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Roll No. :

Invigilator's Signature :

CS/B.TECH (EE/CSE/IT/ECE/EEE/ICE)/SEM-3/CS-302/2009-10

2009

DATA STRUCTURE & 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 any *ten* of the following :

$$10 \times 1 = 10$$

i) The time complexity of binary search is

- a) $O(n^2)$ b) $O(n)$
c) $O(\log n)$ d) $O(n \log n)$.

ii) The fastest sorting algorithm for an almost already sorted array is

- a) quick sort
b) merge sort
c) selection sort
d) insertion sort.



- iii) The ratio of items present in a hash table to the total size is called
- a) balance factor
 - b) load factor
 - c) item factor
 - d) weight factor.
- iv) The Linear Probing Technique for collision resolution can lead to
- a) Primary clustering
 - b) Secondary clustering
 - c) Overflow
 - d) Efficient storage utilization.
- v) A height balanced binary tree is a binary tree in which the height of two subtrees of every node never differ by more than
- a) 1
 - b) 2
 - c) 3
 - d) none of these.
- vi) Which tree structure is used for efficient access of records residing in disc memory ?
- a) AVL Tree
 - b) B Tree
 - c) 2-3 Tree
 - d) Binary Tree.
- vii) Any connected graph with x vertices must have at least
- a) $x + 1$ edges
 - b) $x - 1$ edges
 - c) x edges
 - d) $x/2$ edges.



viii) Which of the following is essential for converting an infix expression to postfix notation ?

- a) A parse tree
- b) An operand stack
- c) An operator stack
- d) None of these.

ix) The values in a BST can be sorted in ascending order by using which of the following traversals ?

- a) Pre-order
- b) In-order
- c) Post-order
- d) Level-order.

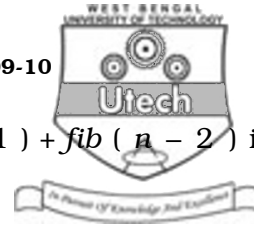
x) The prefix expression for the infix expression

$a * (b + c) / e - f$ is

- a) $/ * a + bc - ef$
- b) $- / * + abcef$
- c) $- / * a + bcef$
- d) None of these.

xi) In C language, malloc() returns

- a) integer pointer
- b) structure pointer
- c) null pointer
- d) void pointer.



xii) Fibonacci function $fib(n) = fib(n-1) + fib(n-2)$ is an example of

- a) Linear Recursion b) Binary Recursion
c) Non-linear Recursion d) Mutual Recursion.

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

- a) Stack b) Queue
c) Dequeue d) Heap.

GROUP – B

(Short Answer Type Questions)

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

2. Prove that

$$O(f(x)) + O(g(x)) = O(\max(f(x), g(x))).$$

3. a) Convert the following infix expression into equivalent postfix expression using stack :

$$(A + B) * C - (D - E) / (F + G).$$

b) What is a Max Heap ? $4 + 1$

4. What is a priority queue ? Mention the different design options for priority queue. $2 + 3$

5. “Binary search technique cannot be implemented using Linked list.” — Justify the validity of the statement.

6. Show how the following integers can be inserted in an empty binary search tree in the order they are given :

50, 30, 10, 90, 100, 40, 60, 20, 110, 5.

Draw the tree in each step.



GROUP – C

(Long Answer Type Questions)

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

7. a) Prove that, the height of a binary tree that contains n elements, $n \geq 0$, is at most n and at least

$$\lceil \log (n + 1) \rceil.$$

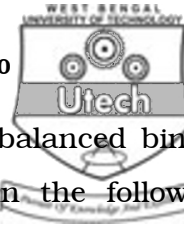
- b) The order of nodes of a binary tree in Preorder and in order traversal are as under :

In order : D B F E G H I A C

Pre-order : A B D E F G H I C

Draw the corresponding binary tree.

- c) How does static allocation differ from dynamic allocation of memory ? $5 + 5 + 5$
8. a) What is a Stack ADT ?
- b) Write a C function for popping an element from a stack implemented using linked list.
- c) Explain three uses of stack data structure. $5 + 5 + 5$
9. a) Explain with a suitable example the principle of operation of QuickSort algorithm.
- b) In which cases, QuickSort becomes a 'SlowSort' ? What is the remedy in those cases ?
- c) Compare the performance and operation of BubbleSort and SelectionSort. $5 + 5 + 5$



10. a) Show the steps in creation of a height balanced binary AVL TREE using insertion of items in the following order — show the balanceing steps required.

(**March, May, November, August, April, January, December, July, February, June, October, September**)

- b) What do you mean by a *B-Tree* and what are the uses of such a tree in data structures ?
- c) Consider a *B-Tree* of order 5 as shown below — insert the elements 4, 5, 58, 6 in this order in the *B-Tree*.

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8 + 2 + 5



11. a) Compare BFS and DFS. Discuss the two different ways of representing a graph.
- b) Draw the minimum cost spanning tree for the graph given below and also find its cost.

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- c) What is a complete graph ? Show that the sum of degree of all the vertices in a graph is always even.

$$5 + 5 + 5$$

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