DATA STRUCTURE & RDBMS
(MECH 3134)

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

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one 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) Average case complexity to search an element in Binary Search Tree with 'n' nodes is _____.
(a) O(n) (b) O(log(n)) (c) $O(n^2)$ (d) $O(\log(n^2))$

(ii) Which of the following is correct with respect to a stack?
(a) push(pop()) (b) pop(pop()) (c) push(push(x)) (d) pop(push(x)).

(iii) Advantages of linked list representation of binary trees over arrays
(a) dynamic size
(b) ease of insertion/deletion
(c) ease in randomly accessing a node
(d) both dynamic size and ease in insertion/deletion.

(iv) When sorting the array {11,22,33,44,55} in ascending order, the sorting algorithm that takes the least amount of time is _____.
(a) Bubble Sort (b) Selection Sort (c) Insertion Sort (d) Quicksort

(v) Any binary tree can be accurately reconstructed from its _____.
(a) Preorder & Postorder sequences (b) Inorder sequence only
(c) Inorder & Postorder sequences (d) None of (a), (b) & (c).

(vi) Consider an implementation of unsorted singly linked list. Suppose it hasits representation with a head pointer only. Given the representation, which of the following operation can be implemented in O(1) time?
I) Insertion at the front of the linked list
II) Insertion at the end of the linked list
III) Deletion of the front node of the linked list
IV) Deletion of the last node of the linked list
(a) I and II (b) I and III (c) I, II and III (d) I, II and IV.

(vii) What must be the ideal size of array if the height of tree is 'l'?
(a) 2^l-1 (b) l-1 (c) l (d) 2l.

(viii) The entity integrity constraint states that _____.
(a) no primary key value can be null (b) a part of the key may be null
(c) duplicate object values are allowed (d) none of (a), (b) & (c).

(ix) Which of the following statements about normal forms is FALSE?
(a) BCNF is stricter than 3NF
(b) Lossless, dependency -preserving decomposition into 3NF is always possible
(c) Loss less, dependency – preserving decomposition into BCNF is always possible
(d) Any relation with two attributes is BCNF.

(x) Which of the following guarantees that - "A transaction is either performed in its entirety or not performed at all"?
(a) Isolation (b) Durability (c) Atomicity (d) Consistency.

Fill in the blanks with the correct word

(xi) A table can have only one _____ key.

(xii) Four DML commands are _____.

(xiii) Cardinality ratio means _____.

(xiv) The set of permitted values for each attribute is called its _____.

(xv) The subset of a super key is a _____.

Group - B

2. (a) Write an algorithm or pseudo-code for inserting an integer in a stack. The stack is implemented through an array. *[(CO1)(Remember/LOCQ)]*

(b) Convert the infix expression given below to its corresponding postfix expression using stack. Show all intermediate steps.
(200+43)*(49-22)/(75+16)
Show how the result would vary if no parentheses were present in the expression. *[(CO1)(Understand/LOCQ)]*

(c) What are the time complexities of enqueue and dequeue operations on a queue? *[(CO1)(Analyse/IOCQ)]*

3 + (5 + 2) + 2 = 12

3. (a) Suppose L is a linked list with n items where each item is considered as an integer. Write a algorithm or pseudo-code to insert an item after a specified integer present in L. *[(CO2)(Analyse/IOCQ)]*

(b) Consider the following operations on a circular queue
i. insert the following values A,B,C,D,E,F,G
ii. delete A, B, C
iii. insert P, Q, R
The circular queue can accommodate a maximum of 5 elements.
What will be the front and rear values after every operation? *[(CO2)(Apply/HOCQ)]*

(c) State the disadvantages of an array. *[(CO2)(Remember/LOCQ)]*

4 + 6 + 2 = 12

Group - C

4. (a) Perform insertion sort on the given list. Show different iterations.
35,55,75,95,85,45,15,65,05,55 *[(CO3)(Analyse/IOCQ)]*

(b) Construct a binary tree whose nodes are traversed in in-order and pre-order as follows (Show all intermediate steps):
In order: D B H E A I F J C G
Pre order: A B D E H C F I J G. *[(CO3)(Apply/HOCQ)]*

(c) Write an algorithm or pseudo-code to implement binary search on an *n* element array. *[(CO3)(Remember/LOCQ)]*

4 + 4 + 4 = 12

5. Consider the given list of numbers:
94, 2, 48, 12, 56, 32, 4, 67, 23, 87, 23, 55.

(i) Construct a Binary search tree (BST) by inserting each number according to the above mentioned sequence and show the diagram of the BST after insertion of each element.

(ii) What is the height of that tree?

(iii) Delete values 94, 56, 87, 67, 2, 12 from the above tree and show the reconstruction of the tree after each deletion separately. *[(CO4)(Apply/HOCQ)]*

(5 + 2 + 5) = 12

Group - D

6. (a) Briefly explain the concept of weak entity set using a suitable example. How does the primary key of a weak entity set is formed in a RDBMS? *[(CO5)(Remember/LOCQ)]*

(b) Consider the following relation:
CUSTOMER (Firstname, MiddileName, SurName, cust_id, age, uniqueMobileNo, Location)
What could be the possible super keys (any four) and candidate keys (any two) of the above-mentioned relation **CUSTOMER**? *[(CO5)(Analyse/IOCQ)]*

(c) What is referential integrity? Explain with a suitable example. *[(CO5)(Remember/LOCQ)]*

(3 + 1) + 4 + 4 = 12

7. Consider a relational database as given below:
Product (p_no, p_name, cost, s_no)Supplier(s_no, s_name, phn) Order(or_no, p_no, s_no, or_date) Determine the primary key for each relation. Write down the SQL statement for the following queries:

(i) List the product number (p-no), product name (p_name) and supplier name (s_name) of those products whose cost is below Rs.2000.

(ii) Find the supplier number and phone number (phn) of those who supplies product number P-32 and P-75.

(iii) Find the order number (or_no) and product name (p_name) of those products that have been supplied within the period of 10th January, 2021 and 31st March, 2021. *[(CO5)(Analyse/IOCQ)]*

(3 + (3 × 3)) = 12

Group - E

8. (a) Discuss with example the insert, update and delete anomalies in case of 1NF. *[(CO6)(Analyse/IOCQ)]*

   (b) Consider the following relation: R (M, Y, P, MP, C) with the following dependencies:
   F = {M → MP; M Y → P; MP → C}
   (i) Find the candidate keys of R.
   (ii) Find the partial dependencies and transitive dependencies (if any) and hence decide the normal form of R with respect to the set of functional dependencies F. *[(CO6)(Apply/HOCQ)]*

   (c) Define BCNF. How does it differ from 3NF? *[(CO6)(Understand/LOCQ)]*

3 + (2 + 4) + (2 + 1) = 12

9. (a) Define isolation and durability properties of a transaction in DBMS. Give examples for both. *[(CO6)(Understand/LOCQ)]*

   (b) What is a recoverable schedule and a non-recoverable schedule. Give example of both. *[(CO6) (Remember/LOCQ)]*

   (c) Let T1, T2 and T3 be transactions that operate on the same data items A, B and C. Let
   r1(A) mean that T1 reads A
   w1(A) means that T1 writes A
   Consider the following schedule:
   S: r1 (X); r2 (Z); r1 (Z); r3 (X); r3 (Y); w1 (X); w3 (Y); r2 (Y); w2 (Z); w2 (Y);
   By using a precedence graph, find out if the given schedule is conflict serializable or not. If so, then write the serializable schedule. *[(CO6)(Analyse/IOCQ)]*

3 + 3 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	34.37	36.46	29.17

Course Outcome (CO):

After the completion of the course students will be able to

1. Understand and remember the basics of data structures and how time complexity analysis is applicable to different types of algorithms.
2. Apply different types of data structures in algorithms and understand how the data structures can be useful in those algorithms.
3. Analyze the behavior of different data structures in algorithms. (For example, given an algorithm that uses a particular data structure, how to calculate its space and time complexity.
4. Evaluate solutions of a problem with different data structures and thereby understand how to select suitable data structures for a solution. (For example, what are the different ways to find the second largest number from a list of integers and which solution is the best.)
5. Formulate, using relational algebra and SQL, solutions to a broad range of query and data update problems.
6. Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*