Department of Computer Engineering, SVNIT, Surat

M Tech I - 1^{st} Semester, Syllabus and Course Plan, COs

CourseCode: Design and Analysis of Algorithms 3-0-2

Last Edited: 24^{th} Sep 2022

Course Plan

Date	Lect no	Topic(s) to be covered	Hrs
16/8/22	1-2	Introduction, Syllabus, Evaluation scheme, Discussing the problem oriented and assignment centric approach that would be followed. Pseudocode notations to be used. Algorithm analysis Techniques to be employed - illustrating mathematical analysis.	2
17/9/21	3	Illustrating mathematical analysis using the Insertion sort. Justification for using the asymptotic analysis.	1
23/8/22	4-5	Missed: To be adjusted due to inauguration of Forensics Lab. One class adjusted on 21/09/22 and the other on 23/09/22	2
24/8/22	6	Approach for empirical analysis, the program to use in the lab. The algorithm BINEXPONENT analysis. Reading Assignment: Asymptotic notations.	1
30/8/22	7-8	Illustrating the failure of Heuristics based approach to solve a problem, using the Robot Arm problem. The need for formal correctness proof. Solving illustrative problems on expressions involving Asymptotic Notations. Lower bound on sorting and the Counting sort.	2
31/8/22	9	Divide and Conquer design technique. Illustrating Merge-sort and its analysis.	1
03/09/22	10-11	Merge-sort Solving recurrences with five different variations viz. substitution, telescopic substitution, Mathematical induction, Recurrence with Ceiling and Floor, Recursion tree method Limitations. Other illustrations of solving recurrences, Applications: Counting Inversions, Introduction to Closest Pairs of Points	2
06/09/22	12-13	Closest Pairs of Points Algorithms and Analysis, Greedy Design technique: The Thirsty-baby problem, Formalizing problem definition, Characteristics of Greedy approach illustrated through the Thirsty-baby problem, The Container Loading problem & its algorithm using Indirect sorting, The Knapsack problem as a specialization of the Container Loading problem: Formal definitions, difference between its variants, The Activity Selection problem and its algorithm	2
07/09/22	14	Proof of the Activity Selection problem, Machine scheduling variant I - proof using contradiction as well as that using the mathematical induction	1
10/09/22	15	Quiz#1 Extra Class: Second missed class of 23/8/22 adjusted	1
13/09/22	16-17	Machine Scheduling: Variant II, its proof. Machine Scheduling Variant III, IV (the NP-Hard one). The variant IV i.e. Classroom scheduling and its proofs.	2
14/09/22	18	EDF Scheduling. EDF scheduling proof. The Optimal Tape Storage problem. The motivation for Huffman coding and comparison of Fixed and Variable length coding with illustrations	1

20/09/22	19-20	The Quicksort algorithm, illustrating two methods of PARTITION and analysis of the number of comparisons made - illustrated through numerous examples. Quicksort analysis: best case, worst case, unbalanced partitioning and balanced partitioning.	2
21/09/22	21	Quicksort analysis: Mathematical average case analysis.	1
24/09/22	-	Quiz#2: Extra Class: Second missed class of 23/8/22 adjusted	1
27/09/22	-	MidSem exam	2
28/09/22	-	MidSem exam	1
04/10/22	22-23	Huffman tree. Proofs w.r.t. Huffman's algorithm, Huffman tree. Proof w.r.t. representation of prefix code, etc. The Optimal Merge Patterns. The NP Theory: Why Classify Problems, Some hard problems.	2
06/10/22	-	Quiz#3	-
05/10/22	-	Holiday: Dussehra	-
11/10/22	24-25	Clique, IS, VC, SAT. Concept of reductions. Illustrations of simple reduction with proofs: VC $\leftrightarrow$ IS reduction, K-Clique $\leftrightarrow$ VC reduction. On leave - missed - hence engaged on 7th Oct during lab classes	2
12/10/22	26	Reductions with example and proof, continued: Set cover $\leftrightarrow$ Vertex cover reduction. The concept of nondeterminism, Non-deterministic Polynomial Algorithms. On leave - missed - hence engaged on 19th Oct, the Wednesday, at 11:30 am onwards	1
14/10/22	-	Quiz#4	-
15/10/22	27-28	Non-determinisitic Algorithms illustrations. Complexity classes. Reduction: SAT and 3-SAT reduction with proof. The Class P, NP and EXP of problems. *Reductions with gadgets and proving a problem to be NPC pending.* Missed as away to IIT Jammu, hence engaged on 21st Oct during lab classes	-
18/10/22	29-30	The Certifier-Certificate approach to prove a problem in Class NP – the Prover-Verifier approach. Example of an NP-Complete and NP-Hard problems. Proofs associated with Class P and NP.	2
19/10/22	31	Dynamic Programming – Introduction, Fibonacci Iterative and Recursive Approaches. DP – Binomial Coefficient Iterative and Recursive Approaches, Memoization. The Problem Subproblem Call Structure and the DAG.	1
21/10/22	32-33	DP versions of the Fibonacci and Binomial Coefficient.The Coin changing problem (Kleinberg Tardos), The Selecting Breakpoints Problem (Kleinberg Tardos) in Assignments	2
22/10/22	34	Tutorial problems on applications of Greedy/Dynamic programming	1
25/10/22	-	Diwali Break	-
26/10/22	-	Diwali Break	-
01/11/22	35-36	DP: Shortest Paths in DAGs. The 0/1 Knapsack problem approach with DP and its complexity. The 0/1 Knapsack Problem: DP Bottom-Up approach. DP: Tutorial Exercise problems solution approach discussions on the problems to be included in the Tutorial Exercises viz. Job Scheduling, Billboards placement, Profits in two stores owned. Any one new problem from Leetcode.	2
02/11/22	37	DP – The Longest Common Subsequence Problem and complexity analysis. Tutorial problem on application of DP.	1
04/11/22	-	Quiz#5	-
08/11/22	38-39	DP – The Longest Common Subsequence Problem and complexity analysis (continued). Tutorial problems on application of DP.	2

09/11/22	40	DP – The All Pairs Shortest Paths Floyd Warshall's Algorithm and analysis	1
11/11/22	-	Quiz#6	-
15/11/22	41-42	NP-Theory again: Reductions by using Gadgets: the Clique $\leftrightarrow$ SAT problem – Design of the gadget, proof; The IS $\leftrightarrow$ 3-SAT problem - Design of the gadget, proof. Proving that Clique and IS are NPC problems	2
16/11/22	43	Approximation Algorithms - applications and illustrations	1
18/11/22	-	Quiz#7	-
22/11/22	44-45	The Bipartite graphs, illustrations, proofs. The k-clustering problem, algorithm and proof. The Minimum Cost Arborescences and Chu and Liu (1965) and Edmonds (1967) algorithms.	2
23/11/22	46	Chu and Liu (1965) and Edmonds (1967) algorithms (contd). Dijkstra and Bellman-Ford algorithms.	1
25/11/22	-	Quiz#8	-