	DATA STRUCTURES AND APPLICATIONS		Semester	3
	Course Code	BCS304	CIE Marks	50
	Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
	Total Hours of Pedagogy	40	Total Marks	100
	Credits	03	Exam Hours	3
	Examination type (SEE)	**Theory**		

Course objectives:

CLO 1. To explain fundamentals of data structures and their applications.
CLO 2. To illustrate representation of Different data structures such as Stack, Queues, Linked Lists, Trees and Graphs.
CLO 3. To Design and Develop Solutions to problems using Linear Data Structures
CLO 4. To discuss applications of Nonlinear Data Structures in problem solving.
CLO 5. To introduce advanced Data structure concepts such as Hashing and Optimal Binary Search Trees

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching
3. Demonstration based Teaching

Module-1	**8Hours**

INTRODUCTION TO DATA STRUCTURES: Data Structures, Classifications (Primitive & Non-Primitive), Data structure Operations
Review of pointers and dynamic Memory Allocation,
ARRAYS and STRUCTURES: Arrays, Dynamic Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, representation of Multidimensional Arrays, Strings
STACKS: Stacks, Stacks Using Dynamic Arrays, Evaluation and conversion of Expressions
Text Book: Chapter-1:1.2 Chapter-2: 2.1 to 2.7 Chapter-3: 3.1,3.2,3.6
Reference Book 1: 1.1 to 1.4

Module-2	**8Hours**

QUEUES: Queues, Circular Queues, Using Dynamic Arrays, Multiple Stacks and queues.
LINKED LISTS : Singly Linked, Lists and Chains, Representing Chains in C, Linked Stacks and Queues, Polynomials
Text Book: Chapter-3: 3.3, 3.4, 3.7 Chapter-4: 4.1 to 4.4

Module-3	**8Hours**

LINKED LISTS : Additional List Operations, Sparse Matrices, Doubly Linked List.
TREES: Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees.
Text Book: Chapter-4: 4.5,4.7,4.8 Chapter-5: 5.1 to 5.3, 5.5

Module-4	**8Hours**

TREES(Cont..): Binary Search trees, Selection Trees, Forests, Representation of Disjoint sets, Counting Binary Trees,
GRAPHS: The Graph Abstract Data Types, Elementary Graph Operations
Text Book: Chapter-5: 5.7 to 5.11 Chapter-6: 6.1, 6.2

Module-5	**8Hours**

HASHING: Introduction, Static Hashing, Dynamic Hashing **PRIORITY QUEUES:** Single and double ended Priority Queues, Leftist Trees **INTRODUCTION TO EFFICIENT BINARY SEARCH TREES:** Optimal Binary Search Trees Text Book: Chapter 8: 8.1 to 8.3 Chapter 9: 9.1, 9.2 Chapter 10: 10.1

Course outcome (Course Skill Set)

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

CO 1. Explain different data structures and their applications.

CO 2. Apply Arrays, Stacks and Queue data structures to solve the given problems.

CO 3. Use the concept of linked list in problem solving.

CO 4. Develop solutions using trees and graphs to model the real-world problem.

CO 5. Explain the advanced Data Structures concepts such as Hashing Techniques and Optimal Binary Search Trees.

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.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

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 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbook:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014

DATA STRUCTURES LABORATORY
SEMESTER – III

Course Code	**BCSL305**	**CIE Marks**	50
Number of Contact Hours/Week	0:0:2	**SEE Marks**	50
Total Number of Lab Contact Hours	28	**Exam Hours**	03

Credits – 1

Course Learning Objectives:

This laboratory course enables students to get practical experience in design, develop, implement, analyze and evaluation/testing of

- Dynamic memory management
- Linear data structures and their applications such as stacks, queues and lists
- Non-Linear data structures and their applications such as trees and graphs

Descriptions (if any):

- Implement all the programs in "C " Programming Language and Linux OS.

Programs List:

1.	Develop a Program in C for the following: a) Declare a calendar as an array of 7 elements (A dynamically Created array) to represent 7 days of a week. Each Element of the array is a structure having three fields. The first field is the name of the Day (A dynamically allocated String), The second field is the date of the Day (A integer), the third field is the description of the activity for a particular day (A dynamically allocated String). b) Write functions create(), read() and display(); to create the calendar, to read the data from the keyboard and to print weeks activity details report on screen.
2.	Develop a Program in C for the following operations on Strings. a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP) b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR Support the program with functions for each of the above operations. Don't use Built-in functions.
3.	Develop a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate how Stack can be used to check Palindrome d. Demonstrate Overflow and Underflow situations on Stack e. Display the status of Stack f. Exit Support the program with appropriate functions for each of the above operations

4.	Develop a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.
5.	Develop 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

6.	Develop a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above operations
7.	Develop a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: *USN, Name, Programme, Sem, PhNo* a. Create a SLL of N Students Data by using *front insertion*. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack) e. Exit
8.	Develop a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: *SSN, Name, Dept, Designation, Sal, PhNo* a. Create a DLL of N Employees Data by using *end insertion*. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit
9.	Develop a Program in C for the following operationson Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial $P(x,y,z) = 6x^2y^2z-4yz^5+3x^3yz+2xy^5z-2xyz^3$ b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations
10.	Develop a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers . a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Exit
11.	Develop a Program in C for the following operations on Graph(G) of Cities a. Create a Graph of N cities using Adjacency Matrix. b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method

12.	Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Develop a Program in C that uses Hash function H: K →L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

Laboratory Outcomes: The student should be able to:

- Analyze various linear and non-linear data structures
- Demonstrate the working nature of different types of data structures and their applications
- Use appropriate searching and sorting algorithms for the give scenario.
- Apply the appropriate data structure for solving real world problems

Conduct of Practical Examination:

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Need to change in accordance with university regulations)*
  c) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  d) For laboratories having PART A and PART B
    i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
    ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks