MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

III SEMESTER B.TECH. END SEMESTER EXAMINATION

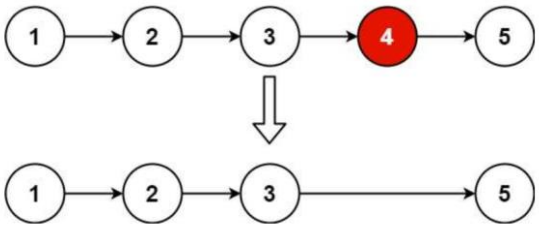
DECEMBER 2022

SUBJECT: DATA STRUCTURES AND ALGORITHMS [MTE 2151]

Date of Exam: **19/12/2022** Time of Exam: **02:00 PM – 05:00 PM** Max. Marks: **50**

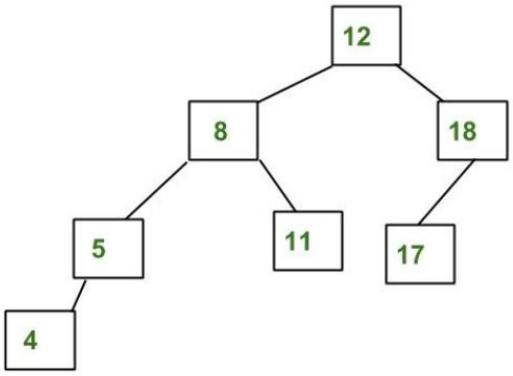
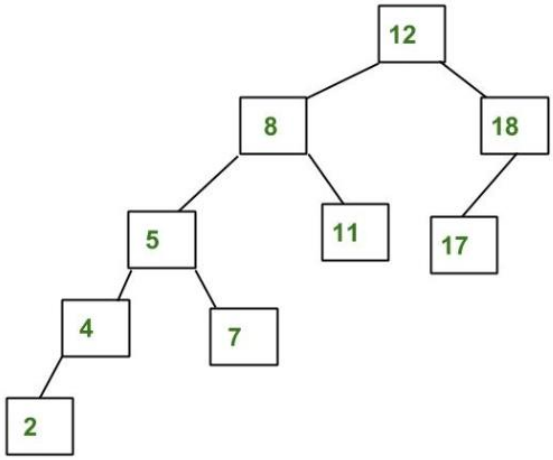
Instructions to Candidates:

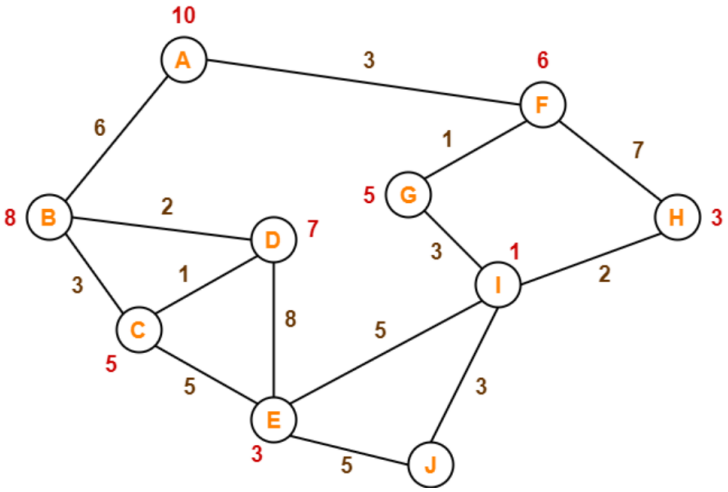
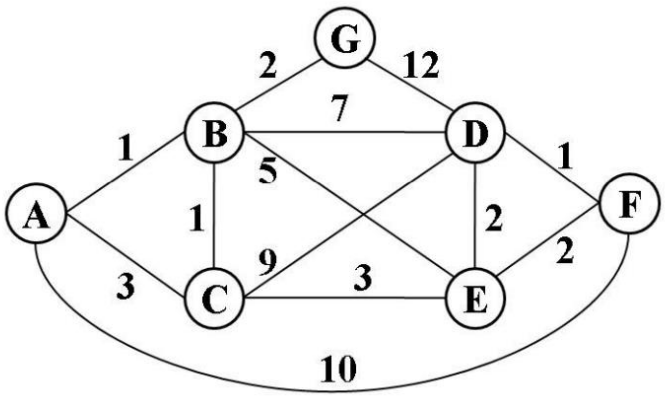
- Answer ALL the questions & missing data may be suitably assumed

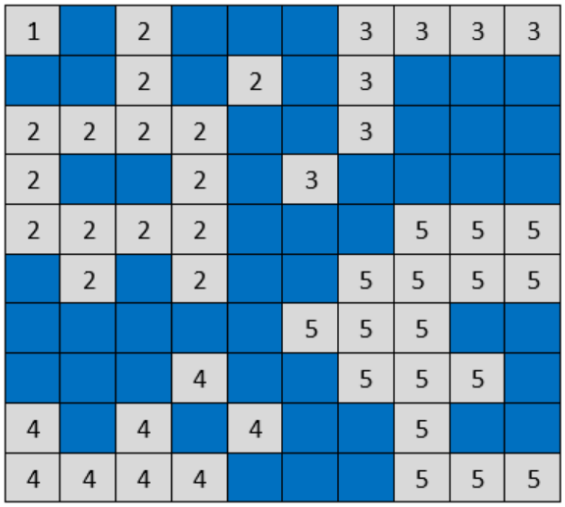
Q.NO.	QUESTION	M	CO	PO	LO	BL
1.	Illustrate the Enqueue and Dequeue operations on a Queue.	**2**	**1**	**1,2**	**1,2**	**4**
2.	Convert $(234)_{10}$ into binary and present the process of conversion using a Stack.	**3**	**1**	**1,2**	**1,2**	**3,4**
3.	Develop an algorithm for the removal of the Node 4 in the first singly linked list to result into the second singly linked list as illustrated in the figure below. 	**5**	**2**	**1,2,3**	**1,2**	**6**
4.	Create an algorithm to find the sum of all the elements in an array of size 10.	**2**	**2**	**1,2,3**	**1,2**	**6**

5.	Compute the time complexity of the code snippet given below.
	int a = 0;
	for (i = 0; i < N; i++) {
	for (j = N; j > i; j--) {
	a = a + i + j;
	}
	}
		3	**2**	**1,2,3**	**1,2**	**4**

6.	Which of the following trees has an imbalance (Tree1/ Tree2)? Perform balancing on the trees if any.	**5**	**2**	**1,2,3**	**1,2**	**4**

	 Tree1  Tree2					
7.	Elaborate on the Chaining scheme in Maps with a suitable exam.	**2**	**2**	**1,2,3**	**1,2**	**3,4**
8.	Describe the difference between average-case and worst-case analysis of algorithms, and give an example of an algorithm whose average-case running time is different from its worst-case running time and state the reason.	**3**	**3**	**1,2,3**	**1,2**	**4**
9.	A k-multiset is a set of *n* elements in which *k* distinct elements each appear exactly *n/k* times. For example, {1,1,2,2,3,3,4,4,5,5} is a sorted 5-multiset of size *n*=10. Write a Pseudo-code to sort a k-multiset of size *n*. For convenience, you may assume that $n = 2^i$ and that $k = 2^j$ for some i ≥j.	**5**	**3**	**1,2,3**	**1,2**	**4**
10.	Suppose you are given an array A of size *n* that either contains all zeros or 2n/3 zeros and n/3 ones in some arbitrary order.	**2**	**3**	**1,2,3**	**1,2**	**3**

	Give an exact lower bound in terms of *n* (not using asymptotic notation) on the worst-case running time of any deterministic algorithm that is tasked to determine whether A contains any ones.					
11.	Consider the problem of searching for genes in DNA sequences using Horspool's algorithm. A DNA sequence consists of a text on the alphabet {A, C, G, T} and the gene or gene segment is the pattern. a. Construct the shift table for the following gene segment of your chromosome 10: **TCCTATTCTT** b. Locate the above pattern in the following DNA sequence: **TTATAGATCTCGTATTCTTTTATAGATCTCCTATTCTT**	**3**	**4**	**1,2,3**	**1,2**	**4**
12.	For the input 30, 20, 56, 75, 31, 19 and hash function h(K) = K mod 11 a. Construct the open hash table (chaining mechanism). b. Find the largest number of key comparisons in a successful search in this table. c. Find the average number of key comparisons in a successful search in this table.	**5**	**4**	**1,2,3**	**1,2**	**4**
13.	Deduce the shortest path from A to J using the A* algorithm. The weights along the edges are costs incurred for traversing the edge and the weight along the nodes represents the heuristics of the corresponding node. 	**2**	**5**	**1,2,3**	**1,2**	**4**
14.	Compute the shortest path from Node A to Node F using the Dijkstra's algorithm 	**3**	**5**	**1,2,3**	**1,2**	**4**

15.	Given a binary matrix where 0 represents water and 1 represents land, and connected ones form an island. The below image highlights water in blue and land in gray in a 10×10 matrix. There are a total of **five islands** present in the below matrix. They are marked by the numbers $1–5$ in the image below.  Develop an algorithm using searching techniques to count the total islands.	**5**	**5**	**1,2,3**	**1,2**	**4**