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

- It is a complex digital Integrated Circuit (IC) device that can take input, perform some arithmetic and logical operations on it, and give the desired output.
- A microprocessor is made up of billions of transistors.
- Working of a Microprocessor
  - It works in a fetch-decode-execute-store-cycle
  - (clock-driven cycle) to process each instruction.
  - In the first stage, the microprocessor gets the instructions from memory.
  - Then, in the next step, it decodes the instructions and understands what to do. The decoding is carried out by the Control Unit.
  - The Arithmetic Logic Unit (ALU) performs the calculations and logical operations.
  - Finally, the output is stored back into the memory.

- Architecture and Components of a Microprocessor
  - A microprocessor usually consists of an ALU, Control Unit, registers, and buses that work together to execute instructions.
  - The ALU performs arithmetic and logical operations.
  - The Control Unit decodes and executes instructions and generates control-signals. It manages the fetch-decode-execute cycle.
  - Registers are small, fast memory units which store data and instructions .
  - Buses are used to transfer information between different parts of a microprocessor and external devices.

- Commonly Used Microprocessors
    - ARM (Advanced RISC Machines) is a microprocessor which is built for low power consumption and high efficiency.
    - It is based on RISC (Reduced Instruction Set Computers), which use simple instructions to execute faster.
    - X86, which was originally developed by Intel, is based on CISC (Complex Instruction Set Computers), which have very high performance and power consumption.
    - It is still commonly used by Intel and AMD for their CPUs.

2) Topic 2 : Microcontrollers

- It is also a digital IC which performs control-oriented tasks. It focuses on controlling hardware in real time rather than performing complex instructions like the microprocessor.
- A microcontroller is made up of millions of transistors.
- Working of a Microcontroller
    - It works in a fetch-decode-execute-store cycle, similar to a microprocessor.
    - It fetches instructions from the memory and the Control Unit decodes it.
    - The ALU performs logical or arithmetic operations when needed and the output is stored in memory.
    - Working is the same as that of a microprocessor.

- Architecture and Components of a Microcontrollers
    - The ALU, Control Unit, Memory and Input-Output ports are all integrated onto a single chip.
    - Thus, it consumes way less power and is more efficient than a microprocessor.

- Commonly Used Microcontrollers
    - Commonly used microcontrollers include 8051, PIC (used in industrial control and automation), AVR (used in Arduinos), and ARM Cortex-M series (modern electronics).

3) Topic 3 : Microprocessors VS Microcontrollers

- Microprocessors are optimized for high-computational capabilities while microcontrollers are useful for real-time control.
- Since microprocessors need external input-output systems and memory, the power consumption is more compared to that of microcontrollers, where everything is integrated onto a single chip.

- Microprocessors are thus more expensive than microcontrollers.
- Microprocessors are most commonly used for computation-heavy systems, while microcontrollers are most commonly used for controlling electronic hardware.