CSE/PC/B/T/213/2020

B. E. COMPUTER SC. & ENGINEERING EXAMINATION, 2020

(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 do you mean by Abstract Data Type? Explain with the help of C language *struct* type. 2+3

(b) What are the basic algorithmic structures used in high level procedural languages? Describe with flow-charts. 5

(c) What is the difference between Binary Recursion and Non-linear Recursion? 3

(d) Show how a general n-ary tree can be represented unambiguously by a binary structure. 3

(e) What is the lower bound on the time complexity of any comparison-based sorting algorithm? Name a comparison based sorting algorithm which is linear-time in a special case. Explain its usage in the special case. 4

2. Answer any two from the following:

(a) Write C language functions for *insert_after* and *delete_after* functions for a Circular Singly Linked List with a tail pointer. You need to define the node types also. Hence write the C functions *enqueue* and *dequeue* for a Queue implemented using the Circular Single Linked List. 4+2+4

(b) Develop a sorting algorithm which does not use comparisons and runs in linear time. What are the constraints on the elements of the array to be sorted by such an algorithm? Write a C function for the sorting algorithm you proposed. Explain how the following array will be sorted in increasing order by the algorithm:

5 3 1 2 5 3 1 2 6 4 1 2 6 4 8 9

3+1+3+3

(c) Explain the Folding Hash function. Write a C language function to compute the hash value for character strings using the concept of folding considering the length of strings to be 20 character and 4 folds to be used. 3+7

3. Answer any two from the following:

(a) Design an algorithm for computing n^{th} Fibonacci number following the Dynamic Programming approach. Explain clearly the rationale of Dynamic Programming and relate to your algorithm. 4+6

(b) Design a greedy algorithm to find out the Minimum Cost Spanning Tree of a Graph. Explain how the greedy strategy has been used in your algorithm. Analyze the time complexity of your algorithm. 4+3+3

(c) Explain the Divide and Conquer strategy for algorithm development. Develop a sorting algorithm using the Divide and Conquer strategy. Present an informal time complexity of your algorithm.

2+4+4

4. Answer any two from the following:

(a) Discuss various Data Structures which can be used to solve the n-queens problem. Explain the space complexity of each of the alternatives. What is the usual method of solving the n-queens problem? How can you make it faster?

4+3+3

(b) What is the post-fix notation of representation of arithmetic expression? Develop an algorithm for evaluation of such expressions. What are the errors which can be detected by your algorithm? Find out the time and space complexities of the algorithm.

2+3+2+3

(c) Define a B-Tree. Why is a B-Tree not very useful for storing and manipulating large volume of data in Hard disk? What changes have been made in B Tree to formulate the B+ Tree? Show a rough calculation to find the amount of records which can be processed using a 4 level B+ Tree.

3+1+3+3

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 1056. You have a maximum of 10,000 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 memory overhead if you want to process all 10,000 structures in memory? Explain situations, when you will select each data structure options.

4+6

(b) You have a very large number of names, each having at most 50 characters, in a file. In an application, the names will be input to the system, and it is required to search the names extremely fast. Explain your choice of data structure for the application. Explain how the names will be actually searched. Is there a chance of false positive or false negative in your proposed method? Explain.

3+5+2

(c) In an application, you need to store the information in a binary tree where frequent in-order traversals are necessary. Explain the choice of your data structure. What are the memory overhead and the savings in the time complexity? Explain with reference to the traversal algorithm.

3+4+3

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