JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2024

B.Tech-2nd Semester (CSE/IT/ECE/CE)

COURSE CODE (CREDITS): **18B11CI211 (4)**   MAX. MARKS: 35

COURSE NAME: **DATA STRUCTURES AND ALGORITHMS**

COURSE INSTRUCTORS: **PKG, EGA, VKL, KLK, FSL**   MAX. TIME: 2 Hours

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Note: Note: (a) Attempt all questions in sequential order.
(b)Marks are indicated against each question in square brackets.
(c) There is no syntax error. In case, if you found the same then ignore it and go ahead with the given problem
*(d) While solving the **Tree-based problems consider the predecessor of a node** wherever required.*

Q1. Let us assume a graph G which has n vertices and m edges. On depth first search of G, What can be the tightest upper bound on the running time when the graph is represented using an

    i.   Adjacency matrix
    ii. Adjacency list

Justify your answer.   **[CO5] [2+2]**

Q2. Which sorting algorithm has the lowest worst-case time complexity? Apply this algorithm to sort the following data. Show all the steps.
    70, 50, 10, 30, 80, 20, 60, 40   **[CO6] [1+2]**

Q3. Differentiate between radix sort and bucket sort. Show all the steps required to apply radix sort and bucket sort on the following set of values also identify which algorithm is better. Consider $\log_{10}(x)$ wherever required.

    546, 342, 123, 354, 2231, 669, 500, 12   **[CO6] [1+2]**

Q4. A Priority Queue is implemented as a Max-Heap. Initially, it has 5 elements. The level-order traversal of the heap is given below: 10, 8, 5, 3, 2. Two new elements 1 and 7 are inserted in the heap in that order. Find the level-order traversal of the heap after the insertion of the elements. Justify your answer.   **[CO6] [2+1]**

Q5. Consider the following operation along with *Enqueue* and *Dequeue* operations on a Queue, where *k* is a global parameter. What will be the worst case time complexity of a sequence of *n* MultiDeq() operations if the queue is empty initially? Justify your answer.

```
MultiDeq(Q)                                        [CO4] [2+1]
{
    m = k;
    while (Q is not empty and m  > 0)
    {
        Dequeue(Q)
        m = m - 1;
}}
```

Q6. Give an algorithm to convert an expression given in infix form to polish form. Analyze it for space and time complexity. Hand run your algorithm on the following expression using stack:

A + (B*C-(D/E^F)*G)*H.   [CO4] [2+2]

Q7. Making use of a queue of size 3 and a stack of size 5, identify the word ESSIDATRITNO. Show all the steps for your findings.   [CO4] [2]

Q8. The following C function takes a single-linked list of integers as a parameter and rearranges the elements of the list. The function is called with the list containing the integers 7,6,5,4,3,2,1 in the given order. What will be the contents of the list after function completes execution? Justify your answer.

[CO4] [2+1]

```
struct node
{
  int value;
struct node *next;
};
void rearrange(struct node *list)
{
struct node *p, *q;
int temp;
  if (!list || !list -> next) return;
p = list; q = list -> next;
while(q)
{
temp = p -> value; p->value = q -> value;
q->value = temp; p = q ->next;
q = p? p ->next : 0;
} }
```

Q9. Draw the Binary Search Tree (BST) that results from inserting the numbers below starting with 70 and ending with 62.   [CO4] [1+1+3]

70 11 47 81 20 61 10 12 13 62

Based on above created BST answer the following:
a) Check tree is height-balanced?
b) If the above BST is not height-balanced then convert it into height-balanced tree. Show all the steps of your operations.

Q10. A function f defined on stacks of integers satisfies the following properties.

$f(S)=0$ and $f(push(S,i))=max(f(S),0)+i$ for all stacks S and integers i.

If a stack S contains the integers 4,−1, -4, 7, -8 in order from bottom to top. Find the final value of $f(S)$? Show all steps for your calculation.   [CO4] [3+2]