IIIT, Bangalore. End Term Exam.
EG 102 Data Structures and Algorithms, 28 April 2018.

1. Design an efficient algorithm to decide if the mimimum spanning tree of a given undirected graph is unique. What is the complexity of your algorithm ? (**6 marks**)

2. There are n chairs arranged around a circular table numbering from $1, 2, 3 \ldots n$. Each chair has a number written on it, say $a_1, a_2, \ldots a_n$ are the numbers written on each chair (a_i is the number on the ith chiar). A person sitting on a chair i can jump a_i number of chairs towards left or right. For example, if you are sitting on chair 4 and it has number 2 written on it, then you can either jump to chair number 2 or chair number 6.

   Given X and Y, design an efficient algorithm to find the minimum number of jumps required go from chair X to chair Y. If its impossible to go from chair X to chair Y, then print -1. What is the complexity of your algorithm ? (**6 marks**)

3. You are given a directed graph with weights on each node of the graph. Design an efficient algorithm to find a pair of nodes, say i, j such that j is reachable from i and $w(j) - w(i)$ is maximum. What is the complexity of your algorithm ? (**6 marks**)

4. You are given a positive weithed graph (edges have positive weights), and all the nodes are colored either red or black. A path is said to be black path, if it has only black nodes, including the end nodes. A black shortest path from i to j is defined as minimum weighted black path, amoung all possible black paths from i to j. Given a node s, design an efficient algorithm to compute the shortest black path from s to every other node. What is the complexity of your algorithm ? (**3 marks**)

5. You are given a tree having n nodes, rooted at node 1. Every node has a weight associated with the node. A pair of nodes say i and j, are called beautiful pair of nodes if node i is ancestor of node j and $w(i) > w(j)$. Recall that a node i is a ancestor of node j, if i is a node on the unique path from 1 to j.

   Design an efficient algorithm to count the total number of beautiful pair of nodes.What is the complexity of your algorithm ? (**6 marks**)