Question 1(a) [3 marks]

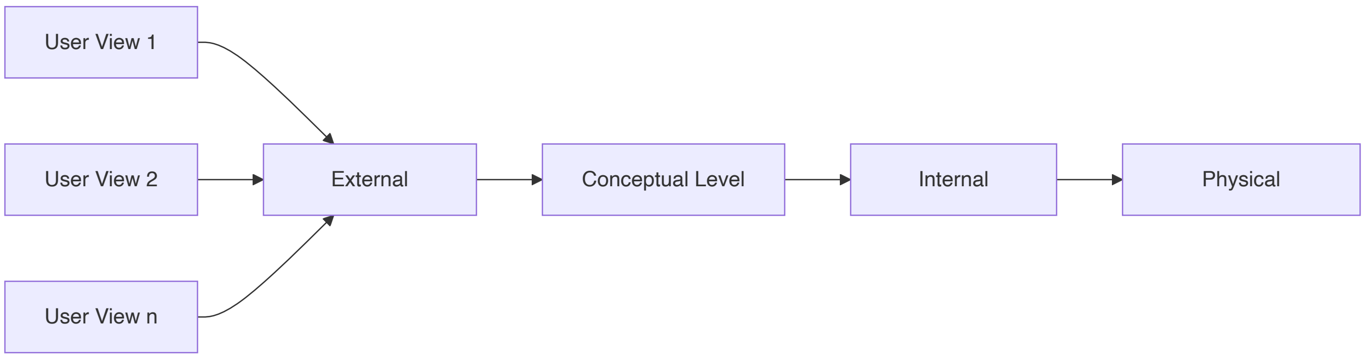
Explain three-level database architecture.

Answer:

Table:

Level	Description	Purpose
External Level	User views and application programs	Data abstraction for users
Conceptual Level	Complete logical structure	Organization-wide data view
Internal Level	Physical storage details	Storage and access methods

Diagram:



- **External Level**: Individual user views and specific application requirements
- **Conceptual Level**: Complete database schema without storage details
- **Internal Level**: Physical storage structures and access paths

Mnemonic: "ECI - Every Computer Interface"

Question 1(b) [4 marks]

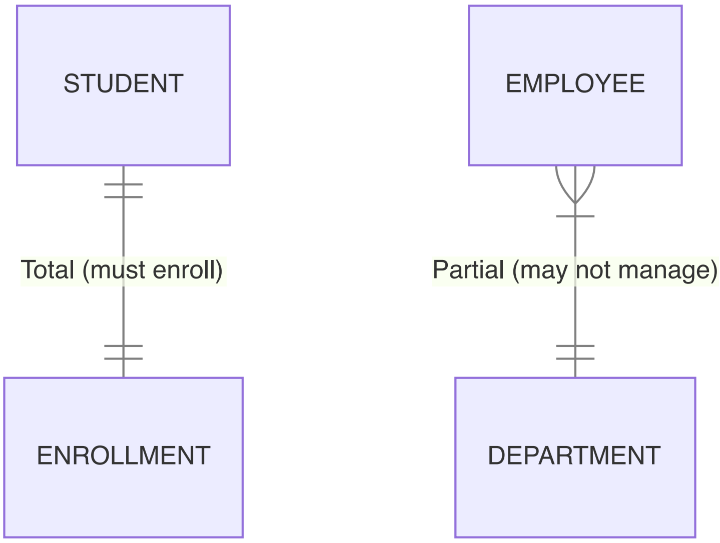
Explain Total Participation and Partial Participation with example.

Answer:

Table:

Participation Type	Definition	Symbol	Example
Total Participation	Every entity must participate	Double line	Student-Course enrollment
Partial Participation	Some entities may not participate	Single line	Employee-Department management

Diagram:



- **Total Participation**: All students must be enrolled in at least one course
- **Partial Participation**: Not all employees manage a department
- **Double lines** indicate total participation constraints
- **Single lines** show partial participation relationships

Mnemonic: "Total = Two lines, Partial = Plain line"

Question 1(c) [7 marks]

Explain advantages of DBMS over file management systems.

Answer:

Table:

Advantage	File System	DBMS
Data Redundancy	High duplication	Controlled redundancy
Data Inconsistency	Common problem	Data integrity maintained
Data Sharing	Limited sharing	Concurrent access support
Security	File-level security	User-level access control
Backup & Recovery	Manual process	Automatic mechanisms

- **Reduced Data Redundancy**: Eliminates duplicate data storage across applications
- **Data Consistency**: Ensures uniform data across all applications
- **Data Independence**: Applications independent of data structure changes
- **Concurrent Access**: Multiple users can access data simultaneously
- **Security Control**: User authentication and authorization mechanisms
- **Backup and Recovery**: Automatic data protection and restoration
- **Data Integrity**: Constraint enforcement maintains data quality

Mnemonic: "RDCCSBI - Really Don't Copy, Control, Secure, Backup, Integrate"

Question 1(c OR) [7 marks]

List out various data models. Explain any two in brief.

Answer:

Data Models List:

- Hierarchical Data Model
- Network Data Model
- Relational Data Model
- Object-Oriented Data Model
- Entity-Relationship Model

Table:

Model	Structure	Advantages	Disadvantages
Relational Model	Tables with rows/columns	Simple, flexible	Performance overhead
Network Model	Graph with records/links	Efficient navigation	Complex structure

Relational Data Model:

- **Structure**: Data organized in tables (relations)
- **Components**: Tuples (rows), attributes (columns), domains

- **Operations**: Select, project, join operations available

Network Data Model:

- **Structure**: Graph-based with owner-member relationships
- **Navigation**: Explicit links between record types
- **Flexibility**: Many-to-many relationships supported naturally

Mnemonic: "HNROE - Have Network Relational Object Entity"

Question 2(a) [3 marks]

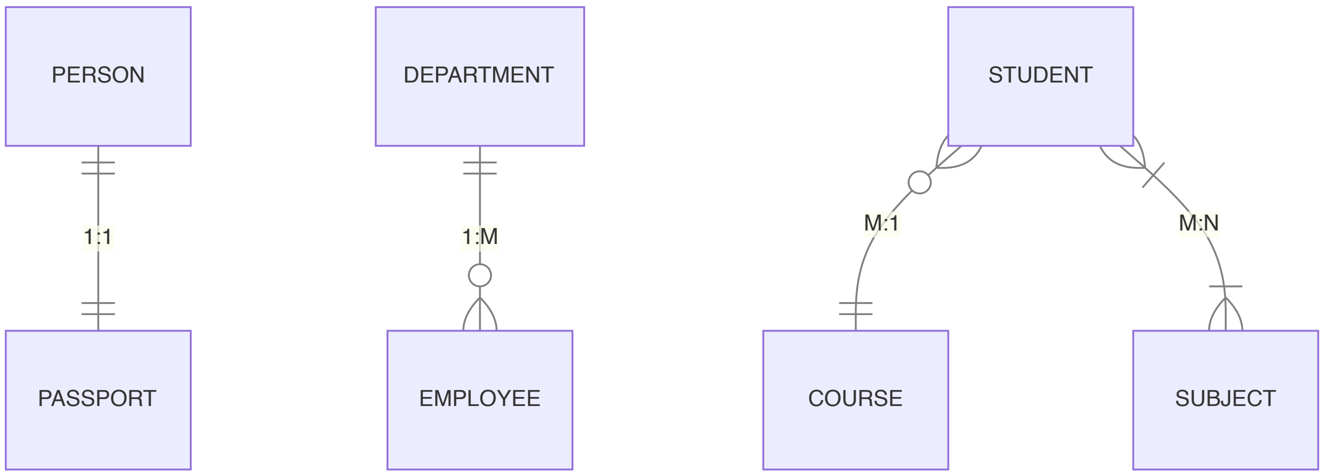
Explain Mapping Cardinalities.

Answer:

Table:

Cardinality	Symbol	Description	Example
One-to-One	1:1	Each entity relates to one other	Person-Passport
One-to-Many	1:M	One entity relates to many	Department-Employee
Many-to-One	M:1	Many entities relate to one	Student-Course
Many-to-Many	M:N	Many relate to many	Student-Subject

Diagram:



- **Cardinality constraints** define relationship participation limits
- **Maximum cardinality** specifies upper bound of associations
- **Helps in database design** and relationship modeling

Mnemonic: "OMOM - One, One-Many, One-Many, Many-Many"

Question 2(b) [4 marks]

Explain Outer Join operation in Relational Algebra.

Answer:

Table:

Join Type	Symbol	Result	NULL Handling
Left Outer Join	⟕	All left + matching right	NULLs for unmatched right
Right Outer Join	⟖	All right + matching left	NULLs for unmatched left
Full Outer Join	⟗	All from both tables	NULLs for unmatched

Example:

```
EMPLOYEE ⟕ DEPARTMENT
- Includes all employees
- NULL values for employees without departments
```

- **Preserves unmatched tuples** from specified relation(s)
- **NULL values** fill missing attribute values
- **Three types**: Left, Right, and Full outer joins
- **Useful for reporting** incomplete data relationships

Mnemonic: "LRF - Left Right Full outer joins"

Question 2(c) [7 marks]

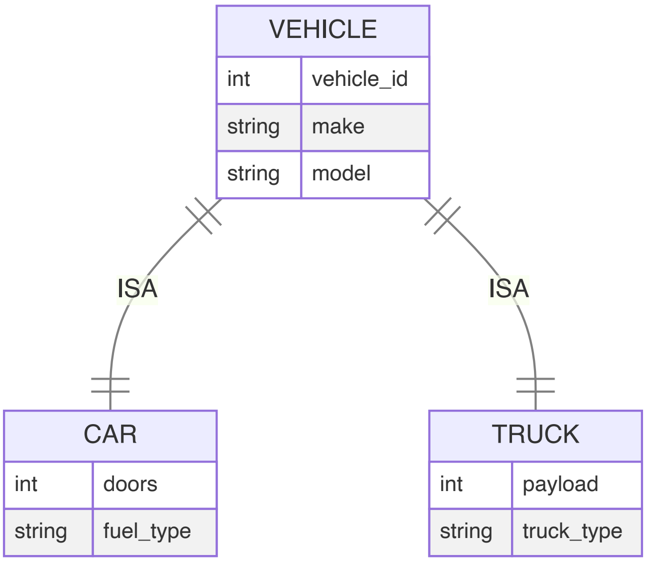
Explain concept of Specialization and Generalization with example.

Answer:

Table:

Concept	Direction	Process	Example
Specialization	Top-Down	General to Specific	Vehicle → Car, Truck
Generalization	Bottom-Up	Specific to General	Car, Truck → Vehicle

Diagram:



Specialization:

- **Process**: Creating subclasses from superclass
- **Inheritance**: Subclasses inherit all superclass attributes
- **Additional attributes**: Subclasses have specific properties

Generalization:

- **Process**: Creating superclass from common subclass features
- **Abstraction**: Identifies common attributes and relationships
- **Simplification**: Reduces complexity through hierarchy

Mnemonic: "SG-TD-BU - Specialization General-To-Detail, Bottom-Up"

Question 2(a OR) [3 marks]

Explain different types of Keys in Relational Algebra.

Answer:

Table:

Key Type	Definition	Uniqueness	Example
Super Key	Any attribute set that uniquely identifies	Yes	{ID, Name, Phone}
Candidate Key	Minimal super key	Yes	{ID}, {Email}
Primary Key	Chosen candidate key	Yes	{StudentID}
Foreign Key	References primary key	No	{DeptID} references Dept

- **Super Key**: Uniquely identifies tuples, may have extra attributes
- **Candidate Key**: Minimal super key without redundant attributes
- **Primary Key**: Selected candidate key for entity identification
- **Foreign Key**: Establishes referential integrity between tables

Mnemonic: "SCPF - Super Candidate Primary Foreign"

Question 2(b OR) [4 marks]

Explain types of attributes in ER-diagram with suitable example.

Answer:

Table:

Attribute Type	Symbol	Description	Example
Simple	Oval	Cannot be subdivided	Age, Name
Composite	Oval with sub-ovals	Can be subdivided	Address (Street, City)
Derived	Dashed oval	Calculated from others	Age from Birth_Date
Multi-valued	Double oval	Multiple values	Phone_Numbers

Diagram:

```
    +----------+
    |   Name   |  <-- Simple
    +----------+

    +----------+
    |  Address |  <-- Composite
    +----+-----+
         |
    +----+---+------+
    | Street | City |
```

```
    +--------+------+

    +----------+
    :|Phone_No|:  <-- Multi-valued
    +----------+

    +----------+
    :   Age    :  <-- Derived
    +----------+
```

- **Simple attributes** are atomic and indivisible
- **Composite attributes** have meaningful sub-parts
- **Derived attributes** computed from other attribute values
- **Multi-valued attributes** store multiple values per entity

Mnemonic: "SCDM - Simple Composite Derived Multi-valued"

Question 2(c OR) [7 marks]

Explain SELECT, PROJECT, UNION and SET-INTERSECTION operation with suitable example.

Answer:

Table:

Operation	Symbol	Purpose	Example
SELECT	σ	Filter rows	σ(salary > 50000)(Employee)
PROJECT	π	Select columns	π(name, age)(Employee)
UNION	∪	Combine relations	R ∪ S
INTERSECTION	∩	Common tuples	R ∩ S

Examples:

SELECT Operation:

```
σ(age > 25)(STUDENT)
- Returns students older than 25 years
```

PROJECT Operation:

```
π(name, course)(STUDENT)
- Returns only name and course columns
```

UNION Operation:

```
SCIENCE_STUDENTS ∪ ARTS_STUDENTS
- Combines students from both streams
```

INTERSECTION Operation:

```
MALE_STUDENTS ∩ SPORTS_STUDENTS
- Returns male students who play sports
```

Mnemonic: "SPUI - Select Project Union Intersection"

Question 3(a) [3 marks]

Differentiate Primary Key and Foreign Key constraint.

Answer:

Table:

Aspect	Primary Key	Foreign Key
Purpose	Unique identification	Referential integrity
NULL Values	Not allowed	Allowed
Uniqueness	Must be unique	Can be duplicate
Number per table	Only one	Multiple allowed

- **Primary Key**: Ensures entity integrity within table
- **Foreign Key**: Maintains referential integrity between tables
- **Uniqueness**: Primary keys unique, foreign keys can repeat
- **NULL handling**: Primary keys never NULL, foreign keys may be NULL

Mnemonic: "PU-FN - Primary Unique, Foreign Nullable"

Question 3(b) [4 marks]

Explain DUAL table and SYSDATE with example.

Answer:

Table:

Component	Type	Purpose	Example
DUAL	Virtual table	Test expressions	SELECT 2+3 FROM DUAL
SYSDATE	System function	Current date/time	SELECT SYSDATE FROM DUAL

DUAL Table:

- **Virtual table** with one row and one column
- **Used for testing** expressions and functions
- **Oracle-specific** pseudo table

SYSDATE Function:

- **Returns current** system date and time
- **Automatic update** with system clock
- **Date/time operations** supported

Examples:

```sql
SELECT SYSDATE FROM DUAL;
SELECT SYSDATE + 30 FROM DUAL;  -- 30 days later
```

Mnemonic: "DT-ST - DUAL Testing, SYSDATE Time"

Question 3(c) [7 marks]

Write SQL queries to use various numeric functions:

Answer:

Table:

Function	Purpose	SQL Query	Result
TRUNC	Integer value	`SELECT TRUNC(125.25) FROM DUAL;`	125
ABS	Absolute value	`SELECT ABS(-15) FROM DUAL;`	15
CEIL	Ceiling value	`SELECT CEIL(55.65) FROM DUAL;`	56
FLOOR	Floor value	`SELECT FLOOR(100.2) FROM DUAL;`	100

SQL Queries:

```sql
-- (a) Display integer value of 125.25
SELECT TRUNC(125.25) FROM DUAL;

-- (b) Display absolute value of(-15)
SELECT ABS(-15) FROM DUAL;

-- (c) Display ceil value of 55.65
SELECT CEIL(55.65) FROM DUAL;

-- (d) Display floor value of 100.2
SELECT FLOOR(100.2) FROM DUAL;

-- (e) Display the square root of 16
```

```sql
SELECT SQRT(16) FROM DUAL;

-- (f) Show value of e³
SELECT EXP(3) FROM DUAL;

-- (g) Display result of 12 raised to 6
SELECT POWER(12, 6) FROM DUAL;

-- (h) Display result of 24 mod 2
SELECT MOD(24, 2) FROM DUAL;

-- (i) Show output of sign(-25), sign(25), sign(0)
SELECT SIGN(-25), SIGN(25), SIGN(0) FROM DUAL;
```

Mnemonic: "TACFSEPM - TRUNC ABS CEIL FLOOR SQRT EXP POWER MOD"

Question 3(a OR) [3 marks]

Explain Unique and Check Constraint with suitable example.

Answer:

Table:

Constraint	Purpose	Duplicates	Example
UNIQUE	Prevent duplicates	Not allowed	Email address
CHECK	Validate data	Value restrictions	Age > 0

Examples:

```sql
-- UNIQUE Constraint
CREATE TABLE Student (
    email VARCHAR(50) UNIQUE,
    phone VARCHAR(15) UNIQUE
);

-- CHECK Constraint
CREATE TABLE Employee (
    age NUMBER CHECK (age >= 18),
    salary NUMBER CHECK (salary > 0)
);
```

- **UNIQUE constraint** ensures no duplicate values in column
- **CHECK constraint** validates data against specified conditions
- **Multiple constraints** can be applied to single column

Mnemonic: "UC-DV - Unique no Copy, Check Validates"

Question 3(b OR) [4 marks]

Explain structure of PL/SQL block.

Answer:

Table:

Section	Required	Purpose	Example
DECLARE	Optional	Variable declarations	var_name VARCHAR2(20);
BEGIN	Mandatory	Executable statements	SELECT ... INTO var;
EXCEPTION	Optional	Error handling	WHEN OTHERS THEN ...
END	Mandatory	Block termination	END;

Diagram:

```
DECLARE
    -- Variable declarations
BEGIN
    -- Executable statements
EXCEPTION
    -- Error handling
END;
```

- **DECLARE section**: Variable and cursor declarations
- **BEGIN-END**: Mandatory executable section
- **EXCEPTION section**: Error handling routines
- **Nested blocks**: PL/SQL blocks can be nested

Mnemonic: "DBE-E - Declare Begin Exception End"

Question 3(c OR) [7 marks]

Consider the following table and solve queries:

Answer:

I) Create the BRANCH table:

```
CREATE TABLE BRANCH (
    branchid VARCHAR2(10) PRIMARY KEY,
    branchname VARCHAR2(50) NOT NULL,
    address VARCHAR2(100)
);
```

II) Create the EMPLOYEE table:

```sql
CREATE TABLE EMPLOYEE (
    empid VARCHAR2(10) PRIMARY KEY,
    name VARCHAR2(50) NOT NULL,
    post VARCHAR2(30),
    gender CHAR(1) CHECK (gender IN ('M', 'F')),
    birthdate DATE,
    salary NUMBER(10,2),
    branchid VARCHAR2(10),
    FOREIGN KEY (branchid) REFERENCES BRANCH(branchid)
);
```

III) Find employees in Ahmedabad branch:

```sql
SELECT e.* FROM EMPLOYEE e, BRANCH b
WHERE e.branchid = b.branchid
AND b.branchname = 'Ahmedabad';
```

IV) Find employees born in 1998:

```sql
SELECT * FROM EMPLOYEE
WHERE EXTRACT(YEAR FROM birthdate) = 1998;
```

V) Find female employees with salary > 5000:

```sql
SELECT * FROM EMPLOYEE
WHERE gender = 'F' AND salary > 5000;
```

VI) Find address where Ajay works:

```sql
SELECT b.address FROM EMPLOYEE e, BRANCH b
WHERE e.branchid = b.branchid
AND e.name = 'Ajay';
```

Mnemonic: "CBEFFA - Create Branch Employee Find Female Address"

Question 4(a) [3 marks]

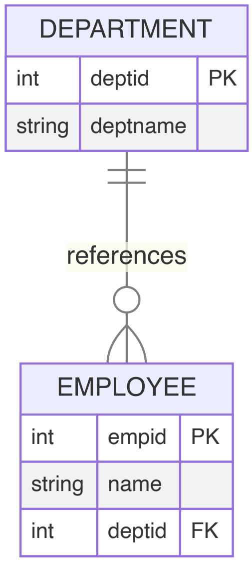
Explain Referential Integrity with suitable example.

Answer:

Table:

Aspect	Description	Example
Definition	Foreign key must reference existing primary key	Employee.deptid → Department.deptid
Purpose	Maintain data consistency	Prevent orphan records
Actions	CASCADE, SET NULL, RESTRICT	ON DELETE CASCADE

Diagram:



- **Referential integrity** ensures foreign key values exist in referenced table
- **Orphan records** prevented by constraint enforcement
- **Cascade operations** maintain consistency during updates/deletes

Mnemonic: "RIO - Referential Integrity prevents Orphans"

Question 4(b) [4 marks]

Differentiate Partial and Full Functional Dependency.

Answer:

Table:

Dependency Type	Definition	Example	Requirement
Partial	Depends on part of composite key	(StudentID, CourseID) → StudentName	Composite primary key
Full	Depends on entire key	(StudentID, CourseID) → Grade	Complete key needed

Examples:

Partial Functional Dependency:

```
(StudentID, CourseID) → StudentName
StudentName depends only on StudentID, not CourseID
```

Full Functional Dependency:

```
(StudentID, CourseID) → Grade
Grade depends on both StudentID and CourseID
```

- **Partial dependency** causes data redundancy and anomalies
- **Full dependency** required for proper normalization
- **2NF eliminates** partial functional dependencies

Mnemonic: "PF-CF - Partial Few, Complete Full"

Question 4(c) [7 marks]

Explain 3rd Normal Form with example.

Answer:

3rd Normal Form Requirements:

1. Must be in 2NF
2. No transitive dependencies
3. Non-key attributes depend only on primary key

Table Before 3NF:

StudentID	StudentName	CourseID	CourseName	InstructorID	InstructorName
S1	John	C1	Math	I1	Dr. Smith
S2	Jane	C1	Math	I1	Dr. Smith

Problems:

- **Transitive dependency**: StudentID → CourseID → InstructorName
- **Update anomaly**: Instructor name change requires multiple updates
- **Delete anomaly**: Removing student may lose instructor information

3NF Solution:

STUDENT Table:

StudentID	StudentName	CourseID
S1	John	C1
S2	Jane	C1

COURSE Table:

CourseID	CourseName	InstructorID
C1	Math	I1

INSTRUCTOR Table:

InstructorID	InstructorName
I1	Dr. Smith

Mnemonic: "3NF-NT - 3rd Normal Form No Transitives"

Question 4(a OR) [3 marks]

Explain Importance of Normalization.

Answer:

Table:

Benefit	Problem Solved	Result
Reduce Redundancy	Duplicate data	Storage efficiency
Eliminate Anomalies	Update/Insert/Delete issues	Data consistency
Improve Integrity	Data inconsistency	Reliable information

- **Data redundancy minimized** through proper table decomposition
- **Update anomalies eliminated** by removing duplicate information
- **Storage space optimized** through normalized structure
- **Data integrity maintained** with referential constraints
- **Maintenance simplified** with logical table organization

Mnemonic: "RESIM - Redundancy Eliminated, Storage Improved, Maintenance"

Question 4(b OR) [4 marks]

Differentiate Prime Attributes and Non-Prime Attributes.

Answer:

Table:

Attribute Type	Definition	Role	Example
Prime	Part of candidate key	Key formation	StudentID, CourseID
Non-Prime	Not part of any candidate key	Data storage	StudentName, Grade

Example:

```
ENROLLMENT (StudentID, CourseID, Grade, Semester)
Candidate Key: (StudentID, CourseID)

Prime Attributes: StudentID, CourseID
Non-Prime Attributes: Grade, Semester
```

- **Prime attributes** participate in candidate key formation
- **Non-Prime attributes** provide additional entity information
- **Functional dependencies** between these determine normal forms
- **2NF requires** no partial dependencies of non-prime on prime attributes

Mnemonic: "PN-KD - Prime in Key, Non-prime for Data"

Question 4(c OR) [7 marks]

Explain 2nd Normal Form with example.

Answer:

2nd Normal Form Requirements:

1. Must be in 1NF
2. No partial functional dependencies
3. All non-key attributes fully depend on primary key

Table Before 2NF:

StudentID	CourseID	StudentName	CourseName	Grade
S1	C1	John	Math	A
S1	C2	John	Physics	B
S2	C1	Jane	Math	A

Problems:

- **Partial Dependencies**: StudentID → StudentName, CourseID → CourseName
- **Update Anomaly**: Student name change requires multiple updates
- **Insert Anomaly**: Cannot add course without student enrollment

2NF Solution:

STUDENT Table:

StudentID	StudentName
S1	John
S2	Jane

COURSE Table:

CourseID	CourseName
C1	Math
C2	Physics

ENROLLMENT Table:

StudentID	CourseID	Grade
S1	C1	A
S1	C2	B
S2	C1	A

Mnemonic: "2NF-FD - 2nd Normal Form Full Dependencies"

Question 5(a) [3 marks]

Explain Transaction states with proper diagram.

Answer:

Diagram:

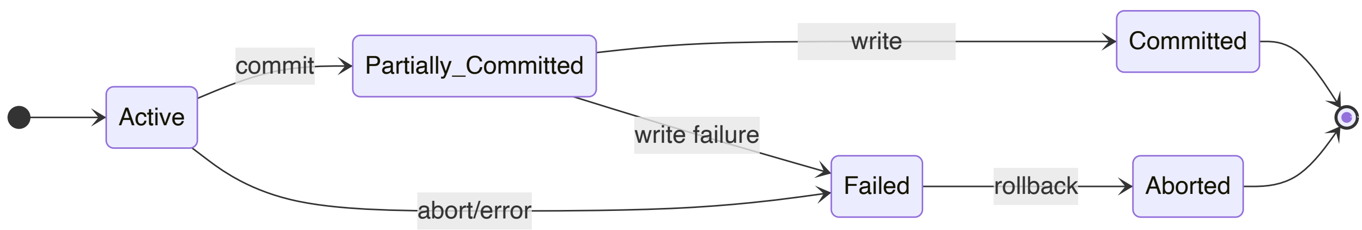


Table:

State	Description	Next State
Active	Transaction executing	Partially Committed/Failed
Partially Committed	Last statement executed	Committed/Failed
Committed	Transaction successful	End
Failed	Cannot proceed normally	Aborted
Aborted	Transaction rolled back	End

- **Active state**: Transaction currently executing operations
- **Partially committed**: All operations executed, waiting for commit
- **Failed state**: Error occurred, transaction cannot continue

Mnemonic: "APCFA - Active Partial Commit Fail Abort"

Question 5(b) [4 marks]

Explain any two DDL commands with a suitable example.

Answer:

Table:

Command	Purpose	Syntax	Example
CREATE	Create database objects	CREATE TABLE	CREATE TABLE Student(...)
ALTER	Modify existing objects	ALTER TABLE	ALTER TABLE Student ADD...

CREATE Command:

```sql
CREATE TABLE EMPLOYEE (
    empid NUMBER(5) PRIMARY KEY,
    name VARCHAR2(50) NOT NULL,
    salary NUMBER(10,2),
    deptid NUMBER(3)
);
```

ALTER Command:

```sql
-- Add new column
ALTER TABLE EMPLOYEE ADD phone VARCHAR2(15);

-- Modify existing column
ALTER TABLE EMPLOYEE MODIFY name VARCHAR2(100);

-- Drop column
ALTER TABLE EMPLOYEE DROP COLUMN phone;
```

- **CREATE** establishes new database structures
- **ALTER** modifies existing table definitions
- **DDL commands** auto-commit changes
- **Schema changes** affect data structure permanently

Mnemonic: "CA-NM - CREATE Adds, ALTER Modifies"

Question 5(c) [7 marks]

Explain ACID Properties in detail.

Answer:

Table:

Property	Definition	Purpose	Example
Atomicity	All or nothing execution	Transaction integrity	Bank transfer
Consistency	Database remains valid	Data integrity	Balance constraints
Isolation	Concurrent execution independence	Concurrency control	Separate transactions
Durability	Committed changes permanent	Recovery guarantee	Power failure survival

Atomicity:

- **All operations** in transaction execute completely or not at all
- **Rollback mechanism** undoes partial changes on failure
- **Example**: Bank transfer requires both debit and credit operations

Consistency:

- **Database state** remains valid before and after transaction
- **Integrity constraints** maintained throughout execution
- **Example**: Account balance never becomes negative

Isolation:

- **Concurrent transactions** do not interfere with each other
- **Locking mechanisms** prevent interference

- **Example**: Two users updating same account simultaneously

Durability:

- **Committed changes** survive system failures
- **Write-ahead logging** ensures recovery capability
- **Example**: Transaction survives power outage after commit

Mnemonic: "ACID - Atomicity Consistency Isolation Durability"

Question 5(a OR) [3 marks]

What is two phase locking technique?

Answer:

Table:

Phase	Action	Description	Lock Operations
Growing Phase	Acquire locks	Transaction obtains all needed locks	LOCK only
Shrinking Phase	Release locks	Transaction releases locks one by one	UNLOCK only

Diagram:

```
Number of Locks
      ^
      |     /\
      |    /  \
      |   /    \
      |  /      \
      | /        \
      |/          \
      +------------>
     Growing  Shrinking
     Phase     Phase
        Time
```

- **Two phases**: Growing (lock acquisition) and Shrinking (lock release)
- **No lock upgrades** allowed after first unlock operation
- **Prevents deadlocks** when properly implemented
- **Serializability guarantee** for concurrent transactions

Mnemonic: "2PL-GS - Two Phase Locking Growing Shrinking"

Question 5(b OR) [4 marks]

Explain any two DML commands with a suitable example.

Answer:

Table:

Command	Purpose	Syntax	Example
INSERT	Add new records	INSERT INTO	INSERT INTO Student VALUES...
UPDATE	Modify existing records	UPDATE SET	UPDATE Student SET name=...

INSERT Command:

```sql
-- Insert single record
INSERT INTO EMPLOYEE (empid, name, salary, deptid)
VALUES (101, 'John Smith', 50000, 10);

-- Insert multiple records
INSERT INTO EMPLOYEE
VALUES (102, 'Jane Doe', 45000, 20),
       (103, 'Bob Wilson', 55000, 10);
```

UPDATE Command:

```sql
-- Update single record
UPDATE EMPLOYEE
SET salary = 60000
WHERE empid = 101;

-- Update multiple records
UPDATE EMPLOYEE
SET salary = salary * 1.10
WHERE deptid = 10;
```

- **INSERT** adds new rows to table
- **UPDATE** modifies existing row values
- **WHERE clause** specifies update conditions
- **DML commands** require explicit commit

Mnemonic: "IU-AM - INSERT Adds, UPDATE Modifies"

Question 5(c OR) [7 marks]

List problems of concurrency control and explain any two in detail.

Answer:

Concurrency Control Problems:

1. Lost Update Problem

2. Dirty Read Problem
3. Unrepeatable Read Problem
4. Phantom Read Problem
5. Inconsistent Analysis Problem

Table:

Problem	Description	Solution
Lost Update	One transaction overwrites another's changes	Locking mechanisms
Dirty Read	Reading uncommitted data	Read committed isolation

Lost Update Problem:

- **Scenario**: Two transactions read same data, modify it, and write back
- **Example**:
  - T1 reads account balance: $1000
  - T2 reads account balance: $1000
  - T1 adds $100, writes$1100
  - T2 subtracts $50, writes$950
  - **Result**: T1's update lost, final balance incorrect

Dirty Read Problem:

- **Scenario**: Transaction reads data modified by another uncommitted transaction
- **Example**:
  - T1 updates account balance from $1000to$1500
  - T2 reads balance as $1500 (uncommitted data)
  - T1 fails and rolls back to $1000
  - **Result**: T2 used incorrect data for calculations

Solutions:

- **Locking protocols**: Prevent simultaneous access to same data
- **Isolation levels**: Control visibility of uncommitted changes
- **Timestamp ordering**: Order transactions based on timestamps
- **Multi-version concurrency**: Maintain multiple data versions

Mnemonic: "LDUI - Lost Dirty Unrepeatable Inconsistent"