



- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Acquire the concept of physical database design and tuning.
CO2	Learn the concept of parallel and distributed database.
CO3	Obtain the knowledge of multimedia and spatial database.
CO4	Apply the concepts of mobile and cloud database in real time applications.
CO5	Distinguish various emerging database technologies and Analyze various security issues in databases.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

- A database system is optimizing query execution using parallel processing techniques. CO2 BL4

In Scenario A, a query consists of a sequence of operations such as selection, projection, and join, where each operation can begin processing as soon as it receives partial input from the previous operation. This approach avoids writing intermediate results to disk and allows multiple processors to work simultaneously on different stages of the query. However, the performance improvement is limited when the number of operations is small, when some operations cannot produce output until all inputs are processed, or when one operation takes significantly longer than the others.

In Scenario B, a query is divided into two separate parts: (Table A ⋈ Table B) and (Table C ⋈ Table D), which can be executed simultaneously on different processors as they do not require results from each other during execution. This approach improves system utilization and scalability, but intermediate results of each part may need to be stored before combining them, and it is less effective when operations must be executed in a strict sequence.

For each scenario, identify the most suitable type of parallelism with diagram. Justify your answer by explaining how the characteristics, advantages, and drawbacks of the approach apply to each scenario.
- In a university system, students from different departments enroll in various courses. Based on academic performance over the years, departments are categorized as Elite, High, Medium, and Basic, as shown in the DEPARTMENT Table. The university administration has decided to organize inter-department collaborative projects, where students can only collaborate with students from departments belonging to different categories (for example, students from a department in the Elite category cannot collaborate with students from another Elite category department). To process this, "Type" is not required from the STUDENT table which is given CO2 BL3

below. After implementing this process, university administration is planning to isolate "Type" from the STUDENT table for other operations.

To improve query performance and data management, the database designer decides to apply hybrid fragmentation on both the STUDENT and DEPARTMENT tables based on the given criteria. Show the result tables and justify your answer: Discuss the process.

Student

Stu_ID	Name	Type	Dept_ID
101	Arjun	UG	D01
102	Meena	PG	D03
103	Ravi	UG	D02
104	Sneha	PG	D04
105	Karthik	UG	D01
106	Priya	PG	D05
107	Aman	UG	D06
108	Divya	PG	D02
109	Rahul	UG	D03
110	Anjali	PG	D04
111	Vikram	UG	D05
112	Neha	PG	D06

Department

Dept_ID	Dept_Name	Category
D01	CSE	Elite
D02	ECE	High
D03	Mechanical	Medium
D04	Civil	High
D05	IT	Elite
D06	Electrical	Basic

3. A multinational banking system maintains a distributed database across four branches represented as Sites A, B, C, and D, where Site A acts as the coordinator and the remaining sites act as participating sites for processing distributed transactions such as fund transfers and loan updates. In Situation 1, a transaction T1 is initiated, and the coordinator sends a prepare request to all participating sites; after performing necessary local checks, all sites respond positively and are ready to commit the transaction. In Situation 2, another transaction T2 is initiated, and the coordinator again sends a prepare request to all sites, but Site C encounters a constraint violation and cannot proceed, while the other sites are ready to commit. Based on these two situations, draw the suitable workflow diagrams for both cases and justify the outcome of each transaction with respect to the phases and message flow of the Two-Phase Commit (2PC) protocol.

CO2 BL4

4. A geographic information system (GIS) is being developed to manage spatial data within a city represented as a 2D rectangular region where both the X and Y coordinates range from 0 to 100 units. To efficiently store and query location data, the system uses a Point-Region (PR) Quadtree, where each node corresponds to a rectangular region of space. Each leaf node can store a maximum of 2 points. The system needs to insert the following points in the given order: A (30, 60), B (70, 90), C (20, 30), D (40, 80), E (60, 40), F (10, 55), G (45, 95), and H (30, 80).

Construct the PR-Quadtree by inserting all the given points step by step while maintaining the region constraints and subdivision rules. Clearly represent the final tree structure along with the corresponding rectangular regions of space. After constructing the tree, delete the point H (30, 80) and show the updated tree structure only.

5. Write the role of the following functions in the Large Object (LOB) of the multimedia databases. For each function, provide two examples – one involving an image and another involving a video.

CO3 BL2

- i. FindType(Obj)
- ii. FindObjWithFeature(f)
- iii. FindObjWithFeatureandAttr(f,a,v)
- iv. FindFeaturesinObj(Obj)
- v. FindFeaturesandAttrinObj(Obj)

6. In a mobile communication system, when a mobile unit moves to a new registration area, its location must be updated in the HLR and VLR to ensure proper service. Draw a workflow diagram showing all entities and message flows, and explain the steps of the location update process.

CO4 BL2

7. A company plans to migrate its on-premises database systems to the cloud to improve scalability, availability, and cost efficiency. It is evaluating different cloud database options such as managed services, virtual machine-based databases, and serverless solutions.

CO4 BL2

- i. As a database expert, analyze the suitable cloud database options. [5]
- ii. Explain how the role of the DBA changes in a cloud environment compared to traditional systems. [5]

8. i. Explain the concept of Discretionary Access Control (DAC) and describe how access permissions are granted and managed in this model with examples. [5]

CO5 BL2

- ii. Explain Role-Based Access Control (RBAC) and compare it with DAC in terms of access control mechanism, security, and practical applications. [5]

- 9.a) Consider the following case study:

CO1 BL3

- i. The company is organized into departments. Each department has a unique name and is managed by a particular employee, with the manager's start date recorded. A department may have multiple locations.
- ii. Each department controls several projects. Every project has a unique name and number, and is located at a single location.

- iii. The company's employees have attributes including name, SSN, address, salary, sex, and birth date. Each employee is assigned to one department but may work on multiple projects (not necessarily managed by their department). The number of hours per week an employee works on each project is recorded, as well as the employee's immediate supervisor.
- iv. Each employee's dependents are tracked for health insurance purposes, with information including dependent name, birth date, and relationship to the employee.

Construct a complete ER Diagram representing all entities, relationships, attributes, and cardinalities based on the above scenario.

OR

- 9.b) Consider the following pet animal's medical report and normalize it to 3NF.

CO1 BL3

petid	pet name	pet type	petage	owner	visit date	proc_no	proc_name
15	Irish	Dog	10	Ram	2/2/26	01	rabies vacci
					5/3/26	05	general check
					6/4/26	09	heart test
20	Boxer	Dog	5	Anish	8/1/26	01	rabies vacci
					4/2/26	10	annual check
25	Moris	Cat	7	Kim	1/1/26	08	eye check
					3/2/26	05	general check
30	Sweety	Bird	2	Cook	15/3/26	09	heart test
					17/4/26	15	skin test

- 10.a) Design a smart healthcare database system that monitors patient vital signs and automatically triggers alerts when abnormal conditions are detected. The system should also infer possible diseases based on symptoms and determine patient eligibility for treatments using logical rules. Explain how Active Database concepts (Event-Condition-Action (ECA) rules) and Deductive Database techniques (inference rules and recursion) can be applied in this scenario. Illustrate your answer with suitable examples and discuss the benefits of integrating both approaches.

CO5 BL3

OR

- 10.b) A financial organization maintains a sensitive database containing customer transactions and confidential records and has recently identified security risks such as unauthorized data leakage through covert channels and insecure data transmission. To strengthen database security, the organization plans to implement encryption and authentication mechanisms. Explain how covert channels can lead to data leakage in database systems and how symmetric encryption (DES) and asymmetric encryption (RSA) can secure data storage and transmission. Additionally, describe the role of digital signatures in ensuring data integrity, authentication, and non-repudiation within the database environment. Design a secure database environment for this financial organization, which will handle these security issues.

CO5 BL3