

**VIVEKANANDA COLLEGE
THAKURPUKUR
KOLKATA-700063**

NAAC ACCREDITED 'A' GRADE



Topic: Instruction Set

Course Title: Microprocessor and its Application

Paper: CMS-A-CC-4-10-TH

Unit: Programming 8085

Semester: 4th Semester

Name of the Teacher: Amitava Biswas

Name of the Department: Computer Science

8085 INSTRUCTION SET

INSTRUCTION DETAILS

DATA TRANSFER INSTRUCTIONS

Opcode	Operand	Description
Copy from source to destination		
MOV	Rd, Rs M, Rs Rd, M	This instruction copies the contents of the source register into the destination register; the contents of the source register are not altered. If one of the operands is a memory location, its location is specified by the contents of the HL registers. Example: MOV B, C or MOV B, M
Move immediate 8-bit		
MVI	Rd, data M, data	The 8-bit data is stored in the destination register or memory. If the operand is a memory location, its location is specified by the contents of the HL registers. Example: MVI B, 57H or MVI M, 57H
Load accumulator		
LDA	16-bit address	The contents of a memory location, specified by a 16-bit address in the operand, are copied to the accumulator. The contents of the source are not altered. Example: LDA 2034H
Load accumulator indirect		
LDAX	B/D Reg. pair	The contents of the designated register pair point to a memory location. This instruction copies the contents of that memory location into the accumulator. The contents of either the register pair or the memory location are not altered. Example: LDAX B
Load register pair immediate		
LXI	Reg. pair, 16-bit data	The instruction loads 16-bit data in the

register pair designated in the operand.
Example: LXI H, 2034H or LXI H, XYZ

Load H and L registers direct

LHLD 16-bit address The instruction copies the contents of the memory location

pointed out by the 16-bit address into register L and copies the contents of the next memory location into register H. The contents of source memory locations are not altered.

Example: LHLD 2040H

Store accumulator direct
STA 16-bit address

The contents of the accumulator are copied into the memory location specified by the operand. This is a 3-byte instruction, the second byte specifies the low-order address and the third byte specifies the high-order address.
Example: STA 4350H

Store accumulator indirect
STAX Reg. pair

The contents of the accumulator are copied into the memory location specified by the contents of the operand (register pair). The contents of the accumulator are not altered.
Example: STAX B

Store H and L registers direct
SHLD 16-bit address

The contents of register L are stored into the memory location specified by the 16-bit address in the operand and the contents of H register are stored into the next memory location by incrementing the operand. The contents of registers HL are not altered. This is a 3-byte instruction, the second byte specifies the low-order address and the third byte specifies the high-order address.
Example: SHLD 2470H

Exchange H and L with D and E
XCHG none

The contents of register H are exchanged with the contents of register D, and the contents of register L are exchanged with the contents of register E.
Example: XCHG

Copy H and L registers to the stack pointer
SPHL none

The instruction loads the contents of the H and L registers into the stack pointer register, the contents of the H register provide the high-order address and the contents of the L register provide the low-order address. The contents of the H and L registers are not altered.
Example: SPHL

Exchange H and L with top of stack
XTHL none

The contents of the L register are exchanged with the

stack

location pointed out by the contents of the stack pointer register. The contents of the H register are exchanged with the next stack location (SP+1); however, the contents of the stack pointer register are not altered.

Example: XTHL

Push register pair onto stack
PUSH Reg. pair

The contents of the register pair designated in the operand are copied onto the stack in the following sequence. The stack pointer register is decremented and the contents of the high-order register (B, D, H, A) are copied into that location. The stack pointer register is decremented again and the contents of the low-order register (C, E, L, flags) are copied to that location.
Example: PUSH B or PUSH A

Pop off stack to register pair
POP Reg. pair

The contents of the memory location pointed out by the stack pointer register are copied to the low-order register (C, E, L, status flags) of the operand. The stack pointer is incremented by 1 and the contents of that memory location are copied to the high-order register (B, D, H, A) of the operand. The stack pointer register is again incremented by 1.
Example: POP H or POP A

Output data from accumulator to a port with 8-bit address

OUT 8-bit port address

The contents of the accumulator are copied into the I/O port specified by the operand.
Example: OUT F8H

Input data to accumulator from a port with 8-bit address

IN 8-bit port address
operand are

The contents of the input port designated in the operand are read and loaded into the accumulator. Example: IN 8CH

ARITHMETIC INSTRUCTIONS

Opcode Operand

ADD	R M	<p>Description Add register or memory to accumulator</p>	<p>The contents of the operand (register or memory) are added to the contents of the accumulator and the result is stored in the accumulator. If the operand is a memory location, its location is specified by the contents of the HL registers. All flags are modified to reflect the result of the addition. Example: ADD B or ADD M</p>
-----	--------	--	---

Add register to accumulator with carry

ADC	R M	<p>The contents of the operand (register or memory) and the Carry flag are added to the contents of the accumulator and the result is stored in the accumulator. If the operand is a memory location, its location is specified by the contents of the HL registers. All flags are modified to reflect the result of the addition. Example: ADC B or ADC M</p>
-----	--------	--

Add immediate to accumulator

ADI	8-bit data	<p>The 8-bit data (operand) is added to the contents of the accumulator and the result is stored in the accumulator. All flags are modified to reflect the result of the addition. Example: ADI 45H</p>
-----	------------	---

Add immediate to accumulator with carry

ACI	8-bit data	<p>The 8-bit data (operand) and the Carry flag are added to the contents of the accumulator and the result is stored in the accumulator. All flags are modified to reflect the result of the addition. Example: ACI 45H</p>
-----	------------	---

Subtract register or memory from accumulator

SUB R
 M

The contents of the operand (register or memory) are subtracted from the contents of the accumulator, and the result is stored in the accumulator. If the operand is a memory location, its location is specified by the contents of the HL registers. All flags are modified to reflect the result of the subtraction.
Example: SUB B or SUB M

Subtract source and borrow from accumulator

SBB R
 M

The contents of the operand (register or memory) and the Borrow flag are subtracted from the contents of the accumulator and the result is placed in the accumulator. If the operand is a memory location, its location is specified by the contents of the HL registers. All flags are modified to reflect the result of the subtraction.
Example: SBB B or SBB M

Subtract immediate from accumulator

SUI 8-bit data

The 8-bit data (operand) is subtracted from the contents of the accumulator and the result is stored in the accumulator. All flags are modified to reflect the result of the subtraction.
Example: SUI 45H

Subtract immediate from accumulator with borrow

SBI 8-bit data

The 8-bit data (operand) and the Borrow flag are subtracted from the contents of the accumulator and the result is stored in the accumulator. All flags are modified to reflect the result of the subtraction.
Example: SBI 45H

Increment register or memory by 1

INR R
 M

The contents of the designated register or memory) are incremented by 1 and the result is stored in the same place. If the operand is a memory location, its location is specified by the contents of the HL registers.
Example: INR B or INR M

Increment register pair by 1

INX R

The contents of the designated register pair are incremented by 1 and the result is stored in the

same place.
Example: INX H

Decrement register or memory by 1

DCR R
memory are
 M

The contents of the designated register or memory are decremented by 1 and the result is stored in the same place. If the operand is a memory location, its location is specified by the contents of the HL registers.

Example: DCR B or DCR M

Decrement register pair by 1

DCX R

The contents of the designated register pair are decremented by 1 and the result is stored in the same place.

Example: DCX H

Decimal adjust accumulator

DAA none

The contents of the accumulator are changed from a binary value to two 4-bit binary coded decimal (BCD) digits. This is the only instruction that uses the auxiliary flag to perform the binary to BCD conversion, and the conversion procedure is described below. S, Z, AC, P, CY flags are altered to reflect the results of the operation.

If the value of the low-order 4-bits in the accumulator is greater than 9 or if AC flag is set, the instruction adds 6 to the low-order four bits.

If the value of the high-order 4-bits in the accumulator is greater than 9 or if the Carry flag is set, the instruction adds 6 to the high-order four bits.

Example: DAA

BRANCHING INSTRUCTIONS

Opcode Operand

Description Jump

unconditionally

JMP 16-bit address
memory location

The program sequence is transferred to the specified by the 16-bit address given in the operand. Example: JMP 2034H or JMP XYZ

Jump conditionally

Operand: 16-bit

address

The program sequence is transferred to the memory location specified by the 16-bit address given in the operand based on the specified flag of the PSW as described below. Example: JZ 2034H or JZ XYZ

Opcode	Description	Flag Status
JC	Jump on Carry	CY = 1
JNC	Jump on no Carry	CY = 0
JP	Jump on positive	S = 0
JM	Jump on minus	S = 1
JZ	Jump on zero	Z = 1
JNZ	Jump on no zero	Z = 0
JPE	Jump on parity even	P = 1
JPO	Jump on parity odd	P = 0

Unconditional subroutine call

CALL 16-bit address The program sequence is transferred to the memory location

specified by the 16-bit address given in the operand. Before the transfer, the address of the next instruction after CALL (the contents of the program counter) is pushed onto the stack.
Example: CALL 2034H or CALL XYZ

Call conditionally

Operand: 16-bit address

The program sequence is transferred to the memory location specified by the 16-bit address given in the operand based on the specified flag of the PSW as described below. Before the transfer, the address of the next instruction after the call (the contents of the program counter) is pushed onto the stack.

Example: CZ 2034H or CZ XYZ

Opcode	Description	Flag Status
CC	Call on Carry	CY = 1
CNC	Call on no Carry	CY = 0
CP	Call on positive	S = 0
CM	Call on minus	S = 1
CZ	Call on zero	Z = 1
CNZ	Call on no zero	Z = 0
CPE	Call on parity even	P = 1
CPO	Call on parity odd	P = 0

Return from subroutine unconditionally

RET none The program sequence is transferred from the subroutine to the calling program. The two bytes from the top of the stack are copied into the program counter, and program execution begins at the new address.
Example: RET

Return from subroutine

conditionally Operand:

none

The program sequence is transferred from the subroutine to the calling program based on the specified flag of the PSW as described below. The two bytes from the top of the stack are copied into the program counter, and program execution begins at the new address.
Example: RZ

Opcode	Description	Flag Status
RC	Return on Carry	CY = 1
RNC	Return on no Carry	CY = 0
RP	Return on positive	S = 0
RM	Return on minus	S = 1
RZ	Return on zero	Z = 1
RNZ	Return on no zero	Z = 0
RPE	Return on parity even	P = 1
RPO	Return on parity odd	P = 0

Load program counter with HL contents

PCHL none The contents of registers H and L are copied into the program counter. The contents of H are placed as the high-order byte and the contents of L as the low-order byte.
Example: PCHL

Restart RST 0-7

The RST instruction is equivalent to a 1-byte call instruction to one of eight memory locations depending upon the number. The instructions are generally used in conjunction with interrupts and inserted using external hardware. However these can be used as software instructions in a program to transfer program execution to one of the eight locations. The addresses are:

Instruction	Restart Address
RST 0	0000H
RST 1	0008H
RST 2	0010H
RST 3	0018H
RST 4	0020H
RST 5	0028H
RST 6	0030H
RST 7	0038H

The 8085 has four additional interrupts and these interrupts generate RST instructions internally and thus do not require any external hardware. These instructions and their Restart addresses are:

Interrupt	Restart Address
TRAP	0024H
RST 5.5	002CH
RST 6.5	0034H
RST 7.5	003CH

LOGICAL INSTRUCTIONS

Opcode Operand

Description Compare register

or memory with accumulator

CMP	R	The contents of the operand (register or memory)
are		
	M	compared with the contents of the accumulator. Both contents are preserved . The result of the comparison is shown by setting the flags of the PSW as follows: if (A) < (reg/mem): carry flag is set if (A) = (reg/mem): zero flag is set if (A) > (reg/mem): carry and zero flags are reset Example: CMP B or CMP M

Compare immediate with accumulator

CPI	8-bit data	The second byte (8-bit data) is compared with
the contents of		
		the accumulator. The values being compared remain unchanged. The result of the comparison is shown by setting the flags of the PSW as follows: if (A) < data: carry flag is set if (A) = data: zero flag is set if (A) > data: carry and zero flags are reset Example: CPI 89H

Logical AND register or memory with accumulator

ANA	R	The contents of the accumulator are logically ANDed with
	M	the contents of the operand (register or memory), and the result is placed in the accumulator. If the operand is a memory location, its address is specified by the contents of of HL registers. S, Z, P are modified to reflect the result of the

operation. CY is reset. AC is set.
Example: ANA B or ANA M

Logical AND immediate with accumulator

ANI 8-bit data

The contents of the accumulator are logically ANDed with the 8-bit data (operand) and the result is placed in the accumulator. S, Z, P are modified to reflect the result of the operation. CY is reset. AC is set.
Example: ANI 86H

Exclusive OR register or memory with accumulator

XRA R
 M

The contents of the accumulator are Exclusive ORed with the contents of the operand (register or memory), and the result is placed in the accumulator. If the operand is a memory location, its address is specified by the contents of HL registers. S, Z, P are modified to reflect the result of the operation. CY and AC are reset.
Example: XRA B or XRA M

Exclusive OR immediate with accumulator

XRI 8-bit data

The contents of the accumulator are Exclusive ORed with the 8-bit data (operand) and the result is placed in the accumulator. S, Z, P are modified to reflect the result of the operation. CY and AC are reset.
Example: XRI 86H

Logical OR register or memory with accumulaotr

ORA R
 M

The contents of the accumulator are logically ORed with the contents of the operand (register or memory), and the result is placed in the accumulator. If the operand is a memory location, its address is specified by the contents of HL registers. S, Z, P are modified to reflect the result of the operation. CY and AC are reset.
Example: ORA B or ORA M

Logical OR immediate with accumulator

ORI 8-bit data

The contents of the accumulator are logically ORed with the 8-bit data (operand) and the result is placed in the accumulator. S, Z, P are modified to reflect the result of the operation. CY and AC are reset.
Example: ORI 86H

Rotate accumulator left

RLC none

Each binary bit of the accumulator is rotated left by one position. Bit D7 is placed in the position of D0 as well as in the Carry flag. CY is modified according to bit D7. S, Z, P,

AC are not affected.

Example: RLC

Rotate accumulator right
RRC none

Each binary bit of the accumulator is rotated right by one position. Bit D₀ is placed in the position of D₇ as well as in the Carry flag. CY is modified according to bit D₀. S, Z, P, AC are not affected.
Example: RRC

Rotate accumulator left through carry

RAL none

Each binary bit of the accumulator is rotated left by one position through the Carry flag. Bit D7 is placed in the Carry flag, and the Carry flag is placed in the least significant position D0. CY is modified according to bit D7. S, Z, P, AC are not affected.
Example: RAL

Rotate accumulator right through carry

RAR none

Each binary bit of the accumulator is rotated right by one position through the Carry flag. Bit D0 is placed in the Carry flag, and the Carry flag is placed in the most significant position D7. CY is modified according to bit D0. S, Z, P, AC are not affected.
Example: RAR

Complement accumulator

CMA none

The contents of the accumulator are complemented. No flags are affected.
Example: CMA

Complement carry

CMC none
are affected.

The Carry flag is complemented. No other flags
Example: CMC

Set Carry

STC none
affected.

The Carry flag is set to 1. No other flags are
Example: STC

CONTROL INSTRUCTIONS

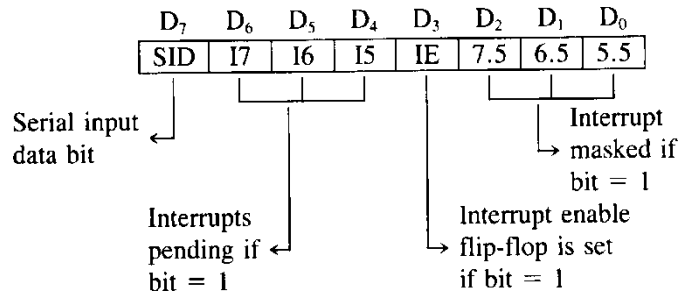
Opcode	Operand	Description
on No operation NOP none		No operation is performed. The instruction is fetched and decoded. However no operation is executed. Example: NOP
Halt and enter wait state HLT none		The CPU finishes executing the current instruction and halts any further execution. An interrupt or reset is necessary to exit from the halt state. Example: HLT
Disable interrupts DI none		The interrupt enable flip-flop is reset and all the interrupts except the TRAP are disabled. No flags are affected. Example: DI
Enable interrupts EI none		The interrupt enable flip-flop is set and all interrupts are enabled. No flags are affected. After a system reset or the acknowledgement of an interrupt, the interrupt enable flip-flop is reset, thus disabling the interrupts. This instruction is necessary to reenables the interrupts (except TRAP). Example: EI

Read interrupt mask

RIM none

This is a multipurpose instruction used to read the status of interrupts 7.5, 6.5, 5.5 and read serial data input bit. The instruction loads eight bits in the accumulator with the following interpretations.

Example: RIM

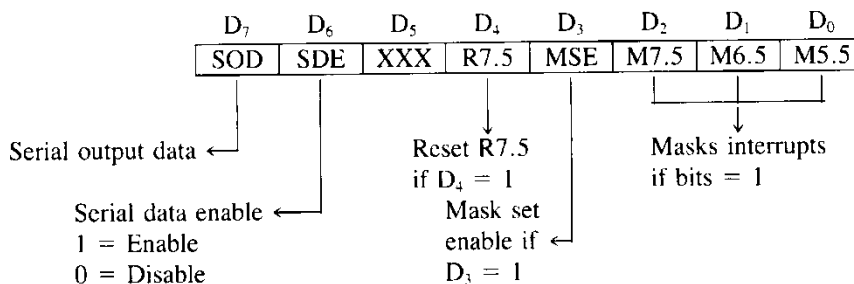


Set interrupt mask

SIM none

This is a multipurpose instruction and used to implement the 8085 interrupts 7.5, 6.5, 5.5, and serial data output. The instruction interprets the accumulator contents as follows.

Example: SIM



- SOD—Serial Output Data: Bit D₇ of the accumulator is latched into the SOD output line and made available to a serial peripheral if bit D₆ = 1.
- SDE—Serial Data Enable: If this bit = 1, it enables the serial output. To implement serial output, this bit needs to be enabled.
- XXX—Don't Care
- R7.5—Reset RST 7.5: If this bit = 1, RST 7.5 flip-flop is reset. This is an additional control to reset RST 7.5.
- MSE—Mask Set Enable: If this bit is high, it enables the functions of bits D₂, D₁, D₀. This is a master control over all the interrupt masking bits. If this bit is low, bits D₂, D₁, and D₀ do not have any effect on the masks.
- M7.5—D₂ = 0, RST 7.5 is enabled.
 = 1, RST 7.5 is masked or disabled.
- M6.5—D₁ = 0, RST 6.5 is enabled.
 = 1, RST 6.5 is masked or disabled.
- M5.5—D₀ = 0, RST 5.5 is enabled.
 = 1, RST 5.5 is masked or disabled.