DATA STRUCTURE & RDBMS
(CSEN 3206)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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)   A table can have only one
         (a) super key   (b) primary key   (c) foreign key   (d) candidate key.

   (ii) In a circular queue, how do you increment the rear end of the queue?
         (a) rear++   (b) (rear+1) % CAPACITY
         (c) (rear % CAPACITY)+1   (d) rear––.

   (iii) What is the corresponding postfix expression of "3+4*5/6"
         (a) 3456+*/   (b) 34+56*/   (c) 345*6/+   (d)34+5*6/.

   (iv) What is the worst-case complexity of quick sort?
         (a) $O(nlogn)$ (b) $O(n^2)$ (c) $O(n^3)$ (d) $O(n^2logn)$.

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

   (vi) A relation R(A,B,C,D,E,F,G) is given with the following set of functional dependencies: F = {AD → E, BE → F, B → C, AF → G}. Identify the prime attributes of R.
         (a) A,B   (b) B,C   (c) A,B,C   (d) A,B,D.

   (vii) Which of the following recursive formulae can be used to find the factorial of a number?
         (a) fact (n) = n * fact(n)   (b) fact(n) = n * fact(n+1)
         (c) fact (n) = n * fact(n-1)   (d) fact(n) = n * fact(1).

   (viii) In a full binary tree, each node has
         (a) exactly zero or two children   (b) exactly two children
         (c) child at the same level   (d) exactly one or two children.

   (ix) Which one is correct with respect to RDBMS?
         (a) Primary key ⊆ Candidate key ⊆ Super key
         (b) Super key ⊆ Primary key ⊆ Candidate key
         (c) Candidate key ⊆ Super key ⊆ Primary key
         (d) Primary key ⊆ Super key ⊆ Candidate key.

   (x)   A transaction must operate properly without interference from concurrently executing transactions. This property of transactions is referred to as
         (a) atomicity   (b) concurrency   (c) isolation   (d) durability.

Group – B

2. (a)   Write a function/pseudo-code for inserting an integer in a stack. The stack is implemented through an array.

   (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.

   (c)   What are the time complexities of enqueue and dequeue operations on a queue?

                                                          3+ (4 + 4) + 1= 12

3. (a)   Suppose L is a linked list with n items where each item is considered as an integer. Write a function/pseudo-code to insert an item "t" after a specified integer present in L.

   (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?

   (c)   What are the demerits of an array?

                                                          4 + 6 + 2 = 12

Group – C

4. (a)   Show how quicksort will be working on the given array:
         23, 35, 14, 76, 54, 29
         Compare between the time complexities of insertion sort and quick sort.

   (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.

                                                          (5 + 3) + 4 = 12

5. (a)   Critically comment: binary search works better than linear search.

(b)   Draw a binary search tree for the following input list 60,25,75,15,50,66,33,44,39,73.

Then delete the nodes 25, 75, 44 from the tree.
Write down the postorder traversal sequence from the constructed BST.

(c)   Write a recursive function for calculating the Fibonacci series.

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

Group – D

6. (a)   Consider the following relations R1 and R2:

A	B	C
1	2	3
4	5	6
2	4	8

C	D	E
3	2	1
3	6	9
4	5	6

Perform the following relational algebraic operations and show the results.
i) R1∩R2   ii) R1∪ R2   iii) R1- R2   iv) R1⋈ R2

(b)   Define the following terms with proper examples:
i) Multi-valued attribute   ii) One-to-many relationship

(4 × 2) + (2 × 2) = 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 (eg. 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.

(b)   What is a weak entity? Explain with suitable example. How is a primary key for a weak entity created?

7 + (3 + 2) = 12

Group – E

8.   Consider the given relation R = {P, Q, R, S, T, U } and the set of functional dependencies F = { P → QRST, S → T, R → 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.

6 × 2 = 12

9. (a)   What are the conditions necessary for two transactions to conflict in a database?

(b)   Describe the two-phase locking protocol. Why is it required? Discuss its limitations. What could be done to overcome these limitations?

(c)   State the differences between immediate modification and deferred modification techniques of recovery management.

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