**National Institute of Technology Karnataka, Surathkal**

**Department of Computer Science and Engineering**

Course Plan (Part-A)

|  |  |  |
| --- | --- | --- |
| **Name of the course: Design and Analysis of Algorithms** | **Course Code: CS253** | **No. of Credits (L-T-P) : (3-1-0) 4** |
| **Year:II**  **Semester:IV**  **Section: S1 and S2** | **Course Type: Program Core** | **Academic Session: Even Semester 2024-25** |

# Prerequisites (if any): CS202 : Data Structures and Algorithms

CS203 : Data Structures and Algorithms Lab

1. **Name and Contact Details of the Course Instructor: Vani M**

**Room #509,**

**Dept. of CS&E, NITK-Surathkal**

**0824-2473405 (O), E-mail:** [**vani@nitk.edu.in**](mailto:vani@nitk.edu.in)

# Assessment Pattern (Use Bloom’s taxonomy to design rubrics for evaluating students’ performance):

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Level No.** | **Knowledge Level** | **Evaluation Component** | | | **Assessment(%)** | |
| Surprise Test /Assignments / Tutorials/ Viva  40% | Mid-sem Exam  20% | Final Exam  40% |
| K1 | Remember | 10% | 10% | 10% | | 10% |
| K2 | Understand | 30% | 15% | 12% | | 20% |
| K3 | Apply | 20% | 20% | 20% | | 20% |
| K4 | Analyse | 15% | 30% | 32% | | 25% |
| K5 | Evaluate | 15% | 15% | 6% | | 10% |
| K6 | Create | 10% | 10% | 20% | | 15% |
| Total | | | | | 100% | |

1. **Assessment Process:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Evaluation Component** | **Assessment Frequency** | **Assessed by** | **Reviewed by** |
| Tutorials | Every week throughout the semester | Course Instructor and Teaching Assistant | DUGC |
| Viva | Once in a semester | Course Instructor | DUGC |
| Surprise Test | Twice in a semester | Course Instructor and Teaching Assistant | DUGC |
| Mid-Sem Exam | Once in a semester | Course Instructor | DUGC |
| End-Sem Exam | Once in a semester | Course Instructor | DUGC |

# Course Objectives:

|  |  |
| --- | --- |
| **Sl. No.** | **Course Objectives** |
| 1 | To provide an in-depth treatment of a broad range of algorithms and design techniques. |
| 2 | To teach how to measure the effectiveness (in terms of time and space complexities) of algorithms. |
| 3 | To teach students to formally prove the correctness of the algorithms they design and also to enhance the capability to come up with counter arguments in case a wrong algorithm. |

1. **Course (Learning) Outcomes (COs):**

|  |  |
| --- | --- |
| **COs** | **Course Outcomes** |
| 1 | Understand different design techniques that are helpful in coming up algorithms for given problem. |
| 2 | Should be able to design and employ appropriate data structures for solving computing problems |
| 3 | Possess the ability to design efficient algorithms for solving computing problems |
| 4 | Possess the ability to identify and prove problems which do not seem to have efficient algorithms |

# Course Articulation Matrix:

(**Note:** Enter correlation levels 1, 2, or 3 as defined below: 1 - Slight (Low), 2 - Moderate (Medium) 3 - Substantial (High), and If there is no correlation, put “-”\_)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** | **PO-6** | **PO-7** | **PO-8** | **PO-9** | **PO-10** | **PO-11** | **PO-12** | **PSO-1** | **PSO-2** |
| 1 | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 3 | 1 | 3 | 1 |
| 2 | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 2 | 1 | - | - |
| 3 | 3 | 3 | 1 | 3 | 3 | 1 | 1 | 1 | 2 | 3 | 2 | 1 | - | 1 |
| 4 | 3 | 3 | 1 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | - |
| **Avg.** | **3** | **3** | **1.5** | **3** | **3** | **1** | **1.5** | **1.5** | **1.75** | **3** | **2.5** | **1.5** | **2** | **1** |

# Program Articulation Matrix:

**(Note:** Enter correlation levels 1, 2, or 3 as defined below: 1 - Slight (Low), 2 - Moderate (Medium) 3 - Substantial (High), and If there is no correlation, put “-”)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** | **PO-6** | **PO-7** | **PO-8** | **PO-9** | **PO-10** | **PO-11** | **PO-12** | **PSO-1** | **PSO-2** |
| **3** | **3** | **2** | **3** | **3** | **1** | **2** | **2** | **2** | **3** | **3** | **2** | **2** | **1** |

# Course Syllabus:

|  |  |  |  |
| --- | --- | --- | --- |
| Module – **Title** | | Content | **L-T-P hours** |
| M1 | Introduction | The role of algorithms in computing,  growth of functions, Solving recurrences | 4-0-0 |
| M2 | Analysis techniques, Sorting and order statistics | Randomized select, Selection in worst case linear  time | 4-0-0 |
| M3 | Divide and conquer | Merge Sort, Strassen’s Matrix multiplication, Closest pair of points | 6-0-0 |
| M4 | Greedy Algorithms | Interval scheduling, knapsack, Independent set on trees, Minimum Spanning Trees Algorithms | 6-0-0 |
| M5 | Dynamic Programming | Weighted interval Scheduling, Edit Distance, LCS, Knapsack | 6-0-0 |
| M6 | Graph Algorithms | Traversal**,**Spanning tree, Single Source Shortest path, All pair shortest path, Max flow algorithms. | 6-0-0 |
| M7 | NP-Completeness | Reducibility, Classes P, NP and NPC, Coping with NP-Completeness using approximation algorithms, exact exponential time algorithms | 10-0-0 |

1. **List of Textbooks & Reference books, Online Course Resources:**

|  |  |  |
| --- | --- | --- |
| **Items** | **Sl. No.** | **Title, Author, Publisher, etc.** |
| Textbooks | 1 | Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein. Introduction to Algorithms. McGraw-Hill, 2001. |
| 2 | Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms (second edition), Universities Press, 2012. |
| 3 | 1. Donald E. Knuth, Art of Computer Programming, Volume 1-3 |
| Reference books | 1 | 1. Aho,Hopcroft and Ullman ,Design and analysis of algorithms. |
| 2 | 1. Jon Kleinberg, Eva tardos,Algorithms Design.Sanjoy Dasgupta, C Papadimitriou,U. Vazirani,Algorithms |
| 3 | Sanjoy Dasgupta, C Papadimitriou,U. Vazirani,Algorithms |
| Online Resources | 1 | NPTEL videos (<https://onlinecourses.nptel.ac.in/noc19_cs47/preview>) |
| 2 | MIT Open Courseware (<https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/>) |
|  |  |

Name and signature of course instructor with date:

Name and signature of DUGC/DPGC Secretary with date:

Name and signature of DUGC/DPGC Chairman with date:

Name and signature of HOD with date:

# \*\*\*\* END \*\*\*

**National Institute of Technology Karnataka, Surathkal**

**Department of Computer Science & Engineering**

**Course Plan – Attainment of COs, POs, and PSOs**

**(Part B)**

|  |  |  |
| --- | --- | --- |
| **Name of the course: Design and Analysis of Algorithms** | **Course Code: CS253** | **No. of Credits (L-T-P) : (3-1-0) 4** |
| **Year:II**  **Semester:IV**  **Section: S1 and S2** | **Course Type: Program Core** | **Academic Session: Even Semester 2024-25** |

**CO Attainment Target Levels:**

|  |  |  |
| --- | --- | --- |
| **Assessment Methods** | **Assessment Levels** | |
| Mid-Sem Examination, | Level 1 | Less than or equal to 60% of the students scoring more than or equal to the class average |
| Level 2 | Above 60% of the students scoring more than or equal to the class average |
| Level 3 | Above 70% of the students scoring more than or equal to the class average |
| Tutorials | Level 1 | Less than or equal to 60% of the students scoring more than or equal to the class average |
| Level 2 | Above 60% of the students scoring more than or equal to the class average |
| Level 3 | Above 70% of the students scoring more than or equal to the class average |
| Quizzes, | Level 1 | Less than or equal to 60% of the students scoring more than or equal to the class average |
| Level 2 | Above 60% of the students scoring more than or equal to the class average |
| Level 3 | Above 70% of the students scoring more than or equal to the class average |
| End-Sem Examination | Level 1 | Less than or equal to 60% of the students scoring more than or equal to the class average |
| Level 2 | Above 60% of the students scoring more than or equal to the class average |
| Level 3 | Above 70% of the students scoring more than or equal to the class average |

**A. Attainment of Course Outcomes through Semester End Examinations (SEE):**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SEE Q. No.** | **Course Outcomes (COs) Attainment Level** | | | |
| **CO-1** | **CO-2** | **CO-3** | **CO-4** |
| SEE-Q1 |  |  |  |  |
| SEE-Q2 |  |  |  |  |
| SEE-Q3 |  |  |  |  |
| SEE-Q4 |  |  |  |  |
| SEE-Q5 |  |  |  |  |
| SEE-Q6 |  |  |  |  |
| SEE-Q7 |  |  |  |  |
| SEE-Q8 |  |  |  |  |
| Avg. |  |  |  |  |

**B. Attainment of Course Outcomes through Cumulative Internal Examinations (CIE):**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Internal Examination** | **Question No.** | **Course Outcomes (Cos)** | | | | | |
|  | | |  | **CO-1** | **CO-2** | **CO-3** | **CO-4** |
| Mid-Sem | | | Q1 |  |  |  | 1 |
| Q2 |  |  |  | 1 |
| Q3 |  |  |  | 1 |
| Q4 |  |  |  | 1 |
| Q5 |  |  |  | 1 |
| Quizzes, Tutorials | | | -- |  |  |  | 3 |
| **Avg.** | | |  |  |  |  | 1.6 |

**Computation of COs Overall Attainment:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COs** | **COs Attainment Level** | | | |
| **SEE** | **CIE** | | **Overall CO Attainment Level = Avg (SEE, CIE)** |
| 1 |  |  | |  |
| 2 |  |  | |  |
| 3 |  |  | |  |
| 4 |  |  | |  |
| **Average CO Direct Attainment** | | |  | |

**COs Corrective Measures**

|  |  |  |
| --- | --- | --- |
| **COs** | **Attainment** | **Action Plan** |
| 1 |  | Continue to provide online resources to make students understand the complex topics. Algorithms design discussions in class, quizzes, tutorials, and other assessments to improve student learning |
| 2 |  |
| 3 |  |
| 4 |  |

**C. Attainment of Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Course | Program Outcomes Attainment Levels | | | | | | | | | | | |
| PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 |
| CS253 | 3 | 3 | 2 | 3 | 3 | 1 | 2 | 2 | 2 | 3 | 2 | 2 |
| Weighted Avg. of POs | 3 | 3 | 1.5 | 3 | 3 | 1 | 1.5 | 1.5 | 1.75 | 3 | 2.5 | 1.5 |
| Direct Attainment Level (A)\* |  |  |  |  |  |  |  |  |  |  |  |  |

\* Direct Attainment Level (A) = (Weighted Avg. of POs \* CO Direct Attainment Avg.)/Target Level

**POs Corrective Measures**

|  |  |  |
| --- | --- | --- |
| **POs** | **Attainment** | **Action Plan** |
| 1 |  | Continue to provide algorithms design discussions in classes, quizzes, tutorials, assignments, and other assessments to improve student learning.  Introduce more program analysis tools to create awareness of modern tools and their usage. Provided several assignments . |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |
| 11 |  | - |
| 12 |  | Continue current course perspective to empower life-long learning. |

**D. Attainment of Program Specific Outcomes:**

|  |  |  |
| --- | --- | --- |
| **Course** | **Program Specific Outcomes Attainment Levels** | |
| **PSO-1** | **PSO-2** |
| **CS253** |  |  |
| **Weighted Avg. of PSOs** |  |  |
| **Direct Attainment Level (A)\*** |  |  |

\* Direct Attainment Level (A) = (Weighted Avg. of PSOs \* CO Direct Attainment Avg.)/Target Level

**PSOs Corrective Measures**

|  |  |  |
| --- | --- | --- |
| **PSOs** | **Attainment** | **Action Plan** |
| 1 |  | Continue course components to strengthen fundamentals, and prepare the learner for tomorrow’s challenges in Industry and R&D |
| 2 |  |

Name and signature of course instructor with date:

Name and signature of DUGC Secretary with date:

Name and signature of DUGC Chairman with date:

Name and signature of HOD with date:

\*\*\*\*