**Q1.**

This is the given table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EmployeeID** | **EmployeeName** | **Department** | **ManagerID** | **Salary** | **HireDate** |
| 1 | John Smith | HR | 101 | 50000 | 2022-01-15 |
| 2 | Alice Brown | IT | 102 | 60000 | 2022-02-20 |
| 3 | Mark Johnson | Sales | 101 | 55000 | 2022-03-10 |

Here, we can observe a deletion anomaly: if an employee is deleted from this table, the data related to department and manager would also be deleted. To avoid this anomaly, we split it into three tables as given below.

Employee Table

|  |  |  |  |
| --- | --- | --- | --- |
| **EmployeeID** | **EmployeeName** | **Salary** | **HireDate** |
| 1 | John Smith | 50000 | 2022-01-15 |
| 2 | Alice Brown | 60000 | 2022-02-20 |
| 3 | Mark Johnson | 55000 | 2022-03-10 |

Department table

|  |  |
| --- | --- |
| **Department** | **DepartmentID** |
| HR | D1 |
| IT | D2 |
| Sales | D3 |

Manager Table

|  |
| --- |
| ManagerId |
| 101 |
| 102 |

EmployeeDepartmentManagerMapping table

|  |  |  |
| --- | --- | --- |
| **EmployeeID** | **DepartmentID** | **ManagerID** |
| 1 | D1 | 101 |
| 2 | D2 | 102 |
| 3 | D3 | 101 |

So now the tables are in 3nf.

**Q2**.Training programs

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **ProgramID** | **ProgramName** | **Trainer** | **Department** | **EmployeeID** | **EmployeeName** | **Date** |
| 1 | Java Fundamentals | John Smith | IT | 101 | Alice Brown | 2022-03-01 |
| 2 | Project Management | Sarah White | HR | 102 | Bob Green | 2022-03-10 |
| 3 | Sales Techniques | Mark Johnson | Sales | 103 | Charlie Black | 2022-03-20 |

It is already in 1nf.

.Remove partial dependency-

EmployeeName depends solely on EmployeeID and not on the entire primary key ProgramID, indicating a partial dependency. To resolve this, separate the information about employees into another table, using EmployeeID as the primary key.

Program table

|  |  |  |
| --- | --- | --- |
| **ProgramID** | **ProgramName** | **Trainer** |
| 1 | Java Fundamentals | John Smith |
| 2 | Project Management | Sarah White |
| 3 | Sales Techniques | Mark Johnson |

ProgramEmployeeMapping

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ProgramID** | **Department** | **EmployeeID** | **EmployeeName** | **Date** |
| 1 | IT | 101 | Alice Brown | 2022-03-01 |
| 2 | HR | 102 | Bob Green | 2022-03-10 |
| 3 | Sales | 103 | Charlie Black | 2022-03-20 |

Removing transitive dependency- The transitive dependency where EmployeeID depends on ProgramID, and ProgramID depends on ProgramName suggests the need to create a separate program table to resolve this issue.

Employee table

|  |  |
| --- | --- |
| **EmployeeID** | **EmployeeName** |
| 101 | Alice Brown |
| 102 | Bob Green |
| 103 | Charlie Black |

Program table

|  |  |  |
| --- | --- | --- |
| **ProgramID** | **ProgramName** | **Trainer** |
| 1 | Java Fundamentals | John Smith |
| 2 | Project Management | Sarah White |
| 3 | Sales Techniques | Mark Johnson |

ProgramEmployeeMapping

|  |  |  |  |
| --- | --- | --- | --- |
| **ProgramID** | **Department** | **EmployeeID** | **Date** |
| 1 | IT | 101 | 2022-03-01 |
| 2 | HR | 102 | 2022-03-10 |
| 3 | Sales | 103 | 2022-03-20 |

To avoid deletion anomaly

Employee table

|  |  |
| --- | --- |
| **EmployeeID** | **EmployeeName** |
| 101 | Alice Brown |
| 102 | Bob Green |
| 103 | Charlie Black |

Program table

|  |  |  |
| --- | --- | --- |
| **ProgramID** | **ProgramName** | **Trainer** |
| 1 | Java Fundamentals | John Smith |
| 2 | Project Management | Sarah White |
| 3 | Sales Techniques | Mark Johnson |

Department table

|  |  |
| --- | --- |
| **DepartmentID** | **Department** |
| 1 | IT |
| 2 | HR |
| 3 | Sales |

ProgramEmployeeMapping

|  |  |  |  |
| --- | --- | --- | --- |
| **ProgramID** | **DepartmentID** | **EmployeeID** | **Date** |
| 1 | D1 | 101 | 2022-03-01 |
| 2 | D2 | 102 | 2022-03-10 |
| 3 | D3 | 103 | 2022-03-20 |

**Q3**.

Customer orders

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **OrderID** | **CustomerName** | **ProductID** | **ProductName** | **Qty** | **UnitPrice** | **TotalAmount** | **OrderDate** |
| 1 | John Doe | 101 | Laptop | 2 | 800 | 1600 | 2022-01-15 |
| 2 | Jane Smith | 102 | Smartphone | 1 | 500 | 500 | 2022-02-20 |
| 3 | John Doe | 103 | Printer | 1 | 200 | 200 | 2022-03-10 |

To make it 2NF divide customerOrders into customer\_details, product\_details and customer\_order tables

**customer\_details**

|  |  |
| --- | --- |
| **CustomerID** | **CustomerName** |
| C1 | John Doe |
| C2 | Jane Smith |

**product\_details**

|  |  |  |
| --- | --- | --- |
| **ProductID** | **ProductName** | **UnitPrice** |
| 101 | Laptop | 800 |
| 102 | Smartphone | 500 |
| 103 | Printer | 200 |

**customer\_order**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **OrderID** | **CustomerId** | **ProductID** | **Qty** | **TotalAmount** | **OrderDate** |
| 1 | C1 | 101 | 2 | 1600 | 2022-01-15 |
| 2 | C2 | 102 | 1 | 500 | 2022-02-20 |
| 3 | C1 | 103 | 1 | 200 | 2022-03-10 |

**Q4**.

Stress management

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **EmployeeID** | **FirstName** | **LastName** | **StressLevel** | **HoursOfWork** | **BreaksTaken** | **PhysicalActivity** | **CounselingSessions** |
| 101 | Sarah | White | Moderate | 45 | 3 | Yoga | 2 |
| 102 | Bob | Green | High | 50 | 2 | Jogging | 1 |
| 103 | Charlie | Black | Low | 40 | 4 | Meditation | 3 |
| 104 | David | Miller | High | 48 | 1 | Gym | 2 |
| 105 | Jane | Doe | Moderate | 42 | 3 | Walking | 1 |

Already in 1NF

separate the employee details into a table to make it 2NF

**employee\_details**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **EmployeeID** | **FirstName** | **LastName** | **HoursOfWork** | **BreaksTaken** |
| 101 | Sarah | White | 45 | 3 |
| 102 | Bob | Green | 50 | 2 |
| 103 | Charlie | Black | 40 | 4 |
| 104 | David | Miller | 48 | 1 |
| 105 | Jane | Doe | 42 | 3 |

**employee\_stress\_management**

|  |  |  |  |
| --- | --- | --- | --- |
| **EmployeeID** | **StressLevel** | **PhysicalActivity** | **CounselingSessions** |
| 101 | Moderate | Yoga | 2 |
| 102 | High | Jogging | 1 |
| 103 | Low | Meditation | 3 |
| 104 | High | Gym | 2 |
| 105 | Moderate | Walking | 1 |

**Q5.**

Given table:-

Flee Market

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ItemID** | **SellerName** | **ItemName** | **Category** | **Price** | **Quantity** | **Description** | **Condition** | **Location** | **DateListed** |
| 101 | John's Treasures | Vintage Chair | Furniture | 50.00 | 2 | Beautiful vintage chair, excellent condition | Like New | Booth 15, Section A | 2022-01-15 |
| 102 | Alice's Finds | Antique Clock | Home Decor | 80.00 | 1 | Authentic antique clock with Roman numerals | Good | Stall 8, Section B | 2022-02-20 |
| 103 | Mark's Collectibles | Vinyl Records | Music | 15.00 | 10 | Various artists and genres, in good condition | Used | Booth 20, Section C | 2022-03-10 |
| 104 | Emma's Treasures | Vintage Jewelry | Accessories | 35.00 | 5 | Assorted vintage jewelry pieces, unique designs | Excellent | Stall 12, Section D | 2022-04-05 |
| 105 | Robert's Finds | Retro Camera | Electronics | 60.00 | 1 | Vintage Polaroid camera with original case | Good | Booth 5, Section A | 2022-05-15 |

To eliminate the deletion anomaly, it is necessary to create three separate tables: category, item, and seller. Finally, a ItemSellerMapping mapping table is established. Through this approach, it can be observed that the resulting tables have no partial dependency, ensuring compliance with the Second Normal Form (2NF). Furthermore, there is no transitive dependency, demonstrating the attainment of the Third Normal Form (3NF).

Category table

Here CategoryId is the primary key

|  |  |
| --- | --- |
| **CategoryId** | **Category** |
| C1 | Furniture |
| C2 | Home Decor |
| C3 | Music |
| C4 | Accessories |
| C5 | Electronics |

Item table

Here ItemID is the primary key

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **ItemID** | **ItemName** | **CategoryId** | **Price** | **Quantity** | **Description** | **Condition** | **DateListed** |
| 101 | Vintage Chair | C1 | 50.00 | 2 | Beautiful vintage chair, excellent condition | Like New | 2022-01-15 |
| 102 | Antique Clock | C2 | 80.00 | 1 | Authentic antique clock with Roman numerals | Good | 2022-02-20 |
| 103 | Vinyl Records | C3 | 15.00 | 10 | Various artists and genres, in good condition | Used | 2022-03-10 |
| 104 | Vintage Jewelry | C4 | 35.00 | 5 | Assorted vintage jewelry pieces, unique designs | Excellent | 2022-04-05 |
| 105 | Retro Camera | C5 | 60.00 | 1 | Vintage Polaroid camera with original case | Good | 2022-05-15 |

Seller table

Here SellerID is the primary key

|  |  |  |
| --- | --- | --- |
| **SellerID** | **SellerName** | **Location** |
| S1 | John's Treasures | Booth 15, Section A |
| S2 | Alice's Finds | Stall 8, Section B |
| S3 | Mark's Collectibles | Booth 20, Section C |
| S4 | Emma's Treasures | Stall 12, Section D |
| S5 | Robert's Finds | Booth 5, Section A |

ItemSellerMapping table

|  |  |
| --- | --- |
| **ItemID** | **SellerId** |
| 101 | S1 |
| 102 | S2 |
| 103 | S3 |
| 104 | S4 |
| 105 | S5 |

**Q6**.Learning Management System

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CID** | **CourseName** | **Instructor** | **Department** | **Credits** | **Enrolled**  **Students** | **StartDate** | **EndDate** | **Location** | **Availability** |
| 101 | Introduction to Biology | Prof. Smith | Science | 3 | 25 | 2022-01-15 | 2022-05-10 | Room 101 | Open |
| 102 | Programming in Python | Prof. Brown | Computer Science | 4 | 30 | 2022-02-20 | 2022-06-15 | Lab 3, Building B | Closed |
| 103 | Financial Accounting | Prof. Green | Finance | 3 | 20 | 2022-03-10 | 2022-07-05 | Room 201 | Open |
| 104 | English Literature | Prof. White | Humanities | 3 | 22 | 2022-04-05 | 2022-08-20 | Room 301 | Open |
| 105 | Web Development Fundamentals | Prof. Black | IT | 4 | 28 | 2022-05-15 | 2022-09-25 | Lab 2, Building A | Closed |

Table is in 1NF.

Since there is no partial dependency it is in 2NF.

**course\_details**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **CourseName** | **Department** | **Credits** | **Availability** |
| 101 | Introduction to Biology | Science | 3 | Open |
| 102 | Programming in Python | Computer Science | 4 | Closed |
| 103 | Financial Accounting | Finance | 3 | Open |
| 104 | English Literature | Humanities | 3 | Open |
| 105 | Web Development Fundamentals | IT | 4 | Closed |

**instructor\_details**

|  |  |
| --- | --- |
| **InstructorID** | **Instructor** |
| I1 | Prof. Smith |
| I2 | Prof. Brown |
| I3 | Prof. Green |
| I4 | Prof. White |
| I5 | Prof. Black |

**learning\_management**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **InstructorID** | **Enrolled**  **Students** | **StartDate** | **EndDate** | **Location** | **Location\_Lab** |
| 101 | I1 | 25 | 2022-01-15 | 2022-05-10 | Room 101 | null |
| 102 | I2 | 30 | 2022-02-20 | 2022-06-15 | Building B | Lab 3 |
| 103 | I3 | 20 | 2022-03-10 | 2022-07-05 | Room 201 | null |
| 104 | I4 | 22 | 2022-04-05 | 2022-08-20 | Room 301 | null |
| 105 | I5 | 28 | 2022-05-15 | 2022-09-25 | Building A | Lab 2 |