Roll Number:_____

Thapar Institute of Engineering & Technology
Department of Computer Science and Engineering
AUXILIARY EXAMINATION

B. E. **(COE/CSE)**
12th Aug., 2024
Monday, Time– 5:30 PM
Time: 3 Hours, Max Marks: 100

Course Code: UCS301
Course Name: Data Structures
Name of Faculty: Dr Simranjit Kaur

Note: Answer all sub-parts of each question at one place. Do mention Page No. of your attempt at front page of your answer sheet. Assume missing data (if any).

Q1

a) Determine the worst case time complexity of the following functions by finding the frequency i.e. the number of times each statement executes: (4)

i) fun1(n)

```
{
  int i, j, k = 0;
  for (i = n / 2; i <= n; i++) {
     for (j = 2; j <= n; j = j * 2)
        k = k + n / 2;
                        }
}
```

ii) fun2 (n)

```
  {
     for (int i = 1; i <= n; i++)
          for (int j = 1; j <= 8; j = j + 1)
               printf ("Passion");
  }
```

b) Given the base address of an array A[1300 ..... 1900] as 1020 and the size of each element is 2 bytes in the memory, find the address of A[1700], A[1800] and A[1900]. (6)

c) Write an algorithm to insert and delete an element from an array of integers. What will be the time complexity of insertion and deletion at the beginning of an array? (10)

Q2

a) Consider the following sequence of operations on an empty stack - push(20), push(17), pop(), push(35), push(62), m = pop() and the following sequence of operations on an empty queue - enqueue(31), enqueue(25), dequeue(), enqueue (18), enqueue(61), n = dequeue(). What will be output of m + n? You need to show the content of stack and queue during these operations. (4)

b) Write the pseudocode to evaluate postfix expression using stack as an intermediate data structure. Show contents of the stack at each intermediate step to evaluate following postfix expression: 3, 8, +, 9, 3, /, - (6)

c) Write the pseudocode to sort an array of integers using bubble sort algorithm. Show the execution steps of bubble sort algorithm on the following unsorted array: (10)

7, 12, 9, 11, 3, 21, 5

Q3

a) What will be output of the following function on a linked list 1->2->3->4->5->6->7->8? The start variable is pointing to the first node of the list and each node of the list has data field and next pointer field. (4)

```
void fun3(struct node* start)
{
 if(start == NULL)
  return;
 printf("%d ", start->data);
 if(start->next != NULL )
   fun(start->next->next);
 printf("%d ", start->data);
}
```

b) A hash table of length 10 uses open addressing with hash function h(k)=k mod 10, and linear probing. After inserting 6 values into an empty hash table, the table is as shown below. Write down a possible order in which the key values could have been inserted in the table? (6)

0	1	2	3	4	5	6	7	8	9
		42	23	34	52	46	33		

c) Write down a C function which takes a simply-linked list as input argument. It should modifies the list by moving the last element to the front of the list and returns the modified list. (10)

Q4

a) Write the pseudocode to perform the following operations on a Doubly ended queue: (i) Insert at the front end and (ii) Delete from the rear end. (4)

b) Apply suitable data structure to covert following infix expressions to postfix expressions: (6)
i) ((A + B) * (C – D) + E) / (F + G)
ii) (A + B * (C - D)) / E

c) Given a function fun4 which takes two arguments (an integer k and a queue of integers) and reverse the order of the first k elements of the queue, leaving the other elements in the same relative order. Write down missing lines of code (1-5) in a function. (10)

```
queue fun4(queue q, int k) {
  solve(q, k);
  int s = q.size() - k;
  while (s-- > 0) {
    int x = q.front();
    _____1_____;
    _____2_____;
  }
  return q;
}
```

```
void solve(queue & q, int k) {
  if (k == 0) return;
  _____3_____;
  _____4_____;
  solve(q, k - 1);
  _____5_____;
}
```

Q5

a) Insert the given numbers into an empty binary search tree in the order 10, 1, 3, 5, 15, 12, 16. Show the reconstructed binary search tree after the deletion of a node 10. What is the height of the tree after the deletion operation? (4)

b) Write down the Kruskal's algorithm to find the minimum spanning tree of a graph. Consider a complete undirected graph with vertex set {0, 1, 2, 3, 4}. Entry Wij in the matrix W below is the weight of the edge {i, j}. What is the minimum possible weight of a spanning tree T in this graph such that vertex 0 is a leaf node in the tree T? (6)

0	1	8	1	4
1	0	12	4	9
8	12	0	7	3
1	4	7	0	2
4	9	3	2	0

c) What will be the adjacency list and adjacency matrix of a below given graph? Write down procedure for Breadth-First-Search traversal of a graph. Show step-by-step execution of Breadth-First-Search procedure for the given graph (consider 0 as source vertex) and write the possible order of visiting the nodes. (10)