

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - CYBER SECURITY

COURSE MODULE OF THE SUBJECT TAUGHT FOR THE SESSION 2026-27

Faculty Name: Prof. Bhavana V R	Academic Year: 2026 - 2027
--	-----------------------------------

Department: Cyber Security

Course Code	Course Title	Core / Elective	Prerequisite	Contact Hours				Total Hrs
				L	T	P	S	
1BCS305	Data structures and Applications	Core	-	42	-	-	-	42

Course outcome (Course Skill Set)

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

1. Recall the fundamental concepts, terminology, and characteristics of various data structures.
2. Explain the principles, representation, and operations of linear and non-linear data structures.
3. Implement different primitive data structures, their operations, and primitive applications.
4. Choose a suitable data structure to solve computational and real-world problems.
5. Make use of hashing techniques and leftist trees to organise the data effectively.

Module-1

Introduction: Data Structures, Classifications (Primitive & Non-Primitive).

Pointers and Dynamic Memory Allocation, Arrays, Dynamically Allocated Arrays, Structures and Unions, Polynomials. Sparse Matrices: Sparse Matrix Representation and Transposing a Matrix.

Textbook: Chapter-1 (1.2), Chapter-2 (2.1-2.4, 2.5.2, 2.5.3), Reference Book-1 (1.3)

Number of Hours: 08

Module-2

Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays, Stack Applications: Polish notation, Infix to Postfix Conversion, Evaluation of Postfix Expression. Queues: Definition, Array Representation, Queue Operations.

Textbook: Chapter-3 (3.1-3.3, 3.6)

Number of Hours: 08

Module-3

Circular 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, Additional List Operations, Sparse Matrices: Sparse Matrix Representation, Doubly Linked List.

Textbook: Chapter-3 (3.4, 3.7), Chapter-4 (4.1 to 4.3, 4.5, 4.7.1, 4.8)

Number of Hours: 09

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - CYBER SECURITY

Module-4

Trees: Introduction-Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals – preorder, Inorder, postorder, Threaded Binary Trees.

Binary Search Trees – Definition, Searching, Insertion, Deletion, Counting Binary Trees.

Textbook: Chapter-5 (5.1.1, 5.2, 5.3.1-5.3.3, 5.5, 5.7.1- 5.7.4, 5.11.1)

Number of Hours: 09

Module-5

GRAPHS: The Graph Abstract Data Types, Elementary Graph Operations.

HASHING: Introduction, Static Hashing, Dynamic Hashing.

PRIORITY QUEUES: Single and double ended Priority Queues, Leftist Trees.

Textbook: Chapter 6 (6.1, 6.2), Chapter 8 (8.1 to 8.3), Chapter 9 (9.1, 9.2)

Number of Hours: 08

Suggested Learning Resources: (Text Book/ Reference Book/ Manuals):

Textbooks:

1. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2023.

Reference books / Manuals:

- Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed., McGraw-Hill, 2014.
- Aaron M Tenenbaum, Data Structures using C, Pearson Education, 2019.
- Reema Thareja, Data Structures Using C, 3rd Ed., Oxford Press, 2012.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - CYBER SECURITY

Web links and Video Lectures (e-Resources):

1. Introduction to Data Structures:
<https://www.youtube.com/watch?v=zWg7U0OEAoE&list=PLBF3763AF2E1C572F&index=1>
2. Stacks:
<https://www.youtube.com/watch?v=g1USSZVWDsY&list=PLBF3763AF2E1C572F&index=2>
3. Queues and Linked Lists:
<https://www.youtube.com/watch?v=PGWZUgzDMYI&list=PLBF3763AF2E1C572F&index=3>
4. Trees:
<https://www.youtube.com/watch?v=tORLeHHtazM&list=PLBF3763AF2E1C572F&index=6>
5. Hashing:
<https://www.youtube.com/watch?v=KW0UvOW0XI0&list=PLBF3763AF2E1C572F&index=5>
6. Infosys Springboard: Data Structures & Algorithms using C++, C and Python – 2026: <https://infyspringboard.onwingspan.com/>
7. Virtual Labs: Computer Science and Engineering - Data Structures-1: <https://ds1-iiith.vlabs.ac.in/>

Teaching-Learning Process (Innovative Delivery Methods):

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching-learning process and facilitate the achievement of course outcomes.

1. Flipped Classroom
2. Problem-Based Learning (PBL)
3. Case-Based Teaching
4. Simulation and Virtual Labs
5. ICT-Enabled Teaching

Assessment Structure:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage.

- To qualify and become eligible to appear for SEE, in the **CIE**, a student must score at least **40% of 50 marks**, i.e., **20 marks**.
- To pass the **SEE**, a student must score at least **35% of 50 marks**, i.e., **18 marks**.
- Notwithstanding the above, a student is considered to have **passed the course**, provided the combined total of **CIE and SEE** is at least **40 out of 100 marks**.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - CYBER SECURITY

Continuous Comprehensive Assessments (CCA) + Internal Assessment Test (IA) = Continuous Internal Evaluation CIE [25 + 25 = 50 marks]

A minimum of **two Internal Assessment Tests (IA)** shall be conducted, carrying a total of **25 marks**.

In addition, **Continuous Comprehensive Assessment (CCA)** shall be conducted for a total of **25 marks**.

It is recommended to include **a maximum of two learning activities** in the CCA to foster students' **holistic development**. These activities shall be:

Sl. No.	Name of the Learning activity	Maximum Marks
1.	Problem-Solving: Competitive Programming Assignments (HackerRank/HackerEarth/LeetCode)	15

Rubrics for Learning Activity -1:

Evaluated for 25 marks and scale down to 15. The students need to submit the report on the solutions to the problems with relevant data to the course instructor.

Criteria/Scale	Superior (5)	Good (4)	Fair (3)	Needs Improvement (2)	Unacceptable (1)
Problem Understanding and Analysis (CO2, CO3 /PO1, PO2)	Clearly understands the problem statement, identifies constraints, and selects an effective approach independently.	Understands the problem well and identifies most constraints with minor guidance.	Understands the basic requirements but misses some constraints or cases.	Has partial understanding and requires significant guidance	Unable to interpret the problem requirements.
Selection and Application of Data Structures (CO3, CO5 /PO1, PO2)	Selects the most suitable data structure (Stack, Queue, List, Tree, Hashing, etc.) and justifies the choice based on problem requirements.	Selects an appropriate data structure with minor inefficiencies.	Uses a suitable data structure but lacks optimization or justification.	Chooses a partially suitable data structure with limitations.	Unable to select an appropriate data structure.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - CYBER SECURITY

Algorithm Design and Problem-Solving Skills (CO3, CO5 /PO2, PO3)	Designs an efficient algorithm with correct logic, optimal complexity, and handles all edge cases.	Develops a correct algorithm with minor logical issues.	Develops a basic algorithm that solves standard cases.	Algorithm is partially correct and requires improvements.	Unable to develop a workable algorithm.
Implementation and Coding Skills (CO4/PO4)	Implements error-free, modular, readable code that passes all test cases on the platform.	Implements correct code with minor errors; passes most test cases.	Code works for normal cases with limited errors.	Code has multiple errors and passes limited test cases.	Code is incomplete or does not execute successfully.
Code is incomplete or does not execute successfully. (CO4, CO5 /PO4)	Performs extensive testing, handles edge cases, debugs effectively, and optimizes time and space complexity.	Tests adequately and improves solution efficiency with minor issues.	Performs basic testing and achieves acceptable efficiency.	Performs limited testing with inefficient solutions.	No proper testing or optimization is performed.

Rubrics for Learning Activity -2:

Evaluated for 25 marks and scale down to 10. The students need to submit the report on problem & solutions to the course instructor.

Criteria/Scale	Superior (5)	Good (4)	Fair (3)	Needs Improvement (2)	Unacceptable (1)
Understanding of Data Structure Concepts through Certification Modules (CO1, CO2 /PO1,PO2)	Demonstrates comprehensive understanding of fundamental and advanced data structure concepts, terminology, and applications through successful completion of certification modules.	Demonstrates good understanding of concepts with minor gaps.	Understands basic concepts and terminology with limited depth.	Shows partial understanding and requires additional support.	Unable to demonstrate understanding of fundamental concepts.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - CYBER SECURITY

Application of Data Structures and Algorithms in Problem Solving (CO3, CO5) /PO1,PO2)	Effectively applies suitable data structures and algorithms to solve complex computational problems and certification assessments.	Applies appropriate concepts to solve problems with minor errors.	Applies basic data structure concepts to solve standard problems.	Applies concepts with significant guidance and limited accuracy.	Unable to apply concept for problem solving.
Completion of Certification and Learning Progress (CO1, CO4) /PO4)	Successfully completes all assigned Infosys Springboard modules, assessments, and certification requirements with excellent performance.	Completes most modules and assessments with good performance.	Completes required modules with satisfactory performance.	Completes only partial modules or assessments.	Does not complete the assigned certification activities.
Implementation Skills and Practical Application (CO4/PO4)	Demonstrates strong programming skills by implementing data structures and algorithms through hands-on exercises and coding activities.	Implements solutions correctly with minor errors.	Implements basic programs with limited optimization.	Requires significant assistance for implementation tasks.	Unable to implement program solutions effectively.
Self-Learning, Technical Skills, and Continuous Improvement (CO2, CO5) /PO4, PO11)	Demonstrates independent learning, explores advanced concepts, and applies knowledge beyond the certification requirements.	Shows good self-learning ability and explores additional resources.	Completes learning activities with moderate involvement.	Shows limited engagement with learning resources.	Does not demonstrate self-learning improvement.

Term Work (TW) and Self Learning (SL) components in Number of Hours per semester

Term work (includes assignments, seminars, micro-projects, industrial visits, any other student learning activities etc.)

Sl. No.	Term Work (TW) Activity	Number of Hours / Semester
1.	Learning Activity -1	20
2.	Learning Activity -2	10

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - CYBER SECURITY

SL: Self-learning, MOOCs, spoken tutorials, online educational resources, etc.

Sl. No.	Self-Learning (SL) Activity	Number of Hours / Semester
1.	Springboard certification on: Data Structures and Algorithms	18

Continuous Internal Evaluation (CIE)

1. The CIE marks shall be decided based on internal tests and other outcome-based activities. The continuous internal evaluation shall be carried out by the teacher handling the course.
2. Out of 50 marks earmarked for CIE, 25 marks shall be assigned for internal tests. The first test shall be conducted after completing two modules of the syllabus and the second one after completing the remaining three modules.
3. The remaining 25 marks shall be assigned for Continuous Course Assessment (CCA), conducted as per the rubrics listed in the assessment section of the respective syllabus.
4. A student shall obtain a minimum of 40% marks or 20 out of 50 marks allotted to CIE to become eligible to appear for the SEE.

Passing requirement in SEE

1. For a pass in the Semester End Examination (SEE), a student shall secure a minimum of 35 marks out of 100.
2. For the declaration of a pass grade, the sum of the Continuous Internal Evaluation (CIE) marks (out of 50) marks and the SEE marks scaled down to 50 shall be greater than or equal to 40 marks.
3. If the total (CIE + SEE) is less than 40 marks, the student shall be awarded the grade 'F' (Fail).

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

Subject Code:	1BCS305		TITLE: Data structures and Applications							Faculty Name:		Ms. Bhavana V R	
List of	Program Outcomes											Total	
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11		
CO-1	2	2	2	-	-	-	-	-	-	-	2	8	
CO-2	2	2	2	-	-	-	-	-	-	-	2	8	
CO-3	2	2	2	-	-	-	-	-	-	-	2	8	
CO-4	2	-	2	-	-	-	-	-	-	2	2	8	
CO-5	2	2	-	-	-	-	-	-	-	-	2	6	
Total	10	8	8	-	-	-	-	-	-	2	10	38	

The Correlation of Course Outcomes (CO's) and Program Specific Outcomes (PSO'S)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - CYBER SECURITY

Course Code:	1BCS305	TITLE: Data structures and Applications	Faculty Name:	Ms. Bhavana V R
List of Course Outcomes	Program Specific Outcomes			Total
	PSO-1	PSO-2		
CO-1	3	-		3
CO-2	3	-		3
CO-3	3	-		3
CO-4	3	-		3
CO-5	3	-		3
Total	15	-		15-

COURSE COORDINATOR

HOD