LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY

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Department of Computer Science And Engineering

Academic Year: 2026-2027

Student Roll Number: 160923733152

Student Name: MOHAMMED UFRAAN

Year: 04 **Semester:** 07 **Branch & Section:** CSE-4A2

Course Name: INTERNET OF THINGS

Course Code: U23EC703

Assignment Number: 01

Date of Assignment: 26/8/26 **Due date:** 29/8/26 **Date of Submission:**

Marks Obtained: 10

Remarks:

Signature of Faculty with date

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(UGC Autonomous)
Approved by AICTE | Affiliated to Osmania University | Estd.2003.
Department of Computer Science Engineering-

Name of the Subject: INTERNET OF THINGS

Assignment – 1 Date : 26/08/26

Answer all the Questions. **CSE-C** Max.Marks:**10**

Q.No.	Question	MARKS	CO	BTL
1.	What is IoT? Explain the Internet of Things today with major features.	**5 M**	**CO1**	**BTL2**
2.	Explain the concept of Time for convergence in IoT.	**5M**	**CO1**	**BTL1**

Bloom's Taxonomy Levels (BTL)		
BTL1 –Remember	BTL2 Understand	BTL3 –Apply
BTL4-Analyze	BTL5 –Evaluate	BTL6 –Create

NOTE:

1.Answer all Questions.

2.Answer to the assignment questions are to be written on A4 size papers only.

3.Each page of the assignment paper should contain full roll number of the student.

4.The hard copy of the assignment is to be submitted on or before 29/08/26.

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01.) What is IoT? Explain the Internet of Things today with major features.

Ans: → Primary Definition:

* A network of physical devices embedded with sensors, software, processors, and network connectivity.
* Collects, exchanges, and acts on data over the internet with minimal human intervention
* Enables physical objects to be monitored and controlled remotely.

Characteristics:

* Seamless physical-to-digital integration.
* Autonomous device-to-device communication.
* Data-driven automated decision-making.

→ Historical Evolution:

* 1982 (Carnegie Mellon): First connected soda machine; monitored inventory remotely.
* 1990 (John Romkey): Created the first internet-connected toaster.
* 1999 (Kevin Ashton): Coined the term "IOT".
* 2000 (LG): Introduced the first smart refrigerator.
* 2008 (Zurich): First international IOT conference held.
* 2017+ (Modern Era): Massive adoption across smart homes, industrial automation and AI integration.

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→ **IOT Today:**
Ubiquitous across smart homes, manufacturing (industry 4.0), healthcare, logistics, smart cities, and agriculture.

Key Growth Drivers:
* Low sensor and hardware costs.
* High-speed wireless networks (5G, WiFi 6, LPWAN).
* Cloud and edge computing capabilities.
* AI and Machine Learning integration for smart processing.

→ **IoT vs Traditional Internet:**

(i.) **Components:**
* Traditional = Humans + PC/servers.
* IoT = Humans + Machines + sensors + Actuators.

(ii.) **Interaction:**
* Traditional = Human-to-computer
* IoT = Machine-to-Machine (M2M).

(iii.) **Data Flow:**
* Traditional = User-initiated.
* IoT = continuous streaming and automated triggers.

IoT Value Chain:
Physical Event → Data Sensing → Communication → Processing → Action Execution.

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→ **Major Features of IoT:**

(i.) **Connectivity:**
Reliable communication via protocols like WiFi, bluetooth, 5G, zigbee, LoRaWAN.

(ii.) **Intelligence:**
Microcontrollers and algorithms process sensory input to trigger actions autonomously.

(iii.) **Heterogeneity:**
Connects hardware across different manufacturers, architectures and operating systems.

(iv.) **Dynamic Nature:**
Real-time adaptation to shifting environmental contexts and conditions

(v.) **Scalability:**
Handles rapid expansion in device numbers and data throughput.

(vi.) **Interoperability:**
Standardized protocols allow cross-platform device cooperation.

(vii.) **Data Analytics:**
Continuous aggregation and processing of real-time sensor streams.

(viii.) **Real-Time Operation:**
Executes tasks with ultra-low latency for time-critical workloads.

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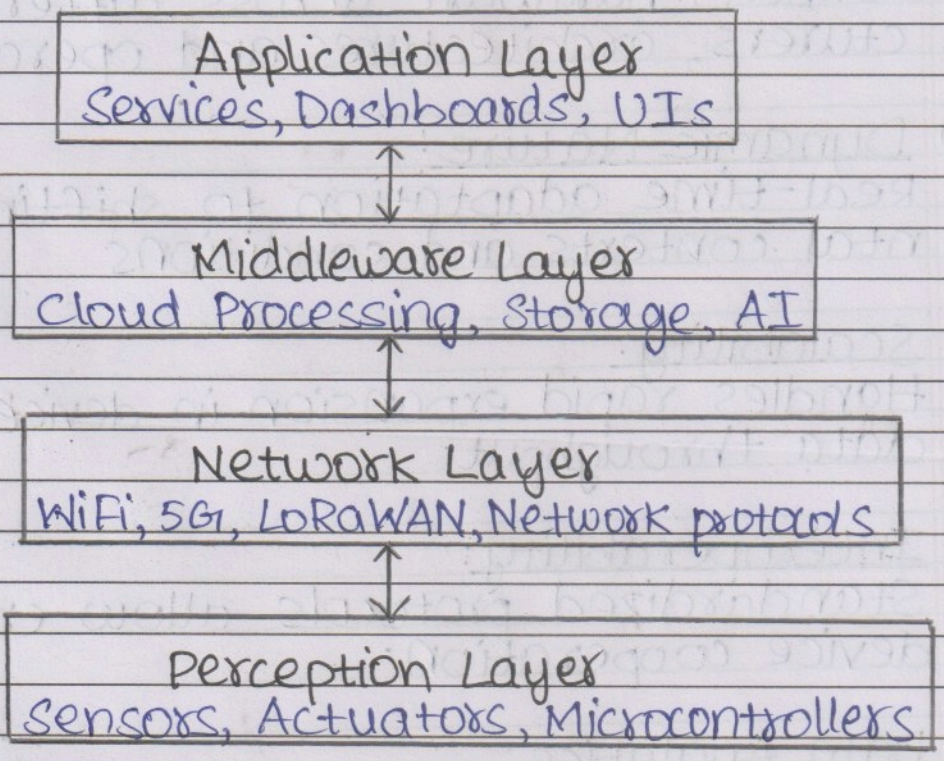
(ix.) **Security:**
Enforces encryption, authentication, and access controls for data safety.

(x.) **Automation:**
Executes repetitive control tasks with zero to minimal human intervention.

(xi.) **Context Awareness:**
Adapts behaviour using spatial, temporal, and, environmental context.



4-Layer IOT Architecture Stack

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Layers	Components
Perception	Sensors, Actuators, Embedded devices.
Network	WiFi, Cellular, Bluetooth, Protocols.
Middleware	Data Processing, Storage, Analytics.
Application	Dashboards, Smart services, UIs.

Benefits:

* Operational efficiency.
* Continuous monitoring.
* Predicted maintenance.
* Automation.

Challenges:

* Security risks.
* Privacy concerns.
* Lack of standards.
* Power constraints.

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02.) Explain the concept of Time for Convergence in IoT.

Ans: Time for Convergence in IOT is the duration required for interconnected sensors, networks, edge/cloud systems, and actuators to process and environmental event and reach a synchronized, stable state across the entire system.

It represents the end-to-end latency from initial event detection to final physical or analytical action.

→ IOT Convergence Stack:

LAYER ①: Physical Systems: Real-world environment, machinery, or infrastructure monitored.

LAYER ②: Sensing and Actuation: Sensors gather data; actuators execute actions.

LAYER ③: Embedded Computing: MCUs and SOCs (ESP32, STM32) running device firmware.

LAYER ④: Connectivity: Networks (WiFi, 5G, LoRaWAN) transmitting data payload.

LAYER ⑤: Edge & Cloud Computing: Local low-latency processing vs centralized analytics.

LAYER ⑥: Data Management & AI: Databases, stream analysis, and machine learning models.

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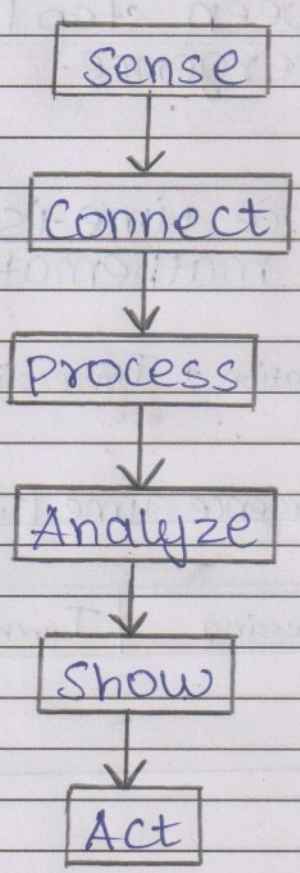
LAYER⑦: Applications & UI: Dashboards, monitoring portals, and user interfaces.

The Operational Process sequence:



The total time spent across all six phases constitutes the overall convergence time.

Illustrative Example:

In a smart agriculture system:

* Soil sensor detects low moisture (Sense).
* Data uploads over LoRaWAN (Connect).

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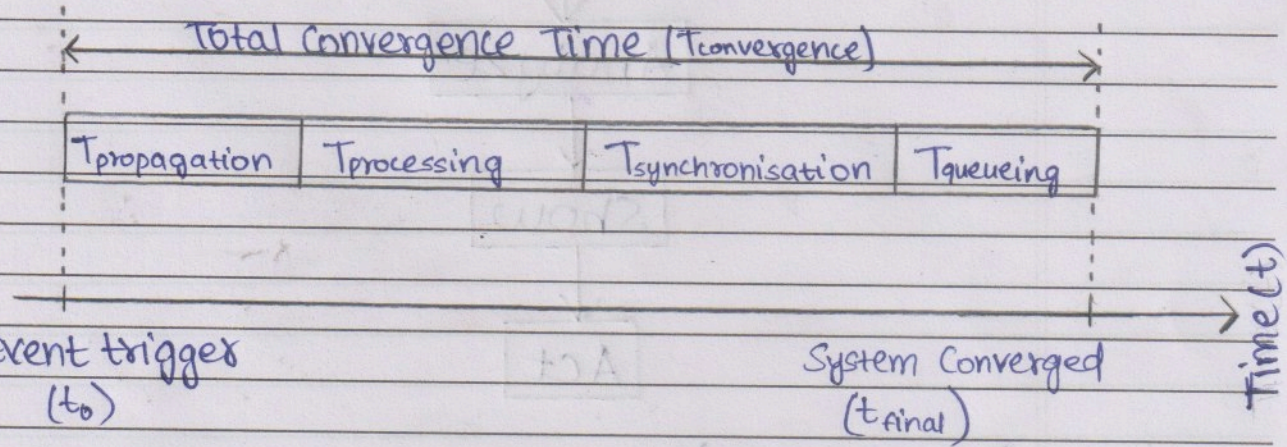
* Edge gateway processes data (Process).
* Analytics rule confirms drought threshold. (Analyze).
* Alert triggers on dashboard (Show).
* Water valve opens (Act).

The delay between step 1 and step 6 is the Time for Convergence.

Total convergence time is calculated using the following mathematical expression:

$$T_{convergence} = T_{propagation} + T_{processing} + T_{sync} + T_{queing}$$



Accumulative Temporal components composing Total IoT convergence Time

* $T_{propagation}$: Physical transmission delay across network links.
* $T_{processing}$: Time taken by CPUs to execute logic and algorithms.
* $T_{synchronisation}$: Latency needed for distributed state consensus across nodes.

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* Iqueueing: Wait time in memory buffers and message queues during congestion.

Example Calculation:

* Sensor to Gateway propagation: 50ms.
* Processing and cloud forwarding: 100ms.
* Cloud analytics execution: 150ms.
* Command propagation to thermostats: 200ms.
* State acknowledgement & sync.: 100ms.
* Total time for convergence: 600ms.

Critical Factors:

* Network topology.
* Node density/scale.
* Bandwidth constraints.
* Protocol overhead.
* Consensus algorithm ($O(n^2)$ and $O(n)$).

Optimisation strategies:

* Shift processing from cloud to edge to cut propagation delay.
* Use lightweight protocols (MQTT, CoAP over UDP).
* Implement hierarchical network partitioning to localize sync tasks.

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System Design Tradeoffs:

Rapid convergence requires higher network bandwidth and continuous CPU active states, which increases energy consumption and hardware costs.
System architects must balance speeds against power and resources.

Application Domain	Target Convergence Time
Emergency Alert Systems	<100ms.
Industrial Control Loops	< 1 second.
Health Monitoring	< 5 seconds.
Smart Home Automation	< 10 seconds.
Smart City Traffic Routing	< 30 seconds.
Environmental Monitoring	Minutes to Hours.