F/E/TZ

Reg. No: 23BCT0044

VIT
Vellore Institute of Technology

Final Assessment Test – April 2026

Course: BCSE313L - Fundamentals of Fog and Edge Computing

Class NBR(s): 2519/2577

Slot: F1+TF1

Time: Three Hours

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. A smart home system uses multiple IoT devices such as smart cameras, motion sensors, smart thermostats, and voice assistants to monitor home security and manage energy consumption in real time. Initially, all data from these devices is sent directly to a centralized cloud platform for processing and decision-making. However, the system starts to experience high latency, network congestion, and slow responses. To address these issues, the system developers decide to implement an Edge Computing Platform, where data is processed locally using edge devices or home gateways before sending necessary information to the cloud.
Describe the potential challenges of deploying edge computing in this environment along with a possible solution. Justify on how implementing an edge computing platform can reduce latency and improve the efficiency of the smart home system. CO1 BL2

2. A hospital deploys a wearable real-time healthcare monitoring system to continuously track patients' vital signs such as heart rate, blood pressure, body temperature, and oxygen levels. Patients wear smart medical sensors (Things layer) that collect health data in real time. The data is first processed by nearby fog nodes located in hospital gateways or local healthcare servers to quickly detect abnormal conditions such as irregular heartbeats. The processed data is then sent to the cloud layer for long-term storage, advanced analytics, and medical decision support. During continuous monitoring, the system experiences issues such as high battery usage in wearable devices, delays in sending alerts to doctors, heavy workload on fog nodes, operational costs of maintaining the system, and the need to protect sensitive patient data. Evaluate the role of five metrics in providing effective real-time healthcare services for wearable real-time healthcare monitoring system. CO4 BL4

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3.	A smart city has implemented an Internet of Vehicles (IoV) system to improve road safety and traffic efficiency. However, the system faces several challenges such as network congestion, high mobility of vehicles, data security risks, and maintaining reliable communication in dense urban environments.	CO2	BL4
	a) Explain two IoV network models that enable communication between vehicles and infrastructure in the smart city system. [4]		
	b) Discuss two major challenges faced in implementing IoV networks in highly dynamic traffic environments. [3]		
	c) Suggest one future technology or approach that can improve IoV performance and explain how it addresses current limitations. [3]		
4.	A smart factory deploys an automated robot collaboration system where multiple mobile robots perform tasks such as material handling, assembly, and inspection. Explain how optimization opportunities arise at different stages of the service life cycle in the robot collaboration system and discuss the benefits of applying optimization at each stage.	CO3	BL3
5.	A drone-based environmental monitoring system is used to capture aerial images and videos for applications such as disaster management and forest monitoring. Instead of sending all data to a distant cloud server, the system offloads image processing tasks to a nearby fog node or edge server to achieve faster analysis and reduce network delays using middleware technologies. Based on the above scenario, draw the architecture and explain the five design goals of Fog and Edge Computing Middleware to improve the performance of the drone monitoring system.	CO1	BL2
6.	Explain how machine learning can be integrated with fog computing to support real-time decision-making in an autonomous car system. Implement a Convolutional Neural Network (CNN) model to classify objects detected by the vehicle's cameras.	CO4	BL2
7.	Discuss the five components of real-time human object tracking in the smart surveillance system which is deployed in a crowded public area such as an airport or railway station to monitor human activities in real time.	CO4	BL3
8.	A smart agriculture system uses drones to capture crop images and detect diseases in real time. Each drone collects 300 MB of image data from the field. The data can be processed either on the drone (end device), a farm fog node (edge server), or the cloud.	CO3	BL4

The system characteristics are given below:

Parameter	End Device (Drone)	Fog Node (Farm Server)	Cloud
Execution Time	15 s	6 s	4 s
Latency	1 s	3 s	9 s
Throughput	20 MB/s	60 MB/s	80 MB/s
CPU Available	1 GHz	3 GHz	5 GHz
Memory	2 GB	8 GB	16 GB
Bandwidth	10 Mbps	40 Mbps	100 Mbps
Energy Consumption	10 units	5 units	3 units
Infrastructure Cost	$0	$2	$4
Data Transmission Cost	$0	$1	$3

The drone battery allows maximum energy usage of 8 units, and the system requires total response time to be below 12 seconds.

a) Calculate the total response time for the end device, fog node, and cloud.
b) Determine the throughput time required to transfer 300 MB of data to the fog node and cloud.
c) Considering energy consumption, response time, and financial cost, determine the optimal processing location.

9.a) Explain the proposed Edge Computing Middleware architecture for the smart factory system. Describe the roles of IoT devices, edge nodes, middleware services, and cloud platforms, and discuss how this architecture improves real-time processing, resource management, and system scalability. CO1 BL3

OR

9.b) Explain the proposed Edge Computing Middleware architecture for the smart waste collection system. Describe the roles of smart bins (IoT devices), edge nodes, middleware services, and cloud platforms, and discuss how this architecture improves real-time monitoring, efficient waste collection, and system scalability. CO1 BL3

10.a) A healthcare system deploys wearable sensors and ECG devices to continuously monitor patients' vital signs such as heart rate, blood pressure, and oxygen levels for real-time heart disease prediction. The collected data is first processed at nearby edge or fog nodes to perform preprocessing and machine learning–based analysis for detecting abnormal heart conditions, while the cloud stores historical data and performs advanced analytics. This architecture helps reduce latency and enables faster medical alerts for emergency situations. CO4 BL3

Based on the above case study, explain how Fog and Edge Computing architecture supports real-time heart disease prediction and discuss the roles of end devices, fog/edge nodes, and cloud computing in improving healthcare monitoring and response time.

OR

10.b) An LPG distribution company deploys IoT sensors and smart meters on LPG cylinders and delivery vehicles to monitor gas levels, leakage detection, and delivery status in real time. The sensor data is first processed at nearby edge or fog nodes installed in distribution centers to quickly detect gas leaks, monitor cylinder usage, and optimize delivery routes. The cloud platform stores historical data and performs large-scale analytics for demand prediction, inventory management, and safety monitoring. CO4 BL3

Based on the above case study, explain how Fog and Edge Computing architecture can improve the efficiency and safety of the LPG distribution system, and discuss the roles of IoT devices, fog/edge nodes, and cloud computing in enabling real-time monitoring and decision-making.

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