BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI, HYDERABAD CAMPUS
SECOND SEMESTER 2024-2025
COURSE HANDOUT (PART-II)

Date: 31/12/2024

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

Course No. : **CS F364**
Course Title : **Design and Analysis of Algorithms**
Instructor-in-charge : Apurba Das
Instructor : Tathagata Ray, Venkatakrishnan Ramaswamy

1. Scope and Objective

This course is the next logical step after the course on Data Structures and Algorithms. This course introduces students to different paradigm of algorithms and various techniques to analyze them. The analysis is of the correctness of the algorithm and the time complexity (also space complexity). They will also learn about the computational intractability; a class of NP-complete problems and techniques to prove NP-completeness. They will learn major techniques to deal with such computationally intractable set of problems.

The objective of the course is to impart students with different algorithmic paradigm and its characteristics. The students at the end of the course will be able to

- To identify suitable algorithms or data structure to apply for a given problem.
- Will be able to argue about the time complexity of algorithms.
- Will be able to write the proof of correctness of algorithms.
- Will be able to understand the intricacies involved in choosing the right data structures to implement algorithms.
- Will be able to implement computational geometric algorithms.

2. Text Books

(T1) Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein. Introduction to Algorithms. Third Ed. MIT(2010)

3. Reference Books:

(R1) Jon Kleinberg, Eva Tardos. Algorithm Design. First Ed. Pearson (2012)
(R2) E. Horowitz, S. Sahni, S. Rajsekaran. Fundamentals of Computer Algorithms. Second Ed. University Press.
(R3) R. Motwani, P. Raghavan. Randomized Algorithms CUP, 1995.
(R4) G. Auseiello, et.al. Complexity and Approximation, Springer.
(AR) Additional Reading assignments

4. Lecture Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book
01-04	• Introduction to algorithms • Revision of asymptotic notations. • Average Case Analysis.	**Introduction to Growth of Function**	T1-Chapter-1,2,3
05-20	• Basic principle of Divide and Conquer. • Recursion of Divide and Conquer. • What is Greedy Strategy • How to prove the correctness of Greedy Algorithm. • Understanding matroid and how it relates to greedy algorithms. • Dynamic Programming Strategy • Amortized Analysis	**Basic Design Techniques:** *Divide and conquer, Greedy, Intro to Matroid, Dynamic Programming, Amortized Analysis*	T1-Chapter-4,15,16,23,24,25, R1, R2, AR
21-26	• Network Flow Problem • Ford-Fulkerson Algorithm • Applications of Network flow. • Difference between deterministic and Randomized algorithm • Strength of Randomized Algorithm. • Analysis of Randomized Algorithm	**Specialized design techniques :** *Network flow, Randomization (Examples, Analysis, Limitation)*	T1-chapter 26, 5, R1, R2, R3, AR
27-33	• Introduction to decision problems. • Difference between P and NP. • Difference between NP-complete and NP-Hard • Significance of SAT. • How to prove reduction for proving NP-completeness.	**Complexity Classes and Hardness of problems:** *P, NP, Reductions, NP hardness and NP Completeness, reduction techniques, Some standard NP complete problems*	T1-Chapter-34, R4, AR
34-37	• Famous N-Queen Problem. • Introduction to Backtracking and Branch and Bound • Introduction to Approximation algorithm and Approximation class	**Design techniques for Hard Problems:** *Backtracking, branch and Bound, Approximation algorithms*	T1-Chapter-35, R2, R4, AR
38-40	• Significance of Linear Programming • Application of LPP • Geometric understanding of LPP and extrema Theorem. • Simplex and how we walk on the polytope.	**Linear Programming:** *LP Problems and Simplex algorithms.*	T1-Chapter-29, AR
41-42	• How to do analysis of parallel programs. • Basic approaches towards parallel programming • Introduction to parallel complexity	*Introduction to design and analysis of parallel and multithreaded programming, introduction to parallel complexity*	T1-Chapter-27, R1, R2, AR

5. Evaluation Scheme:

S. No.	Evaluation Component	Duration	Date and Time	Weightage (%)	Nature of Component
1.	Tutorial - Quiz	In class	Tutorial Classes	10	Open Book
	Assignments	TBA\	TBA	20	Open Book
2.	Midterm	90 Mins	TBA	30	Closed Book
3.	Comprehensive	3 Hours	TBA	40	Closed Book

Note: At least 40% of the evaluation components will be completed by Mid-Semester.

Chamber Consultation Hour: TBA

Notices: All notices pertaining to this course will be displayed on the Google Classroom/CMS. Specific instructions will be often given in the class only.

Make-Up Policy:
No makeups will be given for Assignments
Makeup for tests can be given only for genuine cases and that too with prior approval from the instructor in charge. Makeup for the comprehensive exam will be decided as per instructions issued by AUGSD.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge
Apurba Das