COURSE DESCRIPTION FORM

INSTITUTION FAST - National University of Computers and Emerging Sciences

PROGRAM (S) TO BE EVALUATED BS - Computer Science

A. Course Description

Course Title	Design and Analysis of Algorithms		
Course Code	CS2009	**Credit Hours**	3 + 0
Prerequisites by Course(s)	CS2001	**Semester**	Fall 2024
Assessment Instruments (With tentative weights)	**Semester Work 10%** (5 assignments) **Project 10%** (one project) **Midterm 30%** (Midterm1:12.5, Midterm2: 17.5) **Final 50%** (Comprehensive end of semester exam)		
Current Catalog Description	Main objective of course is to understand required skills and knowledge to design and analyze algorithms. Students will learn several algorithm design techniques and use of mathematical tools for empirical analysis of algorithms. Additionally, students will be able to learn effective problem-solving skills in computing through this course.		
Textbook (or **Laboratory Manual** for Laboratory Courses)	1. Thomas H. Cormen et al, Introduction to Algorithms, 4th Edition		
Reference Material	1. Anany Levitin, Introduction to the design and analysis of algorithms, 3rd Edition		

Course Goals

A. Course Learning Outcomes (CLOs)

CLO No.	Course Learning Outcomes	Bloom Taxonomy	Tools
CLO-1	To apply acquired knowledge to solve computing problems complexities and proofs	C3 (Cognitive)	A1, A2, A3, A4, A5, M1,M2, F
CLO-2	To analyze complexities of different algorithms using asymptotic notations, complexity classes and standard complexity function	C4 (Cognitive)	A1, A2, A3, A4, A5, M1, M2, F

CLO-3	To evaluate generic algorithmic solutions such as sorting, searching and graphs applied to real-world problems	C5 (Cognitive)	A3, A4, A5, M1, M2, F
CLO-4	To construct and analyze real world problems solutions using different algorithms design techniques i.e. Brute Force, Divide and Conquer, Dynamic Programming, Greedy Algorithms.	C6 (Psychomotor)	Project

Tool: A = Assignment, Q = Quiz, M = Midterm, F=Final, CEP = Complex Engineering Problem.

B. Program Learning Outcomes

PLO 1	Computing Knowledge	Apply knowledge of mathematics, natural sciences, computing fundamentals, and a computing specialization to the solution of complex computing problems.
PLO 2	Problem Analysis	Identify, formulate, research literature, and analyze complex computing problems, reaching substantiated conclusions using first principles of mathematics, natural sciences, and computing sciences.
PLO 3	Design/Develop Solutions	Design solutions for complex computing problems and design systems, components, and processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
PLO 4	Investigation & Experimentation	Conduct investigation of complex computing problems using research-based knowledge and research-based methods
PLO 5	Modern Tool Usage	Create, select, and apply appropriate techniques, resources and modern computing tools, including prediction and modeling for complex computing problems.
PLO 6	Society Responsibility	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues relevant to context of complex computing problems.
PLO 7	Environment and Sustainability	Understand and evaluate sustainability and impact of professional computing work in the solution of complex computing problems
PLO 8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of computing practice.
PLO 9	Individual and Team Work	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
PLO 10	Communication	Communicate effectively on complex computing activities with the computing community and with society at large.
PLO 11	Project Mgmnt and Finance	Demonstrate knowledge and understanding of management principles and economic decision making and apply these to one's own work as a member or a team.

PLO 12	Life Long 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 changes.

C. Relation between CLOs and PLOs
(CLO: Course Learning Outcome, PLOs: Program Learning Outcomes)

		PLOs									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CLOs	1	✔									
	2		✔								
	3					✔					
	4									✔	

Topics Covered in the Course (Tentative plan)

Topics	No. of Weeks	Contact Hours	CLO
Basics of Algorithms, Mathematical Foundation, Growth of Function, asymptotic Notations. **(Assignment 1 will be given at the start of week-2 and Project will be announced)**	2	6	CLO-1
Divide and Conquer, Substitution Method, Recurrence-Tree Method, Master's Method.	2	6	CLO-2
Data Structures Review (Stack, Queue, Linked List, Hash Table, Binary Tree). Sorting (Merge, Insertion, Quick, Heap, Counting, Radix, Bucket) (**Assignment 2 will be given)**	1	3	CLO-3
Mid-I Examination	**0.5**	**1**	CLO-1,2,3
Geometric Algorithms (Introduction, Graham Scan, Close Points). String Matching	2	6	CLO-2,3
Dynamic Programming (Assignment 3 will be given)	2	6	CLO-3
Mid-II Examination	**0.5**	**2**	CLO-1,2,3,4
Greedy Algorithms, Graph Theory (Graph Categorization, Graph Terminology, Representation of Graphs, BFS & DFS, Strongly Connected Components, Greedy Algorithms: Kruskal's Algorithm, Prim's Algorithms, Bellman-Ford Algorithms, Dijkstra's Algorithm)	3	9	CLO-3

	(Assignment 4 will be given)			
	NP Complete Problems and Solutions using Approximation Algorithm, Amortized Algorithms **(Assignment 5 will be given)**	2	6	CLO-1
	Project Presentations	1	3	CLO-4
	Final	1	3	CLO-1,2,3,4,5
	Total	**17**	**51(Including 3 hours final exam)**	

Class Time Spent on (in credit hours)	**Theory**	**Problem Analysis**	**Solution Design**	**Social and Ethical Issues**
	8	20	20	0
Oral and Written Communications	Every student is required to submit all 5 assignments and potential oral project presentations.			

Instructor Name _____
Instructor Signature _____
Date ____13-08-2024_____