Question 1(a) [3 marks]

Define the following terms. 1) Metadata 2) Schema 3) Data dictionary.

Answer:

Table:

Term	Definition
Metadata	Data about data that describes structure, format, and characteristics of database
Schema	Logical structure describing database organization and relationships
Data Dictionary	Centralized repository storing information about database elements

- **Metadata**: Information describing data characteristics and properties
- **Schema**: Blueprint defining database structure and constraints
- **Data Dictionary**: Catalog of all database objects and their attributes

Mnemonic: "MSD - My System Dictionary"

Question 1(b) [4 marks]

Write down advantages of Database Management system.

Answer:

Table:

Advantage	Description
Data Independence	Applications independent of data storage
Data Integrity	Maintains accuracy and consistency
Security Control	User authentication and authorization
Concurrent Access	Multiple users access simultaneously

- **Reduced Redundancy**: Eliminates duplicate data storage
- **Centralized Control**: Single point of data management
- **Data Sharing**: Multiple applications can use same data
- **Backup Recovery**: Automatic data protection mechanisms

Mnemonic: "DISC-RCDB - Database Is Super Cool"

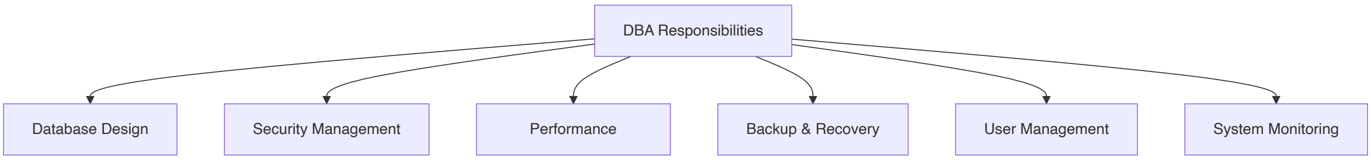
Question 1(c) [7 marks]

Explain Responsibilities of DBA.

Answer:

Table:

Responsibility	Tasks
Database Design	Create logical and physical structures
Security Management	Control user access and permissions
Performance Tuning	Optimize queries and database operations
Backup Recovery	Ensure data protection and restoration
User Management	Create accounts and assign privileges



- **Database Installation**: Setup and configure DBMS software
- **Data Migration**: Transfer data between systems safely
- **Documentation**: Maintain database schemas and procedures
- **Monitoring**: Track system performance and resource usage
- **Troubleshooting**: Resolve database issues and errors

Mnemonic: "DSPBU-DMT - DBA Solves Problems By Understanding Database Management Tasks"

Question 1(c OR) [7 marks]

What is data abstraction? Explain three level ANSI SPARC architecture in detail.

Answer:

Data Abstraction: Hiding complex database implementation details from users while providing simplified interfaces.

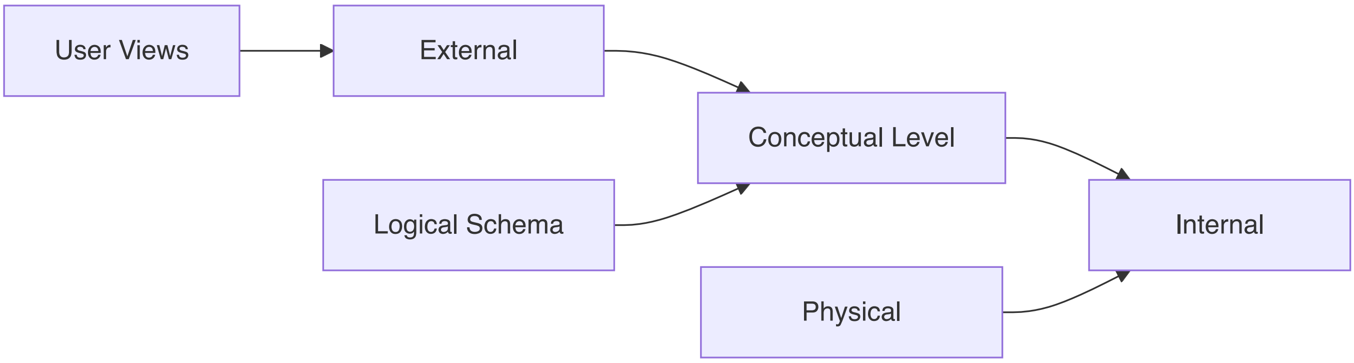


Table:

Level	Description	Users
External Level	Individual user views and applications	End Users
Conceptual Level	Complete logical database structure	Database Designers
Internal Level	Physical storage and access methods	System Programmers

- **External Level**: Multiple user views hiding complexity
- **Conceptual Level**: Complete database schema without storage details
- **Internal Level**: Physical file organization and indexing
- **Data Independence**: Changes at one level don't affect others

Mnemonic: "ECI - Every Computer Implements"

Question 2(a) [3 marks]

Differentiate Schema vs Instance

Answer:

Table:

Aspect	Schema	Instance
Definition	Database structure blueprint	Actual data at specific time
Nature	Static logical design	Dynamic data content
Changes	Rarely modified	Frequently updated

- **Schema**: Describes database organization and constraints
- **Instance**: Snapshot of database content at particular moment
- **Relationship**: Schema defines structure, instance contains data

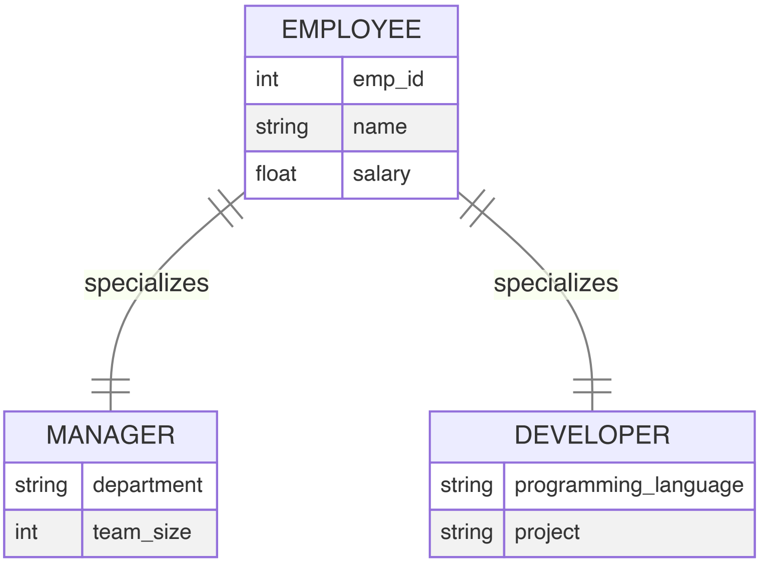
Mnemonic: "SI - Structure vs Information"

Question 2(b) [4 marks]

Explain Specialization with example.

Answer:

Specialization: Process of creating subclasses from superclass based on specific characteristics.



- **Top-Down Approach**: From general entity to specific entities
- **Inheritance**: Subclasses inherit superclass attributes
- **Disjoint**: Manager and Developer are separate categories
- **Example**: Employee specialized into Manager and Developer

Mnemonic: "STID - Specialization Takes Inheritance Down"

Question 2(c) [7 marks]

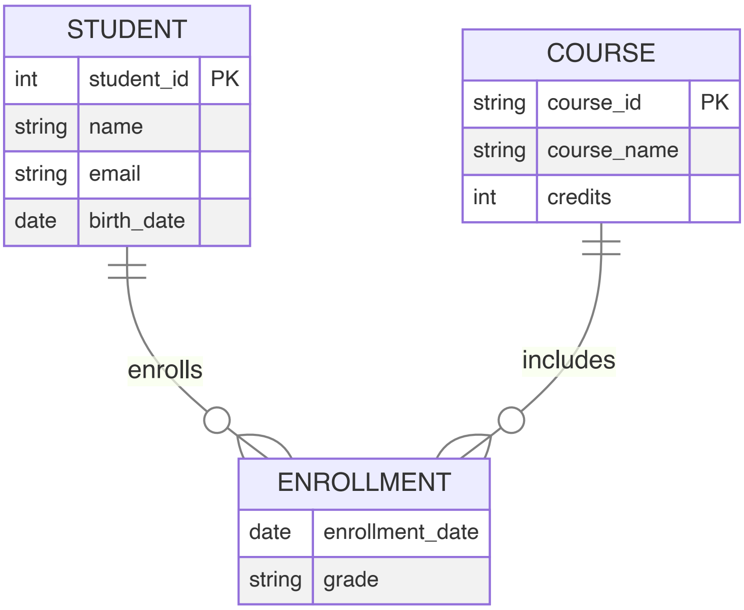
What is ER diagram? Explain different symbols used in E-R diagram with example.

Answer:

ER Diagram: Graphical representation showing entities, attributes, and relationships in database design.

Table:

Symbol	Shape	Purpose	Example
Entity	Rectangle	Real-world object	Student, Course
Attribute	Oval	Entity properties	Name, Age, ID
Relationship	Diamond	Entity connections	Enrolls, Takes
Primary Key	Underlined oval	Unique identifier	Student_ID



- **Entity Sets**: Collection of similar entities with same attributes
- **Weak Entity**: Depends on strong entity for identification
- **Cardinality**: Defines relationship participation (1:1, 1:M, M:N)
- **Participation**: Total (double line) or Partial (single line)

Mnemonic: "EARP - Entities And Relationships Program"

Question 2(a OR) [3 marks]

Differentiate DA vs DBA.

Answer:

Table:

Aspect	Data Administrator (DA)	Database Administrator (DBA)
Focus	Data policies and standards	Technical database operations
Level	Strategic planning	Operational implementation
Scope	Organization-wide data	Specific database systems

- **DA**: Manages data as organizational resource
- **DBA**: Handles technical database maintenance and performance
- **Collaboration**: DA sets policies, DBA implements them

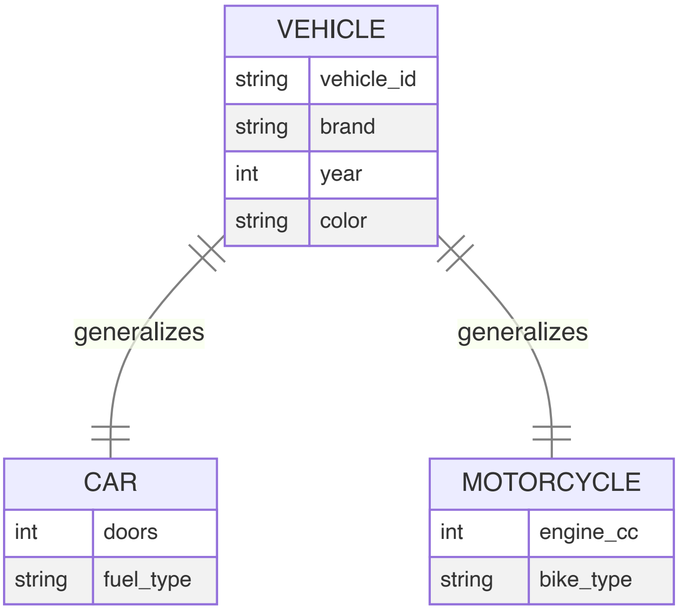
Mnemonic: "DA-DBA: Design Authority - Database Builder Administrator"

Question 2(b OR) [4 marks]

Explain Generalization with example.

Answer:

Generalization: Bottom-up process combining similar entities into common superclass.



- **Bottom-Up Approach**: From specific entities to general entity
- **Common Attributes**: Shared properties moved to superclass
- **Specialization Reverse**: Opposite of specialization process
- **Example**: Car and Motorcycle generalized into Vehicle

Mnemonic: "GBCS - Generalization Brings Common Superclass"

Question 2(c OR) [7 marks]

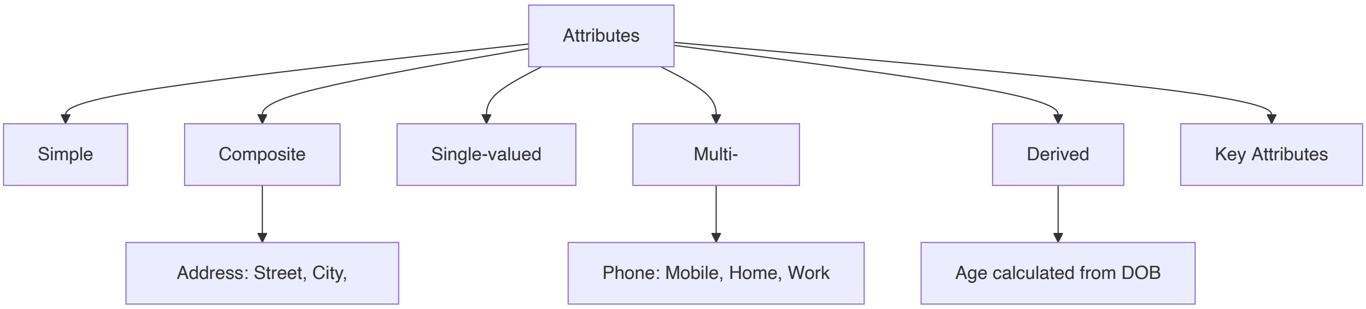
What is attribute? Explain different types of attributes with example.

Answer:

Attribute: Property or characteristic that describes an entity.

Table:

Attribute Type	Description	Example
Simple	Cannot be divided further	Age, Name
Composite	Can be subdivided	Address (Street, City, ZIP)
Single-valued	One value per entity	Student_ID
Multi-valued	Multiple values possible	Phone_numbers
Derived	Calculated from other attributes	Age from Birth_date



- **Key Attribute**: Uniquely identifies entity instances
- **Null Values**: Attributes that may have no value
- **Default Values**: Predetermined values when not specified
- **Constraints**: Rules governing attribute values

Mnemonic: "SCSMD-K - Simple Composite Single Multi Derived Key"

Question 3(a) [3 marks]

Explain the GRANT and REVOKE statement in SQL.

Answer:

Table:

Statement	Purpose	Syntax Example
GRANT	Provides privileges to users	GRANT SELECT ON table TO user
REVOKE	Removes user privileges	REVOKE INSERT ON table FROM user

```sql
-- Grant privileges
GRANT SELECT, INSERT ON employees TO john;
GRANT ALL PRIVILEGES ON database TO admin;

-- Revoke privileges
REVOKE DELETE ON employees FROM john;
REVOKE ALL ON database FROM user;
```

- **Privileges**: SELECT, INSERT, UPDATE, DELETE, ALL
- **Objects**: Tables, views, databases, procedures
- **Security**: Controls data access and modification rights

Mnemonic: "GR - Grant Rights, Remove Rights"

Question 3(b) [4 marks]

Explain following Character functions. 1) INITCAP 2) SUBSTR

Answer:

Table:

Function	Purpose	Syntax	Example
INITCAP	Capitalizes first letter of each word	INITCAP(string)	INITCAP('hello world') = 'Hello World'
SUBSTR	Extracts substring from string	SUBSTR(string, start, length)	SUBSTR('Database', 1, 4) = 'Data'

```sql
-- INITCAP examples
SELECT INITCAP('database management') FROM dual; -- Database Management
SELECT INITCAP('gtu university') FROM dual; -- Gtu University

-- SUBSTR examples
SELECT SUBSTR('Programming', 1, 7) FROM dual; -- Program
SELECT SUBSTR('Database', 5) FROM dual; -- base
```

- **INITCAP**: Converts string to proper case format
- **SUBSTR**: Parameters are string, starting position, optional length
- **Usage**: Text formatting and string manipulation operations

Mnemonic: "IS - Initialize String, Split String"

Question 3(c) [7 marks]

Consider following tables and write answers for the given queries.
stud_master (enroll_no, name, city, dept)

Answer:

```sql
-- 1. Display all student details who study in IT dept
SELECT * FROM stud_master
WHERE dept = 'IT';

-- 2. Retrieve all information about name where name begins with 'p'
SELECT * FROM stud_master
WHERE name LIKE 'p%';
```

```sql
-- 3. Insert new student to table
INSERT INTO stud_master (enroll_no, name, city, dept)
VALUES ('202501', 'John Smith', 'Mumbai', 'CS');

-- 4. Add new column gender to table stud_master
ALTER TABLE stud_master
ADD gender VARCHAR(10);

-- 5. Count number of rows for stud_master table
SELECT COUNT(*) FROM stud_master;

-- 6. Display all student details in descending order of enroll_no
SELECT * FROM stud_master
ORDER BY enroll_no DESC;

-- 7. Destroy table stud_master along with data
DROP TABLE stud_master;
```

Table:

Query Type	SQL Command	Purpose
SELECT	Retrieves data	Display records
INSERT	Adds new data	Create records
ALTER	Modifies structure	Add columns
COUNT	Aggregate function	Count rows

Mnemonic: "SIAC-DOC - SQL Is A Complete Database Operations Collection"

Question 3(a OR) [3 marks]

Explain equi join with example in SQL.

Answer:

Equi Join: Join operation using equality condition to combine tables based on common columns.

```sql
-- Equi Join example
SELECT s.name, c.course_name
FROM students s, courses c
WHERE s.course_id = c.course_id;

-- Using JOIN syntax
SELECT s.name, c.course_name
FROM students s
JOIN courses c ON s.course_id = c.course_id;
```

- **Equality Operator**: Uses = to match column values
- **Common Columns**: Tables must have related attributes
- **Result**: Combined data from multiple tables based on matches

Mnemonic: "EJ - Equal Join"

Question 3(b OR) [4 marks]

Explain following Aggregate functions. 1) MAX 2) SUM

Answer:

Table:

Function	Purpose	Syntax	Example
MAX	Returns maximum value	MAX(column)	MAX(salary) = 50000
SUM	Returns total of values	SUM(column)	SUM(marks) = 450

```sql
-- MAX examples
SELECT MAX(salary) FROM employees; -- Highest salary
SELECT MAX(age) FROM students; -- Oldest student age

-- SUM examples
SELECT SUM(credits) FROM courses; -- Total credits
SELECT SUM(price * quantity) FROM orders; -- Total order value
```

- **Aggregate Functions**: Operate on multiple rows, return single value
- **NULL Handling**: Ignore NULL values in calculations
- **GROUP BY**: Can be used with grouping for category-wise results

Mnemonic: "MS - Maximum Sum"

Question 3(c OR) [7 marks]

Write SQL queries for the following table:
PRODUCT_Master: (prod_no, prod_name, profit, quantity, sell_price, cost_price)

Answer:

```sql
-- 1. Create table PRODUCT_Master
CREATE TABLE PRODUCT_Master (
    prod_no VARCHAR(10) PRIMARY KEY,
    prod_name VARCHAR(50),
    profit NUMBER(10,2),
    quantity NUMBER,
    sell_price NUMBER(10,2),
    cost_price NUMBER(10,2)
);

-- 2. Insert one record in this table
INSERT INTO PRODUCT_Master VALUES
('P001', 'Laptop', 15000, 10, 45000, 30000);

-- 3. Find product having profit greater than 20000
SELECT * FROM PRODUCT_Master
WHERE profit > 20000;

-- 4. Delete product having quantity less than 5
DELETE FROM PRODUCT_Master
WHERE quantity < 5;

-- 5. Add 2% profit in product having sell price greater than 5000
UPDATE PRODUCT_Master
SET profit = profit * 1.02
WHERE sell_price > 5000;

-- 6. Add new field total_price to PRODUCT_Master
ALTER TABLE PRODUCT_Master
ADD total_price NUMBER(10,2);

-- 7. Find product name having no duplicate data
SELECT DISTINCT prod_name FROM PRODUCT_Master;
```

Mnemonic: "CIDFAUD - Create Insert Delete Find Add Update Distinct"

Question 4(a) [3 marks]

Explain fully functional dependency with example.

Answer:

Fully Functional Dependency: Attribute is fully functionally dependent if it depends on complete primary key, not on partial key.

Table:

Dependency Type	Definition	Example
Full FD	Depends on entire key	(Student_ID, Course_ID) → Grade
Partial FD	Depends on part of key	(Student_ID, Course_ID) → Student_Name

```
Example: Student_Course(Student_ID, Course_ID, Student_Name, Grade)

Full FD: (Student_ID, Course_ID) → Grade
Partial FD: Student_ID → Student_Name
```

- **Complete Key**: All attributes of composite primary key required

- **Non-key Attribute**: Depends on full primary key combination
- **2NF Requirement**: Eliminates partial dependencies

Mnemonic: "FFD - Full Function Dependency"

Question 4(b) [4 marks]

Consider following relational schema & give Relational Algebra Expressions:
Employee (Emp_name, Emp_id, birth_date, Post, salary)

Answer:

```
(i) List all Employees having Post="Clerk"
σ(Post='Clerk')(Employee)

(ii) Find Emp_id and Emp_name having salary > 2000 and post='Manager'
π(Emp_id, Emp_name)(σ(salary>2000 ∧ Post='Manager')(Employee))
```

Table:

Symbol	Operation	Purpose
σ	Selection	Filter rows based on condition
π	Projection	Select specific columns
∧	AND	Logical conjunction

- **Selection (σ)**: Chooses rows meeting specified conditions
- **Projection (π)**: Selects required columns from result
- **Combined Operations**: Can use multiple operations together

Mnemonic: "SPA - Select Project And"

Question 4(c) [7 marks]

What are the criteria of 2NF? Find different functional dependencies and normalize into 2NF.

Answer:

2NF Criteria:

- Must be in 1NF
- No partial functional dependencies on primary key

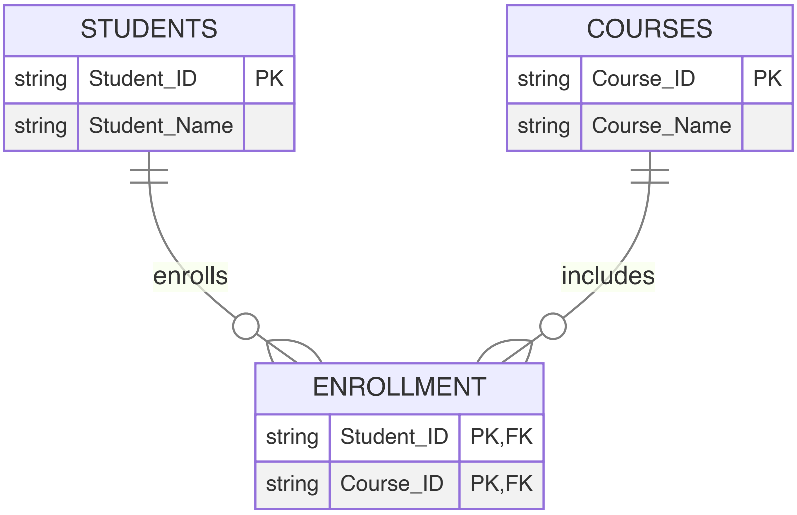
Given Table: Student_Course(Student_ID, Course_ID, Student_Name, Course_Name)

Functional Dependencies:

```
Student_ID → Student_Name (Partial FD)
Course_ID → Course_Name (Partial FD)
(Student_ID, Course_ID) → (Student_Name, Course_Name) (Full FD)
```

2NF Normalization:

```
-- Table 1: Students
Students(Student_ID, Student_Name)

-- Table 2: Courses
Courses(Course_ID, Course_Name)

-- Table 3: Enrollment
Enrollment(Student_ID, Course_ID)
```



Mnemonic: "2NF - Two Normal Form removes partial dependencies"

Question 4(a OR) [3 marks]

Explain 3NF with example.

Answer:

3NF (Third Normal Form): Table in 2NF with no transitive dependencies on primary key.

Table:

Normal Form	Requirement	Eliminates
3NF	In 2NF + No transitive dependencies	Transitive FD

```
Example: Employee(Emp_ID, Dept_ID, Dept_Name)

Transitive Dependency: Emp_ID → Dept_ID → Dept_Name

3NF Solution:
Employee(Emp_ID, Dept_ID)
Department(Dept_ID, Dept_Name)
```

- **Transitive Dependency**: A → B → C where A is primary key
- **Non-key to Non-key**: Dependency between non-key attributes
- **Decomposition**: Split table to remove transitive dependencies

Mnemonic: "3NF - Third Normal Form removes Transitive dependencies"

Question 4(b OR) [4 marks]

Consider following Relational Schema and give Relational Algebra Expression:
Students (Name, SPI, DOB, Enrollment No)

Answer:

```
(i) List all students whose SPI is greater than 7.0
σ(SPI > 7.0)(Students)

(ii) List name, DOB of student whose enrollment number is 007
π(Name, DOB)(σ(Enrollment_No = '007')(Students))
```

Table:

Query	Relational Algebra	Purpose
Filter	σ(condition)	Select rows
Project	π(attributes)	Select columns

- **Selection First**: Apply conditions before projection
- **Specific Value**: Use quotes for string literals
- **Column Names**: Exact attribute names required

Mnemonic: "SPI-DOB: Select Project Information - Display Output Better"

Question 4(c OR) [7 marks]

What are criteria of 1NF? Normalize given table into 1NF with two different techniques.

Answer:

1NF Criteria:

- Each cell contains single atomic value
- No repeating groups or arrays
- Each row must be unique

Given Table:

EnrollmentNo	Name	Subjects
001	DEF	Maths,Physics,Chemistry
002	XYZ	History,Biology,English

Technique 1 - Separate Rows:

EnrollmentNo	Name	Subject
001	DEF	Maths
001	DEF	Physics
001	DEF	Chemistry
002	XYZ	History
002	XYZ	Biology
002	XYZ	English

Technique 2 - Separate Tables:

```
-- Students Table
Students(EnrollmentNo, Name)

-- Subjects Table
Subjects(SubjectID, SubjectName)

-- Student_Subjects Table
Student_Subjects(EnrollmentNo, SubjectID)
```

Mnemonic: "1NF - One Normal Form creates Atomic values"

Question 5(a) [3 marks]

Explain ACID properties of transaction.

Answer:

Table:

Property	Description	Purpose
Atomicity	All or nothing execution	Transaction completeness
Consistency	Database remains valid	Data integrity
Isolation	Concurrent transactions independent	Avoid interference
Durability	Committed changes permanent	Data persistence

- **Atomicity**: Transaction executes completely or not at all
- **Consistency**: Database constraints maintained before/after transaction
- **Isolation**: Transactions don't interfere with each other
- **Durability**: Once committed, changes survive system failures

Mnemonic: "ACID - All Consistent Isolated Durable"

Question 5(b) [4 marks]

Create following table with specification:
STUDENT: (stu_id, stu_name, Address, City, contact_no, Branch_name)

Answer:

```
CREATE TABLE STUDENT (
    stu_id VARCHAR(10) PRIMARY KEY,
    stu_name VARCHAR(50) NOT NULL,
    Address VARCHAR(100),
    City VARCHAR(30),
    contact_no NUMBER(10),
    Branch_name VARCHAR(20) CHECK (Branch_name IN ('IT', 'Computer', 'Electrical', 
'Civil'))
);
```

Table:

Constraint	Purpose	Implementation
NOT NULL	Mandatory field	stu_name NOT NULL
CHECK	Value validation	Branch_name IN (...)

- **Primary Key**: stu_id uniquely identifies each student
- **NOT NULL**: stu_name cannot be empty
- **CHECK Constraint**: Branch_name limited to specified values
- **Data Types**: Appropriate sizes for each field

Mnemonic: "CNPD - Constraints Names Primary Datatypes"

Question 5(c) [7 marks]

What is trigger? Write syntax to create trigger in oracle. Create simple trigger.

Answer:

Trigger: Special stored procedure that automatically executes in response to database events.

Oracle Trigger Syntax:

```
CREATE [OR REPLACE] TRIGGER trigger_name
{BEFORE | AFTER | INSTEAD OF} {INSERT | UPDATE | DELETE}
ON table_name
[FOR EACH ROW]
[WHEN condition]
DECLARE
    -- Variable declarations
BEGIN
    -- Trigger logic
END;
```

Simple Trigger Example:

```
CREATE OR REPLACE TRIGGER display_student_trigger
BEFORE INSERT ON STUDENT
FOR EACH ROW
BEGIN
    DBMS_OUTPUT.PUT_LINE('Inserting student: ' || :NEW.stu_name ||
                        ' with ID: ' || :NEW.stu_id);
END;
```

Table:

Trigger Type	When Executed	Purpose
BEFORE	Before DML operation	Validation, modification
AFTER	After DML operation	Logging, auditing
FOR EACH ROW	Row-level trigger	Per row execution

- **:NEW**: References new values being inserted/updated
- **:OLD**: References old values being deleted/updated
- **Automatic Execution**: Fires automatically on specified events
- **Business Logic**: Enforces complex business rules

Mnemonic: "TBA-FEN - Triggers Before After For Each New"

Question 5(a OR) [3 marks]

Explain problems of concurrency control in transaction.

Answer:

Table:

Problem	Description	Example
Lost Update	One transaction overwrites another's changes	T1, T2 update same record
Dirty Read	Reading uncommitted data	T1 reads T2's uncommitted changes
Unrepeatable Read	Same query returns different results	T1 reads, T2 updates, T1 reads again

- **Phantom Read**: New rows appear between queries in same transaction
- **Deadlock**: Two transactions wait for each other's locks
- **Inconsistent Analysis**: Reading data while it's being modified

Mnemonic: "LDU-PID - Lost Dirty Unrepeatable Phantom Inconsistent Deadlock"

Question 5(b OR) [4 marks]

Create following table with specification:
STUDENT: (stu_id, stu_name, Address, City, contact_no, Branch_name)

Answer:

```
CREATE TABLE STUDENT (
    stu_id VARCHAR(10) PRIMARY KEY CHECK (stu_id LIKE 'S%'),
    stu_name VARCHAR(50),
    Address VARCHAR(100),
    City VARCHAR(30),
    contact_no NUMBER(10),
    Branch_name VARCHAR(20)
);
```

Table:

Constraint	Implementation	Purpose
PRIMARY KEY	stu_id PRIMARY KEY	Unique identification
CHECK	stu_id LIKE 'S%'	Must start with 'S'

- **Primary Key**: stu_id serves as unique identifier
- **Pattern Check**: stu_id must begin with letter 'S'

- **Data Types**: Appropriate field sizes and types
- **Constraint Validation**: Database enforces rules automatically

Mnemonic: "PKC-ST - Primary Key Check Starts"

Question 5(c OR) [7 marks]

What is Explicit cursor? Explain explicit cursor with simple example.

Answer:

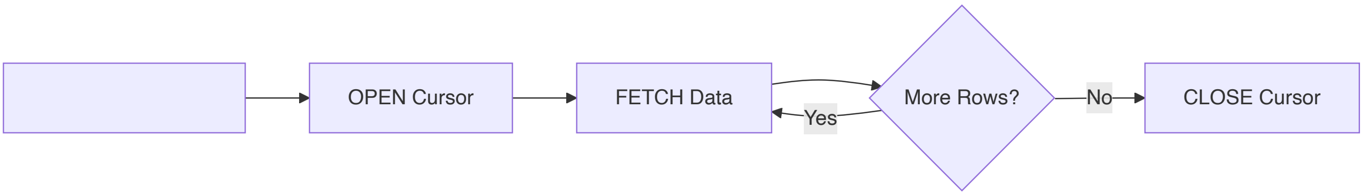
Explicit Cursor: User-defined cursor for handling SELECT statements that return multiple rows with programmatic control.

Cursor Operations:

```
-- Declaration
DECLARE
    CURSOR student_cursor IS
        SELECT stu_id, stu_name FROM STUDENT WHERE city = 'Ahmedabad';
    v_id STUDENT.stu_id%TYPE;
    v_name STUDENT.stu_name%TYPE;
BEGIN
    -- Open cursor
    OPEN student_cursor;

    -- Fetch data
    LOOP
        FETCH student_cursor INTO v_id, v_name;
        EXIT WHEN student_cursor%NOTFOUND;

        DBMS_OUTPUT.PUT_LINE('ID: ' || v_id || ', Name: ' || v_name);
    END LOOP;

    -- Close cursor
    CLOSE student_cursor;
END;
```

Table:

Operation	Purpose	Syntax
DECLARE	Define cursor	CURSOR name IS SELECT...
OPEN	Initialize cursor	OPEN cursor_name
FETCH	Retrieve data	FETCH cursor INTO variables
CLOSE	Release resources	CLOSE cursor_name



- **Manual Control**: Programmer controls cursor operations
- **Memory Management**: Must explicitly open and close
- **Loop Processing**: Typically used with loops for multiple rows
- **Cursor Attributes**: %FOUND, %NOTFOUND, %ROWCOUNT

Mnemonic: "DOFC - Declare Open Fetch Close"