Reg. No. | | | | | | | | | |

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

V SEMESTER B.TECH. (INFORMATION TECHNOLOGY)

END SEMESTER EXAMINATIONS, NOVEMBER 2017

SUBJECT: DESIGN AND ANALYSIS OF ALGORITHMS (ICT 3107)

(REVISED CREDIT SYSTEM)

(15/11/2017)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates:

- Answer **ALL THE** questions
- Missing data may be suitably assumed.

1A. Write the dynamic programming recurrence relation and find optimal packing for the following instance of the knapsack problem: Capacity=5, W=[2,1,3,2] P=[12,10,20,15]. Write the time complexity for the same and justify it. 5

1B. Consider the algorithm given in Figure Q.1B 3

```
ALGORITHM find(A,n)
//Input: An array A[0 .. n - 1] of real numbers
if n = 1 return A[0]
else temp = find(A,n-1)
if temp <= A[n-1] return temp
else return A[n-1]
```

Figure Q.1B

i). What does the above algorithm compute? What is the space complexity of the algorithm?

ii). Set up a recurrence relation for the algorithm's basic operation count and solve it.

1C. Prove that any algorithm to search an element 'K' in an array of 'n' entries must do at least $[log_{10}(n+1)]$ comparisons for some input 2

2A. Find the minimum cost tour for traveling sales person starting from node 1 for the graph given in Figure Q.2A using Backtracking method. 5

2B. Using Dijkstras algorithm find all shortest paths with path length by considering vertex 'a' as source for the graph shown in Figure Q.2B. 3

2C. Analyze the time complexity of the algorithm given in Figure Q.2C — 2

```
void fun()
{
    int i, j;
    for (i=1; i<=n; i++)
        for (j=1; j<=log(i); j++)
            printf("MIT");
}
```

Figure Q.2C

3A. Consider inserting the keys 12,23,13,14,16,38,15,81,19,27,44 into a hash table of length m=11 using open addressing with the auxiliary hash function h′(k)=k. Illustrate the result of inserting these keys using linear probing , using quadratic probing with c1=1 and c2=3, and using double hashing with h_1(k)=k and h2(k)=1+(k mod (m-1)) . — 5

Note : Quadratic probing uses a hash function of the form h(k,i)= (h′$(k) + c1.i + c2.i^2$)

3B. Explain linked list representation of a graph with an example. State an example where adjacency list representation is better than the array representation to reduce the time requirement. — 3

3C. Is the following statement true or false : "If cost of every edge is increased by one, shortest path remains same." Justify the answer. — 2

4A. Write greedy criterion and pseudocode for finding topological sequence using greedy technique. Also find the topological sequence for the graph shown in Figure Q.4A. — 5

4B. What is a NP complete problem? Show the relation between P, NP, NP-complete and NP-hard class of problems when $P \neq NP$ and $P = NP$ — 3

4C. Assume that the function M is defined for all powers of 2 and is described by the recurrence equation $M(n) = n - 1 + 2M(\frac{n}{2})$ and base case M(1)=0. If n is a power of 2, what is the asymptotic order of M(n) ? — 2

5A. Construct an AVL tree and B+ Tree by inserting the elements 100, 200, 300, 250, 270, 70, 40 in sequence and delete 270 showing all the intermediate steps. — 5

5B. Analyze the best case and worst case time complexity of the quicksort and sort the list E,N,T,R,E,P,R,E,N,E,U,R in alphabetical order using the same. — 3

5C. Both Greedy and Dynamic programming methods are used to solve optimization problems. What are the differences between these techniques? — 2

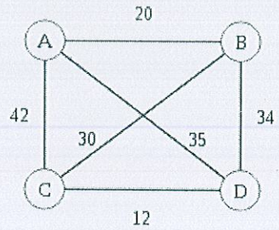

Figure Q.2A

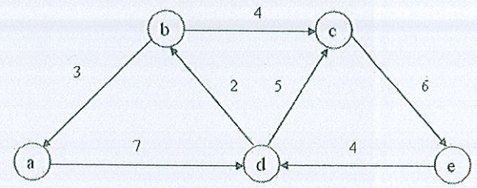

Figure Q.2B

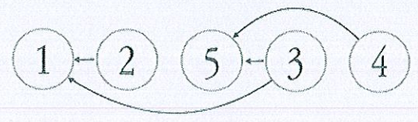

Figure Q.4A