National University of Computer and Emerging Sciences, Lahore Campus

	Course Name:	Design and Analysis of Algorithms	Course Code:	CS2009
	Degree Program:	BSCS	Semester:	Spring 2023
	Due Date:	16-05-2023	Total Marks:	70
	Section:	All	Page(s):	2
	Exam Type:	Assignment 3	CLO	1

Student : Name:_____ **Roll No.**_____ **Section:**_____

Instructions/Notes:

1. **You have to submit this assignment in hand written form in class, no typed/printed/online submission will be accepted.**
2. No late submission will be entertained.
3. Assignment will be collected at the start of class on Tuesday, May 16, 2023.

Q1:

Professor Sabatier conjectures the following converse of Theorem 23.1. Let $G = (V, E)$ be a connected, undirected graph with a real-valued weight function w defined on E. Let A be a subset of E that is included in some minimum spanning tree for G, let $(S, V - S)$ be any cut of G that respects A, and let (u, v) be a safe edge for A crossing $(S, V - S)$. Then, (u, v) is a light edge for the cut. Show that the professor's conjecture is incorrect by giving a counterexample.

Q2:

What is the running time of BFS if we represent its input graph by an adjacency matrix and modify the algorithm to handle this form of input?

Q3:

Give an example of a directed graph $G = (V, E)$, a source vertex $s \in V$, and a set of tree edges $E_\pi \subseteq E$ such that for each vertex $v \in V$, the unique simple path in the graph (V, E_π) from s to v is a shortest path in G, yet the set of edges E_π cannot be produced by running BFS on G, no matter how the vertices are ordered in each adjacency list.

Q4:

Modify the pseudocode for depth-first search so that it prints out every edge in the directed graph G, together with its type. Show what modifications, if any, you need to make if G is undirected.

Q5:

Rewrite the procedure DFS, using a stack to eliminate recursion.

Q6:

Give a counterexample to the conjecture that if a directed graph G contains a path from u to v, and if $u.d < v.d$ in a depth-first search of G, then v is a descendant of u in the depth-first forest produced.

Q7:

Give a counterexample to the conjecture that if a directed graph G contains a path from u to v, then any depth-first search must result in $v.d \leq u.f$.