SUBJECT: COMPUTER SCIENCE							
DCS	BCS-C401	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C	Time for ESE
			4	-	-	4	3 Hrs.

Pre- requisite: Knowledge of algebra and data structure.

Course Objectives:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for 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.

Course Outcomes:

CO1	For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.
CO2	Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
CO3	Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
CO4	Describe the dynamic-programming and backtracking paradigms and explain when an algorithmic design situation calls for them. For given problems of dynamic-programming/ backtracking and develop the dynamic programming/ backtracing algorithms, and analyze them to determine its computational complexity.
CO5	Become familiar with the major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate.

Course Contents

UNIT	Contents	Lectures Required
1.	**Introduction:** Algorithm definition, Algorithm Specification. **Analysis of Algorithms:** Orders of Magnitude (Asymptotic notations), Growth rates, some common bounds (constant, logarithmic, linear, polynomial, exponential), Average and worst-case analysis, Analysing control statements, Recurrence Relations- substitution, change of variables, master's method.	6
2.	**Sorting and searching algorithms:** Selection sort, bubble sort, insertion sort, sorting in linear time, count sort, Linear search.	5
3.	**Divide and conquer algorithms:** Introduction; Quick sort, worst and average case complexity; Merge sort; Matrices multiplication; Binary search.	5
4.	**Greedy algorithms:** General Characteristics of greedy algorithms; Problem solving using Greedy Algorithm- Activity selection problem, Minimum Spanning trees (Kruskal's algorithm, Prim's algorithm)	9

	Graphs: Shortest paths; Purpose of Huffman Coding, Prefix Codes, Huffman Tree, Huffman Coding Algorithm.	
5.	**Dynamic Programming:** Concepts of Dynamic Programming approach for algorithm design, Greedy Algorithm vs Dynamic Programming, Recursion vs Dynamic Programming. Elements of Dynamic Programming Approach. Concept of Matrix Chain Multiplication, its Algorithm, examples and complexity analysis; String Editing Algorithm (edit distance problem with insertion, deletion, replace operation) and its complexity analysis; 0-1 Knapsack problem and its complexity analysis; Travelling Salesman Problem and its analysis. Memoization Strategy Concept of Memoization: Dynamic Programming vs Memoization.	10
6.	**Backtracking:** Concept of Backtracking Approach; Recursion vs Backtracking; Backtracking Algorithms: Concept of Subset Sum, Algorithm for Subset-Sum, its example and Complexity Analysis. 0-1 Knapsack Problem, algorithm with backtracking approach and its analysis; N-Queen Problem and its Analysis.	9
7.	**Introduction to Complexity Theory:** The class P and NP; Polynomial reduction; NP- Complete Problems; NP-Hard Problems.	4
	Total Lectures	48

Suggested Text Book(s):

1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to algorithms", The MIT Press.
2.	Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekiaran, Computer Algorithms, Silicon Press.
3.	Kleinberg, Jon, and Eva Tardos, Algorithm Design", Addison-Wesley.

Suggested Reference Book(s):

1.	S. Base, Computer Algorithms: Introduction to Design and Analysis, Addison Wesley.
2.	A.V. Levitin, Introduction to the Design and Analysis of Algorithms, Pearson Education.

Other Useful Resource(s)

1.	https://onlinecourses.nptel.ac.in/noc18_cs20/preview
2.	https://nptel.ac.in/courses/106101060/
3.	https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/video_galleries/lecture-videos/

Course Outcomes Contributed to Programme Outcomes

PO→ CO↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	AVERAGE
CO1	3	1	1	-	1	3	-	-	**1.1**
CO2	3	1	1	-	1	3	-	-	**1.1**
CO3	3	3	2	1	1	3	2	2	**2.1**
CO4	3	3	2	1	1	3	2	2	**2.1**
CO5	3	3	2	1	1	3	2	2	**2.1**
AVG.	**3.0**	**2.2**	**1.6**	**0.6**	**1.0**	**3.0**	**1.2**	**1.2**	**1.7**

Course Outcomes Contributed to Programme Specific Outcomes

PSO→ CO↓	PSO1	PSO2	PSO3	AVERAGE
CO1	3	2	3	**2.7**
CO2	3	3	3	**3.0**
CO3	3	3	3	**3.0**
CO4	3	3	3	**3.0**
CO5	3	3	3	**3.0**
AVG.	**3.0**	**2.8**	**3.0**	**2.9**