1. **Delete:**

**a) i. Delete the book where Genre is NULL:**

**Violation of referential integrity constraint:** NOT NULL constraint on Genre.

**Solution:** Only delete books where Genre is not NULL. Use SET DEFAULT or SET NULL for cascading constraint.

| **BookID** | **Title** | **Author** | **Genre** | **Price** |
| --- | --- | --- | --- | --- |
| 1 | The Bell Jar | Sylvia Plath | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1984 | George Orwell | Thriller | 14.99 |
| 4 | The Prophet | Kahlil Gibran | Poetry | NULL |

| **OrderID** | **BookID** | **CustomerID** | **Quantity** | **OrderDate** | **OrderStatus** |
| --- | --- | --- | --- | --- | --- |
| 120 | 1 | 12 | 2 | 2024-02-01 | Processing |
| 121 | 2 | 16 | 3 | 2024-02-01 | Completed |
| 122 | 3 | 18 | 4 | 2024-02-02 | Shipped |
| 123 | NULL | 19 | 1 | 2024-02-02 | Processing |
| 124 | 2 | 20 | 6 | 2024-02-02 | Cancelled |

**ii. Delete the book where Price is less than $10.00.**

**violated Referential integrity constraint:** Price constraint.

**Solution**: Only delete books where Price is greater than or equal to $10.00.Use SET DEFAULT or SET NULL for cascading constraint.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 3 | 1984 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | Khalil Jibran | Poetry | NULL |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order ID | Book ID | Customer ID | Quantity | Order Data | Order Status |
| 120 | 1 | 12 | 2 | 2024-02-1 | Processing |
| 121 | 2 | 16 | 3 | 2024-02-1 | Completed |
| 122 | 3 | 18 | 4 | 2024-02-2 | Shipped |
| 123 | NULL | 19 | 1 | 2024-02-02 | Processing |

**iii. Delete the order where Book ID is 1.**

Successful operation. No integrity constraints violated.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order ID | Book ID | Customer ID | Quantity | Order Data | Order Status |
| 121 | 2 | 16 | 3 | 2024-02-1 | Completed |
| 122 | 3 | 18 | 4 | 2024-02-2 | Shipped |
| 123 | NULL | 19 | 1 | 2024-02-02 | Processing |
| 124 | 2 | 20 | 6 | 2024-02002 | Canceled |
| 125 | 5 | 21 | 3 | 2024-02-3 | NULL |

**iv. Delete the book where Book ID is 4.**

Successful operation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1984 | George Orwell | Thriller | 14.99 |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

**b) SET NULL OPTION**

**i. Delete the book where Genre is Autobiography.**

This will delete the rows with book\_id 1 in the books and set book\_id from 1 to null in the  orders table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1984 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | Khalil Jibran | Poetry | NULL |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order ID | Book ID | Customer ID | Quantity | Order Data | Order Status |
| 120 | NULL | 12 | 2 | 2024-02-1 | Processing |
| 121 | 2 | 16 | 3 | 2024-02-1 | Completed |
| 122 | 3 | 18 | 4 | 2024-02-2 | Shipped |
| 123 | NULL | 19 | 1 | 2024-02-02 | Processing |
| 124 | 2 | 20 | 6 | 2024-02002 | Canceled |
| 125 | 5 | 21 | 3 | 2024-02-3 | NULL |

**ii. Delete the order where Book ID is NULL.**

It will delete the row with order\_id 123 in the orders table.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order ID | Book ID | Customer ID | Quantity | Order Data | Order Status |
| 120 | 1 | 12 | 2 | 2024-02-1 | Processing |
| 121 | 2 | 16 | 3 | 2024-02-1 | Completed |
| 122 | 3 | 18 | 4 | 2024-02-2 | Shipped |
| 124 | 2 | 20 | 6 | 2024-02002 | Canceled |
| 125 | 5 | 21 | 3 | 2024-02-3 | NULL |

**iii. Delete the book where Author is ‘George Orwell’**

This will delete the row with book\_id 3 in the books and change book\_id from 3 to null in orders table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 4 | The prophet | Khalil Jibran | Poetry | NULL |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order ID | Book ID | Customer ID | Quantity | Order Data | Order Status |
| 120 | 1 | 12 | 2 | 2024-02-1 | Processing |
| 121 | 2 | 16 | 3 | 2024-02-1 | Completed |
| 122 | NULL | 18 | 4 | 2024-02-2 | Shipped |
| 123 | NULL | 19 | 1 | 2024-02-02 | Processing |
| 124 | 2 | 20 | 6 | 2024-02002 | Canceled |
| 125 | 5 | 21 | 3 | 2024-02-3 | NULL |

**iv. Delete all books.**

This will delete all books and set all book\_id in  orders in the order table to null.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order ID | Book ID | Customer ID | Quantity | Order Data | Order Status |
| 120 | NULL | 12 | 2 | 2024-02-1 | Processing |
| 121 | NULL | 16 | 3 | 2024-02-1 | Completed |
| 122 | NULL | 18 | 4 | 2024-02-2 | Shipped |
| 123 | NULL | 19 | 1 | 2024-02-02 | Processing |
| 124 | NULL | 20 | 6 | 2024-02002 | Canceled |
| 125 | NULL | 21 | 3 | 2024-02-3 | NULL |

**c) NO ACTION**

**i. Delete the book where Price is NULL.**

This will delete row with book\_id 4 in books table.

No changes in orders table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

**ii. Delete the book where Book ID is 4.**

This will delete row with book\_id 4 in books table.

No changes in orders table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

**iii. Delete the book where Book ID is 2.**

This will delete row with book\_id 2 in books table.

No changes in orders table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | Khalil Jibran | Poetry | NULL |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

**2. Insert:**

a) i. Insert <6, “Broken Wings”, “Kahlil Gibran”, “Poetry”, NULL > into Books.

Successful operation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | Khalil Jibran | Poetry | NULL |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |
| 6 | Broken Wings | Khalil Gibran | Poetry | NULL |

ii. Insert <5, “A Tale of Two Cities”, “Charles Dickens”, “Historical Novel”, $9.99 > into Books.

Successful operation.

iii. Insert <NULL, “Animal Farm”, “George Orwell”, “Satire”, $10.99 > into Books.

- Integrity constraint violated: NOT NULL constraint on Book ID.

Solution: Provide a valid Book ID.

iv. Insert <126, 5, 21, 4,” 2024-02-3”,”Processing”> into Orders.

Successful operation.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order ID | Book ID | Customer ID | Quantity | Order Data | Order Status |
| 120 | 1 | 12 | 2 | 2024-02-1 | Processing |
| 121 | 2 | 16 | 3 | 2024-02-1 | Completed |
| 122 | 3 | 18 | 4 | 2024-02-2 | Shipped |
| 123 | NULL | 19 | 1 | 2024-02-02 | Processing |
| 124 | 2 | 20 | 6 | 2024-02002 | Canceled |
| 125 | 5 | 21 | 3 | 2024-02-3 | NULL |
| 126 | 5 | 21 | 4 | 2024-02-3 | Processing |

b)

Here are the updated tables after the insert operations:

Table: Books

| **Book ID** | **Title** | **Author** | **Genre** | **Price** |
| --- | --- | --- | --- | --- |
| 1 | The Bell Jar | Sylvia Plath | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1984 | George Orwell | Thriller | 14.99 |
| 4 | The Prophet | Kahlil Gibran | Poetry | NULL |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |
| 7 | The Zahir | Paulo Coelho | Novel | 9.99 |
| NULL | A Tale of Two Cities | Charles Dickens | Historical Novel | 9.99 |
| 8 | Pride and Prejuidice | Jane Austen | Novel | NULL |

Table: Orders

| **Order ID** | **Book ID** | **Customer ID** | **Quantity** | **Order Date** | **Order Status** |
| --- | --- | --- | --- | --- | --- |
| 120 | 1 | 12 | 2 | 2024-02-01 | Processing |
| 121 | 2 | 16 | 3 | 2024-02-01 | Completed |
| 122 | 3 | 18 | 4 | 2024-02-02 | Shipped |
| 123 | NULL | 19 | 1 | 2024-02-02 | Processing |
| 124 | 2 | 20 | 6 | 2024-02-02 | Cancelled |
| 125 | NULL | 21 | 4 | 2024-02-03 | Cancelled |
| 126 | 6 | 21 | 2 | 2024-02-03 | Processing |

1. For Book ID 7, "The Zahir" by Paulo Coelho is inserted into the Books table.
2. In Orders table, Order ID 125 is inserted with Book ID set to NULL since Book ID 5 doesn't exist in the Books table.
3. Book ID is set to NULL in Orders table for Order ID 125 because of the foreign key constraint with the Set NULL option.
4. Insert <126, 6, 21, 2,” 2024-02-3”,”Processing”> into Orders

This insert operation will set the Book ID of Order 126 to NULL since the Book ID 6 doesn't exist in the Books table. The Orders table will look like this

| **Order ID** | **Book ID** | **Customer ID** | **Quantity** | **Order Date** | **Order Status** |
| --- | --- | --- | --- | --- | --- |
| 126 | NULL | 21 | 2 | 2024-02-03 | Processing |

c) Foreign key with No Action:

i. Insert <8, “Pride and Prejuidice”, “Jane Austen”, “Novel” > into Books.

This insert operation will add a new book to the Books table:

| **Book ID** | **Title** | **Author** | **Genre** | **Price** |
| --- | --- | --- | --- | --- |
| 8 | Pride and Prejuidice | Jane Austen | Novel | NULL |

ii. Insert <125, 7, 23, 1,” 2024-02-3”,”Shipped”> into Orders

This insert operation will not be allowed because Book ID 7 doesn't exist in the Books table and the foreign key constraint is set to No Action. It would violate the foreign key constraint, and the insertion would fail.

**d)**

**i. Insert <8, “Pride and Prejudice”, “Jane Austen”, “Novel” > into Books.**

It will add aforementioned entry into books and set price to null

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | Khalil Jibran | Poetry | NULL |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |
| 8 | Pride and Prejudice | Jane Austen | Novel | NULL |

**ii. Insert <125, 7, 23, 1,” 2024-02-3”,”Shipped”> into Orders**

Primary key violation uniqueness, order\_id 125 already exists in orders table

Foreign key constraint violation there is no book with book\_id 7 in books table.

**3. Update:**

a) i. For Book ID=5 change it to 2 in book table.

Successful operation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | Khalil Jibran | Poetry | NULL |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order ID | Book ID | Customer ID | Quantity | Order Data | Order Status |
| 120 | 1 | 12 | 2 | 2024-02-1 | Processing |
| 121 | 2 | 16 | 3 | 2024-02-1 | Completed |
| 122 | 3 | 18 | 4 | 2024-02-2 | Shipped |
| 123 | NULL | 19 | 1 | 2024-02-02 | Processing |
| 124 | 2 | 20 | 6 | 2024-02002 | Canceled |
| 125 | 2 | 21 | 3 | 2024-02-3 | NULL |

ii. For Book ID=5 change it to 6 in book table.

Successful operation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | Khalil Jibran | Poetry | NULL |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order ID | Book ID | Customer ID | Quantity | Order Data | Order Status |
| 120 | 1 | 12 | 2 | 2024-02-1 | Processing |
| 121 | 2 | 16 | 3 | 2024-02-1 | Completed |
| 122 | 3 | 18 | 4 | 2024-02-2 | Shipped |
| 123 | NULL | 19 | 1 | 2024-02-02 | Processing |
| 124 | 2 | 20 | 6 | 2024-02002 | Canceled |
| 125 | 6 | 21 | 3 | 2024-02-3 | NULL |

iii. For Book ID=2 change the price $6.99.

Successful operation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 6.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | Khalil Jibran | Poetry | NULL |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

iv. For Order ID = 121 change Book ID = 12.

Integrity constraint violated: Foreign key constraint.

Solution: Either provide a valid Book ID or remove the foreign key constraint.

1. **SET NULL**

**i. For Book ID=5 change it to 7 in book table**

book \_id 5 will be updated to 7 in book table and in order table it will be set to null

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | Khalil Jibran | Poetry | NULL |
| 7 | Gulistan | Saadi Shirazi | NULL | 8.99 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order ID | Book ID | Customer ID | Quantity | Order Data | Order Status |
| 120 | 1 | 12 | 2 | 2024-02-1 | Processing |
| 121 | 2 | 16 | 3 | 2024-02-1 | Completed |
| 122 | 3 | 18 | 4 | 2024-02-2 | Shipped |
| 123 | NULL | 19 | 1 | 2024-02-02 | Processing |
| 124 | 2 | 20 | 6 | 2024-02002 | Canceled |
| 125 | NULL | 21 | 3 | 2024-02-3 | NULL |

**ii. For Book ID=4 change the Author to ‘KG’.**

Author of book\_id = 4 will be changed to KG in books table. No changes in the orders table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | KG | Poetry | NULL |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

**iii. For Orders having NULL Order Status change Book ID = 2.**

Book id of order having book\_id 5 previously will be changed to 2.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | Khalil Jibran | Poetry | NULL |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order ID | Book ID | Customer ID | Quantity | Order Data | Order Status |
| 120 | 1 | 12 | 2 | 2024-02-1 | Processing |
| 121 | 2 | 16 | 3 | 2024-02-1 | Completed |
| 122 | 3 | 18 | 4 | 2024-02-2 | Shipped |
| 123 | NULL | 19 | 1 | 2024-02-02 | Processing |
| 124 | 2 | 20 | 6 | 2024-02002 | Canceled |
| 125 | 2 | 21 | 3 | 2024-02-3 | NULL |

1. **NO ACTION**

**i. For Book having book ID=2 change it to 6 in book table.**

Book\_id 2 will be updated to 6 in the books table but there will be no change in the orders table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 6 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | Khalil Jibran | Poetry | NULL |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

**ii. For Book having Book ID=4 change price to $10.99.**

The price of book with book\_id=4 will be updated to 10.99. No changes in the orders table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Book ID | Title | Author | Genre | Price |
| 1 | The Bell Jar | Sylvia Path | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 9.99 |
| 3 | 1983 | George Orwell | Thriller | 14.99 |
| 4 | The prophet | Khalil Jibran | Poetry | 10.99 |
| 5 | Gulistan | Saadi Shirazi | NULL | 8.99 |

**iii. For Orders having NULL Order Status change Book ID = 8.**

Foreign key violation. There is no book with book\_id= 8 in the parent table books.

| **Book ID** | **Title** | **Author** | **Genre** | **Price** |
| --- | --- | --- | --- | --- |
| 1 | The Bell Jar | Sylvia Plath | Autobiography | 12.99 |
| 2 | Crime and Punishment | Fyodor Dostoevsky | Mystery | 6.99 |
| 3 | 1984 | George Orwell | Thriller | 14.99 |
| 4 | The Prophet | KG | Poetry | 10.99 |
| 5 | Gulistan | Saadi Shirazi | NULL | NULL |
| 6 | The Prophet | Kahlil Gibran | Poetry | NULL |
| 7 | The Zahir | Paulo Coelho | Novel | 8.99 |
| 8 | Pride and Prejuidice | Jane Austen | Novel | NULL |

| **Order ID** | **Book ID** | **Customer ID** | **Quantity** | **Order Date** | **Order Status** |
| --- | --- | --- | --- | --- | --- |
| 120 | 1 | 12 | 2 | 2024-02-01 | Processing |
| 121 | NULL | 16 | 3 | 2024-02-01 | Completed |
| 122 | 3 | 18 | 4 | 2024-02-02 | Shipped |
| 123 | 2 | 19 | 1 | 2024-02-02 | Processing |
| 124 | 2 | 20 | 6 | 2024-02-02 | Cancelled |
| 125 | 7 | 21 | 4 | 2024-02-03 | Cancelled |
| 126 | NULL | 21 | 2 | 2024-02-03 | Processing |

**Q2. Database schema is designed as:**

a) Primary keys of all relations:

|  |  |
| --- | --- |
| Relation | Primary Key |
| Flight | FlightId |
| Pilot | PilotId |
| Customer | CusId |
| Booking | BookingId |

b) **Secondary keys:** Not necessary but if we want to make than secondary keys are as follows:

|  |  |
| --- | --- |
| **Relation** | **Secondary Key** |
| Pilot | LisenceNo |
| Customer | PassportNo |

c) Foreign keys are:

|  |  |  |
| --- | --- | --- |
| **Relation** | **Foreign Key** | **References** |
| Flight | PilotId | Pilot (PilotId) |
| Booking | CusId and FlightId | Customer(CusId)  and Flight(FlightId) |

d) Example of insertion in Flight relation that violates referential integrity constraint:

The referential integrity requirement would be broken if we attempted to enter a record with a PilotId into the Flight database that does not exist in the Pilot table. The referential integrity requirement is broken if we insert 652 PilotId into the table since there isn't a pilot with PilotId 652 in the Pilot relation.For example:

Let's say we have the following data in the Pilot table:

Pilot:

| **PilotId** | **PilotName** | **LicenseNo** | **PhoneNo** |
| --- | --- | --- | --- |
| 101 | Fawwaz | 35413 | 03224855632 |
| 102 | khalil | 24612 | 03224855635 |

And let's say we attempt to insert a flight record into the Flight table with a PilotId that does not exist, violating the referential integrity constraint:

Flight:

| **FlightId** | **DepartureDate** | **ArrivalDate** | **PilotId** |
| --- | --- | --- | --- |
| 201 | 2023-02-23 | 2023-02-27 | 103 |

In this case, PilotId 103 does not exist in the Pilot table. Therefore, this insertion violates the referential integrity constraint.

e) Example of insertion in Flight relation that violates entity integrity constraint:

The entity integrity constraint would be broken if we attempted to insert a record with a NULL value in FlightId because FlightId is a main key and cannot be NULL or An entity integrity constraint is broken if we enter a duplicate value for flightId.For example:

Flight:

| **FlightId** | **DepartureDate** | **ArrivalDate** | **PilotId** |
| --- | --- | --- | --- |
| 301 | NULL | 2022-02-24 | 101 |

In this example, the DepartureDate attribute is NULL, violating the entity integrity constraint because DepartureDate is supposed to be a mandatory attribute and cannot be NULL.

**Q3:Database Design for SOFTEC System**

**a) Main Relations are may be as follows:**

1. **Competition:** Stores information about individual competitions
2. **Student:** Stores information about participating students.
3. **Faculty:** Stores information about FAST-NU faculty
4. **Evaluation:** Stores evaluation details for participants by Faculty judges.

**b) Attributes for relations are :**

**Competition:**

* Competition ID (int, Primary Key)
* Name (varchar)
* Faculty ID (int, Foreign Key references Faculty(FacultyID))
* Description (text)

**Student:**

* Student ID (int, Primary Key)
* Name (varchar)
* University (varchar)
* Email (varchar)
* Phone No. (varchar)

**Faculty:**

* Faculty ID (int, Primary Key)
* Name (varchar)
* Department (varchar)
* Email (varchar)
* Phone No. (varchar)

**Evaluation:**

* Evaluation ID (int, Primary Key)
* Competition ID (int, Foreign Key references Competition ID)
* Student ID (int, Foreign Key references Student ID)
* Score (int)
* Feedback (text)

**c) Keys:**

* **Primary Keys:** Each table has a unique identifier as its primary key (Competition\_ID, Student\_ID, Faculty\_ID,  Evaluation\_ID).
* **Secondary Keys:**
  1. Student: Email
  2. Faculty: Email
* **Foreign Keys:**
  1. Competition: HeadFaculty\_ID references Faculty(Faculty\_ID)
  2. Evaluation: StudentID references Student(StudentID)

**d)**1. **Competition**:

| **CompetitionId** | **Name** | **Date** | **Venue** | **FacultyId** |
| --- | --- | --- | --- | --- |
| 1 | Software Competition | 2022-03-21 | Auditorium | 10 |
| 2 | Programming Competition | 2023-03-24 | Lecture room | 12 |
| 3 | AI | 2025-03-15 | Seminar Room | 103 |
| 4 | Tech | 2028-03-20 | Auditorium Hall | 141 |
| 5 | Robo rumble | 2034-03-2 | Auditorium | 20 |

2. **Student:**

| **StudentId** | **Name** | **University** | **ContactNo** | **Email** |
| --- | --- | --- | --- | --- |
| 1 | Fawwaz | FAST University | 03254027546 | Lhrnu1@gmail.com |
| 2 | Talha | FAST Institute | 03254027546 | Lhrnu2@gmail.com |
| 3 | Ibrahim | GCU College | 03254027546 | Lhrnu3@gmail.com |
| 4 | Arbaz | GIKI University | 03254027546 | Lhrnu4@gmail.com |
| 5 | Awais | NUST Institute | 03254027546 | Lhrnu5@gmail.com |

3. **Faculty:**

| **FacultyId** | **Name** | **Department** | **Email** | **PhoneNo** |
| --- | --- | --- | --- | --- |
| 101 | Prof. ISHAQ | Computer Science | asd@fast.nu.edu.pk | 03251023232 |
| 102 | Dr. Sarah | Electrical Eng. | dsaf@fast.nu.edu.pk | 03251023232 |
| 103 | Prof. Aleena | Mechanical Eng. | thgr@fast.nu.edu.pk | 03251023232 |
| 104 | Dr. Yasir | Computer Science | jyghn@fast.nu.edu.pk | 03251023232 |
| 105 | Prof. Yousaf | Chemical Eng. | dhrtr@fast.nu.edu.pk | 03251023232 |

5. **Evaluation**:

| **EvaluationId** | **CompetitionId** | **StudentId** | **Score** | **Remarks** |
| --- | --- | --- | --- | --- |
| 1 | 1 | 1 | 90 | Very good |
| 2 | 1 | 1 | 95 | Very good |
| 3 | 2 | 2 | 75 | good |
| 4 | 2 | 3 | 60 | Very good |
| 5 | 3 | 4 | 58 | Well done |

e) A straightforward centralised DBMS would work well in this situation. A centralised database would be simpler to administer, scale, and maintain because the system is for a single organisation (FAST-NU) and a relatively small amount of data is anticipated. Furthermore, a distributed database would be more difficult to set up and maintain and offer little advantages in this situation as opposed to a centralised database, which would offer superior consistency, dependability, and security.

Scalability: A distributed database management system (DBMS) facilitates smooth extension to accommodate growing demand without compromising performance, even with anticipated increases in contests and players.   
Performance: Softec's multiple locations are made possible via a distributed database management system (DBMS), which lowers latency by storing data closer to users and improves system responsiveness.   
Data Distribution and Usage: Distributed data storage lowers latency and network overhead for users using the system from different places, which helps Softec's broad participant base.