UNIT-I
INTRODUCTION TO 8086

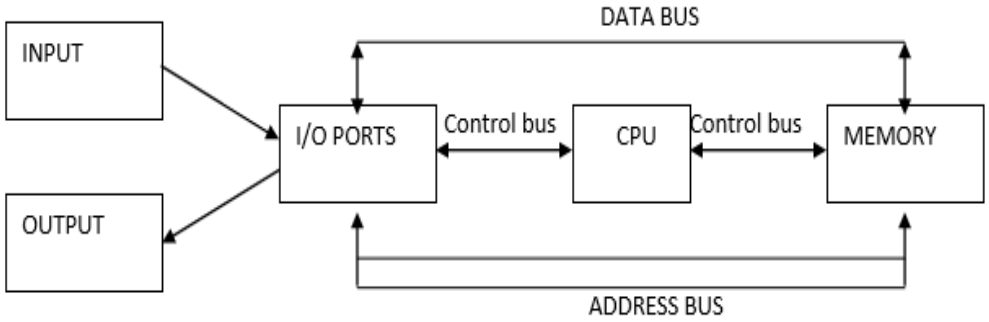
Contents at a glance:

- ✓ Architecture of 8086 microprocessor
- ✓ Register organization
- ✓ 8086 flag register and its functions
- ✓ Addressing modes of 8086
- ✓ Pin diagram of 8086
- ✓ Minimum mode & Maximum mode system operation
- ✓ Timing diagrams

INTRODUCTION TO MICROPROCESSOR:

OVERVIEW OF A SIMPLE MICRO COMPUTER:

The major parts are the central processing unit or CPU, memory, and the input and output circuitry or I/O. Connecting these parts together are three sets of parallel lines called buses. The three buses are the address bus, the data bus, and the control bus.



Block diagram of simple computer or microcomputer.

i) MEMORY: The memory section usually consists of a mixture of RAM and ROM. It may also have magnetic floppy disks, magnetic hard disks, or laser optical disks. Memory has two purposes. The first purpose is to store the binary codes for the sequence of instructions you want the computer to carry out. When you write a computer program, what you are really doing is just writing a sequential list of instructions for the computer. The second purpose of the memory is to store the binary-coded data with which the computer is going to be working.

ii) INPUT/OUTPUT: The input/output or I/O section allows the computer to take in data from the outside world or send data to the outside world. These allow the user and the computer to communicate with each other. The actual physical devices used to interface the computer buses to external systems are often called ports.

iii) CPU: The central processing unit or CPU controls the operation of the computer. It fetches binary-coded instruction of the computer. It fetches binary-coded instructions from memory, decodes the instructions into a series of simple actions, and carries out these actions. The CPU contains an arithmetic logic unit, or ALU. Which can perform add, subtract, OR, AND, invert, or exclusive-OR operations on binary words when instructed to do so. The CPU also contains an address counter which is used to hold the address of the next instruction or data to be fetched from memory, general-purpose registers which are used for temporary storage of binary data, and circuitry which generates the control bus signals.

iv) ADDRESS BUS: The address bus consists of 16, 20, 24, or more parallel signal lines. On these lines the CPU sends out the address of the memory location that is to be written to or read from. The number of address lines determines the number of memory locations that the CPU can address. If the CPU has N address lines then it can directly address 2^N memory locations.

v) DATA BUS: The data bus consists of 8, 16, 32 or more parallel signal lines. As indicated by the double-ended arrows on the data bus line, the data bus lines are bi-directional. This means that the CPU can read data in on these lines from memory or from a port as well as send data out on these lines to memory location or to a port. Many devices in a system will have their outputs connected to the data bus, but the outputs of only one device at a time will be enabled.

vi) CONTROL BUS: The control bus consists of 4-10 parallel signal lines. The CPU sends out signals on the control bus to enable the outputs of addressed memory devices or port devices. Typical control bus signals are memory read, memory write, I/O read, and I/O writer. To read a byte of data from a memory location, for example, the CPU sends out the address of the desired byte on the address bus and then sends out a memory read signal on the control bus.

What is a Microprocessor?

- The word comes from the combination micro and processor.
  - Processor means a device that processes numbers, specifically binary numbers, 0's and 1's.
  - Micro is a new addition.
  - In the late 1960's, processors were built using discrete elements.
  - These devices performed the required operation, but were too large and too slow.
  - In the early 1970's the microchip was invented. All of the components that made up the processor were now placed on a single piece of silicon. The size became several thousand times smaller and the speed became several hundred times faster.
  - The "Micro" Processor was born.

Definition of Microprocessor:

- Microprocessor is a multipurpose, programmable device that accepts digital data as input, processes it according to instructions stored in its memory, and provides results as output.

or

- A microprocessor is a multipurpose, programmable, clock-driven, register-based electronic device that reads binary instructions from a storage device called memory accepts binary data as input and processes data according to instructions, and provides result as output.

MICROCONTROLLER:

- A **microcontroller** (sometimes abbreviated µC, uC or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals.

or

- CPUs with integrated memory or peripheral interfaces

History fo Microprocessors:

Processor	No. of bits	Clock speed (Hz)	Year of introduction
4004	4	740K	1971
8008	8	500K	1972
8080	8	2M	1974
8085	8	3M	1976

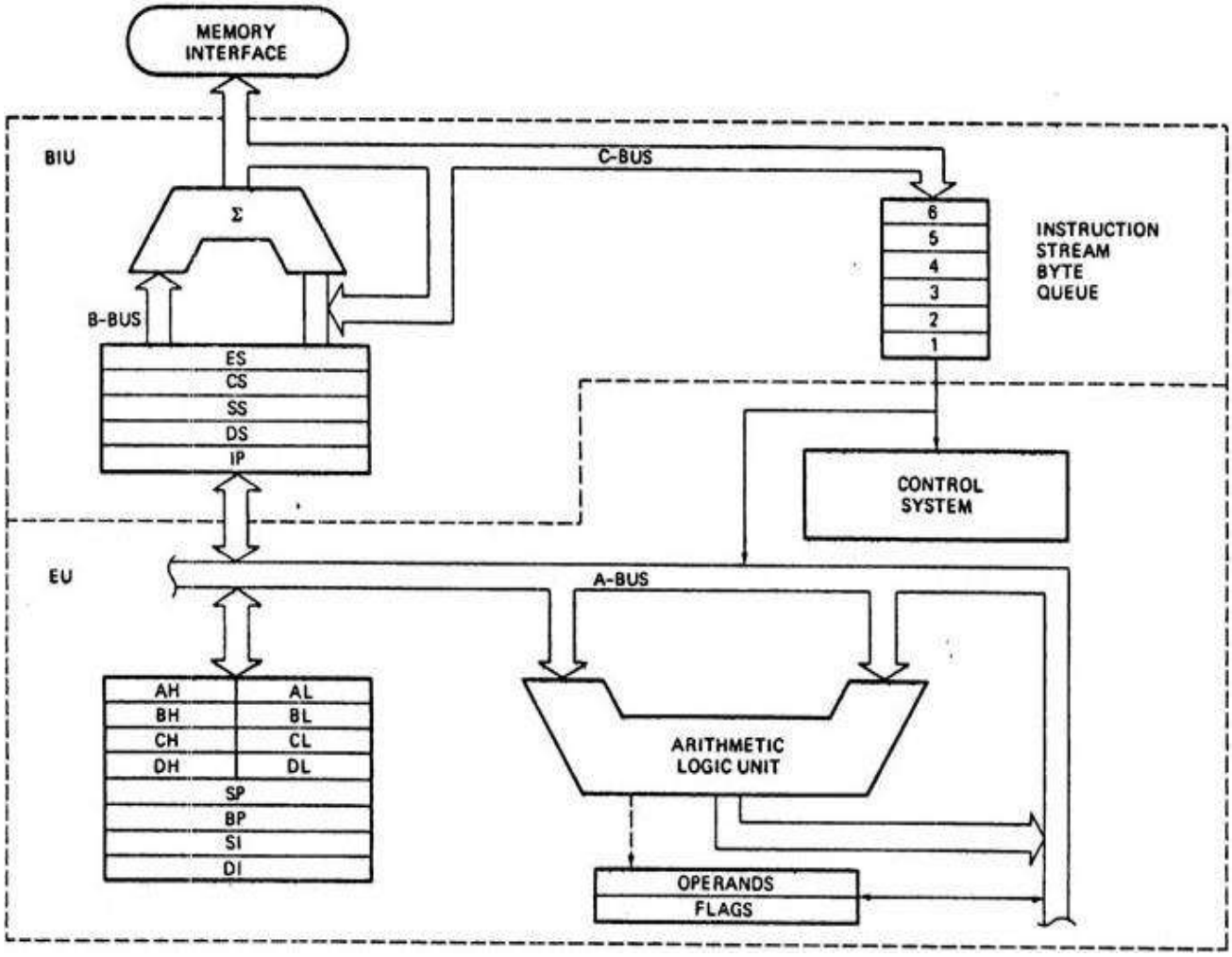
8086	16	5, 8 or 10M	1978
8088	16	5, 8 or 10M	1979
80186	16	6M	1982
80286	16	8M	1982
80386	32	16 to 33M	1986
80486	32	16 to 100M	1989
Pentium	32	66M	1993
Pentium II	32	233 to 500M	1997
Pentium III	32	500M to 1.4G	1999
Pentium IV	32	1.3 to 3.8G	2000
Dual core	32	1.2 to 3 G	2006
Core 2 Duo	64	1.2 to 3G	2006
i3, i5 and i7	64	2.4G to 3.6G	2010

8086 Microprocessor features:

1. It is 16-bit microprocessor
2. It has a 16-bit data bus, so it can read data from or write data to memory and ports either 16-bit or 8-bit at a time.
3. It has 20 bit address bus and can access up to 2^{20} memory locations (1 MB).
4. It can support up to 64K I/O ports
5. It provides 14, 16-bit registers
6. It has multiplexed address and data bus AD_0-AD_{15} & A_{16}-A_{19}
7. It requires single phase clock with 33% duty cycle to provide internal timing.
8. Prefetches up to 6 instruction bytes from memory and queues them in order to speed up the processing.
9. 8086 supports 2 modes of operation
    a. Minimum mode
    b. Maximum mode

Architecture of 8086 microprocessor:

- As shown in the below figure, the 8086 CPU is divided into two independent functional parts
    - Bus Interface Unit(BIU)
    - Execution Unit(EU)
- Dividing the work between these two units' speeds up processing.



The Execution Unit (EU):

- The execution unit of the 8086 tells the BIU where to fetch instructions or data from, decodes instructions, and executes instructions.
- The EU contains **control circuitry,** which directs internal operations.
- A decoder in the EU translates instructions fetched from memory into a series of actions, which the EU carries out.
- The EU has a 16-bit **arithmetic logic unit** (ALU) which can add, subtract, AND, OR, XOR, increment, decrement, complement or shift binary numbers.
- The main functions of EU are:
  - Decoding of Instructions
  - Execution of instructions
    - ✓ Steps
      - EU extracts instructions from top of queue in BIU
      - Decode the instructions
      - Generates operands if necessary
      - Passes operands to BIU & requests it to perform read or write bus cycles to memory or I/O
      - Perform the operation specified by the instruction on operands

Bus Interface Unit (BIU):

- The BIU sends out addresses, fetches instructions from memory, reads data from ports and memory, and writes data to ports and memory.