Course code	Design and Analysis of Algorithms		L	T	P	J	C
CSE2012			3	0	2	0	4
Pre-requisite	CSE2011 – Data Structures and Algorithms	Syllabus version					
		v. xx.xx					

Course Objectives:

1. To provide a mathematical foundation for analyzing and proving the efficiency of an algorithm.
2. To focus on the design of algorithms in various domains of computer engineering.
3. To provide familiarity with main thrusts of work in algorithms sufficient to give some context for formulating and seeking known solutions to an algorithmic problem.

Expected Course Outcome:

On completion of this course, student should be able to

1. Ability to use mathematical tools to analyze and derive the running time of algorithms and prove the correctness.
2. Explain and apply the major algorithm design paradigms.
3. Explain the major graph algorithms and their analyses.
4. Explain the major String Matching algorithms and their analysis.
5. Explain the major Computational Geometry algorithms and their analysis.
6. Provide algorithmic solutions to real-world problem from various domains.
7. Explain the hardness of real world problems with respect to algorithmic efficiency and learning to cope with it.

Module:1	Algorithm Development	4 hours	CO: 1

Stages of algorithm development for solving a problem: Describing the problem, Identifying a suitable technique, Design of an algorithm, Proof of Correctness of the algorithm.

Module:2	Algorithm Design Techniques	10 hours	CO: 2

Brute force techniques – Travelling Salesman Problem, Divide and Conquer - Finding a maximum and minimum in a given array -Matrix multiplication: Strassen's algorithm, Greedy techniques Huffman Codes and Data Compression -Fractional Knapsack problem, Dynamic programming - O/1 Knapsack problem-Matrix chain multiplication, LCS, Travelling Salesman Problem, Backtracking- N-Queens Problem, Knights Tour on Chess Board.

Module:3	String Matching Algorithms	5 hours	CO:1,4

Naïve String matching Algorithms, KMP algorithm, Rabin-Karp Algorithm

Module:4	**Computational Geometry Algorithms**	**5 hours**	**CO:1,5**
Line Segments – properties, intersection; Convex Hull finding algorithms- Graham's Scan, Jarvis's March Algorithm.			
Module:5	**Graph Algorithms**	**6 hours**	**CO:1,3**
All pair shortest path – Floyd-Warshall Algorithm. Network Flows - Flow Networks, Maximum Flows – Ford-Fulkerson Algorithm, Push Re-label Algorithm, Minimum Cost Flows – Cycle Cancelling Algorithm.			
Module:6	**Complexity Classes**	**7 hours**	**CO:1,6**
The Class P, The Class NP, Reducibility and NP-completeness – SAT (without proof), 3-SAT, Vertex Cover, Independent Set, Maximum Clique.			
Module:7	**Approximation and Randomized Algorithms**	**6 hours**	**CO:7**
Approximation Algorithms - The set-covering problem – Vertex cover, K-center clustering. Randomized Algorithms - The hiring problem, Finding the global Minimum Cut			
Module:8	**Recent Trends**	**2 hours**	**CO:7**
	Total Lecture hours:	**45 hours**	

Text Book(s)

1.	Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms , Third edition, MIT Press, 2009.

Reference Books

1.	Jon Kleinberg, ÉvaTardos ,Algorithm Design, Pearson education, 2014
2.	Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, "Network Flows: Theory, Algorithms, and Applications", Pearson Education, 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar
Assignment: Exploring Finite Automata and String Matching

List of Experiments (Indicative)	**Total Hours: 30**
1. Design and implement an algorithm that multiplies two 'n' digit numbers faster than $O(n^3)$. 2. Design and implement an algorithm that will find the top and the least scores of students from an online Quiz. Note: The scores are stored in an array. 3. Design a solution for an Airline Customer on what to leave	

behind and what to carry based on cabin baggage weight limits. The Customer has to pack as many items as the limit allows while maximizing the total worth. The data can be shared in a CSV File. 1. Assume you have an unparenthesized arithmetic expression with only + and - operators. You can change the value of expression by parenthesizing at different positions. To keep it simple, assume that parenthesis occur only before or immediately after operands and not operators. Design an algorithm that can take a maximum possible value the expression can take in after adding the parenthesis. 2. About 14 historic sites in Tamilnadu is shown in https://www.google.com/maps/search/historic+sites+in+tamilnadu/@10.7929896,78.2883573,7z/data=!3m1!4b1 Design a solution that identifies the shortest possible routes for a traveler to visit these sites. 3. Design a solution to see if a content C = PGGA is plagiarized in Text T = SAQSPAPGPGGAS. 4. You can find the schematics of Delhi Art Gallery (Ground Floor) in: https://www.archdaily.com/156154/delhi-art-gallery-re-design-vertex-design/50151feb28ba0d02f0000302-delhi-art-gallery-re-design-vertex-design-first-floor-plan Design a model to install fewest possible Closed Circuit Cameras covering all hallways and turns. 5. A maze has to be created and path has to be displayed which will be taken by the rat by using backtracking concept. 6. Consider x=aabab and y=babb. Each insertion and deletion has a unit 1) cost where as a change costs 2 units. Find a minimum cost edit sequence that transforms x into y by using suitable algorithm design technique. 7. Implement N-Queens problem and analyse its time complexity using backtracking. 8. Write a program to find all the Hamiltonian cycles in a connected undirected graph G(V,E) using backtracking 9. Design and implement a solution to find a subset of a given set S = {Sl, S2,.... ,Sn} of n positive integers whose SUM is	

equal to a given positive integer d. For example, if S ={1, 2, 5, 6, 8} and d= 9,there are two solutions {1,2,6}and {1,8}. Display a suitable message, if the given problem instance doesn't have a solution.			
Mode of evaluation:			
Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020