UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSIEN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	EMBEDDED SYSTEMS DESIGN
COURSE CODE	:	BEC 41703
PROGRAMME	:	BEJ
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FIVE** (5) PAGES

Q1 (a) Most of the electronic devices surrounding us are embedded systems. Give reasons why those electronic devices are not built using general purpose systems.

(3 marks)

(b) Programmable devices are of significant importance due to its several advantages over microprocessor based hardware platforms. Aerospace applications are mission critical tasks in which applications must operate reliably in extreme environmental conditions such as for satellite. Some requirements for mission critical applications are non-volatile, low hardware area, security of the designs and radiation resistance. For a given aerospace application, decide and justify what would be the most suitable implementation choice between FPGA (SRAM-based, EEPROM-based, antifuse-based, flash-based) and CPLD?

(4 marks)

(c) Your company is developing a high volume product based on an ASIC architecture. A team of engineer recently noticed that the product requires design flexibility without increasing design cost to be able to compete in the market by adopting new design requirements. Suggest a solution for the problem and support it with reasons.

(4 marks)

(d) You are writing a C code of a keypad driver for a vending machine interface. Through simulation, a task that performs a part of the function in the code is currently in the running state (executing by the processor). Explain three (3) conditions that will move the task to the blocked state.

(3 marks)

Q2 (a) Correlate the memory hierarchy in embedded systems with its characteristics.

(4 marks)

(b) A processor targeted for microcontroller functions needs to be designed and it will be primarily used in electronic home appliances. Justify two (2) reasons, which processor architecture between CISC and RISC is the best suit for the requirement.

(2 marks)

(c) Based on the Figure **Q2**, summarize the function of Nested Vectored Interrupt Controller (NVIC) in ARM Cortex-M0 processor.
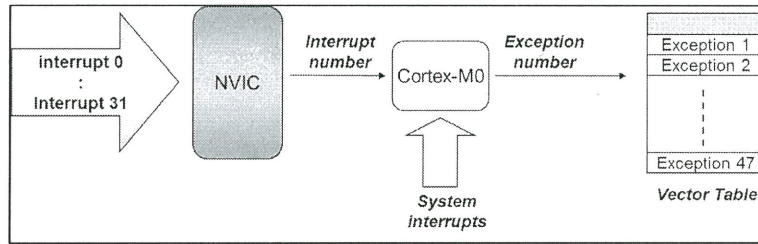
FIGURE Q2

(4 marks)

(d)   Black and white box testing are two (2) types of software testing methods.

      (i)   State the best method to test embedded software designs targeting for checking functionality of the codes with good testing coverage?

(1 mark)

      (ii)   Give two (2) reasons to support your answer in Q2(d)(i).

(4 marks)

Q3   For the specification shown in Figure **Q3**, answer the following questions:

$$X = A - B + 3$$
$$Y = C + 5$$
$$Z = X - Y$$

$$while\ (Z > 0)\ loop$$
$$\qquad Z = Z - 1$$
$$end\ loop$$

FIGURE Q3

(a)   Construct a control/data flow graph (CDFG).

(6 marks)

(b)   Based on the constructed CDFG graph in Q3(a), perform optimization and sketch another CDFG graph (the optimized graph).

(4 marks)

(c)   Deduce what would be the resource cost, between software and hardware only implementation for the initial CDFG and optimized CDFG. Assume each operation (arithmetic and control operation) requires 10 logic gates.

(8 marks)

Q4 (a) With the aid of a block diagram, briefly explain about Serial Peripheral Interface (SPI) communication protocol including its interface signals.

(10 marks)

(b) Analyze the SPI timing diagram in Figure **Q4** and summarize the operation.
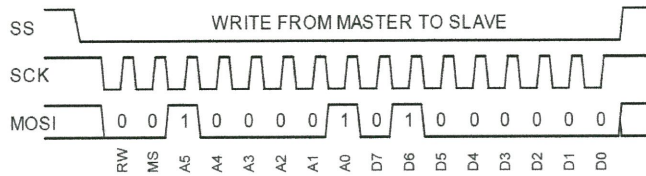

FIGURE Q4

(8 marks)

(c) A microcontroller needs to be interfaced with an LCD to display information about total weight of wastes that a user has thrown for a smart recycle bin application.

(i) Design an I2C communication protocol (a step by step operation) to transfer (write) two (2) blocks of data from a master device to the LCD device (address=0x07).

(9 marks)

(ii) Produce a timing diagram for the proposed data transfer in Q4(c)(i).

(11 marks)

Q5 Analyse the program shown in Figure **Q5**.

(a) Write a suitable comment for comment 1 until 10.

(10 marks)

(b) Summarize the overall function of the program.

(5 marks)

```
1   Int8_t number;

2   char TEXT0[16]="Question Q5";
3   char TEXT1[16]="In:      ";

4   UNLOCKREG();
5   DrvSYS_Open(48000000); // comment 1
6   LOCKREG();

7   Initial_panel(); // comment 2
8   clr_all_panel(); // comment 3
```

```
 9  OpenKeyPad(); // comment 4
10  print_lcd(0,TEXT0); // comment 5

11  while(1) // comment 6
12  {
13  number = Scankey(); // comment 7
14  print(TEXT1+8,"%d",number); // comment 8

15  print_lcd(1, TEXT1); // comment 9
16  DrvSYS_Delay(5000); // comment 10
17  }
```

FIGURE Q5

- END OF QUESTIONS -