UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(TAKE HOME)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	MICROPROCESSOR AND MICROCONTROLLER
COURSE CODE	:	BEC30403 / BEJ30203
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2020
DURATION	:	4 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS. **OPEN BOOK EXAMINATION**

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

Q1 In assembly language, write a program to find a minimum byte data in a block of memory from address 0x20000000 to 0x200001000.

(a) Draw the detail flow chart

(10 marks)

(b) Write the programming code

(10 marks)

Q2 Use Keil µVision5 to answer the following questions:

(a) If register R0 contains 0xFEC88421, write an assembly program to clear bit 25 to bit 31, and set bit 0 to bit 9. Then, move the content of R0 to the memory (you are free to choose your prefer memory location in the memory space). Screenshot the content of memory after you execute your program.

(10 marks)

(b) Write a program to add these numbers 0x12345678, 0x0001, 0x1256, 0x15. Determine The address of your program in memory by providing the start and end address of your program. Give the size of your program in byte.

(10 marks)

Q3 Demonstrate the process of executing a nested subroutine, where you will have three subroutines. Subroutine number 2 will be called from subroutine number 1, while subroutine number 3 will be called from subroutine number 2. In Keil µVision, screenshot your result, by showing the value of PC and LR. Discuss your results by relating the values in PC, LR and stack for each subroutine call.

(10 marks)

Q4 Figure Q4 shows a simple water temperature monitoring system in a plant. The temperature will be displayed on the LCD (C12832). The temperature sensor is the LM35, which is an analog sensor. If the temperature is less than 20°C, the blue LED will be turned on, while if the temperature is more than 40°C, the red LED will be turned on. Otherwise, the yellow LED will be turned on. The system will start the operation when the start button is pressed, and will stop the operation when the stop button is pressed. Note that the sensitivity of LM35 is 10 mV/°C, where 0 V represents 0°C, while 1.5 V represents 150°C.
From the specifications,

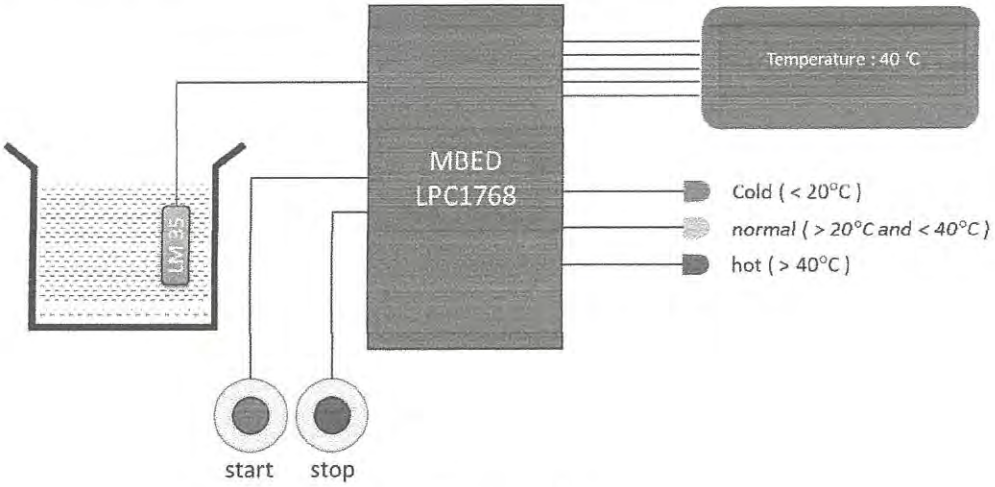

Figure Q4

(a) Draw a flowchart to devise your program

(10 marks)

(b) Write a program using mbed API to implement the application.

(10 marks)

(c) Modify your program accordingly if the LM35 is replaced with SHT31 temperature sensor.

(10 marks)

(d) Discuss the differences of using the LM35 as compared to SHT31 in your application.

(10 marks)

Q5 Examine the program given in **Listing Q5(a)** and **Q5(b)**. By simulating the program in mbed simulator, discuss the differences between the two programs. Use a flowchart to aid your explanation.

```
1:  #include "mbed.h"
2:  Timeout Response;
3:  DigitalIn button (p5);
4:  DigitalOut led1(LED1);
5:  DigitalOut led2(LED2);
6:  DigitalOut led3(LED3);
7:  void blink() {
8:     led2 = 1;
9:     wait(3);
10:    led2=0;
11: }
12: int main() {
13: while(1) {
14:    if(button==1){
15:       Response.attach(&blink,2.0);
16:       led3=1;
17:    }
18:    else {
19:       led3=0;
20:    }
21:    led1=!led1;
22:    wait(0.2);
23:    }
24: }
```

Listing Q5(a)

```
1:  #include "mbed.h"
2:  DigitalOut led1(LED1);
3:  DigitalOut led2(LED2);
4:  DigitalOut led3(LED3);
5:  Timeout Response;
6:  Timeout Response_duration;
7:  InterruptIn button(p5);
8:  void blink_end (void);
9:  void blink (void);
10: void ISR1 (void);
11: void blink() {
12:    led2=1;
13:    Response_duration.attach(&blink_end, 3.0);
14:    }
15: void blink_end() {
16:    led2=0;
17:    }
18: void ISR1(){
19:    led3=1;
20:    Response.attach(&blink, 2.0);
21:    }
22: int main() {
23: button.rise(&ISR1);
24: while(1) {
25:    led3=0;
26:    led1=!led1;
27:    wait(0.2);
28:  }
29: }
```

Listing Q5(b)

(10 marks)

END OF QUESTIONS