**Submitted By.,**

Muhammad Abdullah Khan
Muhammad Usman Khattak
Muhammad Zayam Sabir

**Registration Numbers.,**

4747-FOC/BSSE/F23
4763-FOC/BSSE/F23
4765-FOC/BSSE/F23

**Submitted To.,**

Sir Shakir Rasheed Khan Khattak

**Course.,**

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*Department of Software Engineering*

# Library Management System

**Entity Relationship Diagram (ERD)**

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# Introduction

This document provides a detailed description of the data structure for the Library Management System as modeled in the attached ERD. Each entity and its attributes (including primary and foreign keys), and all the inter entity relationships (with cardinalities) are comprehensively outlined.

# Entity Descriptions

## Library Branch

### 1. Attributes

- Branch ID (Primary Key)

- Name

- Address

- Department ID (Foreign Key from Department)

### 2. Relationships

- Department: One Library Branch can have multiple Departments (1:M)

## Book

### 1. Attributes

- ISBN (Primary Key)

- Title

- Author Name

- Price

- Publisher ID (Foreign Key from Publisher)

**2. Relationships**

- Publisher: Many Books (M) are published by one Publisher (1)

- Staff: Each Book can be maintained by multiple Staff members (M:N)

- Reader: Books can be loaned by multiple Readers (M:N)

- Reservation: Each Book can have multiple Reservations (1:M)

**Publisher**

**1. Attributes**

- Publisher ID (Primary Key)

- Name

- Year Of Publication

**2. Relationships**

- Book: One Publisher (1) publishes many Books (M)

**Staff**

**1. Attributes**

- Staff ID (Primary Key)

- Name

- Login ID (Foreign Key from System)

- Department ID (Foreign Key from Department)
- Manager ID (Foreign Key to Staff - for hierarchical relationships)

## 2. Relationships

- Book: Each Staff member can maintain multiple Books (1:M)
- Reports: One Staff member manages multiple Reports (1:M)
- Reader: Staff can track multiple Readers, and Readers can be tracked by multiple Staff (M:N)
- System: Each Staff member has exactly one login (1:1)
- Department: Multiple Staff members belong to one Department (M:1)
- Reports To: Staff can report to one Manager (another Staff member) (M:1)

### Reader

## 1. Attributes

- User ID (Primary Key)
- Name (Composite: First Name, Middle Name, Last Name)
- Email
- Phone Number

## 2. Relationships

- Book: Readers can loan multiple Books, and Books can be loaned to multiple Readers (M:N)

- Staff: Readers can be tracked by multiple Staff members, and each Staff member can track multiple Readers (M:N)

- Reservation: One Reader can have multiple Reservations (1:M)

- Fine: One Reader can have multiple Fines (1:M)

## Reports

## 1. Attributes

- Report ID (Primary Key)

- User ID (Foreign Key from Reader)

- ISBN (Foreign Key from Book)

- Title

- Staff ID (Foreign Key from Staff)

## 2. Relationships

- Staff: Many Reports (M) are managed by one Staff member (1)

- Reader: Reports relate to Readers through User ID (M:1)

- Book: Reports relate to Books through ISBN (M:1)

## System

## 1. Attributes

- Login ID (Primary Key)

- User Name

- Password

## 2. Relationships

- Staff: Each System Login is assigned to exactly one Staff member (1:1)

## Department

## 1. Attributes

- Department ID (Primary Key)

- Name

- Manager ID (Foreign Key from Staff)

## 2. Relationships

- Staff: One Department can have multiple Staff members (1:M)

- Library Branch: Multiple Departments can belong to one Library Branch (M:1)

- Reports To: Manager relationships within the department

## Reservation

## 1. Attributes

- Reservation ID (Primary Key)

- User ID (Foreign Key from Reader)

- ISBN (Foreign Key from Book)

- Reserve/Return Date

- Status

## 2. Relationships

- Reader: Many Reservations (M) are registered by one Reader (1)
- Book: Reservations relate to Books through ISBN (M:1)

**Fine**

**1. Attributes**

- Fine ID (Primary Key)
- User ID (Foreign Key from Reader)
- Amount
- Date
- Reason

**2. Relationships**

- Reader: Many Fines (M) are paid by one Reader (1)

## Relationship Summary

| Relationship | Entity 1 | Cardinality | Entity 2 | Cardinality | Description |
|---|---|---|---|---|---|
| Publishes | Publisher (1) | 1 | Book (M) | Many | Each publisher publishes many books. |
| Maintain | Staff (1) | 1 | Book (N) | Many | Multiple staff maintain |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | multiple books. |
| Loans | Reader (M) | M | Book (N) | Many | Readers loan multiple books and books are loaned to multiple readers. |
| Manages | Staff (1) | 1 | Reports (M) | Many | Staff track manages multiple reports. |
| Tracks | Staff (1) | M | Reader (M) | Many | Staff tracks multiple readers. |
| Login | Staff (1) | 1 | System (1) | 1 | Each staff member has a unique login in the system. |
| Reports To | Staff | (M) | Staff | (1) | Staff report to a manager (hierarchical) |
| Registers | Reader | (1) | Reservation | (M) | Readers register |

| | | | | | multiple reservations |
|---|---|---|---|---|---|
| Pays | Reader | (1) | Fine | (M) | Readers pay multiple fines |
| Manages | Department | (1) | Staff | (M) | Each department has multiple staff members |
| Has | Library Branch | (1) | Department | (M) | Each branch has multiple departments |
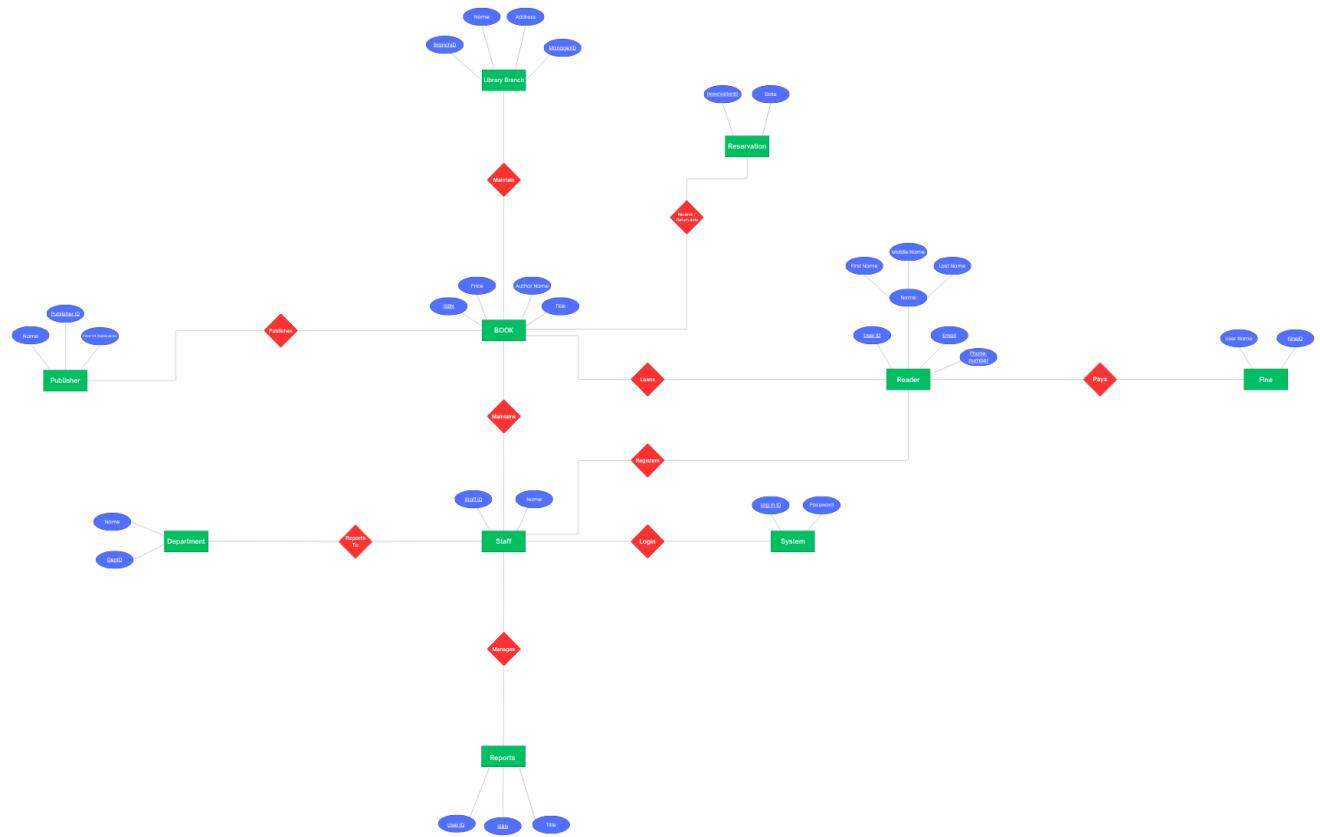
## Keys Overview

| Entity | Primary Key | Foreign Key |
|---|---|---|
| Book | ISBN | Publisher ID |
| Publisher | Publisher ID | None |

| Staff | Staff ID | Login ID, Department ID, Manager ID |
|---|---|---|
| Reader | User ID | None |
| Reports | Report ID | Staff ID, User ID, ISBN |
| System | Login ID | None |
| Library Branch | Branch ID | None |
| Department | Department ID | Manager ID |
| Reservation | Reservation ID | User ID, ISBN |
| Fine | Fine ID | User ID |

# ERD



# Github Link:-

[Library Management System ERD](#)