
   (a) AA00BB00 (b) 00AA00BB (c) BB00CC00 (d) 00BB00CC
   (e) BB00AA00 (f) 00BB00AA (g) CC00BB00 (h) 00CC00BB

Question 6. (3 points) Which instruction initializes the 32-bit value of D1 to 5?
   (a) MOVE.L 5,D1 (b) MOVE.L #5,D1 (c) MOVE.W 5,D1 (d) MOVE.W #5,D1 (e) None of these.
Questions 7 - 11 Consider the following C function:

```c
int *MyProcedure(int A, char *B, char C); {
    int X[400];
    ... function body ...
}
```

Assume that the C compiler generates assembly code for this function using the standard conventions and linkage. When the code is compiled, the -Zp2 compiler flag is NOT used. Furthermore, assume that registers D0-D4 and A0-A4 are used in the body of the function.

**Question 7.** (5 points) Write a line of assembly code that loads D0 with the value of the variable A.

**Question 8.** (5 points) A sequence of code in the procedure is to step through the array X. Write a line of assembly code that would load A0 with the base address of the array X.

**Question 9.** (5 points) Upon entry to the procedure, registers are saved. Write the line of assembly code you would expect to see.

**Question 10.** (5 points) Write the line of assembly code that you would expect to see immediately after the return from MyProcedure to the calling procedure.

**Question 11.** (3 points) MyProcedure is defined as a function that returns a pointer to an int. Where is this pointer returned?

(a) On the stack   (b) In D0   (c) In D1   (d) In A0   (e) None of these.
Questions 12 - 17 Assume that D0 initially contains the value $1F001F2B and D1 contains $360EA3D7

**Question 12.** (5 points) The instruction ADD.B D0,D1 is executed. After the add instruction is executed, what is the value in D1 (your answer should be in HEX)?

**Question 13.** (3 points) What is the value of the C bit in SR after the instruction is executed?
   (a) 0   (b) 1   (c) Not enough information.

**Question 14.** (3 points) What is the value of the N bit in SR after the instruction is executed?
   (a) 0   (b) 1   (c) Not enough information.

**Question 15.** (3 points) What is the value of the V bit in SR after the instruction is executed?
   (a) 0   (b) 1   (c) Not enough information.

**Question 16.** (5 points) Assume D1 has its original value, $360EA3D7. After the instruction ANDI.L #$F00A00C7,D1 is executed, what value is in D1? (Your answer should be in HEX.)

**Question 17.** (4 points) Assume D1 has its original value, $360EA3D7. What are the contents of D1 after the instruction EXT.L D1 is executed? (Your answer should be in HEX.)
Question 18. (3 points) What assembler directive is used to make a label in a particular module available to assembly code in other modules?

Question 19. (5 points) If the target of a branch instruction is a non-external forward reference, when is that reference resolved?

Question 20. (8 points) Consider the instruction:

```
ADD.W D4,(A3)+
```

Using the information on the last page of this exam, write the machine language encoding of this instruction as a sequence of HEX digits grouped into bytes.
Question 21. (2 points) Please check one of the following boxes, then sign your name.

☐ I do NOT want my grades posted.

☐ I would like my grades posted, using the following 6 character code:

[ ] [ ] [ ] [ ] [ ]

(Print neatly)

On my honor, as a University of Colorado at Boulder student, I have neither given nor received unauthorized assistance on this test.

Sign your name:________________________________________________________
Some useful information.

ADD - Add binary

Operation: (Source) + (Destination) -> Destination
Asembler ADD <ea>, Dn
Syntax: ADD Dn, <ea>

Instruction Format:

```
<table>
<thead>
<tr>
<th>15</th>
<th>14</th>
<th>13</th>
<th>12</th>
<th>11</th>
<th>10</th>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Reg.</td>
<td></td>
<td>Op-Mode</td>
<td>Effective Addr. Mode</td>
<td>Reg.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

Instruction Fields:

- Reg. Field - Specifies Destination Data Reg.
- Op-Mode Field -

<table>
<thead>
<tr>
<th>Byte</th>
<th>Word</th>
<th>Long</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>001</td>
<td>010</td>
<td>(&lt;Dn&gt;) + (&lt;ea&gt;) -&gt; &lt;Dn&gt;</td>
</tr>
<tr>
<td>100</td>
<td>101</td>
<td>110</td>
<td>(&lt;ea&gt;) + (&lt;Dn&gt;) -&gt; &lt;ea&gt;</td>
</tr>
</tbody>
</table>

If <ea> is destination, legal addressing modes:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dn</td>
<td>---</td>
<td>---</td>
<td>d(An,Xi)</td>
<td>110</td>
<td>reg. no.</td>
</tr>
<tr>
<td>An</td>
<td>---</td>
<td>---</td>
<td>Abs.W</td>
<td>111</td>
<td>000</td>
</tr>
<tr>
<td>(An)</td>
<td>010</td>
<td>reg. no.</td>
<td>Abs.L</td>
<td>111</td>
<td>001</td>
</tr>
<tr>
<td>(An)+</td>
<td>011</td>
<td>reg. no.</td>
<td>d(PC)</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>-(An)</td>
<td>100</td>
<td>reg. no.</td>
<td>d(PC,Xi)</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>d(An)</td>
<td>101</td>
<td>reg. no.</td>
<td>Imm</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

If <ea> is source, all addressing modes legal.

Except, An can only be word or long word.

Note: A data register as a destination is not legal, because that is one of the Op-Modes. ADDA is used if an address register is the destination. ADDI and ADDQ may also be used for immediates.