PART-A

Course Outline		
I.	**Course No./ Course Code**	CSC 2211
II.	**Course Title**	Algorithms
III.	**Course Type (General Education / Core Course / Electives)**	Core Course
IV.	**Semester**	Fall
V.	**Academic Session**	2022-2023
VI.	**Course Teacher/Instructor**	
VII.	**Pre-requisite (If any)**	CSC 2105: Data Structure
VIII.	**Credit Value:**	3 credits
IX.	**Contact Hours:**	**2 hours theory and 3 hours Lab per week**
X.	**Total Marks:**	100
XI.	**Rationale of the Course:**	**Algorithms can be used to solve different mathematical, computational, and real-life problems in efficient ways. The course will cover the fundamental algorithms for solving a variety of problems, including sorting, searching, and graph algorithms. Moreover, the course will focus on basic algorithm design and techniques such as divide-and-conquer, dynamic programming, and greedy algorithms. Students will be able to design some of their own algorithms after they have a good understanding of the aforementioned methods.**
XII.	**Course Objectives:**	• Analyze the asymptotic performance of algorithms. • Rigorous proofs of algorithm correctness. • Demonstrate major algorithms and data structures. • Apply important algorithmic design paradigms and methods to analyze. • Synthesize efficient algorithms in common engineering design situations.

XIII. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

CLOs	CLO Descriptions	PLO Assessed
CLO1	Demonstrate the selective well known and self-developed (if any) algorithms and their complexity analysis in efficient ways to solve some engineering problems.	PLO-a-2
CLO2	Use break-down techniques to solve some complex realistic problems into modular problems and their solutions.	PLO-a-2
CLO3	Determine the usage of the algorithms and their data structures to solve some complex realistic problems along	PLO-a-2

PART-B

XIV. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning, and assessment strategy mapped with CLOs.

Week	Topic	Teaching-Learning Strategy	Assessment strategy	Corresponding CLOs
1	Knowing Mission & Vision of AIUB. Define the algorithm and its importance. Asymptotic Notation, and Time and Space complexity Analysis.	Lecture, Notes/PPT Slides, Student Feedback, Board work, Exercise Solving, Question/ Answer Session.		
2	Searching & Sorting (linear search, bubble sort, selection sort, insertion sort, counting sort)	Lecture, Notes/PPT Slides, Student Feedback, Board work, Exercise Solving, Question/ Answer Session.	QUIZ	CLO1
3	Recurrences, Repeated (backward) substitution method, Substitution method, Recursion-trees, and Master method (binary search, merge sort, quick sort).	Lecture, Notes/PPT Slides, Student Feedback, Board work, Exercise Solving, Question/ Answer Session.	QUIZ	CLO1
4	Greedy strategy (**a**ctivity selection problem, task scheduling problem, fractional knapsack problem, and coin change problem)	Lecture, Notes/PPT Slides, Student Feedback, Board work, Exercise Solving, Question/ Answer Session.	Mid Term Exam	CLO2

5	Dynamic Programming (Fibonacci problem, and 0-1 Knapsack problem)	Lecture, Notes/PPT Slides, Student Feedback, Board work, Exercise Solving, Question/ Answer Session.	Mid Term Exam	CLO2
6	Dynamic Programming (Matrix Chain Multiplication Problem, and Longest Common Subsequence Problem)	Lecture, Notes/PPT Slides, Student Feedback, Board work, Exercise Solving, Question/ Answer Session.	Mid Term Exam	CLO2
7	**Mid Term Week**			
8	**Graphs and Trees (**basics of graphs and trees and their applications, Depth-first Search, Breadth-first Search)	Lecture, Notes/PPT Slides, Student Feedback, Board work, Exercise Solving, Question/ Answer Session.		
9	**Graphs Algorithms (**Depth-first Search, Breadth-first Search Topological Sort, Strongly Connected Component)	Lecture, Notes/PPT Slides, Student Feedback, Board work, Exercise Solving, Question/ Answer Session.	Final Term Exam	CLO3
10	**Greedy Graph Algorithm (**Minimum Spanning Tree, Prim-Jarnik Algorithm, and Kruskal's Algorithm)	Lecture, Notes/PPT Slides, Student Feedback, Board work, Exercise Solving, Question/ Answer Session.	Final Term Exam	CLO3
11	**Shortest Path Algorithms (**Single Source Shortest Path - Dijkstra's Algorithm, Bellman-Ford Algorithm)	Lecture, Notes/PPT Slides, Student Feedback, Board work, Exercise Solving, Question/ Answer Session.	Final Term Exam	CLO3
12	**Shortest Path Algorithms** (All Pair Shortest Path – Floyd-Warshall Algorithm)	Lecture, Notes/PPT Slides, Student Feedback, Board work, Exercise Solving, Question/ Answer Session.		CLO3
13	Review, Discussion, Open problems, and Brainstorming **(Quiz 2)**			
14	**Final Term Week**			

Part-C

XV. Assessments and Evaluation

1) Assessment strategy:

Bloom's Category Marks	Quiz (Marks)	Assignment (Marks)	Exam (Marks)	Lab Performance (Marks)
Remember				
Understand				
Apply				
Analyze				
Evaluate				
Create				

2) Marks distribution:

Midterm and Final term	
Quiz	20%
Attendance	10%
Assignment	10%
Exam	40%
Lab Performance	20%
Total	100%
Final Grade/ Grand Total	
Midterm:	40%
Final Term:	60%

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(Failed)

p

Procedures:

Set B and Set C examinations will be conducted for the students who will miss regular Set A Mid Term or Final Term examinations.

PART-D

XVI. Learning materials

1) Recommended Readings:

- Introduction to Algorithms, Third Edition, Thomas H. Cormen, Charle E. Leiserson, Ronald L. Rivest, Clifford Stein (CLRS).
- Fundamental of Computer Algorithms, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran (HSR)
- Data Structures And Algorithms Made Easy In JAVA Author: Narasimha Karumanchi

2) Supplementary Readings:

- Algorithms, 4th Edition by Robert Sedgewick and Kevin Wayne

3) Others… (as applicable for the discipline/academic program)

- www.visualgo.net
- **http://acm.uva.es/problemset/**
- www.topcoder.com
- www.codeforces.com

Appendix

Mapping of PLOs to CS courses:

PLO-a: Engineering Knowledge Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization.	
PLO Indicator ID	**PLO Indicators Definition**
PLO-a-1	Apply information and concepts in natural science with the familiarity of issues.
PLO-a-2	Apply information and concepts of mathematics with the familiarity of issues.
PLO-a-3	Apply information and concepts in engineering fundamentals to solve complex engineering problems with a range of conflicting requirements.
PLO-a-4	Apply information and concepts in specialized engineering sciences with the in-depth of analysis of a complex engineering problem.

PLO-b: Problem Analysis Identify, formulate, research literature and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.	
PLO Indicator ID	**PLO Indicators Definition**
PLO-b-1	Identify first principles of natural sciences and engineering sciences in practical applications.
PLO-b-2	Formulate solutions, procedures, and methods using first principles of mathematics for engineering sciences.
PLO-b-3	Analyze solutions for complex engineering problem reaching substantiated conclusion.
PLO-b-4	Research literature of engineering science and analyze the validity and accuracy of existing solution for complex engineering problems.

PLO-c: Design/ development of solutions Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	
PO Indicator ID	**PO Indicators Definition**
PLO-c-1	Design solutions for a complex engineering problem considering public health and safety.
PLO-c-2	Develop system or components that meets specific needs considering health, safety and environment.

PLO-d: Investigation Conduct investigations of complex problems using research-based knowledge and research methods

including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.	
PO Indicator ID	**PO Indicators Definition**
PLO-d-1	Conduct investigations of complex problems using research-based knowledge
PLO-d-2	Use appropriate research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

PLO-e: Modern Tool Usage Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations.	
PO Indicator ID	**PO Indicators Definition**
PLO-e-1	Select and apply appropriate techniques, tools and resources (e.g., prediction & modeling) to solve complex engineering problems considering their limitations.
PLO-e-2	Create appropriate techniques, tools or resources (e.g., prediction & modeling) to solve complex engineering problems considering their limitations.

PLO-f: The Engineer and Society Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems.	
PLO Indicator ID	**PLO Indicators Definition**
PLO-f-1	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues in relation to professional engineering practice and solution.
PLO-f-2	Assess the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems.

PLO-g: Environment and Sustainability Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.	
PLO Indicator ID	**PLO Indicators Definition**
PLO-g-1	Understand the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.
PLO-g-2	Evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.

PLO-h: Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.	
PLO Indicator ID	**PLO Indicators Definition**
PLO-h-1	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PLO-i: Individual and Teamwork Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.	
PLO Indicator ID	**PLO Indicators Definition**
PLO-i-1	Function effectively as an individual in diverse teams and in multi-disciplinary settings.
PLO-i-2	Function effectively as a member or leader in diverse teams and in multi-disciplinary settings.

PLO-j: Communication Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	
PLO Indicator ID	**PLO Indicators Definition**
PLO-j-1	Comprehend and write effective reports and design documentation for effective communication on complex engineering activities.
PLO-j-2	Make effective presentations to exchange clear instructions with engineering community and the society at large.

PLO-k: Project Management and Finance Demonstrate knowledge and understanding of engineering management principles and economic decision making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	
PLO Indicator ID	**PLO Indicators Definition**
PLO-k-1	Apply engineering management principles and economic decision to manage project as a team member / team leader.
PLO-k-2	Apply engineering management principles and economic decision to manage project in multidisciplinary environments.

PLO-l: Lifelong learning Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	
PLO Indicator ID	**PLO Indicators Definition**
PLO-l-1	Identify the need and prepare accordingly for independent learning in solving complex engineering problems and change of technologies.
PLO-l-2	Demonstrate the ability to engage in independent and life-long learning in the broadest context of technological change.

Verification:

Prepared by: ---------- **Dr. Ashraf Uddin** *Course Convener* Date:.....	**Moderated by:** ---------- **Name** *Point Of Contact* *OBE Implementation Committee for CS* Date:.....	
Checked by: ..... **Dr. Md. Abdullah-Al-Jubair** *Head,* *Department of Computer Science* Date:.....	**Certified by:** ..... **Dr. Dip Nandi** *Director,* *Faculty of Science & Technology* Date:.....	**Approved by:** ..... **Mr. Mashiour Rahman** *Associate Dean,* *Faculty of Science & Technology* Date:.....