

**MOHAMED SATHAK A.J COLLEGE OF ENGINEERING**

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| LESSON PLAN                                                                                                                                    |                                          |                              |                  |                              |                      |     |         |
|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|------------------------------|------------------|------------------------------|----------------------|-----|---------|
| Department of INFFORMATION TECHNOLOGY                                                                                                          |                                          |                              |                  |                              |                      |     |         |
| Name of the Subject                                                                                                                            | Data Structures and Algorithms           | Name of the handling Faculty | JEBA MALAR M     |                              |                      |     |         |
| Subject Code                                                                                                                                   | CD3291                                   | Year / Sem                   | II/III           |                              |                      |     |         |
| Acad Year                                                                                                                                      | 2022-2023                                | Batch                        | 2021-2025        |                              |                      |     |         |
| Course Objective                                                                                                                               |                                          |                              |                  |                              |                      |     |         |
| 1. To understand the concepts of ADTs                                                                                                          |                                          |                              |                  |                              |                      |     |         |
| 2. To Learn linear data structures – lists, stacks, and queues                                                                                 |                                          |                              |                  |                              |                      |     |         |
| 3. To understand sorting, searching and hashing algorithms                                                                                     |                                          |                              |                  |                              |                      |     |         |
| 4.Be exposed to graph algorithms                                                                                                               |                                          |                              |                  |                              |                      |     |         |
| 5.To apply Tree and Graph structures                                                                                                           |                                          |                              |                  |                              |                      |     |         |
| Course Outcome                                                                                                                                 |                                          |                              |                  |                              |                      |     |         |
| CO1. Explain abstract data types                                                                                                               |                                          |                              |                  |                              |                      |     |         |
| CO2. Design, implement, and analyze linear data structures, such as lists, queues, and stacks,according to the needs of different applications |                                          |                              |                  |                              |                      |     |         |
| CO3. Design, implement, and analyze efficient tree structures to meet requirements such as                                                     |                                          |                              |                  |                              |                      |     |         |
| CO4 .Model problems as graph problems and implement efficient graph algorithms to solve them                                                   |                                          |                              |                  |                              |                      |     |         |
| CO5. Critically analyse the various algorithms.                                                                                                |                                          |                              |                  |                              |                      |     |         |
| Lesson Plan                                                                                                                                    |                                          |                              |                  |                              |                      |     |         |
| Sl. No.                                                                                                                                        | Topic(s)                                 | T / R*                       | Periods Required | Teaching (BB / PPT / NPTEL / | Blooms Level (L1-L6) | CO  | PO      |
| UNIT-I ABSTRACT DATATYPES                                                                                                                      |                                          |                              |                  |                              |                      |     |         |
| 1                                                                                                                                              | Abstract Data Types (ADTs)               | T1                           | 1                | BB                           | L1                   | CO1 | PO1-PO2 |
| 2                                                                                                                                              | ADTs and classes                         | T1                           | 1                | BB                           | L1                   | CO1 | PO1     |
| 3                                                                                                                                              | Introduction to OOP                      | T1                           | 1                | BB                           | L1                   | CO1 | PO1     |
| 4                                                                                                                                              | classes in Python,Inheritance            | T1                           | 1                | BB                           | L2                   | CO1 | PO1     |
| 5                                                                                                                                              | namespaces                               | T1                           | 1                | BB                           | L2                   | CO1 | PO1-PO3 |
| 6                                                                                                                                              | shallow and deep copying                 | T1                           | 1                | BB                           | L1                   | CO1 | PO2     |
| 7                                                                                                                                              | asymptotic notations                     | T1                           | 1                | BB                           | L2                   | CO1 | PO1     |
| 8                                                                                                                                              | divide and conquer                       | T1                           | 1                | BB                           | L2                   | CO1 | PO3     |
| 9                                                                                                                                              | Recursion,Analyzing recursive algorithms | T1                           | 1                | PPT                          | L2                   | CO1 | PO1     |
| Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any                         |                                          |                              |                  |                              |                      |     |         |

|                                                                                                                          |                                  |          |   |        |    |     |         |
|--------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------|---|--------|----|-----|---------|
| Evaluation method                                                                                                        |                                  |          |   |        |    |     |         |
| <b>UNIT II LINEAR STRUCTURES</b>                                                                                         |                                  |          |   |        |    |     |         |
| 10                                                                                                                       | List ADT                         | T1       | 1 | BB     | L1 | CO2 | PO1     |
| 11                                                                                                                       | array based implementation       | T1       | 1 | BB     | L2 | CO2 | PO2     |
| 12                                                                                                                       | linked list implementation       | T1       | 1 | BB     | L1 | CO2 | PO1     |
| 13                                                                                                                       | singly linked lists              | T1       | 1 | BB     | L2 | CO2 | PO2     |
| 14                                                                                                                       | circularly linked list           | T1       | 1 | BB     | L2 | CO2 | PO2     |
| 15                                                                                                                       | doubly linked lists              | T1,W2    | 1 | BB,PPT | L3 | CO2 | PO2-PO3 |
| 16                                                                                                                       | Stack ADT                        | T1,W2    | 1 | BB,PPT | L3 | CO2 | PO1-PO3 |
| 17                                                                                                                       | Queue ADT                        | T1       | 1 | BB,PPT | L3 | CO2 | PO2     |
| 18                                                                                                                       | double ended queues,Applications | T1       | 1 | PPT    | L2 | CO2 | PO1-PO3 |
| Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any . |                                  |          |   |        |    |     |         |
| Evaluation method                                                                                                        |                                  |          |   |        |    |     |         |
| <b>UNIT III SORTING AND SEARCHING</b>                                                                                    |                                  |          |   |        |    |     |         |
| 19                                                                                                                       | Bubble sort                      | T1       | 1 | BB     | L1 | CO3 | PO1     |
| 20                                                                                                                       | selection sort                   | T1       | 1 | BB     | L1 | CO3 | PO1,PO2 |
| 21                                                                                                                       | Insertion sort                   | T1       | 1 | BB     | L1 | CO3 | PO1,PO2 |
| 22                                                                                                                       | merge sort                       | T1       | 1 | BB     | L2 | CO3 | PO1     |
| 23                                                                                                                       | quick sort                       | T1       | 1 | BB     | L2 | CO3 | PO2     |
| 24                                                                                                                       | Analysis of sorting algoriths    | T1       | 1 | BB,PPT | L2 | CO3 | PO2     |
| 25                                                                                                                       | linear search,binary search      | R1,W1    | 1 | BB,PPT | L2 | CO3 | PO2     |
| 26                                                                                                                       | Hashing- Hash Functions          | T1,W2    | 1 | BB,PPT | L1 | CO3 | PO2     |
| 27                                                                                                                       | Collision handling,rehashing     | T1,W1    | 1 | BB     | L3 | CO3 | PO1-PO3 |
| Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any   |                                  |          |   |        |    |     |         |
| Evaluation method                                                                                                        |                                  |          |   |        |    |     |         |
| <b>UNIT IV TREE STRUCTURES</b>                                                                                           |                                  |          |   |        |    |     |         |
| 28                                                                                                                       | Tree ADT                         | T1       | 1 | BB     | L1 | CO4 | PO1     |
| 29                                                                                                                       | Binary tree ADT                  | T1       | 1 | BB     | L1 | CO4 | PO2     |
| 30                                                                                                                       | tree traversals                  | T1       | 1 | BB     | L2 | CO4 | PO2     |
| 31                                                                                                                       | binary search trees              | T1       | 1 | BB     | L2 | CO4 | PO1     |
| 32                                                                                                                       | AVL trees                        | T1       | 1 | BB     | L2 | CO4 | PO1     |
| 33                                                                                                                       | Examples                         | T1       | 1 | BB     | L3 | CO4 | PO2     |
| 34                                                                                                                       | Binary heap                      | T1       | 1 | BB,PPT | L3 | CO4 | PO1-PO3 |
| 35                                                                                                                       | heaps                            | T1,R1,W2 | 1 | BB,PPT | L2 | CO4 | PO1     |
| 36                                                                                                                       | multiway search trees            | T1,R1,W2 | 1 | BB,PPT | L3 | CO4 | PO3     |
| Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any   |                                  |          |   |        |    |     |         |
| Evaluation method                                                                                                        |                                  |          |   |        |    |     |         |

## UNIT V GRAPH STRUCTURES

|    |                                          |       |   |        |    |     |         |
|----|------------------------------------------|-------|---|--------|----|-----|---------|
| 37 | Graph ADT                                | T1    | 1 | BB     | L1 | CO5 | PO1-PO2 |
| 38 | representation of graph                  | T1    | 1 | BB     | L2 | CO5 | PO1-PO2 |
| 39 | graph traversals                         | T1    | 1 | BB     | L2 | CO5 | PO2     |
| 40 | DAG                                      | T1    | 1 | BB     | L2 | CO5 | PO2     |
| 41 | topological ordering                     | T1    | 1 | BB,PPT | L3 | CO5 | PO2     |
| 42 | greedy algorithms                        | T1    | 1 | PPT    | L4 | CO5 | PO1-PO3 |
| 43 | dynamic programming,shortest path        | T1,W2 | 1 | BB     | L3 | CO5 | PO1-PO3 |
| 44 | minimum spanning tree                    | R1,W2 | 1 | BB     | L3 | CO5 | PO2-PO3 |
| 45 | to complexity classes and intractability | R1,W2 | 1 | BB     | L3 | CO5 | PO1-PO3 |

|                                                                                                                         |                              |
|-------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Suggested Activity: Assignment / Case Studies / Tutorials/ Quiz / Mini Projects / Model Developed/others Planned if any | 1.Kruskal and Prim algorithm |
|-------------------------------------------------------------------------------------------------------------------------|------------------------------|

## Evaluation method

### Content Beyond the Syllabus Planned

|   |                        |
|---|------------------------|
| 1 | R-Programming Language |
| 2 | Graph Databases        |

## Text Books

|   |                                                                                                                                                                |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, “Data Structures & Algorithms in Python”, An Indian Adaptation, John Wiley & Sons Inc., 2021 |
| 2 | T2. 2. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, 2nd Edition, Pearson Education, 2005                                                 |

## Reference Books

|   |                                                                                                  |
|---|--------------------------------------------------------------------------------------------------|
| 1 | Lee, Kent D., Hubbard, Steve, “Data Structures and Algorithms with Python” Springer Edition 2015 |
| 2 | Rance D. Necaise, “Data Structures and Algorithms Using Python”, John Wiley & Sons, 2011         |

| Website / URL References                           |                                                                                                                                                       |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----|-----|------------------------------------|---------------------------|----------|-----|-----|------|--------------------------------|-----------|-------|------|
| 1                                                  | W1: <a href="http://nptel.ac.in/">http://nptel.ac.in/</a>                                                                                             |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
| 2                                                  | W2: <a href="https://www2.cs.siu.edu/~mengxia/Courses%20PPT/435/Chapter_03.pdf">https://www2.cs.siu.edu/~mengxia/Courses%20PPT/435/Chapter_03.pdf</a> |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
| 3                                                  | W3: <a href="http://www.cs.tau.ac.il/~nachumd/models/Nets.pdf">http://www.cs.tau.ac.il/~nachumd/models/Nets.pdf</a>                                   |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
| Blooms Level                                       |                                                                                                                                                       |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
| Level 1 ( L1 ) : Remembering                       |                                                                                                                                                       |            |     |     | Lower<br>Order<br>Thinking<br>Exam | Level 4 (L4) : Analysing  |          |     |     |      | Projects /<br>Mini<br>Projects |           |       |      |
| Level 2 (L2) : Understanding                       |                                                                                                                                                       |            |     |     |                                    | Level 5 (L5) : Evaluating |          |     |     |      |                                |           |       |      |
| Level 3 (L3) : Applying                            |                                                                                                                                                       |            |     |     |                                    | Level 6 (L6) : Creating   |          |     |     |      |                                |           |       |      |
| Mapping syllabus with Bloom's Taxonomy LOT and HOT |                                                                                                                                                       |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
| Unit No                                            | Unit Name                                                                                                                                             |            |     |     | L1                                 | L2                        | L3       | L4  | L5  | L6   | LOT                            | HOT       | Total |      |
| Unit 1                                             | ABSTRACT DATA TYPES                                                                                                                                   |            |     |     | 4                                  | 5                         | 0        | 0   | 0   | 0    | 9                              | 0         | 9     |      |
| Unit 2                                             | LINEAR STRUCTURES                                                                                                                                     |            |     |     | 2                                  | 4                         | 3        | 0   | 0   | 0    | 9                              | 0         | 9     |      |
| Unit 3                                             | SORTING AND SEARCHING                                                                                                                                 |            |     |     | 4                                  | 4                         | 1        | 0   | 0   | 0    | 9                              | 0         | 9     |      |
| Unit 4                                             | TREE STRUCTURES                                                                                                                                       |            |     |     | 2                                  | 4                         | 3        | 0   | 0   | 0    | 9                              | 0         | 9     |      |
| Unit 5                                             | GRAPH STRUCTURES                                                                                                                                      |            |     |     | 1                                  | 3                         | 5        | 1   | 0   | 0    | 8                              | 1         | 9     |      |
| Total                                              |                                                                                                                                                       |            |     |     | 13                                 | 20                        | 12       | 1   | 0   | 0    | 44                             | 1         | 45    |      |
| Total Percentage                                   |                                                                                                                                                       |            |     |     | 29                                 | 44                        | 27       | 2   | 0   | 0    | 98                             | 2         | 100   |      |
| CO PO Mapping                                      |                                                                                                                                                       |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
|                                                    | PO1                                                                                                                                                   | PO2        | PO3 | PO4 | PO5                                | PO6                       | PO7      | PO8 | PO9 | PO10 | PO11                           | PO12      | PSO1  | PSO2 |
| CO1                                                | 3                                                                                                                                                     | 2          | 1   | 0   | 0                                  | 0                         | 0        | 0   | 0   | 0    | 0                              | 0         | 3     | 2    |
| CO2                                                | 3                                                                                                                                                     | 2          | 1   | 0   | 0                                  | 0                         | 0        | 0   | 0   | 0    | 0                              | 0         | 3     | 2    |
| CO3                                                | 3                                                                                                                                                     | 2          | 1   | 0   | 0                                  | 0                         | 0        | 0   | 0   | 0    | 0                              | 0         | 3     | 2    |
| CO4                                                | 3                                                                                                                                                     | 2          | 1   | 0   | 0                                  | 0                         | 0        | 0   | 0   | 0    | 0                              | 0         | 3     | 2    |
| CO5                                                | 3                                                                                                                                                     | 2          | 1   | 1   | 0                                  | 0                         | 0        | 0   | 0   | 0    | 0                              | 0         | 3     | 2    |
| Avg                                                | 3                                                                                                                                                     | 2          | 1   | 0.2 | 0                                  | 0                         | 0        | 0   | 0   | 0    | 0                              | 0         | 3     | 2    |
| Justification for CO-PO mapping                    |                                                                                                                                                       |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
| CO1                                                | Implement abstract data types                                                                                                                         |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
| CO2                                                | Design,implement and analyse linear data structures such as lists queues and stack according to the needs of different applications                   |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
| CO3                                                | Design and implement and analyse efficient tree strucyures to meet requirements such as searching                                                     |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
| CO4                                                | Critically analyse the various algorithms.                                                                                                            |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
| CO5                                                | Identify the different data structures to problem solutions.                                                                                          |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
| 3                                                  |                                                                                                                                                       | High level |     |     | 2                                  |                           | Moderate |     |     | 1    |                                | low level |       |      |
| Name & Sign of Subject Expert :                    |                                                                                                                                                       |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |
| Head of the Department :IT                         |                                                                                                                                                       |            |     |     |                                    |                           |          |     |     |      |                                |           |       |      |