



AMERICAN INTERNATIONAL UNIVERSITY – BANGLADESH (AIUB)

Faculty of Engineering

Department of Electrical and Electronic Engineering

Course/Lab Name: EEE4103 Microprocessor and Embedded Systems

Semester: Fall 2023-23

Term: Mid

Quiz: 02M

Total Marks: 10

Time: 20 Minutes

Question Mapping with Course Outcomes:

Item	COs	POIs	K	P	A	Marks	Obtained Marks
Q1-2	CO1	P.a.4.C.3	K4			2×5	
Total:						10	

Student Information:

Student Name:	Solve Sheet			Section:	B
Student ID #:	Solve Sheet		Date:	09.10.2023	Department:

1. Write an Arduino microcontroller code for a 500 ms interval LED blinking system using Timer1 Interrupts and a Pre-scalar value of 1024. LED is connected to pin 5 of the board. Compute the value to be loaded into the OCR0A register. [5]

Answer:

Required delay = 500 ms = 500000 μ s

Given system frequency = 16 MHz

So, clock period = 1/frequency = 1/16 MHz = 0.0625 μ s

As such, Timer Count = Required delay/(clock period×pre-scalar value) – 1

= 500000/(0.0625×1024) – 1 = 7,812.5 – 1 = 7,811.5 \approx 7812

But Timer 0 can count up to 255 and Timer 1 can count up to 65,535, so Timer 1 is suitable for this application. So, the Timer Count value (7,812) should be loaded into the OCR1A register.

The required program is shown below:

```
bool LED_State = 'True';

void setup() {
    pinMode(10, OUTPUT);
    cli();
    TCCR1A = 0;
    TCCR1B = 0;
    TCCR1B = 0b00000101;
    TIMSK1 = 0b00000010;
    OCR1A = 7,812;
    sei();
}

void loop() {
    // main code here, to run repeatedly.
}

// With the settings above, this ISR will trigger each 400 ms.
ISR(TIMER1_COMPA_vect) {
    TCNT1 = 0;
    LED_State = !LED_State;    // To invert the LED State
    digitalWrite(12, LED_State); // Write this new state to the LED connected to pin D5
}
```

2. Determine the output of the program if the signal at pin 2 becomes 0 from 1.

[5]

```
volatile boolean flag;

void isr() {
  flag = true; }

void setup () {
  attachInterrupt (digitalPinToInterrupt (2), isr, CHANGE); }

void loop () {
  if (flag) {
    // interrupt has occurred
  }
}
```

Answer:

If the signal at pin 2 becomes 0 from 1, that means there is a CHANGE at the digital pin, 2. So, the Interrupt Service Routine (ISR) Function, isr() is called. This function will just change the value of the volatile Boolean type of variable 'flag' to 'true'. So, if an LED is connected to the pin 2 then this LED will be turned ON.