B.Tech/AEIE/IT/3rd Sem/CSEN-2001/2015

2015

Data Structure & Basic Algorithm

(CSEN 2001)

Time Alloted : 3 Hours *Full Marks : 70*

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : **[10×1=10]**

   i) A binary tree T has n leaf nodes. The number of nodes of degree 2 in T is

   (a) $\log_2 n$ (b) n – 1

   (c) n (d) 2n

   ii) The given items :M, N, O,P and Q are pushed in a stack, one after the other starting from M.The stack is popped four times and each element is inserted in a queue. Then two elements are deleted from the queue and pushed back on the stack. Now one item is popped from the stack. The popped item is

   (a) M (b) Q

   (c) P (d) O

   iii) The postfix equivalent of the prefix * + xy – wz is?

   (a) xy + wz – * (b) xywz + – *

   (c) xy + wz * – (d) xy + – wz *

   iv) Identify the steps to be taken when a first node is to be deleted from linear linked list.

   (i) Obtain the address of the second node in the list.

   (ii) Set link of start pointer to the second node in the list.

   (iii) Free the space associated with first node.

   (iv) Count the number of nodes in the list.

   (a) (i) and (ii) (b) (i), (ii) and (iv)

   (c) (i), (ii) and (iii) (d) (i), (ii) and (iv)

   v) Consider a linked list, implemented by the following data structure :

```
typedef struct link_node        void print_list(snode*p){
{                               if (p==0) return;
int data;                       else {print_list(p->next);
struct link_node*next;          print("%d", p ->data);}
}snode;                         }
```

   Now suppose the list has the following data inside in this order:

   12 45 37 9 26

   What is the output on screen of calling print_list(head)on the above list?

   (a) 12 45 37 9 26 (b) 9

   (c) 26 9 37 45 26 (d) none of the above

vi) Consider the following recursive function declaration :

```
void test (int n)
{
printf{"%d", n);
if (n > 0)
test (n –2);
}
```

Now if we call the function test (8) what will be the depth of the recursion tree?

(a) 0 (b) 4
(c) 5 (d) 8

vii) Any connected graph of x-vertices have at least

(a) x–1 edges (b) x+1 edges
(c) x-edges (d) x/2 edges

viii) Which of the following two things are used in DFS algorithm

(a) queue (b) BST
(c) recursion (d) stack

ix) You have a sorted array and now you are given an element to be placed in that array so that the resulting array is also sorted, the best sorting technique in this case is

(a) Quick sort (b) Merge sort
(c) Insertion sort (d) Bubble sort

x) Suppose you place m terms in a hash table with an array size of s. What is the correct formula for the load factor?

(a) s – m (b) m – s
(c) s/m (d) m/s

GROUP - B

2. (a) Define Big-Ω (Omega) notation. Show that $1000n^2 + 100n - 8 = O(n^2)$.

(b) A square tri-diagonal matrix A has n elements on the diagonal and (n–1) elements each, below and above the diagonal. The elements are stored row wise in an one dimensional array B with A[1,1] being stored in B[1]. Obtain an addressing formula to determine the value of A[i,j], (1<i<n, 1<j<n) from array B.

(c) How can we represent sparse matrix efficiently in the memory? Write an algorithm to find the transpose of a sparse matrix, which is represented in memory efficient way.

(2+3)+(3)+(4) = 12

3. (a) Polynomials can be represented either by an array or linked list. Compare and contrast these two types of representation. How can a polynomial such as $7y^4 - 4x^3 + 16x - 23$ be represented by a linked list?

(b) Write a function to reverse the direction of all the links of a single linked list.

(c) Write a function which will take any number n as its argument. The function will break this number into tis individual digits and then store every single digit in a separate node thereby forming a linked list. The function must be a return type function which is going to return the head node address of the created linked list at the end. (for example if the number is 13579, then there will be 5 nodes in the list containing nodes with values 1, 3, 5, 7, 9).

(3+2)(4)+(3) = 12

GROUP - C

4. (a) Convert the following infix expression into equivalent postfix expression using stack

   (A+B+*X)/(!A – D)* R – C ^ Y.

   (b) Write insert and delete functions for input restricted Dequeue.

(6)+(3+3) = 12

5. (a) Show how a queue can be implemented using two stacks.

   (b) Write a recursive functions for Tower of Hanoi problem. Compute the time and space requirement of the above function by drawing the recursion tree for set of initial values. Also eliminate the tail recursion of the above function.

(4)+(3+3+2) = 12

Group - D

6. (a) Write a non-recursive function for inorder traversal of a right in-threaded binary tree.

   (b) The inorder and preorder traversal sequence of nodes in a binary tree are given below :

   Inorder : 5 1 3 9 6 8 4 2 7

   Preorder : 6 1 5 9 3 4 8 7 2

   Draw the binary tree. State briefly the logic used to construct the tree.

   (c) Construct the expression tree for the expression

$$E = (3a+b) * (6x - 7y)^3$$

(5)+(5)+(2) = 12

7. (a) Insert the following keys in order to build them into an AVL tree:

   A Z B Y C X D W E V F

   Clearly mention the different rotations used and the balance factor of each node.

   (b) In a 2-tree if **E** be the external path length, **I** be the internal path length and **q** be the number of vertices that are not leaves, then prove that **E = I + 2q**.

   (c) Prove that the number of odd degree vertices in a finite graph is always even.

(5)+(4)+(3) = 12

GROUP - E

8. (a) Consider the following sequence of numbers

   92, 37, 52, 12, 11, 25

   Use bubble sort algorithm to arrange the sequence in ascending order. Give the sequence at the end of each of the first five passes.

   (b) Write a C function to sort an array of integers using Insertion Sort Algorithm.

(5)+(7) = 12

9. (a) Write an algorithm to perform interpolation search. How is it different from binary search?

   (b) Explain linear probing, quadratic probing and double hashing with suitable examples.

(4+2)+(6) = 12
