PART – A (10x2=20 Marks)

1. Mention how modern database systems address the inherent limitations of traditional file-based data management systems. CO

2. Define attribute redundancy in the context of Entity-Relationship (ER) modeling. Suggest a method to minimize it during schema design. CO

3. Formulate a relational algebra expression to retrieve details of all employees whose salary exceeds 50,000. CO

4. Write a SQL statement to define a stored procedure that inserts a new record into a specified table. CO

5. State the necessary condition that must be met for a relation to conform to Third Normal Form (3NF) in database normalization. CO

6. Why is dependency preservation a critical property in the process of relational schema decomposition? CO

7. Define intent locking in the context of transaction management within a database system. What is its significance? CO

8. Differentiate between optimistic and pessimistic concurrency control techniques used in database systems. CO

9. Highlight the key advantage of B+ trees over traditional binary search trees when used for indexing in databases. CO

10. List any two potential threats to database security and briefly describe their implications. CO

PART - B (5x16=80 Marks)

11. a) i) Explain how entities, relationships, and attributes are depicted in Entity-Relationship (E-R) modeling. Provide a detailed explanation of the various types of attributes. CO1

ii) An e-commerce platform tracks sellers, buyers, products, transactions, and reviews, design an E-R model and explain each component. CO1

(OR)

b) i) Evaluate the role of data models in ensuring data integrity, consistency, and security. CO1

ii) Discuss the role of the DBMS in managing mappings between the three levels of architecture. How are schema and instances handled at each level? CO1

12. a) The system contains a table named: CO2

Products(product_id, product_name, price, stock_quantity)

1) Write an SQL statement to create the Products table with appropriate data types and a primary key.

2) Insert three sample records into the Products table.

3) Grant the following privileges to the user store_manager:

- SELECT, INSERT, and UPDATE on the Products table.
- Also, ensure that the user can grant these privileges to other users. (Hint: Use WITH GRANT OPTION)

4) Grant only the SELECT privilege on the Products table to user auditor.

5) Later, you decide to restrict the store_manager from modifying the product data.

- Write the SQL command to revoke the UPDATE privilege from store_manager.

6) Write the SQL statement to revoke all privileges from the user auditor.

(OR)

b) You have two tables in a college database: CO

Students(student_id, student_name, course_id).

Courses(course_id, course_name).

1) Write an SQL statement to create the Students table and Courses table with appropriate data types and a primary key.

2) Insert three sample records into the Students table and Courses table.

3) Write an SQL query using INNER JOIN to display the list of student names along with the course names they are enrolled in.

4) Write an SQL query using LEFT OUTER JOIN to display all students and their corresponding course names. Also, include students who are not enrolled in any course.

5) Write an SQL query using RIGHT OUTER JOIN to display all courses and the names of students enrolled in them. Include courses that have no students enrolled.

13. a) Given a relation Employee(emp_id, emp_name, dept_id, dept_name, location) with the following functional dependencies:

- emp_id → emp_name, dept_id
- dept_id → dept_name, location

1) Identify all the candidate keys.

2) Determine the highest normal form the relation satisfies.

3) Normalize the relation step-by-step up to Third Normal Form (3NF).

4) Explain how this decomposition is lossless and dependency preserving.

(OR)

b) i) Define Boyce-Codd Normal Form (BCNF). How does it differ from Third Normal Form (3NF)?

ii) Explain why a relation in 3NF might still have redundancy.

iii) Given the relation R(A, B, C, D) with functional dependencies:

- $A \rightarrow B$
- $B \rightarrow C$
- $C \rightarrow A$
- $D \rightarrow A$

1) Find all candidate keys of the relation.

2) Identify violations of BCNF.

3) Decompose the relation into BCNF ensuring the decomposition is lossless.

4) Check if the decomposition is dependency-preserving.

14. a) i) Explain the difference between transaction recovery and system recovery.

ii) Discuss the types of failures that require recovery mechanisms.

iii) Describe how the log-based recovery technique works using UNDO and REDO operations.

(OR)

b) You are managing a banking system where two concurrent transactions, T1 and T2, operate on the same data items in the database.

- T1: Read(A); Write(A); Read(B); Write(B)
- T2: Read(B); Write(B); Read(A); Write(A)

1) Construct a schedule showing interleaved operations of T1 and T2.

2) Determine whether the schedule is conflict serializable. Justify your answer by drawing a precedence (conflict) graph.

3) Explain why serializability is important for the correctness of concurrent transactions in a database system.

15. a) A company is setting up a data server for high availability and performance. They are considering RAID 0, RAID 1, and RAID 5.

1) Explain each of these RAID levels.

2) Compare them in terms of redundancy, read/write performance, and storage efficiency.

3) Recommend the best RAID level for a high-performance transactional database with a need for fault tolerance, and justify your answer.

(OR)

b) i) What is a B+ Tree? Explain its structure and key characteristics.

ii) Construct a B+ Tree for the following set of keys:
30, 31, 23, 32, 22, 28, 24, 29

Assume that the B+ Tree has a maximum of 5 pointers per node (i.e., the order of the tree is 5).

1) Show each step of the insertion process clearly.

2) Indicate how the nodes split and how leaf nodes are linked.

3) Draw the final B+ Tree structure after all insertions.
