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Course: BE-CSE (AI&ML)

Subject: Database Management System

Experiment: Library Management System Implementation

1. Aim of the Session

The aim of this lab session was to design and implement a relational database for a Library Management System. The task involved building structured tables, defining relationships among entities, and enforcing role-based security to ensure controlled access.

2. Software Requirements

- **Database**:
  - ○ Oracle Database Express Edition (Oracle XE)
  - ○ PostgreSQL Database (PgAdmin)

3. Objective of the Session

By the end of the session, the following objectives were achieved:

- Developed relational tables with **Primary Keys, Foreign Keys, and Check Constraints** to ensure data accuracy.
- Practiced **DML operations** (INSERT, UPDATE, DELETE, SELECT) for managing records.
- Applied **DCL commands** to configure role-based permissions for secure access.
- Maintained **referential integrity** across tables such as BOOKS, LIBRARY_VISITORS, and BOOK_ISSUE.

4. Practical / Experiment Steps

The work was carried out through the following activities:

1. Schema Design: Created tables for books and visitors with constraints like NOT NULL, UNIQUE, and CHECK (e.g., minimum age requirement).

2.Relationship Setup: Built the BOOK_issue table linking BOOKS and LIBRARY_VISITORS using foreign keys.

3.Data Insertion: Added sample records to validate schema and constraints.

4.Functional Testing: Performed update and delete operations to check cascading and referential rules.

5.Security Setup: Created a role with login privileges and controlled access using GRANT and REVOKE.

5. Procedure of the Practical

Execution was performed in the following order:

1. **Environment Setup:** Logged into DBMS interface and accessed the server instance.
2. **Database Setup:** Created a dedicated database for the library system.
3. **Schema Execution:** Executed CREATE TABLE commands ensuring parent tables were defined first.
4. **Data Entry Phase:** Inserted records into BOOKS and LIBRARY_VISITORS.
5. **Verification Queries:** Verified data using SELECT queries
6. **Update/Delete Checks:** Tested mutability with UPDATE and DELETE.
7. **Role Creation:** Created a librarian role and assigned relevant operations through DCL.
8. **Permission Testing:** Validated access control by revoking permissions and checking role privileges.
9. **Documentation:** Saved final SQL script and captured outputs for reporting.

6. I/O Analysis (Input / Output Analysis)

Input Queries

SQL

```
CREATE TABLE BOOKS(

BOOK_ID INT PRIMARY KEY,

NAME VARCHAR(20) NOT NULL,

AUTHOR_NAME VARCHAR(20),
BOOK_COUNT INT CHECK(BOOK_COUNT>0) NOT NULL

)

CREATE TABLE LIBRARY_VISITORS(

USER_ID INT PRIMARY KEY,

NAME VARCHAR(20) NOT NULL,

AGE INT CHECK(AGE>=17) NOT NULL,

EMAIL VARCHAR(30) NOT NULL UNIQUE

)

CREATE TABLE BOOK_ISSUE(

BOOK_ISSUE_ID INT PRIMARY KEY,

USER_ID INT NOT NULL,

BOOK_ID INT NOT NULL,

ISSUE_DATE DATE NOT NULL,

FOREIGN KEY(USER_ID) REFERENCES LIBRARY_VISITORS(USER_ID),

FOREIGN KEY(BOOK_ID) REFERENCES BOOKS(BOOK_ID)

)

INSERT INTO BOOKS VALUES(101,'STAR WARS','DAVID',5)

INSERT INTO BOOKS VALUES(102,'DEMON','JAMES',8)

SELECT * FROM BOOKS


INSERT INTO LIBRARY_VISITORS(USER_ID,NAME,AGE,EMAIL)

VALUES(501,'SHIVAM SINGH',20,'SHIVAM18@GMAIL.COM')

INSERT INTO LIBRARY_VISITORS(USER_ID,NAME,AGE,EMAIL)

VALUES(502,'SAM SHARMA',20,'SAM18@GMAIL.COM')

SELECT * FROM LIBRARY_VISITORS
```

```
INSERT INTO BOOK_ISSUE VALUES(10001,501,101,'2026-01-08')

INSERT INTO BOOK_ISSUE VALUES(10002,502,102,'2026-01-09')

SELECT * FROM BOOK_ISSUE


UPDATE BOOK_ISSUE

SET ISSUE_DATE='2026-02-09'

WHERE BOOK_ISSUE_ID=10001

SELECT * FROM BOOK_ISSUE


DELETE FROM BOOK_ISSUE WHERE  BOOK_ISSUE_ID=10002

SELECT * FROM BOOK_ISSUE


CREATE ROLE LIBRARIAN WITH LOGIN PASSWORD 'PASSWORD'

GRANT SELECT, INSERT, DELETE, UPDATE ON BOOKS TO LIBRARIAN

GRANT SELECT, INSERT, DELETE, UPDATE ON LIBRARY_VISITORS TO LIBRARIAN

GRANT SELECT, INSERT, DELETE, UPDATE ON BOOK_ISSUE TO LIBRARIAN


REVOKE SELECT, INSERT, DELETE, UPDATE ON BOOKS,LIBRARY_VISITORS,BOOK_ISSUE
FROM LIBRARIAN
```

Output Details

1. Schema Creation

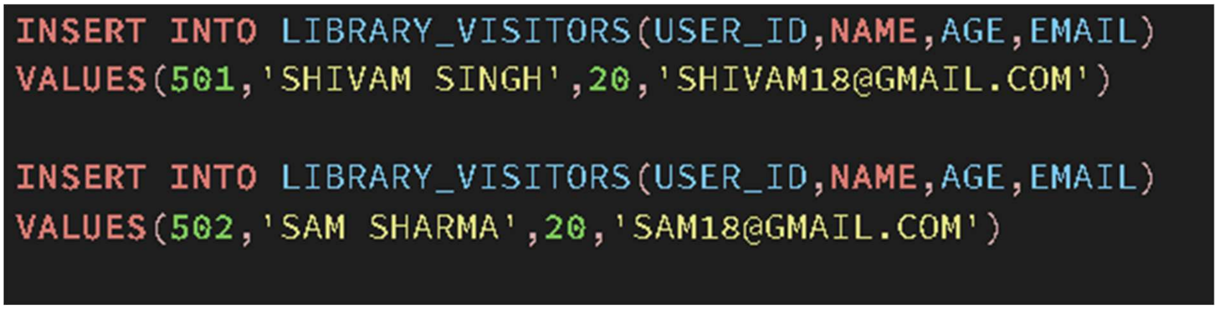
- All three tables (BOOKS, LIBRARY_VISITORS, and BOOK_ISSUE) were successfully created.
- The PRIMARY KEY constraints ensured unique identification of books and visitors.
- The CHECK(age>=18) constraint prevented entries of visitors below 18 years of age.
- The CHECK(count>0) constraint disallowed non-positive values for book count.
- FOREIGN KEY constraints ensured that book issue entries could only reference existing books and visitors.

✓ Result: Schema creation completed without errors.

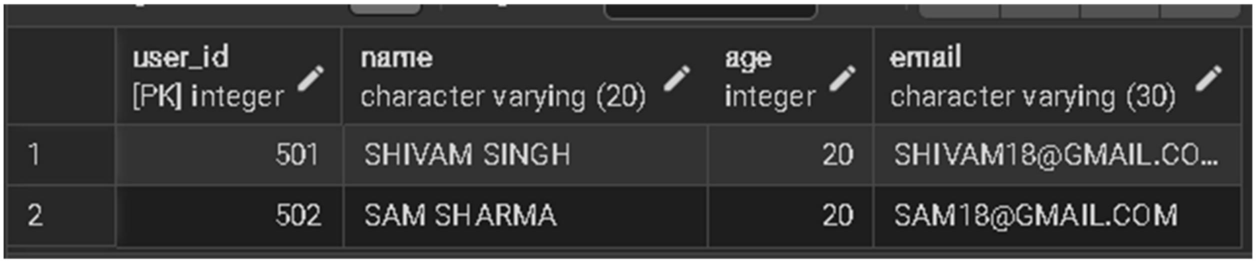
2. **DML Outputs**

The following SQL commands executed successfully:

visitor insertion :

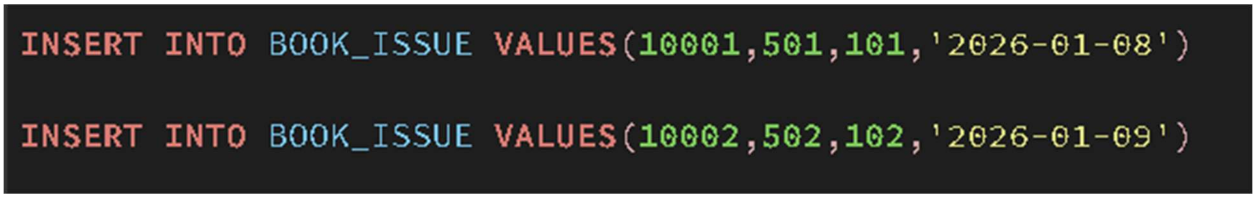


```
INSERT INTO LIBRARY_VISITORS(USER_ID,NAME,AGE,EMAIL)
VALUES(501,'SHIVAM SINGH',20,'SHIVAM18@GMAIL.COM')

INSERT INTO LIBRARY_VISITORS(USER_ID,NAME,AGE,EMAIL)
VALUES(502,'SAM SHARMA',20,'SAM18@GMAIL.COM')
```

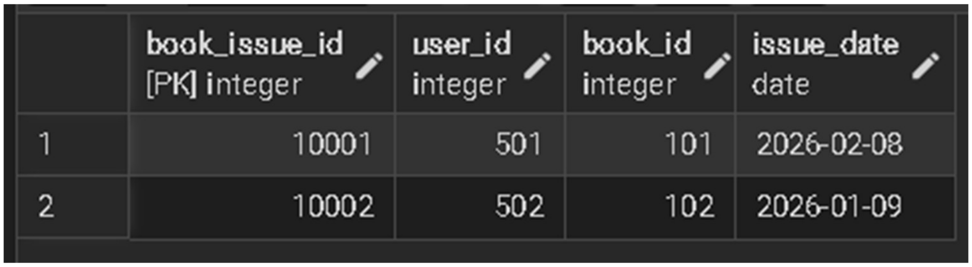


	user_id [PK] integer	name character varying (20)	age integer	email character varying (30)
1	501	SHIVAM SINGH	20	SHIVAM18@GMAIL.CO...
2	502	SAM SHARMA	20	SAM18@GMAIL.COM

Book Issue Entry :

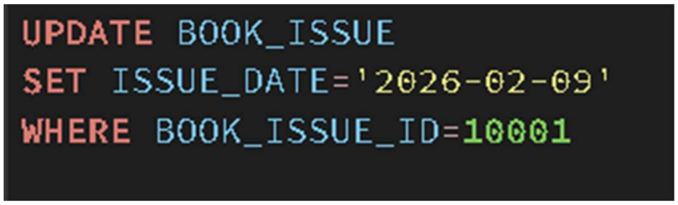


```
INSERT INTO BOOK_ISSUE VALUES(10001,501,101,'2026-01-08')

INSERT INTO BOOK_ISSUE VALUES(10002,502,102,'2026-01-09')
```

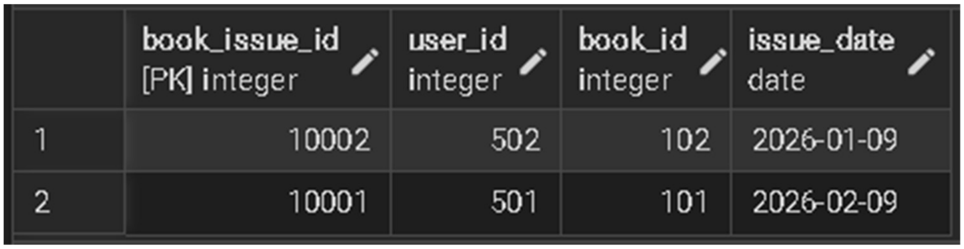


	book_issue_id [PK] integer	user_id integer	book_id integer	issue_date date
1	10001	501	101	2026-02-08
2	10002	502	102	2026-01-09

Update Book Issue Entry :

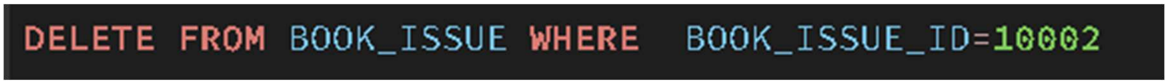


```
UPDATE BOOK_ISSUE
SET ISSUE_DATE='2026-02-09'
WHERE BOOK_ISSUE_ID=10001
```

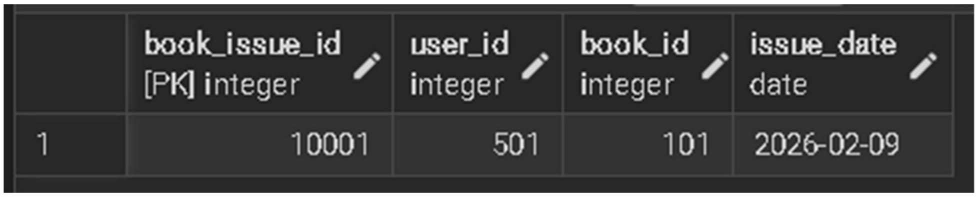


	book_issue_id [PK] integer	user_id integer	book_id integer	issue_date date
1	10002	502	102	2026-01-09
2	10001	501	101	2026-02-09

3. DELETE Operation Result



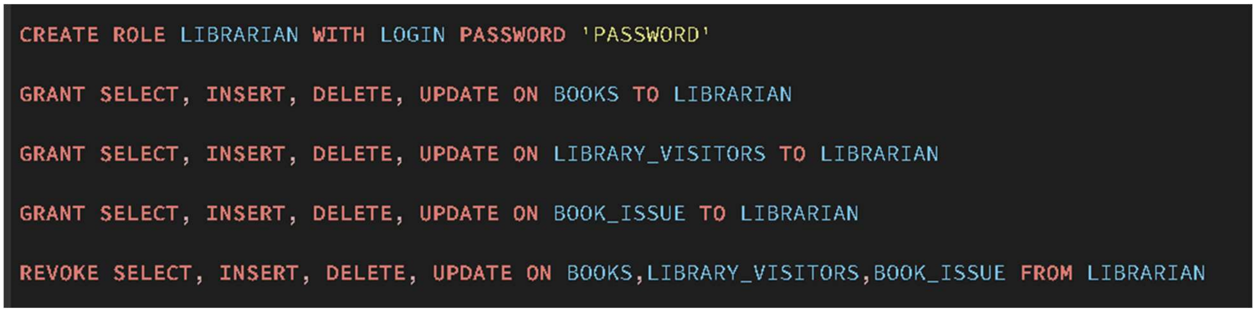
```
DELETE FROM BOOK_ISSUE WHERE  BOOK_ISSUE_ID=10002
```



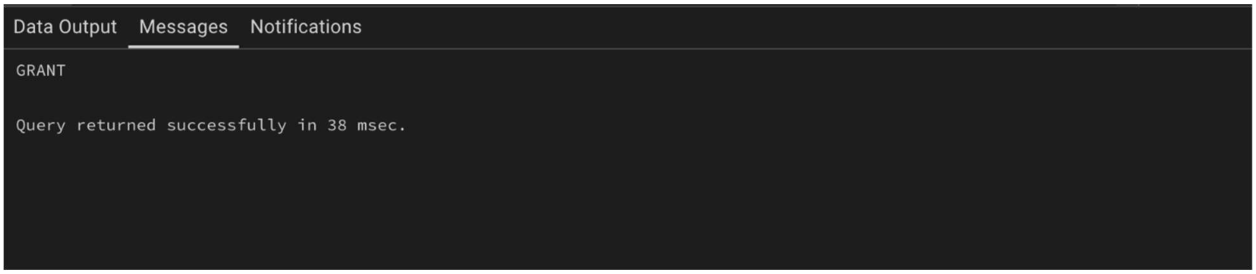
	book_issue_id [PK] integer	user_id integer	book_id integer	issue_date date
1	10001	501	101	2026-02-09

4. DCL (Security / Role-Based Access Control) Output

- **DCL Verification:** The `librarian` role was successfully created and assigned the necessary privileges for library management tasks.

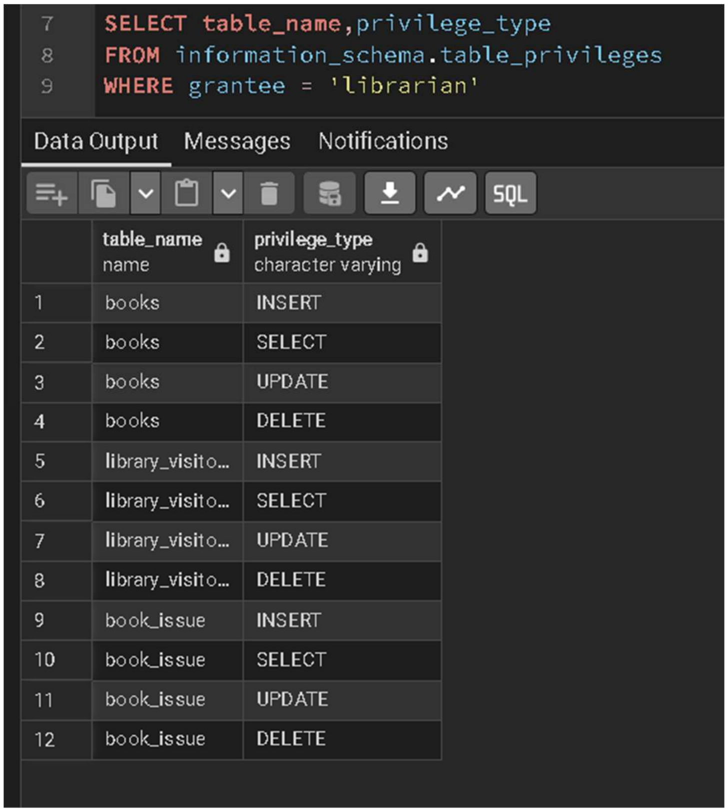


```
CREATE ROLE LIBRARIAN WITH LOGIN PASSWORD 'PASSWORD'

GRANT SELECT, INSERT, DELETE, UPDATE ON BOOKS TO LIBRARIAN

GRANT SELECT, INSERT, DELETE, UPDATE ON LIBRARY_VISITORS TO LIBRARIAN

GRANT SELECT, INSERT, DELETE, UPDATE ON BOOK_ISSUE TO LIBRARIAN

REVOKE SELECT, INSERT, DELETE, UPDATE ON BOOKS,LIBRARY_VISITORS,BOOK_ISSUE FROM LIBRARIAN
```



```
GRANT

Query returned successfully in 38 msec.
```

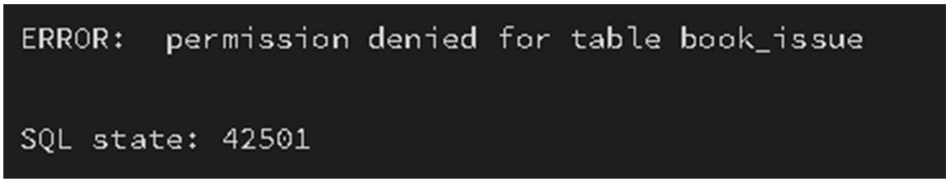
- We also confirmed the permissions of the role “librarian” by checking the table privileges.



```sql
SELECT table_name,privilege_type
FROM information_schema.table_privileges
WHERE grantee = 'librarian'
```

	table_name name	privilege_type character varying
1	books	INSERT
2	books	SELECT
3	books	UPDATE
4	books	DELETE
5	library_visito...	INSERT
6	library_visito...	SELECT
7	library_visito...	UPDATE
8	library_visito...	DELETE
9	book_issue	INSERT
10	book_issue	SELECT
11	book_issue	UPDATE
12	book_issue	DELETE

- **Validation:** Testing confirmed that after the `REVOKE` command, the `librarian` could no longer perform operations on the `books` table, ensuring the security policy is functional.



```
ERROR:  permission denied for table book_issue

SQL state: 42501
```

7. Learning Outcome

From this practical, the following knowledge and skills were gained:

- **Schema Design Insight:** Learned how relational constraints like CHECK, UNIQUE, and FOREIGN KEY contribute to logical data consistency.
- **Database Security Skills:** Understood the advantage of assigning roles instead of individual user permissions for scalable security.
- **Real-world Contextualization:** Saw how SQL is applied in real applications (such as library systems) where multiple entities interact systematically.