DATA STRUCTURE & RDBMS
(CSEN 3106)

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) For implementing recursive function the data structure used is
(a) Queue (b) Stack (c) Linked List (d) Tree.

(ii) The number of nodes in a complete binary tree of depth *d* (depth of root is 0) is
(a) $2^{d-1} + 1$ (b) $2^{d+1} - 1$ (c) $2^{d-1} - 1$ (d) $2^{d+1} + 1$.

(iii) A functional dependency X→Y means that association from the domain of X to domain of Y is
(a) many to many (b) one to many (c) many to one (d) none.

(iv) A superkey set consists of {AB, A, BC, ABC}. Out of this the minimal super keys are
(a) {A, BC, AB} (b) {ABC} (c) {A, AB} (d) {A, BC}.

(v) Random access of elements is not possible in
(a) one dimensional array (b) two dimensional array
(c) linked list (d) string.

(vi) Relational algebra is a
(a) Procedural language (b) Non-Procedural language
(c) Data definition language (d) High level language.

(vii) A primary key field
(a) may contain null values, but if any value is inserted, it must be unique
(b) cannot contain null values, and the inserted values may be duplicate
(c) cannot contain null values, and the inserted values must be unique
(d) must contain null values only.

(viii) TCL statements in SQL are
(a) grant and revoke (b) commit and rollback
(c) commit, rollback and savepoint (d) none.

(ix) The time complexity of 4 algorithms that solves the same task is given below. Which algorithm will execute the slowest for large values of n
(a) $O(n^2)$ (b) $O(n)$ (c) $O(2^n)$ (d) $O(n\log n)$.

(x) A table is in BCNF if it is in 3NF and if every determinant is a _____ key.
(a) normal (b) dependent (c) perfect (d) candidate

Group- B

2. (a) Convert the following infix expression into postfix expression:
A * (B + D) / E – F * (G +H / K) [(CO2)(Analyze/HOCQ)]
(b) Write an algorithm/pseudocode to print the data stored in each node of a singly-linked list. [(CO1)(Remember/LOCQ)]
8 + 4 = 12

3. (a) 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 given. 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
Start	*empty*	2, 4
s.push(3)		
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.
[(CO1)(Understand/IOCQ)]

(b) What are the advantages of circular queue over normal queue?
[(CO1)(Remember/LOCQ)]

(c) Write an algorithm to print the middle node of a linked list, assuming that the number of nodes is odd. [(CO2)(Analyse/HOCQ)]
6 + 2 + 4 = 12

Group – C

4. (a) Construct the binary search tree from the inorder and postorder traversals of the tree given below:
Inorder: 23, 36, 39, 41, 45, 48, 56, 69, 76, 89, 98, 115
Postorder: 23, 41, 39, 36, 48, 69, 56, 98, 115, 89, 76, 45 [(CO2)(Analyse/HOCQ)]
(b) Write two differences between binary search and linear search algorithms?
[(CO1)(Remember/LOCQ)]
(c) Write the binary search algorithm. [(CO1)(Remember/LOCQ)]
6 + 2 + 4 = 12

5. (a) Construct a binary search tree with the keys 50, 33, 44, 22, 77, 35, 60 and 40. Display each step of the construction of the tree by using these keys in the order in which they are given. [(CO4)(Understand/IOCQ)]

(b) Now, insert two keys 75 and 88 to this binary search tree.
[(CO4)(Understand/IOCQ)]

(c) Now, delete two keys 33 and 77 from this binary search tree.
[(CO4)(Understand/IOCQ)]
6 + 2 + 4 = 12

Group - D

6. (a) Following are the details about a hospital management system, which maintains the medical records of their patients, doctors, rooms, etc. Draw an ERD with respect to the following functionalities.
(i) You should assign unique IDs to the patients and store the relevant information about Patients. You'll have to add the patient's name, personal details, contact number, disease name, and the treatment the patient is going through. You'll also have to mention under which hospital department the patient is (such as cardiac, gastro, etc.).
(ii) After that, you should add information about the hospital's Doctors. A doctor can treat multiple patients, and he/she would have a unique ID as well. Doctors would also be classified into different departments.
(iii) Patients would get admitted into Rooms, where room-id is unique. Apart from that, there would be room types (like ICUs, Operation Theaters, etc.) in the hospital. [(CO3)(Analyse/IOCQ)]

(b) What is a weak entity set, describe with an example. [(CO1)(Understand/LOCQ)]
7 + 5 = 12

7. (a) Consider relation Student(roll, name, birth-date, stream, cid), Course(cid, c-name, start-date, location).
Write the algebra and SQL for the following query
(i) To find the courses undertaken by students whose course location is Bhagalpur. Project only the roll number, course name, start-date of courses. Exclude any courses whose stream is 'S1'.
(ii) To find all students who are born before '27-APR-22'. [(CO5)(Evaluate/HOCQ)]

(b) Every candidate key is a super key. Justify [(CO1)(Understand/LOCQ)]
8 + 4 = 12

Group – E

8. (a) Given a relation R(P, Q, R, S, T) and Functional Dependency set FD = { PQ → R, S → T }, determine whether the given R is in 2NF? If not convert it into 2NF.
[(CO3)(Analyze/HOCQ)]

(b) Show that, every table with two single-valued attributes is in BCNF.
[(CO3)(Analyze/HOCQ)]
8 + 4 = 12

9. (a) What are the properties of transaction in relation to RDBMS? Explain them in brief.
[(CO2)(Remember/LOCQ)]

(b) Reorder the following schedule into an equivalent serial schedule:
r1(A)w1(A)r2(A)w2(A)r1(B)w1(B)r2(B)w2(B) [(CO2)(Understand/IOCQ)]

(2 + 6) + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	30.2	30.2	39.6

Course Outcome (CO):

After the completion of the course students will be able to
CO1: Analyze and remember the basics of data structures along with terminology, features, classifications, and characteristics embodied in database systems.
CO2: Understand the significance and utility of different data structures and the context of their application.
CO3: Evaluate an understanding of the relational data model.
CO4: Analyze and remember the behavior of different data structures in algorithms.
CO5: Analyze and apply using SQL and relational algebra, solutions to a broad range of query and data update problems.
CO6: Evaluate different types of solutions (e.g. sorting in data structure, complex querying in dbms) to the same problem

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