Birla Institute of Technology and Science, Pilani
Comprehensive examination May 2023 - Question paper

Course name: Data Structures & Algorithmic thinking — Course code: MPBAG537
Time: 3 PM – 6 PM (3 hours) — Total marks: 35
Note: Attempt all the questions

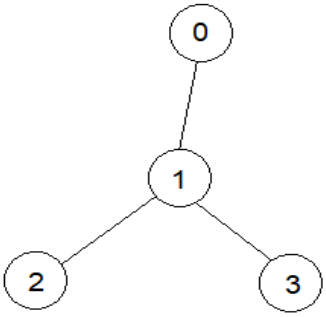
1. There exists a tree which is a heap as well as a BST. (True/False) - Briefly explain. 1

2. For the array = [5, 6, 4, 9, 10, 3, 2, 7, 1, 8] 3
   Insert each array value (read from left to right) to a BST and write the pre-order, in-order and post-order traversal output.

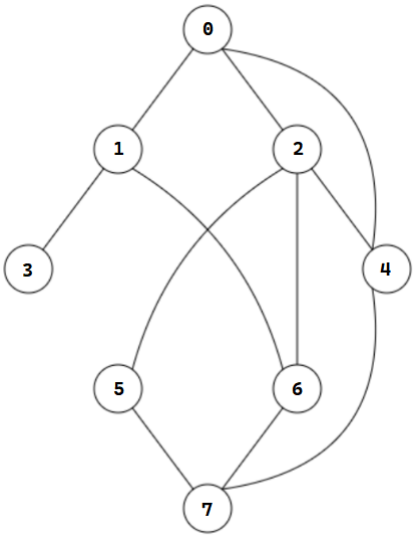
3. For two strings X = ATGATGCT and Y = TATTACG find the longest common subsequence. 3

4. Which sorting algorithm will terminate fastest to sort a sorted array? (MCQ) 1
   a. Insertion sort
   b. Merge sort
   c. Selection sort
   d. Merge sort

5. Write the order of visiting the nodes (traversal) for the G2 graph using Depth-First Search (DFS) algorithm, preferring lower value node for a visit. Write the complete order of traversal as given as an example for graph G1. Start traversal from node 0. 2



Graph G1

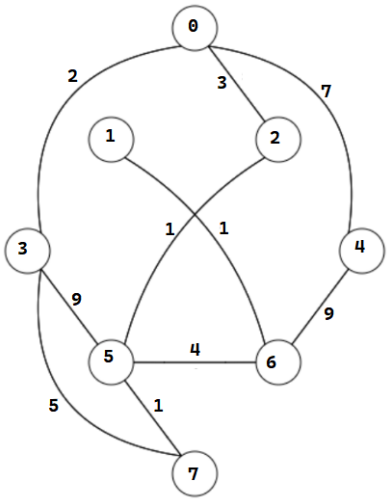


Graph G2

DFS traversal: [0, 1, 2, 1, 3]

Write your answer as a list of nodes visited logically in order to visit each node at least once using DFS.

6. Using Floyd-Warshall algorithm, write the all pairs shortest path length matrix for the given graph G3. 4

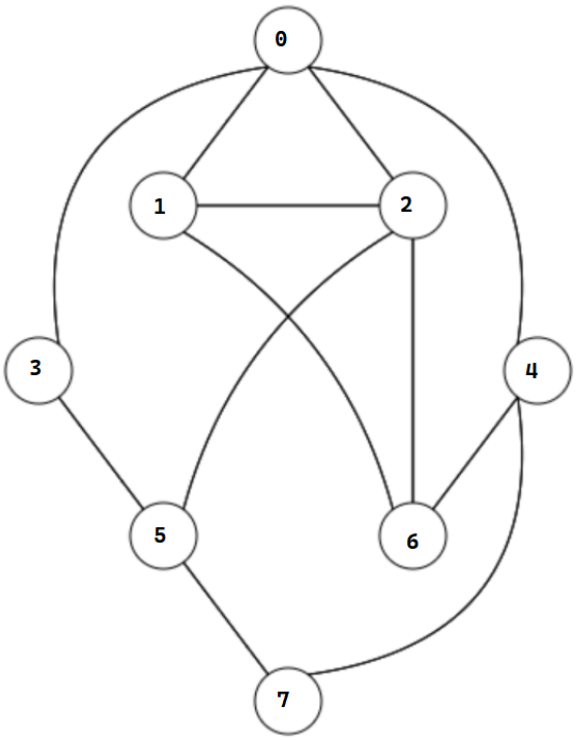


Graph G3

	0	1	2	3	4	5	6	7
0	0							
1		0						
2			0					
3				0				
4					0			
5						0		
6							0	
7								0

Write the shortest path cost matrix

7. Use Breadth First Search (BFS) algorithm on graph G4 and write the enqueued and dequeued nodes during BFS traversal. Start from node 0. 2

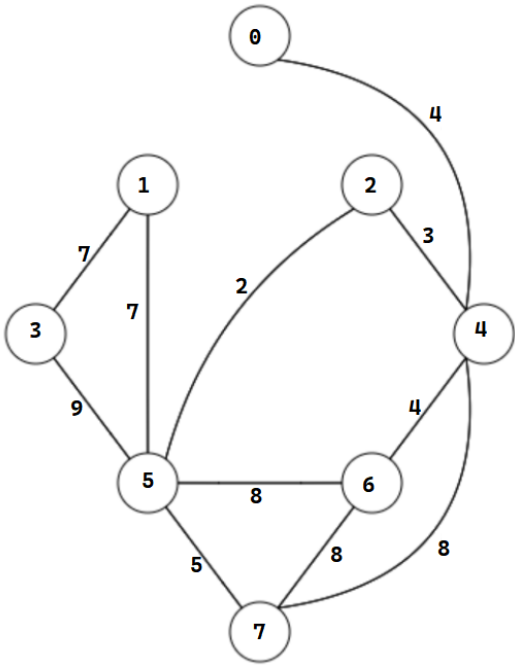


Graph G4

Write your answer in the following format.

Enqueue(0)
Enqueue(1)
.
..
Dequeue(?)
…
…

8. What are input size variables, briefly explain with the example of Kruskal's MST algorithm and its relation to computational complexity. 2



Graph G5

9. Calculate the total number of spanning trees possible for graph G5. Calculate the Minimal Spanning Tree (MST) cost for graph G5. Draw the pictorial representation of the obtained MST. 2

10. Bellman-Ford algorithm can be used to find shortest path length in case of presence of negative weight cycle. (True/False) - Briefly explain. 1

11. DFS follows Divide and Conquer approach. (True/False) - Briefly explain. 1

12. Binary search follows Divide and Conquer approach. (True/False) - Briefly explain. 1

13. Write the name of the sorting algorithms behind Python's sort function. 1

14. Briefly explain the top-down and bottom-up approach of problem solving using appropriate programming constructs. 2

15. Searching an element is O(1) if a hash table is used as an underlying data structure with hash function y = f(x) = x%2. (True/False) - Briefly explain 1

16. Draw the recursion tree for calculating fibonacci(6) with and without memoization. 2

17. A priority queue can not be implemented using a binary heap data structure. (True/False) - Briefly explain 1

18. Write 2 key differences between DFS and BFS. 2

19. Write 1 key difference between Kruskal's and Prim's MST algorithms. 1

20. The order of insertion of values in Binary Search Tree (BST) is unimportant as it does not affect the traversal of BST. (True/False) - Briefly explain. 1

21. Write the successor node which will take place of root node upon deletion of node-10 in the following tree. 1