

**BACHELOR OF COMP. SC. & ENGINEERING EXAMINATION, 2010**  
(2nd Year, 1st Semester)

**DATA STRUCTURES AND ALGORITHMS**

Time : Three hours

Full Marks : 100

Answer question no. 1 and any *four* from the rest.

1. (a) Show how the following array will be sorted in increasing order using insertion sort:  
30 90 60 100 10 20 40 70 50. 2
- (b) What do you mean by non-linear recursion? 2
- (c) Draw the binary search tree (BST) constructed by inserting the following integers in the order they are given below. Show how you can find out the minimum of the integers from the BST.  
9, 26, 0, 31, 24, 11, 35, 6, 53, 3. 3
- (d) Show that  $5x^3 - 16x + 7 = \Theta(x^3)$ . 6
- (e) What is a synonym? Explain. 2
- (f) Show how the following polynomial can be efficiently represented using a linked list:  
 $3x^{99} - 10x^{10} + 13x^2 - 20$  2
- (g) What is the difference between a generalized tree with a root and two children nodes, and a binary tree with a root and two children nodes? Explain. 3
2. Explain the rationale of Quicksort. Why does the algorithm perform so fast? What are the cases when the Quicksort algorithm behaves like a slow sort? What is the effect of the choice of pivots on the performance of Quicksort algorithm?

Describe the algorithm of Quicksort and explain its working with the help of the following input array:

23, 4, 55, 6, 66, 7, 77, 8, 88, 90.

$$5+2+2+3+8=20$$

3. What do you mean by Hashing? What are the applications where you will prefer Hash Tables to other data structures? Differentiate between Mid-square and Folding hash functions.

What are the advantages and disadvantages of Quadratic Probing and Double Hashing? Explain with their definitions.

What is the use of Bucket Hashing?

$$4+2+6+6+2=20$$

4. What are the uses of the stack data structure? Explain how recursive subroutines can be implemented using stack.

State and explain how you can use a stack for converting an infix expression to the postfix notation using the following infix expression:  $x + y * 5 / (2 + z) - 3 * (x - z) - p$  \$. (\$ is sentinel)

$$3+7+10=20$$

5. Write the following functions in C with proper comments:
- Given an integer  $n$  as an input parameter, to compute the  $n^{\text{th}}$  Fibonacci number recursively and to output the value of the Fibonacci number along with the number of recursive calls made.
  - To add a node as a left child of a node of a threaded binary tree.
  - To rotate right an AVL tree.
  - To search a Graph using non-recursive Depth First Search Algorithm.

6+4+3+7=20

6. Explain how a Height-Balanced tree can be formed by inserting the following elements in the given order:

4, 5, 7, 2, 1, 3, 6, 15, 10.

Show how the root element can be deleted from the above tree.

What is a Priority Queue? Show how a Heap can be used to implement a Priority Queue.

8+3+3+6=20

7. What do you mean by the term Abstract Data Type (ADT)? How does it differ from Data Structure?

Write the ADT for Set and comment on the various designs and implementations of the ADT.

4+6+6+4=20

8. Write a C program to find out the change for some paise using minimum number of coins. Assume that you have coins of denominations 1p, 5p, 10p, 25p. Your program should be fully commented and should print suitable messages, wherever required.

Write the approach you have taken to develop the above algorithm and find out the time complexity of your program.

Show how the following integers are inserted in a 2-3 Tree:

15, 4, 9, 2, 17, 3, 19, 7, 10, 21, 5, 25. Show the tree in each step.

6+3+5+6=20

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