TUTORIAL 3 (Embedded Systems 60603)
Assembly Language Program

1. State the purpose of the following tools:
   (In Assembly for PIC)
   i) Simulator
   a computer program that allows the user to observe an operation through simulation without actually performing that operation.
   ii) Editor
   a computer program that serve the purpose of text editing for programming purpose, normally comes with autocomplete, code snippets, text highlighting, file management and more.
   iii) Assembler
   a computer program that translates assembly to object file (.o) or machine language format
   iv) Linker
   a computer program that takes one or more object files generated by compiler and combines them into single executable file, library file or another object file
   v) Compiler
   computer software that transforms computer code written in one programming language (the source language) into another computer language (the target language).

2. Write an asm program to add the numbers stored in locations 31_H, 45_H, and 47_H and store the result in location 22_H. (Verify using PIC Simulator).

```
LOC1    EQU 0X31
LOC2    EQU 0X45
LOC3    EQU 0X47
RESULT EQU 0X22

MOVF    LOC1, 0
ADDWF  LOC2, 0
ADDWF  LOC3, 0
MOVWF RESULT
```

3. The addresses for each of the instructions of a program are shown in the table below. Simulate the program and record down the values of related registers at the end of each instruction. (Use PIC16 Simulator).

Address (ROM)	OP CODE	Assembly instruction	WREG	10h	PC
▨	▨	SUM EQU 0x10	▨	▨	▨
00000	3025	MOVLW 0x25	37		
00001	3E34	ADDLW 34	89		
00002	3E11	ADDLW 0x11	106		
00003	3E12	ADDLW D'18'	124		
00004	3E1C	ADDLW $1C_h$	152		
00005	3E06	ADDLW b'00000110'	158		
00006	0090	MOVWF SUM	158	158	
00007	2807	HERE GOTO HERE			

4. Write an assembly language program to swap 0x10 in location 0x31with 0x20 in location 0x11. and verify using PIC Simulator.

```
LOC1  EQU 0x31
LOC2  EQU 0x11
TEMP EQU 0x12

MOVLW 0x10
MOVWF LOC1
MOVLW 0x20
MOVWF LOC2

CLRW

MOVF    LOC1,  0
MOVWF TEMP
MOVF    LOC2, 0
MOVWF LOC1
MOVF    TEMP, 0
MOVWF LOC2
```

5. Write assembly language programs to do the following operations without loop: (Write status register value)

a) 3 x 5

	WREG
MOVLW 0X05	5
ADDLW 0X05	10
ADDLW 0X05	15

b) $4^2 - 9 - 7$

	WREG	0x20
MOVLW 0X04	4	
ADDLW 0X04	8	
ADDLW 0X04	12	
ADDLW 0X04	16	
MOVWF 0X20	16	16
CLRW	0	16
MOVLW 0X09	9	16
SUBLW 0X20	16 – 9 = 7	16

MOVWF 0X20	7	7
CLRW	0	7
MOVLW 0X07	7	7
SUBLW 0X20	0	7

c) 0xA + 0Xc

MOVLW 0X0A	10
ADDLW 0X0C	10+12 = 22