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RAJALAKSHMI ENGINEERING COLLEGE
An AUTONOMOUS Institution
Affiliated to ANNA UNIVERSITY, Chennai

Continuous Assessment Test- II (CAT - II)

Year	: II
Semester	: III
Branch	: B.E Computer Science and Engineering
Sub. Code	: CS23332
Subject Name	: Database Management Systems
QP Code	: 072104

[Regulations 2023]

(Common to Information Technology, Artificial Intelligence and Machine Learning, Computer Science and Design, Artificial Intelligence and Data Science, Computer Science and Engineering – CS)

Date: 16.11.2024 **Time: 120 Minutes** **Marks: 75**

Answer ALL Questions

Part A [2 x 2 = 4 Marks]

3.4. Define the term 'BCNF' in database normalization. [A1] CO3

3.5. What is a B+ tree? Explain its basic structure. [A2] CO3

Part B [1 x 11 = 11 Marks]

3.6. a. Given the following table: [B2] CO3

Student_ID	Name	Courses	Instructor
1	Alice	{DBMS, Operating Systems}	{Bob, Carol}
2	Bob	{Data Structures, DBMS}	{Carol, Bob}
3	Charlie	{Data Structures, Networks}	{Alice, Dave}

Normalize this table up to 3NF. Provide a step-by-step explanation of your process, identify any dependencies, and redesign the table at each normal form. Discuss the rationale behind each normalization step, including the elimination of partial, transitive, and other forms of dependencies. Draw the final schema diagram illustrating the normalized tables.

[OR]

b. Consider a database that uses a B-Tree for indexing names in the above student table, assuming the B-Tree order is 3 (i.e., each node can have a [B1] CO3

maximum of 3 keys). Demonstrate how the B-Tree is structured after inserting the names 'Alice', 'Bob', and 'Charlie'. Explain each step, show how the nodes are split (if applicable), and draw the final structure of the B-Tree. Discuss how B-Tree indexing improves query performance in terms of search, insert, and delete operations.

Answer ALL Questions

Part A [4 x 2 = 8 Marks]

4.1.	What is the primary function of the ACID properties in a database management system?	[A1]	CO4
4.2.	Define serializability in the context of transaction processing.	[A2]	CO4
4.3.	What role does Two-Phase Locking play in concurrency control?	[A1]	CO4
4.4.	What is the concept of timestamp-based concurrency control.	[A2]	CO4

Part B [2 x 11 = 22 Marks]

4.5. a. Consider the following schedule of transactions: [B1] CO4

Time	Transaction 1	Transaction 2
T1	Read(A)	
T2		Read(B)
T3	Write(A)	
T4		Write(B)
T5	Commit	
T6		Commit

Analyze the schedule for serializability and recoverability. Describe any conflicts and determine if the schedule is conflict serializable. Use precedence graph technique to support your analysis. Explain the impact if the schedule is not serializable and propose modifications to ensure serializability and recoverability.

[OR]

b. Explain the ARIES algorithm. [B2] CO4

4.6. a. You are given the following initial database state and a sequence of actions for two transactions, T1 and T2: [B1] CO4

Variable	Value
A	100
B	200

Actions:

- T1: BEGIN; READ(A); A = A + 50; WRITE(A); READ(B); B = B - 50; WRITE(B); COMMIT;
- T2: BEGIN; READ(A); A = A - 30; WRITE(A); COMMIT;

Illustrate the steps of both transactions using Two-Phase Locking (2PL) protocol with shared (S) and exclusive (X) locks. Identify any possible deadlocks and suggest a resolution strategy using timeout or deadlock detection mechanisms.

[OR]

b. Explain the Multiversion Concurrency Control and its techniques. [B2] CO4

Answer ALL Questions

Part A [4 x 2 = 8 Marks]

5.1.	List the data models in NoSQL.	[A1]	CO5
5.2.	What is MongoDB sharding and how does it help in database scalability?	[A2]	CO5
5.3.	Define CRUD operations in the context of MongoDB.	[A1]	CO5
5.4.	Compare and contrast NoSQL and SQL databases in terms of schema flexibility and scalability.	[A2]	CO5

Part B [2 x 11 = 22 Marks]

5.5. a. You are tasked with migrating a relational database to a NoSQL system using MongoDB. The original RDBMS schema includes tables for Customers, Orders, and Products with typical foreign key relationships. Design a MongoDB schema that consolidates this information into a document-oriented model suitable for a high-transaction e-commerce platform. Outline the steps for migrating the data, discuss the challenges of data consistency during migration. [B1] CO5

[OR]

b. Explain the MongoDB's sharding and replication techniques. [B2] CO5

5.6.	a.	Develop a web application using MongoDB,and Python, and that implements a basic user management system. (registration, login, update profile). Provide a detailed explanation of the MongoDB schema used, Python code snippets for handling CRUD operations.	[B1]	CO5
		[OR]		
	b.	Explain the CAP thermo with examples.	[B2]	CO5