LABORATORY MANUAL FOR MICROPROCESSOR AND MICROCONTROLLER LAB

B. Tech.

DEPARTMENT OF ELECTRICAL AND INSTRUMENTATION ENGINEERING

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About Laboratory Manual

This manual is intended for the Second year students of engineering branches in the subject of Microprocessor and Microcontroller. This manual typically contains practical/Lab Sessions related microprocessor and microcontroller covering various aspects related to the subject to enhance understanding.

Students are advised to thoroughly go through this manual rather than only topics mentioned in the syllabus as practical aspects are the key to understanding and conceptual visualization of theoretical aspects covered in the books.

Subject Code : PCEE-713
Title of the course : Microprocessor and Microcontroller Lab

1. Do's and Don'ts in the laboratory
2. Lab Experiments:

To understand the practicability of **Microprocessor and Microcontroller**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers.
2. Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.
3. To perform multiplication and division of two 8 bit numbers using 8085.
4. To find the largest and smallest number in an array of data using 8085 instruction set.
5. To write a program to arrange an array of data in ascending and descending order.
6. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085 instruction set.
7. To write a program to initiate 8251 and to check the transmission and reception of character.
8. To interface 8253 programmable interval timer to 8085 and verify the operation of 8253 in six different modes.
9. To interface DAC with 8085 to demonstrate the generation of square, saw tooth and triangular wave.
10. Serial communication between two 8085 through RS-232 C port.

DO'S and DON'TS in Laboratory

1. Come fully prepared for the experiment in the laboratory.
2. Check for appropriate power supply before connecting to the equipment.
3. Decide the appropriate range of the measuring instruments on the basis of quantity to be measured.
4. Make the connections without connecting the leads to the supply.
5. Re-check the connections and show it to the teacher /instructor before switching-on the power supply to the circuit.
6. Energize the circuit only with the permission of the teacher/instructor.
7. After the experiment, disconnect the connections and put back the connecting wires/leads at appropriate place.
8. Return all the apparatus to the lab-staff.
9. In case of shock, switch-off the power supply immediately.
10. Strictly follow the procedure given with the respective experiments.
11. Avoid loose connections.
12. Don't touch the main power supply leads with bare hand and avoid body earth.
13. Don't use the mobile phones during laboratory.

EXPERIMENT NO. – 1(a)

OBJECTIVE:
Write a program to add two hexadecimal & decimal numbers.

APPARATUS REQUIRED: -

Sr. no.	Name of equipment's/components/software	Specification/range/rating/version	Quantity
1	8085 Microprocessor programming kit, instruction coding sheet.	SCIENTECH-8085	1
2.	Power supply	A.C (230V Mains)	

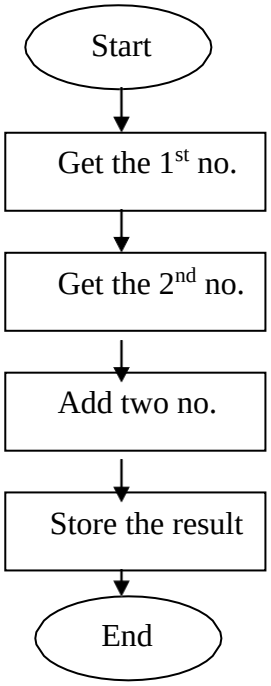
DESCRIPTION/ALGORITHM: -

Hexadecimal Addition: The program takes the content of 2009, adds it to 200B & stores the result back at 200C.

Steps: 1. Initialize HL Reg. pair with address where the first number is lying.
2. Store the number in accumulator.
3. Get the second number.
4. Add the two numbers and store the result in 200B.
5. Go back to Monitor

Let: (2009 H) = 80 H
(200B H) = 15 H
Result = 80 H + 15 H = 95 H
(2009 H) → A
A → B
(200B H) → A
A + B → A
A → (200C H)

FLOWCHART: -



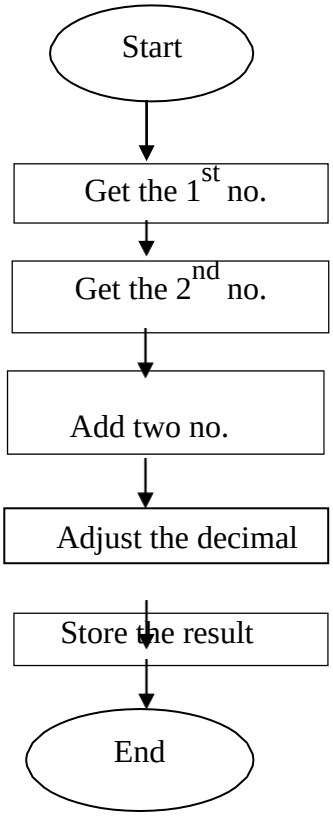
PROGRAM: -

```
LXI H, 2009    ;    Point 1st no.
MOV A, M       ;    Load the acc.
INX H          ;    Adv Pointer
ADD M          ;    ADD 2nd NO.
INX H          ;    Adv Pointer
MOV M, A       ;    Store Result
RST 5
```

Decimal Addition:

Steps: 1. Initialize HL Reg. pair with address where the first number is lying.
2. Store the number in accumulator.
3. Get the second number.
4. Add the two numbers and store the result in 200B.
5. Go back to Monitor

FLOWCHART:-



PROGRAM: -

```
LXI H, 2009    ;    Point 1st no.
MOV A, M       ;    Load the acc.
INX H          ;    Adv Pointer
ADD M          ;    ADD 2nd NO.
DAA            ;    Adjust the decimal
INX H          ;    Adv Pointer
MOV M, A       ;    Store Result
RST 5
```

REULTS: -

Thus the numbers at 2009H and at memory are added.

CONCLUSION: -

Thus the program to add two 8-bit numbers was executed.

PRECAUTION: -

EXPERIMENT NO. – 1 (b)

OBJECTIVE: - Write a program to subtract two hexadecimal & decimal numbers

APPARATUS REQUIRED: -

Sr. no.	Name of equipment's/components/software	Specification/range/rating/version	Quantity
1	8085 Microprocessor programming kit, instruction coding sheet.	SCIENTECH-8085	1
2.	Power supply	A.C (230V Mains)	

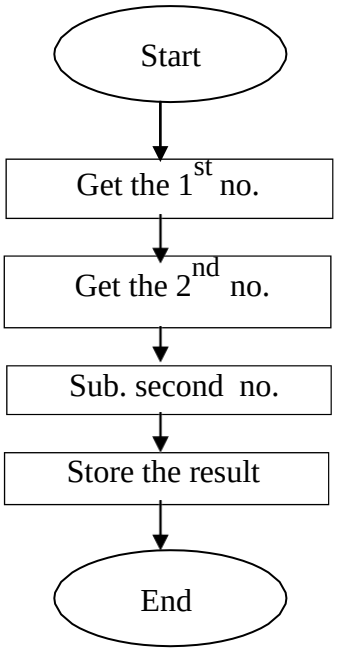
DESCRIPTION/ALGORITHM: -

Hexadecimal Subtraction: The program takes the content of 2009, subtracts it to 200B & stores the result back at 200C.

Steps: -

1. Initialize HL Reg. pair with address where the first number is lying.
2. Store the number in accumulator.
3. Get the second number.
4. Subtract second no from acc and store the result in 200B.
5. Go back to Monitor

FLOWCHART: -



PROGRAM: -

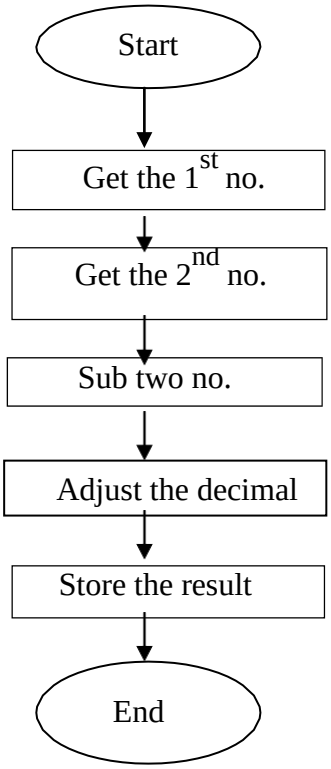
```
LXI H, 2009    ;    Point 1st no.
MOV A, M       ;    Load the acc.
INX H          ;    Adv Pointer
SUB M          ;    Subtract IIND NO.
INX H          ;    Adv Pointer
MOV M, A       ;    Store Result
RST 5
```

Decimal Subtraction:

Steps: -

1. Initialize HL Reg. pair with address where the first number is lying.
2. Store the number in accumulator.
3. Get the second number.
4. Subtract second no from acc and store the result in 200B.
5. Adjust the decimal
6. Go back to Monitor

FLOWCHART: -



PROGRAM: -

```
LXI H, 2009     ;       Point 1st no.
MOV A, M        ;       Load the acc.
INX H           ;       Adv Pointer
SUB M           ;       Subtract IIND NO.
DAA             ;       Adjust the decimal
INX H           ; Adv Pointer MOV
M, A            ;    Store Result RST5
```

REULTS: -

Numbers at 2009H and in HL pairs (Memory) are subtracted

CONCLUSION: -

Thus the subtraction operation is taken out using assembly language**.**

EXPERIMENT NO. –0 2

OBJECTIVE: - Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.

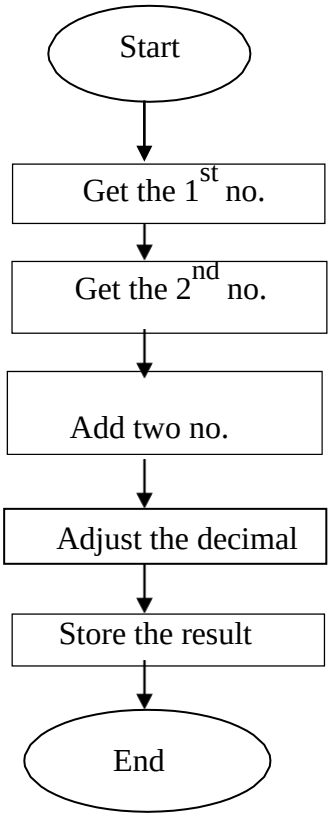
APPARATUS REQUIRED: -

Sr. no.	Name of equipment's/components/software	Specification/range/rating/version	Quantity
1	8085 Microprocessor programming kit, instruction coding sheet.	SCIENTECH-8085	1
2.	Power supply	A.C (230V Mains)	

DESCRIPTION/ALGORITHM: -

Steps: 1. Initialize HL Reg. pair with address where the first number is lying.
2. Store the number in accumulator.
3. Get the second number.
4. Add the two numbers and store the result in 200B.
5. Go back to Monitor

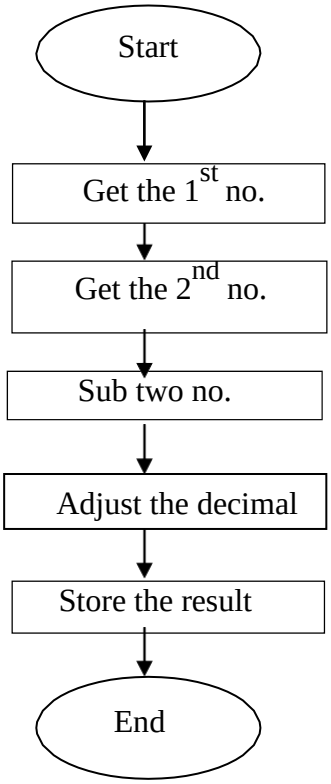
FLOWCHART: -



Steps: -

7. Initialize HL Reg. pair with address where the first number is lying.
8. Store the number in accumulator.
9. Get the second number.
10. Subtract second no from acc and store the result in 200B.
11. Adjust the decimal
12. Go back to Monitor

FLOWCHART: -



PROGRAM:-

```
LXI H, 2009     ;       Point 1st no.
MOV A, M        ;       Load the acc.
INX H           ;       Adv Pointer
SUB M           ;       Subtract IIND NO.
DAA             ;       Adjust the decimal
INX H           ;       Adv Pointer
MOV M, A        ;       Store Result
RST 5
```

REULTS: -
The BCD numbers at 2009H and memory are added or subtracted.

CONCLUSION: -
Thus the subtraction operation is taken out using assembly language**.**

EXPRIMENT NO. – 3 (a)

OBJECTIVE: - Write a program to perform multiplication of two 8 bit numbers using bit addition method

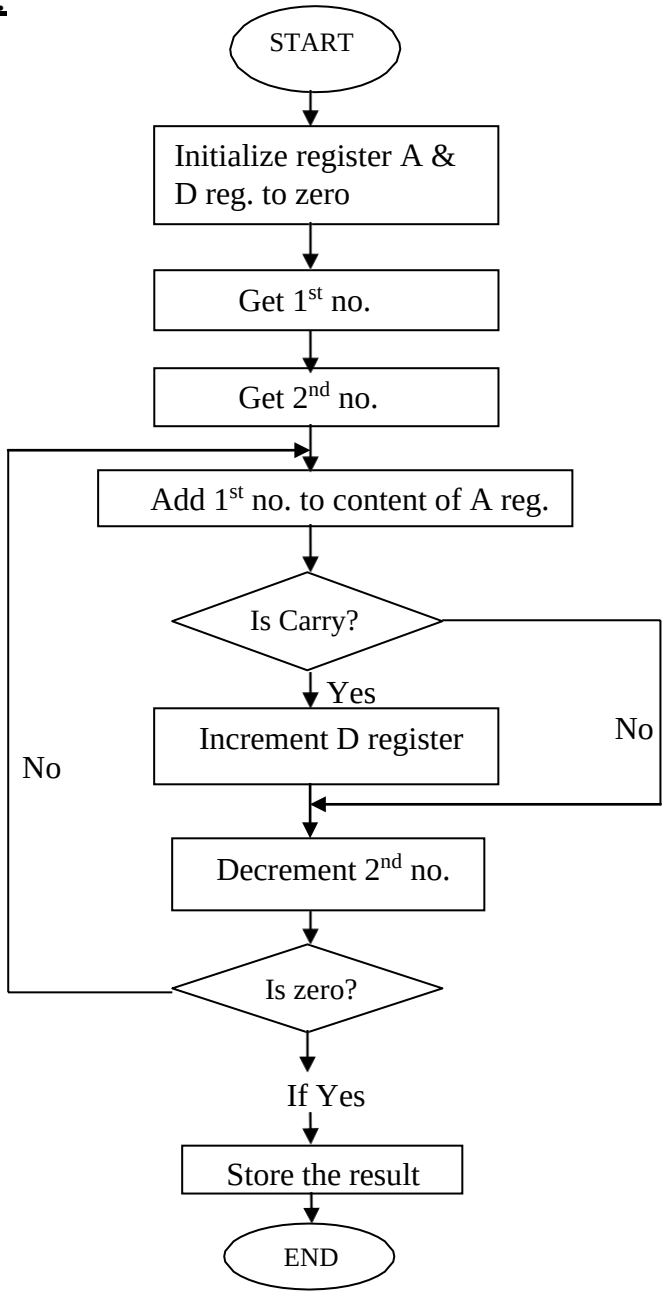
APPARATUS REQUIRED: -

Sr. no.	Name of equipment's/ components/ software	Specification/range/rating/ version	Quantity
1	8085 Microprocessor programming kit, instruction coding sheet.	SCIENTECH-8085	1
2.	Power supply	A.C (230V Mains)	

DESCRIPTION/ALGORITHM: -

1) Start the program by loading HL register pair with address of memory location.
2) Move the data to a register (B register).
3) Get the second data and load into Accumulator.
4) Add the two register contents.
5) Check for carry.
6) Increment the value of carry.
7) Check whether repeated addition is over and store the value of product and carry in memory location.

FLOWCHART:



PROGRAM:

```
MVI  D, 00      ;   Initialize register D to 00
MVI  A, 00      ;   Initialize Accumulator content to 00
LXI H, 4150     ;   HL Points 4150
MOV B, M        ;   Get the first number in B - register
INX H           ;   HL Points 4151
MOV C, M        ;   Get the second number in C- reg.
LOOP : ADD B    ;   Add content of A - reg to register B.
JNC NEXT        ;   Jump on no carry to NEXT.
INR D           ;   Increment content of register D
NEXT : DCR C    ;   Decrement content of register C.
JNZ LOOP        ;   Jump on no zero to address
STA 4152        ;   Store the result in Memory
MOV A, D        ;   Get the carry in Accumulator
STA 4153        ;   Store the MSB of result in Memory
HLT             ;   Terminate the program.
```

REULTS:-

Input: FF (4150)
FF (4151)
Output: 01 (4152)
FE (4153)

CONCLUSION: -

Thus the multiplication process is taken out using assembly language for 8085 microprocessor

EXPRIMENT NO. – 3 (b)

OBJECTIVE: - Write a program to perform multiplication of two 8 bit numbers using bit rotation method

APPARATUS REQUIRED: -

Sr. no.	Name of equipment's/components/software	Specification/range/rating/version	Quantity
1	8085 Microprocessor programming kit, instruction coding sheet.	SCIENTECH-8085	1
2.	Power supply	A.C (230V Mains)	

DESCRIPTION/ALGORITHM: -

1) Start the program by loading HL register pair with address of memory location.
2) Move the data to a register (E register).
3) Get the second data and load into Accumulator.
4) Add the two register contents.
5) Check for carry.
6) Increment the value of carry.
7) Check whether repeated addition is over and store the value of product and carry in memory location.
8) Terminate the program.

EXAMPLE:

Steps	Product								Multiplier					Comments
	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	CY	B_3	B_2	B_1	B_0	
	0	0	0	0	0	0	0	0	0	0	1	0	1	Initial Stage
Step 1	0	0	0	0	0	0	0	0	0	1	0	1	0	Shift left by 1
	0	0	0	0	0	0	0	0	0	1	0	1	0	Don't add since CY= 0
Step 2	0	0	0	0	0	0	0	0	1	0	1	0	0	Shift
	0	0	0	0	1	1	0	0	1	0	1	0	0	Add multiplicand;CY=1
Step 3	0	0	0	1	1	0	0	0	0	1	0	0	0	Shift left by 1
	0	0	0	1	1	0	0	0	0	1	0	0	0	Don't add since CY= 0
Step 4	0	0	1	1	0	0	0	0	1	0	0	0	0	Add multiplicand;CY=1

PROGRAM:

```
        LXI H, 2200 H    ;   Initialize the memory pointer
        MOV E , M        ;   Get multiplicand
        MVI D, 00 H      ;   Extend to 16 bits
        INX H            ;   Increment memory pointer
        MOV A , M        ;   Get Multiplier
        LXI H , 0000 H   ;   Product = 0
        MVI B, 08 H      ;   Initialize counter with count 8
LOOP:   DAD H            ;   Product = product X 2
```

```
        RAL
        JNC XYZ         ;   Is carry from multiplier 1?
        DAD  D          ;   Yes, product = product + multiplicand
XYZ:    DCR  B          ;   Is counter = 0
        JNZ  LOOP       ;   No, repeat
        SHLD 2300 H     ;   Store the result
        HLT
```

REULTS: -

Multiplication has been carried out between the data of 2200H and 2201 H.

CONCLUSION: -

Thus the multiplication process for 8 bit binary numbers is taken out in 8085 microprocessor

EXPRIMENT NO. – 4 (a)

OBJECTIVE: - Write a program to perform division of two 8 bit numbers using Repeated Subtraction method.

APPARATUS REQUIRED: -

Sr. no.	Name of equipment's/components/software	Specification/range/rating/version	Quantity
1	8085 Microprocessor programming kit, instruction coding sheet.	SCIENTECH-8085	1
2.	Power supply	A.C (230V Mains)	

DESCRIPTION/ALGORITHM: -

1) Start the program by loading HL register pair with address of memory location.
2) Move the data to a register (B register).
3) Get the second data and load into Accumulator.
4) Compare the two numbers to check for carry.
5) Subtract the two numbers.
6) Increment the value of carry.
7) Check whether repeated subtraction is over and store the value of product and Carry in memory location.
8) Terminate the program.

PROGRAM:

```
        LXI H, 4150
        MOV B , M     ;   Get the dividend in B – reg.
        MVI C, 00     ;   Clear C – reg for quotient
        INX H         ;
        MOV A , M     ;   Get the divisor in A – reg.
NEXT:   CMP B         ;   Compare A - reg with register B.
        JC LOOP       ;   Jump on carry to LOOP
        SUB B         ;   Subtract A – reg from B- reg.
        INR C         ;   Increment content of register C.
        JMP NEXT      ;   Jump to NEXT
LOOP:   STA 4152      ;   Store the remainder in Memory
        MOV A, C      ;
        STA 4153      ;   Store the quotient in memory
        HLT           ;   Terminate the program.
```

RESULTS:

Input: FF (4150)
FF (4251)
Output: 01 (4152) ---- Remainder
FE (4153)-----Quotient

EXPERIMENT NO.- 4 (b)

OBJECTIVE: - Write a program to perform division of two 8 bit numbers using bit rotation method.

APPARATUS REQUIRED: -

Sr. no.	Name of equipment's/components/software	Specification/range/rating/version	Quantity
1	8085 Microprocessor programming kit, instruction coding sheet.	SCIENTECH-8085	1
2.	Power supply	A.C (230V Mains)	

PROGRAM:

```
        MVI E, 00 H      ;    Quotient = 0
        LHLD 2200 H      ;    Get Dividend
        LDA 2300 H       ;    Get Divisor
        MOV B , A        ;    Store Divisor
        MVI C , 08 H     ;    Count = 08
NEXT :  DAD H            ;    Dividend = Dividend X 2
        MOV A , E
        RLC
        MOV E , A        ;    Quotient = X 2
        MOV A , H
        SUB B            ;    Is MSB of dividend > divisor
        JC SKIP          ;    No go to next step
        MOV H , A        ;    Yes subtract divisor
        INR E            ;    Quotient = Quotient + 1
SKIP :  DCR C            ;    Count = count – 1
        JNZ  NEXT        ;    Is count = 0 repeat
        MOV A , E
        STA 2401 H       ;    Store Quotient
        MOV A , H
        STA 2401 H       ;    Store Remainder
        HLT              ;    End of program
```

REULTS: -

Number at 220H is divided from the number at 2300H

CONCLUSION: -

Thus the division process is taken out in 8085 microprocessor

EXPERIMENT NO.- 5

OBJECTIVE: - Finding the largest and smallest number from an array.

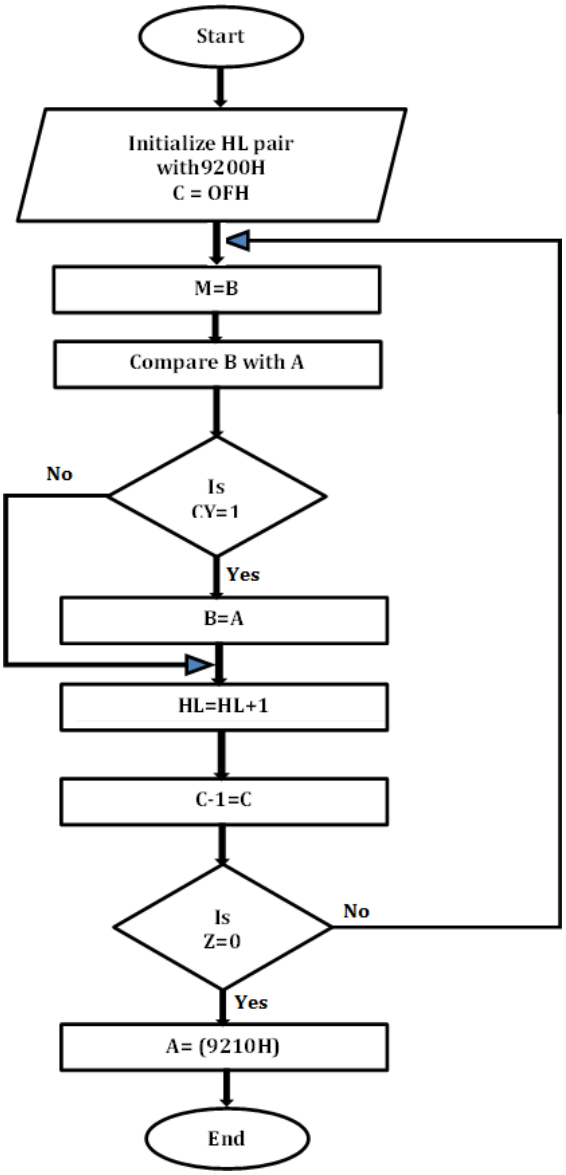
APPARATUS REQUIRED: -

Sr. no.	Name of equipment's/components/software	Specification/range/rating/version	Quantity
1	8085 Microprocessor programming kit, instruction coding sheet.	SCIENTECH-8085	1
2.	Power supply	A.C (230V Mains)	

DESCRIPTION/ALGORITHM: -

Write a program to find the largest number in a given array of 16 elements. The array is stored in memory from 9200H onwards. Store the result at the end of the array.

FLOWCHART: -



PROCEDURE: -

To find largest of given no. of a given string we compare all given no. one by one. Suppose given no. is 2, 4, 3, 1, 0 1st we compare 2 & 4 (2 is in register A & 4 is in Register B).
A < B so put B into (A) & Compare with next number i.e. 3 Here A > B so directly compare 4 with 1 then 0.

RESULT AND INFERENCE: -
The largest number from the array of 16 numbers from memory location 9200H is found out and stored at 9210H

PRECAUTION: - Take memory locations according model of kit.

EXPERIMENT NO.- 6

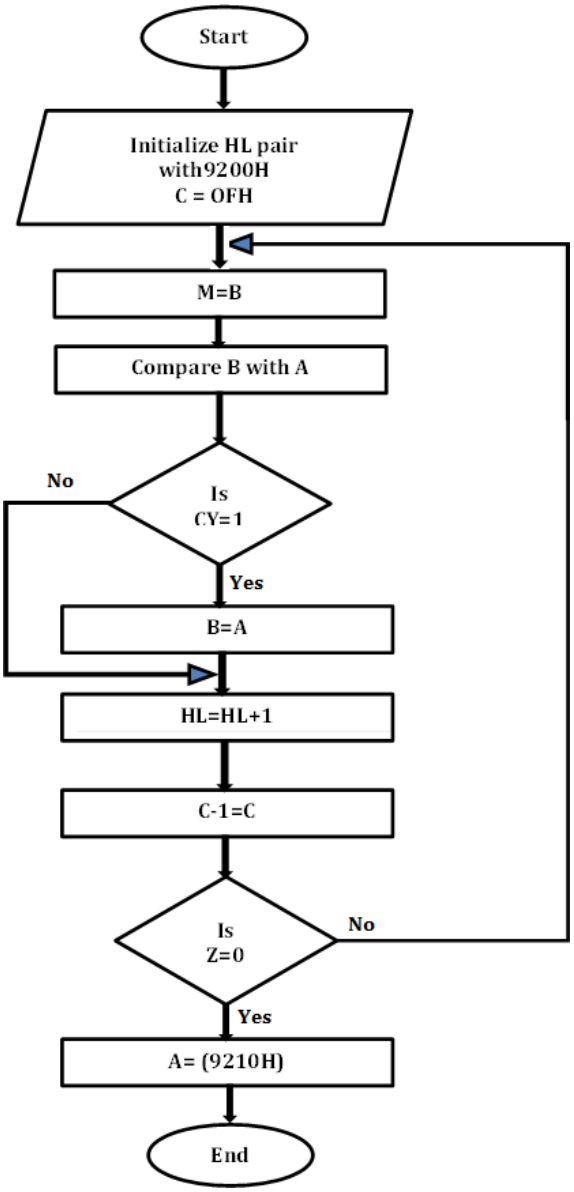
AIM: - Finding the smallest number from an array.

Write a program to find smallest number from an array of 16 elements the array is stored in memory from 9200H onwards. Store the result at memory location 9210H.

REQUIREMENT: - 8085 microprocessor programming kit, instruction coding sheet.

THEORY: - Same as largest no. we compare two number one by one but comparison process is reverse.

PROCEDURE: -



RESULTS:

Smallest number has been found out from a 16-bit array starting from 9200H and is stored at 9210H.

CONCLUSION:

Thus the smallest number has been found out from the array in assembly language for 8085 microprocessor

EXPERIMENT NO.- 7

OBJECTIVE: - Interfacing a program to initiate 8251 and to check transmission and reception of character

APPARATUS REQUIRED: -

Sr. no.	Name of equipments/components/software	Specification/range/rating/version	Quantity
1	8085 Microprocessor programming kit, instruction coding sheet.	SCIENTECH-8085	1
2.	Power supply	A.C (230V Mains)	

DESCRIPTION/ALGORITHM: -

Steps:

1. Initialize timer IC
2. Move the mode command word to A
3. Output it to port address C2
4. Move the command instruction word to A reg.
5. Output it to port address C2
6. Move the data to be transferred to A
7. Output it to port address C0
8. Reset the system
9. Get data from input port C0
10. Store the value in memory
11. Reset the system

PROGRAM:

```
MVI A,36H
Out CEH
MVI A,0AH
Out C8H
LXI H,4200H
MVI A,4EH
Out C2H
MVI A, 37H
Out C2H
MVI A, 42H
Out C0H
RST 1
ORG 4200H
In C0H
STA 4500H
RST 1
```

RESULT

Output at 4500=1

CONCLUSION

Thus the 8251 was initiated and the transmission and reception character was done successfully.

EXPERIMENT NO.- 8

OBJECTIVE: - To interface Programmable Interval timer to 8085 and verify the operation of 8253 in six different modes

APPARATUS REQUIRED: -

Sr. no.	Name of equipment's/components/software	Specification/range/rating/version	Quantity
1	8085 Microprocessor programming kit, instruction coding sheet.	SCIENTECH-8085	1
2.	Power supply	A.C (230V Mains)	
3.	CRO	20MHz	1

DESCRIPTION/ALGORITHM: -

MODE 0- Interrupt On Terminal Count:

At first let us see the channel in mode0. Connect the CLK0 to the debounce circuit and execute the following program.

Program:

```
MVI A, 30H
OUT CEH
MVI A, 05H
OUT C8H
MVI A, 00H
OUT C8H
HLT
```

MODE 1- Programmable One Shot

After loading the count, the output will remain low following the rising edge of the gate input. The output will go high on the terminal count.
The program initializes channel 0 of 8253 in Mode 1 and also initializes triggering of gate.

Program:

```
MVI A, 32H
OUT CEH
MVI A, 05H
OUT C8H
MVI A,00H
OUT C8H
OUT DOH
HLT
```

MODE 3-Square Generation
In this the output will remain high until one half of the count and goes low for the order half provided the count is an even number. This mode is used to generate the baud rate of 8251.

Program:

```
MVI A, 36H
OUT CEH
MVI A, 0AH
OUT C8H
MVI A, 00H
OUT C8H
HLT
```

RESULT:
Thus the 8253 PIT was interfaced to 8085 and the operations for mode 0, 1 and 3 were verified.