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BSCpE – 2A

SOFTWARE DESIGN

Laboratory Exercise No. 5 CH4

Title: Fundamentals of Database Design

Brief Introduction

Database design is critical in managing and organizing data effectively. This exercise introduces relational database concepts, data modeling, and SQL basics.

Objectives

Understand the importance of database design.

Create an ER diagram for a simple system.

Write SQL queries for basic database operations.

Detailed Discussion

Databases store and manage data systematically. Relational databases organize data into tables connected by relationships. Key database design concepts include:

Entities: Represent real-world objects (e.g., students, books).

Attributes: Describe entity properties (e.g., name, ID).

Relationships: Define associations between entities (e.g., a student borrows a book).

Database Design Element	Description	Example
Entity	Real-world object	Student, Book
Attribute	Property of an entity	Name, ID
Relationship	Association between entities	Student borrows Book

Materials

MySQL or SQLite environment

SQL editor

Procedure

Create an ER diagram for a library system using an online tool like Lucidchart or draw.io.

Define the entities, attributes, and relationships.

Implement the database in MySQL or SQLite.

SQL Example:

```sql
CREATE TABLE Students (
  student_id INT PRIMARY KEY,
  name VARCHAR(100)
);


CREATE TABLE Books (
  book_id INT PRIMARY KEY,
  title VARCHAR(100)
);


CREATE TABLE Borrowed (
  student_id INT,
  book_id INT,
  borrow_date DATE,
  FOREIGN KEY (student_id) REFERENCES Students(student_id),
  FOREIGN KEY (book_id) REFERENCES Books(book_id)
);

-- Insert example data
INSERT INTO Students VALUES (1, 'Alice');
INSERT INTO Books VALUES (101, 'Python Programming');
INSERT INTO Borrowed VALUES (1, 101, '2025-01-07');

-- Query borrowed books
SELECT Students.name, Books.title FROM Borrowed
JOIN Students ON Borrowed.student_id = Students.student_id
```
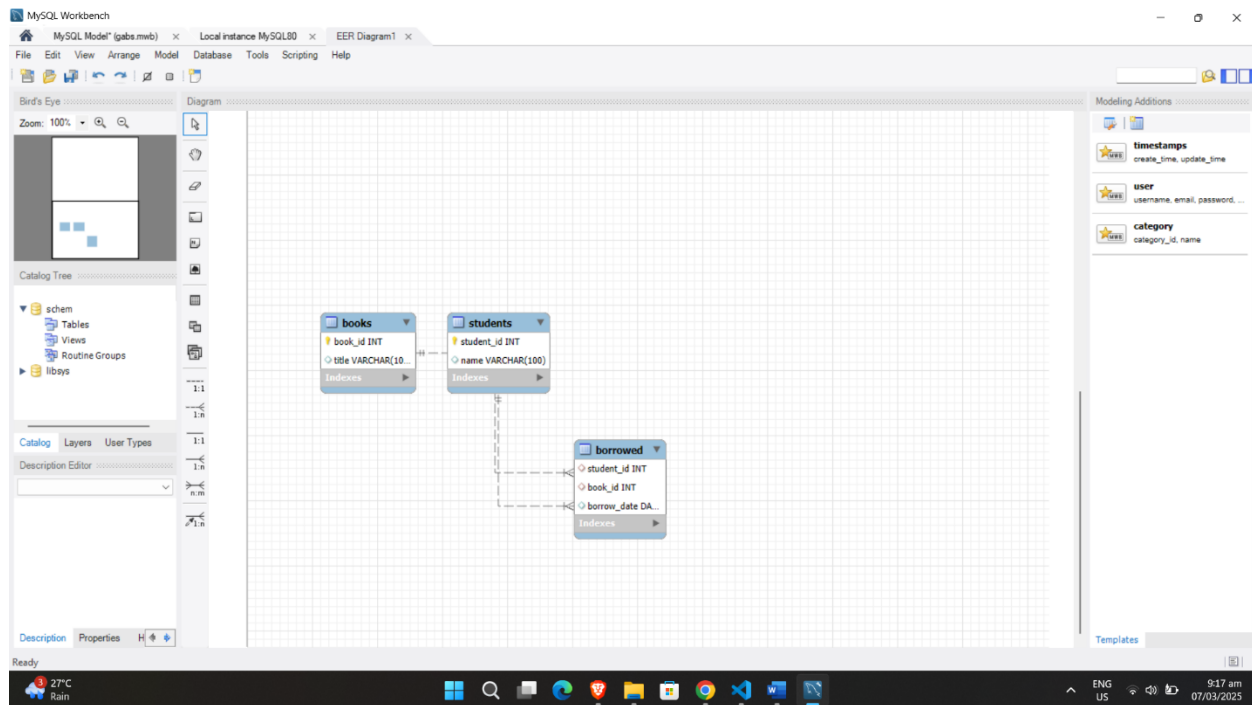
JOIN Books ON Borrowed.book_id = Books.book_id;

Results

Provide screenshots of the ER diagram and query results.

Follow-Up Questions

1. Why is an ER diagram useful in database design?

ANSWER: An Entity-Relationship (ER) diagram is useful in database design because it visually represents the structure of a database, including the entities (e.g., students, books) and their relationships (e.g., borrowing, returning). It helps in understanding how data is connected, making it easier to design, organize, and implement the database schema. It also aids in identifying key constraints and optimizing database structure.

2. How do foreign keys enforce data integrity?

ANSWER: Foreign keys enforce data integrity by ensuring that the value in one table corresponds to a valid entry in another table. A foreign key creates a link between two tables, ensuring that references to rows in a related table are valid. This prevents orphan records (e.g., a borrowed book record without a valid student ID) and ensures consistency between tables by restricting invalid or non-existent values.

3. Write a query to find all students who borrowed a specific book.

ANSWER:

SELECT s.student_name

FROM students s

JOIN borrowings b ON s.student_id = b.student_id

```
JOIN books bo ON b.book_id = bo.book_id

WHERE bo.title = 'BookTitle';
```