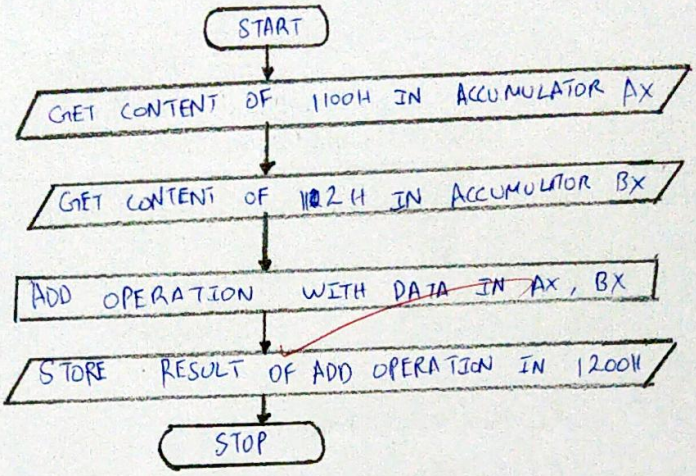
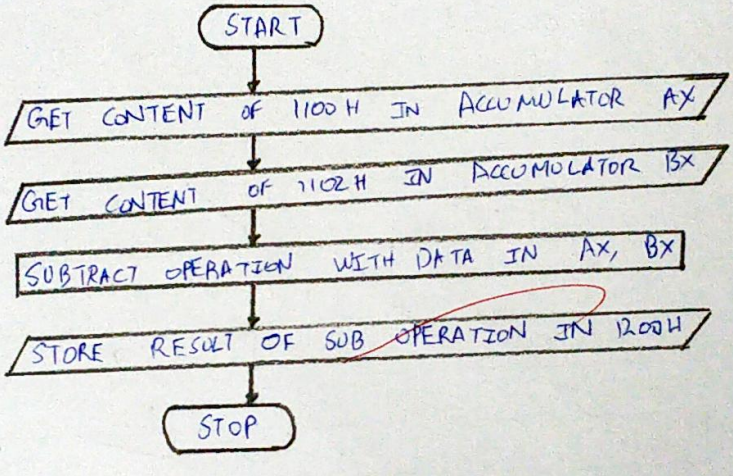
Addition



Subtraction



Lab 2

Ex.No.2 Arithmetic operation using 8086

2.1 Introduction:

The purpose of this experiment is to learn about the registers, instruction sets, and arithmetic operators of 8086 by addition, subtraction, multiplication and division for the given two 16-bit numbers and store them in a memory location.

2.2 Hardware Requirement:

The 8086 Microprocessor kit, Power Supply.

2.3 Program Logic:

The add instruction requires either the addend or the augend to be in a register, irrespective of the addressing modes. Consider we have two 16-bit numbers in AX and BX registers. Addition is performed using ADD instruction in 8086 microprocessor. The result is transferred to the destination memory location.

Similar to addition operation subtraction is performed using SUB instruction in 8086 microprocessor.

The 8086 processor provides both signed and unsigned multiplication in their instruction set to overcome the loss of efficiency in performing the repeated addition. The MUL instruction can have both 16-bit and 8-bit operands and the multiplicand should be in AX or AL register, accordingly the result for a byte multiply is a 16-bit number in AX while that for a word multiply is a 32-bit number, the lower word of which is in AX and the higher word in DX.

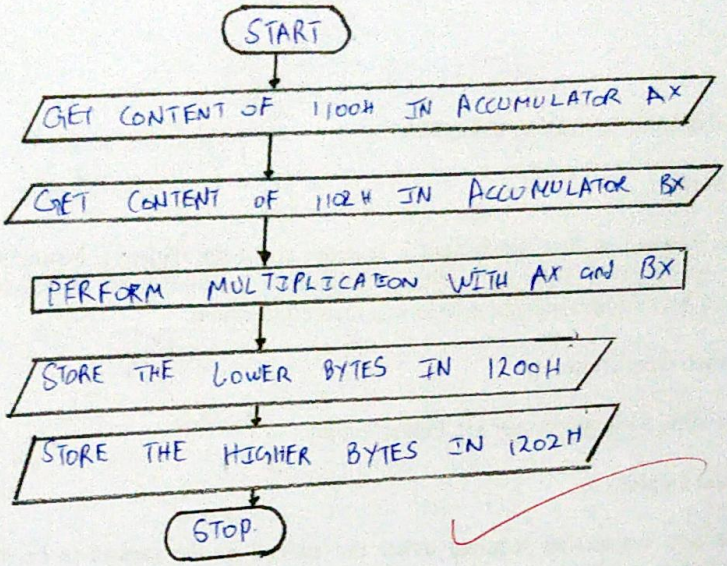
To perform division, the divisor should be in AX register and dividend can be in any register. Using DIV instruction, the operation is performed and the results will be available in AX and DX registers. In AX we have the quotient and in DX remainder. The results are moved to the memory locations.

2.4 Program

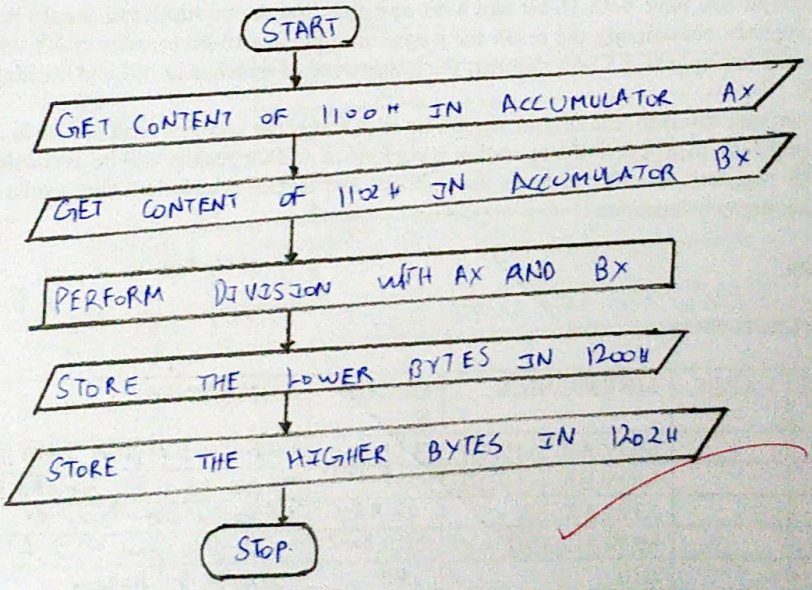
Addition without carry:

ADDRESS	LABEL	MNEMONICS	OPCOD E	COMMENTS
1000		MOV AX, [1100H]	8B 06 0011	Trans for Data to AX from address [110H]
1004		MOV BX, [1102H]	8B 1E 0021	Trans for Data to BX from address [1102H]
1008		ADD AX, BX	01 D8	ADD operation b/w Axand Bx
100A		MOV [1200H], AX	89 0600 12	Trans for Data from Ax to [1200H]
100E		HLT	F4	Terminate the program

Multiplication



Division



Observation

IN PUT ADDRESS	DATA
1100H	67
1101H	45
1102H	14
1103H	32

OUT PUT ADDRESS	DATA
1200H	7B
1201H	77

Subtraction without borrow:

ADDRESS	LABEL	MNEMONICS	OPCODE	COMMENTS
1000		MOV AX, [1100H]	8B0600 11	Transfer Data from [1100H] to AX
1004		MOV BX, [1102H]	8B1E0211	Transfer Data from [1102H] to BX
1008		SUB AX, BX	29 D8	SUB operation b/w AX and BX
100A		MOV [1200H], AX	8906 0012	Transfer Result from AX to [1200H]
100E		HLT	F4	Terminate the Program

Observation

IN PUT ADDRESS	DATA
1100H	78
1101H	56
1102H	34
1103H	12

OUT PUT ADDRESS	DATA
1200H	44
1201H	44

Addition: Inputs are 1234H, 5678H

1234H →	0001	0010	0011	0100
5678H →	0101	0110	0111	1000
	1010	1000	1010	1100
	6	8	A	C

Subtraction: Inputs are 5678H, 1234H,

5678H →	0101	0110	0111	1000
	0001	0011	0011	0100
	0100	0100	0100	0100
	4	4	4	4

Multiplication:

```
  12 34 H
  56 78 H
  -------
  A1A0
 1F6C
 6D28
CB04
-------------
062600 60
```

Division:

```
        4100
      ------
1234 | 5678
       4800
       ----
       DA80
       DA70
       ----
        100
          0
        ----
        1000
        -0
        ----
        1000
```

$\frac{5678}{1234} = 4100$

Multiplication:

ADDRESS	LABEL	MNEMONICS	OPCODE	COMMENTS
1000		MOV AX, [1100H]	8B060011	Transfer Data from [1100H] to AX
1004		MOV BX, [1102H]	8B1E0211	Transfer Data from [1102H] to BX
1008		MUL BX	F7 E3	MUL Operation b/w AX and BX
100A		MOV [1200H], AX	8906 0012	Transfer Result from AX to [1200H]
100E		MOV [1202H], DX	8916 0212	Transfer Data from DX to [1202H]
1012		HLT	F4	Terminate the Program

Observation

OUT PUT ADDRESS	DATA
1200H	78
1201H	56
1202H	34
1203H	71

Manual

IN PUT ADDRESS	DATA
1100H	26
1101H	06
1102H	60
1103H	00

Division:

ADDRESS	LABEL	MNEMONICS	OPCODE	COMMENTS
1000		MOV AX, [1100H]	8B060011	Transfer data from [1100H] to AX
1004		MOV BX, [1102H]	8B1E0212	Transfer Data from [1102H] to BX
1008		DIV BX	F7F3	DIV Operation B/W AX and BX
100A		MOV [1200H], AX	8906 0012	Transfer Data from AX to [1200H]
100E		MOV [1202H], DX	8916 0312	Transfer Data from DX to [1202H]
1012		HLT	F4	Terminate the program

Observation

OUT PUT ADDRESS	DATA
1200H	78
1201H	56
1202H	34
1203H	12

IN PUT ADDRESS	DATA
1100H	AB
1101H	0D
1102H	04
1103H	00

2.5 Pre Lab Questions

1. Give the format of Flag register and state the conditions to set the flags.
2. Assume DS = 2000H, calculate the physical addresses of all datas (input and output).
3. List the addressing modes used in each program.

2.6 Post Lab Questions

1. Write an ALP to solve the following expressions:
   (i) 2a + 3b
   (ii) (a + b) / (a – b)
   (iii) (a * b) / (a + b) * (a – b)

2. Simulate the programs using emulator 8086.

Result: Given Arithmetic operation have been performed and verified using the 8086 Microprocessor.

Microprocessor and Microcontroller Lab

Experiment 2: Arithmetic Operation Using 8086

I Pre-Lab

1. Give the format of Flag register and state the conditions to set the flags.

Soln. 8086 has 16 bit flag register, the format is,

Bits	D_{15}	D_{14}	D_{13}	D_{12}	D_{11}	D_{10}	D_9	D_8	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
Flags					O	D	I	T	S	Z		AC		P		CY

The flag register is divided into two parts,

(a) Condition (or) Status flags

(b) Machine control flags

The condition code flags contains the lower 16 bit and the machine control flags contain the higher 16 bit.

Together these 2 parts control the conditions of the flags.

2. Assume DS = 2000H, Calculate the physical addresses of all data (input and output).

Soln. A Bus is a high speed internal connection. Buses are used to sent control signals and data between the pins and other components.

There are 3 types of Buses:

① Address Bus ② Data Bus

③ Control Bus

3. List the addressing modes used in each program.

Soln. i) Register addressing mode

ii) Direct addressing mode.

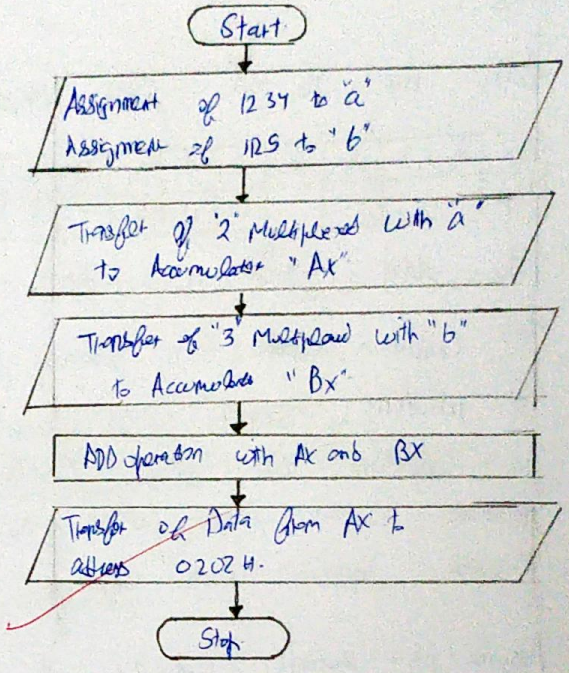
II Post-lab Questions

1. Write an ALP to solve the expression

$2a + 3b$

Soln Code:

```
a = 1234H
b = 1125H
MOV AX, 2*a
MOV BX, 3*b
ADD AX, BX
MOV [0202H], AX
HLT
```



Calculation:

a = 1234

b = 1125

2a = 2468

3b = 336F

$2a + 3b$ = 2468 + 336F = 5707

$\therefore 2a + 3b =$ 5707 H