

## **PART - I**

### **8086 MICROPROCESSOR**

#### **Experiment - 1A: 16-BIT ADDITION & SUBTRACTION:**

##### **1.1 OBJECTIVE**

To add and subtract two 16-bit numbers residing in memory and store the result in memory.

##### **1.2 RESOURCES**

The 8086 Microprocessor kit, Power Supply.

##### **1.3 PROGRAM LOGIC**

The add instruction requires either the addend or the augend to be in a register, unless the source operand is immediate since the addressing modes permitted for the source and destination are register-register, memory to register, register to memory, register to immediate, and finally memory to immediate.

Hence one of the operands is initially moved to AX. Then using the add instruction, 16-bit addition is performed.

The next arithmetic primitive is SUB. As discussed in ADD it permits the same modes of addressing. Hence moving the minuend to a register pair is necessary. Then the result is moved to a location in memory.

##### **1.4 PROCEDURE:**

1. Enter the opcodes in ram memory from location 1000 using SUB command
2. Using STEP command, execute the program instruction by instruction
3. After each instruction verified register contents and see that they are initialised to the required values.

##### **1.5 PRE LAB QUESTIONS:**

1. Difference between Microprocessor & Microcontroller?
2. Define BUS and give the classification of Buses
3. What is an addressing mode?
4. How the Microprocessors can be categorized?
5. What is stack and Subroutine?
6. Mention the features of 8086?
7. Define Opcode and Operand
8. Explain how physical address is formed in 8086.

### 1.6 LAB ASSIGNMENT

1. Write an assembly language program to move the content in memory location 1100h into register BX and also move to register CX, and also store the content in CX in memory location 1300h.
2. Write an assembly language program to add and subtract the two 16-bit numbers using the program logic given in 1.3. (Use immediate and direct addressing modes).
3. Write an algorithm for the questions 1 & 2, and also draw the flowchart?

### 1.7 POST LAB QUESTIONS:

1. Calculate the physical address for the given data. DS=1000h, BP=1234h
2. What is the purpose of HLT instruction?
3. What happens if the result is greater than 16bit?
4. Give the steps to calculate physical address?
5. If carry is set to 1 before subtraction what is the instruction to be used?
6. What is the difference between MOV AX, [1100] and MOV [1200], AX?

## **Experiment - 1B: MULTIPLICATION AND DIVISION**

### **1.8 OBJECTIVE**

To multiply and Divide two 16-bit numbers and store the result in memory.

### **1.9 RESOURCES**

The 8086 Microprocessor kit, Power Supply.

### **1.10 PROGRAM LOGIC**

The 8086 Processor provides both signed and unsigned multiply in their instruction set to overcome the loss of efficiency in performing the repeated addition.

The MUL instruction can have both 16 and 8 bit operands and the multiplicand is AX or AL, 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.

### **1.11 PROCEDURE**

1. Enter the opcodes in ram memory from location 1000 using SUB command
2. Using STEP command, execute the program instruction by instruction.
3. After each instruction verified register contents and see that they are initialised to the required values.

### **1.12 PRE-Lab Questions**

1. A single instruction may use more than one addressing modes or some instructions may not require any addressing modes. Why?
2. How is the addressing mode of an instruction communicated to the CPU?
3. How does the CPU identify between 8-bit and 16-bit operation?
4. What do you mean by pipelined architecture?
5. What is a Flag register?
6. What is a machine cycle?
7. What is a status signal?
8. What is minimum mode operation of 8086?
9. What is the maximum memory addressing and I/O addressing capabilities of 8086?
10. From which address the 8086 starts execution after reset?

### **1.13 LAB ASSIGNMENT**

1. Write an assembly language program to move the content in memory location 1100h into register BX and also move to register CX, and also store the content in CX in memory location 1300h.(Use based indexed addressing mode)
2. Write an assembly language program to multiply and divide the two 16-bit

numbers using the program logic given in 1.9. (Use immediate and direct addressing modes)

3. Write an algorithm for the questions 1 & 2, and also draw the flowchart?

#### **1.14 POST-Lab Questions**

1. List out the type of addressing modes used in your program.
2. If result exceeds 32 bit where is it stored?
3. What is the name given to the register combination DX:AX?
4. What is the instruction used for signed division?
5. In the above program instead of DIV BX, is it possible to use DIV num2?
6. Where is the remainder in 16 bit division?

## **Experiment - 2 TO FIND LARGEST AND SMALLEST NUMBERS**

### **2.1 OBJECTIVE**

To find the largest and smallest number in an array of data.

### **2.2 RESOURCES**

The 8086 Microprocessor kit, Power Supply.

### **2.3 PROGRAM LOGIC**

To find the largest number in any given array, the contents of the array must be compared with an arbitrary biggest number. The first number of the array is taken in a register AL. The second number of the array is compared with the first one. If the first one is greater than the second one, it is left unchanged. However if the second one is greater than the first, the second number replaces the first one in the AL register. The procedure is repeated for every number in the array and thus it requires n iterations. At the end of nth iteration the largest number will reside in the register AL.

For smallest number the above said logic is repeated but, If the first number is smaller than the second one it is left unchanged. Otherwise the second number replaces the first number in the AL register.

### **2.4 PROCEDURE**

1. Enter the opcodes in ram memory from location 1000 using SUB command
2. Using STEP command, execute the program instruction by instruction
3. After each instruction verified register contents and see that they are initialized to the required values
4. Execute the program and check for results.

### **2.5 PRE-LAB QUESTIONS**

1. Draw the flowchart to find the largest and smallest number of an array?
2. What is the similarity and difference between Subtract and Compare Instruction?
3. What are the addressing modes are used in your program?
4. Initialize register CX to value FFFF and register AX to value 0000, write a program to exchange the contents of both these register?
5. Illustrate the use of LEA, LDS, and LES instruction and to initialize registers using these instructions?
6. Logic calculations are done in which type of registers?
7. In an 8086 microprocessor program, data and stack memory occupies uniform memory space. State true or false?
8. Explain cross-compiler, linker, editor and debugger?

9. Suppose that DS=1000h, SS=2000h, BP=1000h and DI=0100h. Determine the memory address accessed by each of the following instructions.

MOV AL, [BP + DI]

MOV CX, [BP]

10. Form a jump instruction that jumps to the address pointed by the BX register?

## **2.6 LAB ASSIGNMENT**

1. Write an assembly language program to find largest and smallest number in a given array of data.
2. Write an assembly language program using DAA instruction?
3. Write an algorithm and draw the flowchart for the above mentioned questions.

## **2.7 POST-LAB QUESTIONS**

1. What is the purpose of MOV DS, AX?
2. What will be the status of flags after executing the program?
3. What are the addressing modes are used in our program?
4. What is the difference between JUMP and LOOP instructions?
5. What instructions are needed to add AL, 3L and DL together, and place the result in CL? Do not destroy BL or DL.
6. show the instruction needed to count the number of 1's found in AL. For example if AL contains 10110001, the number of 1's is 4.
7. What is purpose served by CX register?

## **Experiment - 3: SUM OF SERIES**

### **3.1 OBJECTIVE**

To find the sum of a series of 8-bit numbers in a given array of 10 numbers.

### **3.2 RESOURCES**

The 8086 Microprocessor kit, Power Supply.

### **3.3 PROGRAM LOGIC**

In this program we show the addition of 10 numbers and is used as count for number of additions. The initial sum is assumed as zero. Initially, the resulting sum of the first two numbers will be stored. To this sum, the third number will be added. This procedure will be repeated till all the numbers in the series are added. A conditional JUMP instruction will be used to implement the counter checking logic.

### **3.4 PRE-LAB QUESTIONS**

1. Draw the flowchart to find the sum of series of 8-bit numbers in a given array of 10 numbers?
2. Given an instruction, how do you identify the addressing mode of the instruction, explain with example?
3. Identify the type of addressing modes used in the following data transfer operations. When data is moved from AX register to EX and when the data is moved from Ex register to a memory location whose address is given by DX register.
4. A 20-bit **address bus** allows access to a memory of capacity
  - (a) 1 MB
  - (b) 2 MB
  - (c) 4 MB
  - (d) 8 MB
5. Programs are written in assembly language because they
  - (a) run faster than High-level language
  - (b) are portable
  - (c) easier to write than machine code programs
  - (d) they allow the programmer access to registers or instructions that are not usually provided by a High-level language
6. What is meant by Maskable interrupts?
  - (a) An interrupt that can be turned off by the programmer.
  - (b) An interrupt that cannot be turned off by the programmer.
  - (c) An interrupt that can be turned off by the system.
  - (d) An interrupt that cannot be turned off by the system

7. Is overlapping of segment possible in 8086?

### 3.5 LAB ASSIGNMENTS

1. Write a program to find the sum of series for the given logic.
2. Write an assembly language program using XCHG Instruction.

### 3.6 POST-LAB QUESTIONS

1. In our program, List out the instructions which are not affected by the flags.
2. Which are pointers present in this 8086?
3. Which Flags can be set or reset by the programmer and also used to control the operation of the processor?
4. Find the error in this program?

```
MOV AL, 00
MOV BL, 05
MOV CL, 02
AGAIN: ADD AL, BL
       JNZ AGAIN
       DEC CL
       MOV DI, 1300
       MOV [DI], AL
       HLT
```

5. List the instructions that can be used to clear the accumulator or any registers?

## **Experiment - 4: ASCENDING ORDER**

### **4.1 OBJECTIVE**

To write an assembly language program to arrange a given series of numbers in ascending and descending order.

### **4.2 RESOURCES**

The 8086 Microprocessor kit, Power Supply.

### **4.3 PROGRAM LOGIC**

To arrange the given numbers in ascending and descending order, the bubble sorting method is used. Initially the first number of the series is compared with the second one. If the first number is greater than second, exchange their positions in the series otherwise leave the position unchanged. Then compare the second number in the recent form of the series with third and repeat the exchange part that you are carried out for the first and second number, and for all the remaining number of the series. Repeat this procedure for complete series (n-1) times. After n-1 iterations you will get the largest number at the end of the series. Again start from the first number of the series. Repeat the same procedure right from the first element to the last element. After n-2 iteration you will get the second highest number at the last but one place in the series. Repeat this till the complete series is arranged in ascending order.

### **4.3 PRE-LAB QUESTIONS**

1. Draw the flow chart to arrange a given series of numbers in ascending and descending order.
2. In a given program how many times DEC and JNZ instructions are executed? What will be content in AX register after executing the program?

```
MOV AX, 00FF
```

```
MOV CL, 05
```

```
REPEAT: INC AX
```

```
DEC CL
```

```
JNZ REPEAT
```

Write a small program using AAA instruction?

3. Which type of jump instruction (short, near or far) assembles for the following:

If the distance is 0210H bytes

If the distance is 0020H bytes

If the distance is 100000H bytes

If DL = 0F3H and DH = 72H, List the difference after DH subtracts from DL, and show the contents of the flag register bits.

4. How is register AL is used during execution of XLAT?

5. What conditional jump instruction should be used after `CMP AL, 30H` to jump when `AL` equals `30H`?

#### **4.4 LAB ASSIGNMENT**

1. Write an assembly language program to sort the given array of 16-bit numbers in ascending order.
2. Write an assembly language program to find the 1's complement.

#### **4.5 POST-LAB QUESTIONS:**

1. What is the purpose of `XCHG` instruction?
2. What is the use of `PUSH` and `POP` instruction?
3. Write an assembly language program in 8086 to sort the given array of 16-bit numbers in descending order.
4. What do square brackets mean when they appear in an operand?
5. What is the difference between `MOV AX, 0` and `SUB AX, AX`? There may be more than one difference to comment on.
6. Write a routine to swap nibbles in `AL`. For example if `AL` contains `3E`, then it will contain `E3` after execution.