

**ECE 425 Introductions to Microprocessors**  
**Laboratory Work 12**

**Objective:**

- 1) Reading and Writing EEPROM Memory.
- 2) Understanding EEPROM Write Complete Interrupt

**Preparation:**

Find the addresses of EEADR, EEDATA, EECON1, and EECON2 registers. In which banks they reside and learn the function of each bit of the registers.

Set your oscillator frequency to 8 kHz and simulate the following program segments. What happens if you increase your oscillator frequency to 4 kHz? Can you see the write complete operation using F7?

- 1) The following program writes 0x48 to EEPROM address 0x00. Simulate the program step by step using F7 and note how much time it takes for the write operation to complete.

```
LIST P=16F84A
INCLUDE "P16f84A.INC"

__config _CP_OFF&_WDT_OFF&_XT_OSC

    movlw 0x00          ;
    movwf EEADR        ; Address to write
    movlw 0x48         ;
    movwf EEDATA       ;

    bsf    STATUS, RP0    ; Bank 1
    bcf    INTCON, GIE    ; Disable INTs
    bsf    EECON1, WREN   ; Enable Write
    movlw 0x55           ;
    movwf EECON2         ; Write 55h
    movlw 0xAA          ;
    movwf EECON2         ; Write AAh
    bsf    EECON1, WR     ; Set WR bit, begin write
    bsf    INTCON, GIE    ; Enable INTs

loop
    btfsc  EECON1, WR     ; Wait for the write operation to complete
goto     loop;

nop;
nop;

end
```

- 2) The following program writes 0x88 to EEPROM location 0x00 and when write is complete an interrupt is generated. Simulate the program using F7 and understand when interrupt occurs and note the value of EEIF.

```
LIST P=16F84A
INCLUDE "P16f84A.INC"
```

```
__config _CP_OFF&_WDT_OFF&_XT_OSC
```

```
    goto    main
    org     0x04
    goto    EEPROM_WRITE_ISR;
```

```
main
```

```
    bsf     INTCON, EEIE           ; Enables the EE Write Complete interrupts
```

```
    movlw  0x00                   ;
    movwf  EEADR                   ; Address to write
    movlw  0x88                   ;
    movwf  EEDATA                  ;
```

```
    bsf     STATUS, RP0           ; Bank 1
    bcf     INTCON, GIE            ; Disable INTs
    bcf     EECON1, EEIF          ; Clear EEPROM Write Complete Interrupt Flag
    bsf     EECON1, WREN          ; Enable Write
    movlw  0x55                   ;
    movwf  EECON2                  ; Write 55h
    movlw  0xAA                   ;
    movwf  EECON2                  ; Write AAh
    bsf     EECON1, WR            ; Set WR bit, begin write
    bsf     INTCON, GIE            ; Enable INTs
    bcf     STATUS, RP0           ; Bank 0
```

```
loop
```

```
    nop                               ;
    nop                               ;
    goto   loop                       ;
```

```
EEPROM_WRITE_ISR
```

```
    bsf     STATUS, RP0           ; Bank 1
    bcf     EECON1, EEIF          ;
    bcf     STATUS, RP0           ; Bank 0
    nop                               ;
    nop                               ;
    nop                               ;
    nop                               ;

    retfie                           ;
```

```
end
```

3) Manually fill the EEPROM memory location 0x00 with value 0xAA and simulate the following program using F7. The program reads the content of EEPROM memory location 0x00 and displays it at PORTB.

```
LIST P=16F84A
INCLUDE "P16f84A.INC"

__config _CP_OFF&_WDT_OFF&_XT_OSC

    movlw 0x00          ;
    movwf EEADR        ; Address to read

    bsf    STATUS, RP0 ; Bank 1

    clrf   TRISB       ;
    bsf    EECON1, RD  ; EE Read

    bcf    STATUS, RP0 ; Bank 0

    movf   EEDATA, W   ; W = EEDATA
    movwf  PORTB      ;
    nop                    ;

loop
    goto  loop        ;

end
```

4) Fill the first 8 locations of EEPROM with arbitrary numbers manually. The following program reads the first 8 locations of EEPROM and displays the registers' contents at PORTB. Simulate the program using F7 and try to understand its operation.

```

LIST P=16F84A
INCLUDE "P16f84A.INC"

__config __CP_OFF&__WDT_OFF&__XT_OSC

ADDRESS_COUNTER equ 0x0C;

        clrf    ADDRESS_COUNTER

read_ON
        movf    ADDRESS_COUNTER, W
        movwf   EEADR                ; Address to read
        call   read_and_display_EEPROM_location ;
        incf   ADDRESS_COUNTER, F
        movf   ADDRESS_COUNTER, W
        sublw  .7
        btfss STATUS, Z
        goto  read_ON

loop    goto    loop

read_and_display_EEPROM_location_content

        bsf    STATUS, RP0            ; Bank 1
        clrf   TRISB

        bsf    EECON1, RD            ; EE Read

        bcf    STATUS, RP0            ; Bank 0
        movf   EEDATA, W              ; W = EEDATA
        movwf  PORTB
        return

end

```

### Laboratory Work:

- 1) Trace program segments in preparation 1-4 using F7 and comment on the results.
- 2) Write a program that fills the EEPROM locations 0x00...0x07 with integers 1, 2, 4, 8, 16, 32, 64, 128. And your program reads EEPROM locations 0x00...0x07 and displays their contents at PORTB.

**During your LAB work show every step that you complete to the LAB assistant. Get a copy of assembly files you write during the LAB hour via a flash disk for future reference.**