

DATA STRUCTURE & RDBMS
(CSE3107)

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) Pushing an element into a stack which is already full, results in
(a) Overflow (b) Underflow
(c) Crush (d) None of the above
- (ii) The function that deletes values from a queue is called
(a) Enqueue (b) Dequeue (c) Pop (d) Peek
- (iii) Quick sort is faster than
(a) Selection sort (b) Bubble sort
(c) Insertion sort (d) All of the above
- (iv) Visiting root node after visiting left and right sub-trees is called
(a) Pre- order Traversal (b) Post-Order Traversal
(c) In-Order Traversal (d) Level ordered Traversal
- (v) The postorder traversal of a tree is D, F, H, G, E, B, C, A, then
(a) The root node is A (b) The root node is D
(c) The root node is G (d) The root node cannot be determined
- (vi) The average-case time complexity of binary search algorithm is
(a) $O(n)$ (b) $O(n^2)$ (c) $O(\log n)$ (d) $O(n \log n)$
- (vii) An entity in set A is associated with any number (zero or more) of entities in set B. An entity in B, however, can be associated with at most one entity in A. What type of cardinality is this?
(a) One-to-many (b) One-to-one
(c) Many-to-many (d) Many-to-one
- (viii) The ____ operation of relational algebra allows us to find tuples that are present in one relation but not in the other.
(a) Union (b) Intersection (c) Set-difference (d) Projection

- (ix) Let R (A,B,C,D,E) be a relation with following functional dependencies: $A \rightarrow C, E \rightarrow D, B \rightarrow C$. Which of the following is the candidate key of R?
 (a) AC (b) ABE (c) CD (d) EB
- (x) In a functional dependency $X \rightarrow Y$, Y is a subset of X or Y and X are same. What type of FD is it?
 (a) Non-trivial FD (b) Trivial FD
 (c) Partial functional FD (d) Full functional dependency

Fill in the blanks with the correct word

- (xi) _____ linked list stores the address of the head node in the next pointer of the last node.
- (xii) Degree of a leaf node is ____.
- (xiii) The root node of a binary tree is visited first in _____ traversal.
- (xiv) A table is in BCNF if it is in 3NF and if every determinant is a _____ key.
- (xv) The _____ command makes the transaction permanent in the database.

Group - B

2. (a) Explain how you can make a queue by using two stacks. [[CO2](Analyse/HOCQ)]
 (b) Given a stack s and a queue q, show the contents of each after the indicated operations. The starting contents of s and q are shown. If an operation would result in an error, write "error" and assume the contents of s and q do not change. If there is no change otherwise, leave the cell blank.

Operation	Contents of stack s		Contents of queue q	
	Top	bottom	front	rear
<i>Start</i>	<i>empty</i>		2, 4	
s.pop()				
s.push(3)				
q.add(5)				
s.push(q.peek())				
q.add(s.peek())				
q.add(s.pop())				
s.push(s.pop())				
q.add(q.remove())				

where push(), pop() and peek() have their usual meaning with respect to stack and add(), remove() and peek() have their usual meaning with respect to queue.

[[CO2](Understand/LOCQ)]

4 + 8 = 12

3. (a) Write a pseudo-code or algorithm to perform the following operations on a singly linked list:
 (i) Insert a new node after a given node
 (ii) Search for a particular value in the list. [[CO2](Apply/IOCQ)]

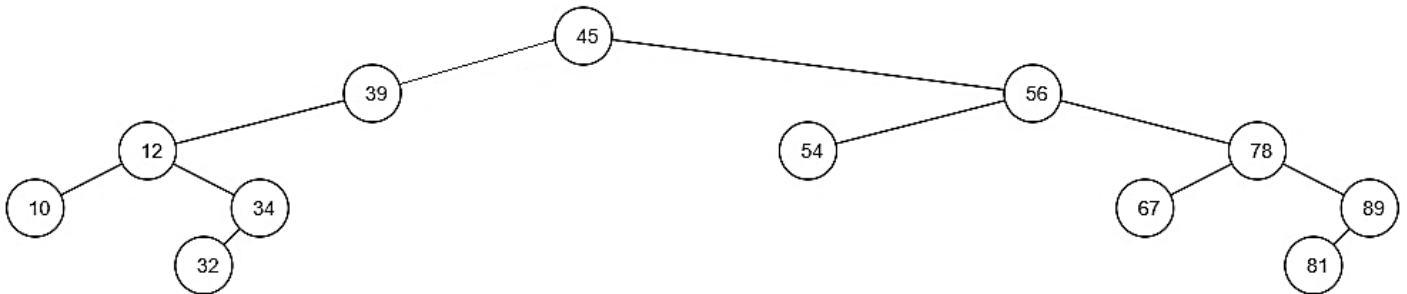
- (b) How is a Queue data structure implemented using an array? What is/are the demerit(s) of an array representation? How can the demerit(s) be solved?

[[CO2](Analyze/HOCQ)]

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

Group - C

4. Given the following binary search tree (BST):



- (i) Write the inorder, preorder and postorder traversal sequences. [[CO1](Understand/LOCQ)]
 (ii) Delete the root node. [[CO1](Remember/LOCQ)]
 (iii) Then insert 11, 22, 33, 44 in the existing BST. [[CO1](Understand/IOCQ)]

$$[(2 \times 3) + 2 + 4] = 12$$

5. (a) Make BST for the sequence of numbers: 45, 32, 90, 34, 68, 72, 15, 24, 30, 66, 11, 50. Show all intermediate trees. [[CO4](Apply/IOCQ)]
 (b) Write the bubble sort algorithm. [[CO4](Remember/LOCQ)]
 (c) Arrange the following list of elements using bubble sort.
 77, 66, 55, 44, 33, 11, -2, -10
 Show each step of the algorithm. [[CO4](Understand/LOCQ)]

$$6 + 2 + 4 = 12$$

Group - D

6. (a) Consider the following given tables:
Hotel (h-no, h_name, city)
Room (r-no, h-no, type, price)
Booking (h-no, g-no, date_from, date_to, r-no)
Guest (g-no, g_name, address)
 where the underlined attributes are the primary keys.
 Write the following queries using SQL:
 (i) List all hotel numbers (h-no) and names (h-name) which are located in 'Shimla' and the hotel name starts with 'S'.
 (ii) List the names of guests, who have booked 'Park Hotel' between 25th March, 2023 and 2nd July, 2023.
 (iii) Modify the table Booking such that the room no (r-no) field must always contain some value.
 (iv) Display the different cities and the number of hotels in each city, sorted in the alphabetical order of the cities. [[CO5](Design/HOCQ)]

- (b) What are DDL commands used for? Give two examples of DDL commands in SQL.
 [[CO5](Remember/LOCQ)]
(4 × 2) + (2 + 2) = 12
7. (a) What do you understand by referential integrity constraint? What restrictions are imposed on the two relations if a referential integrity constraint is established between them?
 (CO1)(Analyse/IOCQ)]
- (b) Define and explain the terms: Primary Key and Candidate Key, by using a single illustrative example.
 [(CO3)(Remember/LOCQ)]
- (c) What is/are the difference(s) between a Primary Key and a Unique Key?
 [(CO3)(Understand/LOCQ)]
(2 + 4) + 4 + 2 = 12

Group - E

8. Consider the given relation $R = \{ P, Q, R, S, T, U \}$ and the set of functional dependencies $F = \{ P \rightarrow QRST, S \rightarrow T, R \rightarrow U \}$
- (i) Find out the candidate key(s) of R.
 (ii) What are the prime and non-prime attributes of R?
 (iii) Identify the full, partial and transitive dependencies in R, if any.
 (iv) Which highest normal form is R in?
 (v) If R is not in BCNF, decompose R into BCNF.
 (vi) Between 3NF and BCNF, which normal form is stricter and why?
 Each answer should be presented with sufficient explanation.
 [(CO5)(Design/HOCQ)]
(6 × 2) = 12
9. (a) Let T1 and T2 be two transactions that operate on the same data items A and B. R1(A) means that T1 reads A, W1(A) means that T1 writes A. The same is applicable for T2 also. Consider the following schedule:
 $S = R1(A), R1(B), W1(A), R2(A), W2(A), W1(B), R2(C), W2(C)$.
 Using a precedence graph, find out if schedule S is conflict-serializable or not? If it is conflict serializable, then what is the equivalent serial schedule?
 [(CO6)(Analyse/HOCQ)]
- (b) Describe the Two-phase Locking protocol. What are the drawbacks of this protocol?
 [(CO6)(Remember/LOCQ)]
6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	39.58	22.92	37.5