

**DATABASE MANAGEMENT SYSTEMS
(CSEN 3101)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Which of the following relational algebra operations must require the participating tables to be union-compatible?
(a) Inner Join (b) Outer Join (c) Intersect (d) Natural Join.
- (ii) Which clause of CREATE SEQUENCE indicates whether the sequence "wraps around" to reuse numbers after reaching its maximum value (for an ascending sequence) or its minimum value (for a descending sequence)?
(a) BUFFER (b) CACHE 20 (c) NOORDER (d) CYCLE
- (iii) Which are considered as disadvantages of index in DBMS?
(a) Index makes search operation perform very fast.
(b) Index takes up a little more space than the main table.
(c) Index needs to be updated periodically for insertion or deletion of records in the main table.
(d) All of them.
- (iv) Consider the following DDL statement
Create table student(rollNo number(5) primary key, mobile number(10), dname varchar(5) references Department(dname));
Which of the following integrity constraints have been imposed on the table Employee using the above DDL statement:
(a) Entity Integrity constraint and Domain Integrity Constraint
(b) Entity Integrity constraint and Referential Integrity Constraint
(c) Entity Integrity constraint
(d) Entity Integrity constraint and Self-referential Integrity Constraint.
- (v) In a relation R, a multivalued dependency $A \twoheadrightarrow B$ is called non trivial if and only if
(a) $B \subseteq A$ (b) $A \cup B = R$ (c) $B \not\subseteq A$ (d) None of the above.

- (vi) If both the functional dependencies : $X \rightarrow Y$ and $Y \rightarrow X$ hold for two attributes X and Y then the relationship between X and Y is
 (a) many to many (b) many to one (c) one to one (d) many to one.
- (vii) Which one is not a state of RDBMS transaction?
 (a) Active (b) Passive (c) Partially Committed (d) Committed.
- (viii) What data type is used to store JSON data in Oracle table?
 (a) VARCHAR2(4000) (b) BLOB (c) (a) and (b) (d) TEXT(4000).
- (ix) You have two table Customers and Orders. There may be no or one/many orders in the Order table for a customer. You want to find out the customer's detail along with the order details if any, irrespective of whether customer places any order or not. What type of join is most appropriate?
 (a) Customer LEFT JOIN Order (b) Order LEFT JOIN Customer
 (c) Customer RIGHT JOIN Order (d) Any of the above options.
- (x) Consider a B+-tree in which the maximum number of keys in a node is 5. What is the minimum number of keys in any non-root node?
 (a) 1 (b) 2 (c) 3 (d) 4.

Group - B

2. (a) Let R(A,B,C) and S(C,D,E) be two relations:

A	B	C
1	b1	c1
a2	b2	c2
a3	b3	c3

R

C	D	E
c1	d1	e1
c2	d2	e2
c4	d4	e4

S

Show the outcome of the followings for the relational algebraic expressions involving the above relations R and S :

- (i) $R \bowtie S$ (ii) $R \ltimes S$ (iii) $R \bowtie S$ (iv) $R \ltimes S$.

- (b) Consider the following database tables with primary keys underlined
 Project(Proj_ID, PName, Mentor_empid, duration)
 Mentor(Emp_id, EName, profile)
 Scholars(RollNo , Name, Edu_qualification)
 Assigned_to(RollNo,Proj_ID)

Write the relational algebra for the following:

- (i) List the details of the Mentors working on the projects with duration more than 3 years.
- (ii) List the details of scholars working on multiple projects
- (iii) List the details of scholars and mentors working with each other.

6 + 6 = 12

- 3. (a) What are the different types of constraints generally used in ER diagram?
- (b) A company has several departments and each employee works in a particular department since a particular date. An employee of the department is working as a

manager of the department for a period. Draw an ER diagram to represent this scenario indicating all participation constraints. You may consider attributes of the entities as you wish.

- (c) The flight database stores details about airlines, flights operated by them, and seat bookings by passengers. You design a simplified version of ER diagram for this database considering only the following requirements:
- (i) Each airline operates one or more flights and each flight has a unique flight number, a departure airport, a destination airport, a departure date and time, and an arrival date and time.
 - (ii) Each flight is carried out by a single airline.
 - (iii) A passenger can book a seat on a flight and must provide at least name, a surname, a unique email address, mobile no.
- You can choose additional attributes beside the attributes needed for satisfying the above requirements.

2 + 4 + 6 = 12

Group – C

4. (a) Consider a relation R {ABCDEF} on which the following set of functional dependencies **F** is applicable
F = {A → B; BC → D; C → A; B → D; BE → F; CF → D }.
Find the candidate keys of R. Show each steps.
- (b) What is usefulness of minimal cover of functional dependencies in designing a database? What are the differences between minimal cover and closure of functional dependencies.
- (c) Find minimal cover for the following set of functional dependencies
F: {AC→BDE; BC → D; CB→AD; B → D; BE → F; BCF → DE; C → AB; A → FCB; A → B; A → D}.
- 4 + (1 + 1) + 6 = 12**
5. (a) For summing the invoice amount from Invoice table you have written a query `Select CustomerID, SUM(InvAmount) From Invoice;` for showing customer wise total invoice amount. What is wrong in this statement? Correct it so that it can be executed.
Assume Salary table contains salary and emp_id of each employee. Write a PL/SQL block to calculate bonus of an employee as per following business rule and display it in console.
Business rule: If salary < 500 applicable bonus percentage is 10%, If salary is between 5000 and 10000 applicable bonus percentage is 15%, If salary is > 10000 applicable bonus percentage is 20%
You have to supply the emp_id for which bonus will be calculated during execution time of the block.
- (b) Given two tables:
- (i) **Airport** to store information of airports such as AirportId, AirportName, Location.

(ii) **Schedule** to store the schedule flights running between two airports. Each schedule contains information such as ScheduleId, SourceAirport, DestAirport, FlyingDateTime.

Write create statements for the above two tables with appropriate referential integrity constraints.

Write a SQL query to display all the airports for which there is no flight scheduled for. You have to show AirportId, AirportName, Location in the order of Location and AirportName.

(2 + 3) + (4 + 3) = 12

Group - D

6. (a) What is Normalization? What are the problems associated with a database schema that can be removed by normalization?
Define BCNF normal form with an example.

(b) Suppose you have the following relation and set of functional dependencies.
R(elevator_no, building_no, building_name, capacity, staff_no, first_name, last_name, date_examined) with the following functional dependencies:

(i) elevator_no \rightarrow building_no,capacity

(ii) building_no \rightarrow building_name

(iii) staff_no \rightarrow first_name,last_name

(iv) elevator_no,staff_no \rightarrow date_examined.

Normalize the relation R up to BCNF starting from 1st NF. Show all work and clearly indicate the primary and foreign keys.

(2 + 2 + 2) + 6 = 12

7. Consider the relation **T**(A, B, C, D, E, F, G, H) and the set of functional dependencies **F** : {A \rightarrow B; D \rightarrow E; A \rightarrow F; A \rightarrow C; F \rightarrow G; G \rightarrow H}.

Decompose the relation **T** to 3rd Normal Form with respect to F, implementing lossless join decomposition by preserving all the function dependencies.

[**N.B.** Show each step in detail, explaining how each normal form is satisfied by each decomposed relation at each step of normalization.]

12

Group - E

8. (a) Consider the concurrent schedule **S** of three transactions T1,T2 and T3, where R_i(A), R_i(B) are read operations and W_i(A), W_i(B) are write operations of Transaction T_i on data items A and B accordingly:

S = R₁(A) R₃(C) W₁(A) R₂(A) W₃(C) W₂(A) R₁(B) R₂(C) W₁(B) W₂(C)

Find out whether the above concurrent schedule **S** is serializable or not – Justify your answer.

(b) “Two phase Locking protocol always ensures recoverability of schedules”-Argue in favour or against this statement.

(c) Define idempotent operation with example.

Briefly discuss the use of idempotent operation in database recovery.

5 + 3 + (1 + 3) = 12

9. (a) What are the different Ordered Indexing Methods? What are the advantages and disadvantages of primary index method?

(b) Suppose you have written following query to list the employees working in the 'database' project and born after the year 1965.

```
SELECT ENAME
FROM EMPLOYEE, WORKSON, PROJECT
WHERE PNAME = 'database' AND PNUM = PNO AND ENO = ENUM
AND BDATE > '1965'
```

Employee table contains the employee information,
Workson table contains the projects no (PNUM) and employee no (ENUM) works on that project.

Project table contains the information of project.

Apply heuristic approach to transform the canonical query trees of above SQL query to an optimized query tree.

(2 + 2) + 8 = 12

Department & Section	Submission link:
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