

Birla Institute of Technology & Science, Pilani
Work Integrated Learning Programmes Division
Second Semester 2024-2025
Mid-Semester Test
(EC-2 Regular)

Course No. : SE ZG583
Course Title : Scalable Services
Nature of Exam : Open Book
Weightage : 30%
Duration : 2 Hours
Date of Exam :

No. of Pages = 2

Note to Students:

1. Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
2. All parts of a question should be answered consecutively. Each answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

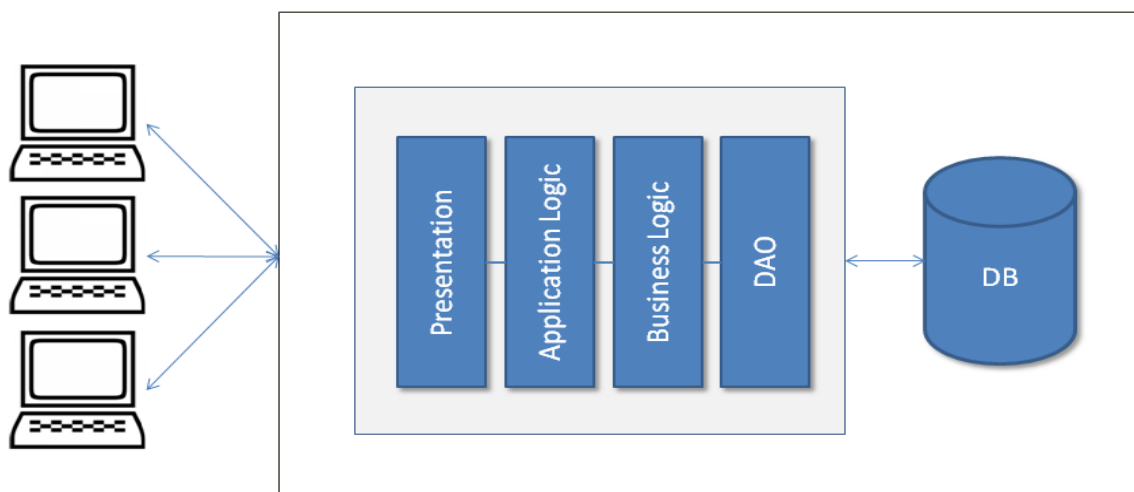
Ques1. In the context of microservices, how does the **CAP theorem** influence the design of distributed systems, and why is it important to understand trade-offs between **Consistency, Availability, and Partition Tolerance**? [2Marks]

Ques2. StreamSphere is an emerging video streaming platform that allows users to:

- Upload videos for **public or private viewing**.
- Watch publicly available videos from other users.
- **Download videos** within the app for offline viewing.
- Receive **personalized recommendations** based on viewing history and preferences.
- Maintain a **watch history** and resume videos from where they left off.

StreamSphere implements **user authentication** via a **username and password-based login system**. Currently, the application runs on a **private data center infrastructure**, but with its growing popularity, the platform is facing **performance and scalability challenges** due to the increasing number of users and uploaded content. Explain briefly at least **three** issues in the below architecture and how can we solve each of these problems in order to cater to the increasing demand.

[3Marks]



Ques3. What scalability approach should we use to solve the problems given in the below-mentioned scenarios? Justify your answer. [10Marks]

- a) Smart home system collects real-time sensor data from multiple IoT devices, but sending all data to a central cloud for processing increases latency. Which scaling approach can reduce latency and process data closer to the user's location?
- b) A ride-sharing app needs to process real-time events such as ride requests, driver availability, and trip status updates. The current architecture struggles with handling **high volumes of concurrent events**. Which scaling approach can efficiently handle **real-time event streaming** at scale?
- c) An online stock trading platform needs to provide live price updates and trend analysis for thousands of stocks in real-time. Which scaling approach can help analyze and process stock price changes instantly?
- d) A news website receives millions of visitors daily. Frequently accessed articles take too long to load, affecting the user experience. Which scaling approach can improve response time and reduce database load?
- e) A weather forecasting app needs to process **weather data periodically** but does not require continuous server usage, making it inefficient to keep servers running all the time. Which scaling approach can help execute code **only when needed** without maintaining dedicated servers?

Ques4. Microservices are not a one-size-fits-all solution. Provide a real-world example to illustrate this. [3Marks]

Ques5. BookHaat is an online bookstore that allows users to:

- Browse and purchase physical and digital books.
- Add books to a wishlist or shopping cart.
- Download e-books for offline reading.
- Receive personalized book recommendations.
- Track order history and manage deliveries.

Initially, BookHaat was developed as a monolithic application hosted on a private data center. As the platform gained popularity, it began experiencing scalability, performance, and reliability issues due to:

- Increased traffic leading to slow response times.
- Frequent downtime during high sales events.
- Difficulty in adding new features without disrupting existing services.

To improve its performance, BookHaat transitioned to a Service-Oriented Architecture (SOA). However, SOA introduced new challenges such as inter-service dependencies, bottlenecks from a centralized service bus, and complex deployments.

Now, BookHaat wants to redesign its architecture to handle growing demand efficiently.

- a) If you were asked to redesign BookHaat's architecture, what approach would you follow and why? Justify your answer with an appropriate architecture diagram. [3Marks]
- b) How would you transition BookHaat's architecture smoothly? [3Marks]
- c) How will different components of your system communicate with each other and with users? Justify your answer. [3Marks]
- d) How will you ensure reliability and handle failures in BookHaat's new architecture? [3Marks]