Reg. No.										

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

IV SEMESTER B.TECH. (INFORMATION TECHNOLOGY | COMPUTER AND COMMUNICATION TECHNOLOGY)

GRADE IMPROVEMENT/ MAKEUP EXAMINATION, Aug 2021

SUBJECT: DESIGN AND ANALYSIS OF ALGORITHMS [ICT 2257]

REVISED CREDIT SYSTEM

(11/08/2021)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer Any **FOUR FULL** questions.
- Missing data if any, may be suitably assumed.

1A. Find asymptotic space and time complexity of the following function: **6**

```
void function (int n)
{
   int count = 0;
   for (int i=n/2; i<=n; i++)
      for (int j=1; j+n/2<=n; j = j++)
         for (int k=1; k<=n; k = k * 2)
            count++;
}
```

For calculating time complexity make use of step count method.

1B. A gas pipeline network has to be built across 'n' cities. The laying of pipelines between any two cities involves a cost. The network building is carried out connecting each city at a time. Design an algorithm to obtain a network of pipelines which while preserving the connectivity between cities does it with minimum cost. Comment on the time complexity of the chosen algorithm. **4**

2A. Design an algorithm which computes 3^n using only c log n instructions for some positive constant c. Hint: Write a method based on the following recursive formulation of 3^n carefully. **6**

$$3^n = \begin{cases} 1 & \text{if } n = 0 \\ 3^{n/2} * 3^{n/2} & \text{if } n\%2 == 0 \\ 3^{n/2} * 3^{n/2} * 3 & \text{if } n\%2 == 1 \end{cases}$$

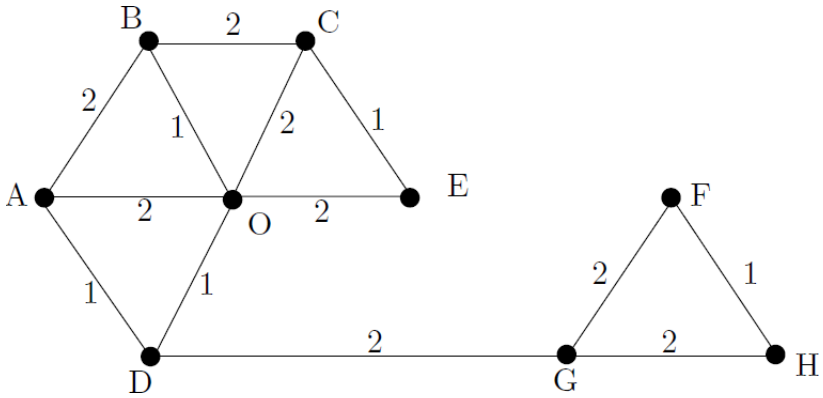
2B. Three thieves Bob, Max and Alex, plan to rob an antique store. However, they can carry only a maximum of 1500kgs in their van and can either take an item completely or cannot take it at all. Among the items of display the following details are available with them. **4**

	A	B	C	D	E	F	G
Weight(in kgs)	200	300	500	700	100	400	100
value	1000	500	1500	700	600	1800	300

Bob plans to load by picking items in ascending order of their weights while Alex plans to load by picking items in descending order of their profit. Would you work out a new plan that convinces Max that it would give k-optimal solution when k=2? Whose plan will Max agree to and which items would be robbed?

3A. With a suitable example show that Dijkstra's algorithm will not work for graph with negative edge cost. Also find time complexity of Dijkstra's algorithm using step count method. **6**

3B. Identify the number of distinct minimum spanning trees for the weighted graph given below: **4**



Also give definition for Spanning Tree and Minimum Spanning Tree? Mention one algorithm used for finding minimum spanning tree and what is the complexity of suggested algorithm?

4A. Consider a matrix multiplication chain M1 x M2 x M3 x M4 x M5, where matrices M1, M2, M3, M4 and M5 are of dimensions 10×20, 20×5, 5×20, 20×5 and 5×5 respectively. Find the optimal sequence for multiplying the above matrices using Dynamic Programming. Show all intermediate steps. **6**

4B. Consider a ship with capacity C= 13 and four containers with weights [9, 7, 2, 3]. Find out the optimal container loading plan using Backtracking technique. Make use of proper bounding function. **4**

5A. What is the use of Hashing in data structure? Using hash function f(x)= x mod 15, insert the following elements in the hash table: **6**

105, 589, 2455, 1044, 910, 91, 455, 1178, 444, 121, 182, 273, 637, 728, 819

To handle the collision, make use of following methods:

- Linear Probing
- Double Hashing

5B. Let S be a problem which is not known to be in NP. How to prove S is NP-hard? Give examples for class P, NP, NP hard and NP complete problems. **4**

6A. a) Insert the following sequence of elements into an AVL tree, starting with an empty tree: 100, 200, 150, 250, 300, 160, 180, 190. **6**
(b) Delete 300 in the AVL tree that you got.

6B. With a suitable example, trace the approximation algorithm for the vertex cover problem. **4**