

# 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
<b>Strong Entity</b>	Exists independently	Has its own primary key
<b>Weak Entity</b>	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
<b>Physical Level</b>	Describes how data is stored physically	System Administrators
<b>Conceptual Level</b>	Describes what data is stored and relationships	Database Designers
<b>View Level</b>	Describes part of database relevant to users	End Users

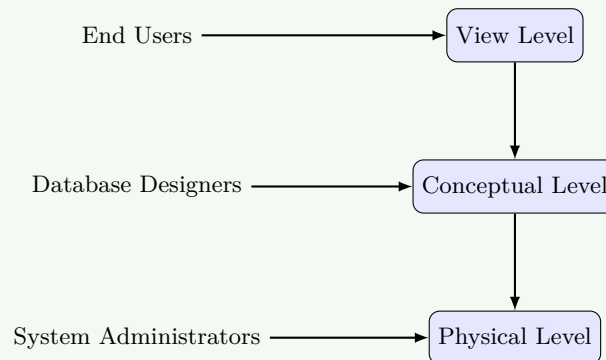


Figure 1. Data Abstraction Levels

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

## 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 ( $\sigma$ )

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

#### 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
<b>Primary Key</b>	Unique identifier for each record
<b>Foreign Key</b>	Attribute linking to primary key in another table
<b>Super Key</b>	Set of attributes that can uniquely identify records
<b>Candidate Key</b>	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

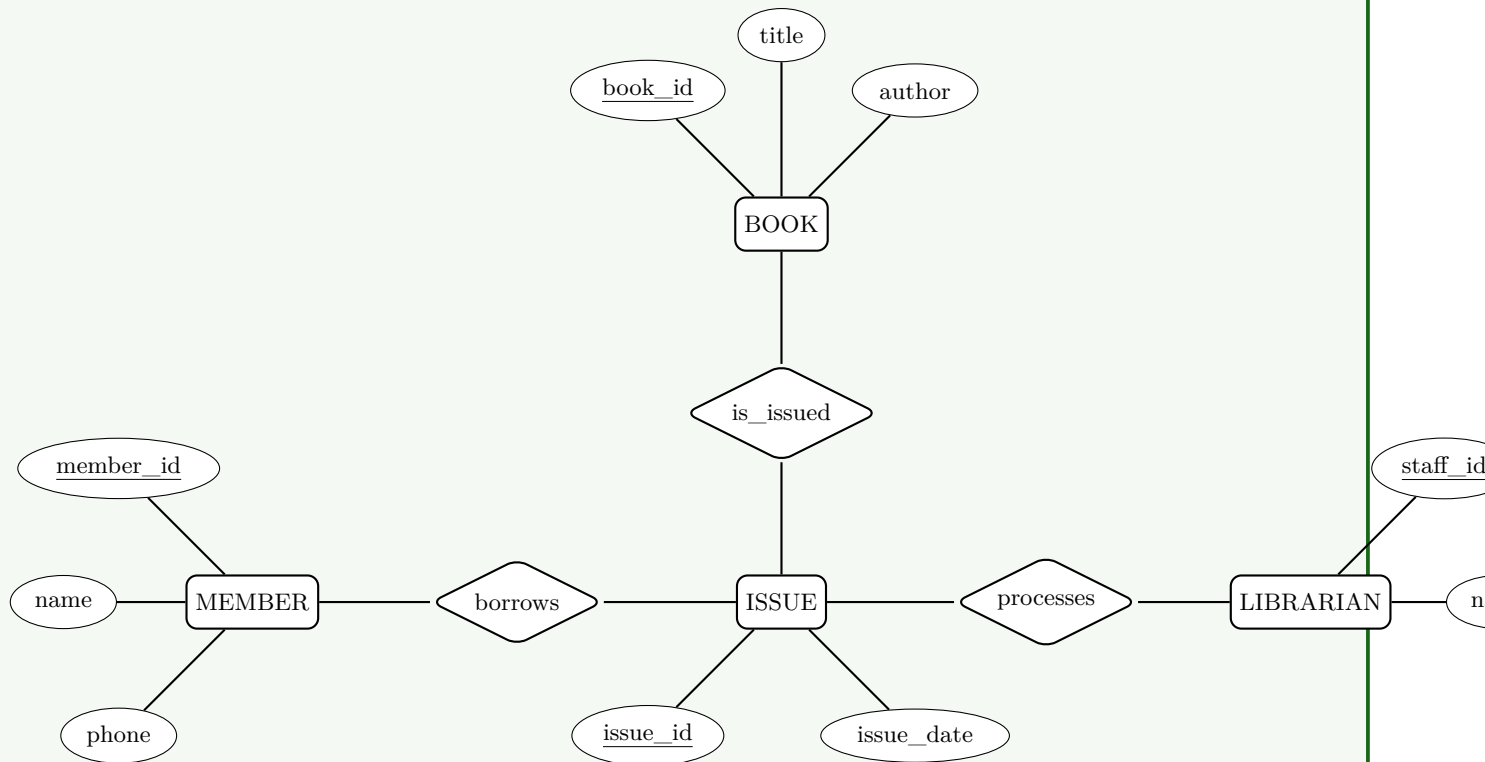


Figure 2. Library Management System ER Diagram

## 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)

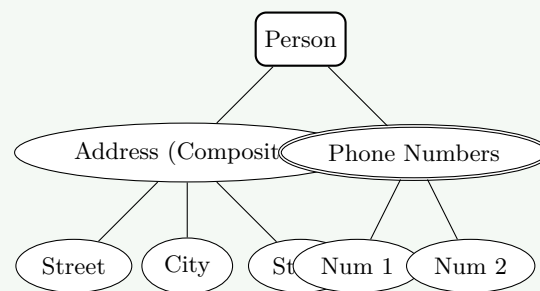
OR

**Question 2(b) [4 marks]**

Define Composite attribute and Multivalued attribute with example

**Solution****Table 7.** Attribute Types

Attribute Type	Description	Example
<b>Composite</b>	Can be divided into smaller subparts	Address (street, city, state, zip)
<b>Multivalued</b>	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

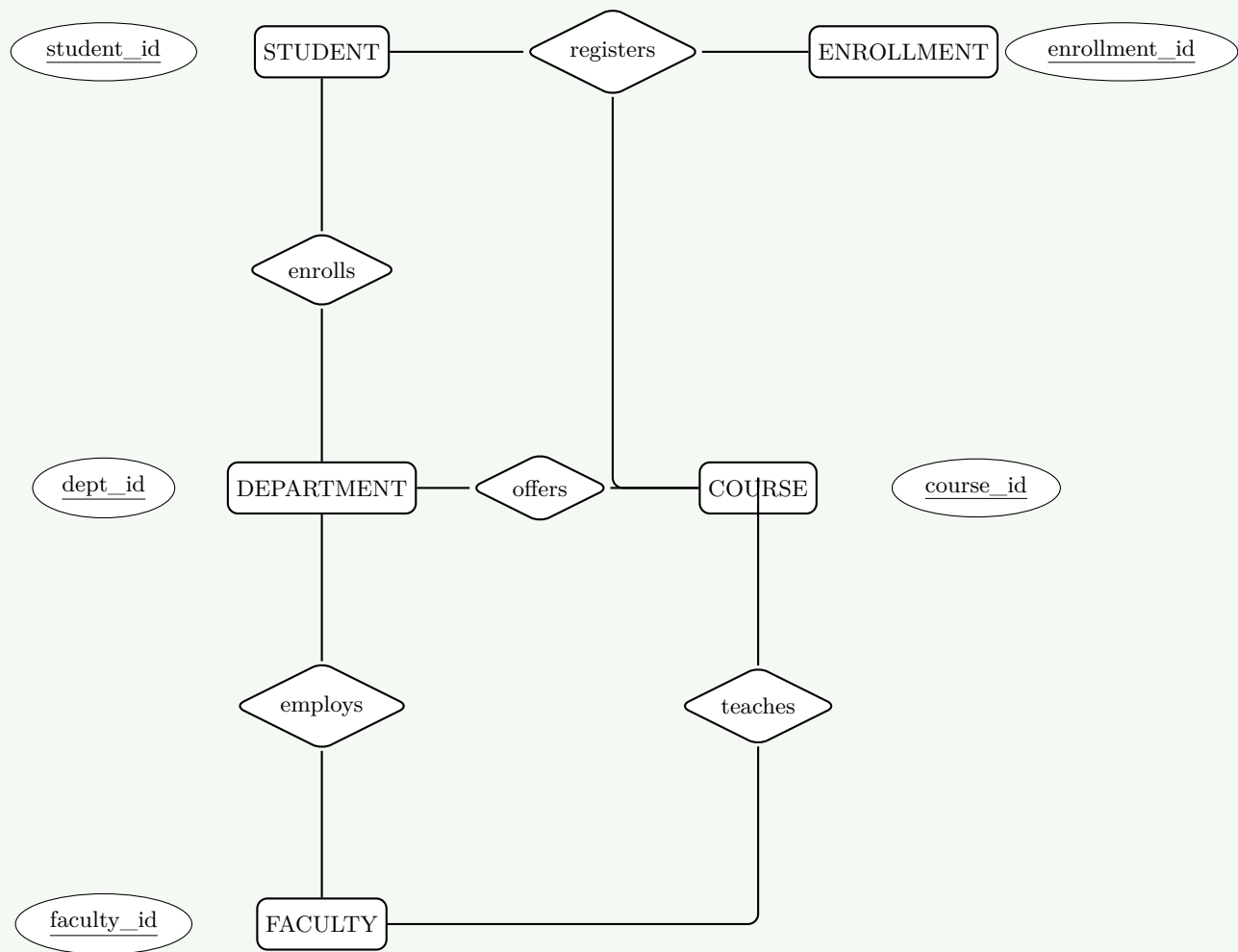


Figure 4. College Management System ER Diagram

## 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
<b>Numeric</b>	INT, FLOAT, DECIMAL	Store numbers
<b>Character</b>	CHAR, VARCHAR, TEXT	Store text
<b>Date/Time</b>	DATE, TIME, TIMESTAMP	Store temporal data
<b>Boolean</b>	BOOLEAN	Store true/false values
<b>Binary</b>	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
<b>CREATE</b>	CREATE TABLE t (cols);	CREATE TABLE Student (id INT, n TEXT);
<b>ALTER</b>	ALTER TABLE t ADD c type;	ALTER TABLE Student ADD email TEXT;

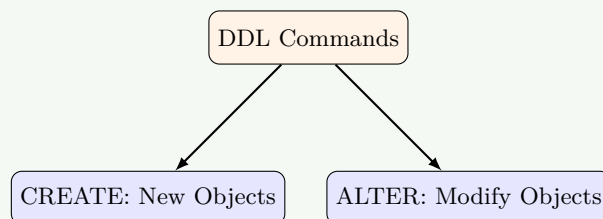


Figure 5. DDL Commands

## 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:** "CMRFLA" (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;

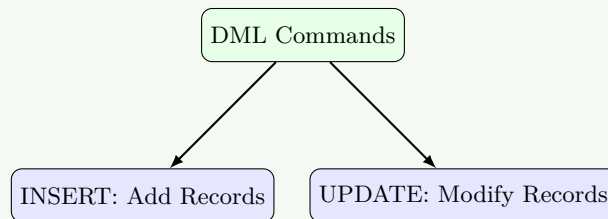


Figure 6. DML Commands

## 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
<b>SUM</b>	Calculates total
<b>AVG</b>	Calculates average
<b>COUNT</b>	Counts number of rows
<b>MAX</b>	Finds maximum value
<b>MIN</b>	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
<b>ACID</b>	Atomicity, Consistency, Isolation, Durability
<b>States</b>	Active, Partially Committed, Committed, Failed, Aborted

```

1 BEGIN TRANSACTION;
2     UPDATE Accounts SET balance = balance - 5000 WHERE acc_no = 'A123';
3     UPDATE Accounts SET balance = balance + 5000 WHERE acc_no = 'B456';
4 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
<b>Arithmetic</b>	+, -, *, /, %	5 + 3 = 8
<b>Logical</b>	AND	salary > 3k AND dept = 'IT'
<b>Logical</b>	OR	salary > 5k OR dept = 'HR'
<b>Logical</b>	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
<b>ROUND</b>	Rounds to decimal places
<b>TRUNC</b>	Truncates to decimal places
<b>CEIL</b>	Smallest integer $\geq$ number
<b>FLOOR</b>	Largest integer $\leq$ number
<b>ABS</b>	Absolute value

**Example (ROUND):**  $\text{ROUND}(125.679, 2) \rightarrow 125.68$

**Mnemonic**

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

OR

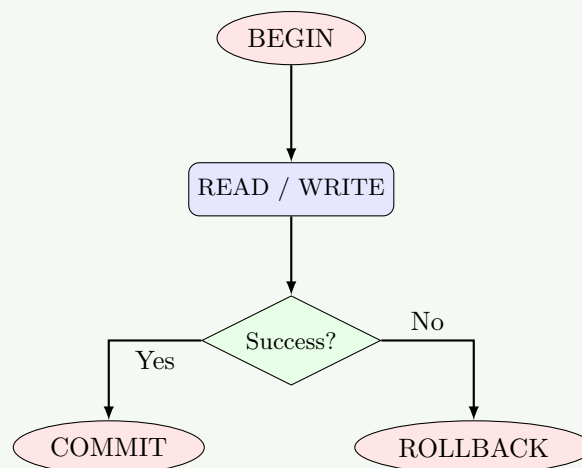
## Question 4(b) [4 marks]

List various database operations of a transaction.

## Solution

Table 17. Transaction Operations

Operation	Description
<b>BEGIN</b>	Marks start
<b>READ</b>	Retrieves data
<b>WRITE</b>	Modifies data
<b>COMMIT</b>	Saves changes
<b>ROLLBACK</b>	Undoes changes
<b>SAVEPOINT</b>	Partial rollback point



**Figure 7.** Transaction Flow**Mnemonic****Mnemonic:** "BRWCRS" (Begin, Read, Write, Commit, Rollback, Savepoint)

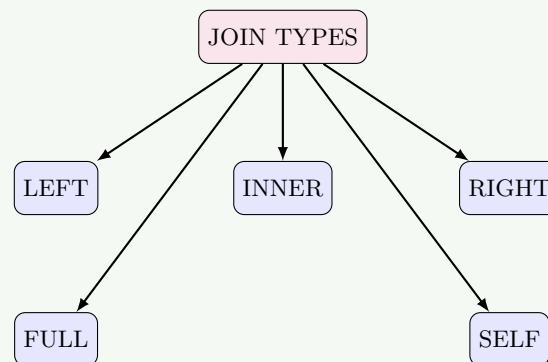
OR

**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
<b>INNER JOIN</b>	Match in both tables
<b>LEFT JOIN</b>	All from left, matched from right
<b>RIGHT JOIN</b>	All from right, matched from left
<b>FULL JOIN</b>	Match in either table
<b>SELF JOIN</b>	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**

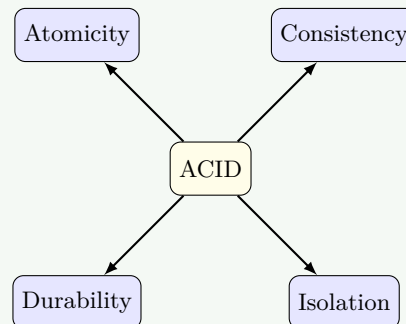
**Mnemonic:** "AFM" (Atomic values, Flatten Multivalued attributes)

**Question 5(b) [4 marks]**

List and Explain ACID properties of transaction.

**Solution****Table 20.** ACID Properties

Property	Description
<b>Atomicity</b>	All or nothing
<b>Consistency</b>	Database remains valid
<b>Isolation</b>	Transactions don't interfere
<b>Durability</b>	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	$Y \subseteq X$	$\{ID, Name\} \rightarrow \{Name\}$
Non-trivial FD	$Y \not\subseteq X$	$\{ID\} \rightarrow \{Name\}$
Partial FD	Part of key determines attr	$\{Course, Student\} \rightarrow CourseName$
Transitive FD	$X \rightarrow Y \rightarrow Z$	$Student \rightarrow Dept \rightarrow DeptName$
Multivalued FD	One determines set of another	$Course \twoheadrightarrow Textbook$

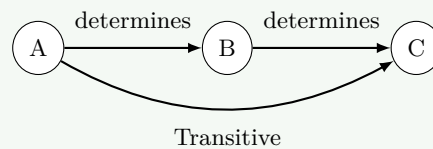


Figure 10. Transitive Dependency

## 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

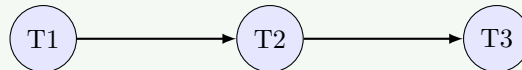
### Question 5(b) [4 marks]

Explain conflict serializability.

#### Solution

**Table 22.** Conflict Serializability

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



No Cycle  $\Rightarrow$  Serializable

**Figure 11.** Precedence Graph

#### Mnemonic

**Mnemonic:** "COGS" (Conflict Operations Graph Serializable)

OR

### Question 5(c) [7 marks]

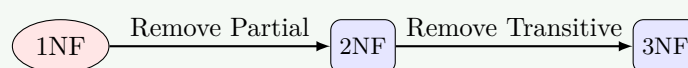
Explain 3NF normalization with example

#### Solution

**Table 23.** Normal Forms

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

**Example:**  $\text{Emp}(\text{ID}, \text{Name}, \text{DeptID}, \text{DeptName}) \rightarrow$   
 $\text{Emp}(\text{ID}, \text{Name}, \text{DeptID}) + \text{Dept}(\text{DeptID}, \text{DeptName})$





**Figure 12.** Normalization Flow**Mnemonic****Mnemonic:** "APTN" (Atomic, Partial, Transitive, Normalized)