

## 1. Course Rationale

Algorithms deals with the efficient ways to solve different mathematical and real life problems. It covers the common algorithms, algorithmic paradigms, and data structures used to solve computational problems. This course emphasizes the relationship between algorithms and programming and explores algorithms from the programmer's perspective for solving problems efficiently using various programming languages.

### 1.1. Course Objective

This course introduces students to the analysis and design of computer algorithms. Upon completion of this course, students will be able to do the following:

- Analyze the asymptotic performance of algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

## 2. Course Outcomes (CO's):

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

CO1	Analyze and calculate time complexity and space complexity of various algorithms or any written code using mathematical formula and comparison of algorithms.
CO2	Generate and interpret the output of iterative and recursive codes with the analysis of the problem definition.
CO3	Identify which algorithm listed under which algorithmic paradigm. Compare among various algorithms/implemented codes and choose the efficient one.
CO4	Break down and describe the simulation of various algorithms for different input values.
CO5	Design and apply appropriate algorithms to solve real life problems.

### 2.1. Program Outcomes (PO's)

Program Outcomes are reported in Appendix-I.

### 1.4 CO-PO Mapping [attainment level used for COs from 1(weak)-3(strong) correlation]

PO's CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2		3										
CO3			3									
CO4				3								
CO5			3									

### 2.2. CO Assessment Scheme

Assessment Task	CO's					Mark (Total=100)
	CO1	CO2	CO3	CO4	CO5	
Attendance	--	--	--	--	--	7
Class Test (CT1, CT2, CT3)	--	--	--	--	--	15
Assignment	--	--	--	--	--	5
Presentation	--	--	--	--	--	8
Midterm Examination	5	5	5	5	5	25
Semester Final Examination	8	8	8	8	8	40
Total Mark	13	13	13	13	13	100

## 3. Strategies and approaches to learning

### 3.1. Teaching and Learning Activities (TLA)

<b>TLA1</b>	Lectures using whiteboard/ multimedia of different topics.
<b>TLA2</b>	Active discussion in class regarding efficient solving of the logical, mathematical and real life problems.
<b>TLA3</b>	Group discussion and presentation regarding diverse problems and corresponding lectures.
<b>TLA4</b>	Evaluation of class performances to reach each student in a class for every topic.

## 4. Course Schedule and Structure

<b>3.1.Textbook</b> Introduction to Algorithms (3 <sup>rd</sup> Edition, MIT Press, 2009) ISBN: 9780262033848. Authors: Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein	
<b>3.2.Reference Books</b> i. Algorithms (4 <sup>th</sup> Edition) Author: Robert Sedgewick and Kevin Wayne ii. Algorithm Design Author: Jon Kleinberg, Eva Tardos iii. Data Structures And Algorithms Made Easy In JAVA Author: Narasimha Karumanchi	<b>3.3. Useful Web Links:</b> <a href="http://www.visualgo.net">www.visualgo.net</a> <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.topcoder.com">www.topcoder.com</a> <a href="http://www.codeforces.com">www.codeforces.com</a>

### 3.4 Course Plan/Lesson Plan

Week	Lesson.	Topic	Teaching and Learning Activities (TLAI)	Textbooks & Web References	Related CO's
1	Les. 1	Introduction, Motivation Course logistics	TLA1	Text Book (Chapter 1)	
	Les. 2	Function and Recursion Euclid's Greatest Common Divisor(GCD) Algorithm	TLA1, TLA2	Reference book iii (Chapter 3) Text Book (Chapter 31) Reference book ii (Chapter 1) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.topcoder.com">www.topcoder.com</a>	CO2
2	Les. 3	Asymptotic Notation Complexity Analysis	TLA1, TLA3	Text Book (Chapter 3) Reference book ii (Chapter 2)	CO1
	Les. 4	Complexity Analysis	TLA1, TLA4	Reference book iii (Chapter 3)	CO1
3	(Class Test – 1, Assignment – 1)				
	Les. 5	Searching: Linear Search and brute force techniques. Sorting: Insertion Sort	TLA1, TLA2	Text Book (Chapter 2) Reference book iii (Chapter 11) <a href="http://www.visualgo.net">www.visualgo.net</a>	CO1 , CO3 , CO4
	Les. 6	Sorting: Bubble Sort, Selection Sort.	TLA1, TLA2, TLA4	Reference book iii (Chapter 10) <a href="http://www.visualgo.net">www.visualgo.net</a>	CO1, CO4
4	Les. 7	Introduction to Divide and Conquer Approach Searching: Binary Search Sorting: Merge Sort	TLA1, TLA2	Text Book (Chapter 2) Reference book i (Chapter 2) Reference book ii (Chapter 5) <a href="http://www.visualgo.net">www.visualgo.net</a>	CO1 , CO3 ,

					CO4
	Les. 8	Sorting: Quick Sort	TLA1, TLA2, TLA4	Text Book (Chapter 3) <a href="http://www.visualgo.net">www.visualgo.net</a>	CO1, CO3, CO4
5	Les. 9	Introduction to Greedy Approach. Greedy Coin Change Greedy Bin Packing	TLA1, TLA3	Text Book (Chapter 16 and 35) Reference book iii (Chapter 17) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a>	CO1 , CO3 , CO4 , CO5
	Les. 10	Greedy Partial Knapsack Greedy Huffman Coding	TLA1 , TLA2 , TLA4	Text Book (Chapter 16) Reference book iii (Chapter 17) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.codeforces.com">www.codeforces.com</a>	CO1 , CO3 , CO4 , CO5

(Class Test –2, Assignment-2)					
6	Les. 11	Introduction to Dynamic Programming Approach Using DP to solve the Fibonacci Numbers Problem	TLA1 , TLA2 , TLA4	Text Book (Chapter 15) Reference book iii (Chapter 19) <a href="http://www.codeforces.com">www.codeforces.com</a> <a href="http://www.topcoder.com">www.topcoder.com</a>	CO3 , CO2 , CO5
	Les. 12	DP: Coin Change DP: 0/1 Knapsack	TLA1, TLA3	Reference book iii (Chapter 19) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.codeforces.com">www.codeforces.com</a> <a href="http://www.topcoder.com">www.topcoder.com</a>	CO1 , CO3 , CO4 , CO5
(MID-TERM EXAM)					
7	Les. 13	DP: Longest Common Subsequence and Edit Distance	TLA1, TLA4	Text Book (Chapter 15) Reference book iii (Chapter 19) <a href="http://www.codeforces.com">www.codeforces.com</a>	CO1 , CO4 , CO5
	Les. 14	DP: Longest Increasing Subsequence	TLA1, TLA4	Reference book iii (Chapter 19) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a>	CO1 , CO3 , CO4

8	Les. 15	DP : Matrix chain multiplication	TLA1, TLA4	<a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.codeforces.com">www.codeforces.com</a>	
	Les. 16	Backtracking Basic and permutation generator	TLA1, TLA4	<a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.codeforces.com">www.codeforces.com</a>	
9	Les. 17	Introduction to Graph Algorithms Graph Representation	TLA1, TLA4	Text Book (Chapter 22) Reference book i (Chapter 4) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.codeforces.com">www.codeforces.com</a>	CO5
	Les. 18	Breadth First Search Depth First Search	TLA1, TLA3	Text Book (Chapter 22) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a>	CO1, CO4, CO5
10	Les. 19	DFS Applications: Full Tree Traversal Cycle Finding Component Finding Articulation Point Finding	TLA1, TLA4	Text Book (Chapter 22) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a>	CO4
	Les. 20	DFS Application: Topological Sort Strongly Connected Components	TLA1, TLA4	Text Book (Chapter 22) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a>	CO4
11	(Class Test-3, Assignment – 3)				
	Les. 21	Minimum Spanning Tree (MST) MST: Kruskal's Algorithm MST: Prim's Algorithm	TLA1, TLA2	Text Book (Chapter 23) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a>	CO1 , CO3 , CO4 , CO5
	Les. 22	Single Source Shortest Path(SSSP): Dijkstra's Algorithm	TLA1, TLA2, TLA4	Text Book (Chapter 24) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a>	CO1, CO4, CO5
12	Les. 23	SSSP: Bellman Ford Algorithm	TLA1, TLA2	Text Book (Chapter 24) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a>	CO1, CO4

	Les. 24	All Pairs Shortest Path: Floyd–Warshall algorithm	TLA1, TLA2, TLA4	Text Book (Chapter 25) <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a>	CO1, CO4, CO5
13	Les. 25	Articulation Points and Bridges	TLA1, TLA2, TLA4	<a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.codeforces.com">www.codeforces.com</a>	CO1, CO4, CO5
	Les. 26	Stable marriage problem	TLA1, TLA2	<a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.codeforces.com">www.codeforces.com</a>	CO1, CO4, CO5
14	Les. 27	Tree , Binary Tree, Binary Search Tree	TLA, TLA3	<a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.codeforces.com">www.codeforces.com</a>	CO1, CO4, CO5
	Les. 28	AVL Tree, Red Black Tree	TLA, TLA2	<a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.codeforces.com">www.codeforces.com</a>	CO1, CO4, CO5
15	Les. 29	Pre/Post/In order traversal of BST	TLA1, TLA2, TLA4	<a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.codeforces.com">www.codeforces.com</a>	CO1, CO4, CO5
	Les. 30	NP Completeness	TLA, TLA3	<a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a> <a href="http://www.codeforces.com">www.codeforces.com</a>	CO1, CO4, CO5
16	Les. 31	Final Presentation by Students/ Discussion about all the assigned problems.	TLA3	N/A	
	Les. 22	Student’s Problem Discussion	TLA4	N/A	
(FINAL EXAM)					

## 5. Assessment Methods

### 5.1. Grading System

Numerical Grade	Letter Grade	Grade Point
80-100	A+	4.00
75-79	A	3.75
70-74	A-	3.50
65-69	B+	3.25
60-64	B	3.00
55-59	B-	2.75
50-54	C+	2.50
45-49	C	2.25
40-44	D	2.00
Less than 40	F	0.00

## **6. Additional Support for Students**

- Student Portal:  
<http://studentportal.diu.edu.b/>
- Academic Guidelines  
<https://daffodilvarsity.edu.bd/article/academic-guidelines>
- Rules and Regulations of DIU  
<https://daffodilvarsity.edu.bd/article/rules-and-regulation>
- Career Development Center:  
<https://cdc.daffodilvarsity.edu.bd/>
- For general queries:  
<http://daffodilvarsity.edu.bd/>

## **Appendix-1: Program outcomes**

<b>POs</b>	<b>Category</b>	<b>Program Outcomes</b>
<b>PO1</b>	<b>Engineering Knowledge</b>	Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
<b>PO2</b>	<b>Problem Analysis</b>	Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences.
<b>PO3</b>	<b>Design/Development of Solutions</b>	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.
<b>PO4</b>	<b>Investigations</b>	Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
<b>PO5</b>	<b>Modern tool usage</b>	Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
<b>PO6</b>	<b>The engineer and society</b>	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
<b>PO7</b>	<b>Environment and sustainability</b>	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
<b>PO8</b>	<b>Ethics</b>	Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.
<b>PO9</b>	<b>Individual work and teamwork</b>	Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.
<b>PO10</b>	<b>Communication</b>	Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.
<b>PO11</b>	<b>Project management and finance</b>	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member or a leader of a team to manage projects in multidisciplinary environments.
<b>PO12</b>	<b>Life Long Learning</b>	Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.