



COMSATS Institute of Information Technology
Islamabad Campus.

Department of Electrical Engineering

Terminal Exam Spring 2025

Class: BCE-6

Subject: CPE-342 Microprocessor Systems and Interfacing

Instructor: Dr. Haroon Ahmed Khan

Date: 03-07-2025

Time Allowed: 2 Hrs

Marks: 25

Note:

- Attempt all questions.
- Plagiarism/cheating will be severely punished.

Q1. Write equivalent AVR Assembly program for the following C Program. Show all the timings calculations as well. (CLO2/PLO2) (10 marks)

```
#define F_CPU 8000000UL
#include <util/delay.h>
#include <avr/io.h>

int main (void)
{
    DDRB = 0x0F;
    unsigned char data = Your Roll No+ 76;
    do
    {
        PORTB = 0xFF;
        _delay_ms(1);
        PORTB = 0x00;
        _delay_ms(1);
        data = (data >> 1);
    }while(data > 0);

    while(1);
}
```

Code Listing-1

- Q2. You are required to generate a PWM signal with frequency = (Your Roll No + 20) kHz. The duty cycle of the signal should be $\frac{(\text{Your Roll No} + 76)}{255} \times 100\%$. You have to use Timer/Counter 1 for this purpose. Report the register values and system parameters you will choose to achieve this. Specifically report the following: (CLO3/PLO3) (10 marks)
1. System Clock (Must be between 1MHz and 20 MHz and in whole numbers).
 2. Desired PWM frequency
 3. Desired PWM duty cycle
 4. Mode of operation for Timer 1

5. Top value for the TCNT1 register.
6. Value of the Compare Match register.
7. Percentage error between the required frequency and the one you managed to generate.

Q3. In a UART system, Atmega328p is connected to a device. The MCU wants to send a data byte (**Your Roll No + 76**) to the device. The device returns data byte 0x45. Draw a voltage-time diagram depicting the complete communication session. The frame for the UART contains 8 data bits, 1 parity bit, and 1 stop bit. Use even parity if your roll number is even, odd otherwise. Show calculations for the parity bit as well. (CLO1/PLO1) (10-marks)

Q4. You are tasked with upgrading the old toaster in your home. The old toaster works with a bi-metallic thermostat. The timing (the duration for which the slices are being heated) you get using these thermostats usually depend on the starting temperature of the device. i.e. there is a lot of variance between the amount slices are toasted. Even with newer toasters, which fix the time slices need to be heated, we see that based on the moisture content of the bread there is large variation in the final appearance of the toasts.

Propose a microcontroller-based electronic system that will address these issues and make sure the user gets evenly done toasts irrespective of the initial temperature, the moisture content of the slices and the seasonal temperature variations. Explain your design with a block diagram, propose solutions for each of the problems described above, and what sensors can you use for this task etc. Also provide a flowchart of your control software. (CLO4/PLO4) (10 marks)

Q5. Digital reading from the 10-bit ADC of your Atmega328p MCU is

$$\text{Digital reading} = (\text{Your Roll No} \times 3) + 125$$

If the reference voltage of the ADC (V_{ref}) is given by the following formula

$$V_{ref} = ((\text{Your Roll No} \% 2) + 3) \times 1.1 \text{ V}$$

What analog voltage does this digital reading correspond to? Show the calculations. (CLO1/PLO1) (10 marks)

-----Good Luck-----