Reg. No: 23BCT0133

G/E/TZ

Final Assessment Test – April 2026

VIT
Vellore Institute of Technology

Course: BCSE313L - Fundamentals of Fog and Edge Computing
Class NBR(s): 2522/2527
Time: Three Hours

Slot: F2+TF2
Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Explore technologies behind the communication and management of fogs and edge resources.
CO2	Learn the techniques for storage and computation in fogs, edges, 5G and clouds
CO3	Implement Internet of Everything (IoE) applications through fog computing architecture and use optimization techniques for the same.
CO4	Analyze the performance and issues of the applications developed using fog and edge architecture.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

1. An oil and gas company deploys thousands of IoT sensors along its pipelines to continuously monitor parameters such as pressure, temperature, leakage detection, and environmental conditions. These sensors generate large volumes of real-time data every minute. If all the generated data is transmitted directly to a centralized cloud server for storage and analysis, the system may experience high network bandwidth usage, increased latency, and delayed response to critical events such as leaks or pressure fluctuations. — CO1 BL3

   a) Explain the limitations of processing and storing all pipeline sensor data directly in the cloud computing environment. [3]

   b) Analyze how Fog Computing can improve the efficiency of the system by performing local data filtering, processing, and temporary storage near the data source. [4]

   c) Describe how the fog layer and cloud layer can work together to ensure real-time monitoring and long-term data analysis in this pipeline monitoring system. [3]

2. A smart city deploys thousands of IoT devices generating real-time data for traffic, energy, and safety services. To reduce latency, fog nodes process data locally and send selected data to the cloud. This large-scale setup raises challenges in cost, device diversity, security, and efficient resource management across the system. — CO1 BL2

   Assess the opportunities and challenges of implementing large-scale fog computing in a smart city, and explain their impact on IoT application performance, scalability, and reliability.

3. A smart healthcare system uses wearable IoT devices to monitor patient data, which is transmitted to servers for analysis and emergency response. It involves sensing, transmission, processing, storage, and alerts. Designers use a Petri Net model to analyze data flow, system states, and interactions during normal and emergency conditions. CO4

Explain how Petri Nets can be used to model the data flow and system behavior of the healthcare IoT monitoring system. Describe how places, transitions, and tokens can represent different stages of data collection, transmission, processing, and alert generation in the system.

4. A research lab develops a Cloud–Fog–Things (C2F2T) architecture to support IoT applications like energy consumption in Cloud–IoT environments, energy management in Fog–IoT integration, remote health monitoring systems, smart living spaces with cloud access and real-time airplane monitoring systems. They use modeling techniques to evaluate performance metrics such as energy use, latency, reliability, and resource utilization. CO4

Analyse and Identify the appropriate

i. Modeling techniques [2]
ii. Performance metrics, and [4]
iii. Key objectives or findings for each of the applications within the C2F2T architecture. [4]

5. A telecom company serves enterprises with varying needs: high security for finance, low latency for healthcare, and high bandwidth for streaming. Instead of separate networks, it uses Software-Defined Networking (SDN) and Network Function Virtualization (NFV) to create multiple virtual networks and deploy services like firewalls, routers, and load balancers efficiently. CO2

Draw and explain the architecture how SDN and NFV technologies support the implementation of network slicing and enable efficient resource management for different enterprise services within the same physical network infrastructure.

6. A government transportation authority deploys an IoV-based traffic monitoring system that collects sensitive data such as vehicle location, driver identity, and traffic conditions. Since the system handles critical and sensitive information, strong multi-layer security mechanisms are required to protect data from cyber threats such as unauthorized access, spoofing, and data manipulation. Based on the above scenario, CO2

i. Explain the Seven-layer security model architecture for the Internet of Vehicles (IoV). [4]
ii. Describe how security mechanisms at each layer help protect vehicular communication and ensure data integrity, authentication, and privacy. [6]

7.a) A smart factory uses IoT sensors and machines to monitor operations, sending data to fog nodes for real-time analysis. Limited fog resources cause energy, delay, and efficiency issues. To improve performance, management adopts multi-objective optimization to optimize task scheduling and resource allocation across IoT, fog, and cloud systems. CO3

i. Explain how multi-objective optimization in fog computing minimizes latency, reduces energy use and improves resource utilization. [6]

ii. How balancing these factors enhances efficiency and reliability in smart manufacturing systems. [4]

OR

7.b) A smart agriculture system uses IoT sensors to collect field data and send it to fog nodes for initial processing before cloud analysis. Limited fog resources can cause delays and overload when many sensors transmit data simultaneously, making efficient task allocation essential for improving performance and resource utilization. Formulate this scenario as an optimization problem. CO3

i. Define the objective function to minimize processing latency, considering constraints like fog node computation, memory, and bandwidth. [5]

ii. Explain how optimal task allocation from IoT devices to fog nodes can be achieved. [5]

8.a) *A smart retail store uses IoT devices to monitor inventory, customer behavior, and security. Relying only on cloud computing can cause delays,* high bandwidth usage, and dependency on internet connectivity. To address this, the store adopts fog and edge computing, enabling local processing for faster decisions, reduced data transfer, and improved reliability, while sending only summarized data to the cloud. CO

i. Which types of middleware can enhance the functionality of the smart retail system using fog and edge computing? [3]

ii. Explain how middleware helps in integrating IoT devices, managing communication, processing data at the edge and fog layers, and coordinating with cloud services. [7]

OR

8.b) A smart warehouse uses IoT devices like RFID readers, Automated Guided Vehicles (AGVs), and sensors to manage inventory and operations. Sending all raw data to the cloud can cause delays, high bandwidth usage, and reliance on connectivity. Processing data at nearby fog servers enables faster decisions, reduces network load, and ensures continuous, efficient warehouse operations. CC

i. Discuss the various middleware design challenges in a fog-enabled smart warehouse system. [4]

ii. Draw and explain the suitable middleware architecture which integrating heterogeneous IoT devices, ensuring real-time processing, managing communication, supporting scalability, optimizing resource allocation, and maintaining security across IoT, fog, and cloud layers. [6]

9. A city authority deploys a smart parking system that uses sensors and cameras to monitor parking space availability across multiple parking lots. The collected data is processed by fog nodes to predict parking demand and guide drivers to available spaces. The system designers plan to use FogTorch to evaluate different application deployment configurations across fog and cloud resources. CO

i. Explain how FogTorch can be used to perform predictive analysis and deployment planning for the smart parking system. [5]

ii. Discuss how FogTorch helps evaluate factors such as latency, resource availability, and application placement in fog computing environments. [5]

10. A hospital implements an IoT-based patient monitoring system that uses wearable sensors, smart beds, and fog computing nodes to enable real-time data analysis and clinical alerts. The system continuously collects and processes sensitive patient health data and transmits summarized information to the cloud for storage and advanced analytics. CO4

i. Examine how data is managed and processed across different layers (device, fog, and cloud). [2]

ii. Analyze the legal challenges, including data privacy, regulatory compliance, patient consent, data ownership, retention policies, and jurisdiction. [3]

iii. Evaluate the role of testing and validation in ensuring compliance, security, and system reliability. [3]

iv. Analyze how legal and testing considerations impact the deployment, operation, and management of fog-enabled healthcare monitoring systems. [2]

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