Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (INFORMATION TECHNOLOGY) END SEMESTER EXAMINATIONS, NOVEMBER 2019

SUBJECT: DESIGN AND ANALYSIS OF ALGORITHMS [ICT 3107]
REVISED CREDIT SYSTEM
(14/11/2019)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:
- Answer **ALL** questions.
- Write the detailed steps for all the problems/algorithms.
- Missing data, if any, may be suitably assumed.

1A. Consider a B-Tree of order 5 and perform the insertion and deletion operations for the given keys. Insert: 4, 8, 10, 24, 46, 2, 6, 15, 26, 25, 14, 12, 9, 20, 5, 32, 36, 57,7
Delete: 9,46,24,26 **5**

1B. Represent the graph given in Fig.Q.1B using linked adjacency list and array adjacency list, and do the following:
(i) Draw a breadth-first spanning tree starting at vertex 3
(ii) Draw a breadth-first spanning tree starting at vertex 7
(iii) Draw a depth-first spanning tree starting at vertex 3
(iv) Draw a depth-first spanning tree starting at vertex 7

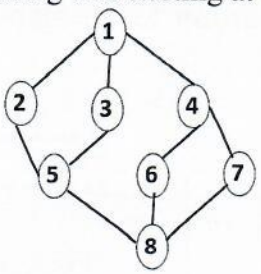

Fig.Q.1B. **3**

1C. Write the recurrence relation for the merge sort and solve by using the substitution method. **2**

2A. Find a minimum spanning tree for the graph given in Fig.Q.2A using both Prim's and Kruskal's algorithms.

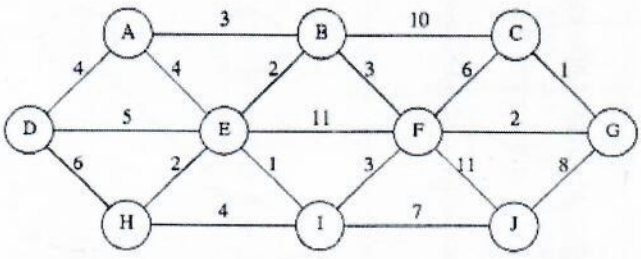

Fig.Q.2A **5**

2B. What is a Binary Search Tree (BST)? Write it's properties and give the pseudocode to (i) find an element (ii) find minimum element (iii) find maximum element **3**

2C. Write the Master's theorem used to determine the time complexity of an algorithm. Find the time complexity of $T(n) = 4T(n/2) + n^2$ by applying the Master's theorem. **2**

3A. Write the backtracking bounding function used to solve Max-Clique problem. Draw a solution-space tree for the graph depicted in Fig.Q.3A and trace the working of backtracking algorithm with bounding function on this tree to find the max-clique.

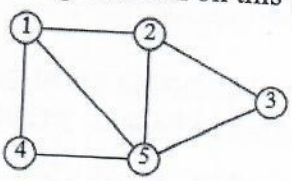

Fig.Q.3A

3B. The keys 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using the hash function h(k) = k mod 10 and linear probing. Show the resultant hash table. If, quadratic probing is used what would be the resultant hash table? **5**

3C. Find the Big-O time complexity of the following code fragments. Justify. **3**

(i)
```
int i = n;
while (i > 0)
{
    for (int j = 0; j < n; j++)
        print("*");
    i = i / 2;
}
```

(ii)
```
while (n > 0)
{
    for (int j = 0; j < n; j++)
        print("*");
    n = n / 2;
}
```

4A. Determine the optimal way of multiplying the matrix chain $A_1A_2A_3A_4A_5A_6$ and write the required matrix representations. Given: r = [10, 20, 1, 40, 5, 30, 15]. **2**

4B. Insert keys "30, 40, 5, 2, 80, 35, 60, 32, 85, 33, 31" into an initially empty BST. Draw the splay trees after accessing 80 and 31 respectively. **5**

4C. Find the topological order of vertices for the graph given in Fig.Q.4C by using the DFS method. **3**

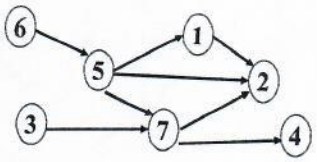

Fig.Q.4C

5A. Fig.Q.5A shows five places and roads connecting them. The numbers indicate the distances in kilometers, between the places. A person, who arrived at Manipal, wishes to visit each of the other places with minimum distance and return to Manipal. Find the least cost tour for this person by using the backtracking bounding function with the solution space tree representation. **2**

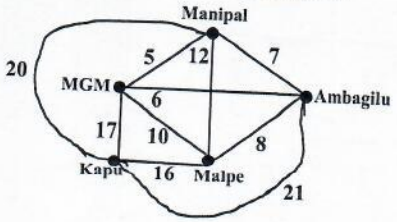

Fig.Q.5A

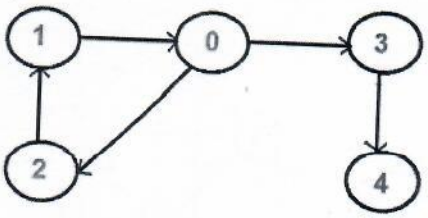

Fig.Q.5C

5B. What are NP-complete and NP-hard problems? Give one example for each. Write the approximate vertex cover algorithm and apply the same on the graph given in Fig. Q.2A. **5**

5C. A mother vertex in a graph G=(V,E) is a vertex v such that, all other vertices in G can be reached by a path from v. Determine all mother vertices for the graph given in Fig.Q.5C using DFS method. **3**

2