EE 371 Final Exam -
Tuesday December 14, 2004
3 pages, 7 questions, 55 points, 15% of Final Grade

Please put your name on the outside of the paper also Name _____KEY_____

1. The memory display shows:
   4000: 08 29 3F 7F - 86 99 A0 64 - . . .
   and the current value in the X register is $4000
   Give the results of the following instructions: (3 points)
   a. LDAA $4000 A = __**08**____
   b. LDAB $4,x B = __**86**____
   c. LDY $4001 Y = __**293F**____
   Now, with these values in the A and B registers, the following instructions are executed:
   CMPB #$50
   BGT Someplace
   d. Is the branch taken? __**No**_____ (2 points)
2. A 10-bit successive approximation A/D converter has the following specs:
   Minimum conversion time: 10^{-4}; input voltage: -5 to +5 volts
   a. What is the maximum frequency that can be sampled without aliasing? (5 points)

$$f_{MAX} = \frac{1}{2 * 10^{-4}} = 5000 Hz$$

   b. For this frequency, what is the aperture time required so that errors in sampling are less than plus or minus ½ least significant bit? (5 points)

$$t_{AP} = \frac{1}{2\Pi * f_{MAX} * 2^n} = 31.08 ns$$

   c. What is the resolution of this A/D in volts? (5 points)

$$\text{Re}\, solution = \frac{V_{MAX}}{2^n} = \frac{10}{1024} = 9.8 mV$$

3. List three things that must be done in software to allow interrupts from an internal interrupting source in the HC12 to be acted upon. (6 points)
   a. Set the vector(s)
   b. Enable the interrupting system
   c. Unmask interrupts

4. Why, in most processors with interrupts, are further interrupts disabled when the processor reaches the interrupt service routine (4 points).
   So the programmer has control over further interrupts and to keep one interrupt from interrupting another.

5. Write structured pseudo-code (do not write assembly language code) using the principles of structured programming for the following problem statement: (10 points)

   The program is the prompt for and accept a two-digit hexadecimal number from a user typing characters on the keyboard. These are to be converted to an 8-bit binary number and displayed on the LEDs. After a one second delay, the complement of the byte is to be displayed on the LEDs for one second. After this delay, the LEDs are to be turned off and the process repeated starting at the prompt. The program is to continue until the user types two zeros ("00").

   Your design should following the principles of top down design and you may postpone (you don't have to show the design) for details such as how to convert the two input characters to binary and the details of the prompt and how it is to be printed.

   ; Initialize stack pointer
   ; Initialize I/O
   ; Enable LEDs
   ; DO
   ; Prompt for an input
   ; Get two characters from the Keyboard
   ; Convert to binary
   ; Output to LEDs
   ; Delay 1 second
   ; Complement the data
   ; Output to LEDs
   ; Delay 1 second
   ; Blank LEDs
   ; ENDDO
   ; WHILE User has not entered "00"

6. Write a section of HC12 code to implement the design:

   IF Data1 > Data2
   THEN Data2 = Data1
   ELSE Data2 = 64_{10}
   Assume Data1 and Data2 are memory locations containing 8-bit unsigned integer data. Structured code must be used and comments must be included: (5 points)

```
; IF Data1 > Data2
    ldaa   Data1
    cmpa   Data2
    bls    elsepart
; THEN Data2 = Data1
    staa   Data2
    bra    endif
; ELSE Data2 = 64
elsepart:
    movb   #64,Data2
endif:
; ENDIF
```

7. Assume an 8K x 8-bit memory with a single CS* signal. Design a full address decoder for a 16-bit address bus to select the chip for memory addresses $A000 - $BFFF. (10 points)

Bits 15, 14, 13 must be decoded by an AND gate or a 3-8 decoder.