

U.G. 3rd Semester Examination - 2021**COMPUTER SCIENCE****[HONOURS]****Course Code : COM.SC-H-CC-L-305****(Data Structures)**

Full Marks : 60

Time : $2\frac{1}{2}$ Hours*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.*

1. Answer any **ten** questions: $2 \times 10 = 20$
- a) What is abstract datatype? Give examples.
 - b) Define time complexity of an algorithm.
 - c) What are the limitations of recursion?
 - d) What is a stack? Give two applications of stack.
 - e) Explain prefix expression.
 - f) How array is used to represent sparse matrix?
 - g) Define skip list in data structure.
 - h) Define skew tree and strictly binary tree.

- i) Calculate the total number of nodes of a complete binary tree of height h .
 - j) Note that a queue can be implemented using a linear linked list or a circular linked list. Which implementation is algorithmically more efficient?
 - k) Given the following input (4322, 1334, 1471, 9679, 1989, 6171, 6173, 4199) and the hash function $x \bmod 10$, among which data items there will be collisions?
 - l) Explain height balanced trees. Give examples.
 - m) How can a directed graphs be represented in memory using adjacency matrix?
 - n) What is the preprocessing step required to search an item from an array using binary search? What is the time complexity of the overall process?
 - o) Define hash table and hash function.
 - p) What do you understand by indexed file?
2. Answer any **four** questions: $5 \times 4 = 20$
- a) Suppose a two-dimensional array A of size $M \times N$ is stored in memory as column major order. If the address of $A[p][q] = B$, find the address of

A[i][j] considering each element of the array can be stored in 3-byte memory word. 5

- b) Design an algorithm / pseudocode for sorting n integers stored in an array using selection sort. Write down the best-case time complexity of the selection sort algorithm. 4+1

- c) Find the post-order traversal of the binary tree using the following information:

In order: 10, 15, 17, 18, 20, 25, 30, 35, 38, 40, 50

Pre order: 20, 15, 10, 18, 17, 30, 25, 40, 35, 38, 50

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- d) Apply quick sort algorithm considering the first element as the pivot on an Array A1 :

{15, 12, 33, 28, 47, 12, 22, 31, 15, 42, 34}.

5

- e) Design algorithms/pseudocodes for the insert and delete operations at the beginning in a circular queue in memory. $2\frac{1}{2} + 2\frac{1}{2}$

- f) Discuss any two collision resolving techniques in hashing. $2\frac{1}{2} + 2\frac{1}{2}$

3. Answer any **two** questions: 10×2=20

- a) i) Construct a BST tree if the elements are in the following order: 60, 70, 30, 20, 55, 90, 95, 80, 55, 35, 45, 40, 50, 12, 45, 67.

- ii) What are the differences between B-tree and B+ tree?

- iii) How can we compute the in-degree and out-degree of the vertices of a graph when the graph is represented by an adjacency linked-list? 5+2+3

- b) i) Convert the following infix expression to prefix notation: $(A^B - C)/(D + E * F)$. (^ represents exponential operation)

- ii) Design algorithms/pseudocodes to implement enqueue and dequeue operations of queue when queue is represented by an array. 5+5

- c) i) Explain the working principle of merge sort.

- ii) Apply radix sort to the list of following elements: 92, 25, 86, 48, 51, 33, 12, 108, 10.

- iii) What is the best-case and worst-case time complexity of merge sort algorithm?

3+5+2

- d) i) Design a recursive algorithm to print n Fibonacci numbers.

- ii) What are the limitations of recursion?

- iii) Design recursive algorithms for tree traversals. 3+2+5