IOT (NETWORK AND CONNECTION)

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UNIT I – Fundamentals of IoT

1. Introduction to IoT

Internet of Things (IoT) means connecting physical devices (things) like sensors, mobiles, vehicles, home appliances to the internet to collect and exchange data.

Example: Smart watch, Smart bulb, Smart AC.

2. Definitions of IoT

IoT is a network of physical objects embedded with sensors, software, and connectivity to exchange data over the internet.

3. Characteristics of IoT

- Connectivity
- Intelligence
- Automation
- Dynamic changes
- Scalability
- Security

4. IoT Architecture

Three Layer Architecture:

1. **Perception Layer** – Sensors collect data.
2. **Network Layer** – Transfers data.
3. **Application Layer** – Provides services to users.

Five Layer Architecture:

- Perception
- Transport
- Processing
- Application
- Business Layer

5. Physical & Logical Design

- **Physical Design** – Sensors, actuators, hardware devices.

- **Logical Design** – Data flow, communication protocols, software.

6. Enabling Technologies

- RFID
- Sensors
- Cloud Computing
- Big Data
- AI
- Wireless Communication

7. History of IoT

- 1999 – Kevin Ashton introduced the term IoT.
- Development with RFID and wireless networks.
- Growth due to smartphones and cloud computing.

8. IoT Frameworks

Platforms used to develop IoT apps.
Example: AWS IoT, Google Cloud IoT.

9. IoT and M2M

- **M2M (Machine to Machine)** – Devices communicate without human.
- IoT is advanced form of M2M using internet.

UNIT II – Sensor NetWorks

1. Sensors

Device that detects physical changes. A **sensor** is a device that **detects or measures physical changes** in the environment and converts them into an **electrical signal** that a system or computer can understand.

Examples:

- Temperature sensor
- Humidity sensor
- Motion sensor

2. Actuators

Device that converts electrical signal into physical action. An **actuator** is a device that converts **electrical energy, hydraulic energy, or pneumatic energy** into **mechanical motion or physical action.**

Examples:

- Motor
- LED
- Buzzer

3. Types of Actuators

- Electrical
- Hydraulic
- Pneumatic

4. IoT Development Boards

- Arduino
- Raspberry Pi
- NodeMCU

Used to build IoT projects.

5. RFID

Radio Frequency Identification.

Components:

- Tag

- Reader
- Antenna

Used in smart cards, toll gates.

6. Wireless Sensor Networks (WSN)

Group of sensors connected wirelessly to collect and send data.

Features:

- Low power
- Self-configured
- Used in agriculture, military

7. Networking Nodes

- Sensor Node
- Gateway Node
- Sink Node

UNIT III – Wireless Technologies for IoT

1. WPAN Technologies

- Zigbee
- Bluetooth (BLE)
- NFC
- Z-Wave

2. IEEE 802.15.4

Standard for low-rate wireless personal area network.

Used in Zigbee.

3. IP Based Protocols

- IPv6
- 6LoWPAN
- RPL

4. Application Protocols

- REST
- AMQP
- CoAP
- MQTT (Most popular lightweight protocol)

5. Edge Connectivity

Processing data near device instead of cloud.

Advantages:

- Faster response
- Less delay
- Better security

UNIT IV – Data Handling & Analytics

Big Data;

Big Data refers to extremely large and complex volumes of data that cannot be easily stored, processed, or analyzed using traditional data management systems. This data is generated from various sources such as social media platforms, online transactions, mobile devices, and IoT sensors. Big Data is characterized by the five V's: Volume (large amount of data), Velocity (speed of data generation), Variety (different types of data), Veracity (accuracy of data), and Value (useful insights obtained from data). Advanced technologies like Hadoop and cloud computing are used to manage and analyze Big Data effectively.

5V's:

- Volume
- Velocity
- Variety
- Veracity
- Value

2. Data Flow

Data Flow means the movement of data from IoT devices to the final user application.

Sensor → Gateway → Cloud → Application

3. Data Acquisition

Collecting data from sensors. **Data Acquisition is the process of collecting data from sensors or devices for analysis.**

4.Data Storage

Data Storage is the process of saving data in a device or system so that it can be accessed and used later.

- Cloud storage
- Local database

5. Hadoop

Framework for storing and processing big data. **Hadoop** is an open-source framework used to **store and process large amounts of data (Big Data)** across multiple computers.

6. Types of Data Analytics

- Descriptive – What happened?
- Diagnostic – Why happened?

- Predictive – What will happen?
- Prescriptive – What to do?

7. Cloud Analytics

Processing IoT data in cloud platforms. **Cloud Analysis** means analyzing and processing data using **cloud computing platforms** instead of local computers.

UNIT V – Applications of IoT

1. Home Automation

Smart lights, smart locks, smart AC. **Home Automation** means controlling and monitoring home appliances automatically using the **Internet**, **sensors**, and **smart devices**.

2. Smart Cities

Smart traffic control, smart waste management. A **Smart City** is a city that uses **IoT technology, sensors, and internet connectivity** to improve the quality of life of people and manage city services efficiently.

3. Energy

Smart meters, smart grid.energy. s the ability to do work or produce change. It is essential for all living beings, machines, and technological systems to function properly.

4. Retail

Inventory tracking, smart billing. **Retail** means selling goods or products **directly to customers** for personal use.Retail is the process of selling goods and services directly to end customers in small quantities for personal consumption.

5. Agriculture

Smart irrigation, soil monitoring. **Agriculture in IoT** means using **Internet of Things technology** like sensors, smart devices, and internet connectivity to improve farming activities.

6. Healthcare

Remote patient monitoring, wearable devices. **Healthcare in IoT** means using Internet of Things technology like sensors, wearable devices, and internet connectivity to monitor and improve patient health.

7. Industrial IoT

Factory automation, predictive maintenance. **Industrial IoT (IIoT)** means using Internet of Things technology in **industries and factories** to improve production, efficiency, and safety.

8. Legal Challenges

- Data privacy
- Security issues
- Cyber attacks

9. IoT Design Ethics

- Data protection
- User consent

10. Environmental Protection

- Pollution monitoring
- Smart water management
- Climate monitoring