EMBEDDED PLATFORMS FOR IOT

1. Introduction to IoT Embedded Platforms

- Embedded systems are at the core of IoT devices, enabling data collection, processing, and communication.
- IoT embedded platforms integrate hardware and software to support real-time operations.

2. Key Components of IoT Embedded Platforms

- **Microcontrollers (MCUs) / Microprocessors (MPUs):** Act as the brain of the IoT device. Examples: ESP32, STM32, Raspberry Pi.
- **Sensors & Actuators:** Collect data (e.g., temperature, motion) and perform actions (e.g., turn on a motor).
- **Connectivity Modules:** Enable communication using Wi-Fi, Bluetooth, Zigbee, LoRa, or Cellular (4G/5G).
- **Memory & Storage:** Flash memory for firmware and RAM for processing.

- **Power Management:** Low-power operation is crucial for battery-powered IoT devices.

3. Popular IoT Embedded Platforms

- **Arduino:** Easy-to-use development board, suitable for beginners.
- **ESP8266/ESP32:** Affordable, Wi-Fi-enabled MCUs for IoT projects.
- **Raspberry Pi:** Single-board computer with Linux support, suitable for advanced IoT applications.
- **BeagleBone:** Open-source platform with high-performance computing.
- **STM32:** Industrial-grade MCUs with rich peripheral support.

4. IoT Communication Protocols

- **MQTT (Message Queuing Telemetry Transport)** – Lightweight, used for cloud communication.

- **CoAP (Constrained Application Protocol)** – Optimized for low-power devices.
- **HTTP/HTTPS** – Web-based communication.
- **LoRaWAN** – Long-range, low-power wireless communication.
- **Bluetooth Low Energy (BLE)** – Short-range, low-power communication.

5. Embedded OS for IoT

- **FreeRTOS** – Real-time OS for microcontrollers.
- **Zephyr OS** – Lightweight open-source RTOS.
- **RIOT OS** – Secure, energy-efficient OS for IoT.
- Linux (Raspberry Pi, BeagleBone) – Used for complex applications.

6. IoT Cloud Platforms

- AWS IoT Core

- Google Cloud IoT
- Microsoft Azure IoT
- IBM Watson IoT
- ThingsBoard (Open-source IoT platform)

7. Security Considerations in IoT Embedded Platforms

- Secure boot and firmware updates.
- Data encryption and authentication.
- Network security (TLS, VPNs).
- Hardware security (TPMs, Secure Elements).