United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Final Exam Trimester: **Fall - 2019**

Course Code: **CSI 217** Course Title: **Data Structures**

Total Marks: **40** Duration: **2 hours**

Answer all 5 questions. *Each question contains 8 marks.*

Question 1.

a) Construct a Binary Search Tree using the values below: [2]

55 20 30 75 80 15 78 5 25 85 28

(Remember you have to insert these values in the given order)

b) Is the tree that you constructed in 1.b) a height balanced tree? If your answer is Yes, justify it. [1]

c) Perform pre-order and post order traversal on the tree constructed in 1.b). [2]

d) Apply the following operations **sequentially** on the Binary Search Tree you constructed in 1.b) and draw the state of the Binary Search Tree after each operation. [3]

(i) Delete 20

(ii) Insert 20

(iii) Delete 30

Question 2.

a) From the following array show where it violates the min heap property. Also convert it to a Min Heap. [1+2]

	8	13	45	3	21	17	39	24	1	12	9

b) Suppose you want to sort the Min Heap you created in 2.a) in ascending order using Heapsort algorithm. Is it possible to perform the sorting without using any extra array? Or do you need to use an extra array? Clearly explain how you would perform the heap sort. [2]

c) Apply the following operations sequentially on the Min Heap you constructed in 2.a) and draw the state of the Min Heap after each operation [3]

(i) Insert 2

(ii) Decrease key of 39 to 5

(iii) Delete 21

Question 3.

a) Write the pseudocode to perform a Depth First Search (DFS) on a Binary Tree. [4]

b) Consider the following structure for a binary tree node. [4]

```
struct Node{
    int data;
    struct Node* left;
    struct Node* right;
};
```

Write a pseudocode to determine if a Binary Tree is height balanced or not. The function will take the root node as parameter and will return true if tree is height balanced.
Otherwise it will return false. The prototype of the function is given below.

```
bool is_height_balanced(struct Node* n)
```

(Hints: A tree is height balanced if for every node the difference of height of its left sub-tree and right sub-tree is at max 1)

Question 4.

a) How would you store a weighted graph using Adjacency Matrix and Adjacency List? Give your answer with an example. [2]

b) Suppose G=(V,E) is a simple **DIRECTED** Graph consisting of 7 vertices with edges (0,2), (0,3), (0,4), (1,0), (1,3), (2,1), (3,5), (3,6) and (4,3). Draw the graph G and also draw the adjacency matrix and the adjacency list for G. [3]

c) Apply BFS on the Graph G in 3b). Start with vertex 0 as source. Also **prepare an array** which will keep track of the parent of all vertices in BFS. [3]

Question 5.

a) Which data structure that would you use to represent the site map of Facebook? The site map of Facebook displays different pages and the links between the pages. There may be multiple links between the web pages and the links are always one way. Describe clearly how you would store the webpages and the links. [2]

b) Answer the following questions on Set operations.

(i) Assuming that there are 10 items, perform the following union operations. You have to show the changes in the sets after each operation. [3]

Union(1,2), Union(3,4), Union(5,6), Union(7,8), Union(7,9), Union(2,8), Union(0,5)

(ii) How many connected components are there after performing the operations in 5.b)(i)? [1]

(iii) After performing the operations in 5.b)(i) [2]

a. Is 6 and 7 connected? Explain your answer.
b. Is 1 and 2 connected? Explain your answer.