DATABASE MANAGEMENT SYSTEMS
(CSEN 3101)

Time Allotted : 2½ hrs   **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 4 (four)</u> from Group B to E, taking <u>one</u> from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Which of the following is an advantage of using a database system over a file system?
(a) Data redundancy   (b) Lack of data integrity
(c) Data independence   (d) Difficulty in accessing data

(ii) Which of the following best defines a candidate key in a relational model?
(a) Any super key that canuniquely identify a tupleof strong entity
(b) A minimal super key that can uniquely identify a tupleof strong entity
(c) A discriminator key of a weak entity
(d) A foreign key attributeof strong entity.

(iii) Which of the following is an example of a unary operation in relational algebra?
(a) Join   (b) Intersection   (c) Selection   (d) Cross product

(iv) Which type of constraint ensures that a value exists in parent / base table before it can be referenced from another dependent table?
(a) Entity Integrity constraint   (b) Participation constraint
(c) Referential Integrity constraint   (d) Mapping cardinality constraint

(v) If a relation has the functional dependencies A -> B, B -> C, and A -> C, what can be said about the closure of attribute A?
(a) {A}   (b) {A, B}   (c) {A, C}   (d) {A, B, C}

(vi) Which of the following is NOT a Data Definition Language (DDL) command?
(a) ALTER   (b) CREATE   (c) INSERT   (d) DROP

(vii) For a relation R= { J, K, L } with functional dependenciesF = { JK –>L L –> K }, the candidate keys are
(a) Two separate candidate keys as following: (i) J and (ii) K
(b) Composite candidate key {J,K}
(c) Only J
(d) Only K

(viii) If both the functional dependencies : X→Y and Y→ 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

(ix)   Which of the following is not a step in query processing?
(a) Parsing and translation　　　　(b) Optimization
(c) Evaluation　　　　　　　　　　(d) Normalisation

(x)   Assume transaction T1 only holds a shared lock R. If transaction T2 also requests for a shared lock on R
(a) it will result in a deadlock
(b) it will immediately be granted
(c) it will immediately be rejected
(d) it will be granted as soon as it is released by X)

Fill in the blanks with the correct word

(xi)   In normalization, a relation is in _____ when it has no atomic attribute with non-atomic data value.

(xii) A relation R is not in 3NF if there exist a mutual functional dependency between two _____ attributes of R.

(xiii) The SQL sub query structure is known as a _____ sub query when an inner nested sub query may be evaluated once for each row evaluated by the outer query and the final query output will be a result of repetitive execution of the inner query in dependence with the outer query.

(xiv) Serializability ensures _____ property of database transactions in concurrent execution environment.

(xv)   In a table, a B+ tree index is created on _____ attribute of a table, which is frequently accessed in application query.

Group - B

2. (a) Consider a database that stores information about suppliers, parts, and supply details for a bus manufacturer. The database must contain the following information:
Suppliers:
- Each supplier has a unique supplier id.
- Each supplier has name, phone number, age, city, and Pin code attributes.
- Each supplier can supply one or more parts.
Parts:
- Each part has unique part id and part name.
- Each part has a price
- Eachpart can be supplied by one or more suppliers.
Supply details
- Each supply detail involves a supplier supplying a part.
- Each supply detail has a quantity and date.

- Each supply detail is identified uniquely by its supplier, part, and date.
  Draw an ER diagram for the above database clearly showing the entities, relationships, Cardinalities, and attributes. *[(CO1)(Analyse/IOCQ)]*
(b) Clearly mention the number of relations (tables) you need corresponding to the ER diagram. Mention the attributes and keys for each relation. *[(CO1)(Understand/LOCQ)]*

8 + 4 = 12

3. Consider the relational database as given below:
   Project (PId, PName, Project_Amount, Project_Location)
   Department (DId, DName, DLocation)
   Proj_Dept (PId, DId, Start_date, End_date)
   The underlined attributes are the primary keys.
   Write down the relational algebra expressions for the following queries:
   (i) Show the project details having project_amount more than Rs. 250000
   (ii) Show the project_location wise maximum project_amount
   (iii) Find the PId, PName, DId, and DNamedetails where the project has started on or after 01-04-2023 and ended on or before 31-03-2024
   (iv) Find the DId, DName of the departments which have worked on the projects having ids P11 or P25. *[(CO2)(Analyse/IOCQ)]*

(4 × 3) = 12

Group - C

4. Consider the following relational schema:
   SALESPERSON (s_id, s_name, s_city, grade, commission)
   CUSTOMER (cust_id, cust_name, cust_city, salesperson_id)
   ORDERS (ord_id, order_amt, order_date, cust_id)
   SALESPERSON table stores data on every salesperson with their grade and commission earned. s_city is the city where a salesperson lives. CUSTOMER table stores data on customers where cust_city is the city where a customer lives, and salesperson_id is the salesperson who serves the customer. A customer is served by one salesperson but a salesperson can serve a number of customers. Orders are stored in ORDERS table. cust_id in ORDERS stores the customer who places the order. A customer can place a number of orders.
   Based on the above tables, write the following queries using SQL:
   (i) Display the customer name, customer city along with their salesperson name, salesperson city, salesperson commission if the following are true:
       - salesperson does not live in the same city where the customer lives and
       - salesperson has received a commission of more than Rs. 12000/- from the company.
   (ii) Generate a list of the name; city and grade of salespersons who serve one or more customers. The list should be in ascending order of names.
   (iii) Display the number of salespersons for every grade if the grade is above the average grade of salespersons living in New Delhi city.
   (iv) Findord_id, order_amt, order_date and cust_id of all the orders issued by the salesperson named 'V Krishnamurthy'. *[(CO3)(Design/IOCQ)]*

(4 × 3) = 12

5. For relation R = (L, M, N, O, P), the following dependencies hold: M → O, NO → P, P → L and L → MN. R is decomposed into R1 = (L, M, N, P) and R2 = (M, O).

(i) Is the above decomposition lossless-join decomposition? Explain.

(ii) Is the above decomposition dependency preserving? If yes, show how the dependencies are preserved. Otherwise, list all the dependencies that are not preserved.

(iii) What is the highest normal form satisfied by the above decomposition.

[(CO4)(Apply/HOCQ)]

(4 + 4 + 4) = 12

Group - D

6. (a) Describe the different anomalies that may exist in a database without normalisation. *[(CO4)(Understand/LOCQ)]*

(b) Let R = (V, W, X, Y, Z) be a relational schema and let F be the set of FDs such that F = {Z→V, W→Y, XY→Z, V→WX}. Determine whether the following decompositions arelossy or lossless. Explain your answer properly.

(i) R1 = (V, W, X) and R2 = (V, Y, Z)

(ii) R1 = (V, W, X) and R2 = (X, Y, Z) *[(CO4)(Analyse/IOCQ)]*

6 + (3 × 2) = 12

7. (a) Let R be a relation: R = (A, B, C, D, E, F) having the following functional dependencies.

F = {A→B, A→C, CD→E, CD→F, B→E}

Find out candidate key(s) of R. What is the highest normal form that relation R is in? *[(CO4)(Evaluate/HOCQ)]*

(b) What do you understand by partial and multi-valued dependency?

[(CO4)(Understand/LOCQ)]

(c) Justify the statement "BCNF is stronger than 3NF". *[(CO4)(Analyse/IOCQ)]*

(2 + 3) + (2 × 2) + 3 = 12

Group - E

8. (a) Consider two transactions T1 and T2 and the concurrent schedule S. The read and write operations are given below.

T1: r1(X); w1(X); r1(Y); w1(Y)　　**T2**: r2(X); w2(X); r2(Z); w2(Z)

S = r1(X); w1(X); r2(X); w2(X); r1(Y); w1(Y); r2(Z); w2(Z)

Find out whether the schedule S is serializable or not. *[(CO5)(Analyse/HOCQ)]*

(b) Discuss the ACID properties of Transaction. *[(CO5)(Remember/LOCQ)]*

4 + 8 = 12

9. (a) What are the differences between sequential and indexed file organization?

[(CO6)(Remember/LOCQ)]

(b) Write the difference between commit and rollback. *[(CO6)(Remember/LOCQ)]*

(c) Construct a B+ tree for the key values 1, 3, 5, 7, 9, 2, 4, 6. Order of each node is 4. Show each step. *[(CO6)(Apply/IOCQ)]*

3 + 3 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	29.17	48.95	21.88