



**UNIVERSITI TUN HUSSEIN ONN
MALAYSIA**

**FINAL EXAMINATION
SEMESTER 1
SESSION 2018/2019**

COURSE NAME : MICROCONTROLLER
COURSE CODE : DAE 32203
PROGRAMME CODE : DAE
EXAMINATION DATE : DECEMBER 2018/JANUARY 2019
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : ANSWER **THREE (3)** QUESTIONS
ONLY IN SECTION A AND ALL
QUESTION IN SECTION B.

TERBUKA

THIS QUESTION PAPER CONSISTS OF NINE (9) PAGES

SECTION A

Q1 (a) Give the definition of microcontroller and list **four (4)** important aspects that require attention in choosing a suitable microcontroller. (5 marks)

(b) System bus is a collection of wires carrying information within a computer system. Briefly explain the **three (3)** types of busses. (3 marks)

(c) There are 8 data buses and 12 address buses connected between CPU and memory. Considering 1Kb is equal to 1024bytes. Calculate the size of the memory for this microcontroller. (2 marks)

(d) (i) Design a circuit diagram of a system that using serial communication technology in Arduino.

There are **two (2)** button connected in the first Arduino. When button SW1 is pressed, it will turn on LED1 in the second Arduino, and when the button SW2 is pressed, it will turn off the LED1.

(4 marks)

(ii) Write a full programming code for **Q1(d)(i)**. (11 marks)

TERBUKA

Q2 (a) Convert these numerical base system. Show your calculation.

- (i) 1001001_2 to hexadecimal
- (ii) AF_{16} to binary
- (iii) 1023_{10} to binary

(9 marks)

(b) Explain each of the following program instruction below:

- (i) `#define LED 13`
- (ii) `millis();`
- (iii) `pinMode(3, INPUT);`
- (iv) `digitalWrite(4, LOW);`
- (v) `analogWrite(9, 255);`

(5 marks)

(c) Write a program to control 3 LEDs as follow:

Table Q2(c)

Time sequence	LED 1	LED 2	LED 3
0 – 1 second	Led_status	Led_status	Led_status
1 – 3 seconds	!Led_status	Led_status	!Led_status
3 – 5 seconds	Led_status	!Led_status	Led_status

Let say the initial state of all the LEDs is OFF. In your program, write a comment of LED's status in each statement of controlling the LEDs.

Example:

```
digitalWrite(xx, Led_status); //LOW
```

Note that the Led_status value is continuous from 0-5 seconds.

(11 marks)



Q3 (a) In the Arduino world, Timer0 is been used for the timer functions like millis(). millis() function returns the number of milliseconds since the Arduino board began running the current program.

(i) What is the estimated number of days before millis() will overflow (go back to zero) ?

(1 mark)

(ii) Based on the code below, if the condition is TRUE with assume that the initial value of variable TIMEOUT is zero(0) and the code is located in loop function, how long it take in seconds to light up the LED?

```
unsigned long CURRENTMILLIS = millis();
if (CURRENTMILLIS - TIMEOUT > 2000)
{
    digitalWrite(LED,HIGH);
}
```

(1 mark)

(iii) Based on the **Figure Q3(a)(iii)**, write a program to blink LED at pin 13 every 3 seconds using timer millis() as a delay.

(6 marks)

(b) Interrupts in Arduino is an external event that interrupts the running program and runs a special interrupt service routine (ISR). It's useful for making things happen automatically in microcontroller programs.

(i) List out **two (2)** functions to enable and disable the interrupts.

(2 marks)

(ii) Based on the syntax below, briefly explain each parameter.

```
attachInterrupt (pin, ISR, mode) ;
```

(3 marks)

TERBUKA

- (iii) Based on the button sequence in **Figure Q3(b)(iii)** and the sample program below, fill in the correct results for an LED (ON/OFF) for each interrupt mode in the **Table Q3(b)(iii)**.

```
int LED = 13;
int state = LOW;

void setup() {
  pinMode(LED, OUTPUT)
  attachInterrupt(0, ISR0, MODE );
}
void loop() {
  digitalWrite(LED, state);
}
void ISR0() {
  state = !state;
}
```

Table Q3(b)(iii)

Interrupt Mode	LED Status (ON/OFF)		
	i (initial)	ii	iii
LOW			
RISING			
FALLING			
CHANGE			

(12 marks)

TERBUKA

Q4 (a) LCD is an electronically modulated optical device that uses the light-modulating properties of liquid crystals. LCDs are used in a wide range of applications.

(i) Briefly describe the function of LCD. (1 mark)

(ii) Give an example of LCD application in daily life. (2 marks)

(b) All of the LCD programming code uses the LiquidCrystal library that comes pre-installed with the Arduino IDE.

(i) Briefly explain the meaning of the following codes:

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

void setup() {
  lcd.begin(16, 2);
}
```

(3 marks)

(ii) Write a program to display an analog value on LCD. (4 marks)

(iii) Write a program to blink and no blink the cursor. (7 marks)

(c) One of the application of LCD is displaying the temperature by interfacing the Arduino and LM35. Construct a circuit diagram to build an Arduino LM35 temperature sensor with LCD display. You can refer **Figure Q4(c)** for labelled LCD pins and Arduino UNO pins.

(8 marks)

TERBUKA

SECTION B

- Q5** Design a system to control a servo motor position using a 10k ohm potentiometer with **four (4)** LEDs as indicator. The potentiometer must control the servo motor position from 0 to 180 degree. The LEDs operation are as follow:

Table Q5

Servo position	LED 1	LED 2	LED 3	LED 4
Less than or equal to 45°	ON	OFF	OFF	OFF
Between 46° to 90°	ON	ON	OFF	OFF
Between 91° to 135°	ON	ON	ON	OFF
More than 135°	ON	ON	ON	ON

In your program, use Servo library to control the servo motor position.

- (a) Illustrate your proposed system circuit diagram.

(8 marks)

- (b) Develop a program based on the operation stated.

(17 marks)

- END OF QUESTION -

TERBUKA

FINAL EXAMINATION

SEMESTER/SESSION: SEM 1/2018/2019
 COURSE NAME : MICROCONTROLLER

PROGRAMME CODE: DAE
 COURSE CODE: DAE 32203

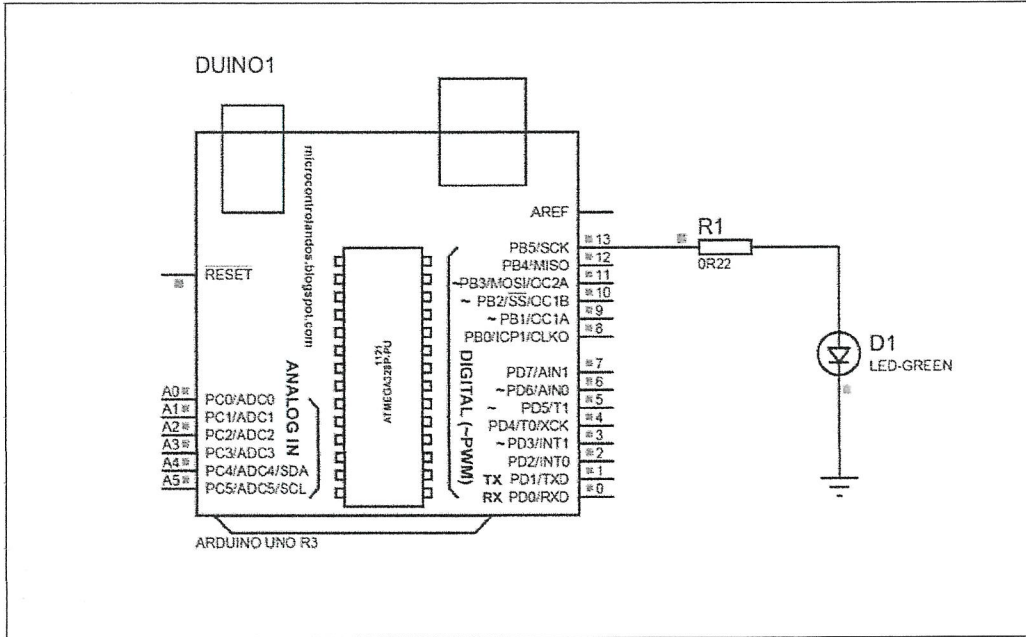


FIGURE Q3(a)(iii)

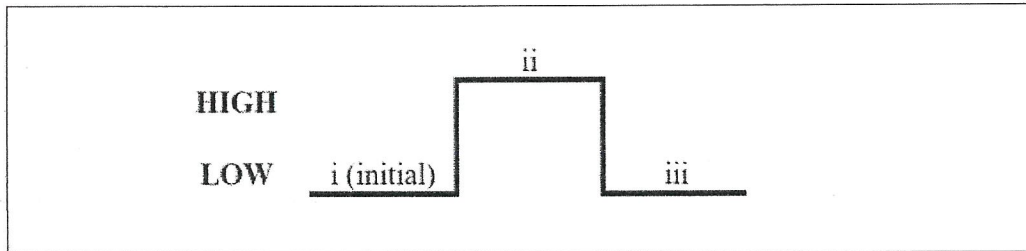


FIGURE Q3(b)(iii)

TERBUKA

FINAL EXAMINATION

SEMESTER/SESSION: SEM 1/2018/2019
COURSE NAME : MICROCONTROLLER

PROGRAMME CODE: DAE
COURSE CODE: DAE 32203

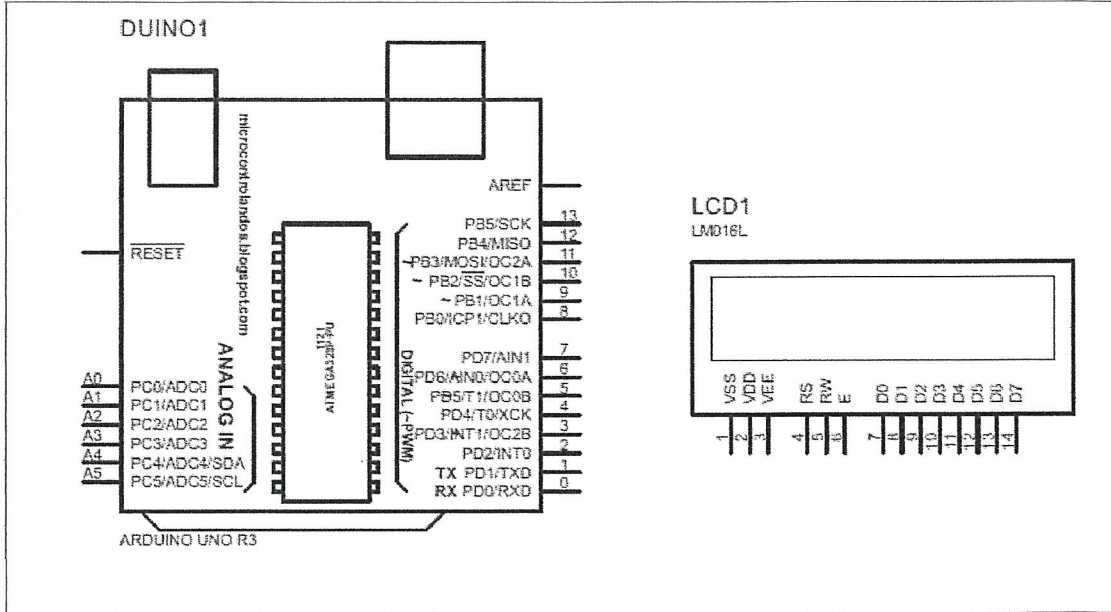


FIGURE Q4(c)

TERBUKA