AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH (AIUB)
Faculty of Science and Technology (FST)
Department of Computer Science (CS)
Undergraduate Program

COURSE PLAN	SEMESTER: Fall 2024-2025
I. Course Code and Title CSC 2106 Data Structure (Theory) **II. Credit** 3 Credits (2 hours 20 minutes. theory per week) **III. Nature** Core Course for CSE. **IV. Prerequisite** CSC 1204: Discrete Mathematics CSC 1205 Object Oriented Programming 1	**V. Vision** Our vision is to be the preeminent Department of Computer Science through creating recognized professionals who will provide innovative solutions by leveraging contemporary research methods and development techniques of computing that is in line with the national and global context. **VI. Mission** The mission of the Department of Computer Science of AIUB is to educate students in a student-centric dynamic learning environment; to provide advanced facilities for conducting innovative research and development to meet the challenges of the modern era of computing, and to motivate them towards a life-long learning process.

VII - Course Description:

- Learn the concept of Data Structure and Algorithms.
- Understand the memory representation of array.
- Develop solutions for simple to complex problems using concepts of array.
- Learn the concept of pointer.
- Use pointers to understand memory representation of variables.
- Use pointers to access and manipulate array.
- Learn string manipulation.
- Learn the concept of structure/record.
- Use structure to create non-primitive data types and solve complex problems.
- Learn different sorting and searching algorithms and perform complexity analysis.
- Learn the concepts of different types of Linked List (single, doubly, and circular).
- Create linked list and execute Insertion, Deletion and Search Operation.
- Solve simple to complex problems using linked list.
- Learn the basic concepts and working principles of Stack and Queue.
- Implement Stack and Queue.
- Solve arithmetic problems using stack and queue.
- Learn basic concepts and classification of Graph along with different representations.
- Understand graph traversal algorithms (BFS and DFS).
- Learn basic concepts and classification of Tree.
- Create MST from graph (Prim's algorithm and Kruskal's algorithm).
- Construct BST, traverse BST and execute Insertion, Deletion and Search Operation

VIII - Course outcomes (CO) Matrix:

By the end of this course, students should be able to:

COs*	CO Description	Level of Domain***			PO Assessed ****
		C	P	A	

CO1	**Distinguish** the concepts of data structures to solve problems.	2			PO-b-1
CO2	**Apply** the proper data structures to solve simple to complex problems.	3			PO-a-3
CO3 **	**Illustrate** the solution of real-life problems by specific requirements.	4			PO-d-2
CO4 **	**Explain** the procedure for complex problems meeting appropriate substantiated conclusion.	5			PO-b-3

C: Cognitive; P: Psychomotor; A: Affective Domain

* CO assessment method and rubric of COs assessment is provided in later section

** COs will be mapped with the Program Outcomes (POs) for PO attainment

*** The numbers under the 'Level of Domain' columns represent the level of Bloom's Taxonomy each CO corresponds to.

**** The numbers under 'PO Assessed' column represent the POs each CO corresponds to.

IX - Topics to be covered in the class and/or lab: *

Time Frame	CO Mapped	Topics	Teaching Activities	Assessment Strategy(s)
Week 1	CO1	Mission and Vision, Elementary data types Introduction to Data Structures and 1D Array	Lecture Q/A session	Quiz, Term Exam
Week 2	CO1 CO2	2D Array, String	Lecture Q/A session	Quiz, Term Exam
Week 3	CO1 CO2	Pointer, Structure **Quiz 1**	Lecture Q/A session	Quiz, Term Exam
Week 4	CO1 CO2	Sorting (Selection sort, Bubble sort, Insertion sort) and searching (Linear search and Binary Search)	Lecture Q/A session	Quiz, Term Exam
Week 5	CO1 CO2	Linked List: Singly, Creation and Traversal Insertion and Deletion in Linked List	Lecture Q/A session	Quiz, Term Exam Assignment
Week 6	CO1 CO2	Linked List: Doubly, Circular Traversal Insertion and Deletion in Linked List **Quiz 2**	Lecture Q/A session	Quiz, Term Exam
Midterm (Week 7)				
Week 8	CO3	Stack and Queue and their operations	Lecture Q/A session	Quiz, Term Exam
Week 9	CO3 CO4	Stack and Queue Applications, Infix, prefix and postfix expressions, infix expression-postfix expression, postfix expression evaluation **Quiz 1**	Lecture Q/A session	Quiz, Term Exam
Week 10	CO3 CO4	BFS, DFS	Lecture Q/A session	Quiz, Term Exam
Week 11	CO3 CO4	Graph and Tree and their applications and representations, BST	Lecture Q/A session	Quiz, Term Exam Assignment
Week 12	CO3 CO4	Prims, Kruskal algorithms **Quiz 2**	Lecture Q/A session	Quiz, Term Exam
Week 13	CO3 CO4	Heap and Heap sort	Lecture Q/A session	Quiz, Term Exam

Final term (Week 14)
Project/Makeup Assessment (Week 15)

* The faculty reserves the right to change, amend, add, or delete any of the contents.

X - Mapping of PO to Courses and K, P, A

PO Indicator ID	PO Indicators Definition (As per the requirement of WKs)	Domain	K	P	A
PO-a-3	Apply information and concepts in *engineering fundamentals* to solve complex computer science and engineering problems with a range of conflicting requirements.	Cognitive Level 3 (Applying)	K3	P1 P2 P6	
PO-b-1	Identify first principles of natural sciences and computer sciences and engineering in practical applications.	Cognitive Level 2 (Understanding)	K1		
PO-d-2	Analysis and Interpretation of collected data to provide valid conclusion acknowledging the limitations.	Cognitive Level 4 (Analyze)	K3	P1 P2 P3	
PO-b-3	Analyze solutions for complex computer science and engineering problem reaching substantiated conclusion.	Cognitive Level 5 (Evaluate)	K8	P1 P2 P3	

XI – K, P, A Definitions

Indicator	Title	Description
K1	Theory based natural science	A systematic, theory-based understanding of the natural sciences applicable to the discipline
K3	Theory based engineering fundamentals	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
K8	Research Literature	Engagement with selected knowledge in the research literature of the discipline
P1	Depth of knowledge required	Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach
P2	Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering, and other issues
P3	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
P6	Extent of stakeholder involvement and conflicting requirements	Involve diverse groups of stakeholders with widely varying needs

XII – Mapping of CO Assessment Method and Rubric

The mapping between Course Outcome(s) (COs) and The Selected Assessment method(s) and the mapping between Assessment method(s) and Evaluation Rubric(s) is shown below:

COs	Description	Mapped POs	Assessment Method	Assessment Rubric

CO1	**Distinguish** the concepts of data structures to solve problems.	PO-b-1	Quiz/Assignment	Rubric for Quiz/Assignment
CO2	**Apply** the proper data structures to solve simple to complex problems.	PO-a-3	Quiz/Assignment	Rubric for Term Exam
CO3 **	**Illustrate** the solution of real-life problems by specific requirements.	PO-d-2	Mid Term Exam	Rubric for Quiz/Assignment
CO4 **	**Explain** the procedure for complex problems meeting appropriate substantiated conclusion.	PO-b-3	Final Term Exam	Rubric for Term Exam

XIII – Evaluation and Assessment Criteria

CO1: Distinguish the concepts of data structures to solve problems.

Assessment Criteria	Not Attended/ Incorrect (0)	Inadequate (1-2)	Average (3)	Good (4)	Excellent (5)
Knowledge and proper use of Data Structure	The individual demonstrates a lack of comprehension of fundamental data structures, either uses incorrect or inappropriate data structures, and fails to provide a clear explanation for their decision.	The individual demonstrates limited understanding of data structures, makes significant implementation errors, and provides minimal explanation for the chosen data structure's suitability for the problem.	The text demonstrates a basic understanding of commonly used data structures, selects suitable ones for most problems, and provides a thorough explanation of the rationale behind their selection.	The individual demonstrates a comprehensive understanding of various data structures, selects suitable ones for various problems, and provides clear explanations of their selection and benefits.	The individual demonstrates a deep understanding of data structures, effectively applying them to solve complex problems, and provides insightful explanations for data structure selection, considering trade-offs and optimizations.
Understanding	The individual misinterprets the fundamental concepts of data structures and fails to comprehend the connection between data structures and problem-solving.	The text highlights a lack of understanding of the role of data structures in problem-solving and struggles to explain how these structures contribute to efficient solutions.	The individual comprehends the fundamental principles of data structures and their importance in problem-solving, but may lack sufficient depth in explaining these structures.	Demonstrates a comprehensive comprehension of the influence of data structures on problem-solving strategies, effectively highlighting the advantages and disadvantages of various data structures in their specific context.	Demonstrates a deep understanding of data structures and their practical applications in problem-solving, demonstrating exceptional proficiency in utilizing diverse data structures for diverse problem types.

CO2: Apply the proper data structures to solve simple to complex problems.

Assessment Criteria	Not Attended/ Incorrect (0)	Inadequate (1-2)	Average (3)	Good (4)	Excellent (5)

	Not Attended/Incorrect (0)	Inadequate (1-2)	Average (3)	Good (4)	Excellent (5)
Knowledge and proper use of Data Structure	The student appears to have limited comprehension of data structures and their proper usage.	The student's comprehension of data structures is limited, and they may struggle to apply them effectively.	The student demonstrates a basic understanding of data structures and is proficient in applying them in straightforward problems.	The student exhibits a comprehensive comprehension of data structures and consistently employs them to effectively tackle various issues.	The student demonstrates a profound comprehension of data structures and consistently employs them in innovative and effective ways to tackle intricate issues.
Applying	The student fails to effectively utilize data structures to solve problems or makes significant implementation errors.	The student's attempt to apply data structures is deemed incorrect or inefficient, leading to incomplete or suboptimal solutions.	The student effectively utilizes data structures to solve most problems but may struggle with complex scenarios or fail to optimize solutions.	The student effectively utilizes various data structures to solve various problems, demonstrating a comprehensive understanding of their usage and application.	The student demonstrates exceptional proficiency in applying data structures, consistently producing elegant and efficient solutions to complex problems.

CO3: Illustrate the solution of real-life problems by specific requirements.

Assessment Criteria	Not Attended/ Incorrect (0)	Inadequate (1-2)	Average (3)	Good (4)	Excellent (5)
Knowledge and proper use of Data Structure	The solution either fails to use appropriate data structures or uses them incorrectly, indicating a lack of comprehension of how data structures can be effectively utilized in problem-solving.	The solution effectively utilizes some data structures, but there are significant gaps in understanding their proper use in the problem's context.	The solution uses suitable data structures, but there are minor errors or inefficiencies in their implementation, and the understanding of these structures could be improved.	The solution effectively utilizes appropriate data structures to address the problem, demonstrating a strong understanding of their application.	The solution demonstrates mastery in selecting and implementing data structures, utilizing them optimally to effectively solve the problem with precision and clarity.
Analyzing	The problem analysis is flawed or incomplete due to a misunderstanding of the problem's requirements or constraints.	The analysis addresses some problem aspects but overlooks crucial details, and the solution's reasoning is not fully developed or logical.	The analysis identifies key problem components but lacks depth. The solution's reasoning is reasonable but may contain minor inconsistencies or oversights.	The analysis offers a comprehensive understanding of the problem, considering all relevant factors, and the solution's reasoning is clear and well-supported.	The analysis is comprehensive, considering all possible perspectives and implications of the problem, and the solution's reasoning is flawless, showcasing a profound comprehension of the problem domain.

CO4: Explain the procedure for complex problems meeting appropriate substantiated conclusion.					
Assessment Criteria	**Not Attended/ Incorrect (0)**	**Inadequate (1-2)**	**Average (3)**	**Good (4)**	**Excellent (5)**
Knowledge and proper use of Data Structure	The individual lacks understanding of the appropriate data structure for a problem, incorrectly or inappropriately uses it, and is unaware of its impact on problem-solving.	The individual demonstrates a lack of understanding of the appropriate data structure for a problem, uses it correctly but with significant gaps or errors.	The individual demonstrates a basic understanding of the appropriate data structure for a problem, uses it correctly, and is aware of its impact on problem-solving.	The individual demonstrates a thorough understanding of the appropriate data structure for a problem, effectively employing it to arrive at mostly accurate conclusions.	The individual demonstrates a strong understanding of data structure, effectively employing it to draw accurate conclusions and demonstrating a profound understanding of its impact on problem-solving.
Evaluating	The individual fails to adequately evaluate the problem, draws conclusions without considering all relevant factors or evidence, and makes unsubstantiated or illogical conclusions	The evaluation is superficial, focusing on relevant factors or evidence, and may lack depth or be unsubstantiated in its conclusions.	The evaluation provides a thorough evaluation of the problem, but may overlook some nuances and may lack substantiation, indicating a need for more thorough analysis.	The individual provides a comprehensive evaluation of a problem, presenting well-supported conclusions based on a thorough analysis, demonstrating critical thinking and sound judgment.	The individual provides a thorough evaluation of a problem, presenting insightful and substantiated conclusions based on a nuanced analysis, demonstrating exceptional critical thinking and sound judgment.

XIV- Course Requirements

- Students are expected to attend at least 80% of the class.
- Students are expected to participate actively in the class.
- For both terms, there will be at least 2 quizzes based on the theoretical knowledge and conceptual understanding of the topic covered discussed in the classes.
- Submission of assignments should be in due time (NA)

XV – Evaluation & Grading System*

The following grading system will be strictly followed in this class:

MID TERM		FINAL TERM	
Attendance	10%	Attendance	10%
Quiz 1 out of 2	30%	Quiz 1 out of 2	30%
Midterm written exam	60%	Final term written exam	60%
Total	100%	Total	100%
Grand Total 100% = 40% of Midterm + 60% of Final Term			

Letter	Grade Point	Numerical %
A+	4.00	90-100
A	3.75	85 - < 90
B+	3.50	80 - < 85
B	3.25	75 - < 80
C+	3.00	70 - < 75
C	2.75	65 - < 70
D+	2.50	60 - < 65
D	2.25	50 - < 60
F	0.00	< 50
I		Incomplete
W		Withdrawal
UW		Unofficially Withdrawal

The evaluation system will be strictly followed as per the AIUB grading policy.
CO attainment will be achieved with 60% of the evaluation marks.

XVI – Textbook/ References

	Text Books
1.	**"Schaum's outline of theory and problems of data structures"**. By Lipschutz, Seymour
2.	*Data Structures Fundamentals*, Md. Rafiqul Islam, Ph.D and M. A. Mottalib, Ph.D, 3rd Edition
	Other Reference Books
1	"Schaum's Outline of Data Structures with C++". By John R. Hubbard
2.	"Data Structures and Program Design", Robert L. Kruse, 3rd Edition, 1996.
3.	"Data structures, algorithms and performance", D. Wood, Addison-Wesley, 1993
4.	"Advanced Data Structures", Peter Brass, Cambridge University Press, 2008
5.	"Data Structures and Algorithm Analysis", Edition 3.2 (C++ Version), Clifford A. Shaffer, Virginia Tech, Blacksburg, VA 24061 January 2, 2012.
6.	"C++ Data Structures", Nell Dale and David Teague, Jones, and Bartlett Publishers, 2001.
7.	"Data Structures and Algorithms with Object-Oriented Design Patterns in C++", Bruno R. Preiss.

XVII - List of Faculties Teaching the Course (Not in seniority order)

FACULTY NAME	SIGNATURE
1. MR. AMINUN NAHAR	
2. DR. MD. MANZURUL HASAN	
3. MR. ATKIA AKILA KARIM	

4.	DR. AFROZA NAHAR	
5.	DR. FIROZ AHMED	
6.	DR. KAMRUDDIN MD. NUR	
7.	DR. MD IFTEKHARUL MOBIN	
8.	DR. MD. ASRAF ALI	
9.	DR. MUHAMMAD FIROZ MRIDHA	
10.	DR. RAJARSHI ROY CHOWDHURY	
11.	MR. MASHIOUR RAHMAN	
12.	MD. REAZUL ISLAM	
13.	PROF. DR. MD. RAFIQUL ISLAM	
14.	DR. RAZUAN KARIM	
15.	MR. TANVIR AHMED	

XVI – Verification

Prepared by: -------------------------------- **Dr. Md. Manzurul Hasan** *Course Convener* Date:.......................................	**Moderated by:** -------------------------------- **Dr. M. Mahmudul Hasan** *Point Of Contact* *OBE Implementation Committee* Date:.......................................	**Checked by:** -------------------------------- *Head (Undergraduate Program)* *Department of Computer Science* Date:.......................................
Verified by: .... **Dr. Md. Abdullah-Al-Jubair** *Director* *Faculty of Science & Information Technology* Date:.......................................	**Certified by:** .... **Prof. Dr. Dip Nandi** *Associate Dean,* *Faculty of Science & Information Technology* Date:.......................................	**Approved by:** .... **Mr. Mashiour Rahman** *Dean,* *Faculty of Science & Information Technology* Date:.......................................