Unit – 8 : MICROPROCESSORS

- Evaluation of microprocessors,

- 8085 architecture,

- 8085 pin diagram

- 8085 flag register & timing diagram,

- instruction sets,

- addressing modes,

- 8086 architectures,

- 8086 pin diagram,

- addressing modes

What is Microprocessor ?

- A microprocessor is an electronic component that is used by a computer to do its work.

- It is a single integrated circuit chip containing millions of very small components including transistors, resistors, and diodes that work together.

Technology Used :

- Transistor-Transistor Logic (TTL)

- Emitter Coupled Logic (ECL)

- Complementary Metal-Oxide Semiconductor (CMOS)

- N-channel metal-oxide semiconductor (NMOS)

- High-speed Metal Oxide Semiconductor(HMOS)

Classification of Microprocessors :

Based on size of data bus

- ➢ 4-bit microprocessor

- ➢ 8-bit microprocessor

- ➢ 16-bit microprocessor

- ➢ 32-bit microprocessor

- ➢ 64-bit microprocessor

Based on architecture :

- ➢ Reduced Instruction Set Computer (RISC) processors

- ➢ Complex Instruction Set Computer (CISC) processors

RISC	CISC
Focus on software	Focus on hardware
Fixed sized instructions	Variable sized instructions
Can perform only Register to Register Arithmetic operations	Can perform REG to REG or REG to MEM or MEM to MEM
Code size is large	Code size is small
An instruction executed in a single clock cycle	Instruction takes more than one clock cycle

Evaluation/Generations of microprocessors :

- Generation in computer terminology is a change in technology a computer is being used.
- There are five generations of microprocessor till date :

First-generation :

➢ The period of first generation of 4-bit microprocessor from 1971 to 1972

➢ Processors like INTEL 4004/4040 etc.

Second generation

➢ The period of second generation of 8-bit microprocessors from 1973 to 1978.

➢ INTEL 8085 Motorola 6800 and 6801 etc came into existence.

Third generation

➢ The period of third generation of 16-bit processors from 1979 to 1980.

➢ INTEL 8086/80186/80286 Motorola 68000 68010 etc.

Fourth generation

➢ The period of fourth-generation of 32-bit processors from 1981 to 1995.

➢ INTEL 80386 and Motorola 68020 are some of the popular processors of this generation.

Fifth-generation

➢ From 1995 till now we are in the fifth generation.

➢ 64-bit processors like PENTIUM, Celeron, dual, quad, and octa-core processors came into existence.

Microprocessor - 8085 Architecture

- It is an 8-bit microprocessor designed by Intel in 1977 using NMOS technology.

- It has the following configuration

- 8-bit data bus

- 16-bit address bus, which can address upto 64KB

- Six 8-bit registers arranged in pairs: BC, DE, HL

- Requires +5V supply to operate at 3.2 MHz single phase clock

- It is a 40-pin IC package.

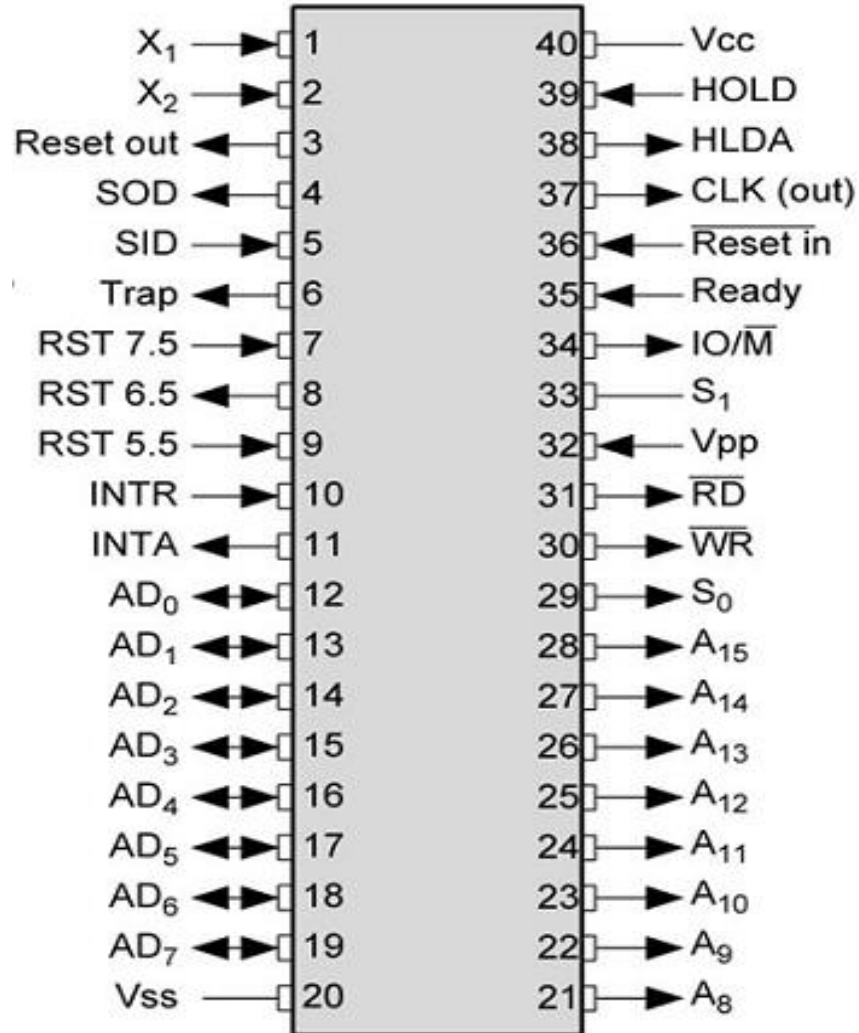- It is used in washing machines, microwave ovens, mobile phones, etc.
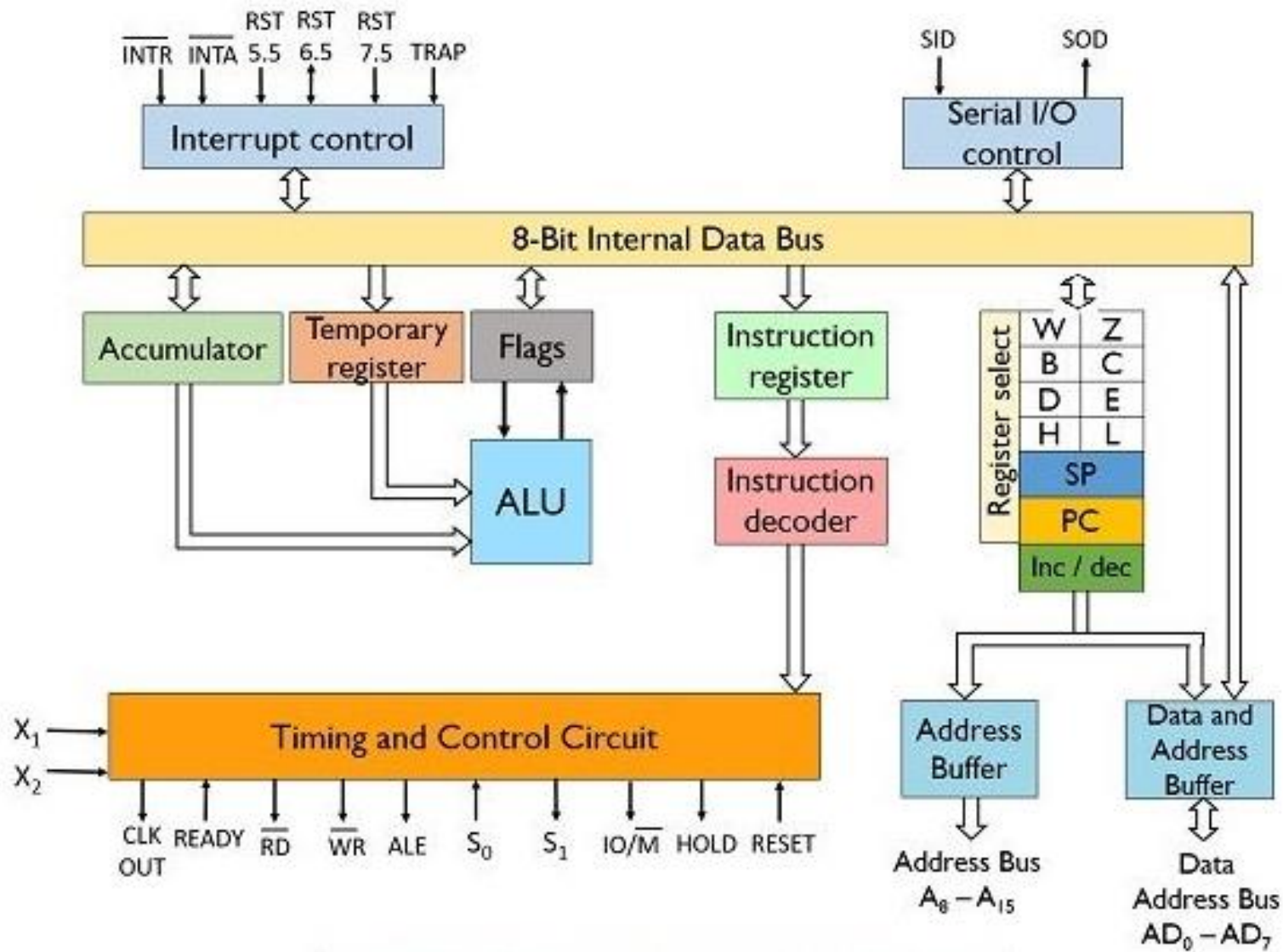
Pin diagram of 8085 microprocessor :

- 8085 is a 8-bit microprocessor having 40 pin.

- It has 16-bit address bus and 8-bit data bus.

The pins of a 8085 microprocessor can be classified into seven groups :

➢ A15 - A8, it carries the most significant 8-bits of memory/IO address.

➢ AD7-AD0, it carries the least significant 8-bit address and data bus.

➢ Three control signals are RD, WR & ALE.

➢ Three status signals are IO/M, S0 & S1.

➢ There are 2 power supply signals – VCC & VSS. VCC indicates +5v power supply and VSS indicates ground signal.

➢ There are 3 clock signals, i.e. X1, X2, CLK OUT.

➢ There are 5 interrupt signals, i.e. TRAP, RST 7.5, RST 6.5, RST 5.5, and INTR.

Flag Register :

- The flag register is a status register and it is used to check the status of the current operation which is being carried out by ALU.

- It is a 8-bit register, out of which 5-bits are important and the rest of 3-bits are Don't Care.

- The flag register is a dynamic register because after each operation to check whether the result is zero, positive or negative whether there is any overflow occurred or not.

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
S	Z		AC		P		CY

1. **S = Sign Flag,**   S=1, if MSB of ALU result is 1.

2. **Z = Zero Flag,**   Z=0, if ALU result is zero.

3. **AC = Auxiliary Carry Flag**   AC=1,   if carry is occurs from lower to upper nibble

4. **P = Parity Flag**   P=1,   if ALU result is even parity.

5. **CY = Carry Flag**   CY=1,   if carry is occurs.

Timing Diagram of 8085 microprocessor :

- Timing Diagram of 8085 microprocessor is a graphical representation of T- states.

- It represents the execution time taken by each instruction in a graphical format.

- The execution time is represented in T-states.
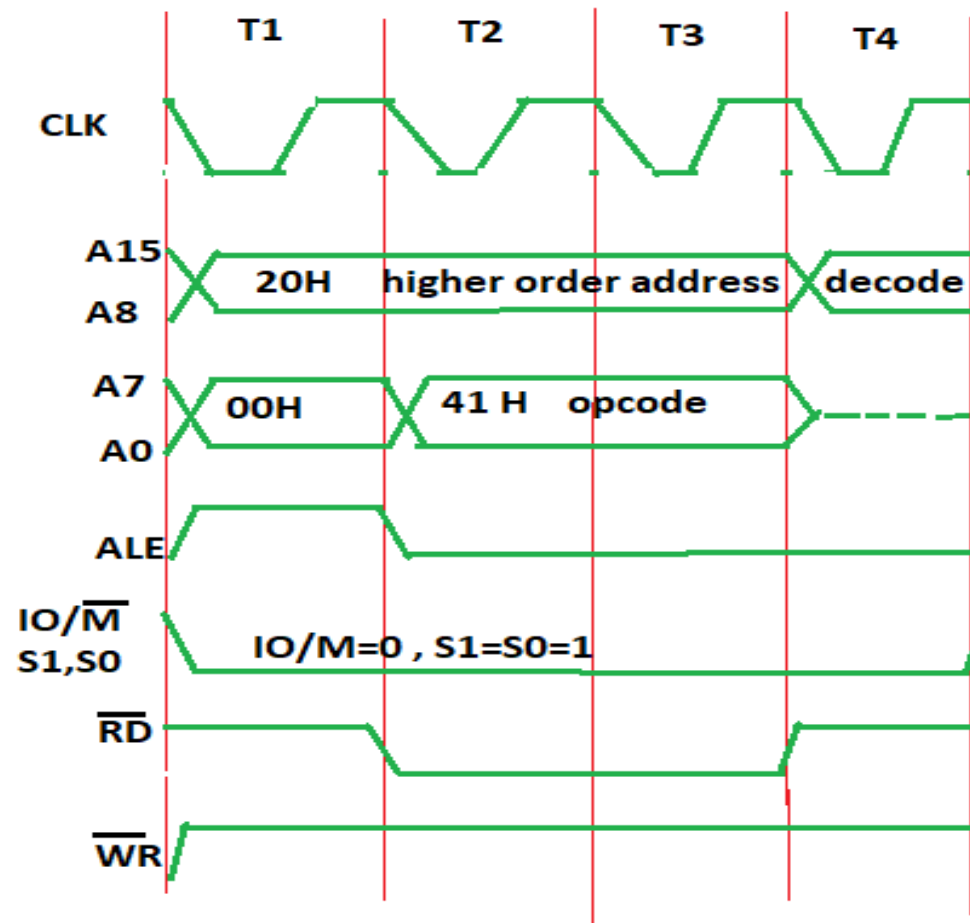
Instruction Set of 8085

- An instruction is a binary pattern designed inside a microprocessor to perform a specific function.

- The entire group of instructions that a microprocessor supports is called Instruction Set.

- 8085 microprocessor has 246 instructions.

- Each instruction is represented by an 8-bit binary value.

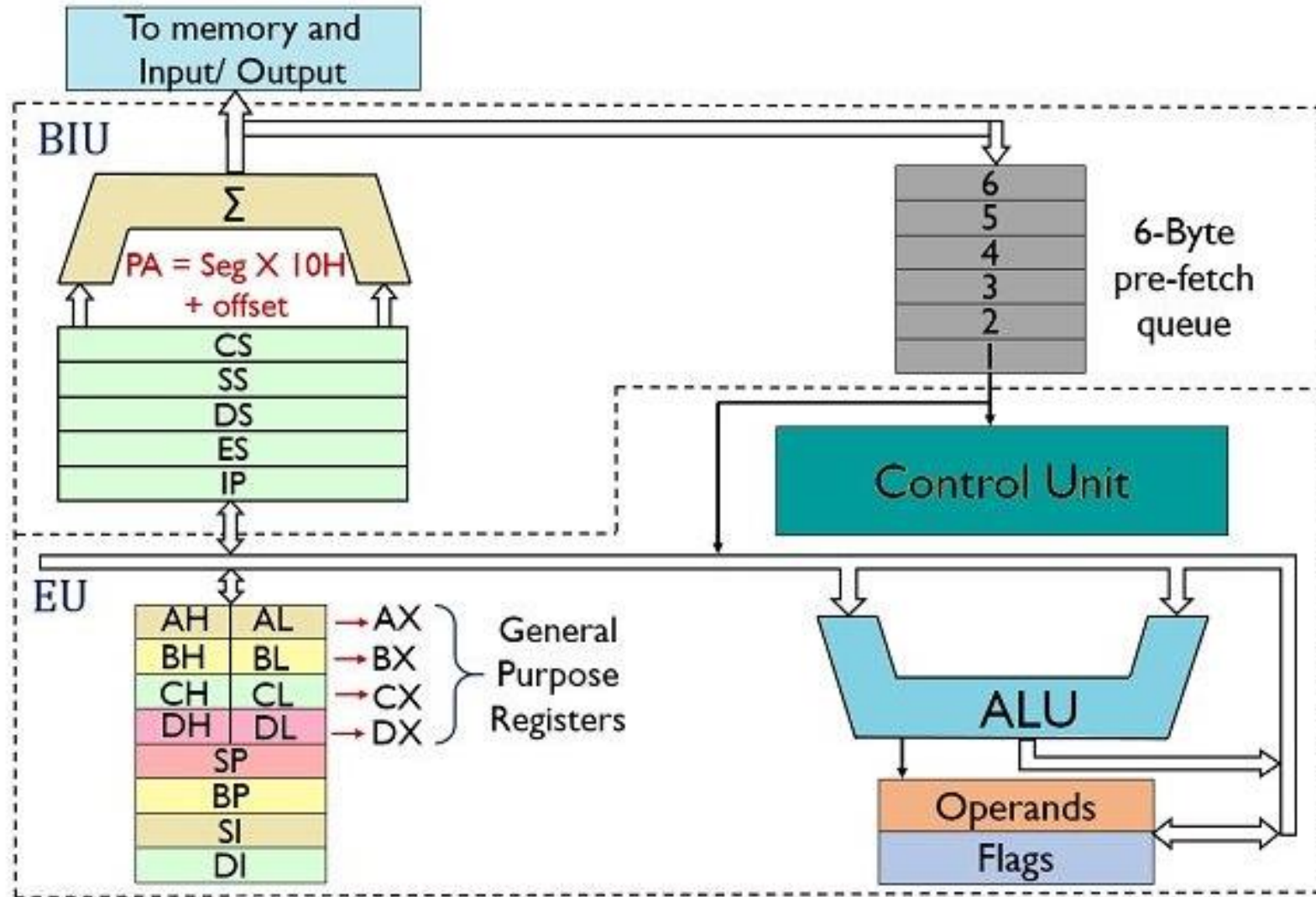- These 8-bits of binary value is called Op-Code or Instruction Byte.

Addressing modes in 8085 microprocessor :

- The way of specifying data to be operated by an instruction is called addressing mode.

- In 8085 microprocessor there are 5 types of addressing modes :

1. **Immediate Addressing :** In immediate addressing mode the source operand is always data.

2. **Register Addressing :** Data is copied from one register to another register.

3. **Direct Addressing Mode :** Data is directly copied from the given address to the register.

4. **Indirect Addressing Mode :** The data is transferred from the address pointed by the data in a register to other register.

5. **Implied Addressing Mode :** This mode doesn't require any operand. The data is specified by opcode itself.

8086 microprocessor :

- Intel 8086 microprocessor is the enhanced version of Intel 8085 microprocessor.

- It was designed by Intel in 1976.

- The 8086 microprocessor is a 16-bit, N-channel, HMOS microprocessor.

- HMOS is used for "High-speed Metal Oxide Semiconductor".

- It is a 40-pin IC package. The type of package is DIP (Dual Inline Package).

- Intel 8086 uses 20 address lines and 16 data- lines.

- It can directly address up to 2^{20} = 1 Mbyte of memory.

- 8086 is designed to operate in two modes, i.e., Minimum and Maximum mode.

To memory and Input/ Output
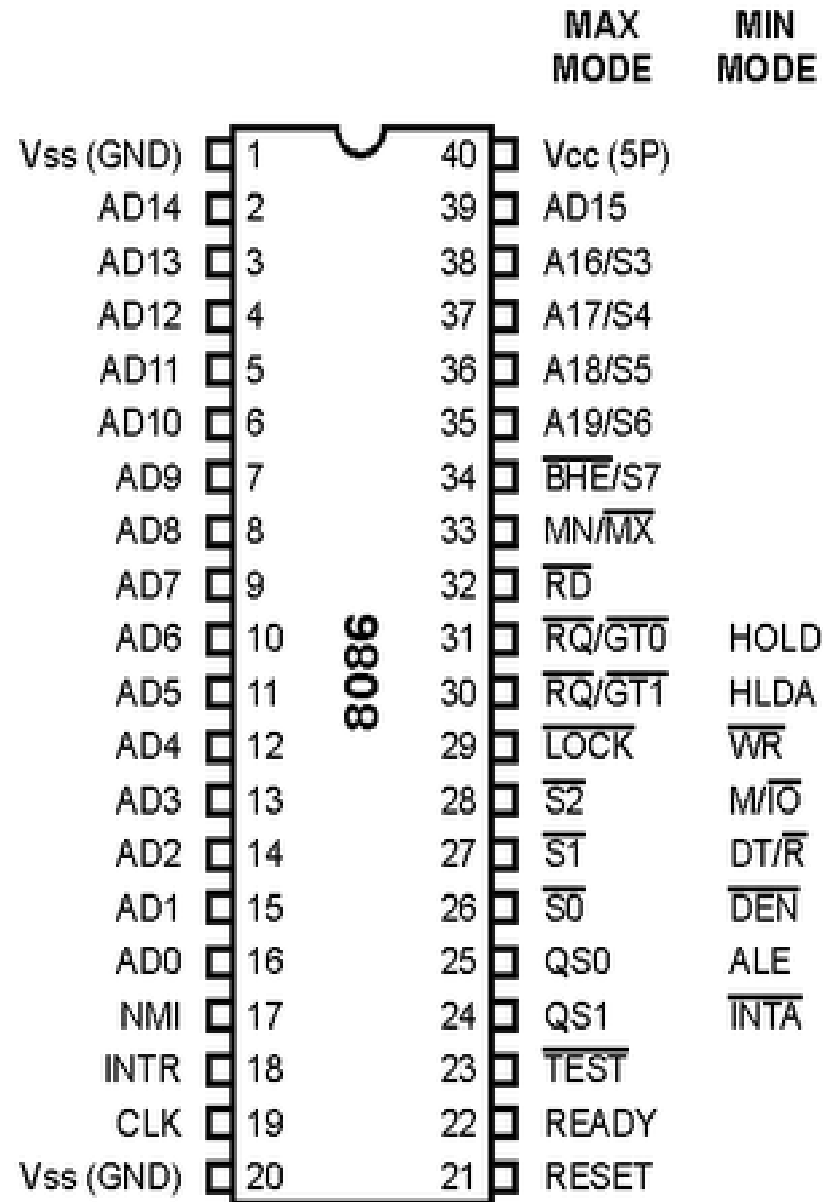
BIU

Σ

PA = Seg X 10H + offset

CS
SS
DS
ES
IP

6-Byte pre-fetch queue

Control Unit

EU

AH	AL	→ AX
BH	BL	→ BX
CH	CL	→ CX
DH	DL	→ DX

General Purpose Registers

SP
BP
SI
DI

ALU

Operands

Flags

8086 Pin diagram :

- It is available in 40 pin DIP chip.

- It uses a 5V DC supply for its operation.

- The 8086 uses 20-line address bus.

- It has a 16-line data bus.

- The 20 lines of the address bus operate in multiplexed mode.

	MAX MODE	MIN MODE
Vss (GND) □ 1	40 □ Vcc (5P)	
AD14 □ 2	39 □ AD15	
AD13 □ 3	38 □ A16/S3	
AD12 □ 4	37 □ A17/S4	
AD11 □ 5	36 □ A18/S5	
AD10 □ 6	35 □ A19/S6	
AD9 □ 7	34 □ $\overline{BHE}$/S7	
AD8 □ 8	33 □ MN/$\overline{MX}$	
AD7 □ 9	32 □ $\overline{RD}$	
AD6 □ 10	31 □ $\overline{RQ/GT0}$	HOLD
AD5 □ 11	30 □ $\overline{RQ/GT1}$	HLDA
AD4 □ 12	29 □ $\overline{LOCK}$	$\overline{WR}$
AD3 □ 13	28 □ $\overline{S2}$	M/$\overline{IO}$
AD2 □ 14	27 □ $\overline{S1}$	DT/$\overline{R}$
AD1 □ 15	26 □ $\overline{S0}$	$\overline{DEN}$
AD0 □ 16	25 □ QS0	ALE
NMI □ 17	24 □ QS1	$\overline{INTA}$
INTR □ 18	23 □ $\overline{TEST}$	
CLK □ 19	22 □ READY	
Vss (GND) □ 20	21 □ RESET	

8086

Addressing modes of 8086 :

- The way for which an operand is specified for an instruction in the accumulator is called **addressing mode**.

- The 8086 microprocessors have 8 addressing modes.

- Two addressing modes have been provided for instructions which operate on register or immediate data.

- **These two addressing modes are :**

  1) Register Addressing &

  2) Immediate Addressing.

- The remaining 6 addressing modes specify the location of an operand which is placed in a memory.

- **These 6 addressing modes are :**

  3) Register Indirect Addressing mode

  4) Direct Addressing mode

  5) Indexed Addressing mode

  6) Base Relative Addressing mode

  7) Base Indexed Addressing mode

Unit – 08 : Microprocessor

8085 Microprocessor	8086 Microprocessor
It is an 8-bit microprocessor.	It is a 16-bit microprocessor.
It has a 16-bit address line.	It has a 20-bit address line.
It has a 8-bit data bus.	It has a 16-bit data bus.
The memory capacity is 64 KB.	The memory capacity is 1 MB.
It has five flags.	It has nine flags.
8085 microprocessor does not support memory segmentation.	8086 microprocessor supports memory segmentation.
It has no minimum or maximum mode.	It has minimum and maximum modes.
It contains about 6500 transistor.	It contains about 29000 in size.
The cost of 8085 is low.	The cost of 8086 is high.