Practice Sheet
Chapter 10 (Normalization)

*Solutions are at the end of the document. SOLVE IT YOURSELF first. (NOT COMPLETE YET)

NOTE: If dependency of any attribute is not mentioned, assume that it is dependent on the "whole" primary key.

Question 1:

Consider the following Relational Schema:
Car_Sales (CarID, SalesmanID, CarModel, CarYear, CarPrice, CarCompany, SMName, Discount, CommissionPercentage, DateSold).

The primary key is underlined.
The schema has the following additional Functional Dependencies:

FD1: CarID → CarModel, CarYear, CarPrice, CarCompany
FD2: SalesmanID → SMName, CommissionPercentage
FD3: DateSold → Discount

 a. Explain if the relational schema is in first normal form (1NF) or not. If not, normalize to 1NF.
 b. Explain if the relational schema is in second normal form (2NF) or not. If not, normalize to 2NF.
 c. Explain if the relational schema is in third normal form (3NF) or not. If not, normalize to 3NF.

You MUST show the complete "current" schema after each normalization step.

Question 2:

Consider the following relational Schema:
Books (ISBN, AuthorName, BookTitle, Publisher, Price, Year, AuthorAffiliation, Type, Category)

The primary key is underlined.
The schema has the following additional Functional Dependencies:

AuthorName → AuthorAffiliation
Type → Category

Identify and explain which normal form the above schema is in. Step by step normalize it until 3rd normal form. You MUST show the complete "current" schema after each normalization step.

Question 3:

Consider the following relational Schema:
Books (AuthorName, BookTitle, Publisher, Price, Year, AuthorAffiliation, Type, Category)

The primary key is underlined.
The schema has the following additional Functional Dependencies:

AuthorName → AuthorAffiliation
BookTitle → Publisher, Price, Year, Type, Category
Type → Category

Identify and explain which normal form the above schema is in. Step by step normalize it until 3rd normal form. You MUST show the complete "current" schema after each normalization step.

Consider the following Relational Schema:
Student_Project (StudentID, ProjectID, SName, PName, CourseCode, CTitle, Semester, Score, CGPA).

The primary key is underlined.
The schema has the following additional Functional Dependencies:

FD1: StudentID → SName, CGPA
FD2: ProjectID → PName, CourseCode, CTitle, Semester
FD3: CourseCode → CTitle

    a. Explain if the relational schema is in first normal form (1NF) or not. If not, normalize to 1NF.
    b. Explain if the relational schema is in second normal form (2NF) or not. If not, normalize to 2NF.
    c. Explain if the relational schema is in third normal form (3NF) or not. If not, normalize to 3NF.

You MUST show the complete "current" schema after each normalization step.

SOLUTIONS:

   a. It is in 1NF, because no multivalued/composite attributes or nested relations present in the given schema.
   b. Not in 2NF, there are partial dependencies due to FD1 and FD2 present in the schema. Normalizing to 2NF:

   Cars (CarID, CarModel, CarYear, CarPrice, CarCompany)
   Salesmen (SalesmanID, SMName, CommissionPercentage)
   Car_Sales (CarID, SalesmanID, Discount, DateSold)

   c. Above schema is not in 3NF because there are transitive dependencies due to FD3 in the Car_Sales table. Normalizing to 3NF:

   Cars (CarID, CarModel, CarYear, CarPrice, CarCompany)
   Salesmen (SalesmanID, SMName, CommissionPercentage)
   Car_Sales (CarID, SalesmanID, DateSold)
   Discount_Info (Discount, DateSold)

It is in 2NF. 2nf has 2 conditions: 1. should be in 1NF and 2. Should not have any partial dependency on the primary key. It is already in 1NF because no multivalued/composite attributes or nested relations present in the given schema and also there are no partial dependencies. So it is currently in 2NF.

It is not in 3nf because there are transitive dependencies due to the additional FDs.

Normalizing to 3nf:

Books (ISBN, AuthorName, BookTitle, Publisher, Price, Year, Type)
Author(AuthorName, AuthorAffiliation)
BookType (Type, Category)

It is in 1NF because no multivalued/composite attributes or nested relations present in the given schema. But, not in 2nf as partial dependency on the primary key present due to the first two FDs and the third FD causes transitive dependency so also not in 3NF.

Normalizing to 2NF:

Author(AuthorName, AuthorAffiliation)
Book1 (BookTitle, Publisher, Price, Year, Type, Category)
Book2 (AuthorName, BookTitle)

Normalizing to 3NF:

Author(AuthorName, AuthorAffiliation)
Book1 (BookTitle, Publisher, Price, Year, Type)
BookType(Type, Category)
Book2 (AuthorName, BookTitle)

<mark>Answer 4:</mark>

a. It is in 1NF, because no multivalued/composite attributes or nested relations present in the given schema.

b. Not in 2NF, there are partial dependencies due to FD1 and FD2 present in the schema. Normalizing to 2NF:

   Students (StudentID, SName, CGPA)
   Projects (ProjectID, PName, CourseCode, CTitle, Semester)
   Student_Project (StudentID, ProjectID, Score)

c. Above schema is not in 3NF because there are transitive dependencies due to FD3 in the Projects table:

   Students (StudentID, SName, CGPA)
   Projects (ProjectID, PName, CourseCode, Semester)
   Courses (CourseCode, CTitle)
   Student_Project (StudentID, ProjectID, Score)