Assignment-4

DBMS assignment based on topics: Relational Algebra, E R Models, FDs and Normalisation.

1. Explain the basic operations of Relational Algebra with suitable examples.

2. Consider two relations STUDENT(RollNo, Name, DeptID) and DEPARTMENT(DeptID, DeptName). Write relational algebra expressions to:
   (a) Find names of students in the 'CSE' department.
   (b) List departments having no students.

3. Draw an ER diagram for an online shopping system that manages customers, products, orders, and payments. Convert the ER diagram into relational schema.

4. Differentiate between strong and weak entity sets with examples.

5. Define Functional Dependency. Explain how it is used to identify candidate keys in a relation with an example.

6. Given a relation R(A, B, C, D, E) with functional dependencies {A → B, B → C, A → D, D → E}, find all candidate keys and normalize R up to 3NF.

7. Explain the difference between 1NF, 2NF, and 3NF with suitable examples.

8. Write relational algebra expressions for the following:
   (a) Retrieve employees whose salary is greater than 50,000.
   (b) Find departments having more than five employees.

9. Design an ER model for a library management system showing books, members, loans, and fines. Convert the model into relational schema and identify primary and foreign keys.

10. Consider relation R(StudentID, CourseID, InstructorID, InstructorName, CourseName). The following dependencies hold:
{StudentID, CourseID → InstructorID, InstructorID → InstructorName, CourseID → CourseName}.
Decompose R into 3NF and justify your steps.

11. Explain how redundancy and anomalies are reduced using normalization. Illustrate with an example.

12. Given the following data:
EMPLOYEE(EmpID, Name, DeptID, Salary)
DEPARTMENT(DeptID, DeptName, Location)
Write relational algebra queries to:
(a) Find the average salary of employees per department.
(b) List the names of employees who work in 'IT' department.

13. A relation **STUDENT_INFO(StudentID, StudentName, CourseID, CourseName, InstructorID, InstructorName)**has the following functional dependencies:
{ StudentID → StudentName, CourseID → CourseName, InstructorID → InstructorName, CourseID → InstructorID }.

- Identify the anomalies present in this relation.
- Decompose the relation step-by-step up to **3rd Normal Form (3NF)**.
- Show all intermediate tables after each normalization step.

14. Given the relation **R(A, B, C, D, E, F)** and the set of functional dependencies:
{ A → B, B → C, CD → E, E → F, F → A }.

- Determine all **candidate keys**.
- Identify the **highest normal form** of R.
- Decompose the relation into **3NF** relations, explaining each step clearly.

15. A database designer defines the relation **EMP_PROJECT(EmpID, EmpName, ProjectID, ProjectName, DepartmentID, DepartmentName)** with the following dependencies:
{ EmpID → EmpName, ProjectID → ProjectName, DepartmentID → DepartmentName, EmpID → DepartmentID }.

- Find the **candidate key** for this relation.
- Normalize the relation step-by-step up to **3NF**, showing intermediate tables and dependencies.
- Explain how redundancy is reduced through normalization.