



American International University- Bangladesh (AIUB)
Faculty of Engineering

Course Name: Microprocessor and Embedded Systems
Semester: Spring 2023-24
Total Marks: 20
Instructor Name: Protik Parvez Sheikh

Course Code: EEE 4103
Term: Mid
Submission Date: **11-03-2024**
Assignment: 02

Course Outcome Mapping with Questions

| Item | COs | POIs | K | P | A | Marks | Obtained Marks |
|----------|-----|----------|----|------------|---|-------|----------------|
| Q1 to Q5 | CO1 | P.a.4.C3 | K4 | P1, P3, P7 | | 4x5 | |
| Total: | | | | | | 20 | |

Student Information:

| | | | |
|----------------------|----------------------|--------------------|-------------------|
| Student Name: | RIFAH SANZIDA | Student ID: | 22-47154-1 |
| Section: | E | Department: | BSc CSE |

Marking Rubrics (to be filled by Faculty):

| | Excellent [4] | Good [3] | Acceptable [2] | Unacceptable [1] | No Response [0] | |
|-----------|--|--|---|--|--|---------------|
| Problem # | Detailed unique response explaining the concept properly and answer is correct with all works clearly shown. | 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) | Secured Marks |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| Comments | | | | | Total marks (20) | |

1. 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** and calculate the **hysteresis voltage**. The worst-case V_{th} of 74HC14 for a signal going low is **2.2 V** and that of when going high is **0.8 V**. Consider that the CMOS device leakage current is **15 μA** and the gate's best-case switching point is of the order of **0.4 V**. Also, consider that a Si diode is connected in the circuit and its forward voltage drop, $V_D = 0.7 V$. The supply voltage of the IC is $V_{CC} = 5 V$. [4]

2. **Prepare** a program that triggers Timer0 interrupt every **10 μs** in order to blink an LED light. [4]

3. For the processor ATmega328P, state the contents of registers R26, R25, and the data memory locations at 0xFA50 and 0xFA51 after the following program is executed: [4]

```
LDI R25, 4;
LDI R26, 20;
SUB R26, R25;
STS 0xFA50, R26;
ADD R25, R26;
STS 0xFA51, R25;
```

4. Determine the output of the following programs: [4]

| | |
|--|---|
| <p>a) #include "LowPower.h"</p> <pre>void setup() { pinMode(12, OUTPUT); } void loop() { digitalWrite(12, HIGH); delay(5000); digitalWrite(12, LOW); LowPower.powerDown(SLEEP_2S, ADC_OFF, BOD_OFF); }</pre> | <p>b) volatile boolean var_b;</p> <pre>void isr_f() { var_b = false; digitalWrite(7, HIGH); } void setup () { attachInterrupt (digitalPinToInterrupt(2), isr_f, CHANGE); pinMode(7, OUTPUT); digitalWrite(7, LOW); } void loop () { if (var_b) { // interrupt has occurred} }</pre> <p>NB. Consider an LED is connected to pin 7 and a switch is connected to pin 2</p> |
|--|---|

5. **a)** Prepare a C++ program for an Arduino UNO to configure the Sleep Mode Control Register (SMCR) so that the system enters **power-save mode** and powers down Timer0, Timer1, and SPI peripherals using power reduction register (PRR).

b) Develop an assembly program for an Arduino UNO to set the Sleep Mode Control Register (SMCR) to enter the **power-down mode** while keeping Timer0 and Timer1 active using power reduction register (PRR). [4]