

## **FR. Conceicao Rodrigues College Of Engineering**

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

**Department of Information Technology**

**T.E. (IT) (semester V) (2020-2021)**

### **Lesson Plan**

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

**Credits-4**

### **SYLLABUS**

| <b>Sr. No.</b> | <b>Module</b>            | <b>Detailed Content</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>CO Mapping</b> |
|----------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 00             | Prerequisite             | Data structures and analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                |                   |
| 01             | Introduction             | Introduction <ul style="list-style-type: none"><li>• Introduction to advanced data structures:</li><li>• Introduction/Fundamentals of the analysis of algorithms<ul style="list-style-type: none"><li>o Recurrences: ♣ The substitution method</li><li>♣ Recursive tree method ♣ Masters method</li><li>o Probabilistic analysis</li><li>o Amortized analysis</li><li>o Randomized algorithms</li><li>o Mathematical aspects and analysis of algorithms</li></ul></li></ul> | CO1<br>CO2        |
| 02             | Advanced Data Structures | Introduction <ul style="list-style-type: none"><li>• 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</li></ul>                                                                                                                                                                                                         | CO1<br>CO2<br>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<br>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<br>CO3<br>CO5 |



## CO Assessment Tools

| Direct Methods |       |       |                          | Indirect Method    |
|----------------|-------|-------|--------------------------|--------------------|
|                | Test1 | Test2 | University Theory Result | Course Exit Survey |
| 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:

| Sr. No. | Planned Date | Actual Date | Topic Planned                                                                                | Link for Lecture recording                                                                                                                                                            |
|---------|--------------|-------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | 13/07        | 13/07/2020  | Asymptotic Notations and examples on it.                                                     | <a href="https://drive.google.com/file/d/16cQb707WU-RrPCjLUkINbolzTqGgN9-g1/view?usp=sharing">https://drive.google.com/file/d/16cQb707WU-RrPCjLUkINbolzTqGgN9-g1/view?usp=sharing</a> |
| 2       | 14/07        | 14/07/2020  | Analysis of Iterative Algorithms                                                             | <a href="https://drive.google.com/file/d/1WoRklfFgkYRFlcFSDKOILdqfoEiF5VQX/view?usp=sharing">https://drive.google.com/file/d/1WoRklfFgkYRFlcFSDKOILdqfoEiF5VQX/view?usp=sharing</a>   |
| 3       | 16/07        | 16/07/2020  | Analysis of Iterative Algorithms continued and started with analysis of recursive algorithms | <a href="https://drive.google.com/file/d/1YPE4KsGG3diHhCLU-PpmhUFPQfCNH9k7/view?usp=sharing">https://drive.google.com/file/d/1YPE4KsGG3diHhCLU-PpmhUFPQfCNH9k7/view?usp=sharing</a>   |
| 4       | 17/07        | 17/07/2020  | Analysis of recursive Algorithms                                                             | <a href="https://drive.google.com/file/d/1tRuQxaZt277X4HF42ABt7ULkGPo_ArvK/view?usp=sharing">https://drive.google.com/file/d/1tRuQxaZt277X4HF42ABt7ULkGPo_ArvK/view?usp=sharing</a>   |
| 5       | 20/07        | 20/07/2020  | Analysis of Recursive algorithms using Recursion Tree method                                 | <a href="https://drive.google.com/file/d/1ujS84GFLT9FLcG2je2pzokcl12Oimu4o/view?usp=sharing">https://drive.google.com/file/d/1ujS84GFLT9FLcG2je2pzokcl12Oimu4o/view?usp=sharing</a>   |
| 6       | 21/07        | 20/07/2020  | Analysis of Recursive Algorithms using Master's Theorem.                                     | <a href="https://drive.google.com/file/d/1AkTBhuJA7hdpx_S0a7o9yvkegOHvAaZv/view?usp=sharing">https://drive.google.com/file/d/1AkTBhuJA7hdpx_S0a7o9yvkegOHvAaZv/view?usp=sharing</a>   |

|    |       |            |                                                                                |                                                                                                                                                                                       |
|----|-------|------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7  | 23/07 | 23/07/2020 | Few problems on Master's Theorem, Space complexity of iterative algorithm.     | Forgot to start recording in the lecture.                                                                                                                                             |
| 8  | 24/07 | 24/07/2020 | Space complexity of recursive algorithm.                                       | <a href="https://drive.google.com/file/d/1uWJy5zbTxjRvidyqSZXFYS-n26jcFEhp/view?usp=sharing">https://drive.google.com/file/d/1uWJy5zbTxjRvidyqSZXFYS-n26jcFEhp/view?usp=sharing</a>   |
| 9  | 27/07 | 27/07/2020 | Merge Sort and its analysis                                                    | <a href="https://drive.google.com/file/d/13cjLn1b6L2BAquzXoCXVvDNjoBtKot-2/view?usp=sharing">https://drive.google.com/file/d/13cjLn1b6L2BAquzXoCXVvDNjoBtKot-2/view?usp=sharing</a>   |
| 10 | 28/07 | 28/07/2020 | Quick Sort and its analysis                                                    | <a href="https://drive.google.com/file/d/1xJIEI2cCEtwW1FEA0V-cxGv8IKnfaZI/view?usp=sharing">https://drive.google.com/file/d/1xJIEI2cCEtwW1FEA0V-cxGv8IKnfaZI/view?usp=sharing</a>     |
| 11 | 30/07 | 30/07/2020 | Binary Search and Minmax algorithm and analysis of both algorithms.            | <a href="https://drive.google.com/file/d/1c49GBVse0UNeMbmjAQVS5lw6R5gR6Km/view?usp=sharing">https://drive.google.com/file/d/1c49GBVse0UNeMbmjAQVS5lw6R5gR6Km/view?usp=sharing</a>     |
| 12 | 31/07 | 31/07/2020 | Strassen's Matrix Multiplication using Divide and Conquer                      | <a href="https://drive.google.com/file/d/1-2G9lqCDJfTksZLIJNO1bX3KUG6ZHtd3/view?usp=sharing">https://drive.google.com/file/d/1-2G9lqCDJfTksZLIJNO1bX3KUG6ZHtd3/view?usp=sharing</a>   |
| 13 | 03/08 | 03/08/2020 | Strassen's Matrix Multiplication using Divide and Conquer Examples for solving | <a href="https://drive.google.com/file/d/1bGTq-UcUeVY-m-3zkjlmeQxJPWEbPV5u/view?usp=sharing">https://drive.google.com/file/d/1bGTq-UcUeVY-m-3zkjlmeQxJPWEbPV5u/view?usp=sharing</a>   |
| 14 | 04/08 | 04/08/2020 | Strassen's Matrix Multiplication more examples                                 | <a href="https://drive.google.com/file/d/1bGTq-UcUeVY-m-3zkjlmeQxJPWEbPV5u/view?usp=sharing">https://drive.google.com/file/d/1bGTq-UcUeVY-m-3zkjlmeQxJPWEbPV5u/view?usp=sharing</a>   |
| 15 | 06/08 | 06/08/2020 | Fractional knapsack Problem                                                    | <a href="https://drive.google.com/file/d/1cu2cgmuKOLy6IPDSNZ97B8vPt6FD3G4-/view?usp=sharing">https://drive.google.com/file/d/1cu2cgmuKOLy6IPDSNZ97B8vPt6FD3G4-/view?usp=sharing</a>   |
| 16 | 07/08 | 07/08/2020 | Job sequencing with deadlines                                                  | <a href="https://drive.google.com/file/d/10vhq_MWiopfPWoxaX8wD_P6DIAEefKsD/view?usp=sharing">https://drive.google.com/file/d/10vhq_MWiopfPWoxaX8wD_P6DIAEefKsD/view?usp=sharing</a>   |
| 17 | 10/08 | 10/08/2020 | Job Sequencing and Min. Spanning tree                                          | <a href="https://drive.google.com/file/d/1Xprda0hXzor6dqXOVg4-po8PExzpKEyn/view?usp=sharing">https://drive.google.com/file/d/1Xprda0hXzor6dqXOVg4-po8PExzpKEyn/view?usp=sharing</a>   |
| 18 | 11/08 | 11/08/2020 | Class test and MST using Kruskal's Algo.                                       | <a href="https://drive.google.com/file/d/1mvRSwiTvVqcmfAK_665EI1uXqDjWWqUx/view?usp=sharing">https://drive.google.com/file/d/1mvRSwiTvVqcmfAK_665EI1uXqDjWWqUx/view?usp=sharing</a>   |
| 19 | 13/08 | 13/08/202  | Kruskal's Algo. And Optimal Merge Pattern                                      | <a href="https://drive.google.com/file/d/1XG5E71VZYH9I3mQD9AyvciavuUOdxdh_m/view?usp=sharing">https://drive.google.com/file/d/1XG5E71VZYH9I3mQD9AyvciavuUOdxdh_m/view?usp=sharing</a> |

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| 20 | 14/08 | 17/08/2020 | Optimal Merge Pattern                                                                        | <a href="https://drive.google.com/file/d/11eH8DKZkCcU8mBh2t18BZ08tAGc7XHIs/view?usp=sharing">https://drive.google.com/file/d/11eH8DKZkCcU8mBh2t18BZ08tAGc7XHIs/view?usp=sharing</a>   |
| 21 | 17/08 | 18/08/2020 | Quiz questions                                                                               | <a href="https://drive.google.com/file/d/16evIHTOADEQtFrsJes7TLWwjKWo9u3ij/view?usp=drivesdk">https://drive.google.com/file/d/16evIHTOADEQtFrsJes7TLWwjKWo9u3ij/view?usp=drivesdk</a> |
| 22 | 18/08 | 21/08/2020 | Optimal Storage on Tape                                                                      | <a href="https://drive.google.com/file/d/1TWSRREsxbSdy7iewVuTpLF-FTStJ3bGC/view?usp=sharing">https://drive.google.com/file/d/1TWSRREsxbSdy7iewVuTpLF-FTStJ3bGC/view?usp=sharing</a>   |
| 23 | 20/08 | 31/08/2020 | Revision and Container Loading Problem                                                       | <a href="https://drive.google.com/file/d/1F4BbtX_sifSZyZx-jrZbSul3dHtex4x7/view?usp=drivesdk">https://drive.google.com/file/d/1F4BbtX_sifSZyZx-jrZbSul3dHtex4x7/view?usp=drivesdk</a> |
| 24 | 21/08 | 01/09/2020 | Set cover problem and started with AVL Search Tree                                           | <a href="https://drive.google.com/file/d/19CaPrxUgFglmNsLluO68ENkfEgDI0Ciw/view?usp=sharing">https://drive.google.com/file/d/19CaPrxUgFglmNsLluO68ENkfEgDI0Ciw/view?usp=sharing</a>   |
| 25 | 31/08 | 03/09/2020 | Operations on AVL Tress- RR, RL and examples for practice.                                   | <a href="https://drive.google.com/file/d/1XyWSH2GsMTwVi6pXi0qxUxO8b86EpE0R/view?usp=sharing">https://drive.google.com/file/d/1XyWSH2GsMTwVi6pXi0qxUxO8b86EpE0R/view?usp=sharing</a>   |
| 26 | 01/09 | 04/09/2020 | Operations on AVL Tress- Double rotations, Right Left, Left Right and examples for practice. | <a href="https://drive.google.com/file/d/1KTYsFoHakdeJ1IB_LC14ej7eBxZ-5byY/view?usp=sharing">https://drive.google.com/file/d/1KTYsFoHakdeJ1IB_LC14ej7eBxZ-5byY/view?usp=sharing</a>   |
| 27 | 03/09 | 07/09/2020 | AVL tree examples for practice                                                               | <a href="https://drive.google.com/file/d/1OfQnZe4mqhV2WVhx6tGKdGLG1k0OR1hk/view?usp=sharing">https://drive.google.com/file/d/1OfQnZe4mqhV2WVhx6tGKdGLG1k0OR1hk/view?usp=sharing</a>   |
| 28 | 07/09 | 08/09/2020 | Huffman Algorithm                                                                            | <a href="https://drive.google.com/file/d/1lpa7vrlNoVR05OMMfOLWL8Jhet4c7aY0/view?usp=sharing">https://drive.google.com/file/d/1lpa7vrlNoVR05OMMfOLWL8Jhet4c7aY0/view?usp=sharing</a>   |
| 29 | 08/09 | 10/09/2020 | Huffman Algorithm examples of university papers                                              | <a href="https://drive.google.com/file/d/1tXRht5h3Gk7vit7mMIHqr-LChWrC7aCK/view?usp=sharing">https://drive.google.com/file/d/1tXRht5h3Gk7vit7mMIHqr-LChWrC7aCK/view?usp=sharing</a>   |
| 30 | 10/09 | 11/09/2020 | Revision of previous topics                                                                  | <a href="https://drive.google.com/file/d/1ownCPqb8RD9-dBSZxY1verKOAPPTCryp/view?usp=sharing">https://drive.google.com/file/d/1ownCPqb8RD9-dBSZxY1verKOAPPTCryp/view?usp=sharing</a>   |
| 31 | 11/09 | 22/09/2020 | Started with Heap Data Structure                                                             | <a href="https://drive.google.com/file/d/1CQPzzCC6UQYx0ZbrJ9ordVYpFzsDuN7w/view?usp=sharing">https://drive.google.com/file/d/1CQPzzCC6UQYx0ZbrJ9ordVYpFzsDuN7w/view?usp=sharing</a>   |

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| 32 | 22/09 | 24/09/2020 | Algorithm for Max_Heapify and Buid_Heap with algorithms            | <a href="https://drive.google.com/file/d/148KZfqkl1g-2ChSO9jpXujk0OqzqT-CW/view?usp=sharing">https://drive.google.com/file/d/148KZfqkl1g-2ChSO9jpXujk0OqzqT-CW/view?usp=sharing</a>   |
| 33 | 24/09 | 25/09/2020 | Practice questions asked in GATE exam on topic Heap Data structure | <a href="https://drive.google.com/file/d/1sym3g4y1Ce3TdHBbHwyiDCEk8lpsc4wk/view?usp=sharing">https://drive.google.com/file/d/1sym3g4y1Ce3TdHBbHwyiDCEk8lpsc4wk/view?usp=sharing</a>   |
| 34 | 25/09 | 28/09/2020 | Time complexity of Build Heap and started with B Tree              | <a href="https://drive.google.com/file/d/12kKjuXcru4KCgYm30K_a4e6e_FYElo9E/view?usp=sharing">https://drive.google.com/file/d/12kKjuXcru4KCgYm30K_a4e6e_FYElo9E/view?usp=sharing</a>   |
| 35 | 28/09 | 29/09/2020 | B Tree and construction of B tree with example                     | <a href="https://drive.google.com/file/d/19tGsw8Qv4433MN8JAHLyalbqQers63WV/view?usp=sharing">https://drive.google.com/file/d/19tGsw8Qv4433MN8JAHLyalbqQers63WV/view?usp=sharing</a>   |
| 36 | 29/09 | 01/10/2020 | Construction of b Tree with more examples                          | <a href="https://drive.google.com/file/d/1-5gQxN1wh9GYQ3gJPBCsM8FJ74zvdk3a/view?usp=sharing">https://drive.google.com/file/d/1-5gQxN1wh9GYQ3gJPBCsM8FJ74zvdk3a/view?usp=sharing</a>   |
| 37 | 01/10 | 05/10/2020 | B+ Tree, 2-3 Tree, Red black tree, topological sorting             | <a href="https://drive.google.com/file/d/1E3Ug4t7hTakx1jOagVtyE58cyUq1Viip/view?usp=sharing">https://drive.google.com/file/d/1E3Ug4t7hTakx1jOagVtyE58cyUq1Viip/view?usp=sharing</a>   |
| 38 | 05/10 | 06/10/2020 | Topological sorting examples, questions, analysis and applications | <a href="https://drive.google.com/file/d/1YKYGD_bGezgug7JwrKA2tZEeXOZhpXDN6/view?usp=sharing">https://drive.google.com/file/d/1YKYGD_bGezgug7JwrKA2tZEeXOZhpXDN6/view?usp=sharing</a> |
| 39 | 06/10 | 08/10/2020 | Introduction and basics of Dynamic programming                     | <a href="https://drive.google.com/file/d/1AYkYu1VSI9Qm5LcuxZO2en1D0Nkv1Pfj/view?usp=sharing">https://drive.google.com/file/d/1AYkYu1VSI9Qm5LcuxZO2en1D0Nkv1Pfj/view?usp=sharing</a>   |
| 40 | 08/10 | 09/10/2020 | Knapsack problem by Dynamic Programming                            | <a href="https://drive.google.com/file/d/1Gv2VYWuIPhSua14x34riDYrVGHHo1eJZ/view?usp=sharing">https://drive.google.com/file/d/1Gv2VYWuIPhSua14x34riDYrVGHHo1eJZ/view?usp=sharing</a>   |
| 41 | 09/10 | 12/10/2020 | Knapsack Problem examples                                          | <a href="https://drive.google.com/file/d/1nGFagzEzCz_-f0NVopswdEx5T8S4UNSM/view?usp=sharing">https://drive.google.com/file/d/1nGFagzEzCz_-f0NVopswdEx5T8S4UNSM/view?usp=sharing</a>   |
| 42 | 12/10 | 13/10/2020 | All pair shortest path problem                                     | <a href="https://drive.google.com/file/d/1N8kL9D4k6mFSy3YcU0GjVwmVHL7iPPDk/view?usp=sharing">https://drive.google.com/file/d/1N8kL9D4k6mFSy3YcU0GjVwmVHL7iPPDk/view?usp=sharing</a>   |

|    |       |            |                                                                              |                                                                                                                                                                                       |
|----|-------|------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 43 | 13/10 | 15/10/2020 | Examples on All pair shortest path problem                                   | <a href="https://drive.google.com/file/d/17-y_aNvBZoOMcpkQMTxDX8EqW3957dCz/view?usp=sharing">https://drive.google.com/file/d/17-y_aNvBZoOMcpkQMTxDX8EqW3957dCz/view?usp=sharing</a>   |
| 44 | 15/10 | 16/10/2020 | Travelling Salesman Problem                                                  | <a href="https://drive.google.com/file/d/1i0nQSBbUkw0pMdrOmZnnfzxAVbZWwRwjy/view?usp=sharing">https://drive.google.com/file/d/1i0nQSBbUkw0pMdrOmZnnfzxAVbZWwRwjy/view?usp=sharing</a> |
| 45 | 16/10 | 19/10/2020 | More examples on Travelling Salesman Problem                                 | <a href="https://drive.google.com/file/d/1szs07wQ-ReLLxvk6KmH4QwbXq7MztTY/view?usp=sharing">https://drive.google.com/file/d/1szs07wQ-ReLLxvk6KmH4QwbXq7MztTY/view?usp=sharing</a>     |
| 46 | 19/10 | 20/10/2020 | Matrix chain Multiplication problem                                          | <a href="https://drive.google.com/file/d/1cYhRwXjUwlkQ0RfLgp-gUS9z0uHeYX9E/view?usp=sharing">https://drive.google.com/file/d/1cYhRwXjUwlkQ0RfLgp-gUS9z0uHeYX9E/view?usp=sharing</a>   |
| 47 | 20/10 | 22/10/2020 | More examples on Matrix chain multiplication using DP                        | <a href="https://drive.google.com/file/d/1culixB_NfodyisyH_S-xvq9HLfT0Hk71/view?usp=sharing">https://drive.google.com/file/d/1culixB_NfodyisyH_S-xvq9HLfT0Hk71/view?usp=sharing</a>   |
| 48 | 22/10 | 23/10/2020 | OBST problem using DP                                                        | <a href="https://drive.google.com/file/d/1OLBsKEZUPPVXEs9iQRkhc6FISkF_hTsQ/view?usp=sharing">https://drive.google.com/file/d/1OLBsKEZUPPVXEs9iQRkhc6FISkF_hTsQ/view?usp=sharing</a>   |
| 49 | 23/10 | 26/10/2020 | OBST continued                                                               | <a href="https://drive.google.com/file/d/1UAbGtl8hiBxoNjGYI8dAf5RdbMT78hDD/view?usp=sharing">https://drive.google.com/file/d/1UAbGtl8hiBxoNjGYI8dAf5RdbMT78hDD/view?usp=sharing</a>   |
| 50 | 26/10 | 27/10/2020 | Coin Changing Problem                                                        | <a href="https://drive.google.com/file/d/1H06BJTDRvN0pb12_V3WSVUqvLo9pcWJFh/view?usp=sharing">https://drive.google.com/file/d/1H06BJTDRvN0pb12_V3WSVUqvLo9pcWJFh/view?usp=sharing</a> |
| 51 | 27/10 | 29/10/2020 | String Matching Algorithms: Naive Algorithm and Rabin Karp Algo.             | <a href="https://drive.google.com/file/d/1QOmJQY85PUi_94z2i0_Utb9Cabv9C379/view?usp=sharing">https://drive.google.com/file/d/1QOmJQY85PUi_94z2i0_Utb9Cabv9C379/view?usp=sharing</a>   |
| 52 | 29/10 | 02/11/2020 | Revision of String Matching Algorithms: Naive Algorithm and Rabin Karp Algo. | <a href="https://drive.google.com/file/d/1UX5gz2yXoMYF0ysBtdcK5XiccfUardF9/view?usp=sharing">https://drive.google.com/file/d/1UX5gz2yXoMYF0ysBtdcK5XiccfUardF9/view?usp=sharing</a>   |
| 53 | 02/11 | 03/11/2020 | KMP String Matching Algorithm                                                | <a href="https://drive.google.com/file/d/1uGNJUJU3MZLKV5hQpZtRn5uOlgmwO5d9/view?usp=sharing">https://drive.google.com/file/d/1uGNJUJU3MZLKV5hQpZtRn5uOlgmwO5d9/view?usp=sharing</a>   |
| 54 | 03/11 | 05/11/2020 | LCS problem                                                                  | <a href="https://drive.google.com/file/d/1LIU13dymAJTQBWHfI0PzleG2KMzVJnwW/view?usp=sharing">https://drive.google.com/file/d/1LIU13dymAJTQBWHfI0PzleG2KMzVJnwW/view?usp=sharing</a>   |
| 55 | 05/11 | 06/11/2020 | More problems on LCS and University Question Paper discussion                | <a href="https://drive.google.com/file/d/15tPlxaqMbURp4twqD49b0VV7UmB0wWHV/view?usp=sharing">https://drive.google.com/file/d/15tPlxaqMbURp4twqD49b0VV7UmB0wWHV/view?usp=sharing</a>   |

Lab Plan: Not applicable

**Assignment Plan: Not applicable**

**Term Work: Not applicable**