**IMPORTANT COURSES FOR COMPUTER SCIENCE STUDENTS**

***Disclaimer:***

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**1.** **Programming and Data Structures**

*Faculty: Dr.Sudipta Saha, Dr.Shweta Jain*

This course is the first level course in the field of Computer Science and introduces all basic programming concepts. This course covers the basics of topics that are extremely important from the point of view of campus interviews. If you are looking forward to learning Competitive coding or if you are interested in cracking coding based tests in companies, you must build upon concepts taught in this course to enhance your knowledge. And moreover, the ideas taught in this course are fundamentally applied in all streams for performing computational experiments.

The course starts with teaching students the C programming language, which is a really good language to understand the nuances of programming. The Problems given in this course introduce a student to thinking logically and designing strategies to solve them. Towards the middle of the course, a notorious concept called ‘pointers’ will be introduced, which some may find tricky to understand in the first go. Don’t worry, it’s pretty simple once you get the hang of it! But it is a really fundamental concept that one needs to understand. Most professors follow the popular book, **‘Let Us C’ by Yashwant Kanetkar**, which is a really good book for starters. Follow the lectures and read the book diligently and you will be set to excel in the exams!

Towards the end of the course, you will be introduced to basic data structures like Stack, Queue and Linked list. These are extremely important from the point of view of coding based campus interviews. But however, chances are, that these ideas will not be covered in detail due to lack of time. Don’t worry there are tons of resources available online where you can learn about them.

Parallel to introducing the programming paradigm, the course also briefly teaches about how programs run in a computer, memory-related problems that programs face and a few more ideas about software-hardware interaction.

The questions for exams will be based directly on questions from the book, or on concepts taught in class, with some variations in difficulty. But the questions will definitely not be extremely hard that you can’t solve them!

This course may seem trivial for students who have prior experience with programming, but for others it may pose a challenge in learning the new way of thinking. So our earnest request to those who know programming is to help your batchmates to understand these concepts.

**2.** **Programming and Data Structures Laboratory**

*Faculty: Dr Sudipta Saha, Dr Shweta Jain, Dr Adway Mitra*

This course is intricately intertwined with its theory counterpart and only enhances the ideas learnt in theory by making you sit before a computer and write code. But apart from that, it really teaches patience as a virtue because you will often be faced with problems while running your code. It teaches you how to debug your codes and make them run successfully. But apart from these issues, the problems solved in this course are just to reinforce your theoretical knowledge and to acclimate yourself with coding.

*Dr Shweta Jain and Dr Adway Mitra are no longer faculty members at IIT Bhubaneswar.*

**3.** **Data Structures (CS2L004) and Data Structures Laboratory (CS2P002)**

**Overview:**

This course lays another foundational layer for your programming skills over the PDS course. You will learn different linear and non-linear data structures used in general programming and system memory management. You’ll also learn how the basic operations like insertion, deletion, and search are done efficiently on these structures. Paying good attention to classes can get you through the course, but if you’re interested, you can learn some more interesting data structures from the internet, which are extensions of what you’ll learn in the course.

In Laboratory sessions, you’ll have to implement the data structures you learned, and in some sessions, you’ll be given problems based on the topics previously taught in the class. You can find solutions to these problems or similar ones online, but it is recommended to try to solve them on your own first and then take help or look at the ideal solutions. You must think enough to improve your problem-solving skills.

**Topics to be covered:** In common to all the data structures, Implementations, and basic operations of insertion, deletion, and searching will be taught.

**Linear Data Structures:** Linked List, Stack, Linear Queue, Circular Queue. And their applications.

**Non-Linear Data Structures:**

Tree, Binary Tree, Binary Search Tree (BST). Inorder, Preorder, and Postorder traversals on binary trees. Binary Heap, AVL Tree, Red-Black Tree, Treap, Multiway Search Trees, a-b Tree, B-Tree.

**Miscellaneous:** Merge Sort, Quick Sort, Heap Sort, Huffman Encoding

**Text Books:**

* Thomas H. Cormen, Charles E. Leiserson, R.L. Rivest. Introduction to Algorithms, Prentice Hall of India Publications, 3rd Edition 2015.
* J. Kleinberg and E. Tardos. Algorithm Design, Pearson, 2006.
* Algorithms and Data Structures Made Easy, by Narasimha Karumanchi (Recommended by the instructor for practice)

**Useful Resources:**

* Geeks for Geeks
* Tushar Roy and other channels on YouTube
* A simple google search can give you enough resources.

**Teacher Review:**

The Instructor was Dr. Joy Chandra Mukerjee for both theory and lab courses. Being an alumnus of IIT Kharagpur, he is known for his student-friendly and interactive teaching methods. He gives importance to feedback from students and tries to make sure every student understands the concepts in classes itself. He prefers explaining concepts through problems over conventional methods of teaching and also makes students solve tricky problems during classes and improve understanding over concepts. He often gives puzzles (similar to the ones on Geeks for Geeks) in-class breaks to improve the logical reasoning of students and indirectly activate the sleepy minds(if any).

In Labs, he strives to improve the programming skills of each and every student apart from giving assignments on taught topics. Labs are the best time to improve programming skills under his supervision, also If you have doubts from classes, you can always ask him to explain things once again in the lab sessions. However, it is recommended you solve more problems from Geeks for Geeks or other sources since the number of problems you solve in labs is relatively small.

All the Course Material, including class notes, lecture slides, and lab assignments can be found [here](https://drive.google.com/drive/folders/1FONZ7OPQex166gW2zNQ0nyPfPjp-tPAA?usp=sharing). Make sure that you’re logged in your google account with institute mail id to access the content.

**4.** **Discrete Structures [CS2L001]**

*Instructor: Dr Padmalochan Bera*

**Main topics:** Propositional and Predicate Logic, Sets, Relations, Functions, Prolog, Graph theory

**Books to follow:**

* Introduction to Graph Theory – by Douglas West
* Discrete Mathematics and Its Applications - by Kenneth H. Rosen

**Points to Note:**

* **DEFINITELY** follow **Douglas West** for graph theory. Sir gives many questions **directly from this book** for graph theory. Try to see most of the questions of the first few chapters. This would really help you to develop a way of thinking to tackle problems. Many people faced difficulties during the mid-sems as the paper was tough. But this can be avoided by doing questions from this book as it enhances your way of thinking in the subject and helps you come up with new solutions for problems.
* For the rest of the topics, follow sir’s notes and slides. You can refer to the book mentioned above (Rosen) to practice problems.
* Overall, this subject may look intimidating to some of you but it improves once you grasp the basic few concepts.
* Our mid-sem was tough and end-sem was comparatively easy (for CSE 2022).

**5.** **Design and Analysis of Algorithms: [CS2L002]**

*Instructor Name: Dr. Joy Chandra Mukharjee*

**Overview:** This course introduces you to the basic algorithms which are essential for any computer science student. The course includes Analysis Techniques: Introduction to algorithms and its importance, mathematical foundations, and complexity analysis of algorithms.

**Design Techniques:** Divide and conquer, Greedy Algorithm, Dynamic Programming.

If time permits: Branch and Bound, Backtracking Techniques.

**Elementary Graph algorithms:** DFS, BFS, Topological Sort, Strongly Connected Components, Minimum Spanning Trees, Single source shortest path, Network Flows, Ford Fulkerson Algorithm, Max Flow-Min Cut, Bipartite Matching.

Theory of NP completeness.

Most of these algorithms are essential for competitive programming as well.

**Study Resources:** “Introduction to algorithms” by CLRS.

**6.** **Design and Analysis of Algorithms Laboratory: [CS2P001]**

*Instructor Name: Dr. Joy Chandra Mukherjee*

**Overview:** Implementation of Algorithms covered in Theory Class.

This will involve design and implementation of algorithms for problems not covered in class but related to topics covered in class.

**7. Combinatorics, Probability, and Statistics: [MA2L006]**

*Instructor Name: Dr.Abhijit Datta Banik*

**Overview:** This course aims to give a detailed introduction to combinatorics, probability, and statistics. As the name suggests, the course is divided into three modules: probability, combinatorics, and statistics. The pre-mid sem part will expand on the probability you’ve learned during the 12th standard. The pre-mid sem part might also include 2-4 lectures on combinatorics. The post-mid sem part will start with some lectures on probability, but most lectures will be on statistics, and 6-8 lectures will be on combinatorics.

**Topics covered:**

1. Discrete Random Variables: Probability distributions of various discrete random variables, Probability Mass Functions, Moments, Joint and Conditional distributions
2. Continuous Random Variables: Probability distributions of various continuous random variables, Probability Density Functions, Moments, Functions of Random Variables, Joint and Conditional distributions
3. Probability Generating Functions and Moment Generating Functions
4. Combinatorics: Permutations and Combinations, Principle of Inclusion and Exclusion, Generating Functions, Recurrence Relations
5. Statistics: Chebyshev’s Inequality, Law of Large Numbers, Central Limit Theorem, Sample Moments, Different Distributions (chi-square, gamma, and F distribution), Point Estimation, Unbiased Estimators, The FCR Inequality, Method of Moments and Maximum Likelihood Estimator for Point Estimation, Interval Estimation

**Reference Books:**

* Probability:
  + Probability and Random Processes -Grimmet and Strizaker (Solution manual is available)
  + John E. Freund's Mathematical Statistics with Applications -Miller
* Combinatorics:
  + Discrete and combinatorial mathematics -Ralph Grimaldi (Solution manual is available)
* Statistics:
  + John E. Freund's Mathematical Statistics with Applications -Miller
  + An Introduction to Probability and Statistics -Rohtagi and Saleh

**Other Resources:**

* <https://www.youtube.com/user/jbstatistics/playlists>
* <https://drive.google.com/drive/folders/1z0YGsLftoibSa0CVElm26DVtov1eZgX3?usp=sharing> (Login with your institute E-mail ID)

# **Teacher Review:** The majority of our batch found the teaching style to be less enthusiastic and relatively less engaging. But on the other hand, most of the lectures can be followed if you consistently revise the previous topics and pay your undivided attention in the class. As most of the lecture content will be heavily based on the previous topics, it is advisable to take a glance at them before attending the class. For statistics and combinatorics, reference books are religiously followed, and the books are well written. Hence, the majority of doubts can be clarified by reading the book. You can also rely on the reference book for probability, but the content or notations may diverge. Mid-sem and End-sem will be heavily based on the tutorials. So, complete the tutorial regularly, even though in most cases, the submission is not required.