UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	EMBEDDED SYSTEMS DESIGN
COURSE CODE	:	BEC41703
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	DECEMBER 2018/JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN THIS QUESTION BOOKLET

TERBUKA

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

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

(3 marks)

(b) List **four (4)** characteristics of embedded systems.

(4 marks)

(c) **Figure Q1** shows the block diagram of a general-purpose system exists in a personal computer (PC). Identify the similarity and difference between the block diagram shown in **Figure Q1** with the block diagram of XOLO X900 smartphone. Give an appropriate example.
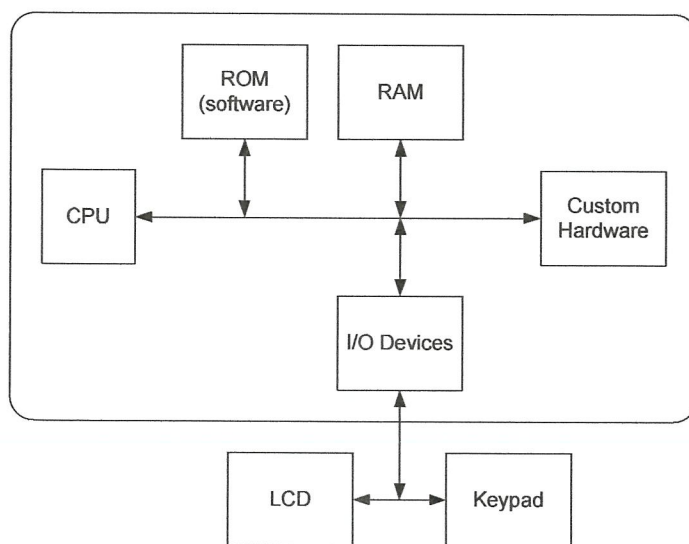

Figure Q1

(6 marks)

2

(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). Describe **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 survey result shown in **Figure Q2** shows that most of embedded system projects finish less than 12 months. Among several hardware platforms available for designing embedded system applications, decide the suitable platforms that can meet this trend.
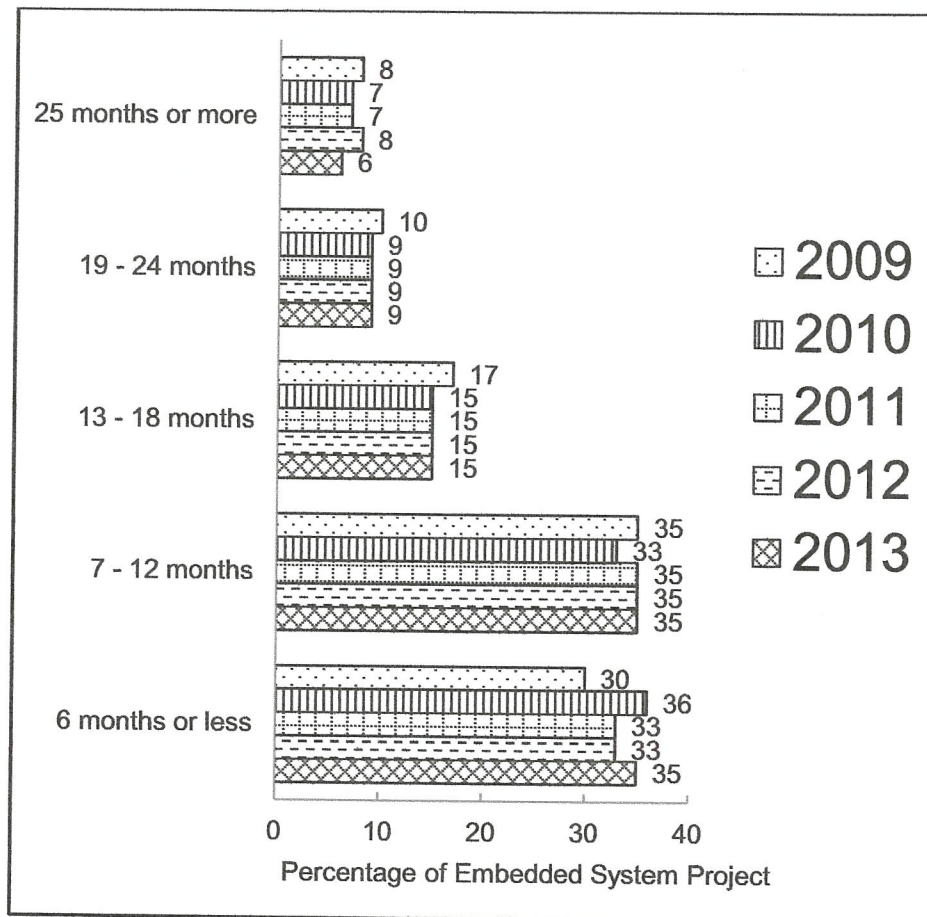

Figure Q2

(4 marks)

(c) **Table Q2** shows the comparison of embedded hardware platforms. Write suitable answers in items (1) to (9).

Table Q2

Characteristic	FPGA	ASIC	μCONTROLLER
Maximum speed	(1)	(2)	(3)
Power consumption	(4)	(5)	(6)
Support for parallel implementation	(7)	(8)	(9)

(9 marks)

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

   (i) An embedded system has been prototyped and software testing must be conducted to ensure it is working as expected. Among the testing requirement is to make sure that the prototype function correctly based on certain input conditions as well as to make sure that the inner structure is written correctly. Choose the best testing method.

(2 marks)

   (ii) Justify your answer for question in **Q1(d)(i)**.

(6 marks)

Q3   (a)   **Figure Q3(a)** shows the requirements for selecting an embedded operating system for a target application. Summarize the embedded operating system selection process based on the requirements.
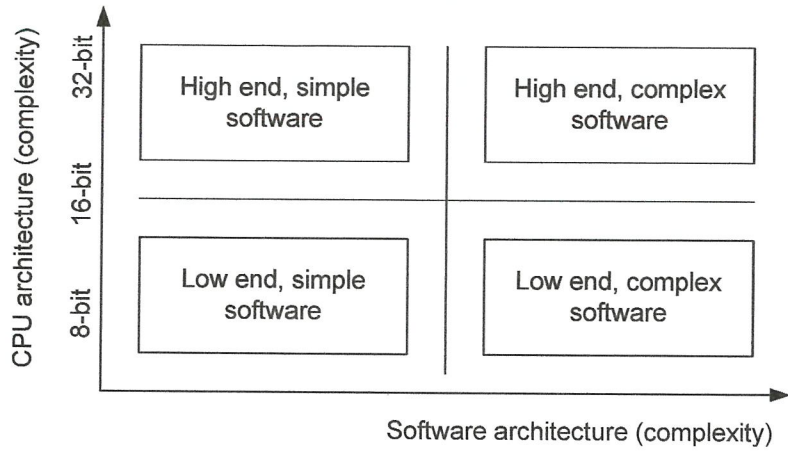

Figure Q3(a)

(8 marks)

(b)   Differentiate between Real Time Operating System (RTOS) and general-purpose operating systems in terms of scheduling and latency.

(4 marks)

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(c)   Explain pre-emptive scheduling concept using appropriate diagram.

(4 marks)

(d)   **Figure Q3(d)** shows the simplified hardware/software co-design flow. Examine the function of items (1) to (4).
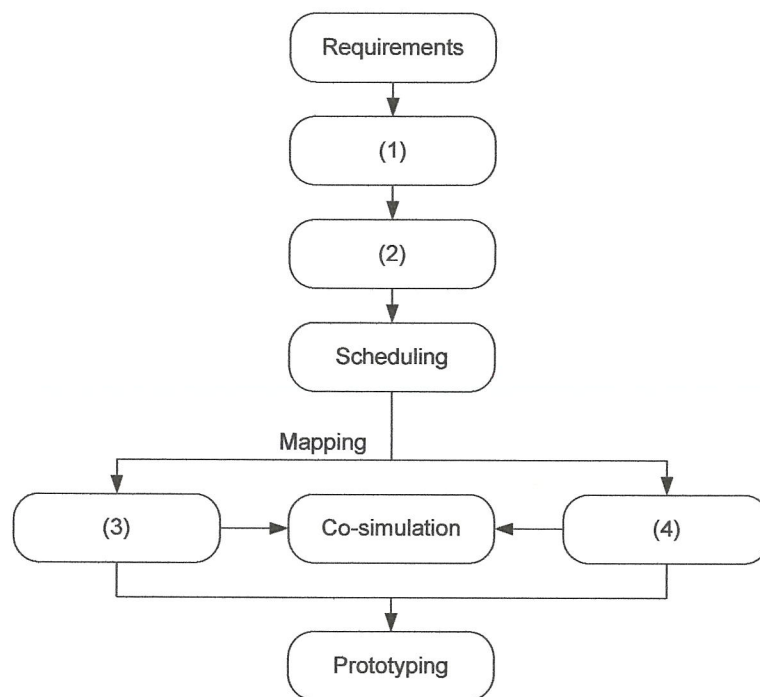
```
                    ┌──────────────┐
                    │ Requirements │
                    └──────┬───────┘
                           ▼
                    ┌──────────────┐
                    │     (1)      │
                    └──────┬───────┘
                           ▼
                    ┌──────────────┐
                    │     (2)      │
                    └──────┬───────┘
                           ▼
                    ┌──────────────┐
                    │  Scheduling  │
                    └──────┬───────┘
                        Mapping
        ┌──────────┐   ┌──────────────┐   ┌──────────┐
        │   (3)    │──▶│ Co-simulation│◀──│   (4)    │
        └────┬─────┘   └──────┬───────┘   └────┬─────┘
             │                ▼                │
             │         ┌──────────────┐        │
             └─────────│  Prototyping │────────┘
                       └──────────────┘
```

Figure Q3(d)

(8 marks)

7

Q4   (a)   Write suitable answers in items (1) to (9) in **Table Q4**.

Table Q4

Characteristic	I2C	SPI	CAN
Error detection	(1)	(2)	(3)
Number of physical wires	(4)	(5)	(6)
Synchronous / asynchronous	(7)	(8)	(9)

(9 marks)

(b)   Analyze the Serial Peripheral Interface (SPI) timing diagram in **Figure Q4** and determine the following things:
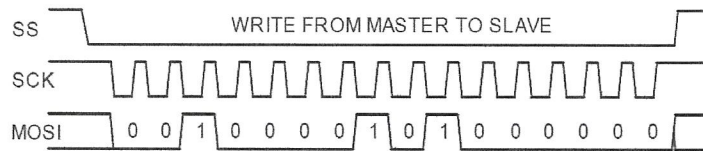

Figure Q4

(i)   Type of operation.

(2 marks)

(ii)   Associate address for the operation in **Q4(b)(i)**.

(2 marks)

(iii)   Associate data for the operation in **Q4(b)(i)**.

(2 marks)

(c)   An embedded system requires RS232 physical ports through Universal Asynchronous Receiver Transmitter (UART) protocol to communicate with a PC. An ASCII character of A (1000001) needs to be transferred from the PC to the device. Any error for every transferred bit data must be checked. Produce a timing diagram for the transfer.

(11 marks)

Q5   Analyse the C code shown in **Figure Q5** by writing suitable comment in items (1) to (9).

(9 marks)

```
Int8_t number;

char TEXT0[16]="QUESTION Q5(B)";
char TEXT1[16]="            ";

UNLOCKREG();
DrvSYS_Open(48000000); //(1)
LOCKREG();

Initial_panel(); //(2)
clr_all_panel(); //(3)

OpenKeyPad();
print_lcd(0,TEXT0); /(4)

while(1) //(5)
{
    number = Scankey(); //(6)
    sprintf(TEXT1+8,"%d",number); //(7)

    print_lcd(1, TEXT1); //(8)
    DrvSYS_Delay(5000); //(9)
}
```

Figure Q5

- END OF QUESTIONS -