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|  | **American International University - Bangladesh (AIUB)**  **Faculty of Engineering** | | | |
| **Course Name:** | Microprocessor and Embedded System | **Course Code:** | EEE 4103 | |
| **Semester:** | Spring 2023-24 | **Term:** | Mid | |
| **Faculty Name:** | **Md. Shaoran Sayem** | **Assignment #:** | | 02/02 |

**Course Outcome Mapping with Questions**

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

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| **CO/**  **CLO Number** | **CO/CLO Statement** | **K** | **P** | **A** | **Assessed Program Outcome Indicator** | **BNQF Indicator** | **Teaching-Learning Strategy** | **Assessment Strategy** |
| **CO1** | Apply knowledge of microprocessors and microcontrollers to configure different modules of a microprocessor or microcontroller-based system as per given specifications and perform in-depth analysis to optimize the performance of the designed system utilizing the basic concepts and properties of a microcontroller. | K4 | P1, P3, P7 |  | P.a.4.C.3 | FS.2 | Lecture/  Discussion/Q&A | Midterm Assignment 2 |

**Student Information:**

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| **Due Date:** | **05/03/2024** | | | | | | | | | | **Submission Date:** | |  | |
| **Student Name:** |  | | | | | | | | | | | | | |
| **Student ID #:** |  |  |  |  |  |  |  |  |  |  | **Department:** |  | **Section:** |  |
| **p** | **q** | **-** | **a** | **b** | **c** | **d** | **e** | **-** | **r** |

**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 the answer is correct with all works clearly shown. | Response with no apparent errors and the answer is correct, but the explanation is not adequate/unique. | The response shows an understanding of the problem, but the final answer may not be correct | The partial problem is solved; the response indicates part of the problem was not understood clearly or not solved. | Unable to clarify the understanding of the problem and method of the problem solving was not correct | No Response/ copied from others/identical submissions with gross errors/ image file printed |
| **1** |  |  |  |  |  |  |  |
| **2** |  |  |  |  |  |  |  |
| **3** |  |  |  |  |  |  |  |
| **4** |  |  |  |  |  |  |  |
| **Comments** |  | | | | | **Total marks (20)** |  |

1. In a biscuit factory, a control system has been designed based on an Arduino Uno microcontroller. This system transfers the biscuit packets at a regular time interval to the conveyor belt from the biscuit-making machine. It was found that the Timer modules in the Arduino microcontroller are perfect candidates to count the number of biscuit packets being transferred to the conveyor belt correctly and appropriately. Compute the number of biscuit packets being transferred using the Timers within the following time intervals (Timer0 or Timer1 may be used as needed).
2. r0 ms
3. abc ms

Assume that the Arduino system clock has been set at 1q MHz and the available pre-scalers of the system are 1, 8, 64, 256, 512, and 1024. Comment on why and how the required counts are possible to implement using Timer0 or Timer1. Write down the program codes for the Arduino board.

1. (a) A TV remote controller 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 b ms and the duty cycle is 50%. 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.r V and that of when going high is 0.pq V. Also, consider that the CMOS device leakage current is pa A and the gate’s best-case switching point is of the order of 0.r V. What is the hysteresis voltage?

(b) Write a software code for the Arduino to read the status of a switch connected to pin number p by avoiding the bouncing problem of the switch and then display that switch status in the LED connected to pin number 1r. If the switch status is HIGH/LOW the LED will be turned ON/OFF respectively. It was observed that the switches exhibit bounce times well under q0 ms and the duty cycle is 50%. Use the Timer0 or Timer1 function of the Arduino to compute this delay. Also, draw the flow chart of this program.

1. A biomedical engineer is to design a new laboratory where biologically hazardous materials are being used for experimental research works. As such, during the experimental works are ongoing, no one is allowed to remain inside the laboratory. To display the message that hazardous materials are being used in the laboratory, 2 lights with green and red colors are installed at the entrance door of the laboratory. When the green light is turned on, it indicates that anybody can enter the laboratory but when the red light is turned on then none can enter the laboratory. It is to be ensured that both lights can’t remain turned on at the same time and these 2 lights should be controlled using a single mechanical switch inside the laboratory, and they can only light up alternatively when the switch is pressed or depressed. The switch has already been debounced using a hardware circuit. Draw a flowchart to show the logical flow of the program and then write a program for the Arduino Uno microcontroller to operate the door lights based on the switch conditions as per the given constraints.
2. Write an Arduino microcontroller code for an acd ms interval LED blinking system using Timer*x* (*x* = 0-2) interrupts and a pre-scalar value of 1024. LED is connected to the pin r of the board. Compute the value to be loaded into the OCR(r-1)A register.