	Data Structures with C	Semester	III
Course Code	**BUE302**	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination type (SEE)	Theory		

Course Learning objectives: This course will enable students:

1. To describe the principles of data structures and their applications, which are necessary for putting problem-solving techniques into practice.
2. To illustrate representation of data structures: Stack, Queues, Linked Lists, Trees and Graphs.
3. To create and Implement Problem-Solving Solutions Using Arrays, Structures, Stacks, Queues, and Linked Lists
4. To examine the use of trees and graphs in the creation of applications.
5. To apply the Hashing techniques in mapping key value pairs.

MODULE-1

Basic Concepts: Pointers and Dynamic Memory Allocation. Arrays and Structures: Arrays, Dynamically Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, Representation of Multidimensional Arrays, Strings.

RBT Level: L1, L2, L3

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, You tube videos, Brain storming, Activity based method, Seminar, Demonstration

MODULE-2

Stacks and Queues: Stacks, Stacks Using Dynamic Arrays, Queues, Circular Queues Using Dynamic Arrays, Multiple Stacks and Queues.

Stack Applications: Infix to postfix conversion, Infix to prefix conversion, evaluation of postfix expression, recursion.

RBT Level: L1, L2, L3

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, You tube videos, Brain storming, Activity based method, Seminar, Demonstration

MODULE-3

Linked List: Singly Linked lists and Chains, Representing Chains in C, Linked Stacks and Queues, Polynomials, Additional List operations, Doubly Linked Lists.

RBT Level: L1, L2, L3, L4

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, You tube videos, Brain storming, Activity based method, Seminar, Demonstration.

MODULE 4

Trees: Introduction, Binary Trees, Binary Tree Traversals, Additional Binary Tree Operations, Threaded Binary Trees, Heaps, Binary Search Trees, Selection Trees, Forests, Representation of Disjoint Sets, Counting Binary Trees, AVL trees and Splay trees.

RBT Level: L1, L2, L3

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, You tube videos, Brain storming, Activity based method, Seminar, Demonstration

MODULE 5

Case Studies and Industry Applications: These case studies and applications provide practical examples of how data structures and algorithms are applied in various industries. By studying real-world scenarios, students can gain insights into the challenges and solutions encountered in the industry, enhancing their understanding and readiness for real-world applications.

Stack:

1. Expression Evaluation: Use a stack to evaluate arithmetic expressions. Push operands onto the stack and perform operations when encountering operators.
2. Function Call Stack: Simulate the function call stack during program execution, allowing for the tracking of nested function calls and their return addresses.

Queue:

1. Job Scheduling: Use a queue to schedule and process jobs in the order of their arrival time. New jobs are enqueued at the end, and the first job in the queue is processed.
2. Breadth-First Search (BFS): Implement BFS using a queue to traverse a graph or tree level by level, visiting all nodes at a given level before moving to the next level.

Linked List:

1. Linked List Implementation: Implement a singly linked list or a doubly linked list to store and manipulate a collection of data elements, such as a linked list of students or employees.
2. Dynamic Memory Allocation: Use a linked list to dynamically allocate and deallocate memory blocks, maintaining a list of available memory chunks and their sizes.

Trees:

1. File System Organization: Represent a file system hierarchy using a tree structure, where directories are represented by nodes and files are represented as leaves.
2. Binary Search Tree (BST): Implement a BST to efficiently store and search for data in a sorted manner, such as maintaining a dictionary of words or a database of records.

RBT Level: L3, L4, L5, L6

Teaching-Learning Process	You tube videos, Brain storming, Activity based method, Demonstration, Implementation.

PRACTICAL COMPONENT OF IPCC: Conduct the experiments using MATLAB/Scilab/TMS 320 C5X DSP Processors

Sl. No	Experiments
1	Write a C program to implement iterative and recursive binary search algorithms. Define and use a macro to compare two integers in your program.
2	Write a C program to find the fast transpose of a sparse matrix.
3	Write a C program to implement a circular queue using dynamically allocated array and perform the following operations on it. (i)Insert an item (ii) Delete an item (iii) Display a circular queue
4	Design, Develop and Implement a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b. Solving Tower of Hanoi problem with n disks.
5	Write a C program to implement a doubly linked circular list with a header node and perform the following operations on it. (i) Insert a node (iii) Display a doubly linked circular list in forward direction (ii) Delete a node (iv) Display a doubly linked circular list in reverse direction
6	Write a C program to implement multiple linked queues (at least 5) and perform the following operations on them. (i) Add an item in ith queue (ii) Delete an item from ith queue (iii) Display ith queue
7	Write a C program to implement a binary search tree using linked representation and perform the following operations on it. (i) Insert an item (ii) Search an item (iii) Inorder Traversal
8	Write a C program to implement Red black tree. (i) Insert an item (ii) delete an item (iii) display the elements
9	Write a C program to perform depth first search of a graph represented as an adjacency list.
10	Design and develop a program in C that uses Hash Function H:K->L as H(K)=K mod m(reminder method) and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing

Suggested Learning Resources:

Text Book(S):

1. Horowitz, Sahni, and Anderson Freed: Fundamentals of Data Structures in C, 2nd Edition, Universities Press, 2008.

Reference Book(S):

1. Yedidyah, Augenstein, Tannenbaum: Data Structures Using C and C++, 2nd Edition, Pearson Education, 2003.
2. Data Structures, SeynourLipschutz and GAV Pai, Schaum’s Outlines, McGraw Hill, 2008

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Recall and explain fundamental data structures, such as arrays, linked lists, stacks, queues, and trees.	Understand
CO2	Implement data structures in C programming language, including operations and algorithms associated with them.	Apply
CO3	Analyse and evaluate the efficiency of different data structures and algorithms, considering their time and space complexities for specific scenarios.	Analyze
CO4	Compare and contrast different data structures and select the most appropriate one for solving a given problem based on the analysis of requirements and constraints	Evaluate
CO5	Design and develop efficient algorithms and solutions using appropriate data structures to solve complex problems, considering factors like performance, scalability, and maintainability.	Create

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering Knowledge	1
2	Problem Analysis	2
3	Design/Development of solutions	3
4	Modern tool usage	5
5	Individual and team work	9
6	Life-long learning	12

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Web links and Video Lectures (e-Resources):

- nptel.ac.in

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Group Discussion
- Seminars