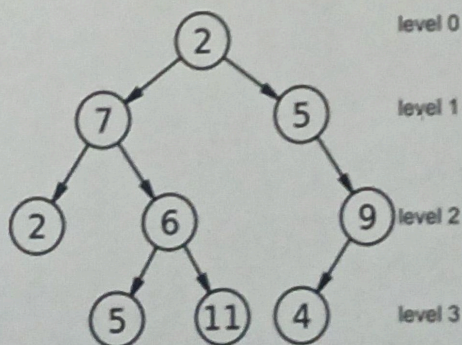


**Final Assessment Test (FAT) – November/December 2022**

Programme	B.Tech.	Semester	Fall Semester 2022-23
Course Title	DATA STRUCTURES AND ALGORITHMS	Course Code	BCSE202L
Faculty Name	Prof. Kavya Alluru	Slot	D1+TD1
		Class Nbr	CH2022231001056
Time	3 Hours	Max. Marks	100

SECTION A (10 X 10 Marks)**Answer All questions**

- (a). Is $2n^3 + 4n^2 + 5 = O(n^5)$? Justify your answer. (5 Marks) [10]
(b). Give asymptotic upper and lower bounds for $T(n) = 2T(n/2) + n^3$. Assume that $T(n)$ is constant for $n \leq 2$. Make your bounds as tight as possible, and justify your answer (5 Marks)
- Consider two singly linked lists **L1** and **L2** of sizes **m** and **n** respectively. Let **X** and **Y** be two nodes in the list **L1**. Write an algorithm to remove the nodes **X** and **Y** from the list **L1** and insert the node **X** before the first node in **L2** and insert the node **Y** as the last node in **L2**. For example, your algorithm produces output **L1**: 9->10->12->13 and **L2**: 11-> 100 -> 101->102->103->14 if **L1**: 9->10->11->12->13->14, **L2**: 100->101->102->103, **X**=11 and **Y**=14. [10]
- Let **Q** be a queue of integers of size **n** and let **k** be a given integer. Write an algorithm to reverse the order of the first **k** elements of **Q**, leaving the other elements in the same order. Your algorithm must use queue operations only. For example, your algorithm produces output **Q** : [50, 40, 30, 20, 10, 60, 70, 80, 90, 100] if **Q** : [10, 20, 30, 40, 50, 60, 70, 80, 90, 100], **k** = 5. [10]
- Nuts and Bolts problem**: You are given a collection of 'n' bolts of different widths and 'n' corresponding nuts. You are allowed to try a nut and bolt together, from which you can determine whether the nut is larger than the bolt, smaller than the bolt, or matches the bolt exactly. However, there is no way to compare two nuts together or two bolts together. The problem is to match each bolt to its corresponding nut. Write an algorithm to solve the Nuts and Bolts problem and also illustrate your algorithm for any sample input. [10]
- Given a Binary Search Tree 'T', and two keys **k1** and **k2**. Write an algorithm to print all keys of **T** in the range of **k1** and **k2**. Illustrate your algorithm with a sample input. [10]
- Write an algorithm to display the list of levels of a binary tree where these levels contain maximum number of nodes. For example, the following binary tree has maximum number of nodes at level-2 and level-3. [10]



Illustrate your algorithm with a sample input.

7. Consider a complete undirected graph $G = (V, E)$ with nodes $v_1, v_2, v_3, \dots, v_n \in V$ and an edge $(v_i, v_j) \in E$ where $i = 1, 2, \dots, n$ and $j = 1, 2, \dots, n$. Derive a new graph $G^1 = (V, E^1)$ from G such that $(v_i, v_j) \in E^1$ where i is an even number and j is an odd number. The graph G^1 is a subgraph of the graph G . Write an algorithm to compute G^1 using adjacency matrix of G . For example, $G = (V, E)$ is a complete graph where $V = \{1, 2, 3, 4\}$. Your algorithm should produce a graph $G^1 = (V, E^1)$ where $V = \{1, 2, 3, 4\}$ and $E^1 = \{(2, 1), (4, 1), (2, 3), (4, 3)\}$ for the graph G . [10]
8. Let $G = (V, E)$ be any directed weighted graph, where $|E| = m$ denotes the number of edges, $|V| = n$ denotes the number of nodes. $w(u, v)$ denotes the weight associated with each edge in G . Assume s is the source node in G . Let p be a given positive integer. The length of a path is equal to the sum of weights of edges on the path. For given G and s , write an algorithm to check whether there is a shortest path from s to any other nodes in G , whose length is equal to p or not. Illustrate your algorithm with a sample input. [10]
9. Given values **{2341, 4234, 2839, 430, 22, 397, 3920}**, a hash table of size 7 and a hash function $h(x) = x \bmod 7$. Show the resultant table after inserting the values in the given order with each of the following collision strategies. [10]
- Linear probing (5marks)
 - Quadratic probing (5marks)
10. Build an AVL tree using the following keys A,B,C,D,E,F,G,H,I,J and K. After the insertion, delete two keys using LIFO (Last In First Out) order i.e., last inserted element should be deleted first. Illustrate the insertion and deletion procedure for the given keys. Write an algorithm for delete operation for the given case. [10]

