3

[This question paper contains 12 printed pages.]

Your Roll No.....

A

Sr. No. of Question Paper : 1388

Unique Paper Code : 32341403

Name of the Paper : Database Management Systems

Name of the Course : B.Sc. (H) Computer Science (2019 onwards)

Semester : IV

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **Section A** is compulsory.
3. Attempt any **FOUR** questions from **Section B**.
4. Parts of questions must be answered together.
5. Marks are indicated against each question.

SECTION A

1. (a) Explain the three-schema architecture with the help of a diagram. How does the three-schema architecture relate to data independence?

(3+1)

P.T.O.

(b) Consider the following database : (4)

Employee *(ID, Name, Address)*

Supervises *(EmployeeID, SupervisorID)*

Illustrate the concept of Recursive Closure using the relational algebraic query to retrieve the supervisors of an employee with *Name* = 'Sonia Verma'. Show the query for the first 2 levels of the recursive closure using the following data :

Employee		
ID	**Name**	**Address**
101	Rajesh Singh	Delhi
102	Viren Garg	Indore
103	Farah Khan	Mumbai
201	Vini Bala	Delhi
202	Ritika Madan	Delhi
205	Satish Meena	Delhi
302	Sonia Verma	Mambai
304	Nilesh Kumar	Mumbai

Manages	
EmployeeID	**SupervisorID**
101	102
302	102
102	103
201	103
205	202
103	304
304	205

(c) Draw the query tree to show a possible order of execution for the following relational expression:

$$R \times S - \pi_P(R \bowtie_{R.P=S.P \text{ AND } R.Q=S.T} S) \qquad (3)$$

(d) Consider the following two interleaved transactions **(T1, T2)** executed concurrently in a railway reservation system. W denotes the number of vacant seats on a train. Assume that the initial value of W is 10.

P.T.O.

T1	T2
	1. read(W); 2. W := W - 2
3. read(W); 4. W := W - 3;	
	5. write(W);
6. write(W);	

Compute the value of **W** after the given schedule is executed. Is this value of **W** correct? If we remove the interleaving between the transactions **(T1, T2)**, what will be the value of **W**. (4)

(e) Consider a relation **R (X, Y, Z, W)**. Prove the correctness of the following **inference rule** :

$\{X \rightarrow Y, YW \rightarrow Z\} \models WX \rightarrow Z$ (3)

(f) Discuss the problem of spurious tuples and how we may prevent it. Illustrate using an example. (3)

(g) Consider a disk with **block size B = 500 bytes**. A block pointer is **P = 14 bytes** long. The records of the relation **BOOK** are stored in a file. The

file has r = 50,000 records of fixed length. Each record has the following fields: **ISBN (16 bytes), Title (35 bytes), Publisher (20 bytes), Author (20 bytes), Publication_Date (8 bytes)**. An additional byte is used as a deletion marker. Calculate the record size R in bytes, the blocking factor bfr and the number of file blocks b, assuming an unspanned organization. (3)

(h) Compare and contrast Naive Users and Casual Users based on their interaction with the database. (2)

(i) Why is it said that good database design in a relational database model is characterized by minimal redundancy? (3)

(j) Draw an EER diagram that shows the entity type(s), attribute(s), relationship(s), and specialization(s) for the following SPORTS-COMPLEX database :

(i) A complex has a location, chief organizing individual, total occupied area, the number of facilities needed, budget, and information on the planned events.

(ii) For each event there is a planned date, duration, number of participants, number of officials.

(iii) A sports complex can be a one-sport or a multi-sport complex.

(iv) Multi-sport complexes have areas of the complex designated for each sport with a location indicator, namely. Fast, West. South, North, Center. (3)

(k) Consider the following relation for a STUDENT database :

STUDENT (SSN, *Name*, *Major*, *BirthDate*)

Which of the three update anomalies may be violated by the command:

"Insert a record in the STUDENT table"

Justify your answer. (3)

SECTION B

2. (a) Draw an ER diagram for the following case study :

Consider a company where the employees take orders for parts from customers. The employees are identified by a unique employee number, first and last name, and location code. Each customer of the company is identified by a unique customer number, first and last name, and location code. Each part sold by the company is identified by a unique part number, a part name, price, and quantity in stock. Each order placed by a customer is taken by an employee and is given a unique order number. Each order contains specified quantities of one or more parts, has a date of receipt as well as an expected shipment, date. The actual shipment date is also recorded.

Specify primary key, cardinality ratio and participation constraints in the diagram clearly.

(7)

(b) Consider the following relation that represents the courses taught in a University: (3)

(b) Consider the following two relations R and S :

R		
P	Q	D
1	a	5
25	b	8
5	a	6

S		
P	B	C
10	b	5
25	c	1
10	b	5

Show the result of the following relational queries :

(i) $\sigma_{C=D}(S \times R)$

(ii) S MINUS (R UNION S)

(iii) $\rho_R(\rho_{(C,D)}(\pi_{(P,Q)}(R)) \div \pi_C(S))$ (7)

6. Consider a relation R (A, B, C, D, E). The corresponding functional dependency set is given as follows :

$F = \{AB \rightarrow E, AE \rightarrow D, C \rightarrow AD\}$

(a) Find the primary key showing the method to arrive at the result.

(b) Assuming that the given relation is in 1NF, find the highest Normal Form that the relation satisfies. Show the steps for reaching the conclusion.

(c) Normalize the relation up to 3NF indicating the decomposition of the relations at each step. (10)

7. Consider the following relations (key of each relation is underlined) :

SALESPERSON (*SNo, SName, Commission*)

PRODUCT (*PId, Pname*)

CUSTOMER (*CNo, CName, CAddress*)

SALE (*Date, CNo, SNo, PId, Quantity*)

Write SQL statements for the following queries :

(i) Write the CREATE TABLE command for the SALE table in SQL ensuring that the following concepts are used at least once: Integer. String, and Date data type, NOT NULL constraint. CHECK constraint. PRIMARY KEY constraint. FOREIGN KEY constraints (with ON DELETE SET NULL and ON UPDATE CASCADE constraints, if applicable).

(ii) Get the names of the SALESPERSON who sold the product with PId = 56.

(iii) Get the names of CUSTOMERS who bought a product "Mixie".

(iv) Get the total number of PRODUCTS sold on "25-02-2022".

(v) Get the total number of PRODUCTS purchased by each CUSTOMER. (10)