



AUTUMN END SEMESTER EXAMINATION-2019

3rd Semester B.Tech & B.Tech Dual Degree

DATA STRUCTURES AND ALGORITHMS

CS2001

(For 2019 (L.E), 2018 & 2017 Admitted Batches)

Time: 3 Hours

Full Marks: 50

Answer any SIX questions.

Question paper consists of four sections-A, B, C, D.

Section A is compulsory.

Attempt minimum one question each from Sections B, C, D.

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

SECTION-A

1. Answer the following questions. [1 × 10]
- (a) Define an *Abstract Data Type* (ADT). Give any two examples.
 - (b) Write a function to find out the number of nodes of degree one, two, and zero in a binary tree.
 - (c) Name the data structure used for *recursion*. Explain with an example.
 - (d) What is a *polynomial*? How it can be represented using array and linked list. Compare both the representations.
 - (e) How many number of binary trees can be constructed with the following set of binary tree traversals? Draw all the tree(s). The alphabets represent the nodes of the binary tree.
Pre-order : A C B D F G E H I J K
Post-order : F G D I J H K E B C A
 - (f) Differentiate between linear queue and circular queue. List any two applications of queue ADT.

- (g) Write a function to copy the content of one stack ADT to another stack ADT without using any additional user defined stack ADT.
- (h) What is an expression tree? Write the steps followed to construct an expression tree from the following expression.
Exp.: $* + a b * c + d e$
- (i) Write the two limitation of applying binary search algorithm on a data structure. Write and justify the time complexity of binary search algorithm.
- (j) Suppose FIRST and LAST represents the address of start node and last node in a double linked list. Write a function to convert the double linked list into a double circular linked list.

SECTION-B

- 2. (a) What is the advantages of binary search tree over binary tree? Write non-recursive functions for the following operations for a binary search tree [4]
 - i) Traverse the tree in pre-order
 - ii) Traverse the tree in level-order

[In case of level order traversal the elements of level l will be traversed after all the elements of level $l-1$ are traversed]
- (b) What are the limitations of a sparse matrix? How to represent a sparse matrix using a header linked list. Write a function to multiply two sparse matrices represented using header linked list. [4]
- 3. (a) What is a heap? Discuss with an example, how priority queue can be implemented using heap. [4]
- (b) Define hashing. What is a collision in hashing? Explain with an example. Write a function to store data in the [4]

hash table, avoiding collision by using chaining –a collision resolution method.

[Select a hash function of your choice]

SECTION-C

4. (a) For a given set of records, analyze the efficiency of processing the records by storing the data in binary search tree, AVL tree and B-tree. Construct an AVL and B-tree for the following set of values: [4]
15, 10, 8, 12, 14, 25, 30, 20, 18, 35
- (b) Write the pseudo code/ function to perform the following sorting algorithms. Analyze its best case and worst case time complexity. [4]
i) Insertion sort
ii) Quick sort
5. (a) Write a function to check whether the parenthesis and curly braces present in a given infix expression are in correct order or not. Use queue ADT for the implementation. [4]
- (b) Suppose the student information i.e. <roll no., name, CGPA> are stored using a binary search tree. Write a function/ pseudo code to delete all the information of a student with CGPA <5.0. [4]
6. (a) Suppose the bank customer information i.e. < customer ID, customer name, customer address, account type, and account balance are stored using a header circular linked list. The header node contains the bank name to which the customer belongs to. One linked list are maintained for each bank. Write pseudo code/ function to perform the following operations: [4]
i) Print the customer details for a given bank
ii) Print the customers' details with low balance (less than 5000)for a given bank.
iii) Delete the detail of all customers with balance 0 for a given branch.

- (b) "A graph is an acyclic tree." (True/ False) List the applications of graph data structures. What are the different ways to represent graph ADT in memory? Write a function to represent a graph ADT using an efficient data structure. [4]

SECTION-D

7. (a) Suppose the mobile locations of different persons are represented by nodes in a graph. Write a pseudo code/ algorithm to find the nearest mobile phones present for a given mobile location. Then, find the subsequent neighbours as per user's requirement. [4]

- (b) Two binary trees are identical if the same elements are present at the same position. Write a function to check whether two given binary trees are identical or not. [4]

8. (a) Suppose a computer system has one processor to execute different tasks. Each task has a time of execution. Each task is assigned with a priority number depending upon the type of task: *Local Printing (Lowest Priority -1)*, *Web Applications (Priority-2)*, *I/O interfacing (Highest Priority -3)*. Every time a task is generated, its execution time and priority number are entered and stored. [4]

Which data structure can efficiently maintain task waiting for the processor? Write functions for insertion and deletion operations for the tasks with the following conditions.

- i) A task will be processed first with minimum execution time.
 - ii) A task will be processed first with highest priority.
- (b) Design a solution to evaluate a postfix expression. Identify the appropriate data structure used for the evaluation. The expression contains one and two digit numbers. The possible operators are '+', '-', '/', '*', and '%'. Write a function for the evaluation. [4]
