**FR. Conceicao Rodrigues College Of Engineering**

Father Agnel Ashram, Bandstand, Bandra-west, Mumbai-50

**Department of Information Technology**

**T.E. (IT) (semester V)  (2019-2020)**

**Lesson Plan**

**Subject: Advanced Data Structures and Analysis of Algorithms (ITDLO5011)**

**Credits-4**

SYLLABUS

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr.**  **No.** | **Module** | **Detailed Content** | **CO**  **Mapping** |
| 00 | Prerequisite | Data structures and analysis |  |
| 01 | Introduction | Introduction  • Introduction to advanced data structures:  • Introduction/Fundamentals of the analysis of algorithms  o Recurrences: ♣ The substitution method ♣ Recursive tree method ♣ Masters method  o Probabilistic analysis  o Amortized analysis  o Randomized algorithms  o Mathematical aspects and analysis of algorithms | CO1  CO2 |
| 02 | Advanced Data Structures | Introduction  • AVL tree • Huffman algorithm • B/B+ tree • 2-3 tree operations • Red-Black Trees • tries • Heap operations • Implementation of priority queue using heap • Topological sort Analysis of All problems | CO1  CO2  CO3 |
| 03 | Divide and Conquer | Introduction • Binary search • Finding the minimum and maximum • Merge sort • Quick sort • Strassen’s matrix multiplication Analysis of All problems | CO2  CO3 |
| 04 | Greedy algorithms | Introduction • Knapsack problem • Job sequencing with deadlines • Minimum cost spanning trees Kruskal’s algorithm o Prim’s algorithm • Optimal storage on tapes • Optimal merge pattern • Subset cover problem • Container loading problem Analysis of All problem | CO2  CO3  CO5 |
| 05 | Dynamic algorithms And NP-Hard and NPComplete | Introduction Dynamic algorithms • All pair shortest path • 0/1 knapsack • Travelling salesman problem • Coin Changing Problem • Matrix Chain Multiplication • Flow shop scheduling • Optimal binary search tree (OBST) • Analysis of All problems • Introduction to NP-Hard And NP-Complete Problems | CO2  CO3  CO4 |
| 06 | String Matching | introduction • The naïve string matching algorithm • Rabin Karp algorithm • Knuth-Morris-Pratt algorithm (KMP) • Longest common subsequence(LCS) • Analysis of All problems • Genetic algorithms | CO2  CO3  CO6 |

Internal Assessment:

Consisting of Two Compulsory Class Tests Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

**CO-Statements:**

CO1. Students will be able to choose appropriate advanced data structure for given problem.

CO2. Students will be able to calculate complexity.

CO3. Students will be able to select appropriate design techniques to solve real world problems.

CO4. Students will able to apply the dynamic programming technique to solve the problems.

CO5. Students will be able to apply the greedy programming technique to solve the problems.

CO6. Students will be able to select a proper pattern matching algorithm for given problem

**CO-PO-PSO Mapping**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Name** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 |  |  |  |  |  |  |  |  |  |  |  | 1 |  |
| CO2 | 3 | 3 |  |  |  |  |  |  |  |  |  |  | 1 |  |
| CO3 |  | 2 | 2 |  |  |  |  |  |  |  |  |  | 1 |  |
| CO4 | 3 | 2 | 2 |  |  |  |  |  |  |  |  |  | 1 |  |
| CO5 | 3 | 2 | 2 |  |  |  |  |  |  |  |  |  | 1 |  |
| CO6 | 3 | 2 |  |  |  |  |  |  |  |  |  |  | 1 |  |

**CO Assessment Tools**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Direct Methods | | | | Indirect Method |
|  | **Test1** | **Test2** | **University Theory Result** | Course Exit Survey |
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| CO1 | **50%** |  | **50%** | 100% |
| CO2 | **50%** |  | **50%** | 100% |
| CO3 | **50%** |  | **50%** | 100% |
| CO4 |  | **50%** | **50%** | 100% |
| CO5 |  | **50%** | **50%** | 100% |
| CO6 |  | **50%** | **50%** | 100% |

**Curriculum Gap/**

**Content beyond syllabus**

**Lecture Plan:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Lecture no | Topic | Planned date | Actual Date | Mode of teaching |
| 1 | Introduction/Fundamentals of the analysis of algorithms. Notations used in Algorithms. Mathematical Aspects of analysis of algorithm. | 01/07/19 | 01/07/19 | Chalk and Black Bard |
| 2 | Time analysis of Iterative algorithms and examples on it. | 04/07/19 | 04/07/19 | Chalk and Black Bard |
| 3 | Time analysis of recursive algorithms-Back substitution method and examples on it. | 05/07/19 | 05/07/19 | Chalk and Black Bard |
| 4 | Time analysis of recursive algorithms- Recursion Tree method and examples on it. | 08/07/19 | 10/07/19 | Chalk and Black Bard |
| 5 | Master’s Theorem and examples on it. | 11/07/19 | 11/07/19 | Chalk and Black Bard |
| 6 | Analyzing space complexity of Iterative and Recursive algorithms. | 12/07/19 | 12/07/19 | Chalk and Black Bard |
| 7 | Advanced Data Structures: Introduction, AVL Tree, Rotations in AVL Tree, and Examples on it. | 15/07/19 | 15/07/19 | Chalk and Black Bard |
| 8 | Huffman Algorithm and examples on it. | 16/07/19 | 16/07/19 | Chalk and Black Bard |
| 9 | B/B+ Tree: Disk Structure, Data Storage, Indexing, Multilevel indexing, Multiway search trees, B trees | 17/07/19 | 17/07/19 | Chalk and Black Bard |
| 10 | B Trees, Insertion and Deletion in B Trees | 19/07/19 | 19/07/19 | Chalk and Black Bard |
| 11 | B+ Trees, 2-3 Tree, Operations on it. | 22/07/19 | 22/07/19 | Chalk and Black Bard |
| 12 | Heap Data Structure, MaxHeap, MinHeap, Heap operations using examples. | 23/07/19 | 23/07/19 | Chalk and Black Bard |
| 13 | Priority queue using heap, examples on it. Heap sort and examples of heap sort. | 24/07/19 | 24/07/19 | Chalk and Black Bard |
| 14 | Algorithm Design Basics, Introduction to Divide and conquer, Standard Divide and conquer Algorithms, Binary Search algorithm and examples, analysis of binary search. | 26/07/19\* | 29/07/19 | Chalk and Black Bard |
| 15 | Algorithm and examples for finding minimum and maximum using divide and conquer, analysis of the same. | 29/07/19 | 30/07/19 | Chalk and Black Bard |
| 16 | Strassen’s Matrix Multiplication using D&C and examples of Strassen’s Matrix Multiplication. | 30/07/19 | 31/07/19 | Chalk and Black Bard |
| 17 | Examples of Strassen’s Matrix Multiplication……..continues, Analysis of the algorithm. | 31/07/19 | 06/08/19 | Chalk and Black Bard |
| 18 | Merge Sort algorithm and tracing examples of merge sort, Analysis of merge sort. | 02/08/19 (OD) | 07/08/19 | Chalk and Black Bard |
| 19 | Quick sort algorithm and tracing examples of quick sort, Analysis of quick sort. | 05/08/19 (Rain) | 09/08/19 | Chalk and Black Bard |
| 20 | Introduction to Algorithm design techniques: Greedy, Divide and Conquer, Dynamic programming. | 6/08/19 | 19/08/19 | Chalk and Black Bard |
| 21 | Greedy Algorithms: Definition, pros and cons, Important concepts about greedy algorithms, Applications of Greedy Algorithms. | 7/08/19 | 20/08/19 | Chalk and Black Bard |
| 22 | Knapsack Problem and examples/problem solving using knapsack. | 9/08/19 | 21/08/19 | Chalk and Black Bard |
| 23 | Examples/problem solving using knapsack…….continued, Analysis of Knapsack using greedy algorithm. | 19/08/19 | 23/08/19 | Chalk and Black Bard |
| 24 | Job sequencing using deadlines and examples on it, Analysis of it. Prim’s Algorithm for finding MST using Greedy algorithm. Problem solving of Prim’s algorithm and analysis of Prim’s algorithms. | 20/08/19 | 26/08/19 | Chalk and Black Bard |
| 25 | Kruskal’s Algorithm for finding MST using Greedy algorithm. Problem solving of Kruskal’s algorithm and analysis of Kruskal’s algorithms. | 21/08/19 | 27/08/19 | Chalk and Black Bard |
| 26 | Optimal Merge Pattern using greedy method and examples on it. Analysis of the same. | 23/08/19 | 28/08/19 | Chalk and Black Bard |
| 27 | Optimal storage on tape, examples and analysis of it. Set cover problem using greedy method, Container loading problem. Analysis of all these problems. | 26/08/19 | 09/09/19 | Chalk and Black Bard |
| 28 | Introduction to Dynamic Programming, Applications of dynamic programming, Difference between dynamic programming and greedy method, Memoization method and examples on it. Tabulation method and examples on it. | 27/08/19 | 11/09/19 | Chalk and Black Bard |
| 29 | Problems on dynamic programming: Longest Common subsequence and examples on it. Analysis of the problem. | 28/08/19 | 13/09/19 | Chalk and Black Bard |
| 30 | 0/1 knapsack algorithm using dynamic programming, examples solving on 0/1 knapsack. | 30/08/19 (Leave) | 16/09/19 | Chalk and Black Bard |
| 31 | examples solving on 0/1 knapsack…….continued, Difference between Knapsack problem using greedy and dynamic technique, | 9/09/19 | 17/09/19 | Chalk and Black Bard |
| 32 | Travelling Salesman Problem using dynamic programming, Coin change problem, examples and analysis of it. | 11/09/19 | 18/09/19 | Chalk and Black Bard |
| 33 | Optimal Binary search tree using dynamic programming, examples and analysis of it. | 13/09/19 | 20/09/19 | Chalk and Black Bard |
| 34 | Matrix chain multiplication using dynamic programming, Algorithm, examples and analysis of it. | 16/09/19 | 23/09/19 | Chalk and Black Bard |
| 35 | All pair shortest path using DP, Algorithm, examples and analysis of it. | 17/09/19 | 24/09/19 | Chalk and Black Bard |
| 36 | String Matching: Naïve method/Algorithm of string matching, Examples and analysis of naïve algorithm. | 18/09/19 | 25/09/19 | Chalk and Black Bard |
| 37 | Applications of string matching, KMP String matching algorithm: Algorithm to compute LPS array, examples on computing LPS array. | 20/09/19 | 27/09/19 | Chalk and Black Bard |
| 38 | KMP algorithm, example tracing of KMP algorithm, Analysis of KMP. | 23/09/19 | 30/09/19 | Chalk and Black Bard |
| 39 | Rabin Karp Algorithm for string matching, examples tracing of Rabin Karp, Drawbacks of algorithm, Analysis of Rabin Karp algorithm. | 24/09/19 | 01/10/19 | Chalk and Black Bard |
| 40 | Longest common Subsequence: What is LCS? LCS using recursion and analysis of it, LCS using memorization/ Top-down approch and analysis of it. LCS using Bottom-Up/Tabulation/DP technique and analysis of it. | 25/09/19 | 04/10/19 | Chalk and Black Bard |
| 41 | Revision of Greedy algorithms and problem solving (previous years question paper questions) | 27/09/19 | 07/10/19 | Chalk and Black Bard |
| 42 | Revision of Dynamic algorithms and problem solving (previous years question paper questions) | 30/09/19 | 09/10/19 | Chalk and Black Bard |

Lab Plan: Not applicable

**Assignment Plan: Not applicable**

**Term Work: Not applicable**