ECE 425 Introductions to Microprocessors
Laboratory Work 6

Objective:

1) Program counter register and its content.
2) Subtraction and addition commands.
3) Summation and subtraction of numbers.

Preparation: No preparation.

Laboratory Work:

1) Program counter register is a 13-bit register which holds the address of the instruction to be executed. Consider the program segment given below.

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

__config _CP_OFF&_WDT_OFF&_XT_OSC

start;
        nop;
        nop;
        nop;
        nop;
        call subroutine_A;
        nop;
        nop;
        nop;
        nop;
        call subroutine_B;
        nop;
        nop;
        nop;

        goto start;

        subroutine_A
                nop;
                nop;
                nop;
        return;

        subroutine_B
                nop;
                nop;
                nop;
                nop;
        return;

end
```

a) Trace the above program using F7 and fill the tables below.

Program Memory			Program Counter Register Content	
Address	Disassembly		PCH (5-bits)	PCL (8-bits)

2) For subtraction commands "sublw k", and "subwf f, d". If a borrow is needed carry and half carry flags are reset. If no borrow is needed carry and half carry flags are set.

```
LIST P=16F84A
INCLUDE "P16f84A.INC"
__config _CP_OFF&_WDT_OFF&_XT_OSC

bcf STATUS, 0; clear carry flag
bcf STATUS, 1; clear half-carry flag
bcf STATUS, 2; clear zero flag

movlw .1;    movlw b'00000001'
sublw .3;     borrow is not needed, carry and half-carry-flags are set
        ;     sublw b'00000011'
nop;

movlw .5;    b'00000101'
sublw .2;    b'00000010',  borrow is needed from low and high nibbles,
        ;    carry and half-carry-flags are reset

nop;
movlw b'10000000';
sublw b'00000001';     only half carry-flag is set, carry flag is reset

loop goto loop;
end
```

Trace the above program segment using F7 command, and see the changes on carry and half carry flags of the status register.

3) The following program finds the difference of two numbers A and B whose values are A=0x1206, B=0x0814

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

__config _CP_OFF&_WDT_OFF&_XT_OSC

AL      equ     0x0C
AH      equ     0x0D
BL      equ     0x0E
BH      equ     0x0F

RL      equ     0x10;   low byte result
RH      equ     0x11;    high byte result

; A=0x1206
movlw  0x06;
movwf  AL;
movlw  0x12;
movwf  AH;

; B=0x0814
movlw  0x14;
movwf  BL;
movlw  0x08;
movwf  BH;

subtraction_operation

movf    BL, W;
subwf   AL, W;              affects the status flags
movwf   RL;                 does not affect the status flags..low-byte result is written to location RL
btfss    STATUS, 0;         btfss STATUS, C .. check carry flag for zero
decf     AH, F;

movf    BH,     W;
subwf   AH,     W;
movwf   RH;                 high-byte result is written to location RH

end
```

Trace the above program using F7 and verify the subtraction results.

4) Write a program that finds the difference of two 24-bit numbers A and B. Give arbitrary values to numbers A and B.

5) Write a program that finds the sum of two 24-bit numbers A and B. Give arbitrary values to numbers A and B.

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.