

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

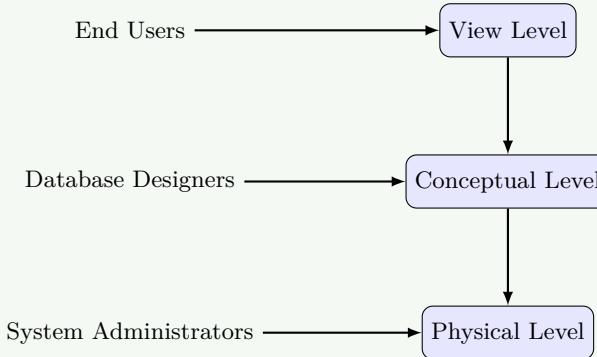
Mnemonic: "SWing" (Strong is With own identity, weak is Not Getting own identity)

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

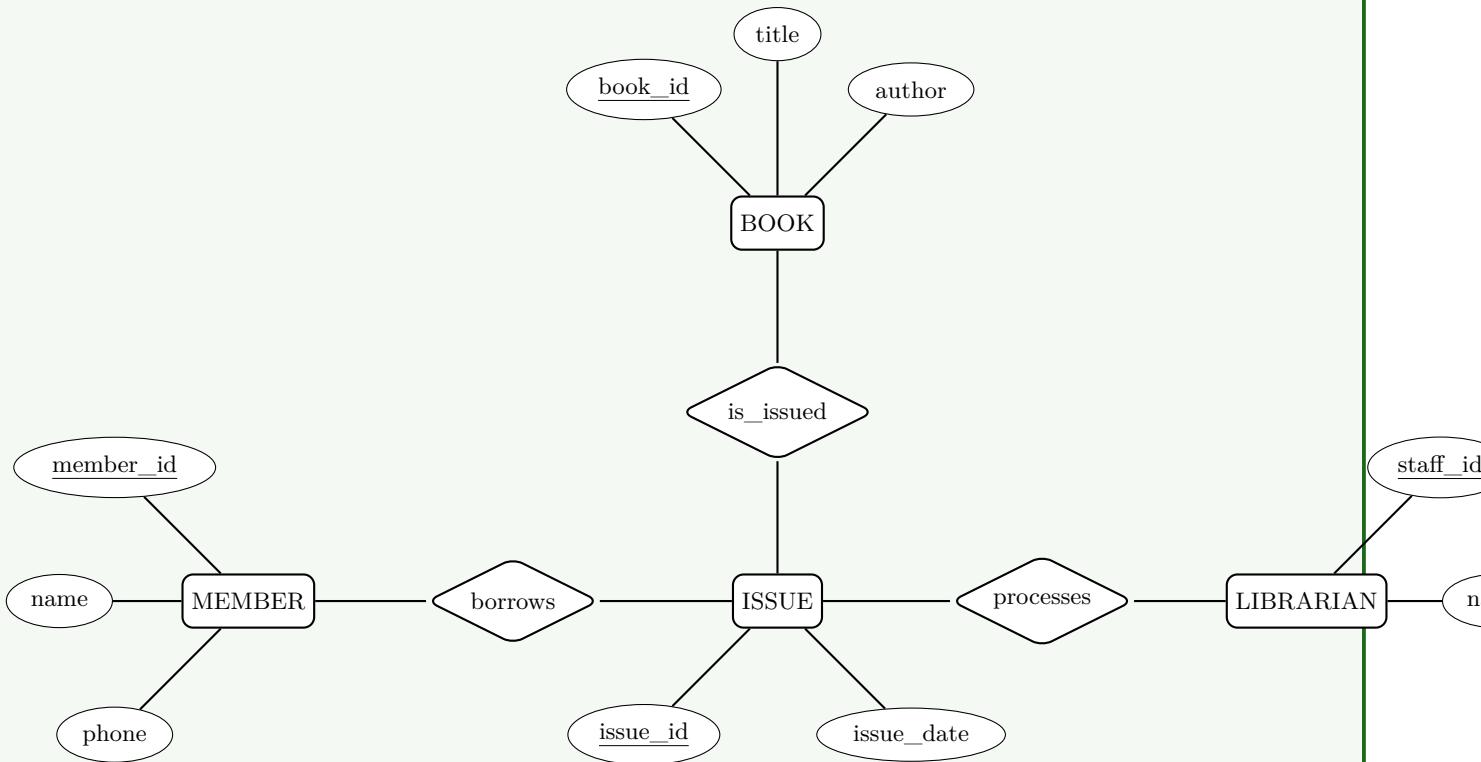
Key Type	Description
Primary Key	Unique identifier for each record
Foreign Key	Attribute linking to primary key in another table
Super Key	Set of attributes that can uniquely identify records
Candidate Key	Minimal super key that can be primary key

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

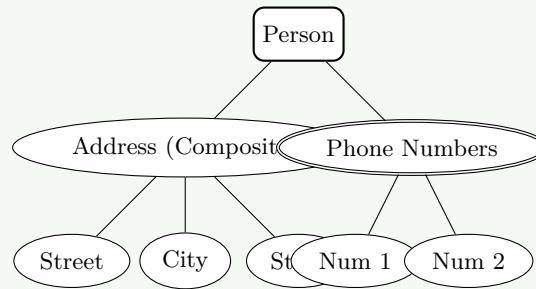


Figure 3. Attribute Types Hierarchy

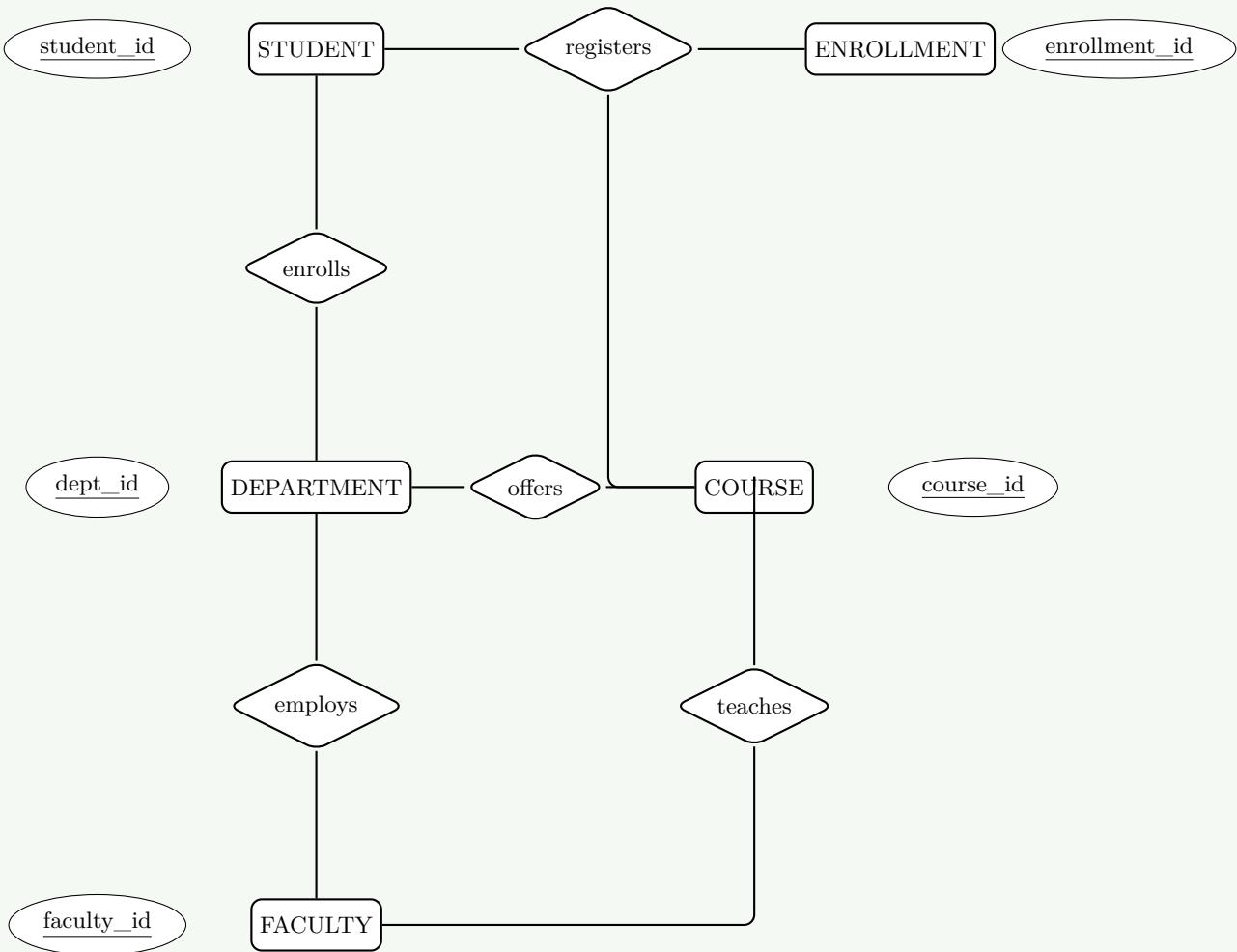
Mnemonic

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

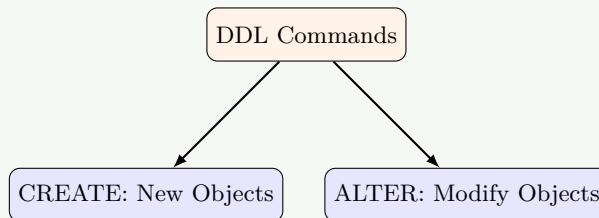
Mnemonic: "NCDBB" (Numbers, Characters, Dates, Booleans, Binaries)

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 ≥ 123.57
CEIL(4.1)	5	Smallest integer ≥ 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 ≤ 25.3
FLOOR(25.7)	25	Largest integer ≤ 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

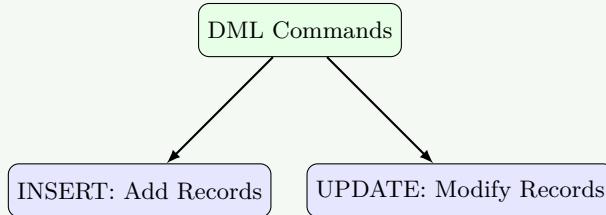
Mnemonic: "AMS" (Add_months, Months_between, Sysdate)

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;

**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

```

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

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

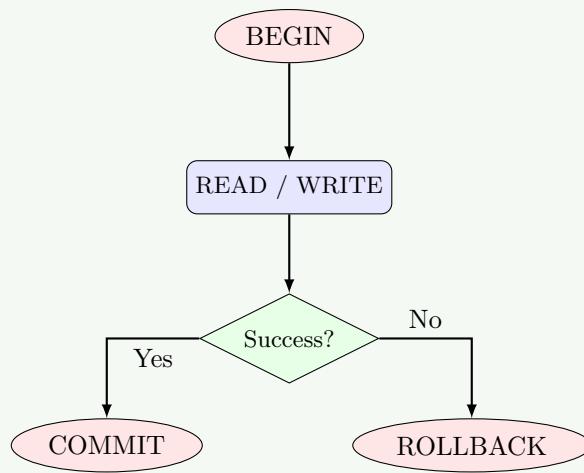


Figure 7. Transaction Flow**Mnemonic**

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

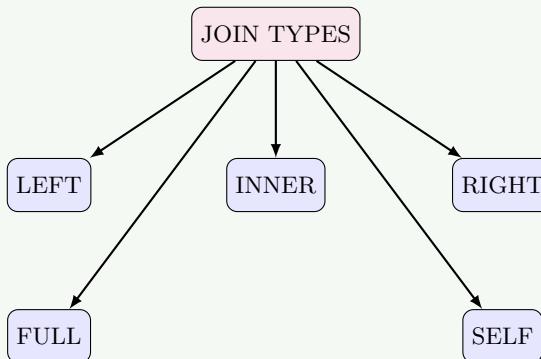
OR

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

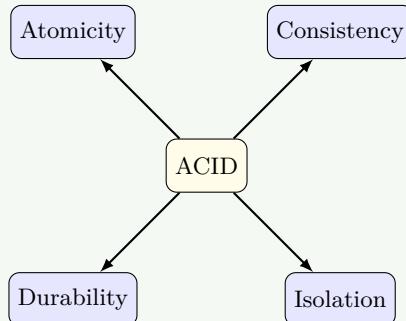
Mnemonic: "AFM" (Atomic values, Flatten Multivalued attributes)

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**

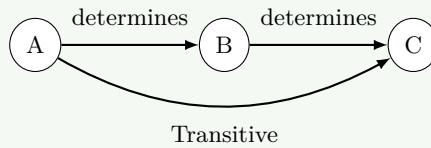
Mnemonic: "ACID" (Atomicity, Consistency, Isolation, Durability)

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	$Y \subseteq X$	$\{ID, Name\} \rightarrow \{Name\}$
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	$Course \rightarrow\rightarrow Textbook$

**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

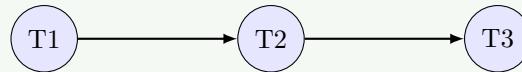
Question 5(b) [4 marks]

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
 $\text{Emp}(\text{ID}, \text{Name}, \text{DeptID}) + \text{Dept}(\text{DeptID}, \text{DeptName})$



Figure 12. Normalization Flow

Mnemonic

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