

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

REG.NO.:

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

SLOT: G2 + TG2

Programme Name & Branch : B.TECH. CSE
Course Code and Course Name : BCSE301L and Software Engineering
Faculty Name(s) : Sivaprakash S, Anand Bihari, Poornima N, Adrija Bhattacharya, Prabin S M, Jafar Ali Ibrahim S, Deepa.K, Samriddhi Sarkar, Mehfooza, Krishnaraj N, Saurabh Agrawal, Deepika J, Ramesh Babu K, Ushus Elizebeth Zachariah, Baskaran P, Parthiban K, Priya Ponnuswamy P, Shashank Mouli Satapathy, Bhawana Tyagi, Anto S, Yoganand S, Naveenkumar J, Baiju B V
Class Number(s) : VL2024250504791, 2237, 5798, 2290, 4790, 2264, 2235, 2287, 2230, 2260, 2282, 2280, 2306, 2232, 4806, 2240, 2277, 2297, 4789, 2302, 2275, 2304, 2251
Date of Examination : 22-March-2025
Exam Duration : 90 minutes **Maximum Marks: 50**

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes
- **CO2:** Demonstrate various software project management activities that include planning Estimations, Risk assessment and Configuration Management
- **CO3:** Perform Requirements modelling and apply appropriate design and testing heuristics to produce quality software systems.

Q. No	Question	M	CO	BL																		
1.	You are leading a team developing an e-learning platform that offers interactive courses, live virtual classes, automated tests, and progress tracking. The platform must support up to 10,000 users at the same time and connect with third-party tools like payment systems, video conferencing, and learning management systems (LMS). The project has a tight deadline, and the client wants high performance, scalability, and security. During planning, your team identified some risks that could affect the project. i. Identify and list five potential risks, their type and likelihood that could arise during the development of the e-learning platform. (5 Marks) ii. Create a detailed Risk Information Sheet (RIS) for any one of the identified risks. (5 Marks)	10	2	4																		
Sol	i) Each Identified risk carries is 1 mark <table><tr><th>Risk</th><th>Type</th><th>Likelihood</th></tr><tr><td>1.Performance bottlenecks due to high concurrency</td><td>Technical Risk</td><td>High</td></tr><tr><td>2.Security vulnerabilities (data breaches, unauthorized access)</td><td>Technical Risk</td><td>High</td></tr><tr><td>3.Underestimating development time for third-party API integrations</td><td>Estimation Risk</td><td>Medium</td></tr><tr><td>4.Changing client requirements after development has started</td><td>Requirement Risk</td><td>High</td></tr><tr><td>5.Project timeline delays due to unforeseen development complexities</td><td>Project Risk</td><td>High</td></tr></table>				Risk	Type	Likelihood	1.Performance bottlenecks due to high concurrency	Technical Risk	High	2.Security vulnerabilities (data breaches, unauthorized access)	Technical Risk	High	3.Underestimating development time for third-party API integrations	Estimation Risk	Medium	4.Changing client requirements after development has started	Requirement Risk	High	5.Project timeline delays due to unforeseen development complexities	Project Risk	High
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ii) Any one risk's information sheet carries 5 Marks

Risk_ID	R-0001
Risk Name	Performance Bottlenecks Due to High Concurrency
Category/Type	Technical
Description	The e-learning platform is expected to support up to 10,000 concurrent users. If the system architecture is not optimized for scalability, it could lead to slow response times, server crashes, or degraded user experience. This can impact live virtual classrooms, assessments, and real-time interactions.
Likelihood	High
Impact	High
Risk Triggers	- Sudden spikes in concurrent users, especially during peak hours. - Inefficient database queries leading to high response times. - Poorly optimized backend logic, causing increased CPU/memory usage. - Network congestion or bandwidth limitations affecting data transfer speed.
Risk Mitigation Strategies	- Implement load balancing to distribute traffic efficiently across multiple servers. - Use horizontal scaling with cloud-based auto-scaling mechanisms. - Optimize database queries and implement caching mechanisms for frequently accessed data. - Conduct stress testing and performance benchmarking during development to identify potential bottlenecks. - Implement CDN (Content Delivery Network) to reduce latency for global users.
Contingency Plan	- Deploy failover servers to take over in case of performance degradation. - Enable real-time monitoring with alerting mechanisms to detect and address slowdowns proactively. - Have a dedicated technical support team available during peak usage hours to handle performance issues.

2.

You are part of a software development team tasked with designing an air traffic control (ATC) system, a hard real-time system where delays or failures could lead to catastrophic consequences. The system is responsible for monitoring and managing aircraft movements within a designated airspace, ensuring safe distances between planes, guiding them during take-off and landing, and providing real-time alerts to air traffic controllers. Radar systems continuously track the position, altitude, speed, and heading of all aircraft in the airspace and feed this data into the ATC system.. The system processes the radar data and displays it on a graphical interface for air traffic controllers, enabling them to make informed decisions. It also calculates potential collision risks based on predefined safety thresholds, such as minimum separation distances. If a potential collision is detected, the system immediately generates an alert and recommends corrective actions, such as adjusting altitude or heading.. Instructions are then communicated to pilots via radio or automated messaging systems. To ensure

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3

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	uninterrupted operation, the system must seamlessly switch to a backup server within milliseconds in the event of hardware or network failure, maintaining the integrity and reliability of the entire operation. i. For this scenario, model the structural blueprint of the system, outlining its key entities and their interconnections using UML approach. (5 Marks) ii. Depict the temporal ordering of method calls/messages and object interactions within the system using UML approach. (5 Marks)			
Sol.	i) Class Diagram or Component Diagram. Check for the correct components, semantics and relationships. ii) Sequence Diagram or Collaboration (Communication) or State chart diagram. Check for the correct components, semantics and relationships.			
3.	Below are six modules interaction given for a Library Management system. Identify the type of coupling in the interaction and types of cohesion that the modules exhibit wherever applicable. Justify the answer. i. When a user logs in, the User Management Module verifies the credentials and checks for any pending fines. It then sends the user's status (active/inactive) and fine details to the Borrowing Module, which decides whether the user can borrow a book. (2 Marks) ii. When a user borrows a book, the Borrowing Module directly accesses and updates the book's availability status in the Book Management Module's database tables. (2 Marks) iii. When a book is borrowed, the Borrowing Module calls the Notification Module and passes the user's contact details, book title, and return due date as function arguments. The Notification Module then sends an email or SMS. (2 Marks) iv. The Report Generation Module retrieves structured data (e.g., JSON responses) from the Borrowing Module, Book Management Module, and User Management Module to generate a report on overdue books and most borrowed books. It does not modify any data, only reads it. (2 Marks) v. Inside the Borrowing Module, the following steps occur sequentially when a user borrows a book: (1 Mark) a. Validate user eligibility b. Check book availability c. Update borrowing records d. Adjust book availability e. Notify the user vi. The Notification Module checks a user's preferred mode of communication (email/SMS/push notifications). It then selects a function based on this preference using multiple if-else conditions. (1 Mark)	10	3	2
Sol	i) Data Coupling - The User Management Module passes only required data (user status and fine details) to the Borrowing Module, without exposing its internal workings. User Management Module: Functional Cohesion OR Borrowing Module: Communicational Cohesion - This module has a well-defined responsibility: verifying credentials and checking pending fines. Since it focuses solely on user-related operations, it aligns with Functional Cohesion. The Borrowing Module processes the same data (user status and fine details) to decide borrowing eligibility, meaning all functions within this module operate on the same dataset.			



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	ii) Content Coupling - The Borrowing Module directly accesses and updates database tables of the Book Management Module, violating encapsulation. Book Management Module: Functional Cohesion OR Borrowing Module: Sequential Cohesion The module has a clear single responsibility managing book-related data (e.g., availability status). This follows Functional Cohesion principles. The Borrowing Module performs a series of dependent steps (checking book availability, updating records, etc.), and these steps must be executed in a specific order. iii) Stamp Coupling - The Borrowing Module passes structured data (user's contact details, book title, return due date) to the Notification Module. Notification Module: Functional Cohesion OR Borrowing Module: Sequential Cohesion The module has a single responsibility: sending notifications. Since it does only one well-defined task, it follows Functional Cohesion. The borrowing process involves multiple dependent steps, including notifying the user at the end of the transaction. Since the notification task follows borrowing in a defined sequence, it aligns with Sequential Cohesion. iv) Data Coupling - The Report Generation Module retrieves structured data (e.g., JSON responses) from other modules without modifying their internal logic. Report Generation Module: Functional Cohesion OR Other Modules (Borrowing, Book Management, User Management): Functional Cohesion The module has a well-defined task: generating reports based on structured data, making it Functionally Cohesive. Each module performs a specific role, ensuring their operations remain functionally cohesive. v) Sequential Cohesion - The Borrowing Module follows a strict sequence of steps when processing a book borrowing request. vi) Logical Cohesion - The Notification Module checks the user's preferred communication mode (email/SMS/push notification) and selects a function based on multiple if-else conditions.			
4.	a) A Food Delivery System follows the workflow given below: - A customer places an order by selecting items from a menu. - The system verifies the payment and generates an order confirmation. - The order is sent to the restaurant for preparation. - Once prepared, a delivery agent is assigned. - The delivery agent picks up the order and delivers it to the customer. Does this system exhibit transaction flow or transform flow? Justify your answer by explaining how the control of execution flows through the different processes.	5		
	b) A payment system is being designed for an e-commerce website. There are two different ways to structure the system - The first method creates a general Payment class, with specific types like Credit_Card, PayPal, and UPI as subclasses. The second method starts with a single Payment_Processor module, which is later divided into separate handlers for each payment method. Which method uses abstraction, and which one uses refinement? Which approach is better for adding new payment methods in the future? Justify your answer.	5	3	3
Sol	a) DFD Expected based on the workflow – 3 Marks The Food Delivery System exhibits transaction flow because: (2 Marks) It processes discrete, independent transactions (orders).			



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	- Each transaction follows a specific sequence of steps, but the system can handle multiple transactions concurrently. - The control flow branches based on the details of each transaction (e.g., payment verification, item preparation, delivery assignment).			
Sol	b) First Method – Abstraction - The Payment class represents a generalized concept of a payment method, abstracting the common behavior (e.g., processing payments, validating transactions). It hides the implementation details of each payment method and provides a high-level interface (Payment). (1 Mark) Second Method – Refinement - The system starts as a single module (Payment_Processor) and is later divided into specialized handlers for each payment type. A general structure is incrementally improved and broken into smaller, more detailed components. (1 Mark) Abstraction is better than Refinement (1 Mark) Justification (2 Mark) - It adheres to the Open/Closed Principle of software design: the system is open for extension (adding new payment methods) but closed for modification (existing code does not need to change). It leverages polymorphism: the Payment class provides a unified interface, and each subclass implements its specific behavior. It minimizes the risk of introducing bugs into the existing codebase when adding new payment methods.			
5.	For the code snippet provided below: - Calculate the cyclomatic complexity (4 Marks) - Identify all independent paths (2 Marks) - Write test cases to cover all independent paths (4 Marks) <pre>#include <stdio.h> #include <string.h> float calculate_discount(float total_amount, int is_member, char coupon_code[]) { if (total_amount <= 0) { return 0; } float discount = 0; if (is_member) { discount += total_amount * 0.1; } if (strcmp(coupon_code, "SAVE20") == 0) { discount += total_amount * 0.2; } else if (strcmp(coupon_code, "SAVE10") == 0) { discount += total_amount * 0.1; } float max_discount = total_amount * 0.3; if (discount > max_discount) { discount = max_discount; } }</pre>	10	3	2



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	<pre>} float final_amount = total_amount - discount; return final_amount; }</pre>																																						
i) Any Method can be utilized for cyclomatic complexity (Region or E – N + 2P or No. of Decision points + 1. (1Mark for approach) Control Flow graph – 2 Marks Examining the code: - if (total_amount <= 0) → 1 decision - if (is_member) → 1 decision - if (strcmp(coupon_code, "SAVE20") == 0) → 1 decision - else if (strcmp(coupon_code, "SAVE10") == 0) → 1 decision - if (discount > max_discount) → 1 decision - Total decisions = 5 Cyclomatic Complexity – 6 (1 Mark) ii) Independent Paths (2 Marks) - Path 1: total_amount <= 0 → Return 0 - Path 2: total_amount > 0, is_member = 0, coupon_code ≠ "SAVE20", coupon_code ≠ "SAVE10" → No discount applied - Path 3: total_amount > 0, is_member = 1, coupon_code ≠ "SAVE20", coupon_code ≠ "SAVE10" → Member discount applied - Path 4: total_amount > 0, is_member = 1, coupon_code = "SAVE20" → Member discount + 20% discount applied - Path 5: total_amount > 0, is_member = 1, coupon_code = "SAVE10" → Member discount + 10% discount applied - Path 6: total_amount > 0, discount exceeds max discount → Cap the discount iii) Test cases (4 Marks) <table><thead><tr><th>Test Case</th><th>total_amount</th><th>is_member</th><th>coupon_code</th><th>Expected Output</th></tr></thead><tbody><tr><td>TC1</td><td>0</td><td>0</td><td>"NONE"</td><td>0 (Handles zero amount case)</td></tr><tr><td>TC2</td><td>100</td><td>0</td><td>"NONE"</td><td>100 (No discount applied)</td></tr><tr><td>TC3</td><td>100</td><td>1</td><td>"NONE"</td><td>90 (Only member discount 10%)</td></tr><tr><td>TC4</td><td>100</td><td>1</td><td>"SAVE20"</td><td>70 (Member discount + 20% coupon)</td></tr><tr><td>TC5</td><td>100</td><td>1</td><td>"SAVE10"</td><td>80 (Member discount + 10% coupon)</td></tr><tr><td>TC6</td><td>200</td><td>1</td><td>"SAVE20"</td><td>140 (Cap applied at 30% discount)</td></tr></tbody></table>					Test Case	total_amount	is_member	coupon_code	Expected Output	TC1	0	0	"NONE"	0 (Handles zero amount case)	TC2	100	0	"NONE"	100 (No discount applied)	TC3	100	1	"NONE"	90 (Only member discount 10%)	TC4	100	1	"SAVE20"	70 (Member discount + 20% coupon)	TC5	100	1	"SAVE10"	80 (Member discount + 10% coupon)	TC6	200	1	"SAVE20"	140 (Cap applied at 30% discount)
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