

A. Course Handout Last updated on 6th November, 2023

Institute/School Name	Chitkara University Institute of Engineering and Technology		
Department Name	Computer Science & Engineering		
Programme Name	Bachelor of Engineering, Computer Science & Engineering		
Course Name	Algorithm Design and Implementation	Session	2023-24
Course Code	CS126	Semester/Batch	5 th /2021
L-T-P (Per Week)	0-0-10	Course Credits	04
Course Coordinator	Er. Chaitanya Singla		

1. Objectives of the Course

Before mastering the higher-level technologies in software development for the web, it is vital to understand the underpinnings of lower-level theory. This is why we will start with a deep dive into data Structures & algorithms in this course. After this course you'll be ready to start focusing on front-end, back-end development, systems, frameworks and ultimately full-stack applications and the main objectives of the course are:

- To make students ready for the programming jobs in software-product based companies.
- Strong knowledge of data structures & algorithms.
- Give students practical exposure (project based) to the concept of data structures and algorithms.
- Exercise and reinforce prior programming knowledge to effectively code standard problems and algorithms with optimized complexity.

2. Course Learning Outcomes

After completion of the course, students will be able to do the following:

CLO01: Students will be able to write high quality code.

CLO02: To code, document, test, and implement a well-structured, robust computer program.

CLO03: Learn debugging issues and end to end testing.

CLO04: Formulate new solutions for programming problems or improve existing code to program effectively.

CLO05: They will understand the concept of scalability, security and extensible code for software applications based on real life applications.

CLO-PO mapping grid | Program outcomes (POs) are available as a part of Academic Program Guide (APG) at

Course Learning Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CLO1	M											
CLO2		H	H	H	H	M					M	
CLO3			H	H		M						
CLO4		H	H						M	M		
CLO5		H	H	M		M						H

3. Recommended Books (Reference Books/Text Books):

B01: Data Structures by Schaums Outlines Indian Adapted Edition by Seymour Lipschutz, Published By Tata McGraw-Hill Edition.

B02: Cracking the Coding interviews 6th edition by Gayle Laakmann McDowell.

B03: The Algorithm Design Manual , Steven S Skiena.

B04: 'Data Structures', by Seymour LipSchutz, McGraw-Hill Education.

4. Other readings and relevant websites:

S. No.	Link of Journals, Magazines, websites and Research Papers
1	https://nptel.ac.in/courses/106/106/106106131/
2	https://onlinecourses.nptel.ac.in/noc19_cs47/preview
3	https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-cs27/
4	https://www.javatpoint.com/daa-tutorial
5	https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm

5. Recommended Tools and Platforms

Visual Studio Code, Coding Ninjas

6. Course Plan:

Lecture Number	Topics	Recommended Book / Other reading material
1 – 4	Mathematical coding problems (Prime Factorization, GCD of two numbers, Distribute in circle)	B01 B02 Link 1
5 – 8	Basic Sorting Algorithms – Bubble sort, Insertion sort, Selection sort	B01 B03 Link 2
9-12	Divide and Conquer algorithms - Quick Sort and Merge Sort	B03
13 - 16	Searching (Linear and Binary)	B01 B03
17 – 22	String Algorithms - String Algorithms (KMP, Manacher, Z-value Algorithm)	B01 B02 Link 4
23 – 27	Hash Table: Introduction to Hash Table, Collision, Open Addressing, Linear Probing, Separate Chaining	B02
28 – 32	Heap and Priority Queues : Heap Sort, Priority Queues, Implement Priority Queue using Linked List, Find max/min in the continuous stream of data	B01 Link 3
ST-I (Syllabus covered from 1-32 lectures)		
33 – 36	Greedy Algorithms: Greedy Algorithms, Fractional Knapsack problem, Interval scheduling , Job Scheduling with deadlines	B02
37 – 40	Dynamic Programming: Why Dynamic Programming, Memorization, Tabulation, Count number of ways to cover a distance	B02
41 – 45	Minimum Cost Path to last element of matrix, Longest Common Subsequence (LCS)	B01 B03 Link 5
46 – 52	Binary Trees	B02 B03 Link 3
53 – 65	Binary Search Trees: Introduction to Binary Search Trees, Traversals (recursive& non recursive), Delete a Node, Find Height of a tree, Path in a tree, Level Order Traversal, Top View and Bottom View of a tree, Lowest Common Ancestor	B02

66 – 72	AVL Trees: Balanced Trees, Introduction to the AVL trees, Implementation of AVL Trees	B03 Link 5
73 – 74	Advance recursion problems and Optimization	B04
ST-II (Syllabus covered from 33-74 lectures)		
75 – 82	Red Black Trees: Balanced Trees - Red Black Trees, Graphs: Graphs, Edge List, Adjacency Matrix, Adjacency List, Depth first traversal, Breadth first traversal, Shortest Path algorithms	B04
83 – 90	Tries: Implementing tries, Suffix Arrays: Suffix Arrays, Longest Repeated string - Overlapping and Non overlapping	B04
ETE(Syllabus covered from 1-90 lectures)		

7. Delivery/Instructional Resources

Lecture Number	Topics	PPT (link of ppts on the central server)	Industry Expert Session(If yes: link of ppts on the central server)	Web References	Audio-Video
1 – 4	Mathematical coding problems (Prime Factorization, GCD of two numbers, Distribute in circle)	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.geeksforgeeks.org/mathematical-algorithms/	https://www.youtube.com/watch?v=DePWIOK1STg
5 – 8	Basic Sorting Algorithms – Bubble sort, Insertion sort, Selection sort	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		http://theoryapp.com/selection-insertion-and-bubble-sort/	https://www.youtube.com/watch?v=o4bAoo_gFBU
9-12	Divide and Conquer algorithms - Quick Sort and Merge Sort	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.geeksforgeeks.org/quick-sort-vs-merge-sort/	https://www.youtube.com/watch?v=9aWRNVB0NtY
13 - 16	Searching (Linear and Binary)	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.freecodecamp.org/news/search-algorithms-linear-and-binary-search-explained/	https://www.youtube.com/watch?v=C46QfTjVCNU
17 – 22	String Algorithms - String Algorithms (KMP, Manacher, Z-value Algorithm)	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.geeksforgeeks.org/kmp-algorithm-for-pattern-searching/	https://www.youtube.com/watch?v=V5-7GzOfADQ



23 – 27	Hash Table: Introduction to Hash Table, Collision, Open Addressing, Linear Probing, Separate Chaining	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.tutorialspoint.com/data_structures_algorithms/hash_data_structure.htm	https://www.youtube.com/watch?v=zeMa9sg-VJM
28 – 32	Heap and Priority Queues : Heap Sort, Priority Queues, Implement Priority Queue using Linked List, Find max/min in the continuous stream of data	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.programiz.com/dsa/heap-sort	https://www.youtube.com/watch?v=Q_eia3jC9Ts
33 – 36	Greedy Algorithms: Greedy Algorithms, Fractional Knapsack problem, Interval scheduling , Job Scheduling with deadlines	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.geeksforgeeks.org/greedy-algorithms/	https://www.youtube.com/watch?v=xZfmHVi7FMg
37 – 40	Dynamic Programming: Why Dynamic Programming, Memorization, Tabulation, Count number of ways to cover a distance	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.programiz.com/dsa/dynamic-programming	https://www.youtube.com/watch?v=IVR2u9lsxl8
41 – 45	Minimum Cost Path to last element of matrix, Longest Common Subsequence (LCS)	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.programiz.com/dsa/dynamic-programming	https://www.youtube.com/watch?v=IVR2u9lsxl8
46 – 52	Binary Trees	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.geeksforgeeks.org/binary-tree-data-structure/	https://www.youtube.com/watch?v=vvey2QCs98o
53 – 65	Binary Search Trees: Introduction to Binary Search Trees, Traversals (recursive& non recursive), Delete a Node, Find Height of a tree, Path in a tree, Level Order Traversal, Top View and Bottom View of a tree, Lowest Common Ancestor	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.javatpoint.com/binary-search-tree	https://www.youtube.com/watch?v=cySVml6e_Fc
66 – 72	AVL Trees: Balanced Trees, Introduction to the AVL trees,	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.javatpoint.com/avl-tree	https://www.youtube.com/watch?v=cySVml6e_Fc

	Implementation of AVL Trees	YkO14Lqcde47R2qUdYz55uispA/edit#gid=0			h?v=YWqla0UX-38
73 – 74	Advance recursion problems and Optimization	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.javatpoint.com/recursion	https://www.youtube.com/watch?v=YWqla0UX-39
75 – 82	Red Black Trees: Balanced Trees - Red Black Trees, Graphs: Graphs, Edge List, Adjacency Matrix, Adjacency List, Depth first traversal, Breadth first traversal, Shortest Path algorithms	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.javatpoint.com/red-black	https://www.youtube.com/watch?v=YWqla0UX-38
83 – 90	Tries: Implementing tries, Suffix Arrays: Suffix Arrays, Longest Repeated string - Overlapping and Non overlapping	https://docs.google.com/spreadsheets/d/1iJ62gyMnRJ1iJ_PsgYkO14Lqcde47R2qUdYz55uispA/edit#gid=0		https://www.javatpoint.com/tries	https://www.youtube.com/watch?v=YWqla0X-42

8. Action plan for different types of learners

Slow Learners	Average Learners	Advanced Learners
<ul style="list-style-type: none"> Remedial Class for slow learners to revise specific topics. Individual feedback of each slow learner. 	<ul style="list-style-type: none"> Doubt Class for average learners Special Doubt session will be arranged for ST topics. Doubts of individual student will be resolved. 	<ul style="list-style-type: none"> Certification exams will be offered to interested students.

9. Evaluation Scheme & Components:

Evaluation Component	Type of Component	No. of Assessments	Weightage of Component	Mode of Assessment
Component 2	Subjective Test/Sessional Tests (STs)	2*	40%	Offline/Online
Component 3	End Term Examinations	1	60%	Offline/Online
Total		100%		

*Out of 2 STs, the ERP system automatically picks the best ST marks for evaluation of the STs as final marks.

10. Details of Evaluation Components:

Evaluation Component	Description	Syllabus Covered (%)	Timeline of Examination	Weightage (%)
Component 2	ST 01	Up to 30%	4 th Week	40%
	ST 02	31% - 50%	8 th Week	
Component 3	End Term Examination*	Up to 100%	10 th Week	60%
Total				100%

*As per Academic Guidelines minimum 75% attendance is required to become eligible for appearing in the End Semester Examination.

11. Syllabus of the Course:

Lecture Number	Topics	No. of Lectures	Weightage %
1 – 4	Mathematical coding problems (Prime Factorization, GCD of two numbers, Distribute in circle)	4	25 %
5 – 8	Basic Sorting Algorithms – Bubble sort, Insertion sort, Selection sort	4	
9 - 12	Divide and Conquer algorithms - Quick Sort and Merge Sort	4	
13 - 16	Searching (Linear and Binary)	4	
17 – 22	String Algorithms - String Algorithms (KMP, Manacher, Z-value Algorithm)	6	
23 – 27	Hash Table: Introduction to Hash Table, Collision, Open Addressing, Linear Probing, Separate Chaining	5	20 %
28 – 32	Heap and Priority Queues : Heap Sort, Priority Queues, Implement Priority Queue using Linked List, Find max/min in the continuous stream of data	5	
33 – 36	Greedy Algorithms: Greedy Algorithms, Fractional Knapsack problem, Interval scheduling , Job Scheduling with deadlines	4	
37 – 40	Dynamic Programming: Why Dynamic Programming, Memorization, Tabulation, Count number of ways to cover a distance	4	
41 – 45	Minimum Cost Path to last element of matrix, Longest Common Subsequence (LCS)	5	35 %
46 – 52	Binary Trees	7	
53 – 65	Binary Search Trees: Introduction to Binary Search Trees, Traversals (recursive& non recursive), Delete a Node, Find Height of a tree, Path in a tree, Level Order Traversal, Top View and Bottom View of a tree, Lowest Common Ancestor	11	

66 – 72	AVL Trees: Balanced Trees, Introduction to the AVL trees, Implementation of AVL Trees	7	20 %
73 – 74	Advance recursion problems and Optimization	2	
75 – 82	Red Black Trees: Balanced Trees - Red Black Trees, Graphs: Graphs, Edge List, Adjacency Matrix, Adjacency List, Depth first traversal, Breadth first traversal, Shortest Path algorithms	8	
83 – 90	Tries: Implementing tries, Suffix Arrays: Suffix Arrays, Longest Repeated string - Overlapping and Non overlapping	8	

This Document is approved by:

Designation	Name	Signature
Course Coordinator	Er. Chaitanya Singla	
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Date		