Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (COMPUTER AND COMMUNICATION ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2019

SUBJECT: FUNDAMENTALS OF ALGORITHM ANALYSIS AND DESIGN [ICT 3151]

REVISED CREDIT SYSTEM
(14/11/2019)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Using FIFO branch and bound find the optimal loading of the containers and analyse the time complexity for the same. Given n=4, W=[2,6,4,10] and capacity of the ship c=20. Show each step clearly. [With bounding functions] **5**

1B. Consider the Algorithm 1B.

```
long find(long a, long b)
    if (b == 0)
        return 1;
    else
        return a * find(a, b-1);
```

Algorithm 1B.

i. What does algorithm compute? What is the space complexity of the algorithm?
ii. Set up a recurrence relation for the algorithm using global variable count method and find the time complexity. **3**

1C. Define the principle of optimality. Give an example which satisfies this. **2**

2A. Consider the partially constructed binary tree using backtracking technique for the 0/1 Knapasack instance W=[2,1,3,2], P=[12,10,20,15] and C=4, shown in Figure 2A. Compute the bound values at nodes A, B and C and find the optimal way of packing. Also, analyze the time complexity. **5**

2B. Write an algorithm to check whether the graph is connected and analyze its time complexity. Check whether the graph shown in Figure 2B is connected or not. Show each function call clearly. **3**

2C. What are P, NP-hard and NP-Complete problems? Explain. **2**

3A. Write the recurrence relations to find the optimal order of matrix multiplication for the chain of matrices using Dynamic Programming technique. Find the optimal order of multiplication for the instance q=5, r =[4, 10, 3, 12, 20, 7]. Compute c(1,5), c(2, 5), c(2,5), c(3,5) and c(1,3) and corresponding Kay values. **5**

3B. What is the best case for insertion sort? How many comparisons of list elements would be done if the number of elements are n for the same? **3**

3C. Use the informal definitions of O, Ω and Θ to determine whether the following assertions are true or false.

i. $\frac{1}{2}\, n(n-1) = \Omega(n^2)$
ii. $n^2/\log n = \Theta(n^2)$
iii. $n^3 2^n + 6n^2 3^n = O(n^3 2^n)$
iv. $n^{1.001} + n \log n = \Theta(n^{1.001})$

2

4A. Analyze the time complexity of Strassen's matrix multiplication method. Compute the first two components (C1 and C2) of the resultant matrix for the input matrices A and B given below using Strassen's method.

$$A = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 1 & 2 & 1 & 1 \\ 3 & 1 & 3 & 1 \\ 1 & 1 & 1 & 1 \end{pmatrix} \qquad B = \begin{pmatrix} 2 & 3 & 1 & 4 \\ 1 & 0 & 3 & 1 \\ 1 & 2 & 1 & 2 \\ 1 & 0 & 1 & 0 \end{pmatrix}$$

5

4B. Explain any two representations of graphs and digraphs. Give an example for each. **3**

4C. Write an algorithm to sort the elements of an array using indirect sort method. Sort the elements of array A=[3, 1, 10, 21, 87, 17], using the same. **2**

5A. Write an algorithm to find the shortest path from source vertex "S" to all other vertices of the graph using Dijkstra's algorithm. Analyze the time complexity of the same. Find the shortest path from source vertex "S" to all other vertices, for the graph shown in Figure 5A. **5**

5B. Write an algorithm to find the minimum cost spanning tree using Prim's Algorithm. Mention the Greedy criterion and analyze the time complexity. **3**

5C. Perform the time complexity analysis of closest pair of points using divide and conquer and brute force method. **2**

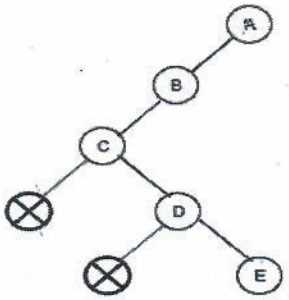

Figure 2A

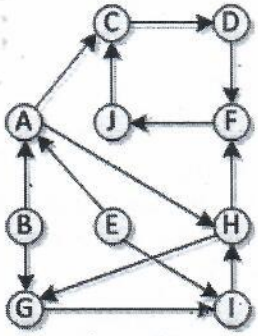

Figure 2B

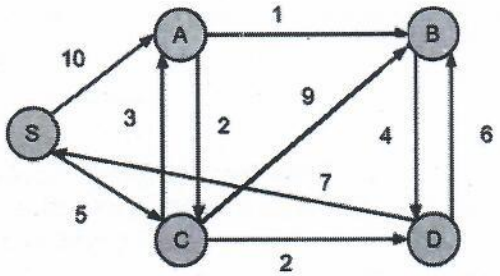

Figure 5A