COURSE HANDOUT

ALGORITHM DESIGN AND ANALYSIS (PSCSATC-224)

MCA-2nd SEMESTER

ACADEMIC YEAR (2023-24)

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Course Code	Course Name	Course Type	Cd	L	T	P	Marks		
							Sessional	Final Exam	Total
PSCSATC224	Algorithm Design & Analysis	Core	4	4	0	0	40	60	100

COURSE OUTCOMES

At the end of the course the student will be able to:	
CO1	To teach the various aspects of development of algorithms.
CO2	To demonstrate a familiarity with the design and analysis of various algorithms.
CO3	Students will have the ability to apply important algorithmic design paradigms.
CO4	Students would be able to analyze and compare the algorithms on the basis of asymptotic complexity.

Unit-I

Introduction to algorithm analysis: Introduction to algorithms, Algorithm Specifications, performance analysis. Recursion and Induction: recursive procedures, recurrence relations, induction proofs, proving correctness. Randomized Algorithms: Basic of Probability Theory, Description of Randomized algorithms, Identifying the repeated Elements, Partiality Testing, Advantages and Disadvantages of using randomized algorithms.

(10 Hours)

Unit-II

Basics of Analysis: Asymptotic Bounds, Concept of Efficiency of an Algorithm, Well Known Asymptotic Functions & Notations, Well Known Sorting Algorithms, Comparison of Sorting Algorithms, Best-Case and Worst-Case Analyses, Average-Case Analysis, Amortized Analysis.

(6 Hours)

Unit-III

Design Techniques-I: Divide-and-Conquer, General Method, Multiplication of two n-bit numbers, Binary Search, Merge Sort, Quick Sort, Strassen's Matrix multiplication, Exponentiation. Dynamic Programming, General Method, The Problem of Making Change, The Principle of Optimality, Chained Matrix Multiplication.

(10 Hours)

Unit- lV

Design Techniques-II: Backtracking, General method, n-queen's problem, Sum of subsets problem. Greedy Algorithms, General Method, Knapsack problem, Job sequencing with deadlines, Minimum Spanning Trees, Kruskal's Algorithm, Prim's Algorithm, Dijkstra's Single Source Shortest Path Algorithm.

(10 Hours)

Unit-V

Classification of Problems & Graphs Algorithms: Non-Deterministic Algorithms, Complexity classes, Introduction to NP-Completeness, Establishing NP-Completeness of Problems, NP-Completeness Proofs, NP-Hard Problems. Graphs Algorithms: Traversing Trees, Depth-First Search, Breadth-First Search, Best-First Search & Topological Sort.

(10 Hours)

Textbooks

S.No	Name of the Books	Name of the Author	Publisher Name	Edition (Pub.Yr.)
1	Introduction to Algorithms	T.Cormen, C. Lieserson, R.Rivest, C.Steina	Prentice-Hall/India	3rd (2009)
2	Algorithms	S. Dasgupta, C. Papadimitriou, Umesh Vazirani	McGraw Hill Education	1st (2017)
3	Computer algorithms-Introduction to Design and Analysis	SaaraBaase and Allen Van Gelder	Pearson Education	3rd (1999)

Reference Books

S.No	Name of the Books	Name of the Author	Publisher Name	Edition (Pub.Yr.)
1	Fundamentals of ComputerAlgorithms	Ellis Horowitz, Sartaj Sahni	Universities Press	2nd (2008)
2	Algorithms Design: Foundations, Analysis and Internet Examples	Michael T. Goodrich, RobertoTamassia	Wiley	1st (2006)
3	The Algorithm Design Manual	Steven S Skiena	Springer	2nd (2008)
4	Introduction to the Design and Analysis of Algorithms: A Strategic Approach	R. C. T. Lee, S. S. Tseng, R. C. Chang & Y. T. Tsai	Tata McGraw-Hill	2nd (2009)

COURSE PLAN		
Unit-I Introduction to Algorithm Analysis		
S.No	**Topics**	**Recommended Books**
1	Introduction to Algorithms	Book 1, Ch.1
2	Algorithm Specifications	Book 1, Ch.2
3	Performance Analysis	Book 1, Ch.3
4	Case Study on analysis of Algorithms	Book 1, Ch.3
5	Recursion and Induction: Recursive Procedures	Book 1, Ch.5
6	Induction proofs and proving correctness	Book 1, Ch.5
7	Recurrence Equations	Book 1, Ch.5
8	Randomized Algorithms: Basic of Probability Theory	Book 1, Ch.6
9	Description of Randomized algorithms	Book 1, Ch.6
10	Identifying the repeated Elements	Book 1, Ch.6
11	Partiality Testing	Book 1, Ch.6
12	Advantages and Disadvantages of using randomized algorithms	Book 1, Ch.6
Unit-II Basics of Analysis		
13	Basics of Analysis: Asymptotic Bounds	Book 1, Ch.3
14	Concept of Efficiency of an Algorithm	Book 1, Ch.3
15	Well Known Asymptotic Functions & Notations	Book 1, Ch.3
16	Comparison of Sorting Algorithms	Book 1, Ch.7,8,9
17	Best-Case and Worst- Case Analyses	Book 1, Ch.12
18	Average Case Analysis	Book 1, Ch.15
19	Amortized Analysis	Book 1, Ch.15
Unit-III Design Techniques-I		
20	Divide-and-Conquer, General Method	Book 1, Ch.4
21	Multiplication of two n-bit numbers	Book 1, Ch.4
22	Binary Search	Book 1, Ch.4
23	Merge Sort	Book 1, Ch.4
24	Quick Sort	Book 1, Ch.4
25	Strassen's Matrix multiplication	Book 1, Ch.4
26	Exponentiation and Dynamic Programming: General Method and The Problem of Making Change	Book 1, Ch.13
27	The Principle of Optimality	Book 1, Ch.13
28	Chained Matrix Multiplication	Book 1, Ch.13

Unit-IV Design Techniques-II		
22	Backtracking, General method	Book 1, Ch.14
23	N-Queen's Problem	Book 1, Ch.14
24	Sum of subsets problem	Book 1, Ch.14
25	Greedy Algorithms	Book 2, Ch. 3
26	Knapsack problem	Book 2, Ch. 3
27	Job sequencing with deadlines	Book 2, Ch. 3
28	Minimum Spanning Trees	Book 2, Ch. 7
29	Prim's and Kruskal's Algorithm	Book 2, Ch. 7
30	Dijkstra's Single Source Shortest Path Algorithm	Book 2, Ch. 7
Unit-V Classification of Problems & Graphs Algorithms		
31	Classification of Problems & Graphs Algorithms	Book 2, Ch. 7
32	Non- Deterministic Algorithms	Book 2, Ch. 17
33	Introduction to NP- Completeness	Book 2, Ch. 18
34	Establishing NP- Completeness of Problems	Book 2, Ch. 18
35	NP- Completeness Proofs and P-Hard Problems	Book 2, Ch. 18
36	Graphs Algorithms	Book 2, Ch. 7
37	Traversing Trees	Book 2, Ch. 7
38	Depth-First, Breadth-First and Best-First Search	Book 2, Ch. 7
39	Minimax Principle	Book 2, Ch. 7
40	Topological Sort	Book 2, Ch. 7

ADDITIONAL WEB RESOURCES

1.	**MOOC: Design and Analysis of Algorithms: By Robert Sedgewick** https://www.coursera.org/learn/analysis-of-algorithms
2.	**NPTEL:** Video lectures on Design and analysis of algorithms series by Prof. Madhavan Chennai Mathematical Institute :https://nptel.ac.in/courses/106106131
3.	**MIT Open Courseware 6.006 Introduction to Algorithms:** https://ocw.mit.edu/courses/6-006-introduction-to-algorithms-spring-2020/: https://ocw.mit.edu/courses/6-006-introduction-to-algorithms-spring-2020/
4.	**MIT Open Courseware :** https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/
5.	**Princeton's Algorithms Course:** https://online.princeton.edu/algorithms-part-i: https://online.princeton.edu/algorithms-part-i
6.	Problems Based on Dynamic Programming: https://medium.com/techie-delight/top-50-dynamic-programming-practice-problems-4208fed71aa3

GRADING AND ASSESSMENT

- **Sessional Test**: 20 marks
- **Assignment**: 10 marks
- **Attendance**: 10 marks
- **Final Examination**: 60 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**

  Wednesday (12:05 PM - 12:55 PM)
  Thursday (12:05 PM - 12:55 PM)

- **Contact Information**
  saurabh.cse@mietjammu.in