Dr. Vishwanath Karad
MIT WORLD PEACE UNIVERSITY | PUNE

COURSE STRUCTURE

Course Code	CSE20080				
Course Category	Program Major				
Course Title	Design and Analysis of Algorithms				
Teaching Scheme	Lectures	Tutorials	Laboratory / Practical	Project	Total
Weekly load hours	3	--	--	--	3
Credits	3	--	--	--	3
Assessment Schema Code	TT1				

Prerequisites:

- Data Structures
- Discrete Structures

Course Objectives:

By participating in and understanding all facets of this Course a student will be able:

1. **Knowledge:**
   ii. Learn the basics of computational complexity analysis of algorithms
2. **Skill:**
   ii. Understand the problem solving and problem classification
   iii. Understand the concept of nondeterministic polynomial algorithms
3. **Attitude:**
   i. Learn how to select and apply appropriate algorithm design strategies to solve real-world problems
   ii. Provide students with foundations to deal with a variety of computational problems using different design strategies

Course Outcomes:

After completion of this course students will be able to:

1. Calculate computational complexity using asymptotic notations for various algorithms.
2. Apply Divide &Conquer as well as Greedy approach to design algorithms
3. Understand and analyse optimization problems using dynamic programming.
4. Illustrate different problems using Backtracking and compare different methods of Branch and Bound strategy.
5. Classify P, NP, NP-complete, NP-Hard problems.

Course Contents:

Unit I - Introductions to Algorithms:

Analysis of Algorithm: Efficiency- Analysis framework, asymptotic notations – big O, theta and omega. Analysis of Non-recursive and recursive algorithms: Solving Recurrence Equations using Masters theorem and Substitution method.

Searching: Search Techniques-Sequential Search/Linear Search, Binary Search

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Unit II - Divide and Conquer & Greedy strategy:

Divide and Conquer: introduction, Principle, control abstraction, Quick Sort, Merge sort, Large Integer multiplication/ Strassen matrix multiplication,

Greedy strategy: Principle, control abstraction, Knapsack problem, Job sequencing with Deadlines, Huffman Encoding

Unit III - Dynamic Programming

Graph- Basic Terminology, Graphs (Directed, Undirected), Various Representations, Traversals & Applications of graph- Prim's and Kruskal's Algorithms, Dijsktra's Single source shortest path, Analysis complexity of algorithm, topological sorting.

Dynamic Programming: Principle of optimality, 0/1 Knapsack, Largest Common Subsequence, Multistage Graph problem (using Forward computation), Traveling Salesman Problem, Optimal Binary Search Tree (OBST)

Symbol Table-Representation of Symbol Tables- Static tree table and Dynamic tree table, Height Balanced Tree- AVL tree

Unit IV - Backtracking & Branch –N –Bound:

Backtracking: Recursive backtracking algorithm, Iterative backtracking method, 8-Queen problem, Hamiltonian Cycle, 0/1 Knapsack Problem

Branch –N -Bound: Branch–N-Bound method, Control abstractions for Least Cost Search, Bounding, FIFO branch and bound, LC branch and bound

Unit V - Complexity Theory:

Computational Complexity, NP, NP Complete, NP Hard

Hashing- Concepts-hash table, hash function, basic operations, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining

Learning Resources:

Text Books:

1. Thomas H Cormen and Charles E.L Leiserson, "Introduction to Algorithm" Third Edition, PHI
2. Horowitz, Sahni & Rajasekaran, "Fundamentals of Computer Algorithms", 2ND Edition. University Press.

Reference Books:

1. Gilles Brassard and Paul Bartley, "Fundamental of Algorithms", PHI, New Delhi.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms" Pearson Education
3. Parag Dave, Himanshu B Dave," Design and analysis of Algorithms",2/e Pearson
4. S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani," Algorithms", 1 edition, McGraw-Hill Education;

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Supplementary Reading:

1. Jon Kleinberg, EvasTardos, "Algorithm Design", Pearson Education
2. S. Srihar , " Design and Analysis of Algorithm", Oxford University Press

Web Resources:

1. https://nptel.ac.in/courses/106106131/
2. https://nptel.ac.in/syllabus/106101060/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2015/lecture-notes/

Web links:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2015/lecture-videos/

MOOCs:

1. https://swayam.gov.in/nd1_noc19_cs47/preview
2. https://www.edx.org/course/algorithm-design-analysis-pennx-sd3x
3. https://www.coursera.org/specializations/algorithms

Pedagogy:

1. Power Point Presentation
2. Video Lectures
3. Flipped Classroom Activity
4. Think Pair & Share
5. Model Based Learning
6. Chalk and Board

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