Bihar Engineering University, Patna
End Semester Examination - 2022

Course: B.Tech. | *Semester: III* | *Time: 03 Hours*
Code: 100304 | *Subject: Data Structure & Algorithms* | *Full Marks: 70*

Instructions:-

(i) The marks are indicated in the right-hand margin.
*(ii) There are **NINE** questions in this paper.*
*(iii) Attempt **FIVE** questions in all.*
*(iv) Question No. **1** is compulsory.*

Q.1 Choose the correct answer of the following (Any seven question only): **[2 x 7 = 14]**

(a) In a stack, if a user tries to remove an element from empty stack it is called:
(i) underflow (ii) empty collection
(iii) garbage collection (iv) overflow

(b) Consider the binary max-heap implemented using an array. Which one of the following array represents the heap:
(i) 25, 12, 16, 13, 10, 8, 14 (ii) 25, 12, 16, 13, 10, 8, 14
(iii) 25, 14, 16, 13, 10, 8, 12 (iv) 25, 14, 12, 13, 10, 8, 16

(c) A hash function h defined as h (key) = key mod 7, with linear probing used to insert keys 44, 45, 79, 55, 91, 18, 63 into a table indexed from 0 to 6. What will be the location of key 18.
(i) 3 (ii) 4
(iii) 5 (iv) 6

(d) If the number of values to be sorted is already partially sorted, then _____ sorting can be efficient.
(i) merge (ii) insertion
(iii) bubble (iv) selection

(e) The time complexity of merge sort is :
(i) $O(n)$ (ii) $O(logn)$
(iii) $O(nlogn)$ (iv) $O(n2)$

(f) State *true* or *false*:
A : Binary search is used for searching in a sorted array.
B : The time complexity of binary search is $O(logn)$
(i) True, False (ii) False, True
(iii) False, False (iv) True, True

(g) In a circular linked list organization, insertion of a record involves modification of
(i) One pointer (ii) Two pointers
(iii) More than two pointers (iv) No pointer

(h) Level order traversal of a rooted tree can be done by starting from the root and performing
(i) pre-order traversal (ii) in-order traversal
(iii) depth first search (iv) breadth first search

(i) An Abstract Data Type (ADT) is
(i) same as an abstract class (ii) a data type that cannot be instantiated
(iii) a data type for which only the operations defined on it can be used, but none else
(iv) all of the above

(j) How many distinct BSTs can be constructed with 3 district keys?
(i) 4 (ii) 5
(iii) 6 (iv) 9

P.T.O.

Q.2 (a) Explain different asymptotic notations (Big-O, Ω, θ) used for comparing the time complexity of an algorithm with neat figures. [7]

(b) The run time of an algorithm is represented by the recurrence relation $T(n) = 2T(n/2) + n\,;\, n \geq 2$ and with boundary condition $T(1) = 0$. What is the time complexity (in terms of θ notation). [7]

Q.3 (a) Discuss pre-order, in-order and post-order traversal techniques of binary tree. Write a C function for non-recursive pre-order traversal. [7]

(b) The pre-order traversal sequence of a Binary Search Tree (BST) is 30, 20, 10, 15, 25, 23, 39, 35, 42. Write step by step process to derive the BST and find post-order traversal also. [7]

Q.4 (a) Consider a circular queue of capacity n-elements implemented with an array. Write C functions for *insertion* and *deletion* operations. [7]

(b) Convert the given infix expression into postfix using stack : $A + B / C * (D + E) - F$. For each input symbol clearly mention the *action taken* and *status of the stack* during conversion. [7]

Q.5 (a) Write a C function to delete last node from a singly linked list. [7]

(b) Create a max-heap by inserting following keys in the given order. Show each insertion step with clear illustration: 25, 35, 18, 9, 46, 70, 48. [7]

Q.6 (a) Write an algorithm for merge sort and discuss space and time complexity. [7]

(b) Define collision in hashing. Explain briefly different methodologies to resolve collision. [7]

Q.7 (a) Write algorithm to count leaf nodes in a binary tree. What is the complexity of your algorithm? [7]

(b) Compare BFS and DFS traversal techniques for graph. Write an algorithm to perform BFS using queue. [7]

Q.8 (a) Differentiate between system defined data types and abstract data types with suitable examples. [7]

(b) What is doubly linked list? What are its applications? Explain how a node can be added as last node using appropriate pseudo code [7]

Q.9 Write short notes on any two of the following: [7x2=14]

(a) AVL Rotations

(b) Open Addressing & Chaining

(c) B-Tree

(d) Priority Queue