

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 :

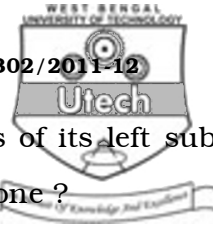
10 × 1 = 10

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 ?
- a) Binary search tree
  - b) AVL tree
  - c) Complete tree
  - d) Threaded binary tree.
- iv) Which traversal technique lists the nodes of a binary search tree in ascending order ?
- a) Post-order
  - b) Pre-order
  - c) In-order
  - d) Linear order.
- v) The equivalent postfix expression for  $d/(e+f) + b * c$  is
- a)  $defbc / ++$
  - b)  $def+ / bc+ *$
  - c)  $def+ / bc * +$
  - d) none of these.
- vi) If the postfix form of a string is  $ABC + - D *$ , the actual string is
- a)  $(A - (B + C)) * D$
  - b)  $((A - B) + C) * D$
  - c)  $((A + B) - C) * D$
  - 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 × 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 :

i) Delete a node with specified value from the list.

ii) 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 ?

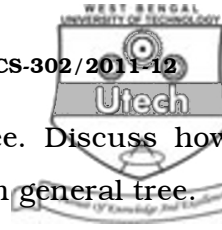
2 + 3 + 1

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
- $$(((a + b) * c) - (d / (a + b))) \neq ((a + b) * c).$$

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