

**B. E. COMPUTER SC. & ENGINEERING EXAMINATION, 2023**  
(2<sup>nd</sup> Year, 1<sup>st</sup> Semester)

**DATA STRUCTURES AND ALGORITHMS**

**Time : Five hours**

**Full Marks : 100**

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

1. (a) What is the difference between Static and Dynamic Data Structures? Explain with the help of examples. 4
- (b) What do you mean by  $T(n) = \Theta(n^2)$ ? Explain with an example. 4
- (c) What is a Binary Search Tree? What are its characteristics? 4
- (d) What is Mutual Recursion? Where is it required? 4
- (e) What is a function pointer in C language? Where do you use it? 4
  
2. Answer any two from the following:
  - (a) Write C language functions for *empty\_list\_delete\_front* and *insert\_at\_end* functions for a circular singly-linked list with a tail pointer. You need to define the required data type(s) also. 2+3+3+2
  - (b) Write a commented C language function for the evaluation of postfix expressions having integer coefficients and integer values of variables. Explain what error conditions can be checked in your function. 7+3
  - (c) Write a C language function to merge two sorted arrays of integers in a third array. Explain if there is any limitation of your implementation. 7+3
  
3. Answer any two from the following:
  - (a) Explain how linked lists can be implemented using an array and cursors. Hence show how the array is to be initialized. How would you create a node in such a design? Write the *createnode* algorithm. 4+1+2+3
  - (b) What do you mean by Depth-First Search (DFS) in a Graph? Write a recursive algorithm for DFS. What kind of recursion you have used in your algorithm? How do you convert your algorithm into an iterative one. What is the time complexity of such implementation? 2+3+1+3+1
  - (c) Develop an algorithm to test whether a given Stack of integers is increasingly sorted from top to bottom. The Stack should remain unchanged after the test. What is the space complexity of your algorithm? 8+2
  
4. Answer any two from the following:
  - (a) A large number of very large records are to be stored in main memory. The records need to be frequently searched, new records may be inserted and sorting may also be required on the key field. Explain an efficient method of storing the data so that time overhead due to data movement may be reduced.

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(b) What mechanism will you use for storing a large number of records in hard disk in hashed manner so that they can be accessed very fast? Explain the method of storage and the number of disk accesses required for reading a record.

6+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 2056. You have a maximum of 20,000 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 20,000 structures in memory? Explain situations, when you will select each data structure option.

4+6

(b) You are going to develop an application for COVID Patient Treatment Resource Help. Consider there are 8 hospitals with known number of initial COVID beds, 6 safe homes with known number of beds, 200 medicine suppliers, 20 ambulance agencies and 15 Oxygen vendors in a region. Explain your choice of data structures and algorithms for the application.

4+6

(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

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