

B. E. COMPUTER SC. & ENGINEERING EXAMINATION, 2025
(2nd Year, 1st Semester)

DATA STRUCTURES AND ALGORITHMS

Time : Three hours

Full Marks : 100

Answer all questions. Be brief and to the point in answering questions.

1. (a) What is the difference between an Abstract Data Type and a Data Type used in Programming Languages? Explain with the help of an example. 3+1
- (b) What do you mean by $\Omega(n^2)$? Explain with an example. 3+1
- (c) What do you mean by a Threaded Binary Tree? Why is it required? 4
- (d) What is Non-linear Recursion? Give an example of such an algorithm? 2+2
- (e) What is the difference between void pointer and byte pointer in C language? 4

2. Answer any two from the following:
 - (a) Write C language functions for *full_q*, *empty_q* and *enqueue* operations for an array-based Queue with only the *front* and *rear* index variables. You need to define the data type for the queue also. 3+3+4
 - (b) Write a commented C language function for right-rotation of a Binary Search Tree about its root. Explain with a diagram why the rotated tree remains a Binary Search Tree. 5+5
 - (c) Write a commented C language function to check whether a given integer array is sorted and to find the sorting order. Include the case, when all the elements of the array are equal. 10

3. Answer any two from the following:
 - (a) Define the "Folding" Hash function. Explain with an example.
 Explain how a record can be deleted in an open addressing hashing environment? 4+2+4
 - (b) What is a Spanning Tree of a Graph? Design a greedy algorithm to find out a minimum cost spanning tree of a graph. Analyze the time complexity of your algorithm. 2+6+2
 - (c) Develop a recursive algorithm to test whether a given Binary Search Tree is Height-balanced or not. What type of recursion you have used in your algorithm? 8+2

4. Answer any two from the following:
 - (a) Discuss various Data Structures which can be used to represent Lists. Explain the space overhead of each of the alternatives. What advantage or disadvantages you get in implementing the Polynomial data structure using the above kind of lists? 6+4

[Turn over

- (b) The files in your computer are arranged in terms of directories, sub-directories and files. What kind of logical data structure can be used for such an arrangement? Explain with an example. Show how the same arrangement can be stored into a binary structure without losing the relationship among the entities.

4+2+4

- (c) What are the data structures for representing Graphs. Which one will you choose for representing very dense graphs and sparse graphs and why?

6+4

5. Answer any two from the following:

- (a) In solving a problem, each data node has a structure containing some information field. The total number of bytes in the structure is 3072. You have a maximum of 40,000 such structures to process. The different options of data structures are array, single linked list and double linked list. Considering each pointer has 6 bytes, what is the percentage memory overhead if you want to process all 40,000 structures in memory? Explain situations, when you will select each data structure option.

4+6

- (b) You have a large number of data records, each having a unique key field. The predominant activities on the records are insertion and search. The application requires the access to each of the record to take almost constant time. Explain your choice of data structure for the application. Explain how the records will be actually accessed and the kind of overhead you have to bear with.

4+3+3

- (c) You are going to develop an application like Google Maps. Explain the choice of data structure for the backend. Can you think of the properties to be associated with the different entities of your chosen data structure?

6+4

-----X-----