Q12

First Normal Form – 1NF:

- A single cell holds only one value
- Primary Key for identification
- No duplicated rows or columns
- Each column has only value for each row in the table

Example not in 1NF:

CustomerID	Name	PhoneNumbers
1	Alice	123-456, 789-012
2	Bob	345-678

Example in 1NF:

CustomerID	Name	PhoneNumber
1	Alice	123-456
1	Alice	789-012
2	Bob	345-678

Second Normal Form – 2NF:

- It is already in 1NF
- No partial dependency → All non-key attributes are fully dependent on a primary key.

Example in 1NF but not in 2NF

OrderID	ProductID	ProductName	Quantity
101	1	Pen	10
102	2	Notebook	5

Normalized to 2NF:

- **Orders Table:**

OrderID	ProductID	Quantity
101	1	10
102	2	5

- **Products Table:**

ProductID	ProductName
1	Pen
2	Notebook

Third Normal Form – 3NF:

- Is already in 2NF
- No transitive partial dependency

Example in 2NF but not in 3NF:

EmployeeID	DepartmentID	DepartmentName
1	10	HR
2	20	IT

➔ DepartmentName depends on DepartmentID, not directly on EmployeeID

Normalized to 3NF:

- **Employee Table:**

EmployeeID	DepartmentID
1	10
2	20

- **Department Table:**

DepartmentID	DepartmentName
10	HR
20	IT

Insertion Anomaly

Occurs when adding new data requires unnecessary information

Example: We want to add a new department (Marketing) without any employees. We can not do so without assigning an employee in a non-normalized schema:

EmployeeID	Name	DepartmentName
1	Alice	HR
2	Bob	IT
3	-	Marketing

With a normalized Schema, the Department Table can simply be updated, without affecting the other tables:

DepartmentID	DepartmentName
10	HR
20	IT
30	Marketing

Update Anomaly

Occurs when updating a value requires changes in multiple rows

Example: We want to change the name of the HR department to “Human Resources”. In a non-normalized schema multiple rows have to be updated → risk of inconsistencies

EmployeeID	Name	DepartmentName
1	Alice	HR → Human Resources
2	Bob	HR → Human Resources

With a normalized Schema, the Department Table can simply be updated:

DepartmentID	DepartmentName
10	HR → Human Resources
20	IT

Deletion Anomaly

Occurs when deleting a row inadvertently removes necessary data

Example: Deleting the only order of “Pen” would result in a complete loss of the product data in a non-normalized schema:

OrderID	ProductID	ProductName	Quantity
101	1	Pen	10
102	2	Notebook	5

With a normalized schema the product information is stored separate from the orders. A deletion of orders therefore does not affect the product information:

ProductID	ProductName
1	Pen