

Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech/ECE(O),EE(O),EEE(O),ICE(O),CSE(O),IT(O)/

SEM-3 / CS-302 / 2011-12

2011

DATA STRUCTURE AND 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 :

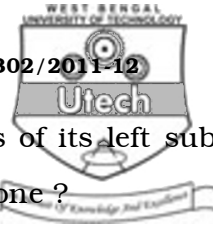
10 × 1 = 10

i) The number of edges in a complete graph with 'n' vertices is

- | | |
|------------------|----------------------|
| a) $n (n - 1)$ | b) $n (n - 1) / 2$ |
| c) n^2 | d) $2 n - 1$. |

ii) Which of the following data structures is used to implement recursion ?

- | | |
|-----------|-----------------|
| a) Arrays | b) Stacks |
| c) Queues | d) Linked list. |



- iii) In what tree, for every node the heights of its left sub-tree and right sub-tree differ at least by one ?
- Binary search tree
 - AVL tree
 - Complete tree
 - Threaded binary tree.
- iv) Which traversal technique lists the nodes of a binary search tree in ascending order ?
- Post-order
 - Pre-order
 - In-order
 - Linear order.
- v) The equivalent postfix expression for $d/(e+f) + b * c$ is
- $defbc / ++$
 - $def+ / bc+ *$
 - $def+ / bc * +$
 - none of these.
- vi) If the postfix form of a string is $ABC + - D *$, the actual string is
- $(A - (B + C)) * D$
 - $((A - B) + C) * D$
 - $((A + B) - C) * D$
 - $(A + (B - C) * D).$



- vii) The following sequence of operations is performed on a stack :

push(1),push(2),pop,push(1),push(20),pop,pop,pop,
(push(2),pop.

The sequene of popped out values is

- a) 2, 2, 1, 2, 1 b) 2, 2, 1, 1, 2
c) 2, 1, 2, 2, 1 d) 2, 1, 2, 2, 2.
- viii) A linear collection of data elements where the linear node is given by means of pointer is called
- a) Linked list b) Node list
c) Primitive list d) None of these.
- ix) p is a pointer to the structure. A member "mem" of that structure is referenced by
- a) $*p.mem$ b) $(*p).mem$
c) $*(p.mem)$ d) none of these.
- x) In linked list representation a node contains at least
- a) node address field, data field
b) node number field, data field
c) next address field, information field
d) none of these.



- xi) In quick sort a desirable choice for the partitioning element will be
- first element of the list
 - last element of the list
 - median of the list
 - none of these.
- xii) An adjacency matrix representation of a graph cannot contain information of
- nodes
 - edges
 - direction of edge
 - parallel edge.

GROUP – B

(Short Answer Type Questions)

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

- Given a strictly binary tree with N leaves. Let $l(i)$ for $i = 1$ to N equals the level of i th leaf. Prove that $\sum 1 / (2^{l(i)}) = 1$.
- Discuss the advantages of doubly linked list as compared to single linked list. Write an algorithm to append a new node after the specified node in a doubly linked list. $1 + 4$
- What are row-major order and column-major order representations ? Find the address of element a_{ij} , in both representations. Given

Base address : B Width of each element : w

Row index ' i ' is specified as : $L_r \leq i \leq U_r$

Column index ' j ' is specified as : $L_c \leq j \leq U_c$. $2 + 3$



5. a) Define $O(f(n))$, $\Omega(g(n))$ and $\Theta(h(n))$.

b) Let $f(n) = 4n^2 - 5n + 6$ and $g(n) = n^2$

Show that $f(n) = O(g(n))$.

3 + 2

6. How polynomials can be represented using linked list ? Write an algorithm to add two polynomials.

1 + 4

GROUP – C

(Long Answer Type Questions)

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

7. a) Explain ADT (Abstract Data Type). Create the ADT list to represent integer linked list.

2 + 2

b) Write the algorithms for the following in single linked list :

- Delete a node with specified value from the list.
- Reverse the links of the list *i.e.* the first node becomes last node.

c) Compare and contrast Array & Linked List.

3

8. a) What is recursion ? Distinguish between primitive and non-primitive recursions. What is tail recursion ?

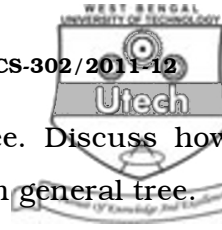
2 + 3 + 1

b) "Iteration is a better choice than recursion." Critically comment on this statement.

4

c) A robot can make steps of three different lengths : 1 cm, 2 cm and 3 cm. Write a recursive algorithm to find the number of different ways the robot can traverse the distance d .

5



9. a) Define General Tree and Binary Tree. Discuss how a binary tree is constructed from a given general tree. 4
- b) Write the algorithm for comp_tree() which has two arguments S, T and return TRUE if binary trees S and T are equal otherwise return FALSE. 3
- c) Prove that for any non-empty binary tree T, if N_0 is the number of terminal nodes and N_2 the number of nodes of degree 2, then $N_0 = N_2 + 1$. 4
- d) The pre-order and in-order traversals of a binary tree are given below :

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

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

Construct the tree. 4

10. a) What is priority queue ? Discuss various ways to represent priority queue. Write an algorithm to add an ITEM with priority number N to a priority queue which is maintained by a two-dimensional array QUEUE.

2 + 2 + 3

- b) Write the algorithm to convert an infix expression to equivalent reverse-polish expression.

Use the following expression to illustrate the algorithm :

$$A * (B + D) / E - F * (G + H / K) \square X \quad 5 + 3$$



11. a) Explain how divide and conquer technique is applied to quick sort algorithm. 2
- b) Write the quick_sort() algorithm. 5
- c) Analyze the algorithm in worst case, best case and average case situations. 6
- d) State different ways of pivot selection. 2
12. a) Define the Fibonacci binary tree of order n as follows : If $n = 0$ or $n = 1$, the tree consists of a single node. If $n > 1$, tree consists of a root with the Fibonacci tree of order $n - 1$ as left subtree and the Fibonacci tree of order $n - 2$ as right subtree.
- i) Is such tree a strictly binary tree ?
- ii) What is the number of leaves of such tree for any value n ?
- iii) What is the depth of the tree ?
- iv) Write a recurrence relation to calculate the total number of nodes in the tree with proper initial condition. $1 + 2 + 2 + 2$
- b) What is DAG ? What do you mean by topological ordering ? $2 + 2$
- c) Draw the DAG to represent the following arithmetic expression : 4
- $$(((a + b) * c) - (d / (a + b))) \neq ((a + b) * c).$$

=====