**COURSE CODE: HCS123/ISH121**

**COURSE TITLE: DATA STRUCTURES AND ALGORITHMS**

**LECTURER: MS M. MADYEMBWA**

**CELL: 0771151011**

**EMAIL: mmadyembwa@gzu.ac.zw**

**OBJECTIVES:**

The course should enable the students to:

* Demonstrate familiarity with major algorithms and data structures.
* Choose the appropriate data structure and algorithm design method for a specified application.
* Determine which algorithm or data structure to use in different scenarios.
* To improve the logical ability.

**Algorithms**

**1. Introduction to data structure**

Definition, Abstract Data Type, Importance of Data structure

**2. The Stack**

Introduction, Stack as an ADT, POP and PUSH Operation, Stack Application: Evaluation of Infix, Postfix, and Prefix Expressions, Conversion of Expression.

**3. Queue**

Introduction, Queue as an ADT , Primitive Operations in Queue, Linear and Circular Queue and Their Application, Enqueue and Dequeue, Priority Queue

**4. List**

Introduction, Static and Dynamic List Structure, Array Implementation of Lists, Queue as a list

**5. Linked Lists**

Introduction, Linked List as an ADT, Dynamic Implementation, Insertion & Deletion of Nodes, Linked Stacks and Queues, Doubly Linked Lists and Its Advantages

**6. Recursion**

Introduction, Principle of Recursion, Recursion vs. Iteration, Recursion Example: TOH and Fibonacci Series, Applications of Recursion, Search Tree

**7. Trees**

Introduction, Basic Operation in Binary tree, Tree Search and Insertion/Deletion, Binary Tree Transversals (pre-order, post-order and in-order), Tree Height, Level and Depth, Balanced Trees: AVL Balanced Trees, Balancing Algorithm, The Huffman Algorithm, Game tree, B-Tree

**8. Sorting**

Introduction, Internal and External Sort, Insertion and Selection Sort, Exchange Sort, Bubble and Quick Sort, Merge and Radix Sort, Shell Sort, Binary Sort, Heap Sort as Priority Queue, Efficiency of Sorting, Big'O'Notation.

**9. Searching**

Introduction to Search Technique; essential of search, Sequential search, Binary search, Tree search, General search tree, Hashing: Hash function and hash tables, Collision resolution technique, Efficiency comparisons of different search technique.

**10. Graphs**

Introduction, Graphs as an ADT, Transitive Closure, Warshall's Algorithm, Types of Graph, Graph Traversal and Spanning Forests, Kruskal's and Round-Robin Algorithms, Shortest- path Algorithm, Greedy Algorithm, DijKstra's Algorithm

**10. Algorithms**

Deterministic and Non-deterministic Algorithm, Divide and Conquer Algorithm, Series and Parallel Algorithm, Heuristic and Approximate Algorithms

**Laboratory Works**

There shall be 10 lab exercises based on Java

I. Implementations of different operations related to Stack

2. Implementations of different operations related to linear and circular queues

3. Solutions of TOH and Fibonacci Series using Recursion

4. Implementations of different operations related to linked list: singly and doubly linked

5. Implementation of trees: AVL trees, Balancing of AVL

6. Implementation of Merge sort

7. Implementation of different searching technique: sequential, Tree and Binary

8. Implementation of Graphs: Graph traversals

9. Implementation of Hashing

10. Implementations of Heap