Uka Tarsadia University

B. Tech.

Semester IV

Data Structures and Algorithms
CE4015

Effective from July-2022

Syllabus version: 1.00

Subject Code	Subject Title	Teaching Scheme			
		Hours		Credits	
		Theory	Practical	Theory	Practical
CE4015	Data Structures and Algorithms	3	2	3	1

Subject Code	Subject Title	Theory Examination Marks		Practical Examination Marks	Total Marks
		Internal	External	CIE	
CE4015	Data Structures and Algorithms	40	60	50	150

Objectives of the course:

- To provide knowledge of linear and non-linear data structures.
- To introduce various sorting and hashing techniques.
- Analyse the asymptotic performance of algorithms.

Course outcomes:

Upon completion of the course, the student shall be able to,

CO1: Learn fundamentals of data structures and explain the concepts of array.
CO2: Explain basic operations of linear data structure stack, queue and linked list in various applications.
CO3: Demonstrate and apply nonlinear data structure trees and graph to solve problem.
CO4: Understand and implement various elementary sorting, searching techniques and hashing.
CO5: learn good principles of algorithm design.
CO6: learn how to analyses algorithms and estimate their worst-case and average-case behaviour.

Sr. No.	Topics	Hours
	Unit – I	
1	**Introduction to Data Structures:** Algorithmic notation, Primary analysis at algorithms, Transmission of information, The storage of information, Data types, Types of data structures, String manipulation and Pattern matching, Storage structure for arrays, Arrays of structures, Application of arrays.	6
	Unit – II	

2	**Linear Data Structures:** Stacks, Applications of stacks, Polish expression, Reverse polish expression and their compilation, Recursion, Queues, Circular queue, Priority queue, Double ended queue, Applications of queue, Pointers and linked allocation, Linked linear lists, Singly linked lists, Doubly linked lists, Circular linked lists, Operation of linked linear lists, Applications of linked linear lists.	9
Unit – III		
3	**Nonlinear Data Structures:** Trees, Applications of trees, Multilinked structures, Representation of binary trees, Binary trees traversal – Inorder, Postorder, and Preorder, Conversion of general trees to binary trees, Binary search trees, Some balanced trees mechanism, e.g., AVL trees, Graph – graph and their representations, Applications of graphs, Elementary graph operations – Breadth first search, Depth first search, and Shortest path.	8
Unit – IV		
4	**Sorting and Searching:** Sorting - Sorting methods, Bubble sort, Selection sort, Quick sort, Merge sort, Radix sort, Searching - Searching methods, Sequential search and Binary search, Hashing.	8
Unit – V		
5	**Introduction to Algorithm:** The role of algorithms in computing, Insertion sort, Analyzing algorithms, Designing algorithms, Asymptotic notation, Standard notations and Common functions, Divide and Conquer, The maximum – subarray problem, Probabilistic analysis and Randomized algorithms, Indicator random variables, Randomized algorithms, Sorting in linear time.	8
Unit – VI		
6	**Basic Algorithmic Techniques:** Red – black trees, Properties of red – black trees, Rotations, Insertion, Deletion, Augmenting data structures, Dynamic order statistics, Dynamic programming, Matrix – chain multiplication, Elements of dynamic programming, Greedy algorithms.	6

Sr. No.	Data Structures and Algorithms (Practical)	Hours
1	Implementation of Array operations - Insert, Delete, Search, Update, and Display.	2
2	Implementation of Array applications of Sparse Matrices.	2
3	Implement a program for stack that performs following operations using array. (a) PUSH (b) POP (c) PEEP (d) CHANGE (e) DISPLAY	4
4	Write a program to implement Queue using arrays that performs following operations. (a) INSERT (b) DELETE (c) DISPLAY	2
5	Write a menu driven program to implement following operations on the singly linked list. (a) Insert a node at the front of the linked list (b) Insert a node at the end of the linked list (c) Insert a node such that linked list is in ascending order (d) Delete a First node of the linked list (e) Delete a node before specified position (f) Delete a node after specified position.	6
6	Implementation of Binary Search Trees.	4
7	Implementation of Sorting techniques. (a) Bubble Sort (b) Selection Sort (c) Merge Sort.	4
8	Implementation of Searching techniques. (a) Sequential Search (b) Binary Search.	2
9	Mini Project - Implementation using above Data Structure	4

Text books:

1. Jean-Paul Tremblay & Paul G – "An Introduction to Data Structures with Applications" – Second Edition, Tata McGraw Hill.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein – "Introduction to Algorithms" – PHI.

Reference books:

1. Ten Baum – "Data Structures using C & C++" – Prentice - Hall International.
2. Horowitz, Sahni, Galgotia – "Fundamentals of Computer Algorithms" Pub. 2001 ed.
3. Sartaj Sahani – "Fundamentals of Data Structures in C++"

Course objectives and Course outcomes mapping:

- To provide knowledge of linear and non-linear data structures: CO1, CO2, CO3
- To introduce various sorting and hashing techniques: CO4
- Analyse the asymptotic performance of algorithms: CO5, CO6

Course units and Course outcomes mapping:

Unit No.	Unit Name	Course Outcomes					
		CO1	CO2	CO3	CO4	CO5	CO6
1	Introduction to Data Structures	✓					
2	Linear Data Structures		✓				
3	Nonlinear Data Structures			✓			
4	Sorting and Searching				✓		
5	Introduction to Algorithm					✓	
6	Basic Algorithmic Techniques						✓

Programme outcomes:

PO 1: Engineering knowledge: An ability to apply knowledge of mathematics, science, and engineering.

PO 2: Problem analysis: An ability to identify, formulates, and solves engineering problems.

PO 3: Design/development of solutions: An ability to design a system, component, or process to meet desired needs within realistic constraints.

PO 4: Conduct investigations of complex problems: An ability to use the techniques, skills, and modern engineering tools necessary for solving engineering problems.

PO 5: Modern tool usage: The broad education and understanding of new engineering techniques necessary to solve engineering problems.

PO 6: The engineer and society: Achieve professional success with an understanding and appreciation of ethical behavior, social responsibility, and diversity, both as individuals and in team environments.

PO 7: Environment and sustainability: Articulate a comprehensive world view that integrates diverse approaches to sustainability.

PO 8: Ethics: Identify and demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work.

PO 9: Individual and team work: An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give/receive clear instructions.

PO 11: Project management and finance: An ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: A recognition of the need for, and an ability to engage in life-long learning.

Programme outcomes and Course outcomes mapping:

Programme Outcomes	Course Outcomes					
	CO1	CO2	CO3	CO4	CO5	CO6
PO1	✓	✓	✓	✓	✓	✓
PO2		✓	✓	✓	✓	✓
PO3		✓		✓		
PO4						
PO5			✓		✓	✓
PO6						
PO7						
PO8						
PO9						
PO10						
PO11				✓	✓	✓
PO12						