

**M.Tech. IN ADVANCED INFORMATION  
TECHNOLOGY – SOFTWARE TECHNOLOGY  
(MTECHST)**

**Term-End Examination**

**June, 2015**

00233

**MIN-004 : MATHEMATICAL FOUNDATION AND  
ALGORITHM DESIGN**

*Time : 3 hours*

*Maximum Marks : 100*

**Note :**

- (i) *Section I is **compulsory** and carries 30 marks. Answer all the questions.*
- (ii) *Section II carries 70 marks. Answer any **five** questions.*
- (iii) *Assume suitable data wherever required.*
- (iv) *Draw suitable sketches wherever required.*
- (v) *Italicized figures to the right indicate maximum marks.*

**SECTION I**

1. A Vegetable and Fruit Mall wants to organize its vegetables and fruit products in a combination of purchase pattern of customers. Solve the problem by suggesting appropriate data structures. Design necessary structure. *10+5*

2. Write a recurrence relation for the following function and solve it by using recursion tree method. Also give its time complexity. 15

```
int fib (int n)
{
    if (n < 2)
        return (n);
    else
        return (fib (n-1) + fib (n-2));
}
```

## SECTION II

3. A dictionary stores keywords and its meanings. Provide facility for adding new keywords, deleting keywords and updating values of any entry. Also provide facility to display whole data sorted in ascending/descending order. Also find how many maximum comparisons may be required for finding any keyword. Make use of appropriate data structures. 7+7
4. (a) How much time does insertion sort take to sort  $n$ -distinct items in the best case? State your answer in asymptotic notation. 8
- (b) Prove that TSP problem is NP-Hard. 6
5. What is principle of optimality? The principle of optimality does not hold for every problem whose solution can be viewed as a result of sequence of decisions. Find the two problems for which principle of optimality does not hold. Explain why principle of optimality does not hold for these problems. 3+4+7
6. (a) Prove or disprove :  
If  $G = (V, E)$  is finite directed graph such that the out degree of each vertex is at least one, then there is a directed cycle in  $G$ . 8
- (b) Suppose that you have a list  $L$   $[1..n]$  representing the results of election so that  $L[i]$  is the candidate voted for by person  $i$ ,  $i = 1..n$ . Design a linear algorithm to determine whether the candidate got majority of the votes, i.e. whether there exists a list element that occurs more than  $n/2$  times in the list. Your algorithm should output a majority winner if one exists. 6

7. (a) Write an algorithm for deletion of element  $x$  from BST. Also comment on the time complexity. 6+2
- (b) Compare NP-Complete and NP-Hard problems. 6
8. (a) A survey has been taken on methods of commuter travel. Each respondent was asked to check bus, train or automobile as a major method of travelling to work. More than one answer was permitted. The results reported were as follows : Bus – 30 people, train – 36 people, automobile – 100 people, bus and train – 16 people, bus and automobile – 15 people, train and automobile – 20 people and all three methods – 5 people. How many people completed the survey form ? 10
- (b) Given the value of  $p \rightarrow q$  is false, find the value of  $(\neg p \vee \neg q) \rightarrow q$ . 4
9. Use  $p$  : today is Monday  
 $q$  : the grass is wet  
 $r$  : the dish ran away with the spoon
- Write an English statement that corresponds to each of the following : 14
- (i)  $\neg r \wedge q$   
(ii)  $\neg q \vee r$   
(iii)  $\neg (p \vee q)$   
(iv)  $p \vee \neg r$
- $p \rightarrow q$  \_\_\_\_\_