Q1) Normalizing Employee Information

Unnormalized Form (UNF) initial table structure:

| **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 |

**1st Normal Form (1NF)**

EmployeeID is identified as the primary key as it uniquely identifies each employee.

Addressing Atomicity: No multivalued or composite attributes observed.

**2nd Normal Form (2NF)**

Removing Partial Dependencies AND making it more efficient:

Department is partially dependent on EmployeeID and ManagerID. To resolve this, you split the tables to:

a. Employees (EmployeeID [PK], EmployeeName, Salary, HireDate,DepartmentID[FK])

| **EmployeeID** | **EmployeeName** | **Salary** | **HireDate** | **DepartmentID** |
| --- | --- | --- | --- | --- |
| 1 | John Smith | 50000 | 2022-01-15 | D1 |
| 2 | Alice Brown | 60000 | 2022-02-20 | D2 |
| 3 | Mark Johnson | 55000 | 2022-03-10 | D3 |

b. Departments (DepartmentID[PK],Department,ManagerID[FK])

| **DepartmentID** | **Department** | **ManagerID** |
| --- | --- | --- |
| D1 | HR | 101 |
| D2 | IT | 102 |
| D3 | Sales | 101 |

**3rd Normal Form (3NF)**

Eliminating Transitive Dependencies:

Each manager (identified by ManagerID) is associated with an EmployeeID from the Employee table, which contains details about the employees, including their respective departments. Create another table to resolve this dependency.

New tables:

a. Employees (EmployeeID[PK], EmployeeName, Salary, HireDate,DeparmentID[FK])

| **EmployeeID** | **EmployeeName** | **Salary** | **HireDate** | **DepartmentID** |
| --- | --- | --- | --- | --- |
| 1 | John Smith | 50000 | 2022-01-15 | D1 |
| 2 | Alice Brown | 60000 | 2022-02-20 | D2 |
| 3 | Mark Johnson | 55000 | 2022-03-10 | D3 |

b. Departments (DepartmentID[PK], Department)

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

c. Managers (ManagerID[PK], EmployeeID[FK])

| **ManagerID** | **EmployeeID** |
| --- | --- |
| 101 | 1 |
| 102 | 2 |
| 101 | 3 |

---------------------------------------------------------------------------------------------------------------------------

Q2) Normalizing Training Programs

Unnormalized Form (UNF) initial table structure:

| **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 |

**1st Normal Form (1NF)**

Identifying Primary Key:

ProgramID can serve as the primary key as it uniquely identifies each program.

Addressing Atomicity: No multivalued or composite attributes observed.

**2nd Normal Form (2NF)**

* Removing partial dependency

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

| **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 |

**3rd Normal Form (3NF)**

* Removing Transitive dependency

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

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

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

Making it more efficient -

Program Table:

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

Employee Table:

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

Program-employee mapping:

| **ProgramID** | **DepartmentID** | **EmployeeID** | **Date** |
| --- | --- | --- | --- |
| 1 | D101 | 101 | 2022-03-01 |
| 2 | D102 | 102 | 2022-03-10 |
| 3 | D103 | 103 | 2022-03-20 |

Department Table:

| **DepartmentID** | **Department** |
| --- | --- |
| D101 | HR |
| D102 | IT |
| D103 | Sales |

---------------------------------------------------------------------------------------------------------------------------

Q3) Normalizing Customer orders

Unnormalized Form (UNF) initial table structure:

| **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 |

**1st Normal Form (1NF)**

Identifying Primary Key:

OrderID can serve as the primary key as it uniquely identifies each order.

Addressing Atomicity: No multivalued or composite attributes observed.

**2nd Normal Form (2NF)**

Removing Partial Dependencies:

ProductName, UnitPrice seems dependent on ProductID, which is not solely dependent on the primary key.

Create a separate table for Products to eliminate this partial dependency.

New tables:

a. Orders (OrderID [PK], CustomerName, ProductID [FK],Qty, UnitPrice, TotalAmount, OrderDate)

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

b. Products (ProductID [PK], ProductName,UnitPrice)

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

**3rd Normal Form (3NF)**

Eliminating Transitive Dependencies:

Resolves the transitive dependency by separating individual items within an order. ItemID, ProductID, and Qty details are directly associated with OrderID, avoiding indirect relationships and ensuring each item relates specifically to an order.

New tables:

1. Orders (OrderID [PK], CustomerName, TotalAmount, OrderDate).

| **OrderID** | **CustomerName** | **TotalAmount** | **OrderDate** |
| --- | --- | --- | --- |
| 1 | John Doe | 1600 | 2022-01-15 |
| 2 | Jane Smith | 500 | 2022-02-20 |
| 3 | John Doe | 200 | 2022-03-10 |

1. Items( ItemID[PK], ProductID[FK], Qty, OrderID[FK])

| **ItemID** | **ProductID** | **Qty** | **OrderID** |
| --- | --- | --- | --- |
| IT1 | 101 | 2 | 1 |
| IT2 | 102 | 1 | 2 |
| IT3 | 103 | 1 | 3 |

C. Products (ProductID [PK], ProductName,Unit Price)

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

---------------------------------------------------------------------------------------------------------------------------

Q4) Normalizing Stress management

Unnormalized Form (UNF) initial table structure:

| **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 |

**1st Normal Form (1NF)**

Identifying Primary Key:

EmployeeID can serve as the primary key as it uniquely identifies each employee.

Addressing Atomicity: No multivalued or composite attributes observed.

**2nd Normal Form (2NF)**

Removing Partial Dependencies:

By splitting the original table into three separate tables, each containing attributes directly related to the respective primary keys

New tables:

a. Employees (EmployeeID [PK], FirstName, LastName, StressLevel)

| **EmployeeID** | **FirstName** | **LastName** | **StressLevel** |
| --- | --- | --- | --- |
| 101 | Sarah | White | Moderate |
| 102 | Bob | Green | High |
| 103 | Charlie | Black | Low |
| 104 | David | Miller | High |
| 105 | Jane | Doe | Moderate |

b. WorkDetails(EmployeeID [FK], HoursOfWork, BreaksTaken)

| **EmployeeID** | **HoursOfWork** | **BreaksTaken** |
| --- | --- | --- |
| 101 | 45 | 3 |
| 102 | 50 | 2 |
| 103 | 40 | 4 |
| 104 | 48 | 1 |
| 105 | 42 | 3 |

c. Activities (EmployeeID [FK], PhysicalActivity, CounselingSessions)

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

**3rd Normal Form (3NF)**

Eliminating Transitive Dependencies: StressLevel and HoursOfWork have no transitive dependencies. The table structure remains unchanged.

---------------------------------------------------------------------------------------------------------------------------

Q5) Normalising Flee Market

Unnormalized Form (UNF) initial table structure:

| **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 | Excellent | 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 |

**1st Normal Form (1NF)**

Identifying Primary Key:

ItemID can serve as the primary key as it uniquely identifies each item.

Addressing Atomicity: No multivalued or composite attributes observed.

**2nd Normal Form (2NF)**

Removing Partial Dependencies: The Items table contains attributes solely dependent on the ItemID, while the Seller table attributes relate directly to SellerID, avoiding partial dependencies by linking each detail explicitly to its primary key.

New tables:

a. Items (ItemID [PK], ItemName,Category, Price, Description)

| **ItemID** | **ItemName** | **Category** | **Price** | **Description** |
| --- | --- | --- | --- | --- |
| 101 | Vintage Chair | Furniture | 50.00 | Beautiful vintage chair, excellent condition, Like New |
| 102 | Antique Clock | Home Decor | 80.00 | Authentic antique clock with Roman numerals |
| 103 | Vinyl Records | Music | 15.00 | Various artists and genres, in good condition |
| 104 | Vintage Jewelry | Accessories | 35.00 | Assorted vintage jewelry pieces, unique designs |
| 105 | Retro Camera | Electronics | 60.00 | Vintage Polaroid camera with original case |

b. Seller (SellerID[PK], ItemID [FK], SellerName, Quantity, Condition, Location, DateListed)

| **SellerID** | **ItemID** | **SellerName** | **Quantity** | **Condition** | **Location** | **DateListed** |
| --- | --- | --- | --- | --- | --- | --- |
| S1 | 101 | John's Treasures | 2 | Excellent | Booth 15, Section A | 2022-01-15 |
| S2 | 102 | Alice's Finds | 1 | Good | Stall 8, Section B | 2022-02-20 |
| S3 | 103 | Mark's Collectibles | 10 | Used | Booth 20, Section C | 2022-03-10 |
| S4 | 104 | Emma's Treasures | 5 | Excellent | Stall 12, Section D | 2022-04-05 |
| S5 | 105 | Robert's Finds | 1 | Good | Booth 5, Section A | 2022-05-15 |

**3rd Normal Form (3NF)**

Eliminating Transitive Dependencies:

Location details are separated into a dedicated Locations Table, ensuring each attribute solely depends on LocationID without transitive dependencies.

a. Items (ItemID [PK], ItemName,Category, Price, Description)

| **ItemID** | **ItemName** | **Category** | **Price** | **Description** |
| --- | --- | --- | --- | --- |
| 101 | Vintage Chair | Furniture | 50.00 | Beautiful vintage chair, excellent condition, Like New |
| 102 | Antique Clock | Home Decor | 80.00 | Authentic antique clock with Roman numerals |
| 103 | Vinyl Records | Music | 15.00 | Various artists and genres, in good condition |
| 104 | Vintage Jewelry | Accessories | 35.00 | Assorted vintage jewelry pieces, unique designs |
| 105 | Retro Camera | Electronics | 60.00 | Vintage Polaroid camera with original case |

b. Seller (SellerID[PK], ItemID [FK], SellerName, Quantity, Condition, LocationID[FK], DateListed)

| **SellerID** | **ItemID** | **SellerName** | **Quantity** | **Condition** | **LocationID** | **DateListed** |
| --- | --- | --- | --- | --- | --- | --- |
| S1 | 101 | John's Treasures | 2 | Excellent | L1 | 2022-01-15 |
| S2 | 102 | Alice's Finds | 1 | Good | L2 | 2022-02-20 |
| S3 | 103 | Mark's Collectibles | 10 | Used | L3 | 2022-03-10 |
| S4 | 104 | Emma's Treasures | 5 | Excellent | L4 | 2022-04-05 |
| S5 | 105 | Robert's Finds | 1 | Good | L5 | 2022-05-15 |

C. Locations(LocationID [PK], Location)

| **LocationID** | **Location** |
| --- | --- |
| L1 | Booth 15, Section A |
| L2 | Stall 8, Section B |
| L3 | Booth 20, Section C |
| L4 | Stall 12, Section D |
| L5 | Booth 5, Section A |

---------------------------------------------------------------------------------------------------------------------------

Q6) Normalising Learning Management System

Unnormalized Form (UNF) initial table structure:

| **CID** | **CourseName** | **Instructor** | **Department** | **Credits** | **EnrolledStudents** | **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 |

**1st Normal Form (1NF)**

Identifying Primary Key:

CID (Course ID) can serve as the primary key as it uniquely identifies each course.

Addressing Atomicity: No multivalued or composite attributes observed.

**2nd Normal Form (2NF)**

Removing Partial Dependencies: In the 2nd Normal Form (2NF), each table is organized to ensure all attributes within them are solely dependent on the primary key. The Courses table holds course-specific details, while the Department and Instructor tables separate departmental and instructor information respectively, avoiding partial dependencies by linking each detail directly to the Course ID (CID) primary key.

New tables:

a. Courses (CID [PK], CourseName, Instructor , Credits, EnrolledStudents, StartDate, EndDate, Location, Availability)

| **CID** | **CourseName** | **Credits** | **EnrolledStudents** | **StartDate** | **EndDate** | **Location** | **Availability** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 101 | Introduction to Biology | 3 | 25 | 2022-01-15 | 2022-05-10 | Room 101 | Open |
| 102 | Programming in Python | 4 | 30 | 2022-02-20 | 2022-06-15 | Lab 3, Building B | Closed |
| 103 | Financial Accounting | 3 | 20 | 2022-03-10 | 2022-07-05 | Room 201 | Open |
| 104 | English Literature | 3 | 22 | 2022-04-05 | 2022-08-20 | Room 301 | Open |
| 105 | Web Development Fundamentals | 4 | 28 | 2022-05-15 | 2022-09-25 | Lab 2, Building A | Closed |

b. Department (DepartmentID[PK], CID [FK], Department)

| **DepartmentID** | **CID** | **Department** |
| --- | --- | --- |
| D1 | 101 | Science |
| D2 | 102 | Computer Science |
| D3 | 103 | Finance |
| D4 | 104 | Humanities |
| D5 | 105 | IT |

c. Instructor(InstructorID [PK], CID[FK] , Instructor)

| **InstructorID** | **CID** | **Instructor** |
| --- | --- | --- |
| IN01 | 101 | Prof. Smith |
| IN02 | 102 | Prof. Brown |
| IN03 | 103 | Prof. Green |
| IN04 | 104 | Prof. White |
| IN05 | 105 | Prof. Black |

**3rd Normal Form (3NF)**

Eliminating Transitive Dependencies: No transitive dependencies observed.

---------------------------------------------------------------------------------------------------------------------------