UNIT 2 QUESTION BANK

PART - A

Define relational algebra and its operations.

Relational algebra is a set of mathematical operations that define manipulation and retrieval operations on relations (tables) in a relational database. It serves as the theoretical foundation for the design and implementation of relational databases. Relational algebra operations help to query and modify data in a consistent and organized manner. The operations are

1. Selection (σ)
2. Projection (π)
3. Union (∪)
4. Intersection (∩)
5. Difference (−)
6. Cartesian Product (×)
7. Join (⋈)

Show that if a relation is in BCNF, then it is also in 3NF.

Boyce and Codd Normal Form is a higher version of the Third Normal form. This form deals with certain type of anamoly that is not handled by 3NF. A 3NF table which does not have multiple overlapping candidate keys is said to be in BCNF. For a table to be in BCNF, following conditions must be satisfied:

· R must be in 3rd Normal Form

· and, for each functional dependency (X -> Y), X should be a super Key.

What is functional dependency? State its importance.

A functional dependency (FD) is **a relationship between two attributes, typically between the PK and other non-key attributes within a table**. For any relation R, attribute Y is functionally dependent on attribute X (usually the PK), if for every valid instance of X, that value of X uniquely determines the value of Y.

List out problems caused by redundancy.

1. Redundancy leads to data inconsistencies when updates are not synchronized across redundant copies.
2. Update anomalies occur when redundant data requires multiple updates to maintain consistency.
3. Redundant data consumes extra storage space, increasing storage costs.
4. Complexity and inefficiency in database maintenance and queries arise with redundancy.
5. Slow data retrieval and manipulation can result from increased redundancy.
6. Data integrity issues, such as constraint enforcement, may arise due to redundancy.

Compare tuple relational calculus and domain relational calculus.

Tuple Relational Calculus: It focuses on selecting tuples (rows) from relations (tables) that satisfy a given condition or predicate. In tuple calculus, you specify **how** you want to retrieve row by row.
Query in TRC: {t | ∃d, n (Employee(t) ∧ Department(d) ∧ t[Department] = d ∧ t[Name] = n ∧ d = "Sales")}

Domain Relational Calculus: It focuses on selecting values from the domains of attributes that satisfy a given condition or predicate. In domain calculus, you specify **what** values you want to retrieve from the attributes.

Query in DRC: {<n> | ∃s (Employee(Name=n),Age,Dept,Desg,Exp ∧ Salary(s) ∧ s > 50000)}
What is meant by lossless-join decomposition? Lossless join decomposition is a decomposition of a relation R into relations R1, and R2 such that if we perform a natural join of relation R1 and R2, it will return the original relation R. This is effective in removing redundancy from databases while preserving the original data.
What is a relationship? What is meant by the degree of relationship set? A relationship in a database management system (DBMS) is a logical connection between tables in a relational database. These relationships determine how data in one table is related to data in another table. A degree of relationship represents the number of entity types that are associated with a relationship.
State the anomalies of 1NF? ● repetition of data ● to change a department name all tuples of the relation need to be updated since the department name can exist in multiple rows.

PART – B

1. i) Show the steps involved in ER to relational mapping in the process of relational database design. (6)

   ii) Exemplify the multi-valued dependency and the fourth normal form-4NF (7)
2. List the operations of relational algebra and the purpose of each with example?
3. Explain first normal form, second normal form, third normal form and BCNF with an example.
4. Explain Functional Dependency and its types with suitable examples. Also, discuss its role in database normalization.
5. i) Exemplify the join dependency and the fifth normal form-4NF (6)

   ii) Describe Transitive and Partial Functional Dependencies. How do they impact database normalization? (7)
6. Draw an ER diagram for a banking enterprise with almost all components and explain the conversion process of the relational model.
7. What are the different types of anomalies in a database? How does normalization help in reducing these anomalies? Provide examples.
8. i) Discuss the correspondence between the ER model construct and the relational model constructs. (6)

   ii) Describe in detail about the lossy and lossless decomposition. (7)

PART – C

1. Design an Entity-Relationship (ER) diagram for a University Management System. Identify the key entities, attributes, relationships, and constraints. Convert the ER diagram into relational tables and explain the process in detail.
2. An agency called Instant Cover supplies part-time/temporary staff to hotels in Scotland. The below lists the time spent by agency staff working at various hotels. The national insurance number (NIN) is unique for every member of staff.

NIN	ContractNo	Hours	eName	hNo	hLoc
1135	C1024	16	Smith J.	H25	East Killbride
1057	C1024	24	Hocine D.	H25	East Killbride
1068	C1025	28	White T.	H4	Glasgow
1135	C1025	15	Smith J.	H4	Glasgow

(i)This table is susceptible to update anomalies. Provide examples of insertion, deletion and update anomalies. (10)

(ii) Normalize this table to the third normal form. State any assumptions. (5)