Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

I SEMESTER M.TECH.(SOFTWARE ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: ADVANCED DATA STRUCTURES AND ALGORITHMS [ICT 5121]

REVISED CREDIT SYSTEM
(24/11/2016)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data, if any, may be suitably assumed.

1A. Derive the time complexity of quick sort algorithm if the median is taken as the pivot element. How does it differ from the analysis of randomised quick sort algorithm? Explain. **5**

1B. Given a collection of data records with a key field, create a B+ tree indexing on the key field clearly showing each step of insertion. Let the order of the tree be 4. The keys of the records are given below:
3,6,8,2,12,34,23,56,54,41,67,78,33,22,76,44,79,21,67. Explain how can you search the record with key value 78? **3**

1C. Define Fermat's theorem and explain how can it be used to test whether an integer is prime or not. **2**

2A. Strassen's matrix multiplication method is used only when $n \geq 8$ and smaller instances are solved using normal method. Compute the number of multiplications and addition/subtraction operations when n=32. Also analyse the time complexity of Strassen's method. **5**

2B. Describe the extendible hashing technique. Trace the technique for following data. Assume the block size as 4.
10, 15, 12, 34,56,23, 61, 22, 55, 36, 2, 44, 58, 49, 24, 51, 27. **3**

2C. Differentiate between union-by-size and union-by-height of disjoint sets with suitable examples. **2**

3A. Construct a skip list with pointers to 4 cells ahead for the following elements:
5, 12, 20, 31, 37, 42, 45, 51, 54, 66, 72, 55.
Also insert an element 38 into the skip list using randomized algorithm. Discuss the time complexity of constructing a skip list. **5**

3B. Construct an expression tree for the expression: (5+7*3/2-(4+5)/2+6)) **3**

3C. Differentiate between Dijkstra's algorithm and Bellman Ford algorithm to solve single source shortest path problem. **2**

4A. A file contains colons, spaces, commas, alphabets-a, e, r, s, t and digits 1, 3, 5, 8, 9 in the following frequency: colon(53), space(200), comma(360), a(350), e(121), r(135), s(225), t(300), 1(175), 3(150), 5(225), 8(700), 9(122), Construct the Huffman code. Determine the time complexity of construction. **5**

4B. Show the result of inserting 8, 11, 16, 24, 6, 4, 7, 15, 13, 9, 17, 4, 21, 23, 12, one at a time, into an initially empty binary min heap. Delete an element and rebuild the heap. Determine the time complexity of both the operations. **3**

4C. Explain the dynamic programming solution for matrix multiplication chain problem with recurrence equations. **2**

5A. Determine the number of elements to be accommodated in each processing element in a hypercube SIMD module if the total number of elements is 110. Explain the procedure with an algorithm to add two matrices using the above module. Determine its time requirement. Trace your algorithm to add the following integers:
12, 10, 4, -15, 9, 22, 3, -4, 6, 17, 20, -2, 29, 56, -14, 17, 33, -29, 75, 32 **5**

5B. Let h be the height of a red-black tree(excluding the external nodes), let n be the number of internal nodes in the tree, and let r be the rank of the root. Prove the following:
i. $h <= 2r$
ii. $n >= 2^r - 1$
iii. $h <= 2\ log_2(n+1)$ **3**

5C. Distinguish between NP hard and NP complete problems. Also explain reducible problems with an example. **2**