JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2023

B.Tech-IV Semester (CSE/IT)

COURSE CODE(CREDITS): 18B11CI412 (3)   MAX. MARKS: 35

COURSE NAME: DESIGN AND ANALYSIS OF ALGORITHMS

COURSE INSTRUCTORS: DHA, RKI, AMN, SGL   MAX. TIME: 2 Hours

Note: (a) All questions are compulsory.
(b)Marks are indicated against each question in square brackets.
*(c) The candidate is allowed to make suitable numeric assumptions wherever required.*

Q1. a) Discuss the concept of Branch and Bound. Compare it with Backtracking.

    b) Apply Branch and Bound approach to solve the following knapsack problem, assuming to maximize benefit over either taking an item 0% or 100%.   **[CO-4, Marks: 2+3]**

Item	0	1	2	3
Weight	2	2	4	5
Benefit	3	7	2	9

Q2. a) Apply Single Source Shortest Path Algorithm on the graph and obtain the shortest path from "a" to all other vertices, assuming it as the source vertex. **[CO-2,5 , Marks:3+1.5+4+1.5]**
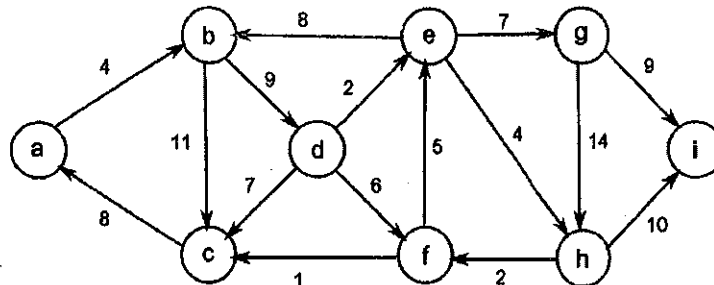
    b) Can you find the shortest path from vertex "a" to "h" via vertex "g" using Dijkstra's Algorithm? If yes, give the strategy for the same. Justify your answer.
    c) In the above graph, change the weight of edge between d and e vertex to -7 and then find the shortest path from "a" to all the vertices.
   d) What is a negative weighted cycle in a graph? How does it affect the shortest path calculation? Justify with an example.

Q3. a) Write an algorithm for Topological Sort.   **[CO-2,5 , Marks:2+2+2]**
    b) Create an adjacency list and perform a Topological sort on the given dependency graph and return a valid topological ordering if it exists.
    c) Perform the time complexity analysis of the Topological Sort algorithm.
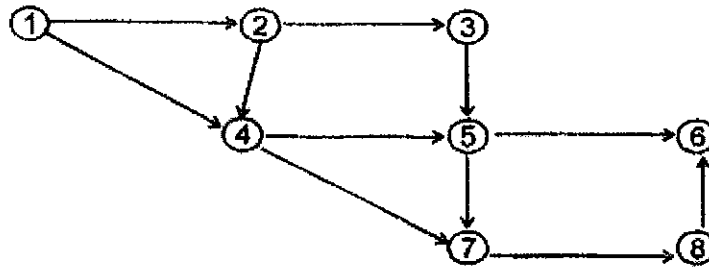
Q4. a) What is a Minimum Spanning Tree (MST)? What are the two different algorithms to find MST? Differentiate between both. **[CO-5 , Marks:3+3+2]**

b) Apply Kruskal's Algorithm on the graph given in Q2 a) by converting it into an undirected graph (Each directed edge is converted into undirected by removing the direction).

Trace the MST as per the algorithm. Also, calculate the weight of the computed MST.

c) Consider the following algorithm:

Description:

Step 1: Compute the MST via kruskal's algorithm.

Step 2: From the computed MST, delete an edge satisfying the two conditions: "it should be the shortest edge" and "its incident vertices should have degree more than 1". If either of the conditions is not true then choose the next shortest edge from the MST satisfying the given conditions.

The edge removal results in disconnected components of the MST.

Step 3: Replace the above deleted edge in the MST with other shortest edge (e) candidates from the excluded MST edges from Step 1 such that adding that edge connects two disconnected component being produced at step 2.

Will the above mentioned strategy give the correct result for finding 2nd best MST from a given graph? If yes, illustrate with an example. If not, justify the answer.

Q5. a) Consider the following 3 different code snippets: i), ii) and iii). Give the time complexity of each. Also, justify your answer. **[CO-10, Marks:1.5*3, 1.5]**

for each i from 1 to n:	Function foo(n):	function bar(n):
j = 1	if n <= 1:	if n <= 0:
while j < n:	return	return
j *= 2	else:	else:
print(i, j)	foo(n - 1)	bar(n - 1)
	foo(n - 1)	print(n)
i)	ii)	iii)

b) Which algorithm can be used to compute the shortest path in a directed unweighted graph? Justify your answer by illustrating with an example.