Roll Number:____________________

Thapar Institute of Engineering & Technology

Department of Computer Science and Engineering

AUXILIARY EXAMINATION

B. E. **(COE/CSE): 2nd Year and 3rd Semester**
19th Feb, 2024
Monday, Time– 5:30 To 8:30 PM
Time: 3 Hours, Max Marks: 100

Course Code: UCS301
Course Name: Data Structures
Nameof Faculty: Tarunpreet Bhatia

Note: Attempt all questions. 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).

Q.1	Draw a resultant Binary Search Tree (BST) by sequentially inserting the elements 21, 26, 30, 9, 4, 14, 28, 18, 15, 10, 2, 3 in the given order. What will be the preorder traversal of the resultant BST? Also, construct the AVL tree for the same set of elements used for constructing BST. After each insertion that includes rotation, redraw the respective AVL tree.	(6+2+ 7)
Q.2	(a) Write an algorithm to sort the elements of an array using insertion sort. Apply your algorithm to sort arr[] = {12, 11, 13, 5, 6}. What will be worst-case and best case time complexity of your algorithm? (b) Consider a priority queue implemented as a min heap. Initially it has 5 elements. The level order traversal of the heap is 99, 142, 305, 221, 440. After that, element 318 is inserted and then extract min operation is performed. This process is repeated one more time with the value to be inserted is 102. Draw the resulting structure of the heap after each operation. Write down the level order traversal of the resultant heap.	(6+2) (8)
Q.3	(a) Write functions to perform following operations on a doubly linked list: (i) Insert at the beginning, (ii) Insert at the specified position, (iii) Delete from the specified position, and (iv) Delete from the end. (b) Write the steps to evaluate a postfix expression using stack. Evaluate the postfix expression, "2 2 3 ^ + 7 * 5 -" using a stack.	(8) (6)

Q.4	(a) Consider inserting the keys 27, 43, 55, 72, 36, 45, 32 into a hashtable of size m=7. Show the result of this insertion using (i) Quadratic probing with hash function h(k)=(k mod m) (ii) Double hashing collision resolution technique with first hash function as h1(k)=(k mod m) and second hash function as h2(k)=1+(k mod 5). Also, draw the resultant hash table in both the cases.
	b) Determine the time complexity of the following functions by finding the frequency i.e. the number of times each statement executes:
	(i) void fun1(int n)
	{
	for (int i = 0; i <= n / 3; i++)
	for (int j = 1; j <= n; j = j + 4)
	cout <<"Hello World";
	}
	(ii) void fun2(int n)
	{
	i = n
	while (i>=1)
	{
	for j = 1 to n
	x=x +1
	i = i/2
	}
	(iii) void fun3(int n)
	{
	for (int i = 0; i < n / 2; i++)
	for (int j = 1; j + n / 2 <= n; j++)
	for (int k = 1; k <= n; k = k * 2)
	printf("Be Positive ");
	}
		(4+4)
		(6)

Q.5 (a) Write an algorithm/pseudocode for graph traversal using Depth First Search (DFS) approach. Consider the directed graph G(V, E) with vertex set {A, B, C, D, E, F, G, H, I} and edge set {AB, AC, BC, BG, DC, ED, AF, CF, EC, EH, GC, GE, HD, FD, HI, IE, IG}, show the adjacency list representation of G. Find the DFS traversal sequence for each vertex of Graph from starting vertex H. Whenever there is a choice of vertex, follow lexicographic (alphabetic) order. You need to show intermediate steps for finding the sequence. (10)

(b) Construct a minimum spanning tree using Kruskal's algorithm for the undirected weighted graph G(V,E) with vertex set (A, B, C, D, E, F, G) and edge set (AB,4), AG,13), (BD,3), (BC,10), (CD,15), (CG,22), (GF,10), (CF,7), (DE,20), (FE,8). What is the total cost? Show intermediate steps. (5)

Q.6 a) Write an algorithm for enqueue() and dequeue() operations in a circular queue implemented using array. (8)

b) Consider the function What_Do_I_Do() given in the form of pseudo code. What will be the structure of circular linked list (CLL) given in Fig 1 after the execution of this pseudo code? (Temp is node type pointer variable, and X and Y are temporary integer variables) (6)

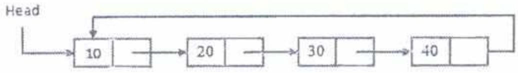

Fig 1.

```
What_Do_I_Do (Head)
Temp=Head
X= Temp.Data
While (Temp.Next ! = Head)
Y= Temp.Next.Data
Temp.Next.Data=X
X=Y
Temp = Temp.Next
End of While
Head.Data=X
End
```

Q.7 (a) Consider an array containing both positive and negative elements. Write an algorithm/pseudocode to move all the negative elements of an array to the front i.e. before all positive elements. The time complexity of your algorithm should be O(n). Assume that the order of elements in the resultant array doesn't matter. (5)

(b) The following C function takes a simply-linked list as input argument. It modifies the list by moving the last element to the front of the list and returns the modified list. Fill in missing lines of code (1-3). (3)

```
typedef struct node
{
 int value;
 struct node *next;
}Node;

Node *move_to_front(Node *head)
{
 Node *p, *q;
 if ((head == NULL: || (head->next == NULL))
   return head;
 q = NULL; p = head;
 while (p-> next !=NULL)
 {
  q = p;
  p = p->next;
 }
 ____1____;
 _____2___;
 _____3____;

 return head;
}
```

(c) What is the output of following function for start pointing to first node of following singly linked list? 1->2->8->4->7->6. (4)

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

**********************************ALL THE BEST**********************************