



LAB MANUAL

MICROPROCESSOR AND INTERFACING **(EC-515-F)**

V SEMESTER

**DEPARTMENT OF ELECTRONICS & COMPUTER ENGG
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KHENTAWAS, GURGAON- 123506**

MICROPROCESSOR AND INTERFACING LAB

LIST OF EXPERIMENTS
V SEM(ECS)

S.NO.	NAME OF THE EXPERIMENT	Page No.
1	STUDY ARCHITECTURE OF 8085 KIT	3
2	WRITE A PROGRAM USING 8085 & VERIFY FOR : A. ADDITION OF TWO 8-BIT NUMBERS. B. ADDITION OF TWO 16-BIT NUMBERS. (WITH CARRY)	6
3	WRITE A PROGRAM USING 8085 & VERIFY FOR : A. SUBTRACTION OF TWO 8-BIT NUMBERS. (DISPLAY OF BARROW) B. SUBTRACTION OF TWO 16-BIT NUMBERS. (DISPLAY OF BARROW)	12
4	WRITE A PROGRAM USING 8085 FOR MULTIPLICATION OF TWO 8- BIT NUMBERS BY REPEATED ADDITION METHOD. CHECK FOR MINIMUM NUMBER OF ADDITIONS AND TEST FOR TYPICAL DATA	17
5	WRITE A PROGRAM USING 8085 FOR MULTIPLICATION OF TWO 8- BIT NUMBERS BY BIT ROTATION METHOD AND VERIFY	20
6	WRITE A PROGRAM USING 8085 FOR DIVISION OF TWO 8- BIT NUMBERS BY REPEATED SUBTRACTION METHOD AND TEST FOR TYPICAL DATA	24
7	WRITE A PROGRAM USING 8085 FOR DIVIDING TWO 8- BIT NUMBERS BY BIT ROTATION METHOD AND TEST FOR TYPICAL DATA	27
8	TO STUDY 8086 MICROPROCESSOR IN DETAIL	31
9	WRITE A PROGRAM USING 8086 FOR COPYING 12 BYTES OF DATA FROM SOURCE TO DESTINATION AND VERIFY.	34
10	WRITE A PROGRAM FOR FINDING THE LARGEST NUMBERS IN AN ARRAY USING 8086	37
11	WRITE A PROGRAM FOR ARRANGING AN ARRAY OF NUMBERS IN DESSCENDING ORDER USING 8086	41
12	WRITE A PROGRAM FOR FINDING SQUARE OF A NUMBER USING LOOK-UP TABLE AND VERIFY.	45

EXPERIMENT NO. 1(A)

AIM : STUDY OF 8085-MICROPROCESSOR KIT.

APPARATUS: 8085 microprocessor kit.

THEORY :

Intel 8085 is an 8-bit microprocessor. It is 40-pin IC package fabricated on a single LSI chip. It uses a single +5 V supply. Its clock speed is about 3 MHz. It consists of three main sections: -

1. ALU (Arithmetic and logic unit):-

The ALU performs the arithmetic and logical operation, addition, subtraction, logical AND, OR, EX-OR, Complement, Increment, Decrement, shift, clear.

2. Timing and Control Unit:-

It generates timing and control signals, which are necessary for the execution of instruction.

3. Registers: -

These are used for temporary storage of data and instruction. INTEL 8085 has following registers: -

- i) One 8 bit accumulator
- ii) Six 8 bit registers (B, C, D, E, H, L)
- iii) One 16 bit stack pointer, SP
- iv) One 16 bit program counter, PC
- v) Instruction register
- vi) Status register
- vii) Temporary registers

PC contains the address of next instruction.

IR holds the instruction until it is decoded.

SP holds the address of the stack top.

Accumulator is used during execution of program for temporary storage of data.

Status flags are as follows: -

- i) Carry (CS)
- ii) Zero (Z)
- iii) Sign (S)
- iv) Parity (P)
- v) Auxiliary Carry (AC)

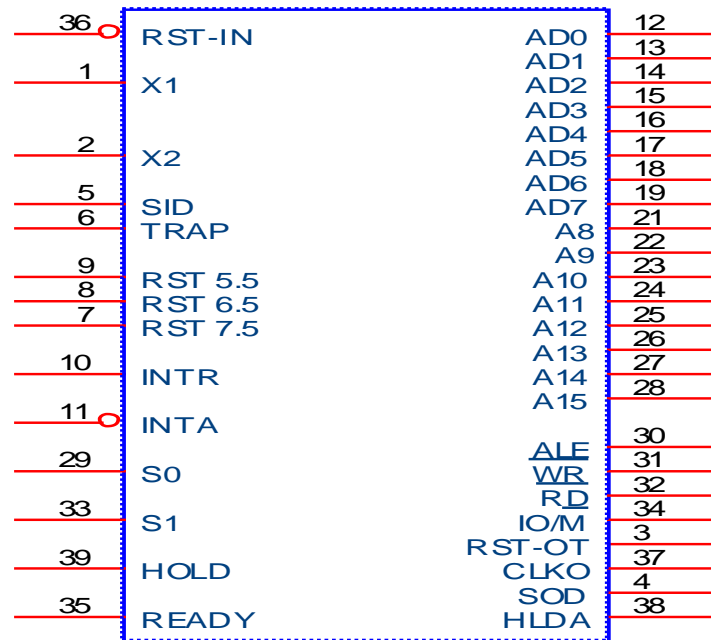
PSW

This 8-bit program status word includes status flags and three undefined bits.

Data and Address bus

Data bus is 8-bit wide and 8 bits of data can be transmitted in parallel. It has 16-bit wide address bus as the memory addresses are of 16 bits.

CIRCUIT DIAGRAM(PIN DIAGRAM):-



PIN CONFIGURATION

A8-A15 (Output):-

These are address bus and used for the most significant bits of memory address.

AD0-AD7 (Input/Output):-

These are time multiplexed address data bus. These are used for the least significant 8 bits of the memory address during first clock cycle and then for data during second and third clock cycle

ALE (Address Latch Enable)

It goes high during the 1st clock cycle of a machine. It enables the lower 8 bits of address to be latched either in the memory or external latch.

IO/M

It is status signal, when it goes high; the address on address bus is for I/O device, otherwise for memory.

So, S1

These are status signals to distinguish various types of operation

S1	So	Operation
0	0	Halt
0	1	Write
1	0	Read

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1 1 Fetch

RD (output)

It is used to control read operation.

WR (output)

It is used to control write operation

HOLD (input)

It is used to indicate that another device is requesting the use of address & data bus.

HLDA (output)

It is acknowledgement signal used to indicate HOLD request has been received.

INTR (input)

When it goes high, microprocessor suspends its normal sequence of operations.

INTA (output)

It is interrupt acknowledgement signal sent by microprocessor after INTR is received.

RST 5.5,6.5,7.5 and TRAP

These are various interrupt signals. Among them TRAP is having highest priority

RESET IN (input)

It resets the PC to zero.

RESET OUT(output)

It indicates that CPU is being reset.

X1, X2 (input)

This circuitry is required to produce a suitable clock for the operation of microprocessor.

Clk (output)

It is clock output for user. Its frequency is same at which processor operates.

SID (input)

It is used for data line for serial input.

SOD (output)

It is used for data line for serial output.

Vcc

+5 volts supply

Vss

Ground reference

EXPERIMENT NO. 2(A)

AIM : WRITE A PROGRAM USING 8085 & VERIFY FOR :

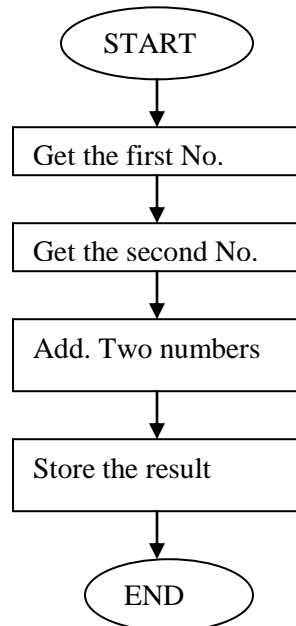
(a) ADDITION OF TWO 8-BIT NUMBERS.

APPARATUS : 8085 microprocessor kit, 5V power supply, Keyboard.

THEORY (Program)

Memory address	Machine code	Mnemonics	Operands	Commands
7000	21,01,75	LXI	H,7501	Get address of 1 st no. in HL pair
7003	7E	MOV	A,M	Move 1st no. in accumulator
7004	23	INX	H	HL points the address 7502H
7005	86	ADD	M	Add the 2 nd no.
7006	23	INX	H	HL points 7503H
7007	77	MOV	M,A	Store result in 7503H.
7008	CF	RST 1		Terminate

CIRCUIT DIAGRAM / BLOCK DIAGRAM:-



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PROCEDURE:-

ANSHUMAN

S

Enter Enter

Program Address

Write Program

Execution Steps

Esc

G

Enter-enter

Prog. Address

Enter

S

Enter

Any key-2

Enter-2

Register Name

SCIENTECH

Reset

Exmem

Starting Address

Next

Write Program

Execution Steps

Reset

GO

Starting Address

Fill

Reset

Exmem

Result Address

INPUT DATA

7501- 13H

7502- 12H

OUTPUT DATA

7503- 25H

PRECAUTIONS:-

Make sure that all the machine codes should be as per specified in the program.

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EXPERIMENT NO. 2(B)

AIM : WRITE A PROGRAM USING 8085 & VERIFY FOR :
(b) ADDITION OF TWO 16-BIT NUMBERS(WITH CARRY).

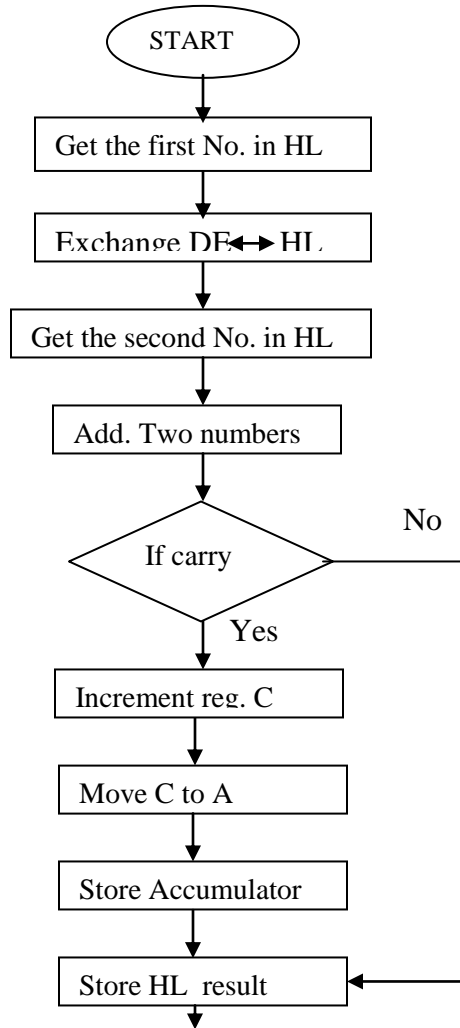
APPARATUS : 8085 microprocessor kit, 5V power supply, Keyboard.

THEORY (Program)

Memory address	Label	Machine code	Mnemonics	Operands	Commands
7000		2A,01,76	LHLD	7601H	Get 1 st no. in HL pair from memory (7601)
7003		EB	XCHG		Exchange cont. of DE ↔ HL
7004		2A,03,76	LHLD	7603H	Get 2 st no. in HL pair from location 7603
7007		0E,00	MVI	C,00H	Clear reg. C.
7009		19	DAD	D	Get HL+DE & store result in HL
700A		D2,12,70	JNC	7012(loop)	If no carry move to loop/if carry then move to next step.
700D		0C	INR	C	Increment reg C
700E		79	MOV	A,C	Move carry from reg. C to reg. A
7011		32,02,75	STA	7502	Store carry at 7502H
7012	loop	22,00,75	SHLD	7500	Store result in 7500H.
7015		CF	RST1		Terminate

CIRCUIT DIAGRAM / BLOCK DIAGRAM:-

∴



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PROCEDURE:-

END

ANSHUMAN

S

Enter Enter

Program Address

Write Program

Execution Steps

Esc

G

Enter-enter

Prog. Address

Enter

S

Enter

Any key-2

Enter-2 Register Name

INPUT DATA

7601 : 13H

7602 : 31H

7603 : 12H

7604 : 10H

OUTPUT DATA

7500 : 25H

7501 : 41H

7502 : 00H

SCIENTECH

Reset

Exmem

Starting Address

Next

Write Program

Execution Steps

Reset

GO

Starting Address

Fill

Reset

Exmem

Result Address

PRECAUTIONS:-

Make sure that all the machine codes should be as per specified in the program.

Question & Answer:

Q.1 Explain MOV r,M ?

Ans: Move the content of memory to register.

Q.2 How many T-state are in MOV instruction?

Ans: 4 T-state.

Q.3 Explain the addressing mode of MOV r,M?

Ans: Register indirect.

Q.4 How many machine cycles are in MOV instruction?

Ans: 2 machine cycle.

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Q.5 What is MOV M,r ?

Ans: move the content of register to memory

Q.6 Which flag is affected in MOV instruction?

Ans: none

Q.7 What is MVI r,data?

Ans: move immediate data to register

Q.8 How many T-state are in MVI instruction?

Ans: seven T-states.

Q.9 Explain the addressing mode of MVI r,data?

Ans: immediate

Q.10 How many machine cycles are in MVI instruction?

Ans: 3 machine cycles.

EXPERIMENT NO. 3(A)

AIM: WRITE A PROGRAM USING 8085 & VERIFY FOR :

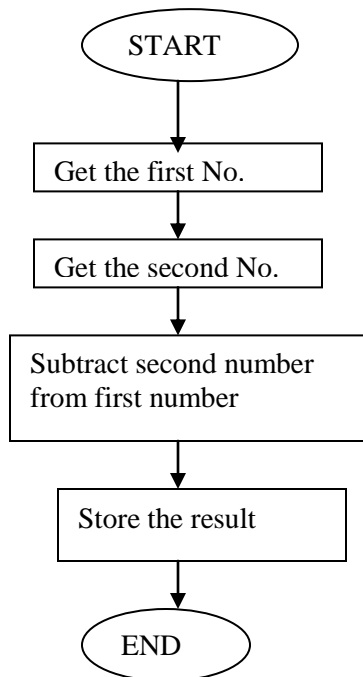
A. SUBTRACTION OF TWO 8-BIT NUMBERS. (DISPLAY OF BARROW).

APPARATUS : 8085 microprocessor kit, 5V power supply, Keyboard.

THEORY(Program) :

Memory address	Opcode	Mnemonics	Operands	Comments
7000	21,01,75	LXI	H, 7501	Get address of 1st no. in HL pair
7003	7E	MOV	A, M	Move 1st no. in accumulator
7004	23	INX	H	HL points 7502H.
7005	96	SUB	M	Subtract 2 nd no. from 1st no.
7006	23	INX	H	HL points 7503 H.
7007	77	MOV	M, A	Move contents of acc. to memory
7008	CF	RST 1		Stop

CIRCUIT DIAGRAM / BLOCK DIAGRAM :-



MP LAB (EC-515-F)

PROCEDURE:-

ANSHUMAN

S

Enter Enter

Program Address

Write Program

Execution Steps

Esc

G

Enter-enter

Prog. Address

Enter

S

Enter

Any key-2

Enter-2

Register Name

SCIENTECH

Reset

Exmem

Starting Address

Next

Write Program

Execution Steps

Reset

GO

Starting Address

Fill

Reset

Exmem

Result Address

INPUT DATA

7501 : 20H

7502 : 10H

OUTPUT DATA

7503 : 10H

PRECAUTIONS:-

Make sure that all the machine codes should be as per specified in the program.

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EXPERIMENT NO. 3 (B)

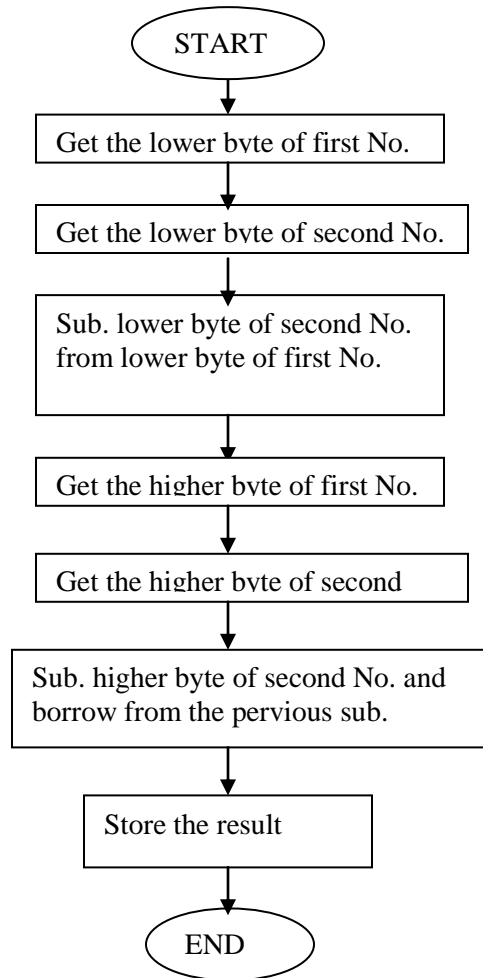
AIM : WRITE A PROGRAM USING 8085 & VERIFY FOR :
B. SUBTRACTION OF TWO 16-BIT NUMBERS. (DISPLAY OF BARROW)

APPARATUS : 8085 microprocessor kit, 5V power supply, Keyboard.

THEORY (Program) :

Memory Address	Machine Code	Mnemonics	Operands	Comments
7000	2A, 01,75	LHLD	7501 H	Get 1st 16 bit no. in HL pair
7003	EB	XCHG		Exchange HL pair with DE.
7004	2A, 03,75	LHLD	7503 H	Get 2nd 16 bit no. in HL pair
7007	7B	MOV	A, E	Get lower byte of 1st no.
7008	95	SUB	L	Subtract lower byte of 2 nd no.
7009	6F	MOV	L, A	Store the result in reg. L
700A	7A	MOV	A, D	Get higher byte of 1st no.
700B	96	SBB	H	Subtract higher byte of 2 nd no. with borrow
700C	67	MOV	H,A	Move from acc. To H
700D,E, F	22,05,75	SHLD	7505H	Store 16 bit result at 7505&7506
7010	CF	RST 1		Terminate

CIRCUIT DIAGRAM / BLOCK DIAGRAM :-



PROCEDURE:-

ANSHUMAN
S
Enter Enter
Program Address
Write Program
Execution Steps

Esc
G
Enter-enter
Prog. Address
Enter

SCIENTECH
Reset
Exmem
Starting Address
Next
Write Program
Execution Steps

Reset
GO
Starting Address
Fill
Reset

EXPERIMENT NO. 4

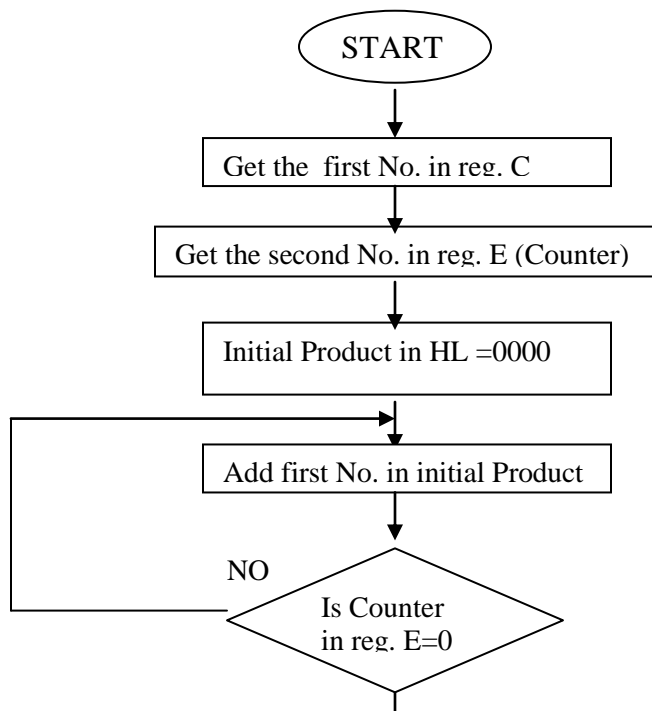
AIM : WRITE A PROGRAM USING 8085 FOR MULTIPLICATION OF TWO 8-BIT NUMBERS BY REPEATED ADDITION METHOD CHECK MINIMUM NUMBER OF ADDITION & TEST FOR TYPICAL DATA

APPARATUS : 8085 microprocessor kit, 5V power supply, Keyboard.

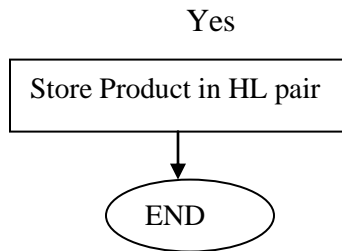
THEORY (Program) :

Memory Address	Label	Machine Code	Mnemonics	Operands	Comments
7000		0E,25	MVI	C,25	Move the no. in reg. C
7002		1E,05	MVI	E,05	Move the no. in reg. E
7004		06,00	MVI	B,00	Clear reg. B
7006		21,00,00	LXI	H,0000	Initial Product=0000
7009	UP1:	09	DAD	B	HL+BC=>HL
700A		1D	DCR	E	Decrement reg. E
700B		C2,09,70	JNZ	UP1(7009)	Jump if not zero to location up1
700E		22,00,75	SHLD	7500	Store HL at 7500
7011		CF	RST 1		Terminate

CIRCUIT DIAGRAM / BLOCK DIAGRAM:-



MP LAB (EC-515-F)



PROCEDURE:-

ANSHUMAN

S

Enter Enter

Program Address

Write Program

Execution Steps

Esc

G

Enter-enter

Prog. Address

Enter

S

Enter

Any key-2

Enter

Name

Register

SCIENTECH

Reset

Exmem

Starting Address

Next

Write Program

Execution Steps

Reset

GO

Starting Address

Fill

Reset

Exmem

Result Address

INPUT DATA

1) Reg.C : 25H

Reg.E : 05H

Reg.B : 00H

OUTPUT DATA

HL pair : 00B9H

PRECAUTIONS:-

Make sure that all the machine codes should be as per specified in the program

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Question & Answer:

1. What is microprocessor?

Ans It is a program controlled semi conductor device (IC), which fetches, decodes and execute instructions.

2. What are the basic units of microprocessor?

Ans The basic units or blocks of microprocessor are ALU, an array of registers and control unit.

3. What is a bus?

Ans Bus is a group of conducting lines that carries data, address and control signals.

4. Why data bus is bi-directional?

Ans The microprocessor is to fetch (read) the data from memory or input device for processing and after processing it has to store (write) the data to memory or output devices. Hence the data bus is bi-directional.

5. Why data bus is bi-directional?

Ans The address is an identification number used by the microprocessor to identify or access a memory location or input/output device. It is an output signal from the processor. Hence the address bus is unidirectional.

6. Define machine cycle?

Ans Machine cycle is defined as the time required to complete one operation of accessing memory input/output, or acknowledging an external request. This cycle may consists of three to six T-states.

7. Define T-state?

Ans T-state is defined as one subdivision of operation performed in one clock period. These subdivisions are internal states synchronized with the system clock, and each T-state is precisely equal to one clock period.

8. What is an instruction cycle?

Ans The sequence of operations that a processor has to carry out while executing the instruction is called instruction cycle. Each instruction cycle of processor contains a number of machine cycles.

9. What is fetch and execute cycle?

Ans The instruction cycle is divided in to fetch and execute cycles. The fetch cycle is executed to fetch the opcode from memory. The execute cycle is executed to decode the instruction and to perform the work instructed by the instruction.

10. List the flags of 8085?

Ans There are five flags in 8085.They are sign flag, zero flag, auxiliary carry flag, parity flag and carry flag.

EXPERIMENT NO. 5

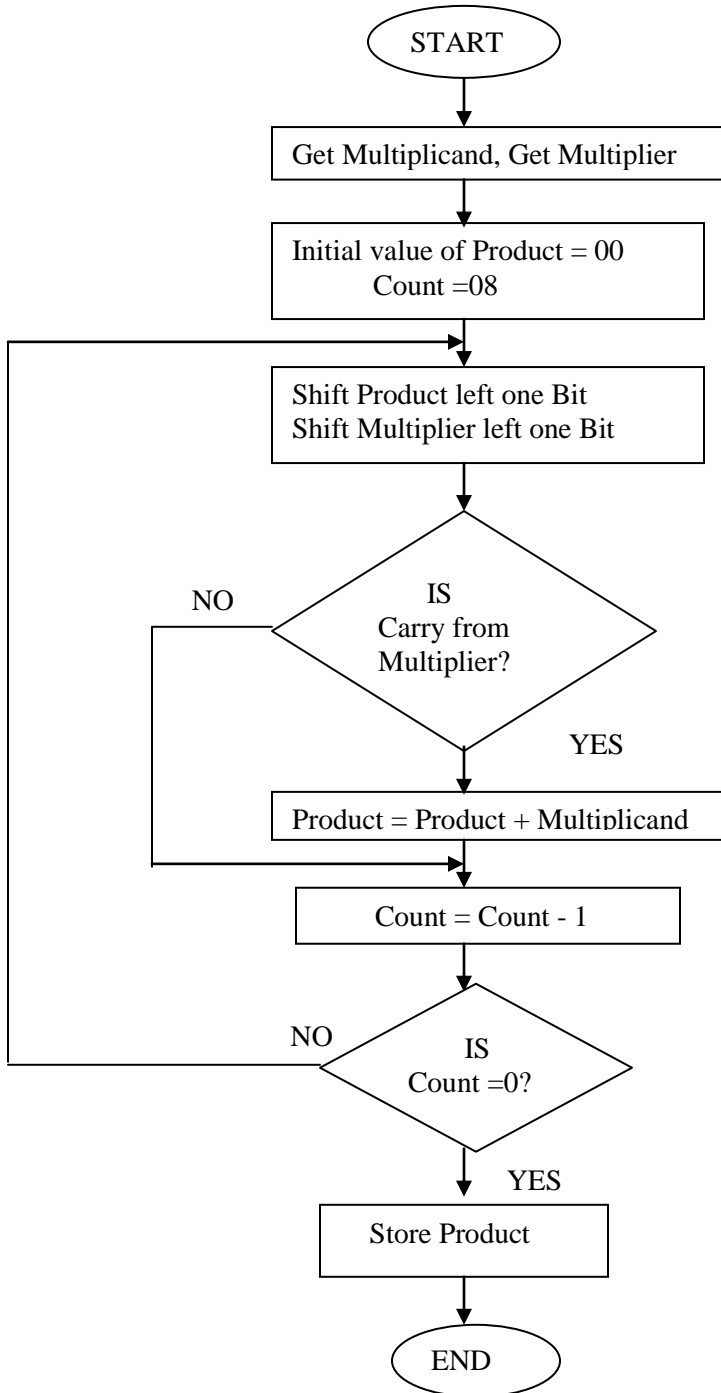
AIM : WRITE A PROGRAM USING 8085 FOR MULTIPLICATION OF TWO 8-BIT NUMBERS BY BIT ROTATION METHOD & VERIFY.

APPARATUS : 8085 microprocessor kit, 5 V power supply, Keyboard.

THEORY(Program)

Memory Address	Label	Machine Code	Mnemonics	Operands	Comments
7000		2A,01,75	LHLD	7501 H	Get Multiplicand in H-L pair.
7003		EB	XCHG		Exchange HL pair with DE pair
7004		3A,03,75	LDA	7503 H	Get 2nd no. in acc.
7007		21,00,00	LXI	H,0000	Initial product in HL=00
700A		0E,08	MVI	C,08H	Count=08 in reg .C
700C	Loop	29	DAD	H	Shift partial product left by 1 bit
700D		17	RAL		Rotate multiplication by 1 bit. Is multiplier = 1?
700E		D2,12,70	JNC	Ahead(7012)	No, go to ahead
7011		19	DAD	D	Product=Product + Multiplicand
7012	Ahead	0D	DCR	C	Decrement Count
7013		C2,0C,70	JNZ	Loop(700C)	
7016		22,04,75	SHLD	7504	Store result
7019		CF	RST 1		Terminate

CIRCUIT DIAGRAM / BLOCK DIAGRAM :-



PROCEDURE:-

ANSHUMAN
S
Enter Enter
Program Address
Write Program
Execution Steps

Esc
G
Enter-enter
Prog. Address
Enter
S
Enter
Any key-2
Enter-2
Register Name

SCIENTECH
Reset
Exmem
Starting Address
Next
Write Program
Execution Steps

Reset
GO
Starting Address
Fill
Reset
Exmem
Result Address

INPUT DATA

7501- 25H
7502- 00H
7503- 05H

OUTPUT DATA

7504- B9H
7505- 00H

PRECAUTIONS:-

Make sure that all the machine codes should be as per specified in the program.

Question & Answer:

Q.1 Explain MOV r,M ?

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Ans Move the content of memory to register

Q.2 How many T-state are in MOV instruction?

Ans Four T-state

Q.3 Explain the addressing mode of MOV r,M?

Ans Register indirect

Q.4 How many machine cycles are in MOV instruction?

Ans Two machine cycle

Q.5 What is MOV M,r ?

Ans Move the content of register to memory

Q.6 Which flag is affected in MOV instruction?

Ans none

Q.7 What is MVI r,data?

Ans Move immediate data to register

Q.8 How many T-state are in MVI instruction?

Ans seven T-states

Q.9 Explain the addressing mode of MVI r,data?

Ans immediate

Q.10 How many machine cycles are in MVI instruction?

Ans Three machine cycles

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EXPERIMENT NO. 6

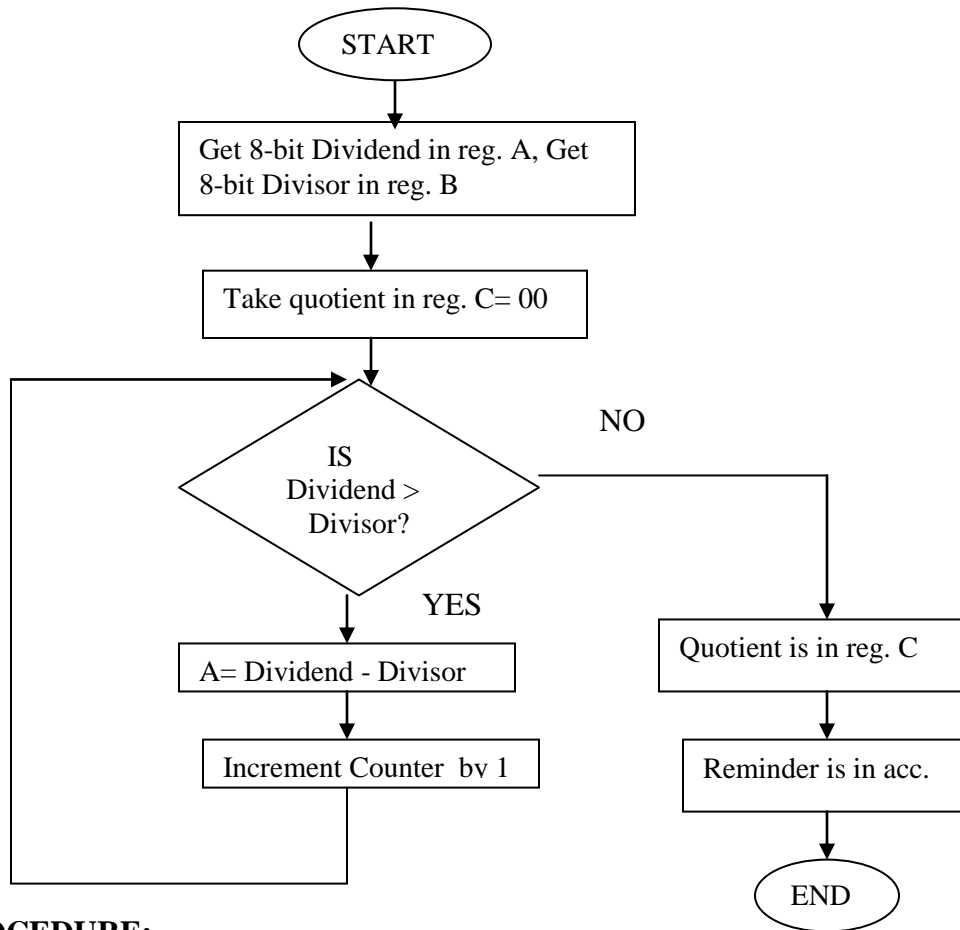
AIM : WRITE A PROGRAM USING 8085 FOR DIVISION OF TWO 8-BIT NUMBERS BY REPEATED SUBTRACTION METHOD & TEST FOR TYPICAL DATA.

APPARATUS : 8085 microprocessor kit, 5V power supply, Key board.

THEORY (Program) :

Memory Address	Label	Machine Code	Mnemonics	Operands	Comments
7000		3A,01,75	LDA	Divisor(7501)	
7003		47	MOV B,A		Take divisor in reg,B
7004		3A,02,75	LDA	Dividend(7502)	Take dividend in reg,A
7007		0E,00	MVI	C,00	Quotient=00
7009		B8	CMP	B	
700A		DA,13,70	JC	Loop(7013)	
700D	loop1	90	SUB	B	Dividend-divisor=>A
700E		0C	INR	C	C=C+1
700F		B8	CMP	B	Is dividend < divisor
7010		D2,0D,70	JNC	Loop1(700D)	If not,go back
7013	loop	32,03,75	STA	Remainder(7503)	Store Remainder
7016		79	MOV	A,C	
7017		32,04,75	STA	Quotient(7504)	Store Quotient
701A		CF	RST 1		Terminate.

CIRCUIT DIAGRAM / BLOCK DIAGRAM:-



PROCEDURE:-

ANSHUMAN

S

Enter Enter

Program Address

Write Program

Execution Steps

Esc

G

Enter-enter

Prog. Address

Enter

S

Enter

Any key-2

Enter-2

Register Name

SCIENTECH

Reset

Exmem

Starting Address

Next

Write Program

Execution Steps

Reset

GO

Starting Address

Fill

Reset

Exmem

Result Address

INPUT DATA

7501- Divisor
7502-Dividend

OUTPUT DATA

7503-Remainder
7504-Quotient

PRECAUTIONS:-

Make sure that all the machine codes should be as per specified in the program.

Question & Answer

Q.1 Explain the addressing mode of STA addr?

Ans: Direct

Q.2 How many machine cycles are in STA instruction?

Ans: 4

Q.3 What is LHL D addr?

Ans: load H - L pair direct.

Q.4 How many T-state are in LHL D instruction?

Ans: 24 sixteen T –states..

Q.5 Explain the addressing mode of LHL D addr?

Ans: Direct

Q.6 How many machine cycles are in LHL D instruction?

Ans: 5

Q.7 What is SHLD addr ?

Ans: store H-L pair direct.

Q.8 How many T-state are in SHLD instruction?

Ans: 16

Q.9 Explain the addressing mode of SHLD addr?

Ans: Direct

Q.10 How many machine cycles are in SHLD instruction?

Ans: 5.

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EXPERIMENT NO. 7

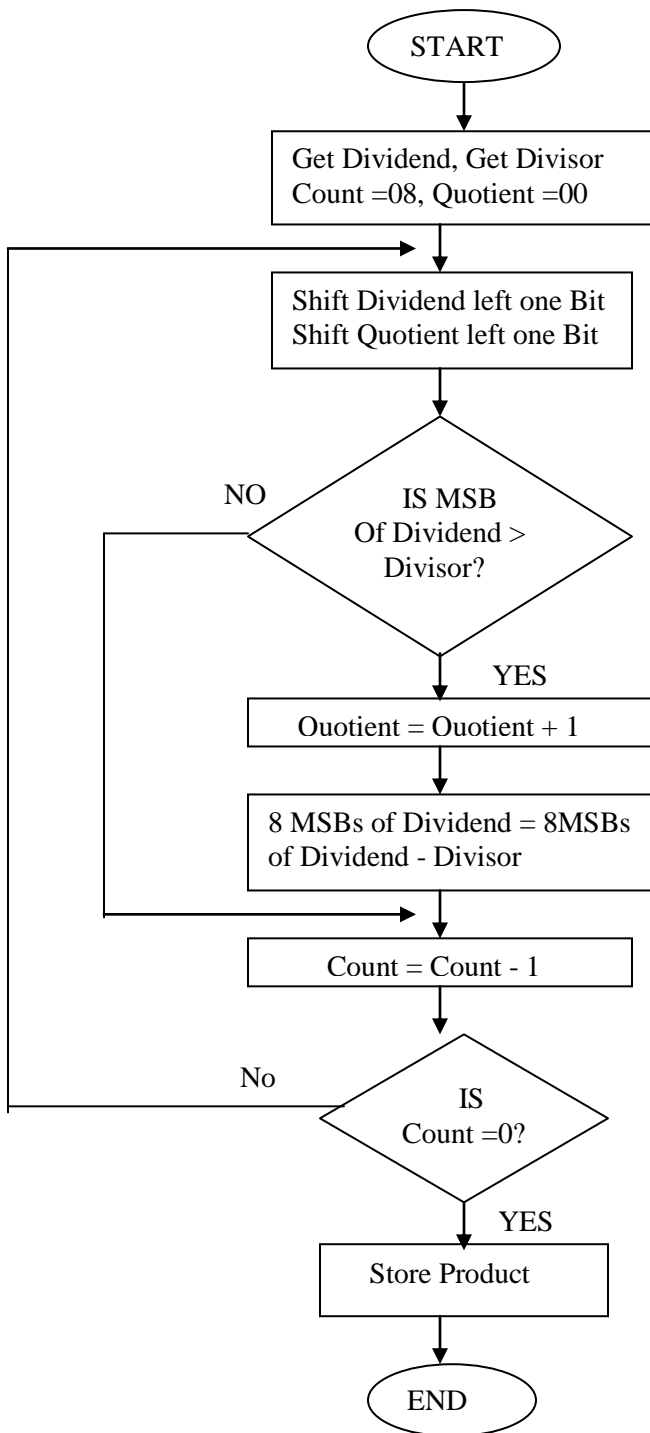
AIM : WRITE A PROGRAM USING 8085 FOR DIVISION OF TWO 8 -BIT NUMBERS BY BIT ROTATION METHOD & TEST FOR TYPICAL DATA.

APPARATUS : 8085 microprocessor kit, Keyboard, and 5V Power Supply.

THEORY (Program)

Memory Address	Label	Machine Code	Mnemonics	Operands	Comments
7000		2A, 01,75	LHLD	7501 H	Enter the 16 bit address in HL pair
7003		3A, 03,75	LDA	7503 H	Get divisor from 7503
7006		47	MOV	B, A	Divisor in register B
7007		0E, 08	MVI	C, 08	Count = 08 in register C.
7009	Loop	29	DAD	H	Shift dividend and quotient left by one bit.
700A		7C	MOV	A, H	Most significant bits of dividend in acc.
700B		90	SUB	B	Subtract divisor from MSB of dividend.
700C		DA, 11, 70	JC	Ahead(7011)	Is MSB of dividend>divisor? No, go to AHEAD.
700F		67	MOV	H, A	MSB of dividend in reg. H
7010		2C	INR	L	Yes, add 1 to quotient.
7011	Ahead	0D	DCR	C	Decrement count.
7012		C2, 09,70	JNZ	Loop(7009)	Is count=0?No, jump to loop.
7015		22,04,75	SHLD	7504 H	Store quotient in 7504 and remainder in 7505 H.
7018		CF	RST1		Stop.

CIRCUIT DIAGRAM / BLOCK DIAGRAM:-



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PROCEDURE:-

ANSHUMAN
S
Enter Enter
Program Address
Write Program

SCIENTECH
Reset
Exmem
Starting Address
Next
Write Program

Execution Steps

Esc
G
Enter-enter
Prog. Address
Enter
S
Enter
Any key-2
Enter-2
Register Name

Execution Steps

Reset
GO
Starting Address
Fill
Reset
Exmem
Result Address

INPUT DATA

7501- LSB of dividend
7502- MSB of dividend
7503- Divisor

OUTPUT DATA

7504- Quotient
7505- Remainder

PRECAUTIONS:-

Make sure that all the machine codes should be as per specified in the program.

Question & Answer ;

Q.1 What is LDAX rp?

Ans: Load accumulator indirect.

Q.2 How many T-state are in LDAX instruction?

Ans: 7

Q.3 Explain the addressing mode of LDAX rp?

Ans: Register indirect .

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Q.4 How many machine cycles are in LDAX instruction?

Ans: 2

Q.5 What is STAX rp ?

Ans: Store accumulator indirect

Q.6 How many T-state are in STAX instruction?

Ans: 7

Q.7 Explain the addressing mode of STAX rp?

Ans: Register indirect.

Q.8 How many machine cycles are in STAX instruction?

Ans: 2

Q.9 What is XCHG ?

Ans: Exchange the contents of H-L pair with D-E pair

Q.10 How many T-state are in XCHG instruction?

Ans: 4

EXPERIMENT NO. 8

AIM : STUDY OF 8086 MICROPROCESSOR KIT.

APPARATUS: 8086 microprocessor kit.

THEORY :The 8086 is a 16-bit, N-channel, HMOS microprocessor. The term HMOS is used for high-speed MOS”. The 8086 uses 20 address lines and 16 data lines. It can directly address up to $2^{20} = 1\text{Mbytes}$ of memory. The 16-bit data word is divided into a low-order byte and a high-order byte. The 20 address lines are time multiplexed lines. The 16 low-order address lines are time multiplexed with data, and the 4 high-order address lines are time multiplexed with status signals.

OPERATING MODES OF 8086

There are two modes of operation for Intel 8086, namely the minimum mode and the maximum mode. When only one 8086 CPU is to be used in a microcomputer system the 8086 is used in the minimum mode of operation. In this mode the CPU issues the control signals required by memory and I/O devices. In case of maximum mode of operation control signals are issued by Intel 8288 bus controller which is used with 8086 for this very purpose. When MN/MX is high the CPU operates in the minimum mode. When it is low the CPU operates in the maximum mode.

Pin Description For Minimum Mode

For the minimum mode of operation the pin $\overline{\text{MN}}/\overline{\text{MX}}$ is connected to 5V d.c supply. The description of the pins from 24 to 31 for the minimum mode is as follows:

$\overline{\text{INTA}}$ (Output) : Pin no. 24 Interrupt acknowledge. On receiving interrupt signal the processor issues an interrupt acknowledge signal. It is active LOW.

ALE(Output) : Pin no. 25 Address latch enable. It goes HIGH during T1. The microprocessor sends this signal to latch the address into the Intel 8282/8283 latch.

$\overline{\text{DEN}}$ (Output) : Pin no. 26 Data enable. When Intel 8286/8287 octal bus transceiver is used this signal acts as an output enable signal. It is active LOW.

$\overline{\text{DT}}/\overline{\text{R}}$ (Output) : Pin no. 27 Data Transmit/Receive. When Intel 8286/8287 octal bus transceiver is used this signal controls the direction of data flow through the transceiver. When it is High data are sent out. When it is LOW data are received.

$\overline{\text{M}}/\overline{\text{IO}}$ (Output) : Pin no. 28. Memory or I/O access. When it is HIGH the CPU wants to access memory. When it is LOW the CPU wants to access I/O device.

$\overline{\text{WR}}$ (Output) : Pin no. 29. Write. When it is LOW the CPU performs memory or I/O write Operation.

HLDA (Output) : Pin no. 30. HOLD acknowledge. It is issued by the processor when it receives HOLD signal. It is active HIGH signal. When HOLD request is removed HLDA goes LOW.

HOLD (Output) : Pin no. 31. Hold. when another device in microcomputer system wants to use the address and data bus, it sends a HOLD request to CPU through this pin. It is an active HIGH signal.

Pin Description For Maximum Mode

For the maximum mode of operation the pin $\overline{MN}/\overline{MX}$ is made LOW. It is grounded. The description of the pins from 24 to 31 is as follows:

QS1, QS0(Output): Pin no. 24,25 Instruction Queue status. Logic are given below:

QS1	QS0	
0	0	No operation
0	1	1 st byte of opcode from queue
1	0	Empty the queue
1	1	Subsequent byte from queue

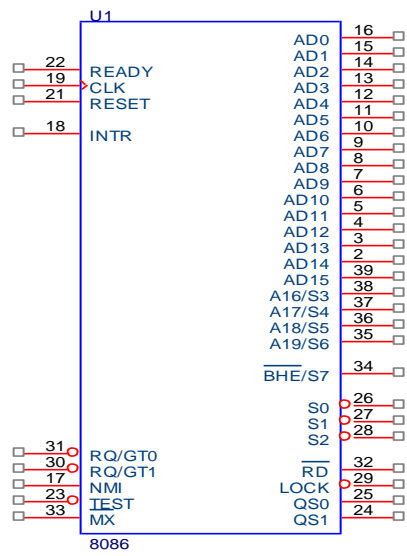
$\overline{S0}, \overline{S1}, \overline{S2}$ (Output) : Pin nos. 26,27,28.status signals. These signals are connected to the bus controller Intel 8288.The bus controller generates memory and I/O access control signals. Table for status signals is :

$\overline{S2}$	$\overline{S1}$	$\overline{S0}$	
0	0	0	Interrupt acknowledge
0	0	1	Read data from I/O port
0	1	0	Write data into I/O port
0	1	1	Halt
1	0	0	Opcode fetch
1	0	1	Memory read
1	1	0	Memory write
1	1	1	Passive state.

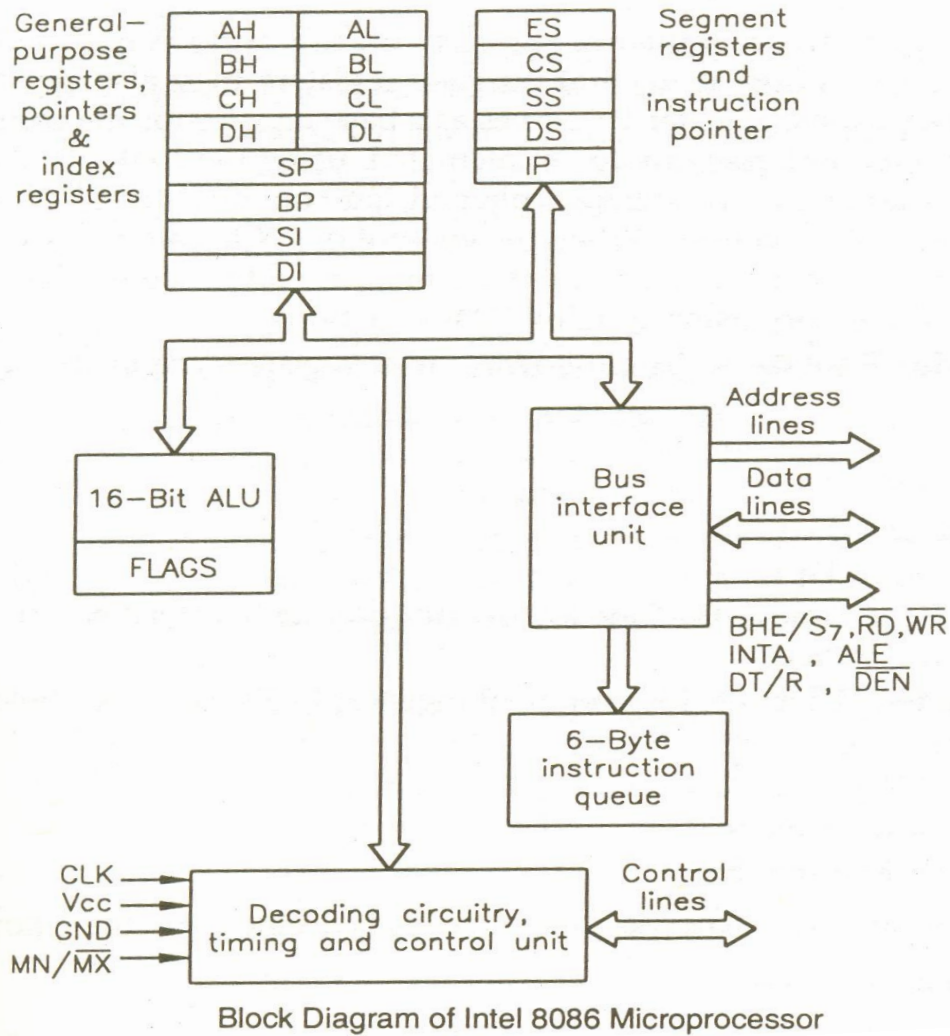
\overline{LOCK} (Output) : Pin no. 29.It is an active LOW signal. When it is LOW all interrupts are masked and no HOLD request is granted. In a multiprocessor system all other processors are informed by this signal that they should not ask the CPU for relinquishing the bus control.

$\overline{RQ} / \overline{GT}_1, \overline{RQ} / \overline{GT}_0$ (Bidirectional) : Pin no. 30,31. Local bus Priority control. Other processors ask the CPU through these lines to release the local bus. $\overline{RQ} / \overline{GT}_1$ has higher priority than $\overline{RQ} / \overline{GT}_0$

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PIN DIAGRAM OF 8086



BLOCK DIAGRAM OF 8086:

REGISTERS OF 8086 : The Intel 8086 contains the following registers:

- a) General Purpose Register
- b) Pointer and Index Registers
- c) Segment Registers
- d) Instruction Registers
- e) Status Flag

EXPERIMENT NO. 9

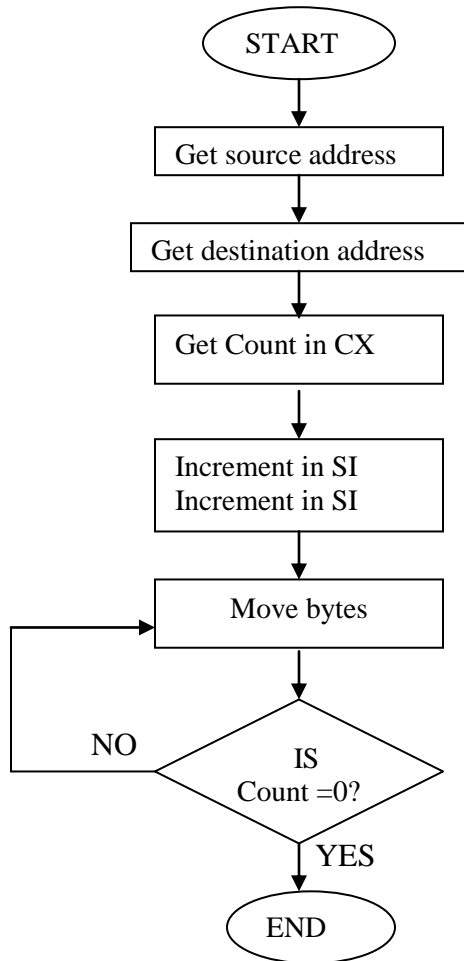
AIM : WRITE A PROGRAM USING 8086 FOR COPYING 12 BYTES OF DATA FROM SOURCE TO DESTINATION & VERIFY.

APPARATUS : 8086 microprocessor kit, 5V power supply, Keyboard.

THEORY(Program)

Memory Address	Label	Machine Code	Mnemonics	Operands	Comments
0101		FC	CLD		Clear direction flag DF
0102		BE,00,03	MOV	SI,0300	Source address in SI
0105		BF,02,02	MOV	DI,0202	Destination address in DI
0108		8B,0C	MOV	CX,[SI]	Count in CX
010A		46	INC	SI	Increment SI
010B		46	INC	SI	Increment SI
010C	BACK	A4	MOV	SB	Move byte
010D		E2,FD	LOOP	BACK	Jump to BACK until CX becomes zero
010F		CC	INT		Interrupt program

CIRCUIT DIAGRAM / BLOCK DIAGRAM:-



INPUT DATA

0300 : 0B
0301 : 00
0302 : 03
0303 : 04
0304 : 05
0305 : 06
0306 : 15
0307 : 07
0308 : 12

0309 : 08
030A : 09
030B : 0A
030C : 0B
030D : 0E

OUTPUT DATA

0202 : 03

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0203 : 04
0204 : 05
0205 : 06
0206 : 15
0207 : 07
0208 : 12

0209 : 08
020A : 09
020B : 0A
020C : 0B
020D : 0E

PRECAUTIONS:-

Make sure that all the machine codes should be as per specified in the program.

Question & Answer:

Q.1 Explain ADI data?

Ans: Add immediate data to accumulator

Q.2 How many T-states are in ADI instruction?

Ans: 7

Q.3 Explain the addressing mode of ADI?

Ans: Immediate

Q.4 How many machine cycles are in ADI instruction?

Ans: 2

Q.5 Explain DAD rp ?

Ans: Add register pair to HL pair.

Q.6 How many T-states are in DAD instruction?

Ans: 10

Q.7 Explain the addressing mode of DAD.

Ans: Register

Q.8 How many machine cycles are in DAD instruction?

Ans: 3

Q.9 Explain DAA.

Ans: Decimal adjust accumulator

Q.10 What is INX rp?

Ans: Increment register pair

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EXPERIMENT NO. 10

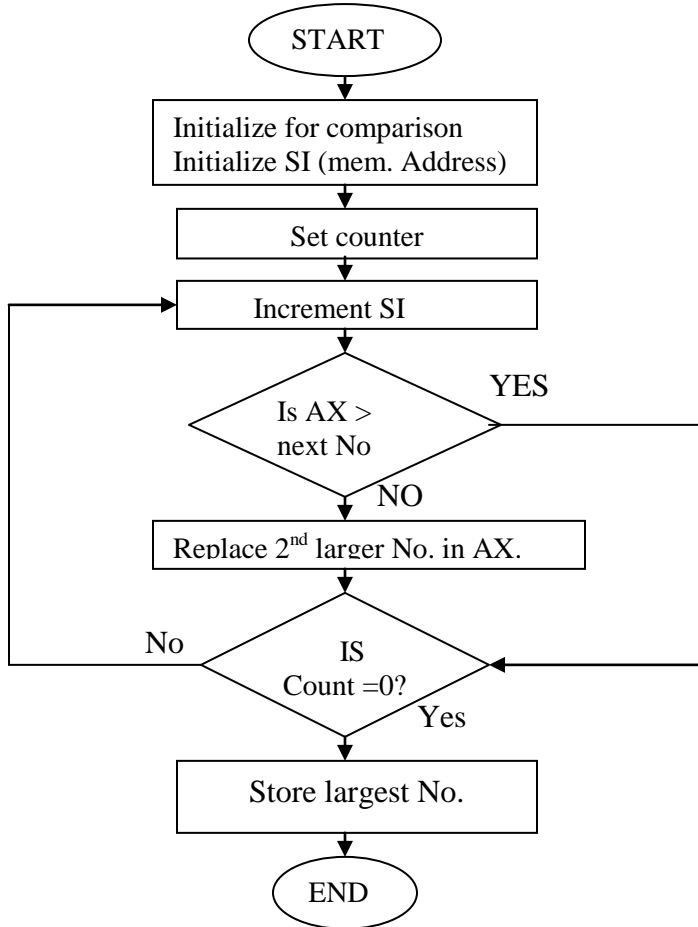
AIM : WRITE A PROGRAM USING 8086 & VERIFY FOR FINDING THE LARGEST NUMBER FROM AN ARRAY.

APPARATUS : 8086 microprocessor kit, 5V power supply, Keyboard.

THEORY(Program)

Memory Address	Label	Machine Code	Mnemonics	Operands	Comments
0101		B0,00,00	MOV	AX,0000	Initial value for comparison
0104		BE,00,02	MOV	SI,0200	Memory address in SI
0107		8B,0C	MOV	CX,[SI]	Count in CX
0109	BACK	46	INC	SI	Increment SI
010A		46	INC	SI	Increment SI
010B		3B,04	CMP	AX,[SI]	Compare previous largest number with next number
010D		73,02	JAE	GO	Jump if number in AX is larger i.eCF=0
010F		8B,04	MOV	AX,[SI]	Save next larger number in AX
0111	GO	E2,F6	LOOP	BACK	Jump to BACK until CX becomes zero
0113		A3,51,02	MOV	(0251),AX	Store largest number in memory
0116		CC	INT3		Interrupt program

CIRCUIT DIAGRAM / BLOCK DIAGRAM:-



PROCEDURE:-

ANSHUMAN
S
Enter Enter
Program Address
Write Program

Execution Steps

Esc
G

SCIENTECH
Reset
Exmem
Starting Address
Next
Write Program

Execution Steps

Reset
GO

MP LAB (EC-515-F)

Enter-enter	Starting Address
Prog. Address	Fill
Enter	Reset
S	Exmem
Enter	Result Address
Any key-2	
Enter-2	
Register Name	

INPUT DATA

0200	: 05H
0201	: 00H
0202	: 41H
0203	: 83H
0204	: 58H
0205	: 72H
0206	: 39H
0207	: 46H
0208	: 53H
0209	: 84H
020A	: 30H
020B	: 96H

OUTPUT DATA

251	: 30H
252	: 96H

PRECAUTIONS:-

Make sure that all the machine codes should be as per specified in the program.

Question & Answer:

Q.50 How many machine cycles are in ADC instruction?

Ans: one

Q.51 Explain ADI data?

Ans: Add immediate data to accumulator

Q.52 How many T-states are in ADI instruction?

Ans: seven T-states

Q.53 Explain the addressing mode of ADI?

MP LAB (EC-515-F)

Ans: immediate

Q.54 How many machine cycles are in ADI instruction?

Ans: two

Q.55 Explain DAD rp ?

Ans: Add register pair to HL pair

Q.56 How many T-states are in DAD instruction?

Ans: ten

Q.57 Explain the addressing mode of DAD.

Ans: register

Q.58 How many machine cycles are in DAD instruction?

Ans: three

Q.59 Explain DAA.

Ans: Decimal adjust accumulator

Q.60 What is INX rp?

Ans: Increment register pair

EXPERIMENT NO.11

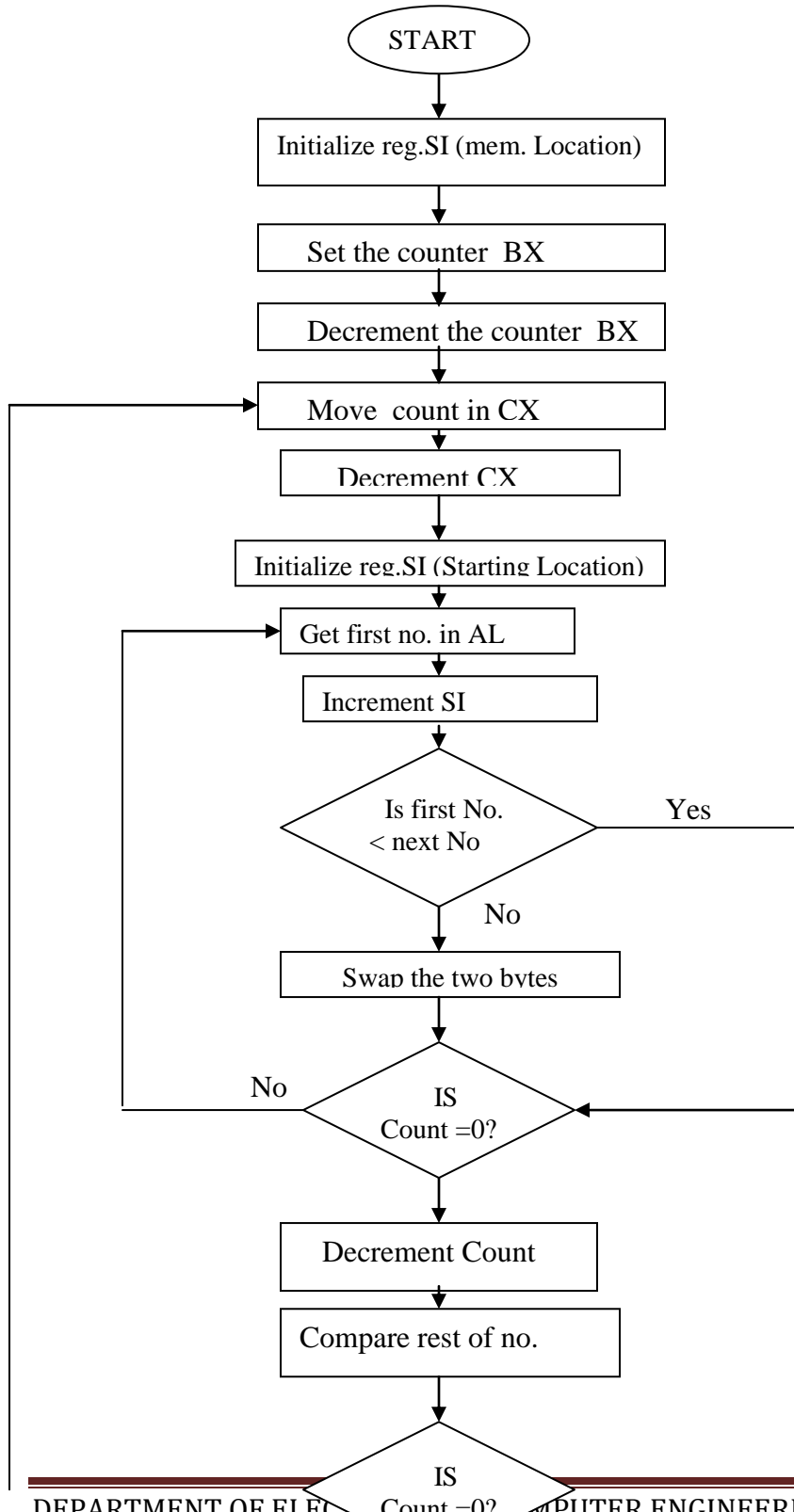
AIM : WRITE A PROGRAM USING 8086 FOR ARRANGING AN ARRAY OF NUMBERS IN DESCENDING ORDER & VERIFY.

APPARATUS : 8086 microprocessor kit, 5V power supply, Keyboard.

THEORY(Program)

Memory Address	Label	Machine Code	Mnemonics	Operands	Comments
0200		BE,00,03	MOV	SI,0300	Initialize SI Reg. with Memory Location. 0300.
0203		8B,1C	MOV	BX,[SI]	BX has no. of bytes
0205		4B	DEC	BX	Decrement the no. of bytes by one
0206	(3)	8B 0C	MOV	CX (SI)	Move no. of bytes in CX
0208		49	DEC	CX	Decrement the no. of bytes by one
0209		BE,02,03	MOV	SI,0303	Initialize SI reg. with the starting address of string
020C	(2)	8A,04	MOV	AL,[SI]	Move first data byte of string into AL
020E		46	INC	SI	Point at the next bytes of the string
020F		3A,04	COMP	AL,[SI]	Com. the two bytes of string.
0211		73,06	JAE	(1)	If two bytes are equal or 1 st byte is above that the second byte branch to (1)
0213		86,04	XCHG	AL,[SI]	Else
0215		4E	DEC	SI	Second byte is less than first byte and swap the two bytes.
0216		88,04	MOV	[SI],AL	
0218		46	INC	SI	Point at next location of string
0219	(1)	E2,F1	LOOP	(2)	Loop if CX is not zero
021B		4B	DEC	BX	
021C		BE,00,03	MOV	SI,0300	
021F		75,E5	JNZ	(3)	
0221		F4	HLT		Halt.

CIRCUIT DIAGRAM / BLOCK DIAGRAM:-



MP LAB (EC-515-F)

No

→ ○ END

PROCEDURE:-

ANSHUMAN

S

Enter Enter

Program Address

Write Program

Execution Steps

Esc

G

Enter-enter

Prog. Address

Enter

S

Enter

Any key-2

Enter-2

Register Name

SCIENTECH

Reset

Exmem

Starting Address

Next

Write Program

Execution Steps

Reset

GO

Starting Address

Fill

Reset

Exmem

Result Address

INPUT DATA

0300 : 05

0301 : 00

0302 : 20

0303 : 25

0304 : 28

0305 : 15

0306 : 07

OUTPUT DATA

0302 : 28

0303 : 25

0304 : 20

0305 : 15

0306 : 07

PRECAUTIONS:-

Make sure that all the machine codes should be as per specified in the program.

Question & Answer:

1. Define stack?

Ans Stack is a sequence of RAM memory locations defined by the programmer.

2. What is program counter? How it is useful in program execution?

Ans The program counter keeps track of program execution. To execute a program the starting address of the program is loaded in program counter. The PC sends out an address to fetch a byte of instruction from memory and increments its content automatically.

3. Define opcode and operand?

Ans Opcode(operation code) is the part of an instruction that identifies a specific operation. Operand is a part of instruction that represents a value on which the instruction acts.

4. How the 8085 processor differentiates a memory access and I/O access?

Ans The memory access and I/O access is differentiated using IO/M signal. The 8085 processor asserts IO/M low for memory operation and high for I/O operations.

5. When the 8085 processor checks for an interrupt?

Ans In the second T-state of the last machine cycle of every instruction, the 8085 processor checks whether an interrupt request is made or not.

6. Why interfacing is needed for I/O devices?

Ans Generally I/O devices are slow devices. Therefore the speed of I/O devices does not match with the speed of microprocessor. And so an interface is provided between system bus and I/O devices.

7. What is interrupt I/O?

Ans If the I/O device initiate the data transfer through interrupt then the I/O is called interrupt driven I/O.

8. What is a port?

Ans The port is a buffered I/O, which is used to hold the data transmitted from the microprocessor to I/O devices and vice versa.

9. What is the need for interrupt controller?

Ans The interrupt controller is employed to expand the interrupt inputs. It can handle the interrupt request from various devices and allow one by one to the processor.

10. What is synchronous data transfer scheme?

Ans For synchronous data transfer scheme, the processor does not check the readiness of the device after commands have been issued for read/write operation. For this scheme the processor will request the device to get ready and then read/write to the device immediately after the request.

EXPERIMENT NO.12

AIM : WRITE A PROGRAM USING 8085 FOR FINDING SQUARE OF A NUMBER USING LOOK-UP TABLE & VERIFY

APPARATUS : 8085 microprocessor kit, 5V power supply, Keyboard.

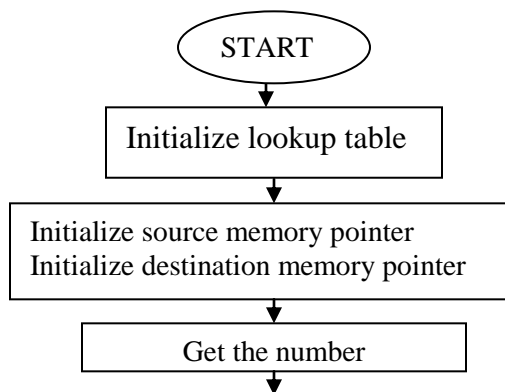
THEORY(Program) :

Memory Address	Machine Code	Mnemonics	Operands	Comments
2000	3A,00,25	LDA	2500 H	Get 1 st no. in acc.
2003	6F	MOV	L,A	Move From A into reg. L
2004	26,26	MVI	H,26H	Get 26 in reg H
2006	7E	MOV	A,M	Square of data in accumulator
2007	32,01,25	STA	2501 H	Store square in 2501 H.
200A	CF	RST 1		Stop

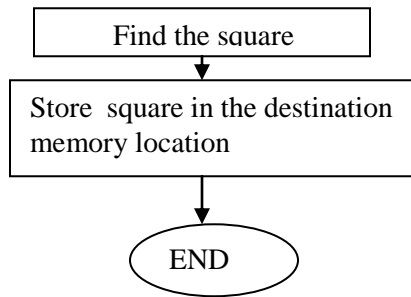
LOOK-UP TABLE

Address		Square
2600	-	00
2601	-	01
2602	-	04
2603	-	09
2604	-	16
2605	-	25
2606	-	36
2607	-	49
2608	-	64
2609	-	81

CIRCUIT DIAGRAM / BLOCK DIAGRAM:-



MP LAB (EC-515-F)



PROCEDURE:-

ANSHUMAN

S

Enter Enter

Program Address

Write Program

Execution Steps

Esc

G

Enter-enter

Prog. Address

Enter

S

Enter

Any key-2

Enter-2

Register Name

INPUT DATA

2500- 07H

OUTPUT DATA

2501- 49H

PRECAUTIONS:-

Make sure that all the machine codes should be as per specified in the program.

Question & Answer:

1. What is ALE?

SCIENTECH

Reset

Exmem

Starting Address

Next

Write Program

Execution Steps

Reset

GO

Starting Address

Fill

Reset

Exmem

Result Address

MP LAB (EC-515-F)

- Ans The ALE (Address latch enable) is a signal used to demultiplex the address and data lines using an external latch. It is used to enable the external latch.
2. Where is the READY signal used?
Ans READY is an input signal to the processor, used by the memory or input/output devices to get extra time for data transfer or to introduce wait states in the bus cycles.
3. Give some examples of port devices used in 8085 microprocessor based system?
Ans The various port devices used in 8085 are 8212,8155,8156,8255,8355,8755.
4. What is the need for timing diagram?
Ans The timing diagram provides information regarding the status of various signals, when a machine cycle is executed. The knowledge of timing diagram is essential for system designer to select matched peripheral devices like memories, latches, ports etc from a microprocessor system.
5. What operation is performed during first T-state of every machine cycle in 8085?
Ans In 8085, during the first T-state of every machine cycle the low byte address is latched into an external latch using ALE signal.
6. What is interrupt acknowledge cycle?
Ans The interrupt acknowledge cycle is a machine cycle executed by 8085 processor to get the address of the interrupt service routine in order to service the interrupt device.
7. What is vectored and non-vectored interrupt?
Ans When an interrupt is accepted, if the processor control branches to a specific address defined by the manufacturer then the interrupt is called vectored interrupt. In Non-vectored interrupt there is no specific address for storing the interrupt service routine. Hence the interrupted device should give the address of the interrupt service routine.
8. List the software and hardware interrupts of 8085?
Ans Software interrupts : RST 0,RST 1,RST 2,RST 3,RST 4,RST 5,RST 6,RST 7
Hardware interrupts : TRAP,RST 7.5,RST 6.5,RST 5.5, INTR.
9. What is TRAP?
Ans The TRAP is a non-maskable interrupt of 8085. It is not disabled by processor reset or after recognition of interrupt.
10. How clock signals are generated in 8085 and what is the frequency of the internal clock?
Ans The 8085 has the clock generation circuit on the chip but an external quartz crystal or LC circuit or RC circuit should be connected at the pins X1 and X2. The maximum internal clock frequency of 8085 is 3.03MHz.