VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SLOT: F2

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
CONTINUOUS ASSESSMENT TEST -2
WINTER SEMESTER 2024-2025

Programme Name & Branch : B.Tech CSE
Course Code & Course Name : BCSE313L Fundamentals of Fog and Edge Computing
Faculty Name(s) : Dr. Naveenkumar J, Dr. Mehfooza, Dr. Padma Priya R, Dr.Baiju B V, Dr. Badrinath N
Class Number(s) : VL2024250501575, 1595, 1601, 1603, 1581
Date of Examination : 21 - Mar – 2025 (Friday) (09.30 AM to 11.00 AM)
Exam Duration : 90 minutes Maximum Marks: 50

M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Course Outcome:

1. Explore technologies behind the communication and management of fogs and edge resources.
2. Learn the techniques for storage and computation in fogs, edges, 5G and clouds.
3. Implement Internet of Everything (IoE) applications through fog computing architecture and use optimization techniques for the same.

General instruction(s):

No	Question	M	CO	BL
1.	You are designing an Internet of Vehicles (IoV) system for a smart transportation network in a large metropolitan city. The IoV system aims to enhance traffic management, reduce congestion, and improve road safety by enabling real-time communication between vehicles (V2V), vehicles and infrastructure (V2I), and vehicles and the cloud (V2C). The system will utilize fog computing to process data locally at the edge while leveraging the cloud for long-term analytics and decision-making. A) **Describe how data would flow through the IoV system, including the types of data generated (e.g., vehicle speed, location, sensor data) and how it would be processed and communicated across the layers. (5M)** B) **What protocols or technologies would you recommend for ensuring low-latency and reliable communication? (5M)**	10	2	4
2.	You are managing a fog computing infrastructure deployed to support a large-scale real-time application, such as industrial IoT monitoring. The system consists of edge devices (IoT sensors), fog nodes (local processing units), and cloud servers for long-term analytics. Recently, the system has experienced unexpectedly high energy consumption, leading to increased operational costs and potential performance degradation. You need to analyse the causes of excessive energy usage and propose strategies to optimize power consumption without compromising the system's performance and reliability. **Justify your reasoning by considering factors such as resource allocation, task distribution, and network bandwidth usage.** A) **Which layer(s) of the fog computing architecture are most likely responsible for the increased energy consumption? Justify your response by considering the roles of each layer in processing and communication. (4M)** B) **What specific factors could contribute to the excessive energy usage? (3M)** C) **How can the system be redesigned to minimize energy consumption while maintaining optimal performance and reliability? Discuss potential solutions. (3M)**	10	3	4
3.	You are tasked with designing a fog computing system for a large-scale agricultural monitoring application on a remote island. The system involves hundreds of IoT sensors deployed across the farmland to monitor soil moisture, temperature, and crop health in real-time. Due to the island's limited connectivity to mainland cloud infrastructure and unreliable power sources, most data processing must be handled locally through fog nodes	10	3	3

	before selectively transmitting insights to the cloud. Farmers rely on this system for real-time irrigation schedules, pest control alerts, and long-term crop health analytics to ensure optimal yields despite unpredictable weather conditions and limited access to external resources. A) **Identify at least three optimization objectives for this system. Explain why these objectives are critical for the success of the agricultural monitoring application. (5M)** B) **Considering the trade-offs between real-time data processing and long-term analytics in a resource-constrained environment, which optimization algorithm(s) would you choose? Justify your selection based on the challenges specific to this remote island scenario. (5M)**			
4.	In a large-scale mining operation involving coal and diamond extraction, workers operate in harsh and hazardous environments where safety, equipment efficiency, and real-time decision-making are critical. A fog and edge computing system is deployed to monitor environmental conditions, worker health, and machine performance. The system uses context-aware middleware to process data locally, reducing latency and improving response times to potential threats such as gas leaks, equipment failures, and worker fatigue. A) **Why is context-awareness essential for the efficient operation of fog and edge computing in a hazardous mining environment? Identify how context-aware mechanisms enhance performance, reliability, and worker safety in coal and diamond mining operations. (4M)** B) **Discuss how real-time data processing and intelligent decision-making optimize resource utilization and emergency response. (3M)** C) **Provide examples of context-aware optimizations that improve worker well-being, equipment efficiency, and disaster prevention. (3M)**	10	1	2
5.	A typical weekday morning, marked by the usual school rush, is suddenly thrown into chaos by a widespread power outage. Traffic signals across a significant portion of the city go dark, plunging intersections into disarray and creating a dangerous environment for both drivers and pedestrians. With traffic signals failing, pedestrians flood the streets, attempting to cross amidst the confusion. School buses, carrying children, struggle to navigate the now-congested roads, while parents scramble to pick up or drop off their children. Public transport systems, including buses and trams, face severe disruptions. Adding to the crisis, a multi-vehicle collision occurs at a major, now-unregulated intersection, resulting in multiple injuries and requiring immediate emergency response. A supply truck carrying critical medical supplies and a delivery vehicle carrying perishable goods are also stuck in the resulting gridlock. Traffic police officers are dispatched to manually direct traffic, but they need real-time information and coordinated support to manage the escalating situation. The power outage also affects some edge nodes, hindering their ability to process traffic data. A) **Under these challenging circumstances, how would a Smart City Traffic Management System, designed with fog and edge computing principles, detect, respond to, and mitigate these simultaneous disruptions, prioritizing emergency services, pedestrian safety, and the restoration of traffic flow? How would the system maintain basic functionality during a partial power outage, and how would it prioritize which edge nodes to keep online with backup power? (5M)** B) **Identify and list all the middleware modules that will be crucial in the above scenario. Elaborate their role. (5M)**	10	1	2