

**DATABASE MANAGEMENT SYSTEMS
(CSEN 3102)**

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) If in a relation R(A,B), the functional dependencies $A \rightarrow B$ then it implies _____ association from A to B.
(a) many to many (b) one to many
(c) many to one (d) one to one.
- (ii) Which of the following cannot be a table-level constraint?
(a) UNIQUE (b) FOREIGN KEY
(c) CHECK (d) NOT NULL.
- (iii) Consider a schedule S_1 which is a view serializable. Which of the following is true?
(a) S_1 is conflict serializable
(b) S_1 may not be conflict serializable
(c) S_1 will only allow concurrent transactions that do not perform any write operation on database
(d) None of the above.
- (iv) Consider the following DDL statement:
Create table Employee(empId number(5) primary key, salary number(10,2), deptno number(5) references Department(deptId));
Which of the following is true?
(a) Deptno of Employee table must be a prime attribute
(b) Deptno of Employee table must be candidate key
(c) Deptno of Employee table is a foreign key
(d) None of these.

- (v) Which of the following statement is false?
(a) Consistency property cannot be ensured for all possible concurrent schedules of a set of transactions
(b) Atomicity always ensures that a transaction must always commit and never rollback
(c) Isolation property can be ensured if a concurrent schedule is serializable
(d) Durability property of a transaction can be achieved by using appropriate log based recovery scheme along with regular database backup in stable storage.
- (vi) A relation $R=\{A,B,C,D,E,F\}$ is given with following set of functional dependencies: $F=\{A \rightarrow B, AD \rightarrow C, B \rightarrow F, A \rightarrow E\}$. Which of the following is a Candidate Key of R?
(a) A (b) AB (c) AC (d) AD.
- (vii) Consider a schema R(A, B, C, D) and functional dependencies $A \rightarrow B$ and $C \rightarrow D$. Then the decomposition $R_1(A, B)$ and $R_2(C, D)$ is
(a) Dependency preserving but not lossless join
(b) Lossless Join but not dependency preserving
(c) Dependency preserving and lossless join
(d) Lossless Join.
- (viii) The following SQL on relation Customer(customer_id, customer_name, account_id) and Account(account_id, balance, branch):
Select customer_id, customer_name, sum(balance) from customer, account where account.account_id = customer.account_id and balance <= 10000 group by customer_id having max(balance) >= 10000;
The output of the above SQL will display:
(a) customers and their corresponding total balance of all accounts, if those customer has at least one account with balance of Rs 10000
(b) customers and their corresponding total balance of those accounts which has a minimum balance of Rs 10000
(c) customers and their corresponding total balance of those accounts which has maximum balance of Rs 10000
(d) no rows will be selected.
- (ix) Which of the following are steps in query processing?
(a) Parsing and translation (b) Optimization
(c) Evaluation (d) All of the above.
- (x) The index which has an entry for every key value is classified as
(a) Sparse Index (b) Linear Index
(c) Dense Index (d) Cluster Index.

Group – E

8. (a) Describe the Two-Phase Locking (2PL) protocol. How can 2PL be used or modified to overcome cascading rollback in concurrent schedules?
- (b) What is a Deadlock? How can deadlocks be detected using wait-for graph? Under what condition deadlock prevention may be considered better than deadlock detection and recovery?
- (c) Differentiate between dense and sparse index. What do you understand by clustering indexing?

$$(2 + 2) + (1 + 2 + 2) + (2 + 1) = 12$$

9. (a) Let T1 and T2 be transactions that operate on same data item x. Let r1(x) mean that T1 reads x, w1(x) mean that T1 writes x, same for T2. Abort (T1) is performed if a transaction T1 fails. Consider the following given schedules:
 S1: r1(x), w1(x), r2(x), r1(x), w2(x), commit(T2), abort(T1)
 S2: r1(x), w1(x), r2(x), r1(y), w2(x), w1(y), commit(T1), commit(T2)
 With proper explanation, determine whether S1 and S2 are recoverable schedules or not.
- (b) What is a Cascadeless Schedule? Why is it desirable?
 "Every cascadeless schedule is also recoverable" – Do you agree with this statement? Justify your answer.

$$(3 + 3) + (1 + 2 + 3) = 12$$

Group – B

2. Consider database requirements of an online cab booking website as given below:
- Each customer must register using a unique email id and a unique mobile, name, Age, Gender and address.
 - Each cab must register using unique motor vehicle number, model name, date of motor registration, etc.
 - A cab ride has a unique Ride_id, start time, journey date, pickup and destination location.
 - A driver must register before driving any registered cab using licence no., Adhaar, name, address mobile, etc.
 - Owners of cabs must register using trade license no., email id, mobile no, name, Age, Gender and address.
 - The system allows payment of a ride only through its own wallet facility provided to each customer. A customer can preload his wallet through multiple online payment facilities like net-banking, debit/credit card, etc.
 - Based on the above requirements of the system, design an Entity Relationship Diagram (ERD) with all appropriately identified strong and weak entities (if any) along with the cardinalities of all relationships.
 - Describe in brief the three-level data abstraction of a DBMS with appropriate diagram.

$$8 + 4 = 12$$

3. Write Relational Algebra expressions of the queries involving the following relations of a database of a Consumer Product Retail store:
 CUSTOMER(cust_Id, name, mobile, reward_points); BILL (BillNo, Bill_date, cust_Id), ITEM(ItemNo, Product_name, Product_Type, MRP, Bill_no, discount, profit), PRODUCT(Product_name, Product_Type, CompanyBrand)
- Find the total monetary amount of sale across all bills dated 1-Dec-2019.
 - Find the customer having highest reward points.
 - Find the company Brand which has maximum type of products in the retail store.

$$(3 \times 4) = 12$$

Group – C

4. (a) Define Functional dependency with a suitable example.
- (b) The set of Functional Dependencies F on a relation Table_R (P,Q,S,T,U) are given as follows:
 F = { P→STU; SU→T; S→U; T→U; QS→P; PS→Q}.
- Compute either canonical cover or irreducible set (minimal cover) of functional dependencies which is equivalent to the given set F.

- (ii) Find all the candidate key (/keys) of this relation Table_R using the given set F.

$$2 + (5 + 5) = 12$$

5. (a) What is de-normalization?
(b) If $A \rightarrow BCE$ and $BDC \rightarrow FE$, then prove that $AD \rightarrow F$ also holds?
(c) In order to achieve 3NF design, consider a decomposition of Table_T(A,B,C,D,E,F) into two tables:
R1 (A, B, C) and R2 (C, D, E, F). The following FDs are applicable here:
 $AB \rightarrow C$; $C \rightarrow B$; $A \rightarrow DEF$; $B \rightarrow DEF$;
(i) "This decomposition of Table_T to achieve 3NF is not appropriately done" — Justify with appropriate reasons.
(ii) Show the appropriate 3NF decomposition of Table_T addressing all problems in the above decomposition.

$$1 + 4 + (3 + 4) = 12$$

Group – D

6. Consider a relational database as given below:
Customer(cust-id, cust-name, cust-city)
Product(p-id, p-name, p-rate)
Sale-Details(cust-id, p-id, p-rate, p-count, sale-date)
where the underlined attributes are the primary keys.

Write the following queries using SQL:

- (i) List all product names in ascending order.
(ii) Find customer name, product name and sale date for all customers.
(iii) Find customer names of those who have purchased the product 'Soap' on or before 21st September, 2019.
(iv) Find the number of 'Soap' (p-name) purchased by customer 'Rani'.
(v) Find the customer ids of those who have ordered products of rate more than Rs.599.
(vi) Find the customer ids of those who have ordered products that were not ordered by customer 'Raj'.

$$(1 + 2 + 2 + 2 + 2 + 3) = 12$$

7. Consider the relation R(U,V,W,X,Y,Z) and the following set of Functional Dependencies F.
 $F = \{V \rightarrow W; UVX \rightarrow YZ; UYZ \rightarrow VX; UXY \rightarrow VZ; UVZ \rightarrow XY; UVY \rightarrow XZ; UXZ \rightarrow VY; Y \rightarrow V; V \rightarrow Y\}$.
(i) Determine the highest normal form of relation T with respect to the given F — Justify your answer with proper reasons.
(ii) If T is not in 3NF, then normalize it to 3NF first and then further normalize it to BCNF.

$$(5 + 7) = 12$$