

Second semester 2016-17

Course Handout Part II

In addition to Part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

CourseNo.: CS F364

CourseTitle: Design & Analysis of Algorithms

Instructor in Charge: Abhishek Mishra

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Course Objectives: To learn about some basic algorithm design techniques like **Divide and Conquer**, **Greedy Algorithms**, **Dynamic Programming**, etc. To learn about **Computational Complexity**. To learn about some advanced algorithm design techniques like **Approximation Algorithms**, and **Randomized Algorithms**. To learn about **Number Theoretic Algorithms**.

Text Book:

[T1] T.H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein, Introduction to Algorithms, 3rd Edition, PHI, 2009.

Reference Books:

[R1] J.Kleinberg, E. Tardos, Algorithm Design, Pearson, 2013.
Lecture slides of the book are available online at:
<http://www.cs.princeton.edu/~wayne/kleinberg-tardos/pearson/>

[R2] D.P. Williamson, D.B. Shmoys, The Design of Approximation Algorithms, Cambridge University Press, 2010. Available online at:
<http://www.designofapproxalgs.com/book.pdf>



[R3] S. Arora, B. Barak, Computational Complexity: A Modern Approach, 2009, Cambridge University Press. Available online at: <http://theory.cs.princeton.edu/complexity/book.pdf>

Lecture Plan:

Lectures	Topics
1	Algorithm Design: Introduction, Analysis of Insertion sort and Merge sort
2	Algorithm Design: Correctness of an algorithm, Growth of a function, Asymptotic notation
3	Algorithm Design: Divide and conquer, Strassen's Algorithm, Solving recurrence relations, Master Method
4	Algorithm Design: Quick sort, and performance analysis.
5	Algorithm Design: Randomized quick sort and performance analysis
6	Algorithm Design: Lower bounds of sorting, sorting in linear time
7	Algorithm Design: Median and order statistics, selection in worst case linear time
8	Algorithm Design: Direct addressing, hashing with chaining, Universal Hashing, Open addressing
9	Algorithm Design: Binary Search Tree and its Expected height
10	Algorithm Design: Red-Black Trees, Expected height, Insertion, deletion.
11	Algorithm Design: Augmentation data structure, retrieval by rank, interval trees
12	Algorithm Design: Dynamic Programming, matrix chain multiplication. elements of DP, LCS
13	Algorithm Design: Greedy Algorithm, activity selection, elements of greedy algorithm, Huffman code
14	Algorithm Design: Amortized Analysis, binary counter



	increment, multipop in stack,
15	Algorithm Design: B tree
16	Algorithm Design: Fibonacci Heap
17	Algorithm Design: Shortest path in graph, Bellman Ford , Floyd-Warshell algorithm
18	Algorithm Design: Maximum Flow
19	Algorithm Design: Linear Programming
20	Computational Complexity: The complexity class P.
21	Computational Complexity: The complexity class NP.
22	Computational Complexity: Polynomial time reductions. The complexity classes NP-Complete, and NP-Hard. The Satisfiability problem.
23	Computational Complexity: Cook-Levin Theorem
24	Computational Complexity: NP-Completeness of 3SAT, 0/1 Integer Programming, and Independent Set.
25	Approximation Algorithms: NP Optimization problems. Definition of Approximation Algorithms. A 2-approximation algorithm for the Cardinality Vertex Cover problem. A 2-approximation algorithm for the Weighted Vertex Cover problem.
26	Approximation Algorithms: LP-Rounding algorithm for Set Cover. Primal LP, Dual LP, LP-Duality Theorem, Weak Duality Theorem, and Complementary Slackness Conditions.
27	Approximation Algorithms: Dual-Rounding algorithm for Set Cover. Primal-Dual algorithm for Set Cover.
28	Approximation Algorithms: PTAS, and FPTAS. FPTAS for the 0/1 Knapsack problem.
29	Approximation Algorithms: Complexity Classes for Approximation.
30	Randomized Algorithms: Randomized Complexity Classes. Markov and Chebyshev Inequalities. Monte Carlo and Las Vegas Algorithms.
31	Randomized Algorithms: Error Reduction of Monte Carlo Algorithms. Randomized Global Minimum Cut Algorithm.



32	Randomized Algorithms: Chernoff Bounds. Randomized Load Balancing Algorithm.
33	Randomized Algorithms: Randomized Approximation Algorithm for MAX 3SAT.
34	Number Theoretic Algorithms: Euclid's Extended GCD Algorithm.
35	Number Theoretic Algorithms: Modular Exponentiation Algorithm.
36	Number Theoretic Algorithms: Miller-Rabin Randomized Primality Testing Algorithm
37	Number Theoretic Algorithms: Pollard's Rho Heuristic for Factorization.

Evaluation:

Component	Mode	Weightage	Duration	Remarks
Quiz 1	Open Book	10%	40 minutes	In February
Mid Semester Exam	Closed Book	30%	90 minutes	10/03, 9:00 - 10:30
Quiz 2	Open Book	10%	40 minutes	In March
Quiz 3	Open Book	10%		In April
Comprehensive Exam	Closed Book	40%	180 minutes	12/05, 8:00 - 11:00

Open Book Policy: Only hard copies are allowed (lecture notes, text book, or reference books).

Make-up Policy: Make-up exam may be arranged only in genuine cases with prior permission.

Malpractise Regulation: A student will get 0 if found cheating.



BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
Instruction Division

Chamber Consultation Hour:

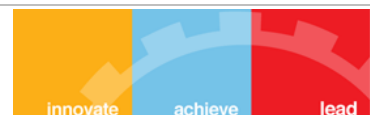
Abhishek Mishra: 11:00 to 12:00 on Saturdays (6121S).

Kamlesh Tiwari: 11:00 to 12:00 on Saturdays (6120N).

Notices: All notices will be posted on Nalanda.



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