

**DATA STRUCTURE & RDBMS**  
**(MECH 3134)**

**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) The root node is visited first in case of  
(a) in-order traversal (b) pre-order traversal  
(c) post-order traversal (d) level order traversal.
- (ii) Process of inserting an element in a stack is called \_\_\_\_\_  
(a) Create (b) Push (c) Evaluation (d) Pop.
- (iii) The number of swapping needed to sort the numbers 8,22,7,9,31,19,5,13 in ascending order, using bubble sort is  
(a) 11 (b) 12 (c) 13 (d) 14.
- (iv) A queue follows \_\_\_\_\_  
(a) FIFO (First In First Out) principle (b) LIFO (Last In First Out) principle  
(c) Ordered array (d) Linear tree.
- (v) What is the postfix expression for the corresponding infix expression?  
 $a+b*c+(d*e)$   
(a)  $abc*+de*+$  (b)  $abc+*de*+$   
(c)  $a+bc*de+*$  (d)  $abc*+(de)*+$
- (vi) The set of permitted values for each attribute is called its  
(a) attribute set (b) attribute range  
(c) domain (d) group
- (vii) The subset of a super key is a candidate key under what condition?  
(a) No proper subset is a super key (b) All subsets are super keys  
(c) Subset is a super key (d) Each subset is a super key.
- (viii) Tables in second normal form (2NF):  
(a) Eliminate all hidden dependencies  
(b) Eliminate the possibility of insertion anomalies

- (c) Have a composite key  
(d) Have all non key fields depend on the whole primary key.
- (ix) Student and Courses Enrolled is an example of  
(a) one-to-one relationship (b) one-to-many relationship  
(c) many-to-one relationship (d) many-to-many relationship.
- (x) Which of the following is not the basic property of a transaction?  
(a) Atomicity (b) Reflexivity (c) Consistency (d) Durability.

**Group – B**

2. (a) Distinguish between direct and indirect recursion.  
[[CO2] (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. [[CO2] (Remember/IOCQ)]
- (c) Write two applications of Stack data structure. [[CO4] (Remember/LOCQ)]  
 **$3 + (4 + 3) + 2 = 12$**
3. (a) Write an algorithm to insert a new node after a given node in a singly linked list.  
[[CO2] (Apply/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?  
[[CO6] (Evaluate/HOCQ)]
- (c) What is an abstract data type? [[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  
Why is the insertion sort most efficient when the input list is almost in sorted order? [[CO2] (Analyse/IOCQ)]
- (b) Construct a binary search tree whose nodes in in-order and pre-order are given 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 [[CO2] (Remember/LOCQ)]
- (c) Write a function to implement sequential search on an  $n$  element array.  
State the advantages of Binary Search over Linear Search.  
[[CO3](Understand/IOCQ)]  
 **$(3 + 1) + 5 + 3 = 12$**

5. (a) Sort the array given below using Quick Sort showing the value of the array elements in each pass.  
39, 9, 81, 45, 90, 15, 27, 18  
Compare between the time complexities of insertion sort and quick sort.  
[(CO4) (Understand/LOCQ)]
- (b) How binary tree can be represented by an array? Give one example using the following elements:  
M, N, B, V, C, D, S, W, A, R. [(CO2), (CO3) (Evaluate/HOCQ)]
- (c) What is a complete binary tree? [(CO2), Remember/LOCQ]
- (5 + 2) + 4 + 1 = 12**

**Group – D**

6. (a) Briefly explain the operation of UNION and INTERSECTION in Relational Algebra. [(CO5) (Remember, Formulate/LOCQ)]
- (b) Draw and explain the 3-schema architecture of RDBMS.  
[(CO6) (Understand, Demonstrate/LOCQ)]
- (c) Consider the following tables:  
*DEPT (Deptno, Dname, Dlocation)*  
*EMP (empid, ename, salary, dateofjoin, deptno)*  
Write SQL to:  
(i) List of all departments which is not in MUMBAI  
(ii) List of all employees whose salary is greater than 50,000 and working in KOLKATA. [(CO5) (Analyse, Formulate/IOCQ)]
- 3 + 4 + 5 = 12**
7. (a) Consider a medical clinic located in Kolkata and its specifications given as follows:  
The clinic has a number of regular patients and new patients come to the clinic regularly.  
Patients book appointments to see one of the doctors related to this clinic.  
Several doctors are associated with the clinic. They are specialists of different types (e.g., general practitioners, cardiologists, endocrinologists, etc.). They also have different schedules. Different doctors may have different fees.  
Doctors send patients for different tests like x-ray, blood tests, etc. The reports are sent from clinic to patients electronically.  
Medical records of each patient need to be stored and maintained.  
Construct a precise ER Diagram to represent the above scenario.  
Show the *primary key(s)*, *cardinality ratio* and different *types of attributes*, wherever applicable. You may add additional details also.  
State such assumptions clearly. [(CO1), (CO3) (Analyse/LOCQ)]
- (b) What is a weak entity? Explain with suitable example.  
[(CO3), (CO4) (Remember/LOCQ)]
- (c) What is Primary Key? [(CO1) (Understand/IOCQ)]
- 7 + 3 + 2 = 12**

**Group – E**

8. (a) What is Normalisation?  
What normal form is the following relation in?  
Relation  
*Stuff (D, Q, N, T, C, R, Y)*  
FDs are  $DO \rightarrow NTCRY$ ,  $CR \rightarrow D$ ,  $D \rightarrow N$  [(C04) (Remember/LOCQ)]
- (b) Find candidate keys for  $R(ABCDEF)$  with following FDs  $AB \rightarrow C$ ,  $C \rightarrow DE$ ,  $E \rightarrow F$ ,  $F \rightarrow B$ ,  $E \rightarrow A$ . [(C06) (Understand/LOCQ)]
- (c) What is *transitive dependency* in Normalization?  
[(C06)(Understand, Demonstrate/LOCQ)]
- (2 + 3) + 4 + 3 = 12**
9. (a) Draw and explain the State transition diagram of a transaction. [(C06) (Remember, Demonstrate/LOCQ)]
- (b) Illustrate the principles of deadlock avoidance and recovery in database transaction. [(C02) (Understand/LOCQ)]
- (c) What is two-phase locking protocol? How does it guarantee serialisability?  
[(C02)(Analyse/IOCQ)]
- 4 + 4 + (1 + 3) = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	59.4%	30.2%	10.4%

**Course Outcome (CO):**

After the completion of the course students will be able to

- Understand and remember the basics of data structures and how time complexity analysis is applicable to different types of algorithms.
- Apply different types of data structures in algorithms and understand how the data structures can be useful in those algorithms.
- 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.
- 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.)
- Formulate, using relational algebra and SQL, solutions to a broad range of query and data update problems.
- 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

<b>Department &amp; Section</b>	<b>Submission link:</b>
<b>ME</b>	<a href="https://classroom.google.com/w/NDA1NjM0MTc1ODI3/t/all">https://classroom.google.com/w/NDA1NjM0MTc1ODI3/t/all</a>