



MANIPAL UNIVERSITY JAIPUR
School of Information, Security and Data Science
DEPARTMENT OF DATA SCIENCE & ENGINEERING

Course Hand-out

Data Structures Lab | DSE 2131 | I Credits | 0 0 2 I

Session: July 24 – Nov 24 | Course Coordinator: Mr. Deevesh Chaudhary

Course Instructor: Mr. Deevesh Chaudhary, Dr. Malvinder Bali, Dr. Shitanshu Jain, Ms. Meenakshi gaur | Semester: III

A. Introduction: This course is offered by Department of Data Science and Engineering, targeting students who wish to pursue development and research in industries or higher studies in field of Data Science. This course will form the base of Data Science and hence this course is introduced at this level to make the students understand various ways of organizing data and storing it into memory and use the type depending upon the application.

B. Course Outcomes: At the end of the course, students will be able to:

[DSE 2131.1] Recall and Understand the basic programming concepts of various data structures.

[DSE 2131.2] Describe arrays, linked lists, stacks, queues and trees with representation in memory and their operations.

[DSE 2131.3] Implement different data structures to solve real world problems.

[DSE 2131.4] Explain different data structures and algorithms work and their advantages and disadvantages

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

[PO.9]. Individual and team work: 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 and receive clear instructions.

[PO.11]. Project management and finance: 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: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

At the end of the program, the students will be able to:

[PSO.1] Understand the role of the mathematical, statistical, and AI techniques in the field of data science & engineering.

[PSO.2] Apply the acquired knowledge and expertise to perform data analytics tasks for multidimensional data sets.

[PSO.3] Develop effective and scalable industrial solutions for real world socio-economic problems using data analytics tools and techniques.

D. Assessment Plan:

Criteria	Description		Maximum Marks
Internal Assessment (Summative)	Continuous Assessments	Lab File :10 Marks Internal Evaluation: 40 Marks	60
Exam (Summative)	Exam (Exam)	Viva: 20 Marks, Implementation of practical: 20 Marks	40
	Total		100
Attendance (Formative)		A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)		Students who miss a lab will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 2 throughout the entire semester.	

E. SYLLABUS

Implementation of array operations: insertion, deletion, linear search and binary search, matrix operation. **Implementation of singly, doubly and circular linked lists:** inserting, deleting, and inverting a linked list, Polynomial addition, subtraction and sparse matrix implementation by linked list. **Stacks and Queues:** adding, deleting elements. **Circular Queue:** Adding & deleting elements, conversion of infix to postfix and Evaluation of postfix expressions using stacks & queues, Implementation of stacks & queues using linked lists. **Recursive and non-recursive traversal of Trees:** Threaded binary tree traversal, BST and AVL tree implementation. **Implementation of sorting and searching algorithms:** bubble sort, Insertion sort, selection sort, quick sort, heap sort, merge sort, Hash table implementation.

Textbooks:

1. Forouzan, R. F. Gilberg, A Structured Programming Approach Using C, Cengage Learning.
2. S. Tannenbaum, J. Augenstein, Data Structures using C, Pearson India.

References Books:

1. E. Horowitz, S. Sahni, Fundamentals of Data Structures in C, Universities Press.
2. Cormen, T. H., Leiserson, C. E., Rivest, R. L., Stein, C. Introduction to Algorithms, Fourth Edition. United Kingdom: MIT Press.

F. Lecture Plan:

Class Number	Topics	Session Outcome	Mode of Delivery	Corresponding Course Outcome	Mode Assessing of the Outcome
1.	Programs based on pointer concept.	describe and implement various operations using pointers	Lab	DSE2131.1	Internal Evaluation Home Assignments External Evaluation
2.	Programs based on 1-D array operations	describe and implement various operations on 1-D array	Lab	DSE2131.2	Internal Evaluation Home Assignments External Evaluation
3.	Programs based on 2-D array operations with pointer notations	describe and implement various operations on 2-D array using pointers and functions.	Lab	DSE2131.2 DSE2131.3	Internal Evaluation Home Assignments External Evaluation
4.	Programs to implement singly linked-list list operations	describe and implement various operations on one way linked list	Lab	DSE2131.2 DSE2131.3	Internal Evaluation Home Assignments External Evaluation
5.	Programs to implement Circular Linked list and Doubly-linked list operations	describe and implement various operations on circular and two way linked list	Lab	DSE2131.2 DSE2131.3	Internal Evaluation Home Assignments External Evaluation
6.	Programs to implement stack and its operations	describe and simulate stack and its operations	Lab	DSE2131.2 DSE2131.3	Internal Evaluation Home Assignments External Evaluation
7.	Programs based on implementation of stack	describe and implement various application programs on stack	Lab	DSE2131.2 DSE2131.3	Internal Evaluation

					Home Assignments External Evaluation
8.	Programs based on implementation of queue and its operations	describe and implement various application programs on queue and priority queue	Lab	DSE2131.2 DSE2131.3	Internal Evaluation Home Assignments External Evaluation
9.	Programs to implement tree and its operations	describe and implement various operations on Binary search tree	Lab	DSE2131.2 DSE2131.3	Internal Evaluation Home Assignments External Evaluation
10.	Programs based on implementation of trees	describe and implement various operations on AVL Tree	Lab	DSE2131.2 DSE2131.3	Internal Evaluation Home Assignments External Evaluation
11.	Sorting	Describe and Implement various sorting techniques	Lab	DSE2131.3 DSE2131.4	Internal Evaluation Home Assignments External Evaluation

List of Experiments

Semester-Odd (III Semester)

Lab 1: Pointers

- Write a program to demonstrate the use of the & (address of) and *(value at address) operators.
- Write a program that takes two integers as input from the user and swaps their values using call by value. Display the values of the numbers before and after swapping.
- Write a program that takes two integers as input from the user and swaps their values using call by reference. Display the values of the numbers before and after swapping.
- Write a program that takes an array of integers as input, doubles the values of each element using a function that accepts a pointer to the array, and then displays the modified array.

Lab 2: Single Dimensional Array

- Write a program to insert an integer (at the start, at the end, in between) in an array of N integers.
- Write a program to delete an integer (at the start, at the end, in between) in an array of N integers.
- Write a program to search an element in an array using linear search technique.
- Write a program to search an element in an array using binary search technique.

Lab 3: Two-Dimensional Array

- Write a program to find the multiplication of two matrices. Write separate functions for reading the matrix, displaying the matrix and to find the multiplication of the matrices.
- Write a program to find the transpose of a matrix. Write separate functions for reading, displaying and to find the transpose of the matrix.
- Write a program to find check whether the matrix is upper triangular or not. Write separate functions for reading the matrix and to check whether the matrix is upper triangular or not.
- Write a program to find check whether the matrix is lower triangular or not. Write separate functions for reading the matrix and to check whether the matrix is lower triangular or not.

Lab 4: Linked List

- Write a program to perform following operations on the singly linked list:
Inserting a node (at the start, at the end, in between), deleting a node (starting node, last node, in between node), displaying information stored in the nodes. Write separate functions for each of the operations.

Lab 5: Circular and Doubly Linked List

- Write a program to perform following operations on the circular linked list:
Inserting a node (at the start, at the end, in between), deleting a node (starting node, last node, in between node), displaying information stored in the nodes. Write separate functions for each of the operations.
- Write a program to perform following operations on the doubly linked list:
Inserting a node (at the start, at the end, in between), deleting a node (starting node, last node, in between node), displaying information stored in the nodes. Write separate functions for each of the operations.

Lab 6 & 7: Stack

- Write a program to implement stack using array. Write separate functions for the following operations on stack: Push (inserting element), Pop (deleting element).
- Write a program to implement stack using linked list. Write separate functions for the following operations on stack: Push (inserting element), Pop (deleting element)

Lab 8: Queue

- Write a program to implement simple queue using array. Write separate functions for the following operations on queue: Enqueue (inserting element), Dequeue (deleting element).
- Write a program to implement simple queue using linked list. Write separate functions for the following operations on queue: Enqueue (inserting element), Dequeue (deleting element).
- Write a program to implement circular queue using array. Write separate functions for the following operations on queue: Enqueue (inserting element), Dequeue (deleting element).
- Write a program to implement circular queue using linked list. Write separate functions for the following operations on queue: Enqueue (inserting element), Dequeue (deleting element).

Lab 9 & 10 : Trees

- Write a program to implement binary search tree. Write separate functions for each of the following operations on binary search tree: Creating Binary Search Tree, Inserting a node in the tree, Deleting a node from the tree and to search an element in the tree.
- Write a program to traverse a binary search tree in pre-order, post-order and in-order.

Lab 11 : Sorting

- Write a program to sort an array of N integers using Bubble sort technique.
- Write a program to sort an array of N integers using selection sort technique.
- Write a program to sort an array of N integers using Insertion sort technique.
- Write a program to sort an array of N integers using Quick sort technique.

H. Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES (POs)														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
[DSE2131.1]	Recall and Understand the basic programming concepts of various data structures	3	2										2	3		
[DSE2131.2]	Describe arrays, linked lists, stacks, queues and trees with representation in memory and their operations.		1	2									2	3		
[DSE2131.3]	Implement different data structures to solve real world problems		1	2									2	3		
[DSE2131.4]	Explain different data structures and algorithms work and their advantages and disadvantages		1	2									2	2		

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation