Summary: Embedded Systems Concepts

What is an Embedded System?

An embedded system is a combination of hardware and software designed to perform a specific, dedicated function. Unlike general-purpose computers, embedded systems are tailored for particular tasks and are often integrated into larger mechanical or electrical systems. Common examples include washing machines, microwave ovens, medical instruments, and automotive control systems.

Key Components

1. **Hardware:**

Microcontroller or Microprocessor: Acts as the central processing unit. Microcontrollers (such as AVR, ARM, and PIC) are widely used due to their integration of CPU, memory, and I/O peripherals.

Memory: Includes both volatile memory (RAM) for temporary data and non-volatile memory (ROM or Flash) for permanent program storage.

Input/Output Interfaces: Inputs like sensors and buttons, and outputs like LEDs, displays, and motors.

Power Supply: Provides the required electrical energy to operate the system reliably.

2.**Software:**

- Typically written in C or C++.
- Responsible for controlling the hardware based on input signals.
- In complex applications, a real-time operating system (RTOS) might be used for task scheduling and timing.

Characteristics of Embedded Systems:

- **Real-Time Operation**: Must respond to inputs or events within defined time constraints.
- **Resource Constraints**: Operate with limited memory, processing power, and energy.
- **Reliability and Stability**: Required to function consistently, especially in safety-critical applications.

- **Dedicated Functionality**: Designed to perform one or a limited set of functions efficiently.