COURSE TITLE	**DATA STRUCTURE AND ALGORITHM**
COURSE CODE	**01EC0116**
COURSE CREDITS	**3**

Objective:

1 The course aims to equip students with a strong foundation in data structures and algorithmic techniques, enabling them to model, analyze, and solve computational problems efficiently. Students will learn to select appropriate data structures, evaluate algorithm performance, and implement solutions using programming languages relevant to Electronics and Communication Engineering applications.

Course Outcomes: After completion of this course, student will be able to:

1 Apply fundamental concepts of data structures and algorithm complexity to implement sorting, searching, and traversal algorithms using linear and nonlinear data structures. (Bloom's Level: Apply)

2 Analyze the time and space complexity of various algorithms to assess their efficiency. (Bloom's Level: Analyze)

3 Evaluate the performance and efficiency of different algorithms in solving engineering problems, considering trade-offs and optimization strategies. (Bloom's Level: Evaluate)

4 Design and develop algorithmic solutions for real-world and engineering problems using appropriate data structures. (Bloom's Level: Create)

Pre-requisite of course: Basic knowledge of programming in C/C++/Python, fundamentals of computer organization, and mathematical reasoning (especially logic and discrete structures).

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
2	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction to Data Structures and Algorithms** Definition, need and classification of data structures, algorithm design, complexity analysis (Big-O,)	2
2	**Arrays, Strings, and Structures** 1D/2D arrays, operations, applications in signal/image storage, string handling, structures in C	2
3	**Linked Lists** Singly, doubly, circular linked lists, insertion, deletion, traversal; use in memory management	3

DR. RAJENDRAKUMAR DAHYALAL PATEL
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DR. RAJENDRASINH BAHADURSINH JADEJA
Digitally signed by (Name of Dean/ Principal)

Contents : Unit	Topics	Contact Hours
4	**Stacks and Queues** Stack and queue operations, Applications (expression evaluation, recursion, buffering), circular and priority queues	3
5	**Trees: Types and Operations** Binary trees, binary search trees (BST), tree traversals (inorder, preorder, postorder), , Applications in parsing and decision-making	3
6	**Balanced Trees and Heaps** AVL trees, heap (min/max), heap sort, introduction to B-trees; relevance in memory and database systems	3
7	**Graphs and Their Algorithms** Graph representations (adjacency list/matrix), BFS, DFS, real-world examples (network routing, circuit design)	3
8	**Searching and Sorting Techniques** Linear and binary search; sorting methods, bubble, insertion, selection, merge, quick, heap sort	3
9	**Algorithm Design Techniques** Divide and conquer, greedy method, dynamic programming – concepts and case examples (e.g., matrix chain, knapsack)	3
10	**Nature-Inspired Algorithms (Emerging Topic)** Basic concepts of genetic algorithms, ant colony optimization, particle swarm optimization; applications in ECE	3
Total Hours		**28**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment-1** Implement insertion, deletion, searching, and traversal in 1D and 2D arrays. Apply arrays to store sensor data.	2
2	**Experiment-2** Develop programs for string operations: copy, reverse, substring, palindrome check, pattern matching (e.g., KMP).	2
3	**Experiment-3** Create SLL and DLL with dynamic memory. Implement insert, delete, and display functions.	3
4	**Experiment-4** Implement stack using array and linked list. Use it to convert infix to postfix and evaluate postfix expressions.	3
5	**Experiment-5** Implement linear and circular queue using arrays and linked lists. Demonstrate with a job scheduling simulation.	2
6	**Experiment-6** Create a BST. Perform insertion, deletion, and all three types of traversal.	3

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Digitally signed by (Name of HOD)

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
7	**Experiment-7** Implement AVL tree with rotation. Create a min-heap and max-heap. Demonstrate heap sort on a data array.	3
8	**Experiment-8** Implement BFS and DFS using adjacency list. Simulate traversal over a communication network graph.	3
9	**Experiment-9** Implement and compare performance of bubble, insertion, merge, quick, and heap sort on large datasets.	3
10	**Experiment-10** Design a mini-project such as routing table simulation, expression parser, Huffman encoding, or signal buffering.	4
Total Hours		**28**

Textbook :

1 Data Structures Using C, Reema Thareja, Oxford University Press, 2nd Edition, 2014

2 Fundamentals of Data Structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, University Press (India), 2nd Edition, 2008

References:

1 Data Structures and Algorithm Analysis in C, Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson Education, 2nd Edition, 2002

2 Data Structures and Algorithms Made Easy, Data Structures and Algorithms Made Easy, Narasimha Karumanchi, CareerMonk Publications, 2nd Edition, 2011

3 Algorithms, Algorithms, Robert Sedgewick, Kevin Wayne, Addison-Wesley, 4th Edition, 2011

4 Introduction to Algorithms, Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, MIT Press, 3rd Edition, 2009

5 Data Structures, Algorithms and Applications in C++, Data Structures, Algorithms and Applications in C++, Sartaj Sahani, Silicon Press, 2004

6 Data Structures Using C & C++, Data Structures Using C & C++, Rajesh K. Shukla, Wiley- India, 2019

7 Data Structures and Algorithms in Python, Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Wiley India, 1st Edition, 2013

8 Problem Solving with Algorithms and Data Structures Using Python, Problem Solving with Algorithms and Data Structures Using Python, Bradley N. Miller, David L. Ranum, Franklin, Beedle & Associates Inc., 2nd Edition, 2011

9 Data Structures and Algorithms Using Python, Data Structures and Algorithms Using Python, Rance D. Necaise, Adapted by: G. T. Thampi , Wiley India Pvt. Ltd., Edition: Indian Edition, 2016

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
5.00	20.00	30.00	20.00	10.00	15.00

Instructional Method:

1 Lectures with multimedia presentations
2 Hands-on labs using C/C++/Python
3 Problem-solving sessions
4 Mini-projects and case studies
5 Quizzes and MCQ-based assessments
6 Use of online platforms for visualization

Supplementary Resources:

1 NPTEL Data Structures and Algorithms by Prof. Naveen Garg https://nptel.ac.in/courses/106/106/106106127/
2 Coursera Data Structures and Algorithms Specialization by UC San Diego & HSE https://www.coursera.org/specializations/data-structures-algorithms
3 YouTube MyCodeSchool – Data Structures Playlist https://www.youtube.com/user/mycodeschool
4 edX Algorithmic Thinking by Rice University https://www.edx.org/course/algorithmic-thinking-1
5 GeeksforGeeks Data Structures Tutorials, https://www.geeksforgeeks.org/data-structures/

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