Graphs Assignment

1. Given a directed acyclic graph (DAG), implement a function to find the longest path between any two vertices in the graph.

Example:
Input:
graph = [[1,2],[2,3],[3,4],[4,5],[5,6],[7,6]]
Output:
6

2. Implement a function to find the minimum number of swaps required to sort an array using graph theory.

Example:
Input:
arr = [5,3,8,6,7]
Output:
2

3. Implement a function to clone a directed graph, where each node contains a label and a list of its neighbors.

Example:
Input:
graph = [[1,2],[2,3],[3,4],[4,5],[5,1]]
Output:
[[1,2],[2,3],[3,4],[4,5],[5,1]]

4. Given a matrix of 0's and 1's, implement a function to find the number of islands in the matrix, where an island is a group of connected 1's.

Example:
Input:
matrix = [[1,1,1,1,0],
[1,1,0,1,0],
[1,1,0,0,0],
[0,0,0,0,0]]
Output:
1

5. Implement a function to find the kth smallest element in a matrix, where the matrix is sorted row-wise and column-wise.

Example:
Input:
matrix = [[1,5,9],
[10,11,13],

[12,13,15]]
k = 8
Output:
13

6. Implement a function to find the number of ways to reach the bottom-right corner of a m x n grid from the top-left corner, where each cell contains a non-negative integer representing the cost to traverse it. You can only move down or right at each step.

Example:
Input:
grid = [[1,3,1],
[1,5,1],
[4,2,1]]
Output:
7

7. Implement a function to find the minimum height trees (MHTs) of a undirected graph, where an MHT is a root of the graph that has the minimum height among all possible roots.

Example:
Input:
n = 6, edges = [[0,1],[0,2],[0,3],[3,4],[4,5]]
Output:
[3, 4]

8. Given a binary tree, implement a function to find the maximum path sum, where a path is defined as any sequence of nodes from some starting node to any node in the tree along the parent-child connections.

Example:
Input:
root = [-10,9,20,null,null,15,7]
Output:
42

9. Implement a function to find the number of paths in a directed acyclic graph (DAG) from the source node to the destination node.

Example:
Input:
graph = [[0,1],[0,2],[1,2],[1,3],[2,3]]
source = 0, destination = 3
Output:
2

10. Implement a function to find the number of connected components in an undirected graph.

Example:
Input:
n = 5, edges = [[0,1],[1,2],[3,4]]
Output:
2

11. Implement a function to find the length of the longest increasing path in a matrix of integers, where a path is defined as a sequence of cells that are adjacent horizontally or vertically and whose values are in strictly increasing order.

Example:
Input:
matrix = [[9,9,4],
[6,6,8],
[2,1,1]]
Output:
4

12. Implement a function to find the minimum number of steps required to reach the end of an array of non-negative integers, where each element of the array represents the maximum number of steps that can be taken forward from that position.

Example:
Input:
nums = [2,3,1,1,4]
Output:
2

13. Given a list of airline tickets represented as pairs of origin and destination airports, implement a function to reconstruct the itinerary in order, assuming that the itinerary starts from "JFK".

Example:
Input:
tickets = [["MUC", "LHR"], ["JFK", "MUC"], ["SFO", "SJC"], ["LHR", "SFO"]]
Output:
["JFK", "MUC", "LHR", "SFO", "SJC"]

14. Implement a function to find the minimum number of swaps required to sort an array of integers in non-decreasing order.

Example:
Input:
nums = [4,3,1,2]
Output:
2

15. Implement a function to find the number of ways to decode a message encoded as a string of digits, where each

digit can be mapped to a character in the alphabet (1 → 'A', 2 → 'B', ..., 26 → 'Z').

Example:
Input:
s = "226"
Output:
3