



Kot Bhalwal, Jammu



Model Institute of Engineering
& Technology (Autonomous)
Course Handout

COURSE HANDOUT

DESIG AND ANALYSIS OF ALGORITHMS (COM-401)

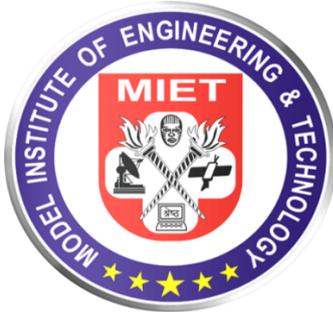
BE CSE Cybersecurity 4th Semester

ACADEMIC YEAR (2024-25)

Mr. Saurabh Sharma

Assistant Professor

Computer Science and Engineering



Department of Computer Science and Engineering

Model Institute of Engineering & Technology (Autonomous)

Kot Bhalwal, Jammu - 181122

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Course Code	Course Name	Course Type	Cd	L	T	P	Marks		
							Sessional	Final Exam	Total
CSE-401	Design and Analysis of Algorithms	PCC	4	3	1	0	50	100	150

COURSE OUTCOMES

At the end of the course the student will be able to:	
CO1	Write algorithms in terms of their composite steps and transformations.
CO2	Analyze time and space complexity of well-known algorithms.
CO3	Demonstrate various algorithm design techniques.
CO4	Evaluate P, NP and NP-Complete algorithms and their characteristics.
CO5	Apply algorithms in devising optimal solutions to given problems in diverse domains.

Section-A

Unit-I

Introduction: What is an Algorithm, Algorithm Specification, Designing and Analysis Framework, Performance Analysis- Space complexity, Time complexity. Growth of Function and Asymptotic Notations- Big-Oh notation (O), Omega notation (Ω), Theta notation (Θ), and Little-oh notation (o), Little-Omega notation (ω), Recursive Algorithms and Relations - Recurrence relations, substitution method, recurrence trees, master's theorem. (12 Hours)

Unit-II

Divide and Conquer- General method, Advantages and Disadvantages, Binary search, Recurrence equation for divide and conquer, Finding the maximum and minimum, Merge sort, Quick sort and its analysis, Stassen's matrix multiplication, fast multiplication of large integers. (6 Hours)

Unit-III

Greedy Method- General Method, Coin Change Problem, Knapsack Problem, Job sequencing with deadlines. Minimum cost spanning trees- Prim's Algorithm, Kruskal's Algorithm. Single source shortest paths- Dijkstra's Algorithm. Optimal Tree problem- Huffman Trees and Codes. Transform and Conquer Approach- Heaps and Heap Sort. (12 Hours)

Section-B

Unit-IV

Dynamic Programming- General Method with Examples, Multistage Graphs. Transitive Closure- Warshall's Algorithm, All Pairs Shortest Paths- Floyd's Algorithm, Optimal Binary Search Trees, Knapsack problem, Bellman-Ford Algorithm, Travelling Salesperson problem, Reliability design. (12 Hours)

Unit-V

Backtracking- General method, N-Queens problem, Sum of subsets problem, Graph colouring, Hamiltonian cycles. Branch and Bound- Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem, FIFO Branch and Bound solution. NP-Complete and NP-Hard problems- Basic concepts, nondeterministic algorithms, P, NP, NP-Complete, and NP Hard classes. (12 Hours)

Textbooks

S. No.	Name of the Books	Author	Publisher	Edition (Pub. Yr.)
1	Introduction to Algorithms	T.Cormen, C. Lieserson, R.Rivest, C.Stein	Prentice-Hall/India	4 th (2022)
2	Algorithms	S. Dasgupta, C. Papadimitriou, Umesh Vazirani	McGraw Hill Education	1 st (2017)
3	Fundamentals of Computer Algorithms	Ellis Horowitz, Sartaj Sahni	Universities Press	2 nd (2008)



Reference Books

S. No.	Name of the Books	Author	Publisher	Edition (Pub. Yr.)
1	Algorithms Design: Foundations, Analysis, and Internet Examples	Michael T. Goodrich, Roberto Tamassia	Wiley	1 st (2006)
2	The Algorithm Design Manual	Steven S Skiena	Springer	2 nd (2008)

COURSE PLAN		
Unit-I		
S.No	Topics	Recommended Books
1	Introduction: What is an Algorithm, Algorithm Specification	Book 2, Ch.1
2	Designing and Analysis Framework	Book 2, Ch.2
3	Performance Analysis- Space complexity, Time complexity.	Book 2, Ch.2
4	Worst-case Analysis	Book 1, Ch.5
5	Average-case Analysis	Book 1, Ch.5
6	Use of order notations and related results	Book 1, Ch.2
7	Recurrence Equations	Book 2, Ch.2
8	Divide and conquer recurrences	Book 2, Ch.2
9	Substitution method	Book 1, Ch.4
10	Recurrence trees	Book 1, Ch.1
11	Master's theorem	Book 1, Ch.1
12	Application of Master's theorem	Book 1, Ch.1
Unit-II		
13	Quick Sort and its analysis	Book 1, Ch.2
14	Merge Sort recurrence	Book 1, Ch.2
15	Strassen's matrix multiplication, fast multiplication of large integers	Book 1, Ch.1
16	Binary search trees	Book 1, Ch.3
17	Priority queues	Book 1, Ch.2
18	Heaps and Heap Sort	Book 1, Ch.2
Unit-III		
19	Data structures for disjoint sets	Book 1, Ch.5
20	Path compression	Book 1, Ch.21
21	Union by rank	Book 1, Ch.21
22	Prim's Algorithm	Book 1, Ch.6
23	Kruskal's Algorithm	Book 1, Ch.6
24	Prim's and Kruskal's Algorithm Examples	Book 1, Ch.6
25	Huffman coding	Book 2, Ch.5
26	LZW coding	Book 5, Ch.18
27	Shortest paths	Book 1, Ch.6
28	Greedy activity selection	Book 1, Ch.35
29	Set cover heuristics	Book 1, Ch.35
30	Greedy heuristics	Book 1, Ch.35
Unit-IV		



31	Dynamic Programming basics	Book 1, Ch.15
32	Matrix-chain multiplication	Book 1, Ch.15
33	Matrix-chain multiplication problems	Book 1, Ch.15
34	DP solution for traveling salesman	Book 2, Ch. 6
35	DP solution for traveling salesman Problems	Book 2, Ch. 6
36	0/1 Knapsack problems	Book 2, Ch. 6
37	Least common subsequences	Book 1, Ch. 15
38	Independent sets	Book 2, Ch. 6
39	Backtracking algorithm	Book 2, Ch. 9
40	Backtracking algorithm problems	Book 2, Ch. 9
41	Breadth-First and Depth-First search algorithms	Book 2, Ch. 6
42	Breadth-First and Depth-First Search Algorithm Problems	Book 2, Ch. 6
Unit-V		
43	Topological sort	Book 2, Ch. 6
44	Recursive graph algorithms	Book 2, Ch. 1
45	KMP algorithm	Book 1, Ch. 32
46	Rabin-Karp algorithm	Book 1, Ch. 32
47	Basics of number theory algorithms	Book 1, Ch. 31
48	GCD and extended Euclidean algorithm	Book 1, Ch. 31
49	Primality testing	Book 1, Ch. 31
50	Non-Deterministic Algorithms	Book 1, Ch. 31
51	Polynomial Time Algorithms	Book 1, Ch. 34
52	NP-hard and NP-complete classes	Book 2, Ch. 8
53	Cook's Theorem	Book 1, Ch.34
54	Introduction to Approximation Algorithms	Book 1, Ch. 35

ADDITIONAL WEB RESOURCES

1.	MOOC: Algorithms, Part I by Princeton University https://www.coursera.org/learn/algorithms-part1#modules
2.	NPTEL: Video lectures on Design and Analysis of Algorithms Lecture series by Prof. Abhiram G Ranade, Prof. Ajit A Diwan, Prof. Sundar Viswanathan, IIT Bombay https://nptel.ac.in/courses/106101060

GRADING AND ASSESSMENT

- **Sessional Test 1:** 10 marks
- **Sessional Test 2:** 10 marks
- **Assignment:** 20 marks
- **Attendance:** 10 marks
- **Final Examination:** 100 marks



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COURSE POLICIES

- **Attendance:** Minimum 75% attendance is mandatory to appear in the final examination of the course.
- **Academic Integrity:** MIET's academic integrity policies apply. Plagiarism will not be tolerated.
- **Late Submissions:** Assignments and projects must be submitted by the specified timelines.

FACULTY INFORMATION

- **Office Hours**
Monday (12:55 PM - 1:45 PM)
Friday (12:55 PM - 1:45 PM)
- **Contact Information**
saurabh.cse@mietjammu.in