Unique Paper Code	**:**	**32341401**
Name of the Course	**:**	**B. Sc. (Hons.) Computer Science - CBCS**
Name of the Paper	**:**	**Design and Analysis of Algorithms**
Semester	**:**	**IV**
Duration	**:**	**2 Hours**
Maximum Marks	**:**	**75**
Year of Admission	**:**	**2015, 2016 & 2017**

Instructions for Candidates:
Attempt Any Four questions. All Questions carry equal marks.

Q1. Following table is a record of minimum and maximum temperatures of 10 cities:

S.No.	City Name	Min Temp (in °C)	Max Temp(in °C)
1	Delhi	26	39
2	Mumbai	28	34
3	Srinagar	02	8
4	Chennai	29	38
5	Bangalore	22	33
6	Kolkata	27	35
7	Shillong	16	21
8	Hyderabad	25	40
9	Patna	24	36
10	Shimla	09	15

Using the most efficient algorithm sort the cities in the increasing order of minimum temperature. Identify the algorithm that can be used to find the city with the 5th maximum temperature without sorting this data again. Apply this algorithm on the above data to find that city, exhibiting the worst-case performance of algorithm.

Q2. Build a Red Black Tree using the following keys

15,30,45,60,75,90

If x denotes the value of the root of tree built with above values then delete x from this tree. Insert the value x again in this tree. Is this tree same as the one before deletion of x? Justify.

Q3. Suppose divide and conquer techniques is used to solve a problem on an array A of size n. The algorithm divides the problem into 'a' subproblems each of size n/b. It solves the problem recursively on these subproblems and combine their solution to construct the solution of the original problem. Let P(n) denotes the cost of dividing the problem into subproblem and M(n) denotes the cost of combining the solutions then write a recursive function to find running time of the algorithm. Give P(n) and M(n) for both Quicksort

and Mergesort. Derive the recursive function to find running time of the following algorithm. Solve this function and derive complexity in terms of asymptotic notation.

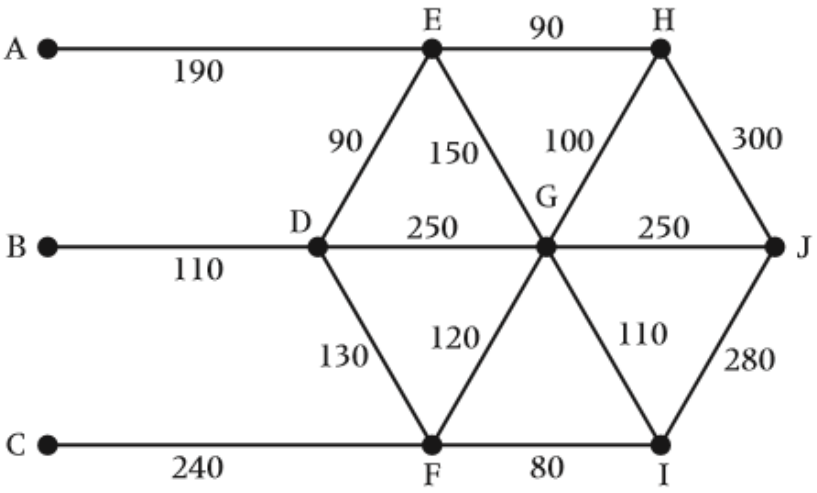
```
My_function(x, a, c, b)
{
  if(x==1)
  {    Print a,c;
       return ();
  }
  else
  {
          My_function(x-1, a, b, c) ;
          print a,c;
          My_function (x-1, b, c, a);
  }
}
```

Q4. A farmer needs to sell his products in the market which is across the river. He has packed each product in separate jute bags and labelled each jute bag a unique number along with its weight and price. He hires a boat to carry these bags to market. But boatman puts a condition. His boat can carry weight of 110 Kg only. Boatman and farmer together weigh 102 Kg. Now the farmer is in a fix - he needs to select the jute bags in such a way that he gets the maximum price in the market without violating the capacity of boat. Write an algorithm to find the optimal solution for farmer's problem. Using that algorithm, find the solution for the following instance, illustrating each step clearly.

Jute Bag Number	Product in bag	Weight of jute bag (Kg)	Price (Rs)
1	Onions	2	63
2	Potatoes	2	80
3	Maize	3	95
4	Rice	4	430
5	Wheat	5	450

Q5. The following diagram shows the network of roads that connect the head office of Jayshree Bank (indicated by J) to its three branches A, B and C. The number on each edge represents the distance in kilometres, along each road. Daily in the morning cash is sent to the branches from head office in a single delivery van. After delivery, the van does not return to head office. It remains stationed at the branch in which last delivery was made. In the evening delivery van collects the cash from the branch where it was stationed and then goes to other two branches and collects the cash from there and return to head office following the same path. For security reasons, the delivery van must take the shortest path in the morning as well as in the evening. Compute the sequence in which it must visit the branches in the morning starting from head office. Consider that after reaching first

branch it goes directly to second branch and then to third branch where it gets stationed. It does not go back to head office in between. Show the complete shortest path that the van should take starting from J to the branch where it will be stationed.



Q6 Following diagram represents a social network. A line between two people means that they are connected on a meeting app. Message broadcasting is a chain reaction in this network. When a person broadcasts a message to all his contacts, his contacts in turn broadcast the message to all their contacts and so on. Write an algorithm to check whether the message broadcasted by any given person 'x' in the network reaches to each and every other person in the network. In the following instance show the path of transmission from Audrey to all other persons using the algorithm. Also check whether it is possible to divide people in this social network in two groups such that people belonging to a group are not connected on the social media.