DATA STRUCTURE & RDBMS
(CSEN 3106)

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

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
<u>any 4 (four)</u> from Group B to E, taking <u>one</u> 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)   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)   The complexity of adding two matrices of order m×n is
    (a) m+n   (b) max(m,n)   (c) min(m,n)   (d) m*n.

    (iv)   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.

    (v)   Random access of elements is not possible in
    (a) One dimensional array   (b) Two dimensional array
    (c) Linked list   (d) String.

    (vi)   Which function places an element on the stack?
    (a) POP()   (b) PUSH()
    (c) PEEK()   (d) isEmpty().

    (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)   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

    (ix)   Which of the following is the full form of DDL?
    (a) Data definition language   (b) Data derivation language
    (c) Dynamic data language   (d) All of (a), (b) & (c).

(x)   SQL is a Non procedural language because
        (a) All commands are like verbs in English
        (b) It is not cryptic like C or other low level language
        (c) User describes the information desired without giving a specific procedure
        (d) None of the above options.

Fill in the blanks with the correct word

(xi)   The property of transaction that protects data from system failure is _____.

(xii)   The Rectangles in ER diagram represents _____.

(xiii) Adjacency list is used to store a _____.

(xiv)   An attribute in a ERD, whose value can be calculated based on the value of another attribute is called _____.

(xv)   Time complexity of bubble sort is _____.

Group - B

2. (a) Convert the following infix expression into postfix expression:
         A * (B + D) / E – F * (G +H / K)   *[(CO4)(Remember/LOCQ)]*
    (b) Write an algorithm to print the data stored in each node of a singly-linked list.
                                                                   [(CO2)(Understand/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.
                                                                   [(CO2)(Understand/IOCQ)]
    (b) What are the advantages of circular queue over normal queue?
                                                                   [(CO2)(Understand/LOCQ)]
    (c) Evaluate the expression using a suitable data structure: 15 3 2 + / 7 + 2 *.
                                                                   [(CO4)(Analyse/IOCQ)]
                                                                   6 + 2 + 4 = 12

Group - C

4. (a) Delete following nodes from the given BST and reconstruct the tree.
16, 24, 35. (Show all intermediate steps.) *[(CO2)(Apply/IOCQ)]*
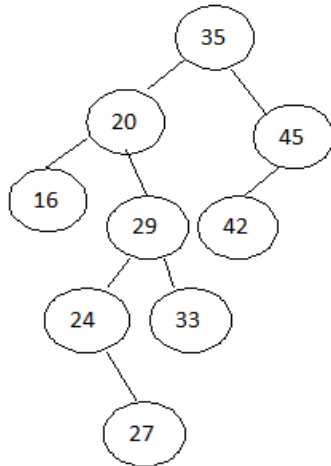
(b) Make a BST for the following sequence of numbers.
45,32,90,34,68,72,15,24,30,66,11,50. Show all intermediate trees.
[(CO4)(Apply/IOCQ)]

(c) Write down the worst case and best case time complexity of
(i) insertion sort and (ii) selection sort. *[(CO6)(Remember/LOCQ)]*
6 + 4 + 2 = 12

5. (a) Construct a binary search tree whose nodes in inorder and preorder are given
as follows (Show all intermediate steps):
Inorder : D B H E A I F J C G
Preorder: A B D E H C F I J G *[(CO4)(Analyze/HOCQ)]*

(b) Perform insertion sort on the given list. Show different iterations.
35 55 75 95 85 45 15 65 05 *[(CO4)(Apply/IOCQ)]*

(c) Write two differences between binary search and linear search algorithms.
[(CO1)(Remember/LOCQ)]
6 + 4 + 2 = 12

Group - D

6. (a) Draw Entity-Relation diagram of an educational institute taking at least five
entities. *[(CO3)(Understand/LOCQ)]*

(b) Consider the following three relations:
S(SNO, SNAME, STATUS, CITY)
P(PNO, PNAME, COLOUR, WEIGHT, CITY)
SP(SNO, PNO, QTY)
Write the following queries in **relational algebra**:
   i) Get supplier numbers for suppliers in Paris with status > 20.
   ii) Get all part numbers whose colour is red and weight is more than 50.
   iii) Get all shipments where the quantity is in the range of 300 to 750.
[(CO5)(Understand/IOCQ)]

(c) Define primary key and foreign key with examples. *[(CO1)(Remember/LOCQ)]*
5 + (1 + 1 + 1) + (2 + 2) = 12

7. Consider the following relation and write the queries in SQL:
   Employee(Empid, Fname, Lname, Sal, JoiningDate, Department)
   (i) List the employees who joined before 1st August, 1999.
   (ii) Find the average salary of each department.
   (iii) List all employees whose first name starts with "S".
   (iv) Count total number of employees, department-wise.
   (v) Find the name and the salary of the employee(s) who earns maximum salary.

   (2 + 2 + 2 + 2 + 4) = 12
   [(CO5)(Understand/IOCQ)]

Group - E

8. (a) Define BCNF. How does it differ from 3NF?   *[(CO3)(Analyze/LOCQ)]*
   (b) Describe the different states of a transaction life cycle.   *[(CO3)(Remember/LOCQ)]*
   (c) Find candidate keys for R(ABCDEF) with following FD's
       AB -> C, C-> DE, E -> F, F -> B, E -> A   *[(CO3)(Apply/IOCQ)]*

   4 + 6 + 2 = 12

9. (a) Create Student table with appropriate integrity constraint(s) for implementing the business rules as per following specification:

Field Name	Data Type	Business Rules
RollNo	Number(4,0)	Unique id for each student
StdName	Varchar2(50)	Must provide some name
StdDeptID	Char(4)	A valid department which must exist in Department table where DeptID is primary key
RegistrationNo	Number(7,0)	Allow null
Age	Number(2,0)	Must be within 18 to 25

   [(CO5)(Analyse/HOCQ)]

   (b) What is a deadlock? How can deadlocks be detected using wait-for graphs? What are the measures to recover from a deadlock?   *[(CO3)(Remember/LOCQ)]*

   5 + (2 + 2 + 3) = 12

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	45.83	42.71	11.46

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