Database Management System (1333204) - Winter 2024 Solution

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Question 1(a) [3 marks]

Define: Field, Record, Metadata

> **Solution**
>
> - **Field**: A single unit of data representing one attribute of an entity.
> - **Record**: Collection of related fields that store data about an entity.
> - **Metadata**: Data about data that describes the structure, properties, and relationships of database objects.
>
> > **Mnemonic**
> >
> > **Mnemonic:** "FRaMe" (Field, Record, Metadata)

Question 1(b) [4 marks]

Define: strong and weak entity set.

> **Solution**
>
> **Table 1.** Strong vs Weak Entity Set
>
> | Entity Type | Description | Identification |
> |-------------|-------------|----------------|
> | **Strong Entity** | Exists independently | Has its own primary key |
> | **Weak Entity** | Depends on strong entity | Requires parent entity key |
>
> **Examples**: Strong Entity - Customer, Employee; Weak Entity - Bank Account, Order Item.
>
> > **Mnemonic**
> >
> > **Mnemonic:** "SWing" (Strong is With own identity, weak is Not Getting own identity)
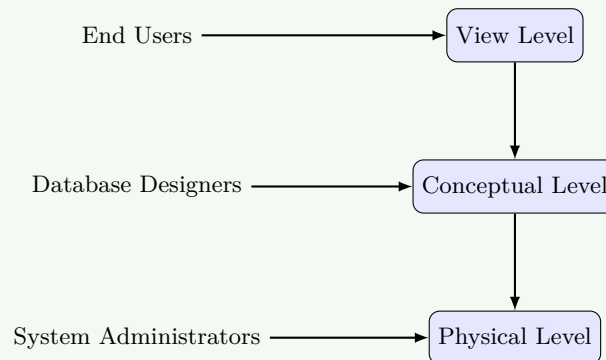
Question 1(c) [7 marks]

Explain 3 Levels of Data Abstraction

Solution

Table 2. Levels of Data Abstraction

Level	Description	Used By
Physical Level	Describes how data is stored physically	System Administrators
Conceptual Level	Describes what data is stored and relationships	Database Designers
View Level	Describes part of database relevant to users	End Users

Figure 1. Data Abstraction Levels

Mnemonic

Mnemonic: "PCV" (Physical, Conceptual, View - bottom to top)

OR

Question 1(c) [7 marks]

Explain advantages and disadvantages of DBMS.

Solution

Table 3. Advantages and Disadvantages of DBMS

Advantages	Disadvantages
Data Redundancy Control	**High Cost** of software and hardware
Data Consistency	**Complexity** in design and maintenance
Improved Data Security	**Performance Impact** with heavy usage
Data Sharing	**Vulnerability** to system failures
Data Independence	**Recovery Challenges** after failure
Standardized Access	**Increased Training Requirements**

Mnemonic

Mnemonic: "BASIC-DV" (Benefits: Access, Security, Independence, Consistency - Drawbacks: Vulnerability)

Question 2(a) [3 marks]

Explain select operation in relational algebra with example

Solution

Table 4. Select Operation (σ)

Feature	Description
Syntax	$\sigma_{condition}(Relation)$
Function	Retrieves tuples satisfying condition
Example	$\sigma_{salary>30000}(Employee)$

Mnemonic

Mnemonic: "SERVe" (Select Exactly Required Values)

Question 2(b) [4 marks]

Define Primary, Foreign, Super, Candidate Keys in DBMS.

Solution

Table 5. Key Types

Key Type	Description
Primary Key	Unique identifier for each record
Foreign Key	Attribute linking to primary key in another table
Super Key	Set of attributes that can uniquely identify records
Candidate Key	Minimal super key that can be primary key

Mnemonic

Mnemonic: "PFSC" (Person First Shows Credentials)

Question 2(c) [7 marks]

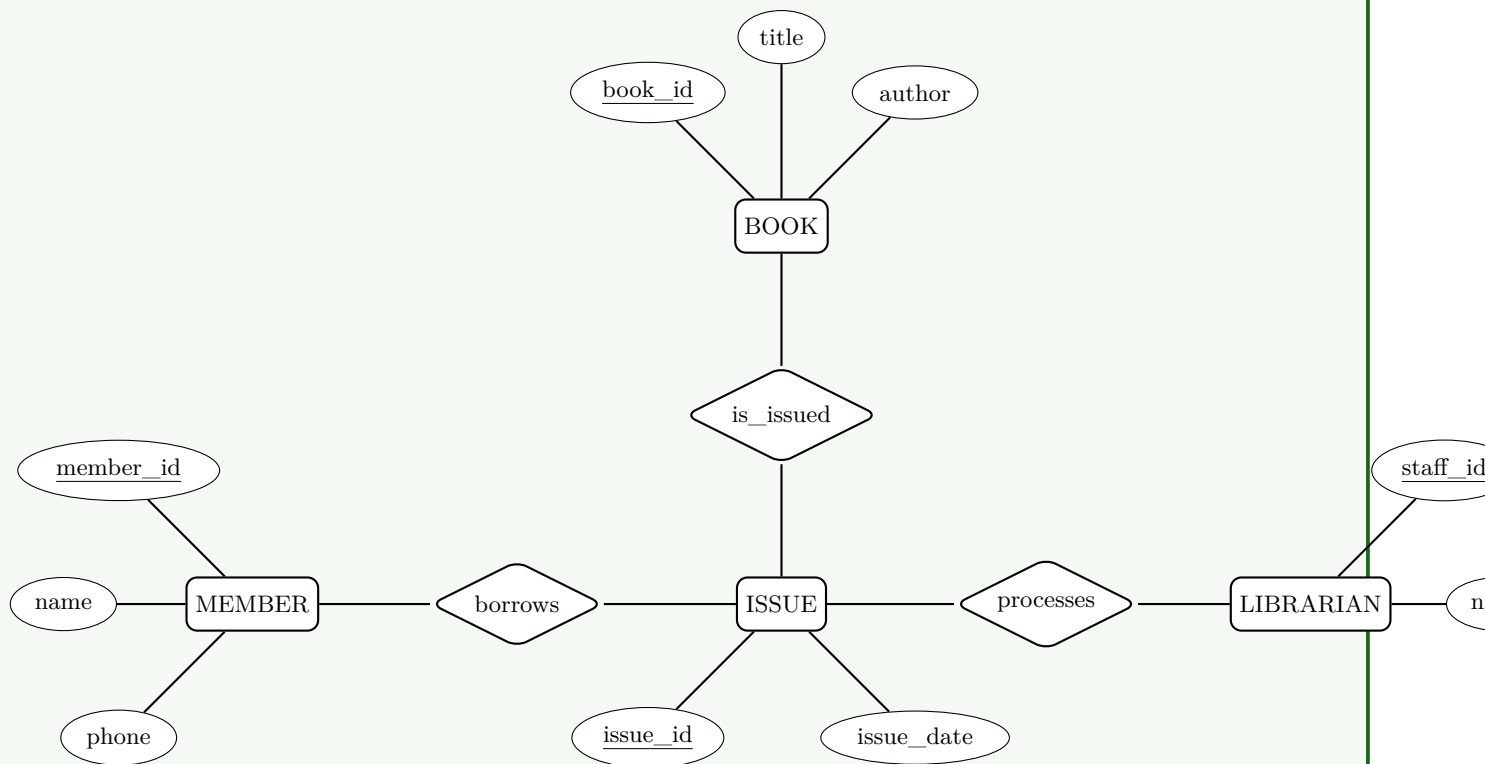**Draw E R Diagram of Library Management System.**

Solution

Figure 2. Library Management System ER Diagram

Mnemonic

Mnemonic: "LIMB" (Library Items, Members, Borrowing)

OR

Question 2(a) [3 marks]

Explain union operation in relational algebra with example.

Solution

Table 6. Union Operation ($\cup$)

Feature	Description
Syntax	$Relation1 \cup Relation2$
Function	Combines tuples from both relations
Requirement	Both relations must be union-compatible

Example: $Students\_CS \cup Students\_IT$

Mnemonic

Mnemonic: "CUP" (Combining Union of Parts)
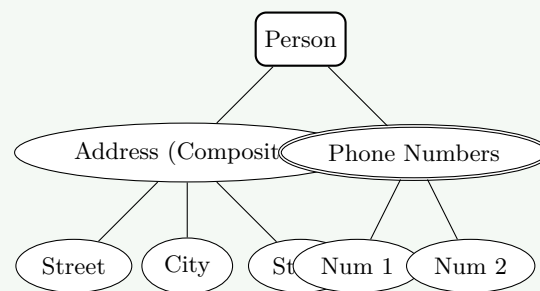
OR

Question 2(b) [4 marks]

Define Composite attribute and Multivalued attribute with example

---

Solution

Table 7. Attribute Types

Attribute Type	Description	Example
Composite	Can be divided into smaller subparts	Address (street, city, state, zip)
Multivalued	Can have more than one value	Phone numbers, Email addresses

Figure 3. Attribute Types Hierarchy

Mnemonic

Mnemonic: "CoMbo" (Composite has Multiple components)

OR

Question 2(c) [7 marks]

Draw E R Diagram of College Management System.
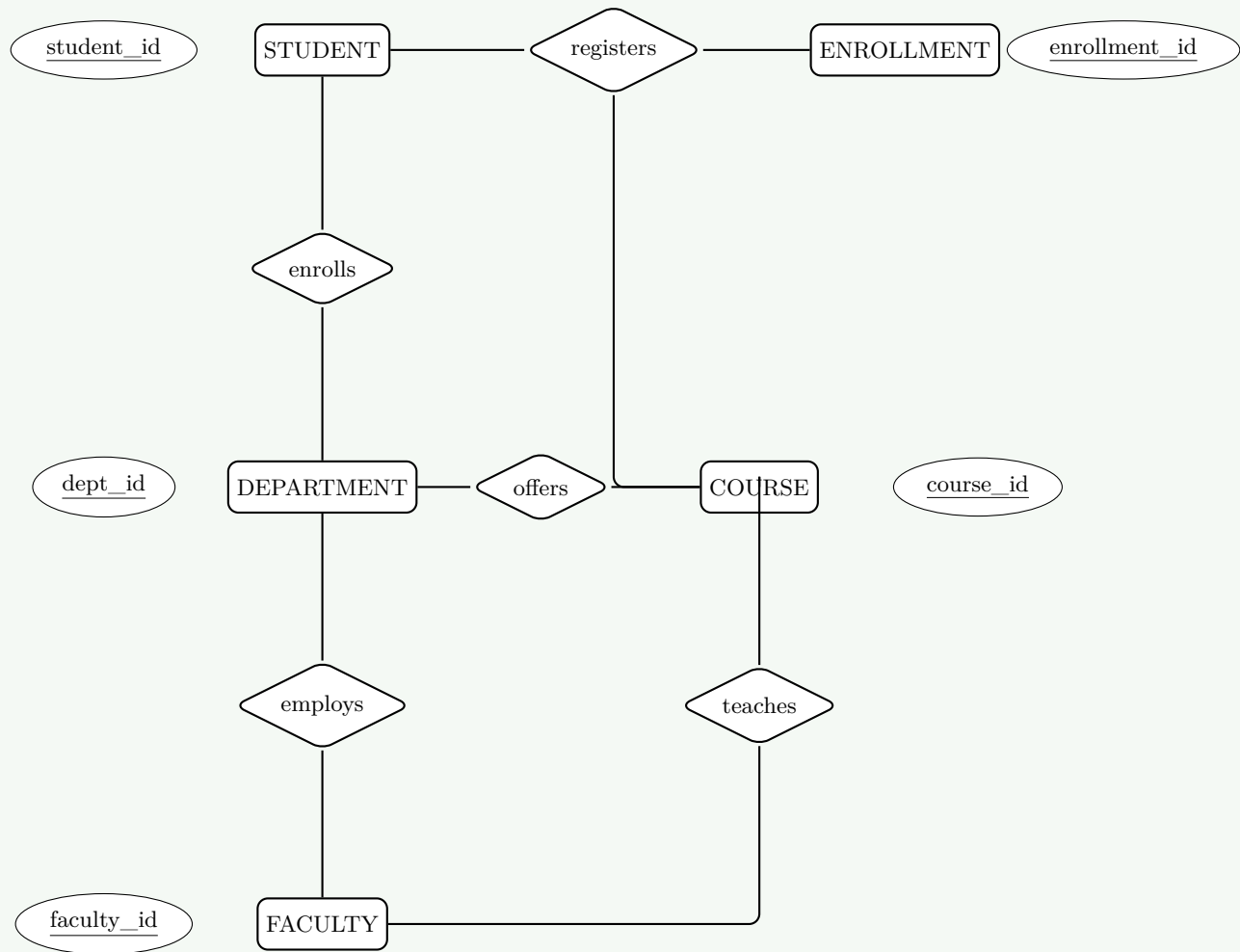
Solution

Figure 4. College Management System ER Diagram

Mnemonic

Mnemonic: "DECFS" (Departments, Enrollments, Courses, Faculty, Students)

Question 3(a) [3 marks]

List different data types in SQL and Explain in brief

Solution

Table 8. SQL Data Types

Category	Examples	Usage
Numeric	INT, FLOAT, DECIMAL	Store numbers
Character	CHAR, VARCHAR, TEXT	Store text
Date/Time	DATE, TIME, TIMESTAMP	Store temporal data
Boolean	BOOLEAN	Store true/false values
Binary	BLOB, BINARY	Store binary data

Mnemonic

Mnemonic: "NCDBB" (Numbers, Characters, Dates, Booleans, Binaries)

Question 3(b) [4 marks]

Explain any two DDL Commands with Syntax and Example

Solution

Table 9. DDL Commands

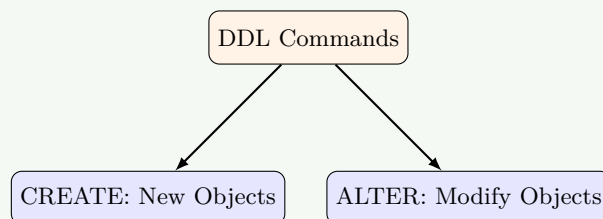| Command	Syntax	Example
CREATE	CREATE TABLE t (cols);	CREATE TABLE Student (id INT, n TEXT);
ALTER	ALTER TABLE t ADD c type;	ALTER TABLE Student ADD email TEXT;

Figure 5. DDL Commands

Mnemonic

Mnemonic: "CAD" (Create And Define)

Question 3(c) [7 marks]

Write the Output of Following Query.

Solution

Table 10. SQL Query Outputs

Function	Result	Explanation
CEIL(123.57)	124	Smallest integer $\geq$ 123.57
CEIL(4.1)	5	Smallest integer $\geq$ 4.1
MOD(12,4)	0	Remainder of 12 $\div$ 4
MOD(10,4)	2	Remainder of 10 $\div$ 4
POWER(2,3)	8	2^3
POWER(3,3)	27	3^3
ROUND(121.413,1)	121.4	Round to 1 decimal
ROUND(121.413,2)	121.41	Round to 2 decimals
FLOOR(25.3)	25	Largest integer $\leq$ 25.3
FLOOR(25.7)	25	Largest integer $\leq$ 25.7
LENGTH('AHMEDABAD')	9	Number of characters
ABS(-25)	25	Absolute value
ABS(36)	36	Absolute value

Mnemonic

Mnemonic: "CMPRFLA" (Ceiling, Modulus, Power, Round, Floor, Length, Absolute)

OR

Question 3(a) [3 marks]

Explain any three Date Functions.

Solution

Table 11. Date Functions

Function	Purpose	Example Idea
ADD_MONTHS	Adds months to date	Add 3 months to Jan $\rightarrow$ Apr
MONTHS_BETWEEN	Calculates months between dates	Months between Mar and Jan $\rightarrow$ 2
SYSDATE	Returns current date and time	Returns system timestamp

Mnemonic

Mnemonic: "AMS" (Add_months, Months_between, Sysdate)

OR

Question 3(b) [4 marks]

Explain any two DML Commands with Syntax and Example

Solution

Table 12. DML Commands

Command	Syntax	Example
INSERT	`INSERT INTO t VALUES (v1...);`	`INSERT INTO S VALUES (1, 'Raj');`
UPDATE	`UPDATE t SET c=v WHERE cond;`	`UPDATE S SET e='n' WHERE id=1;`

```
        DML Commands
         /        \
   INSERT: Add Records   UPDATE: Modify Records
```
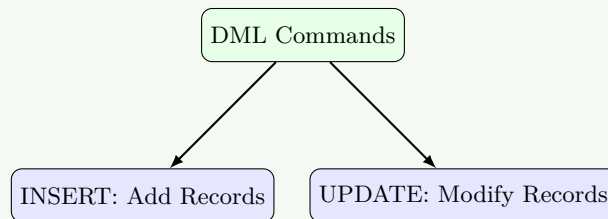
Figure 6. DML Commands

Mnemonic

Mnemonic: "IUM" (Insert, Update, Manipulate)

OR

Question 3(c) [7 marks]

For the table: EMP(emp_no, emp_name, designation, salary, deptno), Write SQL commands for following operations.

Solution

- **Create table EMP**:

```
1  CREATE TABLE EMP (
2      emp_no INT PRIMARY KEY,
3      emp_name VARCHAR(50),
4      designation VARCHAR(30),
5      salary DECIMAL(10,2),
6      deptno INT
7  );
8
```

- **Given Columns Select**:

```
1  SELECT emp_no, emp_name, designation, salary, deptno FROM EMP;
2
```

- **Name starts with 'p'**:

```
1  SELECT * FROM EMP WHERE emp_name LIKE 'p%';
2
```

- **Department wise salary**:

```
1  SELECT deptno, SUM(salary) AS total_salary
2  FROM EMP GROUP BY deptno;
3
```

- **Add email_id**:

```
1  ALTER TABLE EMP ADD email_id VARCHAR(100);
2
```

- **Rename column**:

```
1  ALTER TABLE EMP RENAME COLUMN designation TO post;
2
```

- **Delete all records**:

```
1  DELETE FROM person;
2
```

> **Mnemonic**
>
> **Mnemonic:** "CSDAACD" (Create, Select, Display, Aggregate, Add, Change, Delete)

Question 4(a) [3 marks]

List different aggregate functions and explain any one with syntax and example.

> **Solution**
>
> **Table 13.** Aggregate Functions
>
> | Function | Purpose |
> |---|---|
> | **SUM** | Calculates total |
> | **AVG** | Calculates average |
> | **COUNT** | Counts number of rows |
> | **MAX** | Finds maximum value |
> | **MIN** | Finds minimum value |
>
> **Example (AVG)**: `SELECT AVG(salary) FROM Employee;`
>
> > **Mnemonic**
> >
> > **Mnemonic:** "SCAMM" (Sum, Count, Avg, Max, Min)

Question 4(b) [4 marks]

Define the transaction with example.

> **Solution**
>
> **Transaction**: Logical unit of work that must be completely processed or completely fail.

Table 14. Transaction Properties

Concept	Description
ACID	Atomicity, Consistency, Isolation, Durability
States	Active, Partially Committed, Committed, Failed, Aborted

```sql
BEGIN TRANSACTION;
    UPDATE Accounts SET balance = balance - 5000 WHERE acc_no = 'A123';
    UPDATE Accounts SET balance = balance + 5000 WHERE acc_no = 'B456';
COMMIT;
```

Mnemonic

Mnemonic: "TAPS" (Transaction As Process Set)

Question 4(c) [7 marks]

What is an Operator in SQL? Explain Arithmetic and Logical operators with Syntax and Example

Solution

Table 15. SQL Operators

Type	Operators	Example
Arithmetic	+, -, *, /, %	$5 + 3 = 8$
Logical	AND	salary > 3k AND dept = 'IT'
Logical	OR	salary > 5k OR dept = 'HR'
Logical	NOT	NOT (condition)

Mnemonic

Mnemonic: "ASMDOLA" (Add, Subtract, Multiply, Divide, OR, AND, NOT)

OR

Question 4(a) [3 marks]

List different numeric functions and explain any one with syntax and example.

Solution

Table 16. Numeric Functions

Function	Purpose
ROUND	Rounds to decimal places
TRUNC	Truncates to decimal places
CEIL	Smallest integer $\geq$ number
FLOOR	Largest integer $\leq$ number
ABS	Absolute value

Example (ROUND): `ROUND(125.679, 2)` $\rightarrow$ `125.68`

Mnemonic

Mnemonic: "RTCFA" (Round, Truncate, Ceiling, Floor, Absolute)

OR

Question 4(b) [4 marks]

List various database operations of a transaction.

Solution

Table 17. Transaction Operations

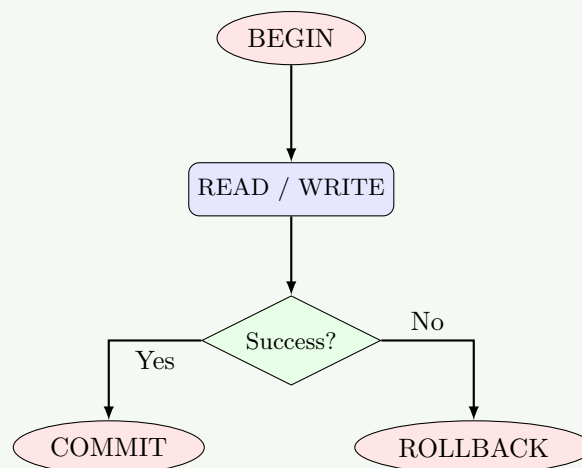| Operation	Description
BEGIN	Marks start
READ	Retrieves data
WRITE	Modifies data
COMMIT	Saves changes
ROLLBACK	Undoes changes
SAVEPOINT	Partial rollback point

Figure 7. Transaction Flow

Mnemonic

Mnemonic: "BRWCRS" (Begin, Read, Write, Commit, Rollback, Savepoint)
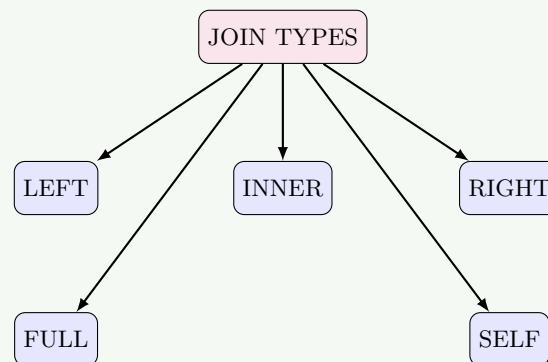
OR

Question 4(c) [7 marks]

What is join? Explain different types of joins with syntax and example.

Solution

Table 18. Join Types

Join Type	Description
INNER JOIN	Match in both tables
LEFT JOIN	All from left, matched from right
RIGHT JOIN	All from right, matched from left
FULL JOIN	Match in either table
SELF JOIN	Join table to itself

Figure 8. Types of Joins

Mnemonic

Mnemonic: "ILRFS" (Inner, Left, Right, Full, Self)

Question 5(a) [3 marks]

Convert the customer relation into 1NF shown below.

Solution

Customer Table (1NF):

Table 19. Customer in 1NF

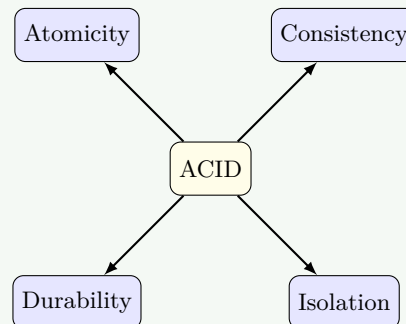| cid	name	society	city	Contact_no
CO1	Riya	Amu aavas	Anand	5322332123
CO2	Jiya	Sardar colony	Ahmedabad	5326521456
CO2	Jiya	Sardar colony	Ahmedabad	5265232849

Mnemonic

Mnemonic: "AFM" (Atomic values, Flatten Multivalued attributes)

Question 5(b) [4 marks]

List and Explain ACID properties of transaction.

Solution

Table 20. ACID Properties

Property	Description
Atomicity	All or nothing
Consistency	Database remains valid
Isolation	Transactions don't interfere
Durability	Changes are permanent

Figure 9. ACID Properties

Mnemonic

Mnemonic: "ACID" (Atomicity, Consistency, Isolation, Durability)

Question 5(c) [7 marks]

List different types of functional dependencies and explain each using example.

Solution

Table 21. Functional Dependencies

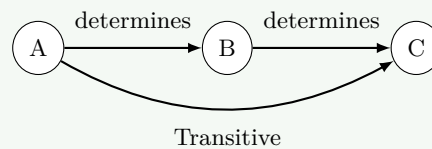| Type	Description	Example
Trivial FD	$Y \subseteq X$	$\{ID, Name\} \to \{Name\}$
Non-trivial FD	$Y \nsubseteq X$	$\{ID\} \to \{Name\}$
Partial FD	Part of key determines attr	$\{Course, Student\} \to CourseName$
Transitive FD	$X \to Y \to Z$	$Student \to Dept \to DeptName$
Multivalued FD	One determines set of another	$Course \to\to Textbook$

Figure 10. Transitive Dependency

Mnemonic

Mnemonic: "TNPTMv" (Trivial, Non-trivial, Partial, Transitive, Multivalued)

OR

Question 5(a) [3 marks]

Convert the Depositor_Account relation into 2NF.

Solution

Account Table (2NF):

ano	balance	bname

Depositor Table (2NF):

cid	ano	access_date

Mnemonic

Mnemonic: "RPKD" (Remove Partial Key Dependencies)

OR

Question 5(b) [4 marks]

Explain conflict serializability.

Solution

Table 22. Conflict Serializability

Concept	Description
Definition	Equivalent to serial schedule
Conflict Ops	RW, WR, WW on same item
Testing	No cycles in precedence graph

No Cycle $\implies$ Serializable

Figure 11. Precedence Graph

Mnemonic

Mnemonic: "COGS" (Conflict Operations Graph Serializable)

OR

Question 5(c) [7 marks]

Explain 3NF normalization with example

Solution

Table 23. Normal Forms

Form	Definition	Example
1NF	Atomic	Split phone numbers
2NF	No Partial Dep	Split Order details
3NF	No Transitive Dep	Split Student Dept

Example: Emp(ID, Name, DeptID, DeptName) $\rightarrow$
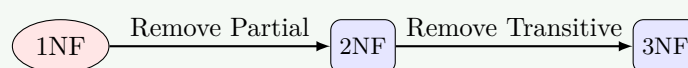Emp(ID, Name, DeptID) + Dept(DeptID, DeptName)

Figure 12. Normalization Flow

Mnemonic

Mnemonic: "APTN" (Atomic, Partial, Transitive, Normalized)