| **Course Code: ITDO5014** | **Course Title: Advance Data Structure and Analysis** | **Credits** |
| --- | --- | --- |
|  |  | 3 |
| **1) Prerequisite:** Basics of Data structures and analysis and programming language, **Time and space complexity of algorithm** | |
| **2) Course Objectives:** | |
| 1 | To learn mathematical background for analysis of algorithm |
| 2 | To learn various advanced data structures. |
| 3 | To understand the different design approaches of algorithms. |
| 4 | To learn dynamic programming methods. |
| 5 | To understand the concept of pattern matching |
| **6** | To learn advanced algorithms. |
| **3) Course Outcomes:** | |
| 1 | Describe the different methods for analysis of algorithms. |
| 2 | Choose an appropriate advanced data structure to solve a specific problem. |
| 3 | Apply an appropriate algorithmic design approach for a given problem. |
| 4 | Apply the dynamic programming technique to solve a given problem. |
| 5 | Select an appropriate pattern matching algorithm for a given application. |
| **6** | Describe the concepts of Optimization, Approximation and Geometric algorithms. |

**4) Syllabus**

| **Module** |  | **Content** | **Hrs** |
| --- | --- | --- | --- |
| 1 | Introduction | Fundamentals of the analysis of algorithms: Time and Space complexity, Asymptotic analysis and notation, average and worst-case analysis, Recurrences: The substitution method, Recursion tree method, Masters method.  Self-learning Topics: Analysis of Time and space complexity of iterative and recursive algorithms | 4 |
| 2 | Advanced Data Structures | B/B+ tree, Red-Black Trees, Heap operations,Implementation of priority queue using heap, Topological Sort.  Self-learning Topics: Implementation of Red-Black Tree and Heaps. | 5 |
| 3 | Divide and Conquer AND Greedy algorithms | Introduction to Divide and conquer, Analysis of Binary Search, Merge sort and Quick sort, Finding minimum and maximum algorithm. Introduction to Greedy Algorithms: Knapsack Problem, Job sequencing using deadlines, Optimal storage on tape, Optimal Merge Pattern, Analysis of all these algorithms and problem solving.  Self-learning Topics: Implementation of minimum and maximum algorithm, Knapsack problem, Job sequencing using deadlines. | 8 |
| 4 | Dynamic algorithms | Introduction to Dynamic Algorithms, all pair shortest path, 0/1 knapsack, traveling salesman problem, Matrix Chain Multiplication, Optimal binary search tree, Analysis of All algorithms and problem solving.  Self-learning Topics: Implementation of All pair shortest path, 0/1 Knapsack and OBST. | 6 |
| 5 | String Matching | Introduction, the naïve string matching algorithm, Rabin Karp algorithm, Boyer Moore algorithm, KnuthMorris-Pratt algorithm, Longest Common Subsequence (LCS), Analysis of All algorithms and problem solving.  Self-learning Topics: Implementation of Robin Karp algorithm, KMP algorithm and LCS. | 7 |
| 6 | Advanced Algorithms and NP problems | Optimization Algorithms: Genetic algorithm(GA)  Approximation Algorithms: Vertex-cover problem and **TSP**,  **Geometric Algorithm: Closest Pair**  Introduction to NP-Hard and NP-Complete Problems  Self-learning Topics: Implementation of Genetic algorithm and Vertex-cover problem, **Randomized algorithms** | 7 |
|  |  | **Total** | **39** |

| **5) Textbooks:** | |
| --- | --- |
| 1 | Introduction to Algorithms, Cormen, Leiserson, Rivest, Stein, PHI. |
| 2 | Algorithms: Design and Analysis, Harsh Bhasin, OXFORD |
| 3 | Fundamentals of Computer Algorithms, Horowitz, Sahani, Rajsekaran, Universities Press. |
| 4 | C and Data structures, Deshpande, Kakde, Dreamtech Press. |
| **6) Reference Books:** | |
| 1 | Data Structures and Algorithms in C++, Goodritch, Tamassia, Mount, WILEY. |
| 2 | Data Structures using C, Reema Thareja , OXFORD. |
| 3 | Data Structures and Algorithm Analysis in C, Mark A. Weiss, Pearson. |
| 4 | Optimization Algorithms and Applications, By Rajesh Kumar Arora by Chapman and Hall |

| **7) Internal Assessment:**  Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40)  Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.  **8) Continuous Assessment:-**  Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-   | **Sr.no** | **Rubrics** | **Marks** | | --- | --- | --- | | 1. | GATE Based Assignment test/Tutorials etc | 10 marks | | 2. | Study and implementation of assigned Algorithms | 10 Marks | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

**\***For sr.no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

**9)Rubrics for slow learners:-**

1.) Case study, Presentation, group discussion, technical debate on recent trends in the said course  (10 marks)

2. Project based Learning and evaluation / Extra assignment / Question paper solution  (10 marks)

3) Multiple Choice Questions  (Quiz) (5marks)

4) Literature review of papers/journals (5 marks)

5) Library related work (5 marks)

**10)Rubrics for Indirect Assessment :-**

1. Mock Viva/Practical

2. Skill Enhancement Lecture

3. Extra Assignments/lab/lecture

| **11)End Semester Theory Examination:** | |
| --- | --- |
| 1 | Question paper will be of 60 marks |
| 2 | Question paper will comprise a total of five questions |
| 3 | All question carry 20 marks |
| 4 | Any three questions out of five needs to be solved. |