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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: III**

Branch: Computer Science and Engineering **Duration: 3 hrs.**

Course Code: 23CS3PCDBM / 22CS3PCDBM **Max Marks: 100**

Course: Database Management Systems

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Explain the main characteristics of database approach	*CO1*	*PO1*	**05**
	b)	Consider that you have an Orders table with columns OrderID, CustomerID, OrderDate, and TotalAmount. Create a view that shows all orders (OrderID, OrderDate, and TotalAmount) for a customer with CustomerID = 5.	*CO3*	*PO3*	**05**
	c)	Consider given relational schema for the Library Management System **Author**: author_id, first_name, last_name, birth_date, biography **Book**: book_id, title, author_id (FK), publication_year, genre, copies_available **Member**: member_id, first_name, last_name, email, phone_number, membership_date **Book Loan**: loan_id, member_id (FK), book_id (FK), loan_date, due_date, return_date Write SQL Queries for the following: i. Get all book loans, including the member's name ii. Find the books that are currently on loan iii. List all books loaned by a specific member iv. Count the number of books in each genre. v. Retrieve the total number of books loaned by each member	*CO3*	*PO3*	**10**
		OR			
2	a)	Write SQL query for the following operations i. To create a table named Books with the following columns: • BookID (Primary Key, Integer) • Title (VARCHAR(100))	*CO3*	*PO3*	**10**

			• Author (VARCHAR(50)) • Price (DECIMAL(5,2)) ii. Insert the following data into the Books table: | BookID | Title | Author | Price | |----------|----------|----------|--------| | 1 | MySQL Basics | John Smith | 19.99 | | 2 | Advanced MySQL | Jane Doe | 29.99 | | 3 | SQL Performance Tuning | Alan Walker | 39.99 | iii. Retrieve only unique author names from the Books table. iv. Write a query to update the price of the book "MySQL Basics" to 24.99.			
	b)	List the advantage of using Database Management Systems.	*CO1*	*PO1*	**05**
	c)	You are working with a database for an online store. Stores table has the information about the products in the store (ProductID, ProductName, Price, QuantityInStock). Stores information about each sale made in the store are (SaleID, ProductID, QuantitySold, SaleDate) Write a trigger that automatically updates the QuantityInStock in the Products table whenever a new record is inserted into the Sales table.	*CO2*	*PO2*	**05**
		UNIT - II			
3	a)	Consider the following relations: **Doctor** (SSN, FirstName, LastName, Specialty, YearsOfExperience, PhoneNum) **Patient**(SSN, FirstName, LastName, Address, DOB, PrimaryDoctor_SSN) **Medicine**(TradeName, UnitPrice, GenericFlag) **Prescription**(Id, Date, Doctor_SSN, Patient_SSN) **Prescription_Medicine**(Prescription Id, TradeName, NumOfUnits) Write the relational algebra expressions for the following queries i. List the trade name of generic medicine with unit price less than $50. ii. List the first and last name of patients whose primary doctor named 'John Smith'. iii. List the first and last name of doctors who are not primary doctors to any patient iv. List the SSN of distinct patients who have 'Aspirin' prescribed to them by doctor named 'John Smith'.	*CO3*	*PO3*	**10**

			v. List the first and last name of patients who have no prescriptions written by doctors other than their primary doctors.			
		b)	Analyze the following specification and design an ER diagram A book has a unique ISBN number, a title and one or more authors. The library service may own several copies of a given book, each of which is located in one of the service's libraries. A given library contains many books, and in order to distinguish different copies of the same book a library assigns a different copy-number to each of its copies of a given book; the price that was paid for each copy is also recorded. Every library has a unique name and is either a main library or a branch library. A main library may have zero or more branch libraries and every branch library is a branch of exactly one main library. A borrower has a name and a unique ID code. A borrower can have many books on loan, but each copy of a book can only be on loan to one borrower. A borrower could borrow the same book on several occasions, but it is assumed that each such loan will take place on a different date.	*CO3*	*PO3*	**10**
			OR			
	4	a)	Consider the following set of requirements for a Bank database. Design an ER diagram for this application: Each BANK has a unique Code, as well as a Name and Address. Each BANK is related to one or more BANK-BRANCHes, and the BranhNo is unique among each set of BANK-BRANCHes that are related to the same BANK. Each BANK-BRANCH has an Address and Branch Name. Each BANK-BRANCH has zero or more LOANS and zero or more ACCTS. Each ACCOUNT has an AcctNo (unique), Balance, and Type and is related to exactly one BANK-BRANCH and to at least one CUSTOMER. Each LOAN has a LoanNo (unique), Amount, and Type and is related to exactly one BANK-BRANCH and to at least one CUSTOMER. Each CUSTOMER has an SSN (unique), Name, Phone, and Address, and is related to zero or more ACCOUNTs and to zero or more LOANs	*CO3*	*PO3*	**10**
		b)	Give the following queries in the relational algebra using the relational schema student(id, name) enrolledIn(id, code) subject(code, lecturer) i. What are the names of students enrolled in cs3020? ii. Which subjects is Hector taking? iii. Who teaches cs1500? iv. Who teaches cs1500 or cs3020? v. Who teaches at least two different subjects?	*CO3*	*PO3*	**10**

			vi. What are the names of students in cs1500 or cs3010? vii. What are the names of students in both cs1500 and cs1200? viii. What are the names of students in at least two different subjects? ix. What are the codes of all the subjects taught? x. What are the names of all the students?			
			UNIT - III			
5	a)		Explain the informal design guidelines for relation schemas. How do these guidelines help reduce data redundancy and improve data integrity? Provide examples to illustrate your answer	*CO1*	*PO1*	**10**
	b)		Consider a relation schema R(P,Q,M,N,E) with the following functional dependencies: $PQ \rightarrow N$, $N \rightarrow M$, and $PN \rightarrow E$ i. Which of the above functional dependencies violates the 3NF condition? Why? ii. Based on the results of i) decide whether R is in 3NF or not.	*CO2*	*PO2*	**10**
			OR			
6	a)		Define multi-valued dependencies and explain the conditions for a relation to be in Fourth Normal Form (4NF). Provide an example to show how 4NF eliminates multi-valued dependencies	*CO1*	*PO1*	**10**
	b)		Consider a relation schema R(X,Y,Z,P,Q) with the following functional dependencies: $XY \rightarrow P$, $P \rightarrow Z$, and $XP \rightarrow Q$ i. Which of the above functional dependencies violates the 3NF condition? Why? ii. Based on the results of i) decide whether R is in 3NF or not.	*CO2*	*PO2*	**10**
			UNIT - IV			
7	a)		Consider schedule S with transaction T1 and T2. T1 transfer Rs. 150 from account A to C and T2 adds Rs. 50 into account A. Prepare concurrent schedule with two phase locking protocol **T1**: Transfer Rs. 150 from account A to account C. • **T1.1**: Read balance of A. • **T1.2**: Deduct Rs. 150 from A. • **T1.3**: Add Rs. 150 to C. **T2**: Add Rs. 50 to account A. • **T2.1**: Read balance of A. • **T2.2**: Add Rs. 50 to A.	*CO2*	*PO2*	**05**
	b)		The following schedules is recoverable or non-recoverable schedule? Explain your answer.	*CO2*	*PO2*	**05**

			i. R1(x), W1(x), R2(x), R1(y), W2(x), C2, A1 ii. R1(x), W1(x), R2(x), W2(x), A1			
		c)	Define ARIES recovery algorithm. Discuss its phases (analysis, redo, undo) and how it handles database recovery efficiently. Provide an example to illustrate the algorithm.	*CO1*	*PO1*	**10**
			OR			
	8	a)	Discuss the potential issues and challenges that arise in database systems when concurrency control mechanisms are not enforced. Provide examples to illustrate their impact on data consistency and integrity.	*CO1*	*PO1*	**10**
		b)	Explain the ACID properties of transactions. How do these properties ensure the reliability of transaction processing?	*CO1*	*PO1*	**05**
		c)	Consider the three transactions T1, T2 and T3 and schedules S1 and S2 given below. Determine whether each schedule is serializable or not? T1: r1(x); r1(z); w1(x); w1(z) T2: r2(y); r2(z); w2(z); T3: r3(y); r3(x); w3(y); S1: r1(x); r3(y); r3(x); r2(y); r2(z); w3(y); w2(z); r1(z); w1(x); w1(z) S2: r1(x); r3(y); r2(y); r3(x); r1(z); r2(z); w3(y); w1(x); w2(z); w1(z);	*CO2*	*PO2*	**05**
			UNIT - V			
	9	a)	List different storage types of NoSQL databases. Describe each type with its characteristics, use cases, and examples.	*CO1*	*PO1*	**10**
		b)	Design NoSQL queries considering MongoDB for the following Assume a collection named students with the following sample data: [{ "_id": 1, "name": "Alice", "age": 22, "grades": [85, 90, 78], "major": "Computer Science" }, { "_id": 2, "name": "Bob", "age": 24, "grades": [88, 76, 92], "major": "Mathematics" }, { "_id": 3, "name": "Charlie", "age": 23, "grades": [95, 89, 96], "major": "Physics" }, { "_id": 4, "name": "Diana", "age": 22, "grades": [72, 84, 80], "major": "Computer Science" }, { "_id": 5, "name": "Eve", "age": 21, "grades": [91, 85, 93], "major": "Mathematics" }]	*CO3*	*PO3*	**10**

			i. Retrieve all students from the collection. ii. Find the student whose name is "Alice." iii. Find all students in the "Mathematics" major. iv. Retrieve only the name and age of all students. v. Retrieve all students sorted by age in ascending order.			
			OR			
	10	a)	Design NoSQL queries considering MongoDB for the following. Assume a collection named `products` with the following sample data: [{ "_id": 1, "name": "Laptop", "category": "Electronics", "price": 1000, "stock": 50, "tags": ["portable", "tech"] }, { "_id": 2, "name": "Headphones", "category": "Electronics", "price": 100, "stock": 200, "tags": ["audio", "tech"] }, { "_id": 3, "name": "Chair", "category": "Furniture", "price": 150, "stock": 30, "tags": ["wooden", "comfort"] }, { "_id": 4, "name": "Desk", "category": "Furniture", "price": 300, "stock": 20, "tags": ["office", "wooden"] }, { "_id": 5, "name": "Smartphone", "category": "Electronics", "price": 700, "stock": 100, "tags": ["portable", "tech"] }] i. Find products with a price greater than 500 ii. Update the stock of the "Chair" to 40 iii. Find products where the price is between 100 and 500 iv. Sort products by name in alphabetical order v. Group products by category and calculate the average price per category	*CO3*	*PO3*	**10**
		b)	Describe the main characteristics of NoSQL databases.	*CO1*	*PO1*	**05**
		c)	Explain the concept of a "vector" in the context of a vector database. How are vectors represented and stored in such databases?	*CO1*	*PO1*	**05**

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