National Institute of Technology Delhi

Name of the Examination: End Semester Examination

(Delayed Spring Semester 2022)

Department: CSE/ECE/ EEE
Course Code: CSB102
Max. Marks: 50

Date: 13/07/2022
Course Title: Data Structures
Duration: 3 hours

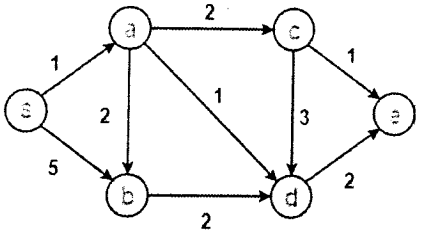
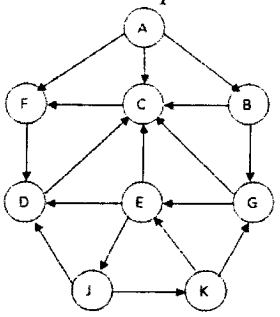
SECTION - A

1.	Write the series of PUSH and POP operations that will transform the STACK from its initial state to its final state. INITIAL: 10, 9, 27, 4, 29, _, _, _ FINAL: 10, 7, 8, 4, 36, _, _, _	1M
2.	Consider a six – element queue, as shown below: QUEUE: _, _, _, _, _, 6 Even though the queue has a capacity to store five more elements, it still leads to an OVERFLOW condition whenever an attempt to insert a new element is made. What could be the possible reason for this? Also, suggest a solution to overcome this situation.	1M
3.	Write the series of INSERT and DELETE operations that will transform the QUEUE from its initial state to its final state. INITIAL: _, 1, 2, 4, 6, _, _, _ FINAL: _, _, _, 4, 6, 8, _, _	1M
4.	Draw NULL Tree.	1M
5.	Draw NULL Graph.	1M

SECTION - B

6.	Suppose a dataset S contains N elements. **a)** Compare the running time T_1 of the linear search algorithm with the running time T_2 of the binary search algorithm when i) N=1000 and ii) N=10000.	1M
	b) Discuss searching a given item in S when S is stored as a linked list.	1M
7.	Suppose the array A contains 14 elements as follows: 66, 33, 40, 22, 55, 88, 60, 11, 80, 20, 50, 44, 77, 30 a) Sort the array using Merge sort and show all the steps in the process.	1M
	b) Write the average case and worst case complexity considering extra memory.	1M
8.	Consider the following list of 14 alphabetic characters: **D** A T A S T R UC T U R E S Apply the Quicksort algorithm to find the final position of character **D.**	2M
9.	The keys 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing and linear probing. Draw the resultant hash table and explain the steps to be followed.	2M
10.	What is collision in hashing? Briefly explain the collision resolution techniques.	2M
11.	Consider the following arithmetic infix expression Q: Q: A + (B * C – (D / E ↑ F) * G) * H Transform Q into its equivalent postfix expression P using stacks.	2M
12.	A binary tree T has 9 nodes. The inorder and preorder traversals of T yield the following sequences of nodes. Draw the tree T. Inorder: E A C K F H D B G Preorder: F A E K C D H G B	2M
13.	Write the prefix and postfix of following expression: (a+b)*d+e/(f+a*d)+c	2M
14.	Evaluate following expression: P: 6, 2, /, 3, -, 4, 2, *, +	2M
15.	Suppose n data items A_1, A_2, ..., A_N are already sorted, i.e., $A_1 < A_2 < .... < A_N$ a) Assuming the items are inserted in order into an empty binary search tree, what is the depth D of the tree T?	1M
	b) Compare D with the average depth AD of a binary search tree with n nodes for n = 50, n=100, n=500	1M
16.	Consider the algebraic expression $E = (2x + y)(5a - b)^3$ Draw the tree which corresponds to the expression E.	1M
	Find the Polish expression P equivalent to E .	1M
17.	a) Towers of Hanoi Problem can be solved in two recursive calls. Rewrite the algorithm using one recursive call instead of two.	1M
	b) Show the corresponding moves of disks at each step.	1M

SECTION - C

18.	Using Dijkstra's Algorithm, find the shortest distance from source vertex 'S' to remaining vertices in the following graph. Also, write the order in which vertices are visited. 	3M
19.	Consider the graph G in figure representing the daily flights between cities of some airline. Suppose we want to fly from city A to city J with the minimum number of stops. Find the minimum path P from A to J where each edge has length 1. Show the updations at each step in the following format:  QUEUE ORIGIN FRONT REAR	3M
20.	a) Briefly describe the notions of the complexity of an algorithm.	2M
	b) Briefly explain the space-time trade-off of algorithms.	1M
21.	Consider a polynomial p(x,y,z) in variables x,y and z. Unless otherwise stated, the terms in p(x,y,z) will be ordered lexicographically. $P(x,y,z)= 8x^2y^2z-6yz^8+3x^3yz+2xy^7z-5x^2y^3-4xy^7z^3$ **a)** Rewrite the polynomial so that the terms are ordered.	1M
	b) Suppose the terms are stored in the order shown in the problem statement in the linear arrays COEF, XEXP, YEXP and ZEXP, with the HEAD node first. Assign values to LINK so that the linked list contains the ordered sequence of terms.	2M
22.	a) Apply Heap sort to sort following numbers in ascending order. 82, 90, 10, 12, 15, 77, 55, 23	2M
	b) Write the best case, worst case and average case complexity of Heap sort	1M
23.	Consider the following deque of characters where DEQUE is a circular array which is allocated six memory cells: LEFT=2 , RIGHT = 4 DEQUE: _, A, C, D, _, _ Describe the deque while the following operations take place. 1)F is added to the right of the deque. 2) Two letters on the right are deleted. 3)K, L, and M are added to the left of deque. 4) One letter on the left is deleted. 5) R is added to the left of the deque. 6) S is added to the right of the deque. 7) T is added to the right of the deque.	3M
24.	Suppose the following list of letters is inserted in order into an empty binary search tree: J, R, D, G, T, E, M, H, P, A, F, Q a) Find the final tree T.	2M
	b) Find the inorder traversal of T.	1M