Semester: IV						
DESIGN AND ANALYSIS OF ALGORITHMS **Category: PROFESSIONAL CORE COURSE** **(Theory and Practice)** **(Common to AI ,CS, IS, CD, & CY)**						
Course Code	**:**	**CD343AI**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**45L+30P**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**8Hrs**
Introduction- Perspectives **Business domain:** Banking, Finance services, IT, Manufacturing, e-Commerce, Online services and marketing, Logistics and Supply Chain Management, Telecommunication. **Applications:** Communication & Networking, Search engines, Machine learning, Database management, Software tools development, Data organization, GPS navigation systems **Introduction:** Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithmic Efficiency: Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms. **Brute Force:** Selection Sort and Bubble Sort.	
Unit – II	**10Hrs**
Divide and Conquer: Merge sort, Quicksort, Multiplication of Long Integers, Strassen's Matrix Multiplication. **Decrease and Conquer:** Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Application of DFS and BFS.	
Unit –III	**10Hrs**
Transform and Conquer: Presorting, Heapsort, Problem reduction. **Space and Time Tradeoffs:** Sorting by Counting, Naive String Matching, Input Enhancement in String Matching: Horspool's and Boyer-Moore algorithm.	
Unit –IV	**10Hrs**
Dynamic Programming: Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, 0/1 Knapsack Problem and Memory Functions. **Greedy Technique:** Prim's Algorithm, Dijkstra's Algorithm, Huffman Trees and codes, Fractional Knapsack Problem.	
Unit-V	**07 Hrs**
Backtracking: N-Queen's Problem, Sum of Subset Problem. **Branch-and-Bound:** Travelling Salesperson Problem, Assignment Problem **Decision Trees:** Decision Trees for Sorting **NP and NP-Complete Problems:** Basic Concepts, Non- Deterministic Algorithms, P, NP, NP Complete, and NP-Hard classes	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Apply knowledge of computing and mathematics to algorithm analysis and design
CO2	Analyze a problem and identify the computing requirements appropriate for a solution
CO3	Apply algorithmic principles and computer science theory to the modeling for evaluation of computer-based solutions in a way that demonstrates comprehension of the trade-offs involved in design choices.
CO4	Investigate and use optimal design techniques, development principles, skills and tools in the construction of software solutions of varying complexity.
CO5	Demonstrate critical, innovative thinking, and display competence in solving engineering problems.
CO6	Exhibit effective communication and engage in continuing professional development through experiential learning.

Reference Books	
1.	Introduction to the Design and Analysis of Algorithms, Anany Levitin, University, 3rd Edition, 2012, Pearson, ISBN 13: 978-0-13-231681-1.
2.	Introduction to Algorithms, Cormen T.H., Leiserson C.E., Rivest R.L., Stein C., 3rd Edition, 2010, PHI, ISBN:9780262033848.
3.	Computer Algorithms, Horowitz E., Sahani S., Rajasekharan S., 2nd Edition, 2006, Galgotia Publications, ISBN:9780716783169.

Laboratory Component

Note: The following programs should be implemented in C++ language

Practice Programs:

- Implementation and execution of simple programs to understand running time analysis of non-recursive algorithms
  - Finding maximum element in a given array.
  - Linear search,
  - Bubble sort,
  - Determine whether all the elements in a given array are distinct.
  - Given 2 NXN matrices, perform matrix multiplication using brute force approach.
- Implementation and execution of simple programs to understand running time analysis of recursive algorithms
  - Find the Factorial of a given number.
  - Print Fibonacci series
  - Given a positive decimal integer n, find the number of binary digits in n's binary representation.
  - To solve tower of Hanoi problem.
  - Recursive linear search.

Lab Programs:(At-least one application from each of the following group)

1. Apply divide and conquer strategy to solve sorting problem
   - Merge sort
   - Quicksort
2. Apply decrease and conquer strategy to solve graph problem
   - Breadth first search
   - Topological sorting using depth first search
3. Apply transform and conquer strategy
   - Heapsort
   - Checking element uniqueness after presorting
4. Apply input enhancement strategy to solve string-matching problem
   - Horspool's algorithm
   - Boyer – Moore's algorithm
5. Apply dynamic programming strategy to solve optimization problem
   - Warshall - Floyd's Algorithms,
   - Knapsack problem solution using memory function.
6. Apply greedy strategy to solve graph problem
   - Dijkstra's algorithm
   - Prim's algorithm
7. Apply backtracking strategy to solve combinatorial problem
   - N- Queen's problem
   - Subset – sum problem

8. Apply branch and bound strategy to solve combinatorial problem
   - Travelling salesperson problem
   - Assignment problem

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10)**Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks),lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	**50**
	MAXIMUM MARKS FOR THE CIE(THEORY+LAB)	**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type of questions covering entire syllabus	20
	PART B (Maximum of THREE Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	10
2	Conduction of the Experiments	20
3	Viva	20
	TOTAL	**50**