

Microprocessors and Microcontrollers

This report shall discuss the following topics:

- Topic 1: Microprocessors
- Topic 2: Microcontrollers
- Topic 3: Microprocessors vs Microcontrollers

1) Topic 1: Microprocessors

- A microprocessor is the brain of a computer.
- It takes instructions from a program, processes data, and gives output.
- Working of Microprocessors:
 - A microprocessor works in a repeated sequence, called the Fetch-Decode-Execute cycle.
 - In the first step, it uses Program Counter (PC), which is special register that stores the address the next instruction. This instruction is then fetched from the memory and stored in the Instruction Register (IR). Once this instruction is fetched, the PC points to the next instruction.
 - In the next step, the Control Unit (CU) decodes these instructions. It supervises the data flow and operations.
 - In the third step, the decoded instruction is executed. After decoding, the CU sends control signals to different parts of the microprocessor. Anything related to arithmetic and logic is taken care by the ALU, while anything related to data transfer is taken care by the registers and memory.
 - The final output of these instruction is then stored in the system memory.
- Architecture and Components of a Microprocessor:
 - Each microprocessor has four important parts namely, ALUs, CU, Registers, Buses.
 - The ALUs perform all arithmetic and logical instruction.
 - The CU directs and coordinates all the processes, and decides what operation to perform, when and, on which data.
 - Registers are small, very fast memory in the microprocessor which temporarily stores data, instructions and addresses.
 - Buses are used to transfer data, and carry addresses and control signals.
- Commonly used Microprocessors:

- Intel Core, ARM Cortex, AMD Ryzen, etc. are most commonly used microprocessors.

2) Topic 2: Microcontrollers

- A microcontroller is a single-chip computer that contains a CPU, memory, and input/output peripherals on the same chip.
- It is mainly used for control-oriented applications.
- Working of Microcontrollers:
 - A microcontroller works in the same way as a microprocessor, i.e., it also follows Fetch-Decode-Execute.
 - The only difference is that it does not require external memory or I/O chips for basic operations.
- Architecture and Components of a Microcontrollers:
 - It involves a CPU, ROM, RAM, I/O ports, serial communication interfaces, etc.
 - The CPU is the control unit of the microcontroller.
 - ROM stores the program instructions while RAM stores temporary data and variables.
 - Serial communication interfaces are used for data communication.
- Commonly used Microcontrollers:
 - Arduinos, ARM Cortex-M, ATmega328, Attiny85, etc. are some most common microcontrollers.

3) Topic 3: Microprocessors vs Microcontrollers

- Microprocessors comprise only the CU/CPU but microcontrollers consist of CPU, RAM, ROM, I/O, timers, etc. all on one single chip.
- While microprocessors work on high speed, high power, and complex computations, microcontrollers work on low power, less complex, and focused on specific tasks.
- Microprocessors are generally used in computer systems while microcontrollers are used in embedded systems.
- Microprocessors are superior to microcontrollers in terms of power, flexibility, and complex operating systems while inferior in terms of efficiency, cost-effectiveness, and dedicated control.