**Question one**

a) Differentiate the following using appropriate examples:

1. Time Complexity and Space Complexity **[2]**
2. Algorithm and Pseudocode **[2]**

b) Explain the following data structures and for each describe any two areas of application using an illustration

1. Stack **[2]**
2. Linked List **[2]**

c) Convert the following infix expression into prefix and postfix

1. A-(B-(C-D))  **[2]**
2. (A\*B)/(C-D) **[2]**
3. (A+B) \*(C/(D-E)) **[2]**

d) Explain the following terms as used in algorithm analysis:

1. Best Case **[2]**
2. Worst Case **[2]**
3. Average Case **[2]**

**Question two**

a) Write an algorithm of BST algorithm and implement it on the array below to find element 15.

{32,70,34,68,72,15,24,30,66,11,50,10} [12]

b. State and explain four properties of a BST **[8]**

**Question three**

a) Describe the following types of graphs and how there are implemented:

1. Mixed graph **[4]**
2. Directed graph **[4]**
3. Unidirected graph **[4]**

iv. Weighted graph [4]

b) State four real world applications of algorithms **[4]**

**Question four**

a) Use the Huffman algorithm on the array of characters below. Clearly show how data has been compressed.

{ACCEBFFFFAAXXBLKE}  **[20]**

**Question five**

Use the following algorithms and show clearly how they are implemented using an appropriate example:

1. Breadth first algorithm.  **[4]**
2. Depth first algorithm. **[4]**
3. Shortest path algorithm.**[4]**
4. Kruskal algorithm. **[4]**
5. MST algorithm.  **[4]**

**Question six**

a) The following algorithm takes as input an array, and returns the array with all the duplicate elements removed. For example, if the input array is {1, 3, 3, 2, 4, 2}, the algorithm returns {1, 3, 2, 4}.

*S = new empty set*

*A = new empty dynamic array*

*for every element x in input array if not S.member(x) then*

*S.insert(x)*

*A.append(x)*

What is the big-O complexity of this algorithm, if the set is implemented as:

1. AVL tree [6]
2. hash table [6]

b) State and Explain four factors that determine the effectiveness of an algorithm **[8]**

**Question seven**

1. Differentiate the following algorithms and give appropriate data structures that are implemented by these algorithms:
2. Greedy algorithm and Best-Case algorithm **[5]**
3. Merge Sort algorithm and Quick Sort  **[5]**
4. Breadth first algorithm and Depth first algorithm **[5]**
5. Stack and Queue **[5]**

**Question eight**

a) Below are stack operations that can implemented on a stack. Use pseudocodes to how these operations work on a stack:

1. IsEmpty() **[3]**
2. IsFull() **[3]**
3. peek()  **[3]**
4. pop() **[3]**
5. remove() **[3]**
6. Implement bubble sort method algorithm on the array below:

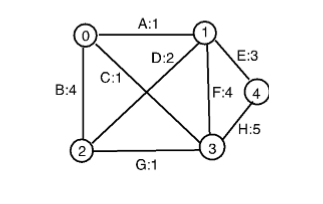
{10,4,5,3,100,30,85,15,70} **[5]**

**Question nine**

a. Write a function to do the following:

1. Returns the *ith* value from a fibonacci series using method of recursion **[4]**
2. Insert an element into a queue **[4]**

b. Below is an undirected graph, use MST algorithm to find the subgraph tree with the most weights. The number on each edge denotes its weight, and the letter is a unique label you should use in your answer to specify that edge. Provide the edges in the order in which they would be found by MST algorithm. Break any ties using the alphabetical label. **[12]**



**Question ten**

a) Differentiate the following:

1. Linked List and Arrays **[4]**
2. Sequential Allocation and Linked Allocation **[4]**

b) Write the selection sort algorithm and implement it on the array below to sort the elements of the array.

A = {10, 2, 3, 90, 43, 56}.  **[12]**

**Question eleven**

a) Evaluate the following postfix expression using a stack. Use a stack evaluation table to express this:

1. 2 3 + - 3 8 2 / + \* 2 / 3 + [**10]**

b) State and explain 5 operations that can be implemented by a circular queue. Write an algorithm on each operation **[10]**

**Question twelve**

a) Define these MST expressions: safe edge, cut, respecting a set of edges. **[3]**

b) Describe an efficient MST-finding algorithm, write some clear pseudocode for it and prove its correctness. **[9]**

c) Write the function that required when reading and deleting a value from the data structures below:

1. List **[4]**
2. Hashtable [**4]**

**Question thirteen**

a) Write the functional program of inserting and retrieving values from map data structures, use java programming language **[8]**

b) i. Construct a binary for the list of elements in the array below:

{japan, sudan, angola, poland, bangaladesh,south korea, zambia} **[3]**

ii. Traverse the tree using tree traversal algorithms methods and list the elements.**[9]**

**Question fourteen**

a. Use the following algorithms and show clearly how they are implemented using an appropriate example:

1. Greedy algorithm **[4]**
2. best case algorithm **[4]**
3. Shortest path algorithm **[4]**

b. State the applications of algorithms below:

1. breadth first algorithm **[4]**
2. depth first algorithm **[4]**

**Question fifteen**

a) The following algorithm takes as input an array, and returns the array with all the duplicate elements removed. For example, if the input array is {A, C, C, B, E, B}, the algorithm returns {A, C, B, E}.

*W = new empty set*

*X = new empty dynamic array*

*for every element x in input array if not W.member(x) then*

*W.insert(x)*

*X.append(x)*

What is the big-O complexity of this algorithm, if the set is implemented as:

1. Linked List [6]
2. hash table [6]

b) Describe the following types of graphs:

1. undirected graph. [2]
2. directed graph. [2]
3. edge attribute. [2]
4. weighted graph. [2]

**Question sixteen**

a) Below are map operations that can implemented on a map. Write the full functional program showing how it is implemented on map data structure:

1. new() [4]
2. put() [4]
3. add() [4]
4. return() [4]
5. lookup() [4]

**Question seventeen**

a) Write the quicksort algorithm and implement it on the array below, show clearly how all the stages:

{8, 33,6, 21, 4} [20]