International Islamic University Chittagong
Department of Computer Science and Engineering
Lesson Plan

Part A

1. **ISCED Code:** **0613**
2. **Course Code:** CSE-2322
3. **Course Title:** Data Structures Lab
4. **Type:** Core, Engineering
5. **Semester:** 3rd
6. **Credit Hours:** 1.5
7. **Contact Hours:** 2 lab hours per week
8. **CIE Marks** : 50
9. **SEE Marks:** 50
10. **Total marks:** 100
11. **Prerequisite:** CSE-1121 (Computer Programming 1)
12. **Co-requisite:** CSE-2321 (Data Structures)
13. **Academic Session:** Spring 2024
14. **Instructor's and Class Schedule and Locations**

    Instructor: Md. Mahiuddin
    Office Location: Room # C405, CSE Academic Building
    Email: mmuict@iiuc.ac.bd
15. **Course Rationale / Summary:** This course is a continuation to the introduction to computer science and is a study of the different types of data structures, their design, implementation, efficiency and effective use in solving problems. It introduces students to new types of data structures such as arrays, linked list, trees, graphs, heaps, stacks and queues. Students will also learn how to design algorithms for each new data structure studied, create and perform simple operations such as insertion, deletion, merging, sorting, and traversing on data structures. It describes and implements common algorithms for working with advanced data structures and recognizes which data structure is the best to use to solve a particular problem. To take this course, students should be able to program in a standard programming language preferably in C/C++. Some mathematical maturity will also be helpful for the students.
16. **Course Objective:** Upon completion of the course, students will be able to:
    1. Impart a thorough understanding of linear data structures such as linked list, arrays, stacks, queues and their applications
    2. Learn a thorough understanding of non-linear data structures such as trees, graphs and their applications.
    3. Familiarize with various sorting, searching and hashing techniques and their performance comparison
    4. Design and analyze recursive algorithms in data structures
17. **Course Outcomes (COs):**

    Upon successful completion of this course, students will be able to:

#	CO Description	Weightage
1.	**Apply** the basic concepts of linear data structures for solving different problems	50%
2.	**Apply** the basic concepts of non-linear data structures for manipulating hierarchical and connected data	30%
3.	**Develop** an application addressing several data structures	20%

18. Mapping of CO-PO-WK-WP-WA:

#	COs	POs	DL	KP	EP	EA	Teaching Learning Strategy (TLS)	Assessment Strategy (AS)
CO1	**Apply** the basic concepts of linear data structures for solving different problems	PO1	C3	K3	-	-	Lecture, Class discussion, Lab work, Note	Assignment, Class performanc e, Exam
CO2	**Apply** the basic concepts of non-linear data structures for manipulating hierarchical and connected data	PO1	C3	K3	-	-	Lecture, Class discussion, Lab work, Note	Assignment, Class performanc e, Exam
CO3	**Develop** an application addressing several data structures	PO5	C3	K3	P1	-	Demo interview, Presentation	Project, Presentation , Report
Note: DL: Domain/level of learning taxonomy, **KP:** Knowledge Profile, **EP:** Attribute of Complex Engineering Problems, **EA:** Attribute of Complex Engineering Activities **Learning Domains** (C: Cognitive, A: Affective, P: Psychomotor)								

Part B

19. Course Content

#	Content	Duration	CLOs
Mid-Term (30 Marks)			
1	**Introduction:** Elementary Data organization, Information; Data types; Data Structure, Data Structure operations; Algorithm; Time-Space tradeoff of Algorithms. Mathematical notation & Functions; Algorithmic Notation; Control structures; Sub-algorithms. String; String operations; Pattern matching algorithms	06	**CLO1**
2	**Array:** Linear Array (LA) & its representation in memory; Traversing LA, Insertion & Deletion in LA, Bubble Sort, Linear Search & binary Search. 2D Array & its representation in memory; Matrices; Algebra of matrices; sparse matrices	06	**CLO1**
3	**Linked list** - Linked list & its representation in memory; Traversing, Searching, Insertion & Deletion operation on Linked list; Header linked lists; two way lists.	06	**CLO1**
Final Exam: 50 Marks **Group-A (20 Marks)**			

4	**Stack:** its representation & applications; PUSH and POP operation on stack. Polish Notation, reverse polish notation; Evaluation of a postfix expression; Transforming infix expression into postfix expression.	03	**CLO1**
5	**Queue** – its representation; Insertion & deletion in Queue; Deques; Priority Queues. **Recursion** [Factorial function, Fibonacci sequence, Ackermann function, Towers of Hanoi]	06	**CLO1**
Group-B (30 Marks)			
6	**Complexity** of algorithms, Rate of growth: Big O, Ω and Θ notations; Complexity of Linear Search, Binary search & Bubble sort algorithm**. Sorting** - Insertion sort, selection sort, quick sort, merge sort; **Searching** & data modification; Hashing: Hash function, collision resolution	06	**CLO3**
7	**Tree**- Tree terminology; representation of binary trees in memory; Traversing binary tree; Binary search tree; Insertion & deletion on binary search tree; Heap; Insertion & deletion on heap; Heapsort; B trees; General tree; Balanced binary search tree (AVL tree, red-black tree)	06	**CLO2**
8	**Graph** – graph terminology; representation of graphs – adjacency matrix, path matrix, adjacency list; Traversing a graph – BFS & DFS	06	**CLO2**

20. Weekly Activity Plan:

Week	Topic	TLS	AS	CLOs
Week 1	1. Write a program to create an array of n elements and then display all the elements of the list. 2. Write a program to find the largest number from a given list of integers. 3. Write a program to calculate the roots of the quadratic equation $ax^2 + bx + c = 0$ where a, b and c are known.	Lab work	Assignment	CLO1
Week 2	1. Write a program to create an array of n elements to read the marks of n students and then count how many students passed [pass marks ≥ 40] in the examination. 2. Write a program to create an array of n elements and then insert an element to the list. 3. Write a program to create an array of n elements and then delete an element from the list. 4. Write a program to sort n numbers using Bubble Sort algorithm.	Lab work	Lab work, Assignment	CLO1

Week	Topic	TLS	AS	CLOs
Week 3	1. Write a program to search an element from a list of n numbers using Linear Search algorithm. 2. Write a program to search an element from a list of n numbers using Binary Search algorithm. 3. Write a program to determine whether a number n is prime or not where $1< n < 2^{15}$ by using sieve method. 4. Write a program to write 100 randomly generated integer to a file called RAND.DAT. And then read the contents of the file and display them on the screen.	Lab work	Lab work, Lab test	CLO1
Week 4	1. Write a program to insert a string S into a text T so that S begins in position K of T. 2. A text T and a pattern P are in memory. Write a program to delete first occurrence of P in T. 3. Write a program that will read a string (S) and find the index of the first occurrence of a pattern (P) in the string S. 4. Write a program which calculates the no. of occurrence of each letter of an input text. 5. A text T and patterns P and Q are given. Write a program to replace the first occurrence of a pattern (P) in T by Q. 6. Write a program to implement the following string operation without using any built in functions related to string. a) Find the length of a string S b) Copy string S2 to S1. c) Concatenate string S2 to S1. d) Compare two strings S1 and S2 e) Reverse a string S.	Lab work	Lab work, Assignment	CLO1
Week 5	1. Write a program to interchange the row and column of a matrix. 2. Write a program to add two matrices. 3. Write a program to calculate the multiplication of two matrices. 4. Write a program to calculate the row sum and column sum of a matrix. 5. Write a program to check if a Matrix is a Sparse Matrix.	Lab work	Lab test, Assignment	CLO1
Week 6	1. Write a program to create a Linked List of n elements and then display the list. 2. Write a program to create a Linked List of n elements and then search an element from the list. 3. Write a program to create a Linked List of n elements and then insert an element to the list.	Lab work	Lab test, Assignment	CLO1

Week	Topic	TLS	AS	CLOs
Week 7	1. Write a program to create a Linked List of n elements and then delete an element from the list. 2. Write a program to create a Circular Header Linked List of n elements and then display the list. 3. Write a program to create a Two way Linked List of n elements and then display the list.	Lab work	Assignment, Lab work	CLO1
Week 8	1. Write a program to implement the push and pop operation of a stack 2. Write a program to evaluate a Postfix expression. 3. Write a program to convert an Infix expression into its equivalent Postfix expression. 4. Write a program to implement the *Euclidean Algorithm* for finding the Greatest Common Divisor (GCD) of two given positive integers. 5. Write a program that will read a positive integer in base ***b*** (2<=b<=16) and convert it into base ***d*** (2<=d<=16).	Lab work	Assignment, Lab test	CLO1
Week 9	1. Write a program to show the insert and delete operations of a circular queue. 2. Write a program to show the insert and delete operations of a priority queue.	Lab work	Assignment, Lab test	CLO1
Week 10	1. Write a program to calculate the Factorial of a number using recursive and non-recursive method 2. Write a program to find the nth term F_n of the Fibonacci sequence using recursive and non-recursive method. 3. Write a program to move n disks for Tower of Hanoi problem.	Lab work	Lab test, Lab work	CLO1
Week 11	1. Write a program to sort n numbers using Insertion Sort algorithm. 2. Write a program to sort n numbers using Selection Sort algorithm. 3. Write a program to sort n numbers using Quick Sort algorithm. 4. Write a program to sort n numbers using Merge sort algorithm.	Lab work	Assignment, Lab test	CLO1

Week	Topic	TLS	AS	CLOs
Week 12	1. Write a program to create a Binary Search Tree of n elements and then display the elements (preorder, inorder and postorder) of the tree. 2. Write a program to create a Binary Search Tree of n elements and then search an element from the tree. 3. Write a program to create a Binary Search Tree of n elements and then delete an element from the tree. 4. Write a program to create a Maxheap of n elements and then display the elements of the heap. 5. Write a program to create a Maxheap of n elements and then delete an element from the heap. 6. Write a program to sort n numbers using Heap sort algorithm.	Lab work	Class work, Assignment	CLO2
Week 13	1. Write a program to display the adjacency matrix of a graph. 2. Write a program to display the adjacency list of a graph. 3. Write a program to display the path matrix of a graph from an adjacency matrix 4. Write a program to display the path matrix of a graph using Warshall's algorithm 5. Write a program to traverse a graph using Breadth First Search. 6. Write a program to traverse a graph using Depth First Search.	Lab work	Assignment, Lab test	CLO2
Week 14	1. Write a program to find the 100! 2. Write a program to determine the value of the ***n***th Fibonacci number F_n where $Fn = F_{n-1} + F_{n-2}$ and $F_1 = F_2 = 1$ and n<=500.	Lab work	Assignment, presentation	CLO1
Week 15	Project	Demo Presentation, Demo Project	Project, Presentation, Report	CLO3

Part C

21. Assessment Strategy:

The assessment and evaluation strategies for the course are given as follows:

Assessment Strategies	***Description***
Class Participation:	Students' individual in-class responses, attention, and sense of discipline, morality will be judged on the basis of 10 (ten) marks.
Lab Test/Quiz:	Students will sit for only 1 (one) class test/quiz during the semester. The test/quiz will be taken before midterm. Class test/quiz marks will be assessed in 5 (five). **No makeup class test will be taken.** Students are strongly recommended not to miss any test.

Assessment Strategies	*Description*
Project	The students will have to form groups consisting of a maximum of 3 members. There will be 1 projects consisting of 15 (Marks) marks. The topics or case studies will be given as assignments in groups during the class which they have to prepare at home and will submit on or before the due date.
Lab Assignment:	Students will be given four (4) lab assignments. Each assignment will consist of 10 to 15 problems and will be worth 10 marks. After submission, students will be evaluated based on their submitted source codes and a viva voce. Late submissions will not be accepted.
Oral Presentation:	Students, in groups, will have to present the report of their project. Oral presentations will be assessed for 5 marks. **No late presentation will be accepted**
Viva-vocé	Students will have to appear for viva-vocé during their Midterm (5 marks) and Final examination (5 marks).
Midterm Exam:	Midterm exam will be held according to the Academic Calendar published by the university. Midterm assessment marks will be 15 (Fifteen).
Final Exam:	Final exams will be held according to the Academic Calendar published by the university. Final assessment marks will be 35 (Fifteen).
Make-up Procedure:	No late submission and/or make-up assignment/presentation/quiz will be allowed without prior permission and adequate and reasonable proof of absence.

22. Marks Distribution:

Course Assessment Pattern (Theory courses):

Bloom's Category		Evaluations out of 100 marks				
		CIE (50 marks)			SEE (50 marks)	
Cognitive learning	Affective learning	Attendance Marks (10)	Assignment / Lab Test (20)	Mid Lab/Viva (20)	Project/Viva (20)	Fina Exam (30)
Remember				5	5	
Understand			5			
Apply			5	15	10	30
Analyze			10		5	
Evaluation						
Create						
	Responding	10				
Total allocated marks		10	20	20	20	30

Note: CIE=Continuous Internal Evaluation, **SEE**= Semester End Examination

Delivery methods & activities: Lecture, White Board Writing, Questions and Answers, Discussions Powerpoint Presentation,

Assessment tools: Class Attendance, Quiz, Lab Assignments, Mid-Term & Final Exam, Project evaluation & Viva-voce.

23. Grading Policy: As per IIUC grading policy

24. Code of Conduct:

a. It is mandatory for all the students to participate in the class regularly and maintain proper discipline in the class.
b. If a student fails to attend any class test, term exams, or final examination, he/she will get a zero in that class test, term, or final examination.
c. Adopting unfair means in the exams will be considered as a serious crime and the student shall be placed to the university disciplinary committee.
d. All the assignments, class test and exam copies should be neat and clear and demonstrate professionalism.
e. No student is allowed to duplicate other student's work directly or with minor changes.
f. Plagiarism is strictly restricted. One needs to provide a reference while using someone else's words, ideas, or research in assignments/exams.

Part D

25. Learning Materials:

Text Books:

#	Name of Authors	Title of Book	Edition	Publisher's Name	Year	ISBN
1	Seymour Lipschutz	Data Structures	Special Indian Edition	Tata McGraw-Hill	2014	ISBN-13: 978-0-07-060168-0

Reference Books:

#	Name of Authors	Title of Book	Edition	Publisher's Name	Year	ISBN
1.	Y. Langsam, Augenstein, A. M. Tanenbaum	Data Structures Using C and C++	2nd Edition	Prentice Hall India	2014	ISBN:13 978-0387202778
2.	Edward M. Reingold, Wilfred J. Hansen	Data Structures	1st Edition	CBS Publishers and Distributors	1983	ISBN-13: 978-0316739511
3.	Robert Sedgewick	Algorithms in C	3rd	Pearson Education, Inc	2001	*ISBN*-13: 978-0321573513
4.	D. Samanta	Classic Data Structures	2nd	Prentice Hall of India	2003	*ISBN*-10: 8120318749