AMERICAN INTERNATIONAL UNIVERSITY – BANGLADESH (AIUB)
Faculty of Engineering
Department of Electrical and Electronic Engineering

Course/Lab Name: EEE4103 Microprocessor and Embedded Systems

Semester: Summer 2023-24 **Term**: Final **Quiz**: 01F **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:	D
Student ID #:	Solve Sheet	Date:	11.09.2024	Department:	

1. **Compute** the baud rate for the asynchronous normal operating mode when the oscillator frequency, f_{OSC} = 16 MHz, and register data is, *UBRRn* = 000110101010. **Compute** the baud error and **comment** on whether there will be any communication errors. Standard Baud rates are 300, 600, 1200, 2400, 4800, 9600, 14400,19200, 38400, 57600, 115200, 230400, ... bps. [5]

Answer:

UBRRn = 000110101010 = $0\times2^{11}+0\times2^{10}+0\times2^{9}+1\times2^{8}+1\times2^{7}+0\times2^{6}+1\times2^{5}+0\times2^{4}+1\times2^{3}+0\times2^{2}+1\times2^{1}+0\times2^{0}$
= 256+128+32+8+2 = 426

For the asynchronous normal operating mode, $Baud\ Rate = \frac{f_{osc}}{16(UBRRn+1)} = \frac{16\times10^{6}}{16(426+1)} = 2342$ bps

Baud Error Rate, $\varepsilon = \frac{Standard\ baud\ rate - calculated\ baud\ rate}{Standard\ baud\ rate} \times 100\% = \frac{1200-2342}{1200} \times 100\% = -2.42\%$

This value is > 2%, therefore, there will be communication errors.

2. For the following program, **show** the output on the serial monitor if the shutter remains open for 5 ms. **Determine** the baud rate and pin number at which the interrupt arrived. [5]

```
volatile boolean started;
volatile unsigned long startTime;
volatile unsigned long endTime;

void shutter() {      // interrupt service routine named shutter started
  if (started)
       endTime = micros();
  else
       startTime = micros();
started = !started; } // end of the ISR named shutter
void setup() {
  Serial.begin(57600);
  Serial.println("Shutter test ...");
  attachInterrupt(digitalPinToInterrupt(3), shutter, CHANGE);
}  // end of the setup

void loop() {
  if (endTime) {
    Serial.print("Shutter open for ");
    Serial.print(endTime - startTime);
    Serial.println(" microseconds.");
    endTime = 0;   }  // end of if statement
} // end of the loop
```

Answer:

```
Shutter test ...
Shutter open for 5000 microseconds.
```

From this command in the code, Serial.begin(57600);
We find the baud rate is 57600 bps
From this command in the code, digitalPinToInterrupt(3),
We find that at pin number 3, the interrupt has arrived.