ROLL NO. _____

Code: AC06/AT06 Subject: DATA STRUCTURES & ALGORITHM DESIGN

AMIETE – CS/IT (OLD SCHEME)

Time: 3 Hours **JUNE 2012** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: **(2×10)**

a. _____ defines an upper bound function $g(n)$ for $f(n)$ which represents time and space complexities of an algorithm with input n characteristics.

(A) Small *o* **(B)** Omega Ω
(C) Big *O* **(D)** Theta Φ

b. In linked list, the link field of last node is set to

(A) ONE **(B)** NULL
(C) Double **(D)** All of the above

c. Balance factor is used in the _____

(A) B-Trees **(B)** Searching
(C) AVL trees **(D)** Heap Trees

d. Preorder traversal is given by

(A) Root, left sub-tree and right sub-tree
(B) Left sub-tree, root and right sub-tree
(C) Left sub-tree, right sub-tree and root
(D) Right sub-tree, left sub-tree and root

e. In hashing, _____ technique divides key into several parts and later transforms it to create target address.

(A) Mid-Square **(B)** Division
(C) Extraction **(D)** Folding

f. In minimum spanning tree, the following is a valid statement

(A) Edges have no weights
(B) Edges contain infinite weights
(C) For a graph, more than one spanning tree exist
(D) Node contain self-loops

g. Which of the following verbs can be represented by MTRANS in Schank's CD formalism?

(A) push **(B)** eat
(C) give **(D)** speak

h. Worst case complexity of heap sort is given as

(A) $O(n \log n)$ **(B)** $O(n^2)$
(C) $O\left(n^2 \log n\right)$ **(D)** $O(\log n)$

i. *m*-way search trees are used in

(A) Sparse Matrin **(B)** Spanning trees
(C) B-Trees **(D)** None of the above

j. Stack over can occur in the _____.

(A) Hashing **(B)** Recursion
(C) Binary sort **(D)** Sparse matrix sort

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Define ordered list. Give any four properties. **(5)**

b. Let J and K be integers. Suppose Q(J,K) is recursively defined by

$$Q(J,K) = \begin{cases} 5 & \text{if } J < K \\ Q((J-K), K+2) + J & \text{if } J \geq K \end{cases}$$

Find Q(2, 7) and Q(15, 2). Give sequence of steps. **(5)**

c. Explain the concept of abstract data types. **(3)**

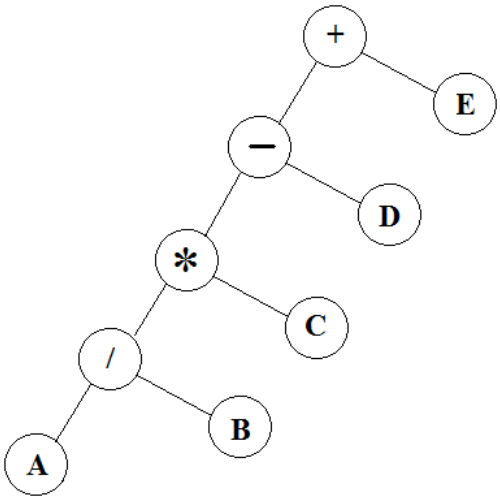
d. Differentiate between space complexity and time complexity. **(3)**

Q.3 a. Write a program to insert a node in single linked list at the following positions:
(i) Start (ii) End
(iii) After a given node position P **(9)**

b. Write a program to implement polynomial addition using linked list. **(7)**

Q.4 a. If a complete binary tree with n nodes is represented sequentially, then for any node with index i, $1 \leq i \leq n$, prove the following: **(6)**
(i) *LeftChild(i)* is at $2i$ if $2i \leq n$.
(ii) *RightChild(i)* is at $2i+1$ if $2i+1 \leq n$

b. Give inorder, preorder and postorder traversals for the following binary tree. **(6)**



c. Give the representation of threaded binary tree. Give an example to insert an element in threaded binary tree. **(4)**

Q.5 a. Explain the properties of binary search tree. **(4)**

b. Explain how heaps are used to implement priority queues. **(3)**

c. Write a program to insert an element into a heap. **(5)**

d. Mention various operations used in AVL trees. Give its applications. **(4)**

Q.6 a. Give time complexity of the following sorting techniques:
(i) Bubble sort (ii) Merge sort
(iii) Quick sort (iv) Heap sort **(8)**

b. Explain the binary search technique by using an example. **(4)**

c. Give the analysis of heap sort algorithm. **(4)**

Q.7 a. Write an algorithm for minimum spanning tree. Give an example with sequence of steps for finding minimum spanning tree. **(6)**

b. Give the analysis of Dijkstra's shortest path algorithm. Suggest a method to improve the performance of the algorithm. **(4)**

c. Differentiate between the DFS and BFS traversal technique. **(6)**

Q.8 a. How sparse matrix represented? Explain any one of representation method. **(3)**

b. Explain B-Trees of order *m.* Give its properties. **(5)**

c. Write a program to evaluate arithmetic expression. Explain with an example. **(8)**

Q.9 a. Write a program to insert a node at the following positions in a binary search tree:
(i) Root node
(ii) After a node position P
(iii) Leaf node **(9)**

b. Define threaded binary tree. Explain inorder threading using suitable example. Discuss advantages of the threaded binary tree. **(7)**