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ROLL NO: 46 Sub: IOT

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Q1.] Explain the steps involved in the IOT design Methodology.

- The IOT Design Methodology provides a systematic process to develop IOT-based applications or systems. The key steps are.

1. Purpose & Requirements Identification
   - Define the main purpose of the IOT application.
   - Identify the user requirements (e.g. data to be collected, devices to be connected, expected output).

2. Process Specification
   - Describe the processes that will occur in the IOT system.
   - Example: In a smart agriculture system → Soil moisture sensing, data transmission, Irrigation control

3 Domain Model Specification
   - Model the entities and their relationships
   - Ex: Soil sensor → sends data to cloud → decision engine → water pump actuator.

4 Information Model Specification
   - Define the type, format, and structure of data
   - Ex: Temperature as float, Time as timestamp.

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5. Service Specification
- Identify the services the system will provide (eg. Real-time monitoring, remote control, alerts).

6. IOT Level Specification
- Decide which IOT level (out of 5 levels: Perception, Network, Edge, Middleware, Application) will be used.

7. Functional View Specification
- Map the functionalities to IOT levels and identify interactions between devices and services.

8. Operational View Specification
- Define how the system operates in real-world conditions (connectivity, availability, scalability).

9. Device & Component Integration
- Choose appropriate sensors, actuators, communication protocols, cloud platforms, and integrate them.

10. Testing & Deployment
- Test the IOT system in real-world scenarios and deploy it for end users.

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Q.2.] Illustrate the different pillars of IOT.

→ -The pillars of IOT are the fundamental building blocks that enable IOT systems to function.

1] RFID (Radio-Frequency Identification)
- Wireless tech to identify & track objects/people using radio waves.

Core Parts:
- Tags (Passive/Active):
  - Store IDs/data
- Readers/Antennas:
  - Read tag data
- Middleware/DB:
  - filter, aggregate, route data

▶ Provides automatic identification, linking physical assets to digital records - foundation for inventory, asset tracking, access control.
Examples: Retail Inventory, Library books

NOTE: Passive tags are low-cost & battery-less; Active tags have range but need power

2] WSN (Wireless Sensor Network)
- Network of sensor nodes (MCU + Sensor(s) + radio + power) that sense environment and communicate, often multi-hop.

Core parts:

- Sensor Nodes: Temperature, humidity, motion, etc
- Topology: Star | mesh | tree
- Gateway | sink: bridges WSN to IP | cloud

- Protocols | Tech: IEEE 802.15.4 (ZigBee), 6LoWPAN | Thread, BLE Mesh;

▶ Provides scalable, low-power data acquisition from the physical world.

Example: Smart agriculture fields, environment monitoring, smart buildings.

3] M2M (Machine-to-Machine Communication)

- Direct device-to-device | cloud data exchange with little | no human involvement

- Connectivity: Cellular (2G|3G|4G|5G), Ethernet, Wi-fi, LPWAN, ZigBee, BLE.

- Protocols: MQTT, COAP, HTTP | REST, AMQP, SMS-based in legacy M2M.

▶ Real-time telemetry, commands, and event-driven automation across heterogeneous devices.

Examples: Smart meters auto-reporting, vending machines restock alerts, fleet telematics

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4] SCADA (Supervisory Control And Data Acquisition)

- Industrial control architecture for monitoring & controlling processes across sites.

- Core Parts:
  - Field Devices : RTUs, PLCs, sensors | actuators
  - Communication : fieldbuses / industrial Ethernet
  - SCADA Server & HMI : data acquisition, alarms, trends, operator control

➤ -Brings supervisory control / telemetry from plants, grids, pipelines into the IOT world;
- Modern IIOT integrates SCADA data with cloud analytics

Examples: Power grid monitoring, water treatment, oil & gas pipelines, factory automation.

NOTE : Security is critical (Network segmentation, authentication, patching).

03.] Explain the concept of Machine-to-Machine (M2M) Communication in the context of IOT.

→ Machine-to-Machine (M2M) communication refers to the direct exchange of data between devices without human ~~interacti~~ intervention.

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- Role in IoT :
  - IoT heavily depends on M2M communication for automation and real-time control.
  - Devices communicate over wired | wireless networks to perform tasks intelligently

- Features

1. Autonomous Communication :
   - Devices talk to each other automatically.

2. Real-time Data Sharing
   - fast transmission of data.

3. Protocol Support.
   - Uses MQTT, CoAP, HTTP, etc.

4. Efficiency
   - Reduces human effort and error.

- Example in IoT

- In Smart homes : Motion sensor detects movement → informs smart light → Light turns on automatically

- In Smart health care : Wearable monitors patient's heartbeat → Sends data to doctor's system → alerts if abnormal

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Q4] Describe device and component integration for IOT-based home automation system

→ In an IOT-based home automation system, multiple devices and components must be integrated for smooth functioning

1. Devices & Components Used:
   - Sensors :- Motion, temperature, humidity, gas, smoke
   - Actuators :- Smart lights, fans, smart locks, alarms.
   - Microcontrollers / Microprocessors : Arduino, Raspberry Pi, ESP 32
   - Communication Modules : Wifi, Bluetooth, Zigbee
   - Cloud Platform : AWS IOT, Blynk, Google firebase
   - User Interface : Mobile App, Voice Assistance

2. Integration Process :

Step 1: Sensors detect environmental changes (motion detected, temperature rise).

Step 2: Data is sent to microcontroller via communication modules.

Step 3: Microcontroller processes data and sends it to the cloud for storage / analysis.

Step 4: Cloud sends command back to actuators.

Step 5: Actuators perform action (turn on AC, switch off lights)

Step 6: User can monitor / control through app or voice command

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Q.5] What are horizontal and Vertical IOT applications?

→ IOT applications are broadly classified into Horizontal and Vertical models:

1. Horizontal IOT Applications

- Provide general-purpose IOT solutions usable across industries
- Focus is on connectivity, cloud storage, and device management
- Example:
  - Cloud IOT platforms (AWS IOT, Azure IOT Hub).
  - Data analytics platforms
  - Connectivity services (LORAWAN, 5G)

2. Vertical IOT Applications

- Industry-specific or domain-specific solutions.
- Tailored to solve a particular sector's needs.
- Example:
  - Healthcare: Remote patient monitoring, wearable devices
  - Agriculture: Smart irrigation systems
  - Smart Home: Home automation and Security systems

• Difference InShort

1. Horizontal = Generic platform (Foundation).
2. Vertical = Specific use case (Industry-focused solutions)