# Shri G.S. Institute of Technology & Science, Indore

## DEPARTMENT OF COMPUTER ENGINEERING

## B.Tech (III$^{rd}$ Year)

## COURSE FILE

**Subject Code: CO34563** **Subject Nomenclature:** Design and Analysis of Algorithms

**Session: 2021-2022** **Semester: B**

**Faculty Name: Surendra Gupta**

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| | **a) Course Objectives** | |
| | **b) Course Outcomes (COs)[ At least four]** | |
| | **c) Text books (at least 3)** | |
| | **d) Reference books (at least 5) (Unit wise reference book)** | |
| | e) Reference web sites (Reading Materials for Course - topic wise) | |
| | f) MOOCs course references | |
| 4. | **Time Table** | |
| 5. | **Mapping of CO with PO** | |
| 6. | **Summary lecture plan (unit wise)** | |
| 7. | **Detail lecture plan ( Day Wise ) [ 40 lectures ]** | |

8. Tutorials sheet/Home Assignments (At least 6)
9. Tutorials sheet solutions with rubrics
10. **Mid Semester papers & its solution with rubrics**
11. Classroom quizzes (at least four) with solution ( 10 min each )
12. Moodle MCQ ( at least 6) (at least 10 questions per MCQ)
13. **Lab Plan (at least 12 Labs) [ What to do in each lab ]**
14. **Lab Assignments (at least 6)**
15. Lab Assignments solution with rubrics
16. Mini Project list and rubrics
17. **Final Exam paper with solution and rubrics**
18. List of CO Assessment activities (Direct & Indirect)
19. **Pie chart of assessments activities w.r.t bloom taxonomy, CO.**
20. **CO and PO Attainment**
21. Mode of Content Delivery ( for Theory & Lab )
22. Question Bank - at least 100 questions (topic–wise)
23. **Course assessment policies ( How to calculate CW/SW )**
24. **CW/SW assessment sheet of students**
25. Mapping of CO with Lab Experiments (If Applicable)
26. **Students attendances record**
27. **Students Feedback (Pre and post)**

28. Mapping of all assessment activities to PI, CO, and Blooms taxonomy
29. **Summary (in Bar/Pi /.. Graph) of all assessment activities.**
30. CO, PO Attainment analysis
31. Student's feedback analysis
32. Any other innovative practice
33. List of actions taken to improve PO attainment

## Vision

To become strong center of excellence for creating competent human resource in the field of Computer Science and Engineering meeting the dynamic societal and industrial needs.

## Mission

**M1:** To produce technically competent professionals in Computer Science and Engineering having a blend of theoretical knowledge and practical skills.
**M2:** To encourage innovation, research and analytical activities with professional ethics and responsibilities through quality education.
**M3:** To provide learning ambience in collaboration with industries to keep pace with dynamic technological advancements and promote spirit of entrepreneurship**.**
**M4:** To motivate students to apply knowledge to resolve societal and environmental challenges and engage in continuous learning towards sustainable development.

## Program Outcomes (POs)

| | |
|---|---|
| **PO 1:** | **Engineering knowledge**: Apply knowledge of mathematics and science with fundamentals of Computer Science & Engineering to be able to solve complex engineering problems related to CSE |
| **PO 2:** | **Problem analysis**: Identify Formulate review research literature and analyze complex engineering problems related to CSE and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. |
| **PO 3:** | **Design/Development of solutions**: Design solutions for complex engineering problems related to CSE and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural societal and environmental considerations |
| **PO 4:** | **Conduct Investigations of Complex problems**: Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| **PO 5:** | **Modern Tool Usage**: Create, Select and apply appropriate techniques, resources and modern engineering and it tools including prediction and modeling to computer science related complex engineering activities with an understanding of the limitations |
| **PO 6:** | **The engineer and society**: Apply Reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the CSE professional engineering practice. |
| **PO 7:** | **Environment and sustainability:** Understand the impact of the CSE professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development. |
| **PO 8:** | **Ethics**: apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO 9:** | **Individual and team work**: Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings |
| **PO 10:** | **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large such as able to comprehend and with write effective reports and design documentation, make effective presentations and give and receive clear instructions. |

| | |
|---|---|
| **PO 11:** | **Project management and finance**: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments |
| **PO 12:** | **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning the broadest context of technological change |

## Program Educational Objectives (PEOs)

**PEO1**: To inculcate self-assurance, integrity, technical, collaborative and communication abilities (Leadership) in students, to be able to inspire and guide the team they work in.

**PEO 2:** To equip students with theoretical knowledge and practical skills to take on the challenges in the industries or research organizations.

**PEO 3:** To promote among graduates, the quest for lifelong learning to remain professionally more efficient.

**PEO 4:** To sensitize students towards professional ethics and practices to take up and resolve socially relevant challenges.

**PEO 5:** To encourage graduates to gain multi-disciplinary knowledge through industrial training and projects leading to innovation, research and sustainable development.

## Program Specific Outcomes (PSOs)

**PSO 1:** To develop conceptual understanding and application of learned concepts to different domains.
**PSO 2:** To imbibe professional ethics, communication abilities and quest for continuous learning.
**PSO 3:** To gain capability to use state of art techniques, skills and tools with mind-set inclined towards innovation and research.

**Session: Jan - June 2022, Semester 'B'**
**Tentative Time Table for offline classes**
**Shri Surendra Gupta**

**w.e.f:21/02/2022**

| | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|---|---|---|---|---|---|---|
| **10:00--10:50** | | | | | | *CO44999/CO44499 PP-II/PP-I ** |
| **10:50--11:40** | CO34563 DesignAA SG LT301 | CO34563 DesignAA SG LT301 | CO34563 DesignAA SG LT301 | CO34563 DesignAA SG LT301 | | |
| **11:40--12:30** | | | | | | *CO34999 MPPS** |
| **12:30--01:20** | | | | | | |
| **01:20--02:20** | **LUNCH** | | | | | |
| **02:20--03:10** | CO34563 DesignAA B1 SG, SOSA, RR', PS'' SE Lab | CO34563 DesignAA B2 SG, SOSA, RR',PS'' SE Lab | CO34563 DesignAA B3 SG, SD, RR',PS'' SE Lab | | | |
| **03:10--04:00** | | | | | | |
| **04:00--04:50** | CO24991 DT B3, B4 SG, JT, AD' DS Lab | | | CO34563 DesignAA B4 SG, SD, RR',PS'' SE lab | | |
| **04:50--05:40** | | | | | | |

| Subject Code | Subject Name |
|---|---|
| **CO24991** | Design thinking Lab-I |
| **CO34563** | Design and Analysis of Algorithms |
| **CO44999/CO44499** | Project Phase - II/Project Phase – I |
| **CO34999** | Major Project Planning and Seminar |

| | Faculty Name |
|---|---|
| **UT** | Dr. Urjita Thakar |
| **JT** | Ms. Jyoti Tiwari |
| **SOSA** | Dr. Soma Saha |
| **SD** | Ms. Shweta Dubey |
| **PS''** | Ms. Pooja Sindel |
| **RR'** | Rishabh Rai |
| **AD'** | Anushka Dixit |

Head,
Dept. of Computer Engg.

**B. E. III YEAR (4YDC)**
**SEMESTER-B**
**CO 34563: DESIGN & ANALYSIS OF ALGORITHMS**

| *Hours per Week | | | Th. Credit | Pr. Credit | MAXIMUM MARKS | | | | |
|---|---|---|---|---|---|---|---|---|---|
| L | T | P | | | TH | CW | SW | Pr. | Total |
| 3 | - | 2 | 3 | 1 | 70 | 30 | 60 | 40 | 200 |

PRE-REQUISITES: CO24507: Data Structures

**COURSE OBJECTIVES:** Analyze the asymptotic performance of algorithms. Demonstrate a familiarity with major algorithms and data structures. Apply important algorithmic design paradigms and methods of analysis. Design efficient algorithms for common engineering design situations.

**COURSE OUTCOMES:**
**After completing the course student should be able to:**

**CO1**. Understand meaning of complexity of an algorithm & various notations to represent time complexity.

**CO2**. Apply and evaluate different algorithm design techniques for getting the effective solutions of specified problems.

**CO3**. Design and analyze different algorithms with its applications.

**CO4**. Explain computability and non-computability and various complexity classes, and approaches to solve complex problems.

**COURSE CONTENTS:**
**THEORY:**

**UNIT 1** Review of elementary Data Structures: Stacks, Queues, Lists, Trees, Hash, Graph. Internal representation of Data Structures, Code tuning techniques: Loop Optimization, Data Transfer Optimization, Logic Optimization, etc.

**UNIT 2** Definitions of complexity, Time and Space Complexity; Time space tradeoff, various bounds on complexity, Asymptotic notation: O-notation, Ω-notation, Θ-notation, Recurrences and Recurrences solving techniques: Recursion-tree method and Master method, Average time analysis methods: Probabilistic methods. Amortized analysis.

**UNIT 3** Design and analysis of algorithms using the brute-force, greedy, dynamic programming, divide-and-conquer and backtracking techniques.

**UNIT 4** Algorithm for sorting and searching, string matching algorithm, Number-theoretic algorithms, linear programming, Matrix Manipulation algorithms, tree and Graph Algorithms.

**UNIT 5** NP-hard and NP-complete problems, Approximations Algorithms, Data Stream Algorithms, Introduction to design and complexity **analysis** of Parallel Algorithms **using CUDA programming.**

**COURSE ASSESSMENT (Th.):**

1. Internal Assessment for continuous evaluation, mid-term tests, Tutorials, Quizzes, Class Performance, etc. (30%).
2. End semester Theory Exam (70%).

**COURSE ASSESSMENT (Pr.):**

1. Internal Assessment for continuous evaluation (40%): Lab assignments, demonstration, Viva, file etc.

2. End semester Practical Exam (60%): Quiz/Programming test, lab journal, demo, viva etc.

**TEXT BOOKS RECOMMENDED:**


1. Cormen, Leiserson, Rivest, Stein, "Introduction to Algorithms", Second Edition, Prentice Hall of India, 2001.
2. Aho A.V., Hopcroft J.E., J. Ullman, "Design and Analysis of Computer Algorithms", Addison Wesley, 1998.
3. Horowitz E. and Sahani, "Fundamentals of Computer Algorithms", Galgotia Publications, 1984.


**REFERENCE BOOKS:**


1. Knuth D., "Fundamental algorithms: The Art of Computer programming", Volume – I, Third Edition, Pearson Education 1998.
2. Knuth D., "Sorting and Searching: The Art of Computer programming", Volume – III, Second Edition Pearson Education 1998.
3. John Kleinberg, Trades E., "Algorithm Design", Pearson Education 2002.
4. A. Papoulis, S.U. Pillai, "Probability, Random Variables and Stochastic Processes", McGraw Hill, Fourth Edition 2006.
5. Goodrich Michael T., R. Tamassia, "Algorithms Design", Willy Publication


## COURSE ASSESSMENT POLICIES (Tentative):

**CLASS WORK(CW) ASSESSMENT**

| | |
|---|---|
| Test - 01 | 15 % |
| Test - 02 | 15 % |
| Test - 03 | 15 % |
| Tutorials Sheets | 15 % |
| Surprise Quzzies | 40 % |
| Attendance | 00 % |

**PRACTICAL WORK(SW) ASSESSMENT**

| | |
|---|---|
| Programming Assignments with analysis | 40% |
| Demos | 40% |
| Viva | 10% |
| Files | 10% |
| Attendance | 00% |

# CO34563: Design and Analysis of Algorithms

# Lecture Plan

| S.NO | Topics | No of Lectures |
|---|---|---|
| 1. | Introduction | 3 |
| 2. | Asymptotic notation | 2 |
| 3. | Divide and conquer | 3 |
| 4. | Recurrences | 3 |
| 5. | Greedy Methods | 2 |
| 6. | Dynamic programming | 3 |
| 7. | Backtracking | 2 |
| 8. | Randomized Algorithms | 2 |
| 9. | NP Problems | 3 |
| 10. | Code tuning techniques | 2 |
| 11. | Sorting Algorithms | 3 |
| 12. | Searching Algorithms | 3 |
| 13. | Data Structures Algorithms | 3 |
| 14. | Graph/Tree Algorithm | 4 |
| 15. | Number-theoretic algorithms | 2 |
| 16. | Data Stream Algorithms | 1 |
| 17. | Semi-Numerical Algorithms | 1 |
| 18. | Parallel algorithm | 2 |
| 19. | Aprroximation Algorithms | 3 |
| 20. | Test/Exam paper discussion | 3 |
| | **Total** | **50** |

# CO34563: Design and Analysis of Algorithms

# Lecture Plan

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|---|---|---|
| 1. | Introduction | 3 |
| 2. | Asymptotic notation | 2 |
| 3. | Divide and conquer | 3 |
| 4. | Recurrences | 3 |
| 5. | Greedy Methods | 2 |
| 6. | Dynamic programming | 3 |
| 7. | Backtracking | 2 |
| 8. | Randomized Algorithms | 2 |
| 9. | NP Problems | 3 |
| 10. | Code tuning techniques | 2 |
| 11. | Sorting Algorithms | 3 |
| 12. | Searching Algorithms | 3 |
| 13. | Data Structures Algorithms | 3 |
| 14. | Graph/Tree Algorithm | 4 |
| 15. | Number-theoretic algorithms | 2 |
| 16. | Data Stream Algorithms | 1 |
| 17. | Semi-Numerical Algorithms | 1 |
| 18. | Parallel algorithm | 2 |
| 19. | Aprroximation Algorithms | 3 |
| 20. | Test/Exam paper discussion | 3 |
| | **Total** | **50** |