Course Title:  **Data Structures and Algorithms (3 Cr.)**  
Course Code:  **CACS201**  
Year/Semester:  **II/III**  
Class Load:  **6 Hrs. / Week (Theory: 3 Hrs., Practical: 3 Hrs.)**

**Course Description**

This course includes fundamental concept of data structures such as stack, queue, list, linked list, trees and graph; application of these data structures along with several algorithms.

**Course Objectives**

The general objective of this course is to provide fundamental concepts of data structures, different algorithms and their implementation.

**Course Contents**

**Unit 1** Introduction to data structure  
2 Hrs.  
Definition, Abstract Data Type, Importance of Data structure.

**Unit 2** The Stack  
3 Hrs.  

**Unit 3** Queue  
3 Hrs.  
Introduction, Queue as an ADT, Primitive Operations in Queue, Linear and Circular Queue and Their Application, Enqueue and Dequeue, Priority Queue.

**Unit 4** List  
2 Hrs.  
Introduction, Static and Dynamic List Structure, Array Implementation of Lists, Queues as a List.

**Unit 5** Linked Lists  
5 Hrs.  
Introduction, Linked List as an ADT, Dynamic Implementation, Insertion & Deletion of Node To and From a List, Insertion and Deletion After and Before Nodes, Linked Stacks and Queues, Doubly Linked Lists and Its Advantages.

**Unit 6** Recursion  
4 Hrs.  
Introduction, Principle of Recursion, Recursion vs. Iteration, Recursion Example: TOH and Fibonacci Series, Applications of Recursion, Search Tree.

**Unit 7** Trees  
5 Hrs.  
Introduction, Basic Operation in Binary tree, Tree Search and Insertion/Deletion, Binary Tree Traversals (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.
Unit 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

Unit 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

Unit 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

Unit 11 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 C or Java
1. 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

Teaching Methods
The general teaching pedagogy includes class lectures, group discussions, case studies, guest lectures, research work, project work, assignments (theoretical and practical), and examinations (written and verbal), depending upon the nature of the topics. The teaching faculty will determine the choice of teaching pedagogy as per the need of the topics.
Examination Scheme

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<thead>
<tr>
<th>Internal Assessment</th>
<th>External Assessment</th>
<th>Total</th>
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<tbody>
<tr>
<td>Theory</td>
<td>Practical</td>
<td>Theory</td>
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<tr>
<td>20</td>
<td>20 (3 Hrs.)</td>
<td>60 (3 hrs.)</td>
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Text Book

Reference Books
1. G. W. Rowe, "Introduction to Data Structure and Algorithms with C and C++", PHI