



Kot Bhalwal, Jammu



Model Institute of Engineering
& Technology (Autonomous)
Course Handout

COURSE HANDOUT

DESIGN AND ANALYSIS OF ALGORITHMS

(COM-301) CSE (AIML)-3rd SEMESTER

ACADEMIC YEAR (2023-24)

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Dr. Arun K. Gupta Teaching-Learning Centre

Version 1.1



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Course Code	Course Name	Course Type	Cd	L	T	P	Marks		
							Sessional	Final Exam	Total
CSE-301	Design and Analysis of Algorithms	PCC	4	4	0	0	50	100	150

COURSE OUTCOMES

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

Section-A

Unit-I : Mathematical preliminaries, time complexity and space complexity, worst-case and average-case analyses, use of order notations and related results, divide and conquer recurrences, recurrence relations: substitution method, recurrence trees, Master’s theorem and its applications. (12 Hours)

Unit-II : Quick Sort and its analyses, Merge Sort recurrence, Stassen’s matrix multiplication, fast multiplication of large integers, binary search trees, priority queues, Heaps and Heap Sort. (6 Hours)

Unit-III : Data structures for disjoint sets, Path compression, and union by rank, Prim’s and Kruskal’s algorithms, Huffman coding, LZW coding, shortest paths, greedy activity selection, set cover and greedy heuristics. (12 Hours)

Section-B

Unit-IV : Dynamic Programming basics, matrix-chain multiplication, DP solution for traveling salesman and 0/1 Knapsack problems, least common subsequences, independent sets and backtracking algorithm, Breadth-First and Depth- First search algorithms. (12 Hours)

Unit-V : Topological sort, recursive graph algorithms, string matching: KMP algorithm, Rabin-Karp algorithm, number theory algorithms: basics, GCD and extended Euclidean algorithm, Primality testing. Non-Deterministic Algorithms, Polynomial Time Algorithms, NP-hard and NP-complete classes, Cook’s Theorem, Introduction to Approximation. (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.Steina	Prentice-Hall/India	3 rd (2009)
2	Algorithms	S. Dasgupta, C. Papadimitriou, Umesh Vazirani	McGraw Hill Education	1 st (2017)



Reference Books

S. No.	Name of the Books	Author	Publisher	Edition (Pub. Yr.)
3	Fundamentals of Computer Algorithms	Ellis Horowitz, Sartaj Sahni	Universities Press	2 nd (2008)
4	Algorithms Design: Foundations, Analysis, and Internet Examples	Michael T. Goodrich, Roberto Tamassia	Wiley	1 st (2006)
5	The Algorithm Design Manual	Steven S Skiena	Springer	2 nd (2008)

COURSE PLAN

COURSE PLAN		
Unit-I		
S.No	Topics	Recommended Books
1	Mathematical preliminaries	Book 2, Ch.1
2	Time complexity	Book 2, Ch.2
3	Space 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:** 20 marks
- **Assignment:** 20 marks
- **Attendance:** 10 marks
- **Final Examination:** 100 marks



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**
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