

Final Assessment Test – November 2024



Course: **BCSE202L - Data structures and Algorithms**
 Class NBR(s): **1789/1796/1801/1805/1812/1816/1819/1823/1826/1830/1835/1840/1844/1847/1850/4223/4422** Slot: **B2+TB2**

Time: **Three Hours**

Max. Marks: **100**

- **KEEPING MOBILE PHONE/ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

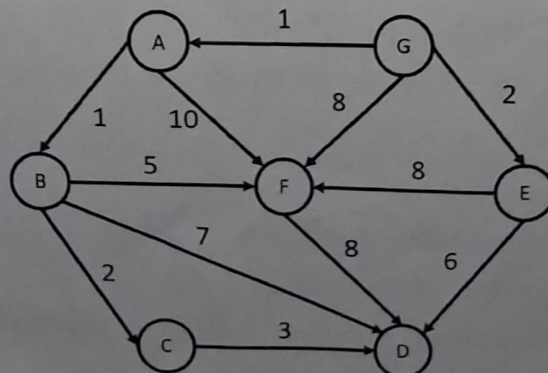
Answer ALL Questions
 (10 X 10 = 100 Marks)

1. Solve the following recursion equation $T(n)$
 - i. $T(n) = T\left(\frac{n}{3}\right) + T\left(\frac{2n}{3}\right) + n, T(1) = 1$, using recursive tree Method. [7]
 - ii. $T(n) = 2T\left(\frac{n}{2}\right) + n \cdot \log n$, using Master's theorem. [3]
2. a) Convert the following expression into Postfix and Prefix Expression [6]

$A * (B - ((C / D) + (E - F) / G)) * H / (I - J)$

 b) Evaluate the given postfix expression using stack Data structure [4]

$9 5 * 5 / 2 2 + 2 - + 4 2 / -$
3. Suppose we have a circular queue implemented using an array. The queue has a maximum capacity of 5 elements. Initially, both the front and rear pointers are set to -1. We perform the following operations:
 - 1) Enqueue 10.
 - 2) Enqueue 20.
 - 3) Dequeue an element.
 - 4) Enqueue 30.
 - 5) Dequeue an element.
 - i. What will be the state of the circular queue after these operations? [4]
 Provide a diagram to illustrate the queue's contents.
 - ii. Can you explain how front and rear pointers work in array implementation of circular queue with pseudo code? [6]
4. Find the shortest path from vertex G to every other vertex using Dijkstra's algorithm. [8]



b) How much time taken by Dijkstra's algorithm for finding minimum $d(v)$ [2]
in each phase for graph $G=(V,E)$ and what is the total running time.

5. a) Consider a logistics manager tasked with optimizing transportation routes [7]
for a delivery company that operates in a city with a complex network of
roads. Your goal is to minimize the distance for packages to reach their
destinations by finding the shortest paths between all pairs of locations.
The transportation route is represented as weighted directed graph given
below. Find the minimum spanning tree using Prim's algorithm, between
all pairs of locations, considering the varying distance, which helps
company to delivery operation. Map (Graph) is represented as a
adjacency matrix is given below.

	A	B	C	D	E	F	G
A	0	2	0	8	0	0	6
B	2	0	6	0	0	0	5
C	0	6	0	0	0	5	2
D	8	0	0	0	7	0	9
E	0	0	0	7	0	7	3
F	0	0	5	0	7	0	1
G	6	5	2	9	3	1	0

b) Define spanning tree with example. [3]

6. Consider the given input {4371, 1323, 6173, 4199, 4344, 9679} and a hash
function $H(X) = X \pmod{10}$, show the results for the following options.
resulting

- i. Open hash table
- ii. Closed hash table using linear probing
- iii. Closed hash table using quadratic probing
- iv. Closed hash table with second hash function $H_2(X) = 7 - (X \pmod{7})$.

7. What is a binary heap? How binary heap are represented? Construct a min heap by inserting elements one by one, elements are 9, 5, 6, 8, 5, 7, 3, 2, 4, 1. Illustrate how many interchanges is required to convert min heap into max heap.

8. a) Construct an AVL tree with following operations Insert(Z), Insert(X), [6]
Insert(Y), Insert(R), Delete(Z), Insert(D), Insert(G), Insert(B), Insert(A),
Delete(X), Delete (A).

b) Discuss the violation might occur during insertion in AVL and explain how [4]
single and double rotations are performed to handle the violations.

9.a) Ten thousand books, all uniquely recognized by their ISBN numbers, are stored in a database at a major library. An array is used to hold the ISBN numbers in ascending order. Book requests are sent to the librarian on a regular basis, and she has to swiftly see if the requested book is in the database. Give the recursion algorithm for the scenario that is presented. Give an example to illustrate the recursion algorithm's operating concept using pseudocode.

OR

9.b) Why is Counting Sort an appropriate choice for sorting, and how does it differ from comparison-based algorithms? Describe the steps of Counting Sort using input array 3, 5, 4, 1, 3, 4, 1, 4.

10.a) Given an array that represents a tree in such a way that **array indexes are values in tree nodes** and **array values give the parent node of that particular index** (or node). The value of the root node index would always be -1 as there is no parent for root. Construct the standard linked representation of given Binary Tree from this given array. Illustrate tree traversal with pseudo code for constructed tree.

Index	0	1	2	3	4	5	6	7	8	9	10
Tree[]	1	5	5	2	2	-1	3	0	3	1	4

OR

10.b) Write a routine to implement the following operations on binary search tree.

Explain each operation with example.

- i. Searching a value in BST
- ii. Deletion in BST
- iii. Find minimum value in BST
- iv. Find maximum value in BST

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