Department of Computer Science & Engineering (CSE)
School of Engineering, Technology & Sciences

INDEPENDENT UNIVERSITY, BANGLADESH (IUB)

Computer Science and Engineering (CSE) Program (*Undergraduate*)

COURSE OUTLINE **SPRING 2024** **FULL MARKS: 100**

Course Code	CSE211L	**Course Title**	Algorithms Lab
Course Type	Core	**Prerequisites (if any)**	CSE203 + Lab: Data Structure
Credit Value	1 (L: 1).	**Contact Hours / Week**	1 hour 30 Minutes
Year	2nd Year	**Semester**	5th Semester

COURSE DESCRIPTION

Introduction to algorithmic thinking and the importance of machine-independent time in algorithm analysis. Application of asymptotic notation for complexity analysis of code written by students. Demonstrations of complexity analysis for iterative algorithms followed by recursive algorithms. Implementation and hands-on exercises on divide-and-conquer strategies. Detailed study and implementation of sorting algorithms: Insertion sort, Merge sort, Quick sort, along with linear-time sorting methods: Counting sort, Radix sort. Practical exercises focusing on graph algorithms: shortest path (Dijkstra), minimum spanning trees (MST algorithms: Kruskal, Prim). Hands-on experience with greedy algorithms applied to MST and shortest path problems. The lab concludes with practical exercises on dynamic programming techniques for optimization problems.

COURSE OBJECTIVE

a. Apply asymptotic notation for complexity analysis of implemented algorithms, understanding the trade-offs between speed and efficiency.
b. Develop critical thinking to solve algorithmic challenges using diverse paradigms including divide-and-conquer and greedy algorithms.
c. Evaluate the correctness of algorithms, understanding the role of mathematical analysis in algorithm design and evaluation.
d. Demonstrate the ability to design and implement efficient algorithms, focusing on sorting algorithms, graph algorithms, and dynamic programming techniques.
e. Analyze research studies to suggest improvements and actively demonstrate algorithmic skills through lab exercises and projects.

COURSE POLICY

It is the student's responsibility to gather information about the assignments and cover topics if they miss lectures. Regular class attendance is mandatory. The following policy as per the faculty manual will be adopted:

a. The date and syllabus of the lectures, quizzes, midterm, and final exam and other announcements will be given ahead of time.
b. The reading materials for each class may be given before that class so that students may have a cursory look into the materials. All materials (lecture notes, supporting reading materials, problem sheets, and solutions) will be made available through google classroom (classroom.google.com).
c. Class participation is vital for a better understanding of the subject matter. Class will be conducted in an interactive environment where both the teacher and the students must pose questions and discuss solutions for better understanding.
d. Students will not be permitted to resit quizzes or other assessments. However, in cases of documented emergencies or illness, permission to sit for the assessments will be granted at the discretion of the course instructor.
e. Failure to meet assessment deadlines will result in the forfeiture of marks or grades for the affected students.
f. Points will be taken off for missing class tests. Without 70% of attendance, sitting for the final exam is NOT allowed.
g. According to the IUB policy, students must enter the classroom within the first 10 minutes to get the attendance submitted. No late attendance will be accepted.
h. Students should take tutorials with the instructor during office hours. Prior appointment is required.
i. Students must maintain the IUB code of conduct and ethical guidelines offered by the school of engineering and computer sciences.

ACADEMIC DISHONESTY

a. A student who cheats, plagiarizes, or furnishes false, misleading information in the course is subject to disciplinary action up to and including an F grade in the course and/or suspension/expulsion from the University.
b. Students must maintain the code of IUB.
c. The goal of homework is to give you practice in mastering the course material. Consequently, you are encouraged to collaborate on problem sets. In fact, students who form study groups generally do better on exams than do students who work alone. If you do work in a study group, however, you owe it to yourself and your group to be prepared for your study group meeting. Specifically, you should spend at least 30-45 minutes trying to solve each problem beforehand by yourself. If your group is unable to solve a problem, talk to other groups or ask your recitation instructor or teaching assistant assigned to your class.

d. You must write up each problem solution by yourself without assistance. It is a violation of this policy to submit a problem solution that you cannot orally explain to a member of the course staff.
e. No collaboration whatsoever is permitted during the examination.
f. Plagiarism and other anti-intellectual behavior cannot be tolerated in any academic environment that prides itself on individual accomplishment. If you have any questions about the collaboration policy, or if you feel that you may have violated the policy, please talk to one of the course staff. Although the course staff is obligated to deal with cheating appropriately, we are more understanding and lenient if we find out from the transgressor himself or herself rather than from a third party or by ourselves.

STUDENT WITH DISABILITIES AND STRESS

Students with disabilities are required to inform the Department of Computer Science & Engineering of any specific requirements for classes or examinations as soon as possible. Additionally, if you experience significant stress or worry, changes in mood, or problems eating or sleeping this semester, whether because of this or any other courses or factors, please do not hesitate to reach out immediately, at any hour, to any of the course's heads to discuss.

NON DISCRIMINATION POLICY

The course and University policy prohibit discrimination based on race, color, religion, sex, marital or parental status, national origin or ancestry, age, mental or physical disability, sexual orientation, or military status. If you see either the course instructor or any other person related to the course showing any form of discrimination, please inform the proctor's office of the wrongdoing.

COURSE CONTENT

a. **Introduction to Colaboratory and Review of Data Structures:** In this lab, students will familiarize themselves with Google Colaboratory and review basic data structures such as arrays, linked lists, etc..
b. **Algorithmic Thinking:** This lab introduces the fundamental concepts of algorithm design and analysis, including problem identification, algorithm definition, and efficiency measurement.
c. **Asymptotic Analysis for Iterative and Recursive Algorithms:** Students will learn about asymptotic analysis, focusing on the performance of iterative and recursive algorithms as the input size increases. This lab covers "big O" notation and other asymptotic analysis techniques.
d. **Searching Algorithms:** Students will explore various searching algorithms, learning about their operation, implementation, and suitable use cases.
e. **Sorting Algorithms:** This lab focuses on the study and implementation of different sorting algorithms. Students will gain a deep understanding of these algorithms, learning how to analyze their performance.
f. **Graph Algorithms:** This lab introduces the basic concepts of graph theory, including graph representation, traversal, and connectivity.
g. **Heap Sort and Heap Based Priority Queue:** In this lab, students will delve into heap sort, a specific sorting algorithm, learning its operation, implementation, and suitable use cases. Moreover, students will also be introduced to the concept of an efficient priority queue using the heap data structure.

COURSE LEARNING OUTCOME (CLO) MATRIX							
CLOs	**CO Description**	Blooms Learning Level*				PLO Assessed	CLO – PLO Correlation **
		C	P	A	S		
CLO1	Students will be able to understand and implement various techniques for measuring the efficiency of algorithms, distinguishing between different problem-solving strategies.		3			PLO-a	3
CLO2	Students will be capable of applying suitable techniques to solve problems, derived from thorough analysis and research.			5		PLO-b	3
CLO3	Students will be able to evaluate any given problem and create an algorithmic solution with the help of mathematical models.			4		PLO-c	2
***Bloom's Learning Level:** Numbers signify the Level of Bloom's skills.							

CLO – PLO Correlation: 3 – high, 2 – medium, 1- low
PLO-a: Apply knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems. **PLO-b:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. **PLO-c:** 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.

LESSON PLANNING WITH MAPPING OF CLO, TEACHING AND ASSESSMENT STRATEGIES

Week	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
1	Lab 1: Introduction to Colaboratory and Review of Data Structures	Lab Work (1 hour 30 Minutes)	Class Test	CLO1
2	Lab 2: Algorithmic Thinking	Lab Work (1 hour 30 Minutes)	Class Test Final-Term	CLO1
3	Lab 3: Asymptotic Analysis for Iterative Algorithms	Lab Work (1 hour 30 Minutes)	Class Test Final-Term	CLO2
4	Lab 4: Asymptotic Analysis for Recursive Algorithms	Lab Work (1 hour 30 Minutes)	Class Test Final-Term	CLO2
5	Lab 5: Divide & Conquer	Lab Work (1 hour 30 Minutes)	Class Test Final-Term	CLO2
6	Lab Project Discussion	Lab Work (1 hour 30 Minutes)	-	CO3
7	Lab 6: Searching Algorithms	Lab Work (1 hour 30 Minutes)	Class Test Final-Term	CLO3
8	Lab 7: Sorting Algorithms	Lab Work (1 hour 30 Minutes)	Class Test Final-Term	CLO3
9	Updates on Lab Project	Lab Work (1 hour 30 Minutes)	-	CLO3
10	Lab 8: Graph	Lecture (1 hour 30 Minutes)	Class Test Final-Term	CLO1
11	Lab 9: Heap Sort, Heap Based Priority Queue & Disjoint Sets	Lab Work (1 hour 30 Minutes)	Class Test Final-Term	CLO2
12	Review	Lab Work (1 hour 30 Minutes)	Class Test Final-Term	CLO2

ASSESSMENT AND EVALUATION

Assessment Type	Assessment Tools	Marks Distribution	Blooms Category	Sub Total
Continuous Assessment	Lab Work/Class Assessment/Home Task	50%	Analyze, Develop	70%
	Programming Contest	20%	Demonstrate, Use	
Summative Assessment	Project	30%	Investigate, Design	30%
			Total	100%

The following chart will be followed for grading. Please note that for each category.
*** Numbers are inclusive**

A	A-	B+	B	B-	C+	C	C-	D+	D	F
90-100	85-89	80-84	75-79	70-74	65-69	60-64	55-59	50-54	45-49	0-44

REFERENCE BOOK AND ADDITIONAL MATERIALS

a. "Algorithms Unlocked" by Thomas H. Cormen - This book provides a general explanation of how algorithms enable computers to solve problems, suitable for beginners.

b. "Data Structures and Algorithms in Python" by Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser - This practical book provides a problem-solving approach to data structures and algorithms using Python.

c. "Python Algorithms: Mastering Basic Algorithms in the Python Language" by Magnus Lie Hetland - This book focuses on the practical aspects of programming in Python and can be a great resource for labs.

d. “Grokking Algorithms: An illustrated guide for programmers and other curious people" by Aditya Y. Bhargava - This book, written in a friendly, illustrative style, can make the understanding and application of algorithms in a lab setting easier.

e. "Algorithm Design Manual" by Steven S. Skiena - This book is more practice-oriented and includes a catalog of algorithmic problems and solutions that can be very useful in a lab setting.

VERIFICATION

Prepared by:

XXXXXXX
Course Coordinator
Date:.....

Moderated by:

XXXXXX
Lead
OBE Committee for CSE
Date:.....

Checked by:

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XXXXX
Head, Dept of CSE, IUB.
Date:.....

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