Course Information

CSE246: Algorithms (section: All)

Credits and Teaching Scheme

	Theory	Laboratory	Total
Credits	3	1.5	4.5

Prerequisite

Data Structure, Programming Knowledge.

Course Objectives

This course introduces students to the general tools and techniques for analyzing and designing computer algorithms. Initially necessary mathematical preliminaries required for analyzing and designing computer algorithms are taught. Then this course familiarizes students with several algorithmic approaches and corresponding problems. This course will work as a backbone to understand different core courses of computer science and will be needed as prerequisite knowledge for future courses such as Artificial Intelligence, Computer Networks, and Compiler Design.

Knowledge Profile

K4: Forefront engineering specialist knowledge for practice

Learning Domains

Cognitive – C3: Applying, C4: Analyzing
Psychomotor - P2: Manipulation, P3: Precision
Affective - A2: Responding

Program Outcomes (POs)

PO1: Engineering Knowledge
PO2: Problem Analysis

Complex Engineering Problem Solution

EP1: Depth of knowledge required
EP2: Range of conflicting requirements

Complex Engineering Activities

EP1, EP2, EP4

Course Outcomes (COs) with Mappings

After completion of this course students will be able to:

CO	CO Description	PO	Learning Domains	Knowledge Profile	Complex Engineering Problem Solving/ Engineering Activities
CO1	**Model** different real-life problems using graph and **apply** graph related algorithms to solve them.	PO1	C3	K4	
CO2	**Apply** the basic concepts of number theory, pattern matching for developing effective problem solutions.	PO1	C3	K4	
CO3	**Choose** and **justify** Advanced	PO2	C4	K4	EP1, EP2, EP4

	algorithm design techniques for solving complex problems.				
CO4	**Analyze** the complexity of different algorithms and **choose** the suitable approach for solving complex problems.	PO2	C4	K4	EP1, EP2

Course Topics, Teaching-Learning Method, and Assessment Scheme

Course Topic	Teaching-Learning Method	CO	Mark of Cognitive Learning Levels			CO (Marks)	Exam (Mark)
			C2	C3	C4		
Introduction to algorithms, complexity analysis, asymptotic notations, typical running time functions, classifying functions by their asymptotic growth rates, etc.		CO4	2			2	Midterm Exam I (15)
Divide and conquer algorithms: Binary search, Closest pair of points, Counting inversion, merge sort, quick sort etc. Greedy algorithms: Coin changing, fractional Knapsack, Huffman codes, Optimal codes, Activity selection. Suitability of all		CO3		3	2	5	

these algorithms in greedy approach.							
Recurrence relation. Iteration, Substitution, Recursion tree and Master methods		CO4			3	3	
Euclid's algorithm for GCD, Extended Euclid's algorithm and Number theoretic algorithms: Sieve Method. Pattern matching and String-matching algorithms (Rabin-Karp algorithm). Computing the transition function and diagram for Strings.		CO2	3	2		5	
Dynamic programmings (DP) and memorized algorithms: Longest Increasing subsequence (LIS), 0-1 Knapsack, longest common subsequence (LCS), Rock climbing, matrix chain multiplication, and miscellaneous problem solving.		C03		4	8	12	Midterm Exam II (20)
Graphs, graph-based algorithm - breadth-first search (BFS), depth-first search (DFS), Edge identification. Modification of DFS to find the topological sort, strongly connected component, articulation points, bridges, and Bi-connected components.		CO1	4	4		8	
Minimal spanning tree: basic terminology, applications and		CO1	4	8		12	Final (20)

algorithms Single source shortest path algorithms: Dijkstra's algorithm, Bellman-Ford algorithm, shortest path in DAG. Floyd-Warshall algorithm, Transitive closure. Algorithm strategy, structure and problem types.							
Network Flow, Max Flow, Min-Cut, Residual Network, Augmenting paths, Ford-Fulkerson and Edmonds-Karp algorithms.		CO4		6		6	
P and NP classes, algorithm completeness, discussion on other complex techniques of algorithm design And analysis.		CO4	2			2	

Laboratory Experiments and Assessment Scheme

Experiment	Teaching - Learning Method	CO	Mark of Cognitive Learning Levels		Mark of Psychomotor Learning Levels		Mark of Affective Learning Levels	CO Mark
			C3	C4	P2	P3	A2	
Implementation of Divide and Conquer Algorithms	Do	CO3						2
Implementation of Greedy- Knapsack (fractional) and Huffman codes	Do	CO3						3

Implementation of String Matching	Do	CO2						
Implementation of Sieve	Do	CO2						4
Implementation of DP- Knapsack, LCS, LIS, Coin change, Matrix chain multiplication and other DP related problem	Do	CO3						5
Implementation of breadth-first search (BFS)	Do	CO1						8
Implementation of depth-first search (DFS)	Do	CO1						
Implementation of Topological sort and find Strongly connected component	Do	CO1						
Implementation of Dijkstra's and Modified Dijkstra's algorithms	Do	CO1						
Implementation of Floyd-Warshall algorithm and Transitive closure	Do	CO1						
Implementation of Max Flow	Do	CO1						
Lab Performance	Individual lab evaluation							
Lab Exam	Individual lab exam							
Total								22

Mini Projects

Mini Project	Teaching-Learning Method	CO	Mark of Cognitive Learning Levels		Mark of Psychomotor Learning Levels		Mark of Affective Learning Levels	CO Mark
			C3	C4	P2	P3	A2	
Mini Lab Project including Report and Presentation	Group based moderately complex project with report writing, and oral/poster presentation	CO3	4	3	1.5	1.5	1	11

Overall Assessment Scheme

Assessment Area	CO				others	Assessment Area Mark
	Co1	Co2	Co3	Co4		
Class Participation					5	5
Class Test/Quiz					7	
Midterm Exam - I		5	5	5		15
Midterm Exam -II	8		12			20
Final Exam	18			2		20
Lab Exercise and Test	8	4	10			22
Mini Project			11			11
Total Mark	34	9	38	7	12	100

Teaching Materials and Equipment

Text Book	1. Introduction to Algorithm (3 rd edition) by Thomas H. Cormen, Charles E. Leiserson, Ronald Rivest, Clifford Stein 2. Algorithms by Robert Sedgewick
Teaching Materials	Lecture notes*, Lab exercise/ assignments/notes*, Reference books, Computer and Software

Grading policy

Marks(%)	Letter Grade	Grade Point
97-100	A+	4.00
90-96	A	4.00
87-89	A-	3.70
83-86	B+	3.30
80-82	B	3.00
77-79	B-	2.70
73-76	C+	2.30
70-72	C	2.00
67-69	C-	1.70
63-66	D+	1.30
60-62	D	1.00
< 60	F	0.00