COMSATS UNIVERSITY ISLAMABAD, Lahore Campus

Department of Computer Engineering

Subject: Microprocessor Systems and Interfacing (CPE342)	**Batch: FA22-BCE-B**
Assignment No. FOUR	**Total Marks: 30**
Handed over on: 3rd June 2025	**Submission Date: 10th June 2025**
Student's Name:	
Registration Number:	

Instructions:

- Provide your solution in the space provided against each problem
- Back side of each leaf is for rough work only
- Submission after the deadline will not be graded
- Do not use lead pencil in your solution

Problem 1 **20+10 = 30 Marks**

Design an 8088 microprocessor-based system that:

1. Reads an analog voltage (0V–5V) using ADC0804.
2. Scales the digital output of ADC to a 0–100 range (where 0V → 0, 5V → 100).
3. Displays the result (0–100) on a 3-digit multiplexed 7-segment display in decimal format.

ADC is interfaced with CPU through 8255 PPI such that ADC uses group A and LED display uses group B.

Provide:

a. Assembly code for 8088 CPU to implement the system.

b. Completely labelled block diagram of the entire system.

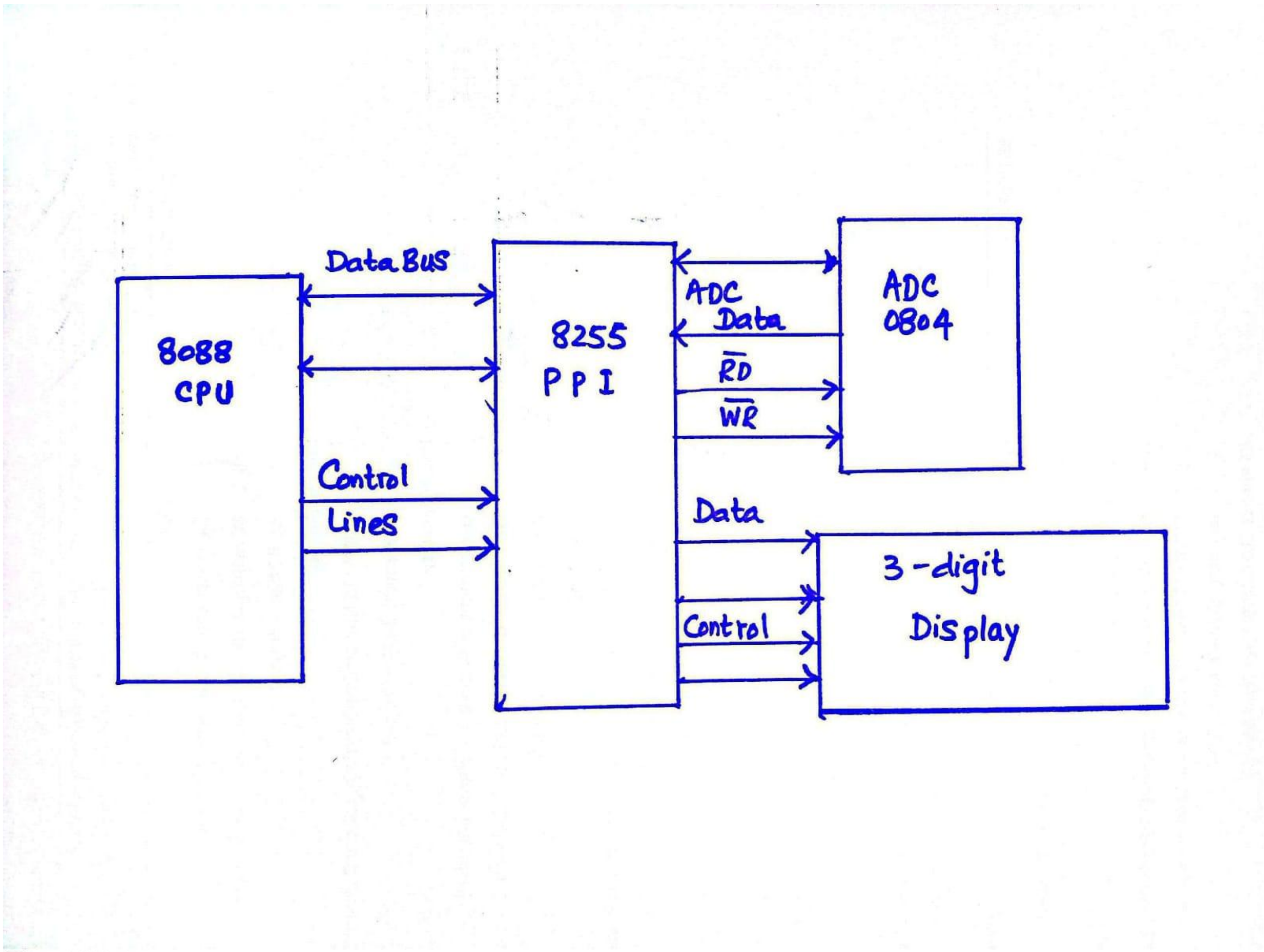
Solution:

```
;===============================================
; 8088 System with ADC0804 and 3-digit 7-segment
; Display via 8255 PPI
;===============================================

; Constants
PORT_A     EQU 00H    ; 8255 Port A (ADC data)
PORT_B     EQU 02H    ; 8255 Port B (7-segment data)
PORT_C     EQU 04H    ; 8255 Port C (control)
CTRL_REG   EQU 06H    ; 8255 Control register
DELAY_TIME EQU 5000   ; 5ms delay counter
```

```
; 7-segment patterns (common cathode)
SEG_TABLE  DB 3FH, 06H, 5BH, 4FH, 66H, 6DH, 7DH, 07H, 7FH, 6FH  ; 0-9

ORG 100H

MAIN:
    ; Initialize 8255
    MOV AL, 10010000b  ; Mode 0: Port A input, Port B/C output
    OUT CTRL_REG, AL

    ; Main loop
READ_ADC:
    ; Start ADC conversion (pulse /WR low-high)
    MOV AL, 00000000b  ; PC3=0 (/WR active)
    OUT PORT_C, AL
    MOV AL, 00001000b  ; PC3=1 (/WR inactive)
    OUT PORT_C, AL

    ; Wait for conversion (poll INTR)
WAIT_EOC:
    IN AL, PORT_C
    TEST AL, 10000000b  ; Check PC7 (INTR)
    JNZ WAIT_EOC        ; Wait for INTR=0

    ; Read ADC value
    IN AL, PORT_A       ; Get 8-bit value (0-255)

    ; Scale to 0-100 range: (AL × 100)/255
    MOV AH, 0
    MOV BL, 100
    MUL BL              ; AX = AL × 100
    MOV BL, 255
    DIV BL              ; AL = AX ÷ 255 (result 0-100)

    ; Convert to BCD digits
    MOV BL, 100
    DIV BL              ; AL=Hundreds, AH=remainder
    MOV BH, AH          ; Save remainder
    MOV CL, AL          ; Store Hundreds

    MOV AL, BH
    MOV BL, 10
    MOV AH, 0
    DIV BL              ; AL=Tens, AH=Units
    MOV CH, AL          ; Store Tens
    MOV DH, AH          ; Store Units

    ; Display digits
    CALL DISPLAY_NUMBER
    JMP READ_ADC

;================================================
; DISPLAY_NUMBER: Shows 3-digit number
; Input: CL=Hundreds, CH=Tens, DH=Units
;================================================
DISPLAY_NUMBER:
    PUSH AX
    PUSH BX
    PUSH CX
    PUSH DX

    ; Display Hundreds
    MOV BX, OFFSET SEG_TABLE
    MOV AL, CL
    XLAT                ; Get 7-seg pattern
    OUT PORT_B, AL      ; Send to segments
    MOV AL, 00000001b   ; Enable Digit1 (PC0=1)
    OUT PORT_C, AL
    CALL DELAY

    ; Display Tens
    MOV AL, CH
    XLAT
    OUT PORT_B, AL
    MOV AL, 00000010b   ; Enable Digit2 (PC1=1)
```

```
      OUT PORT_C, AL
      CALL DELAY

      ; Display Units
      MOV AL, DH
      XLAT
      OUT PORT_B, AL
      MOV AL, 00000100b   ; Enable Digit3 (PC2=1)
      OUT PORT_C, AL
      CALL DELAY

      ; Turn off all digits
      MOV AL, 00000000b
      OUT PORT_C, AL

      POP DX
      POP CX
      POP BX
      POP AX
      RET

  ;===============================================
  ; DELAY: Simple delay loop (~5ms at 5MHz)
  ;===============================================
  DELAY:
      PUSH CX
      MOV CX, DELAY_TIME
  DELAY_LOOP:
      LOOP DELAY_LOOP
      POP CX
      RET

END MAIN
```

Block Diagram:


Data Bus
8088
CPU
Control
Lines
8255
PPI
ADC
Data
$\overline{RD}$
$\overline{WR}$
ADC
0804
Data
Control
3-digit
Display