Roll Number:_____

Thapar University, Patiala

Department of Computer Engineering

END SEMESTER EXAMINATION

B. E. (Second Year): Semester-IV (2016) (COE/COEM/CAG/CML/ECE/ECEM/SEM/ECM)	Course Code: UCS406 Course Name: Data Structures and Algorithms
May 08, 2017	Monday, 09.00 – 12.00 Hrs
Time: 3 Hours, M. Marks: 100	Name of Faculty: MAK, VIJ, RPK, SUK, ASG, TBH, SLP, AVL

Note: Attempt all questions. Assume missing data, if any, suitably

Q.1 Consider a hash table consisting of M = 11 slots, and suppose nonnegative integer key values are hashed into the table using the hash function h1( ): (10)

```
int h1 (int key)
 {
  int x = (key + 7) * (key + 7);
  x = x / 16;
  x = x + key;
  x = x % 11;
  return x;
 }
```

Suppose that collisions are resolved by using linear probing. The integer key values listed below are to be inserted, in the order given.

43,23,1,0,15,31,4,7,11,3

Show the *home slot* (the slot to which the key hashes, before any probing), the *probe sequence* (if any) for each key, and the final contents of the *hash table* after the key values (shown above) have been inserted in the given order.

Q.2 RATING SUMMATION PROBLEM: Robin is an extremely biased person, and he dislikes people who fail to solve all the problems in the interview he takes for hiring people. There are **n** people on a day who came to be interviewed by Robin. (10)

Robin rates every candidate from **0 to 10.** He has to output the total ratings of all the people who came in a day. But, here's the problem: Robin gets extremely frustrated when someone ends up scoring a 0 in the interview. So in frustration he ends up removing the candidate who scored that 0, and also removes the candidate who came before him (not already removed). If there is no candidate before the one who scores a 0, he does nothing.

Input format: The first line of input contains an integer — **n (total no. of people who came for interview).** The next line contains integers, (where the i^{th} integer represents the rating of the i^{th} person.) separated by spaces.

Output: You've to find the summation of all the ratings in a day for Robin (Note: Don't add scores of removed candidates).

a) Which data structure can be best applied for the above mentioned problem?
b) Write down the algorithm to solve above problem (assuming the coding of primitive operations already exists).
c) What will be the total sum of rating for the following input:

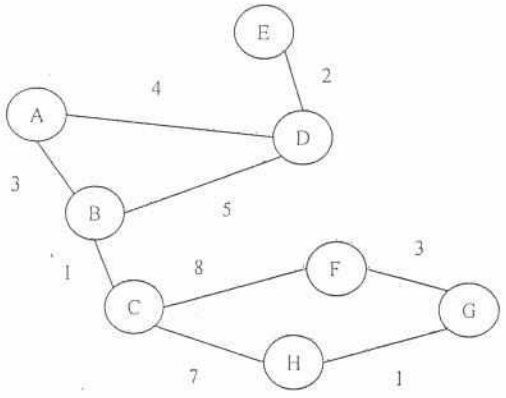
```
22
2 3 0 7 0 9 4 0 6 0 8 2 0 0 5 0 0 9 2 0 0 6
```

Q.3(a) Calculate and justify the time complexity of following function fun (). Assume that log(x) returns log value in base 2. (4)

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

Q.3(b) Write down the recursive algorithm for computing Factorial of a number '*n*'. Analyze the complexity of the algorithm by writing and solving the recurrence relation for the algorithm. (6)

Q.4 What is the difference between Prim's algorithm and Kruskal's algorithm for finding the minimum-spanning tree of a graph? Execute Kruskal's algorithm on the graph shown in Fig. 1. (10)



(Fig. 1)

Q.5 Given two string sequences, write an algorithm to find the longest common subsequence and its length using dynamic programming. Apply the algorithm to following two sequences: (10)

X = <A, B, C, B, A> and Y = <B, D, C, A, B>

Q. 6(a) Consider n jobs $j_1, j_2, \ldots j_n$ each has an associated deadline $d_1, d_2, \ldots d_n$ and profit $p_1, p_2, \ldots p_n$. Profit will only be awarded or earned if the job is completed on or before the deadline. Assume that each job takes unit time to complete. Apply the greedy algorithm (show detailed steps) to the following set of 6 jobs and their associated deadline and profits to earn maximum profit when only one job can be scheduled or processed at any given time. (5)

Jobs	1	2	3	4	5	6
Deadline	2	1	3	2	1	3
Profit	55	40	30	75	60	25

Q.6(b) Write short notes on: (5)
a) Genetic Algorithms
b) Intelligent Algorithms
c)Parallel Algorithms
d) NP-complete problems
e)NP-hard problems

Q7(a) Use the quick sort algorithm and show the steps to sort the following list of elements. (4)

9 7 5 11 12 2 14 3 10 6

Q7(b) Calculate the complexity of quick sort using recursion tree method for the following cases: (6)
i. Worst case ii Best case

Q.8 Make a Binary Search Tree for the following sequence of numbers and write the preorder, inorder and postorder traversal of the tree. (10)

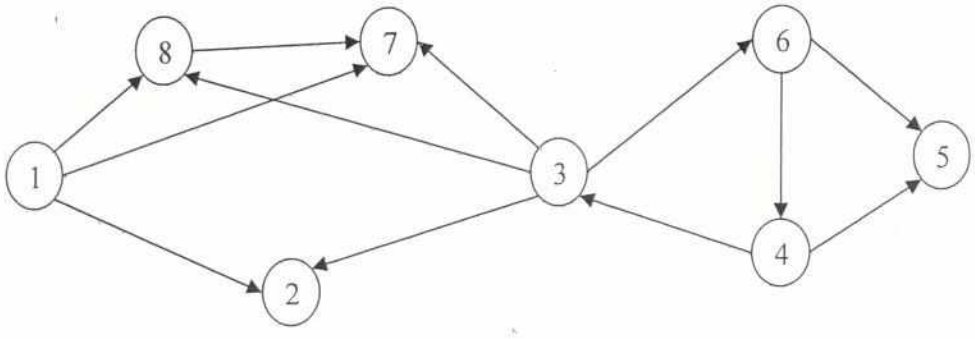
45, 36, 76, 23, 89, 115, 98, 39, 41, 56, 69, 48

Q9(a) Give the complexity (Big O) of the following: (8)

i. Adding an element to the front of a linked list
ii. Finding an element in a sorted array
iii. Finding an element in an unsorted array
iv. Sorting n items by divide and conquer-Mergesort
v. Shortest path between two node
vi. The Tower of Hanoi problem
vii. Matrix multiplication
viii. Sum of elements of linear array

Q9(b) Write any two advantages and two disadvantages of doubly linked list over single linked list. (2)

Q.10 Apply BFS and DFS on the directed graph given in Fig. 2 using vertex 3 as source showing all the intermediate steps. (10)



(Fig. 2)