Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410241: Design and Analysis of Algorithms

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisites Courses: Discrete Mathematics (210241), Fundamentals of Data Structures(210242, Data Structures and Algorithms(210252), Theory of Computation (310242)

Companion Course: Laboratory Practice III(410246)

Course Objectives:

- To develop problem solving abilities using mathematical theories.
- To apply algorithmic strategies while solving problems.
- To analyze performance of different algorithmic strategies in terms of time and space.
- To develop time and space efficient algorithms.
- To study algorithmic examples in distributed and concurrent environments
- To Understand Multithreaded and Distributed Algorithms

Course Outcomes:

On completion of the course, student will be able to–

CO1: Formulate the problem
CO2: Analyze the asymptotic performance of algorithms
CO3: Decide and **apply** algorithmic strategies to solve given problem
CO4: Find optimal solution by applying various methods
CO5: Analyze and **Apply** Scheduling and Sorting Algorithms.
CO6: Solve problems for multi-core or distributed or concurrent environments

Course Contents

Unit I	Algorithms and Problem Solving	07 Hours

Algorithm: The Role of Algorithms in Computing - What are algorithms, Algorithms as technology, Evolution of Algorithms, Design of Algorithm, Need of Correctness of Algorithm, Confirming correctness of Algorithm – sample examples, Iterative algorithm design issues.
Problem solving Principles: Classification of problem, problem solving strategies, classification of timecomplexities (linear, logarithmic etc.)

#Exemplar/Case Studies	Towers of Hanoi
***Mapping of Course Outcomes for Unit I**	CO1,CO3

Unit II	Analysis of Algorithms and Complexity Theory	07 Hours

Analysis: Input size, best case, worst case, average case
Counting Dominant operators, Growth rate, upper bounds, asymptotic growth, O, Ω, Θ, o and ω notations, polynomial and non-polynomial problems, deterministic and non-deterministic algorithms, P- class problems, NP-class of problems, Polynomial problem reduction NP complete problems- vertex cover and 3-SAT and NP hard problem - Hamiltonian cycle.

#Exemplar/Case Studies	Analysis of iterative and recursive algorithm

***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Greedy And Dynamic Programming algorithmic Strate**	**08 Hours**

Greedy strategy: Principle, control abstraction, time analysis of control abstraction, knapsack problem,scheduling algorithms-Job scheduling and activity selection problem.
Dynamic Programming: Principle, control abstraction, time analysis of control abstraction, binomialcoefficients, OBST, 0/1 knapsack, Chain Matrix multiplication.

#Exemplar/Case Studies	Rail tracks connecting all the cities
***Mapping of Course Outcomes for Unit III**	CO3, CO4

Unit IV	**Backtracking and Branch-n-Bound**	**08 Hours**

Backtracking: Principle, control abstraction, time analysis of control abstraction, 8-queen problem,graph coloring problem, sum of subsets problem.
Branch-n-Bound: Principle, control abstraction, time analysis of control abstraction, strategies-FIFO,
LIFO and LC approaches, TSP, knapsack problem.

#Exemplar/Case Studies	Airline Crew Scheduling
***Mapping of Course Outcomes for Unit IV**	CO3, CO4

Unit V	**Amortized Analysis**	**07 Hours**

Amortized Analysis: Aggregate Analysis, Accounting Method, Potential Function method, Amortized analysis-binary counter, stack Time-Space tradeoff, Introduction to Tractable and Non-tractable Problems, Introduction to Randomized and Approximate algorithms, Embedded Algorithms: Embedded system scheduling (power optimized scheduling algorithm), sorting algorithm for embedded systems.

#Exemplar/Case Studies	cutting stock problem
***Mapping of Course Outcomes for Unit V**	CO3,CO5

Unit VI	**Multithreaded And Distributed Algorithms**	**07 Hours**

Multithreaded Algorithms - Introduction, Performance measures, Analyzing multithreaded algorithms,Parallel loops, Race conditions.
Problem Solving using Multithreaded Algorithms - Multithreaded matrix multiplication, Multithreadedmerge sort.
Distributed Algorithms - Introduction, Distributed breadth first search, Distributed Minimum SpanningTree.
String Matching- Introduction, The Naive string matching algorithm, The Rabin-Karp algorithm.

#Exemplar/Case Studies	Plagiarism detection

***Mapping of Course Outcomes for UnitVI**	CO6

Learning Resources

Text Books:

1. Parag Himanshu Dave, Himanshu Bhalchandra Dave, " Design And Analysis of Algorithms",Pearson Education, ISBN 81-7758-595-9
2. Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", PHI, ISBN 978-81-203-1131-2

Reference Books :

1. Michael T. Goodrich, Roberto Tamassia, "Algorithm Design: Foundations," Analysis and InternetExamples‖, Wiley, ISBN 978-81-265-0986-7
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction toAlgorithms", MIT Press; ISBN 978-0-262-03384-8
3. Horowitz and Sahani, "Fundamentals of Computer Algorithms", University Press, ISBN: 978 817371 6126, 81 7371 61262
4. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms" Cambridge University Press, ISBN: 978-0-521-61390-3
5. Dan Gusfield, "Algorithms on Strings, Trees and Sequences", Cambridge University Press,ISBN:0-521-67035-7

e-Books :

1. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/design_and_analysis_of_algorithms_tutorial.pdf
2. https://www.ebooks.com/en-in/book/1679384/algorithms-design-techniques-and-analysis/m-h-alsuwaiyel

MOOC Courses links :

- Design and Analysis of Algorithms - https://nptel.ac.in/courses/106106131

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	-	-	-	-	-	-	2
CO2	2	3	-	-	-	-	-	-	-	-	-	2
CO3	2	3	2	-	-	-	-	-	-	-	-	3
CO4	2	3	3	2	-	-	-	-	-	-	-	3
CO5	2	2	2	2	-	-	-	-	-	-	-	3
CO6	2	2	1	2	-	-	-	-	-	-	-	-