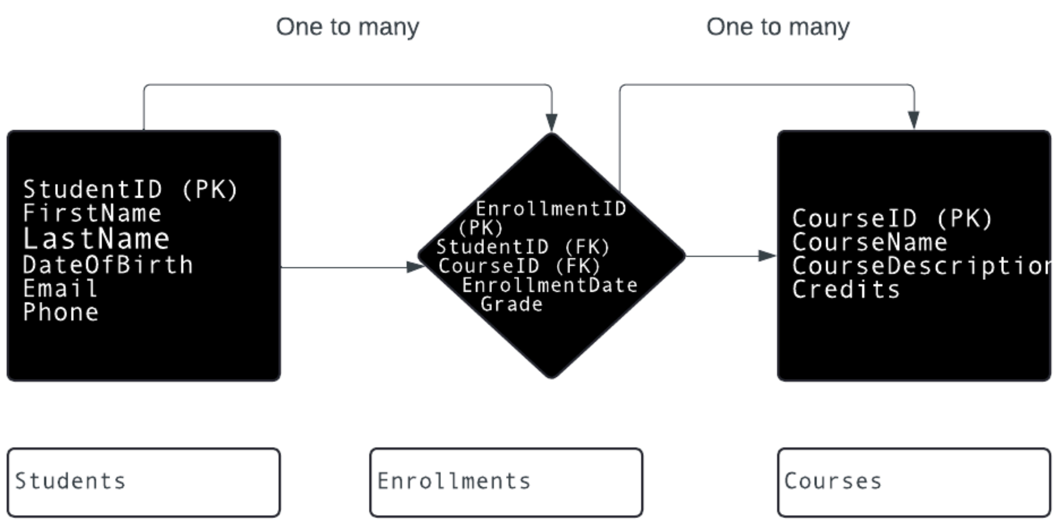
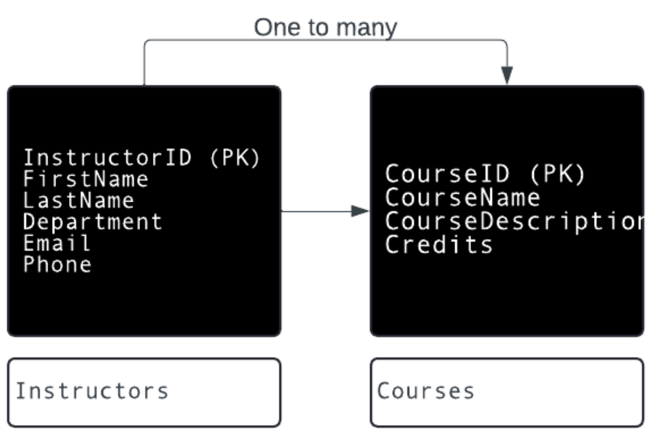
ASSIGNMENT – 8

1) Analyze a given business scenario and create an ER diagram that includes entities, relationships, attributes, and cardinality. Ensure that the diagram reflects proper normalization up to the third normal form.

Answer:





Scenario: University Course Enrollment System

The university needs a system to manage the following:

1. Students: Information about students including their personal details.

2. Courses: Information about courses offered by the university.
3. Instructors: Information about instructors teaching the courses.
4. Enrollments: Records of students enrolling in courses.

Entities and Attributes:

1. Students

- StudentID (Primary Key)
- FirstName
- LastName
- DateOfBirth
- Email
- Phone

2. Courses

- CourseID (Primary Key)
- CourseName
- CourseDescription
- Credits

3. Instructors

- InstructorID (Primary Key)
- FirstName
- LastName
- Department
- Email
- Phone

4. Enrollments

- EnrollmentID (Primary Key)
- StudentID (Foreign Key)
- CourseID (Foreign Key)
- EnrollmentDate
- Grade

Relationships:

1. Student - Enrollments:

- One student can have many enrollments.

● Each enrollment is associated with one student.
2. Course - Enrollments:
● One course can have many enrollments.
● Each enrollment is associated with one course.
3. Instructor - Courses:
● One instructor can teach many courses.
● One course is taught by one instructor.

Explanation:

● The students table stores information about students.
● The course table stores information about courses.
● The instructor table stores information about instructors.
● Enrollments table handles the many-to-many relationship between students and courses.
● The Teaches relationship (which might be represented as part of the Courses table or as a separate relationship entity if needed) ensures each course is assigned to one instructor.

2) Design a database schema for a library system, including tables, fields, and constraints like NOT NULL, UNIQUE, and CHECK. Include primary and foreign keys to establish relationships between tables.

Answer:
Tables:
Books: BookID (Primary Key) , Title, Author
Publisher : PublishYear, ISBN (Unique)
Members: MemberID (Primary Key), Name, Email, Phone
Borrowings: BorrowingID (Primary Key), BookID (Foreign Key referencing Books), MemberID (Foreign Key referencing Members), BorrowDate, ReturnDate, Status (e.g., 'Borrowed', 'Returned')
Constraints:NOT NULL: Ensure that certain fields cannot be empty.
UNIQUE: Ensure that certain fields have unique values.
CHECK: Apply conditions to ensure data integrity.
Field Constraints:
In the Books table:

BookID: NOT NULL
Title: NOT NULL
ISBN: UNIQUE
In the Members table:
MemberID: NOT NULL
Name: NOT NULL
In the Borrowings table:
BorrowingID: NOT NULL
BookID: NOT NULL
MemberID: NOT NULL
BorrowDate: NOT NULL
Status: CHECK (Status must be either 'Borrowed' or 'Returned')
Primary and Foreign Keys:
Primary Keys: Unique identifiers for each record in a table.
BookID in Books table
MemberID in Members table
BorrowingID in Borrowings table
Foreign Keys: Establish relationships between tables.BookID in Borrowings table references BookID in Books table
MemberID in Borrowings table references MemberID in Members table

3) Assignment 3: Explain the ACID properties of a transaction in your own words. Write SQL statements to simulate a transaction that includes locking and demonstrate different isolation levels to show concurrency control.
Answer:
Atomicity: Atomicity ensures that a transaction is treated as a single unit of work. This means that either all of the operations within the transaction are completed successfully, or none of them are. If any part of the transaction fails, the entire transaction is rolled back to its initial state

Consistency: Consistency ensures that a transaction brings the database from one valid state to another valid state. In other words, integrity constraints, business rules, and other constraints are maintained before and after the transaction.

Isolation: Isolation ensures that concurrent execution of transactions results in a system state that would be obtained if transactions were executed serially, i.e., one after the other. Isolation prevents transactions from interfering with each other by ensuring that intermediate transaction states are not visible to other transactions until the transaction is committed.

Durability: Durability guarantees that once a transaction is committed, its effects are permanent and survive system failures. Even in the event of a system crash or power loss, the changes made by committed transactions are preserved in the database.

```
-- Create a table for demonstration
CREATE TABLE Account (
AccountID INT PRIMARY KEY, Balance DECIMAL(10,2)
);
-- Insert some sample data
INSERT INTO Account (AccountID, Balance) VALUES (1, 1000), (2, 2000);

-- Begin a transaction
BEGIN TRANSACTION;
-- Simulate a money transfer between accounts
UPDATE Account SET Balance = Balance - 500 WHERE AccountID = 1;
UPDATE Account SET Balance = Balance + 500 WHERE AccountID = 2;

-- Commit the transaction
COMMIT;

-- Display the updated balances
SELECT * FROM Account;

-- Set isolation level to Read Uncommitted
SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
xSET TRANSACTION ISOLATION LEVEL READ COMMITTED;
SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;SET
TRANSACTION ISOLATION LEVEL SERIALIZABLE;
```

Isolation Level Explanation

READ UNCOMMITTED: The lowest level, allows a transaction to read uncommitted changes made by other transactions. This can lead to "dirty reads." In our scenario, one member might see the book as available even though another transaction is in the process of checking it out.

READ COMMITTED: Prevents dirty reads by only allowing a transaction to read committed changes. However, it can lead to "non-repeatable reads" where a transaction reads the same data twice and gets different results.
REPEATABLE READ: Fixes non-repeatable reads by ensuring that if a transaction reads a row; it will see the same values throughout the transaction. However, it can still experience "phantom reads" where new rows appear in the result set.

SERIALIZABLE: The most restrictive level. It acts as if transactions were executed one after the other, eliminating concurrency issues. This is the safest but also the leastperforming option.

Important Notes:
The FOR-UPDATE clause in the SELECT statement is crucial for locking the book record and preventing race conditions.
Isolation levels are a trade-off between consistency and performance. Choose the appropriate level based on your application's requirements. Most databases use READ COMMITTED as the default isolation level.

4) Write SQL statements to CREATE a new database and tables that reflect the library schema you designed earlier. Use ALTER statements to modify the table structures and DROP statements to remove a redundant table.

Answer:
1) Create a database:
Create database Library;
2) Use the created database:
Use Library;
3) Create the Books table:
Create Table Books (BookID INT PRIMARY KEY,Title VARCHAR(255) NOT

NULL,Author VARCHAR(255) NOT NULL,Publisher VARCHAR(255), PublishYear INT,ISBN VARCHAR(20) UNIQUE);

4) Create the Members table:

Create Table Members (MemberID INT PRIMARY KEY,Name VARCHAR(100) NOT NULL,Email VARCHAR(100),Phone VARCHAR(20));

5) Create the Borrowings table

Create Table Borrowings (BorrowingID INT PRIMARY KEY,BookID INT,MemberID INT,BorrowDate DATE NOT NULL,ReturnDate DATE,Status ENUM('Borrowed', 'Returned'),FOREIGN KEY (BookID) REFERENCES Books(BookID),FOREIGN KEY (MemberID) REFERENCES Members(MemberID));

6) ALTER TABLE Books ADD COLUMN Genre VARCHAR(50);

-- Drop the redundant Watchlist table

Drop Table IF EXISTS Watchlist;

5) Demonstrate the creation of an index on a table and discuss how it improves query performance. Use a DROP INDEX statement to remove the index and analyze the impact on query execution.

Answer:

```
CREATE INDEX idx_title ON Books(Title);
SELECT * FROM Books WHERE Title = 'Harry Potter';
SELECT * FROM Books WHERE Title = 'Harry Potter';
DROP INDEX idx_title ON Books;
SELECT * FROM Books WHERE Title = 'Harry Potter';
```

In summary, creating an index on a table column can improve query performance by allowing the database to quickly locate rows that match the specified criteria without having to scan the entire table. Dropping the index may result in slower query performance, especially for queries that rely on the indexed column for filtering or sorting. However, indexes also have associated costs such as increased storage space and potential overhead on data modification operations.

6)Create a new database user with specific privileges using the CREATE USER and GRANT commands. Then, write a script to REVOKE certain privileges and DROP the user.

Answer: Create a new database user

CREATE USER 'new_user'@'localhost' IDENTIFIED BY 'password';
GRANT SELECT, INSERT, UPDATE ON database_name.* TO 'new_user'@'localhost';
REVOKE INSERT ON database_name.table_name FROM 'new_user'@'localhost';
DROP USER 'new_user'@'localhost';

In this script:Replace 'new_user' with the username you want to create.

Replace 'password' with the password for the new user.

Replace 'database_name' with the name of the database you want to grant privileges on.

Replace 'table_name' with the name of the table from which you want to revoke privileges.

This script creates a new user, grants SELECT, INSERT, and UPDATE privileges on a specific database to the user, revokes the INSERT privilege on a specific table, and finally drops the user.

7) Prepare a series of SQL statements to INSERT new records into the library tables, UPDATE existing records with new information, and DELETE records based on specific criteria. Include BULK INSERT operations to load data from an external source.

Answer:

INSERT INTO statement to add new records:

-- Insert a new book record
INSERT INTO Books (BookID, Title, Author, Publisher, PublishYear, ISBN)
VALUES (1, 'To Kill a Mockingbird', 'Harper Lee', 'J.B. Lippincott & Co.', 1960, '9780061120084');

-- Insert a new member record
INSERT INTO Members (MemberID, Name, Email, Phone)
VALUES (1, 'John Doe', 'john@example.com', '123-456-7890');

UPDATE statement to modify existing records:

-- Update the Publisher of a book with a specific BookID
UPDATE Books SET Publisher = 'Harper Perennial Modern Classics'WHERE BookID = 1;

DELETE FROM statement to remove records based on specific criteria:

-- Delete a book record with a specific BookID
DELETE FROM Books WHERE BookID = 1;

BULK INSERT operation to load data from an external source (e.g., a CSV file):

```
-- Bulk insert data from a CSV file into the Books table
BULK INSERT Books
FROM 'C:\path\to\books.csv'
WITH (
FIELDTERMINATOR = ',',
ROWTERMINATOR = '\n',
FIRSTROW = 2 -- Skip header row
);
```

In these SQL statements:

INSERT INTO is used to add new records to the Books and Members tables.

UPDATE modifies the Publisher of a specific book.

DELETE FROM removes a book record based on a specific BookID.

BULK INSERT loads data from an external CSV file into the Books table, specifying the field and row terminators and skipping the header row.