UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2020/2021

COURSE NAME	:	REAL TIME EMBEDDED SYSTEM
COURSE CODE	:	BEH 42003 / BEJ 44303
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2021
DURATION	:	3 HOURS
INSTRUCTIONS	:	ANSWER **ALL** QUESTIONS. **OPEN BOOK EXAMINATION**

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

Q1   An Arduino Uno as a master controller is used to read an I2C light sensor; to display using a SPI Touch Screen LCD; and to send data to computer using an UART-Bluetooth module. Find the **correct** statement.

(a)   The LCD is a asynchronous and simplex device.
(b)   The LCD is a synchronous and half-duplex device.
(c)   The bluetooth is an asynchronous and half-duplex device.
(d)   The light sensor is a synchronous and half-duplex device.

(3.5 marks)

Q2   An Arduino Uno as a master controller is used to read an I2C light sensor; to display using a SPI Touch Screen LCD; and to send data to computer using an UART-Bluetooth module. Find the **incorrect** statement.

(a)   Pull-up resistors are needed when connecting the Touch Screen LCD.
(b)   Four IOs are needed when connecting the Touch Screen LCD.
(c)   Pull-up resistors are needed when connecting the light sensor
(d)   Two IOs are needed when connecting the light sensor.

(3.5 marks)

Q3   A push button with a **pull-up** resistor is connected to D10. A blue LED was connected to D11 with **sourcing mode**. A red LED was connected to D11 with **sinking mode**. Find the **correct** description for the following code.

```
void setup( ){
        pinMode(10, INPUT);
        pinMode(11, OUTPUT);
        pinMode(12, OUTPUT);
}

void loop( ){
        if (digitalRead(10) = = 1){
                digitalWrite(11, HIGH);
                digitalWrite(12, HIGH);
        else{
                digitalWrite(11, LOW);
                digitalWrite(12, LOW);

        }
}
```

(a)   The blue LED and red LED will light up when the push button is pressed.
(b)   The blue LED and red LED will light up when the push button is not pressed.
(c)   The blue LED will light up but the red LED will not light up when the push button is not pressed.
(d)   The blue LED will not light up but the red LED will light up when the push button is not pressed.

(3.5 marks)

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Q4   A push button with a **pull-up** resistor is connected to D10. A blue LED was connected to D11 with **sinking mode**. A red LED was connected to D11 with **sourcing mode**. Find the **correct** statement for the following code.

```
void setup( ){
        pinMode(10, INPUT);   pinMode(11, OUTPUT);
        pinMode(12, OUTPUT);
}

void loop( ){
        if (digitalRead(10) = = 1){
                digitalWrite(11, HIGH); digitalWrite(12, HIGH);
        else{
                digitalWrite(11, LOW); digitalWrite(12, LOW);
        }
}
```

(a)   The blue LED and red LED will light up when the push button is pressed.
(b)   The blue LED and red LED will light up when the push button is not pressed.
(c)   The blue LED will light up but the red LED will not light up when the push button is not pressed.
(d)   The blue LED will not light up but the red LED will light up when the push button is not pressed.

(3.5 marks)

Q5   A push button with a **pull-down** resistor is connected to D10. Both red and blue LEDs are connected to D11 and D12 with **sourcing mode**. Find the **correct** description for the following code.

```
void setup( ){
        pinMode(10, INPUT);
        pinMode(11, OUTPUT);
        pinMode(12, OUTPUT);
}

void loop( ){
        if (digitalRead(10) = = 0){
                digitalWrite(11, HIGH); digitalWrite(12, HIGH);
        else{
                digitalWrite(11, LOW); digitalWrite(12, LOW);
        }
}
```

(a)   The blue LED and red LED will light up when the push button is pressed.
(b)   The blue LED and red LED will light up when the push button is not pressed.
(c)   The blue LED will light up but the red LED will not light up when the push button is not pressed.
(d)   The blue LED will not light up but the red LED will light up when the push button is not pressed.

TERBUKA (3.5 marks)

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Q6   Calculate the hyperperiod of a real-time system that consists of four tasks of T1(15,4), T2(30,4), T3(40,4), and T4(20,2).

    (a)   14ms.
    (b)   40ms
    (c)   105ms
    (d)   120ms

(3.5 marks)

Q7   Analyze the following source code and then determine the task has highest priority.

```
void setup() {
        xTaskCreate(Task1, "T1", 16, NULL, 2, NULL);
        xTaskCreate(Task2, "T2", 16, NULL, 3, NULL);
        xTaskCreate(Task3, "T3", 16, NULL, 1, NULL);
        xTaskCreate(Task3, "T4", 16, NULL, 0, NULL);
}
```

    (a)   Task1
    (b)   Task2
    (c)   Task3
    (d)   Task4

(3.5 marks)

Q8   Analyze the following source code and then determine the best description.

```
void TaskB(void *pvParameters)
{
    TickType_t          xLastWakeTime;
    const TickType_t    xFrequency = 100 / portTICK_PERIOD_MS;
    xLastWakeTime  = xTaskGetTickCount();
 while (1)
 {
  vTaskDelayUntil( &xLastWakeTime, xFrequency );
  Vin = analogRead(A0);
 }
}
```

    (a)   TaskB will be suspended for 100ms after Vin = analogRead(A0); is executed.
    (b)   TaskB will be blocked for 100ms after Vin = analogRead(A0); is executed.
    (c)   TaskB will be runned once for every 100ms.
    (d)   TaskB will be ready once for every 100ms.

(3.5 marks)

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Q9   Determine the correct description for a real-time system with three tasks of TA(5,10), TB(1,5), and TC(3,10) in which the priority level is TB > TC > TA.

     (a)   At time 5.5ms, the status of Task TA, TB, TC are running, blocked, and ready, respectively.

     (b)   At time 5.5ms, the status of Task TA, TB, TC are running, ready, and blocked, respectively.

     (c)   At time 5.5ms, the status of Task TA, TB, TC are ready, running, and blocked, respectively.

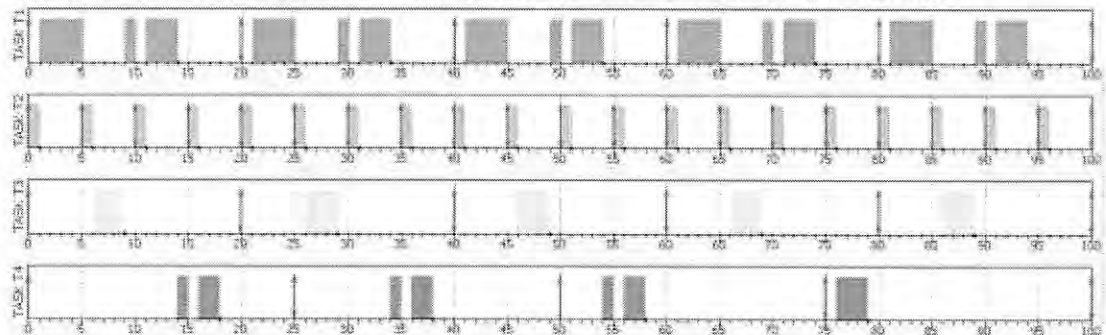   (d)   At time 5.5ms, the status of Task TA, TB, TC are running, ready, and ready, respectively.

(3.5 marks)

Q10   Find the correct description for a real-time system with three tasks of TA(5,10), TB(1,5), and TC(3,10) in which the priority level is TB > TC > TA.

     (a)   At time 7.5ms, the status of Task TA, TB, TC are running, blocked, and ready, respectively.

     (b)   At time 7.5ms, the status of Task TA, TB, TC are running, ready, and blocked, respectively.

     (c)   At time 7.5ms, the status of Task TA, TB, TC are ready, running, and blocked, respectively.

     (d)   At time 7.5ms, the status of Task TA, TB, TC are running, blocked, and blocked, respectively.

(3.5 marks)

Q11   Analyze the following activation diagram and find the correct description.
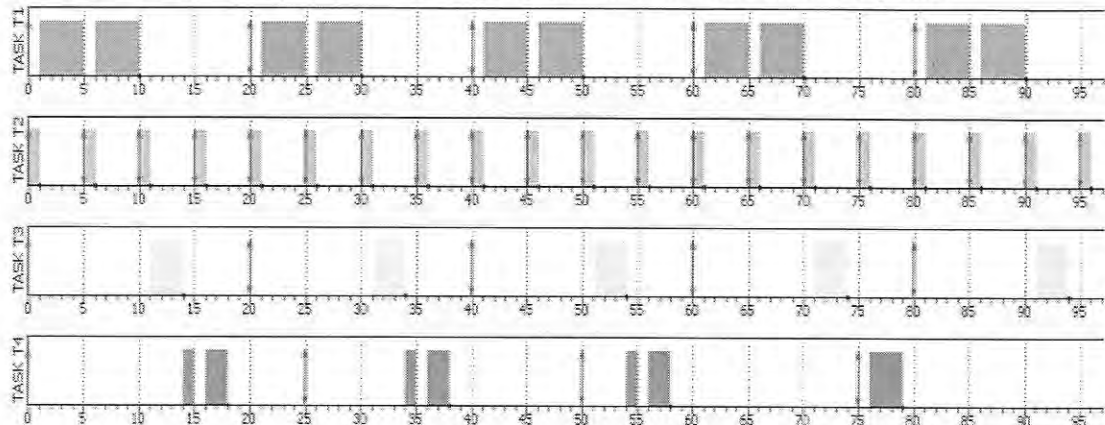

     (a)   Dynamic priority scheduling algorithm of Earliest Deadline First algorithm was used.

     (b)   Dynamic priority scheduling algorithm of Rate Monotonic algorithm was used.

     (c)   Static priority scheduling algorithm of Earliest Deadline First algorithm was used.

     (d)   Static priority scheduling algorithm of Rate Monotonic algorithm was used.

(3.5 marks)

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Q12 Analyze the following activation diagram and find the correct description.

(a) Dynamic priority scheduling algorithm of Earliest Deadline First algorithm was used.

(b) Dynamic priority scheduling algorithm of Rate Monotonic algorithm was used.

(c) Static priority scheduling algorithm of Earliest Deadline First algorithm was used.

(d) Static priority scheduling algorithm of Rate Monotonic first algorithm was used.

(3.5 marks)

Q13 Find the completion time for a real-time system of three tasks of TA(8,20), TB(1,5), and TC(3,20) in which the Rate Monotonic scheduling algorithm was used.

(a) The completion time of TA, TB, TC are 5, 11, and 14ms, respectively.

(b) The completion time of TA, TB, TC are 8, 1, and 3ms, respectively.

(c) The completion time of TA, TB, TC are 10, 1, and 14ms, respectively.

(d) The completion time of TA, TB, TC are 10, 11, and 14ms, respectively.

(3.5 marks)

Q14 Find the start delay for a real-time system of three tasks of TA(8,20), TB(1,5), and TC(3,20) in which the Rate Monotonic scheduling algorithm was used.

(a) The start delay of TA, TB, TC are 1, 0, and 14ms, respectively.

(b) The start delay of TA, TB, TC are 2, 1, and 14ms, respectively.

(c) The start delay of TA, TB, TC are 1, 0, and 11ms, respectively.

(d) The start delay of TA, TB, TC are 2, 1, and 11ms, respectively.

(3.5 marks)

Q15   Find the total utilization for a real-time system of three tasks of TA(8,20), TB(1,5), and TC(3,20) in which the Earliest Deadline First algorithm was used.

(a)   75%
(b)   100%
(c)   25%
(d)   80%

(3.5 marks)

Q16   Analyze the following source code and then find the best description.

```
void Task1(void *pvParameters){
 for (;;) {
  if (xSemaphoreTake(mutex, 10/portTICK_PERIOD_MS) == pdTRUE){
     Serial.println("TaskMutex");
     xSemaphoreGive(mutex);
  } vTaskDelay(10 / portTICK_PERIOD_MS);
 }
}
```

(a)   If the semaphore is not available, the system will wait 10 ticks to see if it becomes free.
(b)   If the semaphore is available within 10ms, the system will send "TaskMutex" via serial communcation.
(c)   If the semaphore is not available after 10ms, the system will send "TaskMutex" via serial communcation.
(d)   This task will be executed every 10ms.

(3.5 marks)

Q17   Analyze the following source code and then find the best description when a LED is connected to D10 and this task has the highest priority.

```
void Task1(void *pvParameters){
 mutex = xSemaphoreCreateMutex( );
 for (;;) {
  if (xSemaphoreTake(mutex, 50/portTICK_PERIOD_MS) == pdTRUE){
     xSemaphoreGive(mutex);
     digitalWrite(10, !digitalRead(10));
  }
  else
     digitalWrite(10, !digitalRead(10));
  vTaskDelay(20 / portTICK_PERIOD_MS);
 }
}
```

(a)   The LED will blink every 20ms when mutex is not available.
(b)   The LED will blink every 70ms when mutex is not available.
(c)   The LED will blink every 50ms when mutex is not available.
(d)   The LED will not blink when mutex is available.

(3.5 marks)

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Q20   Analyze the following source code and then find the best description when Task1() has the highest priority.

```
void Task1(void *pvParameters){
 vSemaphoreCreateBinary( xSemaphore );
  for (;;) {
     if (xSemaphoreTake(xSemaphore, 500/portTICK_PERIOD_MS) == pdTRUE)
         Serial.println("Task1");
      vTaskDelay(200 / portTICK_PERIOD_MS);
 }
}
void Task2(void *parameter) {
  while(1) {
   if (digitalRead(10) == LOW){
      Serial.println("Task2");
      xSemaphoreGive(xSemaphore);
  }
   vTaskDelay(200 / portTICK_PERIOD_MS);
  }
}
```

(a)   Task 1 and Task 2 are mutually excluded.

(b)   Serial.println("Task1") will be executed after Serial.println("Task1") is executed.

(c)   Serial.println("Task2") will be executed after Serial.println("Task1") is executed.

(d)   The period of Task 1 and Task 2 are the same.

(3.5 marks)

Q21   A real-time system contains three tasks of T1(10, 2, 5), T2(15, 6, 10), and T3(20, 2, 2). Analyze the system performance when two different scheduling algorithms are used i.e. Rate Monotonic and Earliest Deadline First scheduling algorithms in the one hyperperiod.

(30 marks)

- END OF QUESTIONS -

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