Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.Tech (EIE-OLD)/SEM-4/CS-405 (EI)/2013

2013

DATA STRUCTURES & ALGORITHMS

Time Allotted : 3 Hours   *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

    i)   Example of a non-linear data structure is

         a) array   b) list

         c) graph   d) none of these.

    ii) In *C* language, malloc( ) returns .... pointer.

         a) integer   b) structure

         c) null   d) void.

    iii) Which of the following is the best time for an algorithm ?

         a) $O (n)$ b) $\log_2 (n)$

         c) $O (2^n)$ d) $O (n \log_2 n)$.

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iv) A linear list in which elements can be added or removed at either end but not in the middle is known as

a) queue

b) deque

c) stack

d) none of these.

v) The process in which function calls itself is called

a) padded list

b) recursion

c) push

d) none of these.

vi) The complexity of binary search is

a) $O(1)$

b) $O(\log n)$

c) $O(n \log n)$

d) none of these.

vii) The maximum number of nodes possible in a binary tree of height h is

a) $2h - 1$

b) $2^h - 1$

c) $2^h + 1$

d) none of these.

viii) In a complete graph, the number of edges with 9 vertices is

a) 18

b) 17

c) 19

d) none of these.

ix) What traversal technique lists the nodes of a binary search tree in ascending order ?

a) Post-order

b) In-order

c) Pre-order

d) None of these.

x) When a graph is traversed by visiting in the forward direction as long as possible, the traversal is called as .... first traversal.

a) depth

b) node

c) breadth

d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. What would be the worst case scenario for bubble sort program ? Also confirm that the best case behaviour is $O(n)$. $3 + 2$

3. Construct an expression tree for the expression $E = (2x + y) * (5a - b)^3$.

4. Write an algorithm to insert a node in a BST.

5. Write the difference between stack and queue and implement the operation of priority queue. $2 + 3$

6. What is the difference between linked list and an array ? How can a polynomial such as $5x^4 - 3x^2 + 9x - 11$ be represented by a linked list ? $2 + 3$
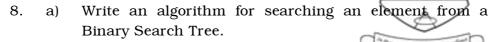
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Given an array of n integers, write an algorithm to find the smallest element. Find number of instruction executed by your algorithm. What are the time and space complexities ?

   b) Write an algorithm/program to implement the insert and delete operations of linked list.

   c) What is Sparse matrix ? Explain with example how sparse matrix be represented by a linked list.

   $(2 + 1 + 2) + 5 + (2 + 3)$

8. a) Write an algorithm for searching an element from a Binary Search Tree.

b) Explain with a suitable example the collision resolution scheme using linear probing with open addressing.

c) Write an algorithm for inserting an element from circular queue. 5 + 5 + 5

9. a) Describe heap sort and show that its worst case performance is O ($n \log n$).

b) Suppose the following sequences list the nodes of binary tree T in pre-order and in-order respectively :

Pre-order : G, B, Q, A, C, K, F, P, D, E, R, H

In-order : Q, B, K, C, F, A, G, P, E, D, H, R.

Draw the diagram of the tree.

c) Draw a graph with 5 vertices each of degree 4.

(4 + 4) + 4 + 3

10. a) Prove that, for any non-empty binary tree T, if L be the number of leaves and V be the number of nodes of degree 2, then $L = V + 1$.

b) What is tower of Hanoi problem ? Write an algorithm to solve it. Also calculate the time of complexity of your algorithm. 5 + (3 + 5 + 2)

11. Write short notes on any *three* of the following :

a) Hashing

b) Indexed sequential file organization

c) Doubly linked list

d) Recursion

e) Binary tree traversal.