Carleton University
Department of Systems and Computer Engineering
SYSC-2003 Assignment 1, Winter 2013

Due Date: January 22nd, at 2:30 pm (electronic submission)

*You must submit the files identified below **using the electronic Submit application**. The submission process will be canceled at the deadline. No assignments will be accepted via email or on disk.*

Name : _____   **Mark : _____ / 30+3 bonus**
Student Number : _____

Question 1 [18 marks] Conceptual Questions. **Be brief, concise and specific.**

a) [4 marks] Briefly discuss the similarities and differences between microprocessors and microcontrollers.

b) [2 marks] Read the board's documentation found in:

http://www.sce.carleton.ca/courses/sysc-2003/w12/doku.php?id=resourcesnew

and look for the CMLDP256 manual.

Find the information about the NOICE Memory Map. Explain, for each of the following sections of memory, where it is located and what it is used for. Why do we need those different kinds of memory? Justify.

    i)   EEPROM
    ii)   Internal RAM
    iii)   External RAM
    iv)   Flash

c) [12 marks] Read the board's documentation found in:

http://www.sce.carleton.ca/courses/sysc-2003/w12/doku.php?id=resourcesnew

Look for the complete Motorola 9S12DP256B Manual. On this archive, look for the file **9S12DP256BDGV2.PDF**, which is the main user manual for the board. Based on the information found in that manual, answer the following questions:

  i.   [4 marks] How much memory does it have, and of what kind? How many channels for I/O and what kind? What are the main features of the HCS12 CPU? How many registers? What size are they?

  ii.   [2 marks] Give a list of specialized Input/Output devices found on the HC12. Which ones of those you would not find normally in a PC?

iii.   [3 marks] How many bits do the PWM channels have? And how many channels are available? What is the largest number you can store in these counters? What are the memory addresses of PWMCNT0?

iv.   [3 marks] What is the size of the Data Bus? What does this mean? Why do we need an external bus of ½ that size? Explain the differences.

d) [2 marks] Give examples of the following kind of systems. Give an actual existing application. Describe what the system does (in 2 lines), and include a URL with actual information about the system.

   i. Embedded Hard Real-Time System
   ii. Soft Real-Time System (non-embedded)
   iii. Embedded Soft Real-Time System
   iv. Hard Real-Time system (non-embedded)

Question 2 [13 marks+3 bonus] Experimenting with Instruction Encoding and Memory

a) [6 marks+2 bonus] Using the CPU technical data found in the Instruction Set sheet the CPU12 user manual found in the appendix of the textbook or in

   http://www.sce.carleton.ca/courses/sysc-2003/w12/doku.php?id=resourcesnew

   and find

i.   [2 marks+2 bonus] One instruction exactly 6 bytes long. Write the whole hex encoding and the flags that are affected ([bonus: 2 marks] explain the meaning for each of the operands).

ii.   [2 marks] The encoding of the ABA instruction. What is the function of this instruction? Explain what is the relation of this encoding and the opcode/operand definition presented in Slide 1-10 in class? Discuss.

iii.   [2 marks] The number of bytes used by the instruction INX and the number of bytes used by the instruction DBNE. What kind of operations do they do? Why one is long and the other is short? Compare and discuss.

b) [3 marks] Start the simulator. Load the *example.s19* program found in the course webpage. Set PC=$4000 and the memory window to display address $800. **Step** through your code (do NOT run). Check the contents of the registers on every step. Upon completion, what is the content of register D? (in Hexadecimal and Decimal) And the content of $800? (in Hexadecimal and Decimal) What is the program doing?

   [Hint: on every part of this and following exercises, use the CODE View window to see the program written also in Assembly]

c) [2 marks+1 bonus] Show and explain the encoding of the instruction found in $4006 [Bonus 1 mark: explain the encoding in detail].

d) [2 marks] Reset the simulator. In runtime, change the instruction in address 4003 (12) by 11. Repeat b). What is this modified version doing?