B.TECH / CSE /3RD SEM/ CSEN 2101/2017
DATA STRUCTURE & ALGORITHMS
(CSEN 2101)

Time Allotted : 3 hrs **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 alternative for the following: **10 × 1 = 10**

(i) Suppose we are having a 2-D array arr[100][50] whose base address or starting address is 100, then what will be the address of arr[50][30] assuming sizeof(int) = 2?
(a) 5162 (b) 5160 (c) 5100 (d) None of these.

(ii) $f(n) = n^2+10, g(n) = 3n^2$, then
(a) $g(n) \in O(f(n))$ (b) $g(n) \in \Omega(f(n))$
(c) $g(n) \in \Theta(f(n))$ (d) all of these.

(iii) A stack S has the entries a, b, c with a on the top. Another stack T is empty. An entry popped out of the stack S can be printed immediately or pushed in to the stack T, finally popped out of the stack T and printed. Then which sequence can never be printed?
(a) b a c (b) b c a (c) c a b (d) a b c.

(iv) Which of these algorithms have sub-linear worst case time complexity?
(a) Searching in an AVL tree
(b) Binary search
(c) Converting an integer into its binary equivalent
(d) All of these.

(v) Secondary clustering is a result of
(a) linear probing (b) quadratic probing
(c) separate chaining (d) double hashing.

(vi) A set of data is given: 23 5 8 -10 5 8 100 -36. Which sorting technique cannot be directly applied to sort the data?
(a) Bubble Sort (b) Quick Sort
(c) Radix Sort (d) Cocktail-shaker sort.

(vii) Time complexity of BUILD-MAX-HEAP is
(a) O(logn) (b) O(nlogn) (c) O(n) (d) $O(n^2)$.

(viii) What will be the post order traversal of the binary tree of fig. 1?

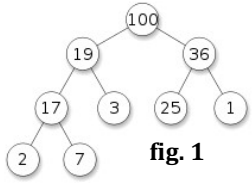

fig. 1

(a) 2, 7, 17, 3, 19, 25 , 1, 36, 100 (b) 2, 7, 17, 3, 19, 25 , 36, 1, 100
(c) 2, 7, 17, 3, 19, 100, 25 , 1, 36 (d) 2, 7, 17, 3, 19, 25 , 100, 36, 1.

(ix) Suppose there is an AVL tree of height 4. What is the minimum number of nodes present in the tree?
(a) 12 (b) 13 (c) 11 (d) 10.

(x) A deque can be used as a
(a) last in first out (b) first in first out
(c) none of the (a) and (b) (d) Both (a) and (b).

Group - B

2. (a) Write an algorithm or pseudo code for inserting a node at the end of a doubly linked list assuming only the head pointer is provided to you.

(b) Write a pseudo-code/C function to reverse a singly linked list.

(c) Say we have a 2 D matrix given below:

0 2 0
0 0 5
0 6 9

What will be the triplet format of the above mentioned matrix? Check transferring the above mentioned matrix to triplet format is at all beneficial or not?

5 + 4 + 3 = 12

3. (a) Write a function in C/pseudo-code to delete the node before a certain value ***v***, from a singly linked list. If there are multiple occurrences, delete only the first occurrence. Discuss the time complexity of the algorithm. (Please cover the test cases when ***v*** will not exist in the list)

(b) Discuss with time complexity, if presence of a tail pointer will make a difference in the following algorithms -

(i) Delete from beginning (singly linked list)

(ii) Delete from end (singly linked list)

(iii) Delete from beginning (circular singly linked list)

(iv) Delete from end (doubly linked list)

6 + (1.5 × 4) = 12

Group - C

4 . (a)
```
int Fibonacci(int n)
{
 if ( n == 0 )
      return 0;
 else if ( n == 1 )
      return 1;
else
      return ( Fibonacci(n-1) + Fibonacci(n-2) );
}
```
Say, a recursive Fibonacci function (as shown above) has been provided. Can this recursive call be optimized by tail recursion? Explain.

(b) Can we build a deque using a singly linked list? Explain.

(c) Is deque a FIFO data structure? Explain.

6 + 3 + 3 = 12

5. (a) Solve the 4-queen puzzle using backtracking. You may explain the solution with diagrams.

(b) Explain the disadvantages of backtracking.

(c) What is the purpose of tail recursion?

(d) Write a tail recursive function in C to calculate and display the sum of first n natural numbers (+ve integers).

4 + 2 + 2 + 4 = 12

Group – D

6. (a) Add the following list of numbers to an initially empty max binary heap: 12, 5, 15, 9, 13, 7, 15, 10, 3, 20, 4. For the heap in the previous problem, show the resulting heap after making two deletions from the top and then the middle element. You have to draw the heap after every deletion.

(b) Draw an AVL tree by inserting nodes in the following sequence – 15, 20, 25, 75, 65, 45, 50, 55, 70, 90, 105

(c) Write a pseudo code for calculating the height of a tree (Give only the pseudo code).

4 + 4 + 4 = 12

7. (a) Perform breadth first traversal on the graph in fig.2, with s as the starting node. Draw the breadth first tree, mark the tree edges with solid lines and mark the non-tree edges with dotted lines.

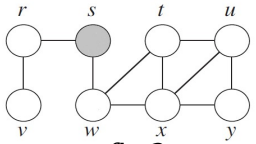

fig. 2

(b) Construct a B-tree of order 5 by inserting the following numbers in the given sequence- 75, 105, 70, 35, 30, 80, 25, 20, 45, 50, 55, 15, 10, 65, 85, 60. After inserting all the elements, delete a few numbers in this sequence – 20, 75, 65, and 105.

6 + 6 = 12

Group – E

8. (a) Use linear probing method to insert the following elements in a table of size 7:- 76 93 40 47 10 55
Use the hash function (h(k) + i) mod 7, h(k) = k mod 7, i = 0, 1.6. After inserting all the elements explain how 76 can be deleted.

(b) Explain the worst case performance for interpolation search.

(6 + 1) + 5 = 12

9. (a) Say I have written a Ternary search algorithm whose recurrence relation is this:
$T(n) = T(n / 3) + c$ (c is a constant)
Then what will be your prerequisites on the data and what will be your algorithm to search a key element in a list, if it is at all possible? Will the time complexity improve over Binary Search?

(b) Arrange the list of elements in ascending order using quick sort – ***(Show each step)***

77, 66, 55, 44, 33, 11, -2, -10,

(where the pivot is chosen the first element of any data set.)

6 + 6 = 12