Roll Number: _____

B. E. (2nd Year): Semester-II (2017/18)   Course Code: UCS406
(COE)   Course Name: Data Structure and Algorithms
Monday, May 21, 2018 9:00a.m.-   Time: 3 Hours, Max Marks: 100
12:00noon

Faculty: Maninder Kaur, Sunita Garhwal, Tarunpreet Bhatia, Sumit Miglani, Karun Verma, Rajeev Kumar
Note: Attempt all the questions. All subparts of the question are to be solved in sequence and in continuation, otherwise only first part(s) would be evaluated. Highlight assumptions (if considered).

1. a) You are an owner of a cable TV company. Your company needs to lay cable to a new   6
      neighborhood (for every house). If it is constrained to bury the cable only along certain
      paths, then there would be a graph representing which points are connected by those
      paths. But the cost of some of the paths is more expensive because they are longer
      (represented by edges with larger weights). If every house is a node and every path from
      house to house is an edge, the network is depicted as ***Figure 1***. Draw a graph-tree
      that has the following characteristics:
      i)   Minimum number of edges covering all vertices without cycle.
      ii)   Overall cost of graph tree should be minimum.

   b) Write Dijkastra's algorithm and apply the same on the graph as shown in ***Figure 2***,   5+5
      where the starting node is "1".

2. a) Suppose the following sequences list the nodes of a binary search tree T in Preorder   7
      and In-order respectively
                Pre-order: $50, 25, 22, 15, 40, 30, 33, 44, 75, 60, 90, 80$
                In-order: $15, 22, 25, 30, 33, 40, 44, 50, 60, 75, 80, 90$
      Draw the diagram of the binary search tree.

   b) Develop a BST by inserting nodes from the following sequence one by one.   9
                $62, 32, 22, 57, 37, 47, 42, 72, 92, 82$
      Delete the following nodes in sequence $82, 47,$ and 62. Show the BST after each
      deletion and explain the process followed in deletion.

3. a) The minimum – queens problem asks for the minimum number of queens that can attack   12
      all of the squares of an $n \times n$ board (that is, the minimum number of queens such that
      each row, columns, and diagonal contains at least one queen). Solve the minimum –
      queens problem for the given values of n, when
                (i) $n = 3$ (ii) $n = 4$ (iii) $n = 5$
      Show at least two possible solutions.

   b) Give the asymptotic complexity of the following loops: 2*3

(i)	(ii)	(iii)
for i = 1 to 2*n	for i = 1 to n	i = 1
for j = 1 to n	for j = 1 to i	while(i ≥ 1)
x = x + 1	for k = 1 to j	{ for j = 1 to n
	x = x * i * j	x = x + 1
		i = i / 2
		}

4. a) Using hash function $h(k) = (k \bmod 11)$ insert the keys below in an array with 11
      elements of size $0\ to\ 10$. Show your process of resolution step by step.
                $54, 26, 93, 17, 77, 31, 44, 56, 20$

      (i)   Draw the hash table to store the elements. Your hash table insertion should use   4
            the method of Linear probing to deal with collision.

(ii) Repeat the insertions using the method of quadratic probing to deal with collisions. **4**

(iii) Mention the number of collisions in both the probes. **1**

b) Write down the steps to heap-sort the sequence **7**

$$3, 6, 17, 5, 11, 23, 38, 19, 26, 14$$

(Note. Write all intermediate arrays of building heap and re-heapify function in sequence)

5. Solve the following traveling sales person problem using branch and bound technique. Assume the start vertex as A. **18**

	A	B	C	D	E
A	∞	11	10	9	6
B	8	∞	7	3	4
C	8	4	∞	4	8
D	11	10	5	∞	5
E	6	9	5	5	∞

6. a) Derive the Worst Case Time Complexity of the Merge Sort Algorithm where **8**

$$T(n) = T(n/2) + T(n/2) + T(n)$$

where $T(n/2)$: Time taken to sort the Left Sub Array

$T(n/2)$: Time taken to sort the Right Sub Array

$T(n)$: Time taken to merge the Left Sub Array and Right Sub Array.

b) Apply the merge sort on the following data and show the results after each pass. **8**

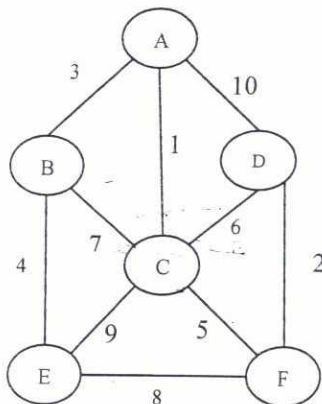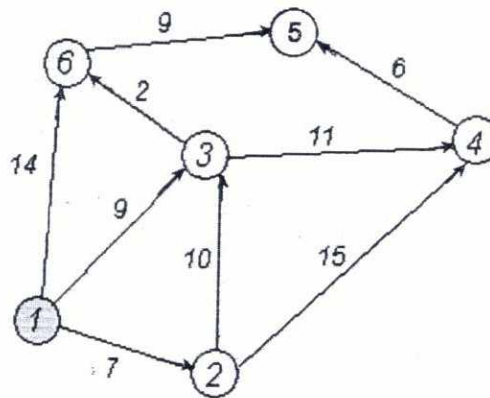$$66, 33, 40, 22, 55, 88, 60, 11, 80, 20, 50, 44, 77, 30$$

Figure 1

Figure 2

Note: Evaluated answer sheets can be seen on June 4, 2018.