



### 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:

- Learn the basics of computational complexity analysis of algorithms

##### 2. Skill:

- Understand the problem solving and problem classification
- Understand the concept of nondeterministic polynomial algorithms

##### 3. Attitude:

- Learn how to select and apply appropriate algorithm design strategies to solve real-world problems
- 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, Dijkstra'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

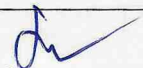
## **Learning Resources:**

### **Text Books:**

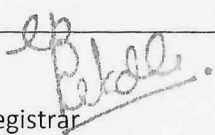
1. Thomas H Cormen and Charles E.L Leiserson, "Introduction to Algorithm" Third Edition, PHI
2. Horowitz, Sahni & Rajasekaran, "Fundamentals of Computer Algorithms", 2ND Edition. University Press.

### **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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Dr. Vishwanath Karad  
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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:

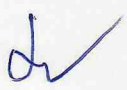
1. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2015/lecture-videos/>

### MOOCs:

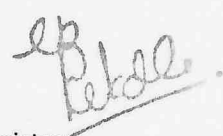
1. [https://swayam.gov.in/ndl\\_noc19\\_cs47/preview](https://swayam.gov.in/ndl_noc19_cs47/preview)
2. <https://www.edx.org/course/algorithm-design-analysis-pennx-sd3x>
3. <https://www.coursera.org/specializations/algorithms>

### 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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