University of Asia Pacific (UAP)
Department of Computer Science and Engineering (CSE)
BSc in CSE Program
Course Outline – Data Structures and Algorithms I

Part A – Introduction

1. **Course No. / Course Code:** CSE 203
2. **Course Title:** Data Structures and Algorithms I
3. **Course Type:** Core Course
4. **Level/Term and Section:** 3rd Semester (2nd Year/1st Semester)
5. **Academic Session:** Fall 2024
6. **Course Instructor:** Nayeema Sultana, Zaforullah Momtaz, Atia Rahman Orthi
7. **Prerequisite (If any):** CSE 103
8. **Credit Value:** 3.0
9. **Contact Hours:** 3.0
10. **Total Marks:** 100
11. **Course Objectives and Course Summary:**

    Data structures and algorithms are two of the most important aspects of computer programming and software development. Data structures allow students to organize and store data, while algorithms allow us to process that data in a meaningful way. Learning data structures and algorithms will help students become better programmers in the future.

12. **Course Learning Outcomes: at the end of the Course, the Student will be able to –**

CLO 1	**Understand** fundamentals of data structures, algorithms, and complexity of algorithms.
CLO 2	**Classify** a problem into its supporting data structures and simulate the process to solve the problem.
CLO 3	**Applying** data structures and algorithms to solve a practical problem or developing a solution using pseudo-code or any high-level programming language.

13. Mapping / Alignment of CLOs with Program Learning Outcomes (PLO) (Optional):

CLO No.	Corresponding PLOs (Appendix-1)	Bloom's taxonomy domain/level (Appendix-2)	Delivery methods and activities	Assessment Tools
CLO1	1	1/Understand	Lecture, multimedia	Quiz, Written Examination
CLO2	2	1/Analyze	Lecture, Problem Solving, Group Discussion	Quiz, Written Examination
CLO3	2	1/Apply	Lecture, Problem Solving	Quiz, Written Examination

Part B – Content of the Course

14. **Course Content: Introduction to Data Structures**, Purposes of data structure, Basic operations (Insertion, Deletion, Searching, and Traverse). **Complexity of Algorithms:** Basic Asymptotic Notation and Runtime Analysis of Algorithms, **Array:** Insertion, Deletion, Matrix representation of arrays, Multidimensional arrays, Pointer arrays, **Linked List:** Singly Linked Lists, Doubly Linked Lists, and Circular Linked Lists. Basic Operations on Linked List. **Recursion:** Direct and indirect recursion, Simulation of recursion, Depth of recursion, Removal of recursion. **Stack:** Basic Stack Operations, Infix, Postfix and Prefix Notation of Arithmetic Expressions, Conversions and Evaluations of Arithmetic Expressions Using Stack, **Queue:** Basic Queue Operations, types of Queue, Linear Queue, Priority Queue, Circular Queue and Double-ended Queue, **Searching:** Sequential Searching, Binary Searching, Interpolation Search, **Basic Sorting:** Quick Sort, Merge Sort, Selection Sort, Insertion Sort, etc., **Trees:** Basic terminology, Binary Tree: Binary tree representation, Traversal of Binary Tree (Inorder, Preorder and Postorder), Application of Binary Trees, Counting Binary Trees, Binary Search Tree BST representation, Basic Operations, Huffman Codes, Heap **Graphs:** Graph Representation (Using Adjacency Matrix and Adjacency List), Basic Operations on Graph (Node/ Edge Insertion and Deletion), Traversing a Graph: Breadth-first Search, Depth-first Search. **Hashing:** Hash Function and Overflow Handling, theoretical evaluation of overflow techniques. Open Hashing and Closed Hashing, Linear Probing, Quadratic Probing, Double Hashing, and randomized hash.

15. Alignment of topics of the courses with CLOs:

SL. No	Topics / Content	Course Learning Outcome (CLO)
1	Fundamentals: Introduction to Algorithms, Problem Solving, and Data Structures	CLO1, CLO2, CLO3
2	Complexity Analysis: Asymptotic Notations, Best/Average/Worst Case	CLO1, CLO2
3	Linear Structures: Arrays, Linked Lists, Stacks, Queues (Insertion, Deletion, Traversal)	CLO1, CLO2, CLO3
4	Non-linear Structures: Trees, Graphs (Binary Tree, BST, Traversals, Representation, BFS, DFS, Shortest Path)	CLO1, CLO2, CLO3

5	Advanced Structures: Heaps, Hash Tables	CLO1, CLO2, CLO3
6	Searching Algorithms: Linear, Binary, Hash-based, Tree-based	CLO1, CLO2, CLO3
7	Sorting Algorithms: Bubble, Insertion, Selection, Counting Sort, Radix Sort, Heap Sort, Topological Sort	CLO1, CLO2, CLO3

15. **Class Schedule/Lesson Plan/Weekly plan:**

Topics	**Specific Outcome (s)**	**Time Frame**	**Suggested Activities**	**Teaching Strategy(s)**	**Alignment with CLO**
Introductory concepts: Data Structures and Algorithm basics, Array: Memory representation, Basic algorithm on array: insert, delete, and search.	CLO1	Week 1	Problem Solving	Lecture, Multimedia	CLO1
Asymptotic Notations: Time and space complexity, best, worst, average case, Big O notation.	CLO1	Week 2	Problem Solving	Lecture, Multimedia	CLO1, CLO2
Basic Sorting Algorithms: Bubble Sort, Insertion Sort, Selection Sort	CLO2, CLO3	Week 3	Problem Solving	Lecture, Multimedia	CLO1, CLO2, CLO3
Searching Algorithms: Linear Search, Binary Search, and Interpolation Search.	CLO2, CLO3	Week 4	Problem Solving	Lecture, Multimedia	CLO1, CLO2, CLO3
Stacks: Definition, Stack representation, Primitive operations on stack, array representation of stacks, Application of stack: Infix, prefix, postfix, their conversion and evaluation	CLO1, CLO2, CLO3	Week 5	Problem Solving	Lecture, Multimedia	CLO1, CLO2, CLO3
Queues: Definition, Queue representation, Primitive operations on queue, array representation of queues, Circular queue, Applications of queues	CLO1, CLO2, CLO3	Week 6	Problem Solving	Lecture, Multimedia	CLO1, CLO2, CLO3
Recursion: Factorial calculation, Fibonacci series, Tower of Hanoi, Greatest Common Divisor, Iterative vs recursive approach	CLO1, CLO2, CLO3	Week 7	Problem Solving	Lecture, Multimedia	CLO1, CLO2, CLO3
MID-TERM EXAMINATION		Week 8			
Linked Lists: Dynamic memory allocation, Introduction to linked list, Representation of linked list in memory, primitive operations on linked list, searching a linked list, circular linked list, doubly linked list	CLO1, CLO2, CLO3	Week 9 & 10			CLO1, CLO2, CLO3

Trees: Introduction, Binary tree – complete binary tree, weighted 2-tree, representing binary tree in memory, traversing a binary tree, binary Search tree, insertion and deletion in binary search tree. Heap tree, creation of heap tree (heapify), insertion in heap, Deletion from heap, Heapsort, Huffman‘s Algorithm	CLO1, CLO2, CLO3	Week 11 &12			CLO1, CLO2, CLO3
Graphs: Introduction to Graph, Graph theory terminologies, adjacency matrix and path matrix, Linked representation of a graph, Operations on a graph, Traversing a graph, Topological sorting	CLO1, CLO2, CLO3	Week 13			CLO1, CLO2, CLO3
Hashing: Hash Function and Overflow Handling, theoretical evaluation of overflow techniques. Open Hashing and Close Hashing, Linear Probing, Quadratic Probing, Double Hashing, and randomized hash.	CLO1, CLO2, CLO3	Week 14			CLO1, CLO2, CLO3
FINAL EXAMINATION		Week 15			

16. **Teaching-Learning Strategies:** Interactive Lectures, Google Classroom

17. **Assessment Techniques for each topic of the course:**

SL. No	Topics / Content	Assessment Techniques
1	Fundamentals: Introduction to Algorithms, Problem Solving, and Data Structures	QA Session, Written Exam
2	Complexity Analysis: Asymptotic Notations, Best/Average/Worst Case	QA Session, Written Exam
3	Linear Structures: Arrays, Linked Lists, Stacks, Queues (Insertion, Deletion, Traversal)	Class Test, Written Exam
4.	Non-linear Structures: Trees, Graphs (Binary Tree, BST, Traversals, Representation, BFS, DFS, Shortest Path)	Class Test, Written Exam
5.	Advanced Structures: Heaps, Hash Tables	Class Test, Written Exam
6.	Searching Algorithms: Linear, Binary, Hash-based, Tree-based	Class Test, Written Exam
7.	Sorting Algorithms: Bubble, Insertion, Selection, Counting Sort, Radix Sort, Heap Sort, Topological Sort	Class Test, Written Exam

Part C – Assessment and Evaluation

18. **Assessment Strategy**

Class Tests: Altogether, 4 class tests may be taken during the semester, 2 class tests will be taken for the midterm, and 2 class tests will be taken for the final term. Out of these 2 class tests after the final exam for each term, the best class test will be counted. No makeup class tests will be taken. Students are strongly recommended not to miss any class tests.

CIE- Continuous Internal Evaluation (30 Marks)

Bloom's Category Marks (out of 30)	Tests (30)
Remember	
Understand	
Apply	30
Analyze	
Evaluate	
Create	

SMEB- Semester Mid & End Examination (70 Marks)

Bloom's Category	Mid	Final
Remember		
Understand	6	13
Apply	11	21
Analyze	3	16
Evaluate		
Create		

19. **Evaluation Policy**

Grades will be calculated as per the university grading structure, and individual students will be evaluated based on the following criteria with respective weights.

1. Class Tests 30%
2. Term Examination 50%
3. Mid-Term Examination 20%

UAP Grading Policy

Numeric Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	D	2.00
Less than 40%	F	0.00

Part D – Learning Resources

20. **Text Book**

1. Data Structures using C, Aaron M. Tanenbaum, Yedidy Seymour Lipschutz, Schaum's Outline Series.
2. Introduction to Algorithms, T.H. Cormen, C.E.Leiserson, R. L. Rivest, C. Stein: HI Learning Pvt. Ltd

Reference Books & Materials

1. Data Structures and Program Design, Robert L. Kruse, Prentice Hall.
2. Data structures and problem solving using C++, Mark Allen Weiss, Pearson Addition Wesley Education.
3. Data Structures Using C and C++, Yedidyah Langsam, Moshe J. Augenstein, and Aaron M. Tenenbaum, Prentice Hall.
4. Data Structures, Edward M. Reigngold. Wilfred J. Hansen, Addison, Wesley Publishing Company