

1.1 Understand the Term of Microprocessor

Q1. What is a Microprocessor?

A microprocessor is an integrated circuit (IC) that performs the functions of a central processing unit (CPU). It can perform arithmetic, logic, control, and data-handling operations. It is programmable, meaning it executes instructions stored in memory.

Q2. Why is a Microprocessor called the “brain” of the computer?

It controls the overall working of the computer by fetching, decoding, and executing instructions. Like the brain, it decides what operation to perform next.

Q3. Give examples of microprocessors.

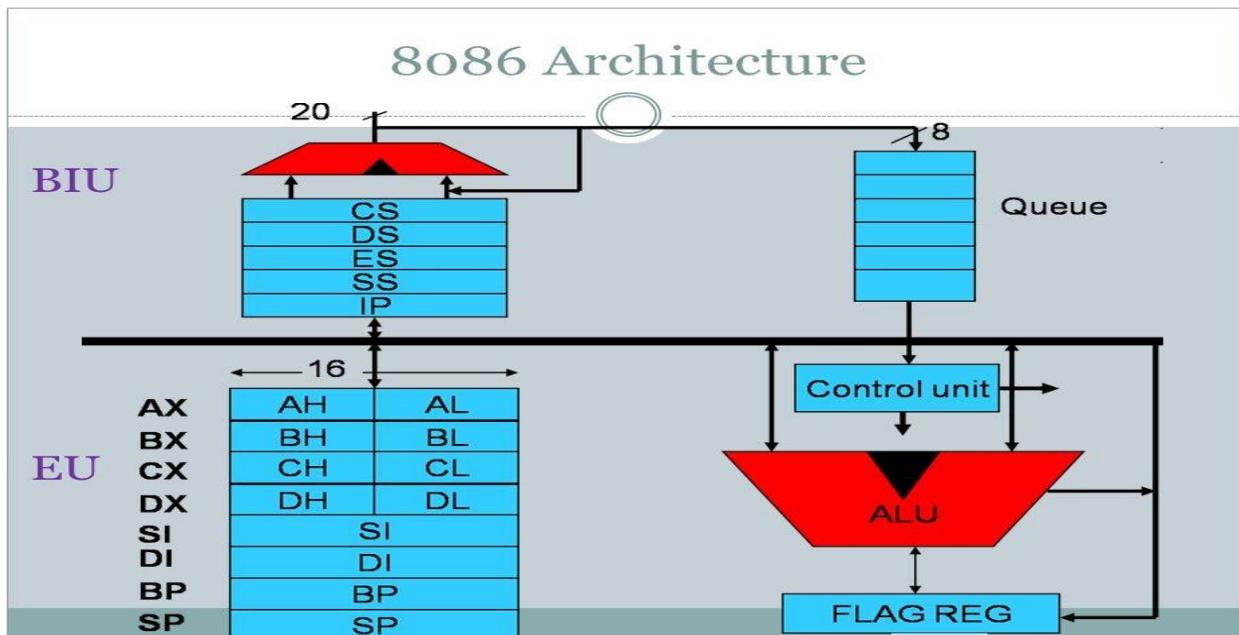
Examples: Intel 8085, 8086, Pentium series, AMD Ryzen processors.

1.2 Understand Basic Architecture of a 16-bit Microprocessor (8086/88)

Q1. Draw and explain the block diagram of 8086.

The 8086 has two main units:

- **Bus Interface Unit (BIU):** Fetches instructions, handles addressing and data transfer.
 - **Execution Unit (EU):** Decodes and executes instructions.
- Internal buses connect ALU, registers, and control circuits.



Q2. What are Buses? Name their types.

A bus is a communication pathway for data transfer between CPU, memory, and I/O devices.

- **Data Bus:** Bi-directional, carries actual data (16-bit in 8086).
- **Address Bus:** Unidirectional, carries addresses of memory (20-bit in 8086 → 1MB memory).
- **Control Bus:** Carries control signals (Read, Write, Interrupt, Clock).

Q3. What is Bus Timing?

Bus timing defines when and how data, address, and control signals are placed on the bus, synchronized with the clock.

Q4. What is Bus Buffering and Latching?

- **Buffering:** Strengthens electrical signals for longer distances.
- **Latching:** Temporarily holds data to stabilize signals before processing.

Q5. Explain Clocking and Power Requirements of 8086.

8086 requires an external clock generator (typically 5–10 MHz). It operates on a +5V DC power supply.

Q6. What is Pin Configuration of 8086?

The pins are divided into groups:

- Address/Data lines (AD0–AD15),
- Address lines (A16–A19),
- Control signals (RD, WR, INTR),

- Power (Vcc, GND),
- Clock input.

1.3 Understand Processor Features

Q1. What is Pipelining?

Pipelining is a technique where multiple instructions are overlapped in execution. While one instruction is executed, the next is fetched. This increases throughput and efficiency.

Q2. What is Multiprocessing?

Multiprocessing means using two or more processors in a single computer system to share tasks. It improves speed and allows parallel execution of programs.

Q3. What is Parallel Processing?

Parallel processing is executing multiple tasks or instructions simultaneously by dividing them across processors or cores.

1.4 Understand Programming Models (Registers)

Q1. What are General Purpose Registers in 8086?

Registers AX, BX, CX, DX are used for arithmetic, data transfer, and intermediate storage. Each is 16-bit and can be divided into 8-bit parts (e.g., AX = AH + AL).

Q2. What are Segment Registers?

Segment registers (CS, DS, SS, ES) hold the starting addresses of memory segments:

- **CS (Code Segment):** Program instructions.
- **DS (Data Segment):** Data storage.
- **SS (Stack Segment):** Stack operations.
- **ES (Extra Segment):** Additional data storage.

Q3. What are Pointer and Index Registers?

- **SP (Stack Pointer):** Points to top of stack.
- **BP (Base Pointer):** Accesses parameters in stack.
- **SI (Source Index):** Used in string operations.
- **DI (Destination Index):** Used in string operations.

Q4. What is the Flag Register?

The flag register shows CPU status. Important flags:

- Zero Flag (Z), Carry Flag (C), Sign Flag (S), Overflow Flag (O), Parity Flag (P), Auxiliary Carry Flag (AC).

1.5 Understand Memory

Q1. What is ROM?

Read-Only Memory is permanent storage that stores programs and instructions. Data cannot be modified during normal operation. Example: BIOS.

Q2. What is Cache Memory?

Cache is a very fast memory located close to the CPU. It stores frequently used instructions/data to speed up processing.

Q3. What is RAM and its types?

RAM is volatile memory used for temporary data storage. Types:

- **Static RAM (SRAM):** Uses flip-flops, faster, costly, used in cache.
- **Dynamic RAM (DRAM):** Uses capacitors, slower, cheaper, used in main memory.

Q4. What is Flash Memory?

Flash is non-volatile memory that can be electrically erased and reprogrammed. Used in SSDs, USB drives.

1.6 Understand Components of Processor

Q1. What is Control Unit (CU)?

The CU directs data flow between memory, ALU, and I/O devices. It generates control signals to coordinate all operations.

Q2. What is Arithmetic Logic Unit (ALU)?

The ALU performs arithmetic (add, subtract, multiply, divide) and logic operations (AND, OR, NOT, XOR). It is the “calculator” of CPU.

Long Question Answers – Chapter 1

1.1 Microprocessor Basics

Q: Explain the term microprocessor. Discuss its importance in modern computing devices with examples.

A microprocessor is an integrated circuit that contains the central processing unit (CPU) of a computer on a single chip. It can perform arithmetic, logic, control, and data-handling tasks. The microprocessor works by fetching instructions from memory, decoding them, and executing them step by step. Its importance lies in being the “brain” of computers, as it controls every operation from booting to application execution. Modern computing devices like laptops, desktops, mobile phones, and embedded systems all rely on microprocessors. For example, Intel Core i7 and AMD Ryzen are advanced microprocessors used in PCs, while ARM processors are used in smartphones. Without microprocessors, modern computing and automation would not be possible.

1.2 8086/88 Architecture and Buses

Q1: Draw and explain the block diagram of 8086 microprocessor.

The 8086 microprocessor consists of two main functional units: the **Bus Interface Unit (BIU)** and the **Execution Unit (EU)**.

- The BIU handles all bus operations such as fetching instructions from memory, reading/writing data, and calculating physical addresses using segment and offset.
- The EU executes instructions using the ALU, control circuitry, and registers. It decodes instructions and performs arithmetic and logical operations.

Internal buses connect the BIU and EU for data and instruction flow.

Together, these units allow the processor to work efficiently in a pipelined manner (while EU executes one instruction, BIU fetches the next).

Q2: Explain different types of buses in 8086 with their roles and width.

The 8086 has three main types of buses:

1. **Data Bus:** 16-bit, bi-directional. Used to transfer actual data between CPU, memory, and I/O.
2. **Address Bus:** 20-bit, unidirectional. Used to carry memory addresses. Allows 8086 to access 1 MB memory space.
3. **Control Bus:** Used to carry control signals like **Read (RD)**, **Write (WR)**, **Interrupt**, and **Clock**. It ensures proper coordination of operations.

Together, these buses provide communication between processor, memory, and I/O devices.

Q3: Write short notes on Bus Timing, Buffering, and Latching.

- **Bus Timing:** Refers to the sequence of events for data transfer. Timing ensures that data is read/written at the correct clock pulse.
 - **Buffering:** Buffers amplify signals so they can travel longer distances without loss.
 - **Latching:** A latch holds the address/data temporarily to stabilize it before being used.
- These techniques improve reliability and synchronization in 8086 operations.

1.3 Processor Features

Q1: What is pipelining? Explain its advantages with an example.

Pipelining is the process of overlapping instruction execution in a processor. In 8086, while one instruction is being executed in the Execution Unit (EU), the Bus Interface Unit (BIU) fetches the next instruction. This reduces idle time and increases the throughput of the processor. For example, instead of waiting for one instruction to finish before fetching the next, pipelining allows multiple instructions to be processed simultaneously at different stages. The main advantage is faster execution and efficient CPU usage.

Q2: Differentiate between multiprocessing and parallel processing.

- **Multiprocessing:** Involves using more than one physical processor (CPU) in a single system. Each processor can execute its own task, leading to better multitasking. Example: Server computers with dual CPUs.

Computer Architecture (ELTR-314)

- **Parallel Processing:** Means dividing a single large task into smaller sub-tasks and executing them simultaneously, either on multiple processors or multiple cores within a processor. Example: A supercomputer solving complex simulations.

In short, multiprocessing is hardware-based (multiple CPUs), while parallel processing is a technique to improve speed by breaking tasks.

1.4 Registers (Programming Model)

Q1: Explain all registers of 8086 microprocessor with examples.

The 8086 has four groups of registers:

1. **General Purpose Registers (AX, BX, CX, DX):** Store operands and intermediate results. Example: AX is the accumulator.
2. **Segment Registers (CS, DS, SS, ES):** Hold starting addresses of memory segments. Example: CS stores code segment address.
3. **Pointer and Index Registers (SP, BP, SI, DI, IP):** Used for addressing and stack operations. Example: SP points to top of stack.
4. **Flag Register:** Stores status of CPU after execution (e.g., Zero Flag, Carry Flag, Sign Flag). These registers allow the processor to perform operations quickly without always accessing slower main memory.

Q2: Discuss the importance of flag register in 8086.

The flag register in 8086 shows the current condition of the CPU after operations. It contains **status flags** (Zero, Sign, Carry, Overflow, Parity, Auxiliary Carry) and **control flags** (Trap, Interrupt Enable, Direction). For example, after an addition, the Carry Flag shows if there was a carry, while the Zero Flag shows if the result is zero. These flags help the CPU decide the next step, such as jumping to another instruction if a condition is true.

1.5 Memory

Q1: Differentiate between SRAM and DRAM with examples.

- **Static RAM (SRAM):** Uses flip-flops to store each bit. Very fast, does not need refreshing, but expensive and consumes more power. Used in cache memory.
- **Dynamic RAM (DRAM):** Uses capacitors to store data. Slower and needs constant refreshing, but cheaper and higher density. Used in main memory (RAM modules).
Example: CPU L1/L2 cache uses SRAM, while the system RAM (like DDR4) uses DRAM.

Q2: Explain Cache memory and its importance in processors.

Cache memory is a small, high-speed memory located close to the CPU. It stores frequently used instructions and data so that the processor does not need to access slower main memory repeatedly. This reduces memory access time and improves performance. For example, when a CPU repeatedly uses a loop of instructions, they are stored in cache for quick access. Cache is faster but smaller in size compared to main memory.

1.6 Processor Components

Q1: Explain the role of ALU and CU in microprocessor operations.

The **Arithmetic Logic Unit (ALU)** performs arithmetic operations (addition, subtraction, multiplication, division) and logical operations (AND, OR, NOT, XOR).

The **Control Unit (CU)** manages the entire operation of the CPU. It fetches instructions, decodes them, and sends control signals to ALU, memory, and I/O devices. Together, the ALU and CU form the core of the microprocessor, enabling it to execute programs correctly.

Q2: With a neat diagram, explain the major components of a processor.

The main components are:

1. **ALU:** Performs calculations and logical decisions.
2. **CU:** Controls instruction execution and directs data flow.
3. **Registers:** Provide fast temporary storage.
4. **Buses:** Connect CPU with memory and I/O.

A diagram usually shows these interconnected, with the CU directing operations and ALU executing instructions.