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| AIUB | **American International University- Bangladesh (AIUB)**  **Faculty of Engineering** | | | |
| **Course Name:** | Microprocessor and Embedded Systems | **Course Code:** | EEE 4103 | |
| **Semester:** | Fall 2023-24 | **Term:** | Mid | |
| **Total Marks:** | 20 | **Submission Date:** | **29-10-2023** | |
| **Instructor Name:** | Protik Parvez Sheikh | **Assignment:** | | 02 |

Course Outcome Mapping with Questions

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **COs** | **POIs** | **K** | **P** | **A** | **Marks** | **Obtained Marks** |
| **Q1 to Q4** | **CO1** | **P.a.4.C3** | **K4** | **P1, P3, P7** |  | **5x4** |  |
| **Total:** | | | | | | **20** |  |

**Student Information:**

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| **Student Name:** |  | **Student ID:** |  |
| **Section:** |  | **Department:** |  |

**Marking Rubrics (to be filled by Faculty):**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Problem #** | **Excellent**  **[5]** | **Proficient**  **[4]** | **Good**  **[3]** | **Acceptable**  **[2]** | **Unacceptable**  **[1]** | **No Response**  **[0]** | **Secured Marks** |
| Detailed unique response explaining the concept properly and answer is correct with all works clearly shown. | Response with no apparent errors and the answer is correct, but explanation is not adequate/unique. | Response shows understanding of the problem, but the final answer may not be correct | Partial problem is solved; response indicates part of the problem was not understood clearly. | Unable to clarify the understanding of the problem and method of the problem solving was not correct | No Response/(Copied/identical submissions will be graded as 0 for all parties concerned) |
| **1** |  |  |  |  |  |  |  |
| **2** |  |  |  |  |  |  |  |
| **3** |  |  |  |  |  |  |  |
| **4** |  |  |  |  |  |  |  |
| **Comments** |  | | | | | Total marks (20) |  |

**1.** Determine the output of the program if the signal at pin 5 becomes 1 from 0. [5]

volatile boolean var\_b;

void isr\_f() {

var\_b = false; }

void setup () {

attachInterrupt (digitalPinToInterrupt (5), isr\_f, CHANGE); }

void loop () {

if (var\_b) {

// interrupt has occurred

}

}

**2.** A TV remote control is to be designed for the selection of channels. The channel selection buttons are required to be debounced, that is, one press must cause the remote to change to the subsequent channel. It was observed that the switches exhibit bounce times well under **5** **ms**. Design a circuit using the **74HC14** Schmitt trigger IC along with the **resistance** and **capacitance**. The worst-case Vth of 74HC14 for a signal going low is **2.2 V** and that of when going high is **0.8 V**. Also, consider that the CMOS device leakage current is **15 A** and the gate’s best-case switching point is of the order of **0.4 V**. [5]

**3.** A space research facility is planning to shoot high powered high frequency pulses into space for research purposes. These pulses are to be shot at a **10 µs** interval. The facility has an **ATMega328P MCU** to count the time. Every **10 µs**, a timer interrupt will be triggered by the MCU and the pulse will be shot. For this purpose, it was decided that the Timer0 interrupt will be used. If the MCU is running at 16 MHz, **prepare** a program that triggers Timer0 interrupt every **10 µs**. Timer0 is an 8-bit timer, and the available pre-scalers are 1, 8, 64, 25, and 1024.

[Hint: **Bits 0 to 2** of the **TCCR0B** register must be set for the required pre-scaler value to be used. The pre-scaler selection bits are shown in **Table 1**. Output Compare Register **OCR0A** holds the necessary Timer0 count to achieve the required delay. **Bit 1** of **TIMSK0** is **OCIE0A** that must be set to enable comparison match with OCR0A. Any bits not mentioned here are to be considered as 0. All registers mentioned are 8-bit registers.] [5]

**Table 1:** Pre-scaler values based on CSxn bits of TCC0B register.

|  |  |  |  |
| --- | --- | --- | --- |
| **CSx2** | **CSx1** | **CSx0** | **Pre-scaler** |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 8 |
| 0 | 1 | 1 | 64 |
| 1 | 0 | 0 | 256 |
| 1 | 0 | 1 | 1024 |

**4.** Prepare a flowchart with appropriate symbols to explain the logic flow of the program to add two numbers taken from the keyboard as input and then display the sum on an LCD screen. [5]