Session objectives

- To learn various software instructions related to the Logical operations for 8085 Microprocessor

- To learn various addressing modes related to the process of Logical operations

- To develop the programming technique in assembly language for given problem statement in which Logical operations are involved, store the source data, execute the program and observe the result.

Logical instructions
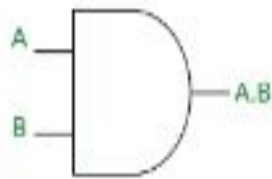
- ANA
- ANI
- XRA
- XRI
- ORA
- ORI
- CMA
- CMP
- CPI

- RRC
- RLC
- RAR
- RAL
- STC
- CMC

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
ANA	R M	Logically AND the 8 bit source R/M with accumulator	This instruction ANDs the contents of the source register/ memory location with Accumulator and result is placed in the accumulator and Flags are modified.	Register addressing mode

- M specifies a memory location whose address is specified by the HL pair
- R specifies Registers A, B, C,D,E, H and L
- Flags are modified

Example of ANA instruction: ANA B

2- Input AND Gate

Truth Table

A (Input 1)	B (Input 2)	X = (A.B)
0	0	0
0	1	0
1	0	0
1	1	1

A	56	0	1	0	1	0	1	1	0
B	43	0	1	0	0	0	0	1	1
A.B	42	0	1	0	0	0	0	1	0

Problem statement 1: 5 data bytes are stored in memory locations starting at 2501H. Write a program to logically AND the contents of those locations with contents of the accumulator, (e.g. 46H). Place the result in same memory locations.
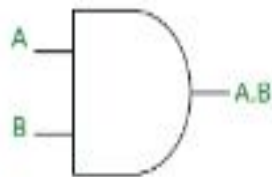
```
LXI H,2501H
MVI C,05H
MVI A,46H
L1: ANA M
    MOV M,A
    INX H
DCR C
JNZ L1
HLT
```

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
ANI	8 bit data	Logically AND the 8 bit data with accumulator	This instruction ANDs the 8-bit data with Accumulator and result is placed in the accumulator and Flags are modified.	Immediate addressing mode

Example of ANA instruction: ANI 7FH

2- Input AND Gate

Truth Table

A (Input 1)	B (Input 2)	X = (A.B)
0	0	0
0	1	0
1	0	0
1	1	1

A	56	0	1	0	1	0	1	1	0
8 bit data	7F	0	1	1	1	1	1	1	1
A	56	0	1	0	1	0	1	1	0

Problem statement 2: 5 data bytes are stored in memory locations starting at 2501H. Write a program to mask lower order nibble Place the result in same memory locations.

LXI H,2501H

MVI C,05H

L1: ANI 0F0H

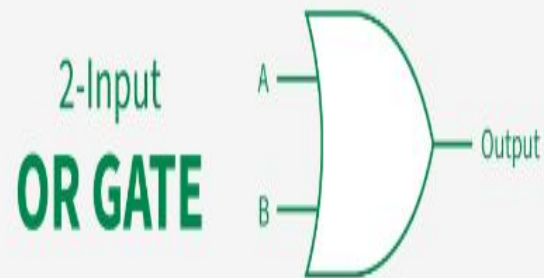   MOV M,A

   INX H

DCR C

JNZ L1

HLT

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
ORA	R M	Logically OR the 8 bit source R/M with accumulator	This instruction logically ORs the contents of the source register/ memory location with Accumulator and result is placed in the accumulator and Flags are modified.	Register addressing mode

- M specifies a memory location whose address is specified by the HL pair
- R specifies Registers A, B, C,D,E, H and L
- Flags are modified

Example of ORA instruction: ORA B

2-Input **OR GATE**

Truth Table		
Input A	Input B	Output
0	0	0
0	1	1
1	0	1
1	1	1

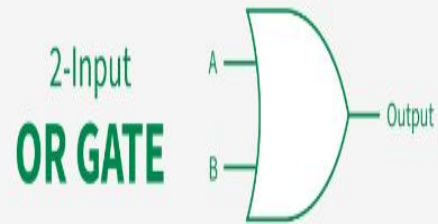|									
A	56	0	1	0	1	0	1	1	0
B	43	0	1	0	0	0	0	1	1
A+B	57	0	1	0	1	0	1	1	1

Problem statement 1: 5 data bytes are stored in memory locations starting at 2501H. Write a program to logically OR the contents of those locations with contents of the accumulator, (e.g. 57H). Place the result in same memory locations.

```
LXI H,2501H
MVI C,05H
MVI A,57H
L1: ORA M
    MOV M,A
    INX H
DCR C
JNZ L1
HLT
```

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
ORI	8 bit data	Logically OR the 8 bit data with accumulator	This instruction ORs the 8-bit data with Accumulator and result is placed in the accumulator and Flags are modified.	Immediate addressing mode

Example of ANA instruction: ORI 7FH

A	56	0	1	0	1	0	1	1	0
8 bit data	7F	0	1	1	1	1	1	1	1
A+8 bit data	7F	0	1	1	1	1	1	1	1

Problem statement 4: 5 data bytes are stored in memory locations starting at 2501H. Write a program to set most significant bit of every data byte without modifying other bits. Place the result in same memory locations.

LXI H,2501H

MVI C,05H

L1: MOV A,M

ORI 80H

MOV M,A

INX H

DCR C

JNZ L1

HLT

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
XRA	R M	Logically EXOR the 8 bit source R/M with accumulator	This instruction logically EXORs the contents of the source register/ memory location with Accumulator and result is placed in the accumulator and Flags are modified.	Register addressing mode

- ☐ M specifies a memory location whose address is specified by the HL pair
- ☐ R specifies Registers A, B, C,D,E, H and L
- ☐ Flags are modified

Example of XRA instruction: XRA B

Truth Table

A (Input 1)	B (Input 2)	X = A'B + AB'
0	0	0
0	1	1
1	0	1
1	1	0

A	56	0	1	0	1	0	1	1	0
B	43	0	1	0	0	0	0	1	1
A⊕B	15	0	0	0	1	0	1	0	1

Problem statement 5: 5 data bytes are stored in memory locations starting at 2501H. Write a program to logically XOR the contents of those locations with contents of the accumulator, (e.g. 77H). Place the result in same memory locations.
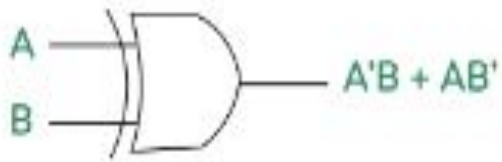
LXI H,2501H

MVI C,05H

MVI A,46H

L1: XRA M

   MOV M,A

   INX H

DCR C

JNZ L1

HLT

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
XRI	8 bit data	Logically EXOR the 8 bit data with accumulator	This instruction EXORs the 8-bit data with Accumulator and result is placed in the accumulator and Flags are modified.	Immediate addressing mode

Example of ANA instruction: ORI 7FH

Truth Table

A (Input 1)	B (Input 2)	X = A'B + AB'
0	0	0
0	1	1
1	0	1
1	1	0

A	56	0	1	0	1	0	1	1	0
8 bit data	7F	0	1	1	1	1	1	1	1
A⊕8 bit data	29	0	0	1	0	1	0	0	1

Problem statement 6: 5 data bytes are stored in memory locations starting at 2501H. Write a program to COMPLEMENT D0. Place the result in same memory locations.

LXI H,2501H

MVI C,05H

L1: MOV A,M

   XRI 01H

   MOV M,A

   INX H

DCR C

JNZ L1

HLT

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
CMA		Complement accumulator	This instruction complements Accumulator by replacing 1 by 0 and 0 by 1 and result is placed in the accumulator	Implicit addressing mode

Example of CMA instruction: CMA

A	56	0	1	0	1	0	1	1	0
A	A9	1	0	1	0	1	0	0	1

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
CMP	R M	Compare accumulator with R/M	This instruction Compares R/M with Accumulator. Contents of Accumulator and R/M are not changed. Only Flags are modified. A<R/M – Carry flag is set A>R/M – Carry flag is reset A=R/M – Zero flag is set	Register addressing mode

Example of CMP instruction: CMP B

A	56	0	1	0	1	0	1	1	0
B	7F	0	1	1	1	1	1	1	1

Carry flag	1

Problem statement 7: A series of 5 data bytes are stored in memory locations starting at 2501H. Write a program to find largest number from the series. Place the result in 2506H

LXI H,2501H

MVI C,05H

MVI B,00H

L1: MOV A,M

CMP B

JC AHEAD

   MOV B,A

AHEAD: INX H

DCR C

JNZ L1

STA 2506H

HLT

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
CPI	8 bit data	Compare accumulator with 8 bit data	This instruction Compares R/M with Accumulator. Contents of Accumulator and R/M are not changed. Only Flags are modified. A<8 bit data – Carry flag is set A>8 bit data – Carry flag is reset A=8 bit data – Zero flag is set	Immediate addressing mode

Example of CPI instruction: CPI 44H

A	56	0	1	0	1	0	1	1	0
8 bit data	44	0	1	0	0	0	1	0	0

Carry flag	0

Problem statement 8: A series of data bytes are stored in memory locations starting at 2501H. End of the string is given by the data byte 00H. Write a program to add the data bytes till you come across 00H. Place the result in 2601H (sum) and 2602H (carry).

LXI H,2501H

LXI D,0000H

L1: MOV A,M

CPI 00H

JZ TERMINATE

ADD E

JNC AHEAD

INR D

AHEAD: MOV E,A

INX H

JMP L1

TERMINATE: MOV A,E

STA 2601H

MOV A,D

STA 2602H

HLT

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
CMC		Complement carry	This instruction complements the carry flag	Implicit addressing mode

Before CMC

After CMC

Carry flag	0

Carry flag	1

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
STC		Set carry	This instruction sets the carry flag	Implicit addressing mode

Before STC

After STC

Carry flag	0

Carry flag	1

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
RLC		Rotate accumulator Left	This instruction Rotates Accumulator left	Implicit addressing mode

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
RRC		Rotate accumulator Right	This instruction Rotates Accumulator Right	Implicit addressing mode

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
RAL		Rotate accumulator Left through carry flag	This instruction Rotates Accumulator left through carry flag	Implicit addressing mode

Logical instructions

Opcode	Operand	Meaning	Explanation	Addressing mode
RAR		**Rotate accumulator Right through carry**	**This instruction Rotates Accumulator Right through carry**	**Implicit addressing mode**

Problem statement : A series of 10 data bytes, given in sign magnitude representation, is stored in memory locations starting at 2501H. Write a program to transfer positive data bytes from 2601H

LXI H,2501H

LXI D,2601H

MVI C,0AH

L1: MOV A,M

RAL

JC REJECT

RAR

STAX D

INX D

REJECT: INX H

DCR C

JNZ L1

HLT