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**UNIVERSITY OF PETROLEUM & ENERGY STUDIES**

**SCHOOL OF COMPUTER SCIENCE**

**DEPARTMENT OF CYBERNETICS**

**Dehradun**

**COURSE PLAN**

Programme : B. Tech – CSE (DevOps)

Course : Design and Analysis of Algorithms

Course Code : CSEG 2003

No. of credits : 4

Semester : III

Session: 2019-20

Batch : 2018-22

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P.O. Bidholi, , Dehradun

**COURSE PLAN**

1. **PREREQUISITE:**
   1. Basic Knowledge of Programming and Data Structure.
   2. Basic Knowledge of Advanced Data Structure.
2. **PROGRAM OUTCOMES (POs) and PROGRAM SPECIFIC OUTCOMES (PSOs) for DESIGN AND ANALYSIS OF ALGORITHMS:**

**B1. PROGRAM OUTCOMES (POs)**

Engineering Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems 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.

PO4. 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.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. 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 professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**B2. Program Specific Outcomes (PSOs)**

Computer Science Engineering with specialization in Big Data, Engineering Graduates will be able to:

PSO1. Perform system and application programming using computer system concepts, concepts of Data Structures, algorithm development, problem solving and optimizing techniques,

PSO2. Apply software development and project management methodologies using concepts of front-end and back-end development and emerging technologies and platforms.

PSO3: Design solutions to challenging and ever growing real world data engineering problems and examine it to uncover hidden patterns, correlations, insights and make better data driven decisions..

1. **COURSE OUTCOMES FOR DESIGN AND ANALYSIS OF ALGORITHMS**

**At the end of this course student should be able to**

CO1. Apply mathematical techniques to find the Complexity of an algorithm design

CO2. Understand and analyze algorithms and estimate their worst and average case behavior.

CO3. Study good principles of algorithm designs

CO4. Design an appropriate data structure to reduce the complexity of an algorithm.

CO5. Implement algorithms in a programming language.

CO6. Understand about P, NP hard and NP Complete problems.

**Relationship between the Course Outcomes (COs) and Program Outcomes (POs)**

|  |  |  |
| --- | --- | --- |
| **Mapping between COs and POs** | | |
|  | **Course Outcomes (COs)** | **Mapped Programmed Outcomes/PSO** |
| **CO1** | Apply mathematical techniques to find the Complexity of an algorithm design | **PO1, PSO 3** |
| **CO2** | Understand and analyze algorithms and estimate their worst and average case behavior. | **PO 2, PO 3,PO5, PSO2** |
| **CO3** | Study good principles of algorithm designs | **PO1, PO 2, PSO 3,PO5** |
| **CO4** | Design an appropriate data structure to reduce the complexity of an algorithm | **PO 3,PO4, PSO1, PSO3** |
| **CO5** | Implement algorithms in a programming language. | **PO4, PSO2** |
| **CO6** | Understand about P, NP hard and NP Complete problems. | **PSO2,PSO3,PO5** |

**Table: Correlation of POs and PSOs v/s COs**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PO/CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO**  **12** | **PSO**  **1** | **PSO**  **2** | **PSO**  **3** |
| CO1 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 |
| CO2 |  | 1 | 2 |  | 3 |  |  |  |  |  |  |  |  | 2 |  |
| CO3 | 1 | 2 |  |  | 2 |  |  |  |  |  |  |  |  |  | 2 |
| CO4 |  |  | 3 | 2 |  |  |  |  |  |  |  |  | 2 |  | 2 |
| CO5 |  |  | 2 | 2 |  |  |  |  |  |  |  |  |  | 2 |  |
| CO6 |  |  |  |  | 2 |  |  |  |  |  |  |  |  | 2 | 2 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Engineering Knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual or team work | Communication | Project management and finance | Life-long Learning | Perform system and application programming using computer system concepts, concepts of Data Structures, algorithm development, problem solving and optimizing techniques | Apply software development and project management methodologies using concepts of front-end and back-end development and emerging technologies and platforms. | Apply computing knowledge to assess, design and propose cyber security solutions and perform forensic procedures on digital systems and cyber world using tools and technologies in the area of cyber security and cyber forensics |
| Course Code | Course Title | PO1 | PO2 | PO3 | PO 4 | PO 5 | PO6 | PO 7 | PO8 | PO9 | PO 10 | PO 11 | PO12 | PSO 1 | PSO 2 | PSO 3 |
| CSEG 2003 | Design and Analysis of Algorithms | 2 | 2 | 3 | 2 | 2 |  |  |  |  |  |  | 2 | 2 | 2 | 3 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

1. **PEDAGOGY**

* **Presentation,**
* **Voiceover Presentation & Video lectures,**
* **NPTEL videos,**
* **YouTube videos.**

1. **COURSE COMPLETION PLAN**

|  |  |
| --- | --- |
| **Total Class room sessions** | 48 |
| **Total Blackboard sessions** | 00 |
| **Total Quizzes** | 02 |
| **Total Test** | 02 |
| **Total Assignment** | 02 |

One Classroom Session = 60 minutes

1. **EVALUATION & GRADING**

Students will be evaluated based on the following 3 points.

|  |  |  |  |
| --- | --- | --- | --- |
| **S. No.** | **Assessment** | **Weightage** | **Schedule** |
| 1 | Internal Assessment (IA) | 30% | Detailed Below |
| 2 | Mid-semester Examination (MS) | 20% | Academic Calendar |
| 3 | End-semester Examination (ES) | 50% | Academic Calendar |

**F1. INTERNAL ASSESSMENT: WEIGHTAGE – 30%**

Internal Assessment shall be done based on the following:

|  |  |  |
| --- | --- | --- |
| S. No. | Description | % of Weightage out of 30% |
| 1 | Class Tests | 30% |
| 2 | Quizzes | 20% |
| 3 | Assignments | 30% |
| 4 | Attendance and Performance in the class | 20% |

**F2*. Internal Assessment Record Sheet (including Mid Term Examination marks)*** *will be displayed online at the end of semester i.e. last week of regular classroom teaching.*

**F3. CLASS TESTS/QUIZZES:** Two Class Tests based on descriptive type theoretical & numerical questions and Two Quizzes based on objective type questions will be held; one class test and one quiz at least ten days before the Mid Term Examination and second class test and second quiz at least ten days before the End Term Examination. Those who do not appear in Viva-Voce and quiz examinations shall lose their marks.

*The marks obtained by the students will be displayed on LMS a week before the start of Mid Term and End Term Examinations respectively.*

**F4. ASSIGNMENTS:** After completion of each two units, there will be home assignments based on theory and numerical problems. Those who fail to submit the assignments by the due date shall lose their marks.

**F5. GENERAL DISCIPLINE:** Based on student’s regularity, punctuality, sincerity and participation in the interactions.

*The marks obtained by the students will be displayed on LMS at the end of semester.*

**F6. MID TERM EXAMINATION: WEIGHTAGE – 20%**

Mid Term examination shall be Two Hours duration and shall be a combination ofShort and Long theory Questions.

***Date of showing Mid Term Examination Answer Sheets: Within a week after completion of mid Sem examination.***

**F7. END TERM EXAMINATION: WEIGHTAGE – 50%**

End Term Examination shall be Three Hours duration and shall be a combination of Short and Long theory/numerical Questions.

**F8. GRADING:**

The overall marks obtained at the end of the semester comprising all the above three mentioned shall be converted to a grade.

1. **COURSE DELIVERY PLAN**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Session** | **TOPICS** | **Course Outcomes Addressed** | **Required Learning Resources**  **(including media)** | **Pedagogy/**  **Discussion(s)/ Postings** | **Assessment** |
|  | **Module 1: Introduction** | | | | |
| **1** | Performance Analysis- Space complexity, Time complexity. | **CO1** | **[T1]** | **Lecture** |  |
| **2** | Asymptotic Notation- Big oh notation, Omega notation, Theta notation with numerical, | **CO1** | **[T1]** | **Lecture** |  |
| **3** | Asymptotic Notation- Big oh notation, Omega notation, Theta notation with numerical, | **CO1** | **[T1]** | **Lecture** |  |
| **4** | different algorithm design techniques, recurrence relation | **CO1** | **[T1]** | **Lecture** |  |
| **5** | solving methods: substitution , | **CO2** | **[T1]** | **Lecture** |  |
| **6** | solving methods: recursion tree | **CO2** | **[T1]** | **Lecture** |  |
| **7** | Master theorem with numerical. | **CO2** | **[T1]** | **Lecture** |  |
| **8** | master theorem with numerical | **CO2** |  | **Lecture** |  |
| **9** | Performance Analysis- Space complexity, Time complexity. | **CO2** | **[T1],[R1]** | **Lecture** |  |
|  | **Module 2: Divide and conquer** | | | | |
| **10** | Binary search | **CO3** | **[T1]** | **Lecture** |  |
| **11** | Quick sort | **CO3** | **[T1],[R1]** | **Lecture** |  |
| **12** | Quick sort: best case , worst case analysis | **CO4** | **[T1],[R1]** | **Lecture** |  |
| **13** | Merge sort | **CO4** | **[T1],[R1]** | **Lecture** |  |
| **14** | Strassen’s matrix multiplication | **CO5** | **[R1]** | **Lecture** |  |
| **15** | Powering Numbers, Fibonacci Number, Maximum contiguous subarray problem,. | **CO4** | **[R1]** | **Lecture** | **Assignment 1 release** |
|  | **Module 3: The Greedy Algorithm** | | | | |
| **16** | activity selection problem | **CO4** | **[T1]** | **Lecture** |  |
| **17** | Interval Scheduling and Interval Partitioning. | **CO4** | **[T1]** | **Lecture** |  |
| **18** | knapsack problem | **CO4** | **[T1]** | **Lecture** |  |
| **19** | Minimum cost spanning trees: Prims | **CO4** | **[T1]** | **Lecture** |  |
| **20** | Minimum cost spanning trees: kruskal,. | **CO4** | **[T1]** | **Lecture** | **Test-1** |
| **21** | Single source shortest path problem: dijkstra’s |  | **[R1]** | **Lecture** |  |
| **22** | Single source shortest path problem: Bellman ford |  | **[T1]** | **Lecture** |  |
| **23** | Huffman codes. |  | **[T1]** | **Lecture** | **Quiz-1** |
|  | **Module 4: Dynamic Programming** | | | | |
| **24** | Matrix chain multiplication | **CO5** | **[T1]** | **Lecture** |  |
| **25** | Dynamic Programming: Matrix chain multiplication | **CO5** | **[T1]** | **Lecture** |  |
| **26** | 0/1 knapsack problem | **CO5** | **[T1]** | **Lecture** |  |
| **27** | 0/1 knapsack problem Analysis | **CO5** | **[T1]** | **Lecture** |  |
| **28** | Optimal binary search tree | **CO5** | **[R1]** | **Lecture** |  |
| **29** | examples | **CO5** | **[R1]** | **Lecture** |  |
| **30** | largest common subsequence | **CO5** | **[R1]** | **Lecture** |  |
| **31** | Analysis and derivation | **CO5** | **[T1]** | **Lecture** |  |
|  | **Module 5: Graph Algorithm** | | | | |
| **32** | Introduction to graphs | **CO6** | **[T1]** | **Lecture** |  |
| **33** | Representation of graph | **CO6** | **[T1]** | **Lecture** |  |
| **34** | Basic traversal techniques(BFS and DFS) | **CO6** | **[T1]** | **Lecture** |  |
| **35** | Applications | **CO6** | **[T1]** | **Lecture** |  |
| **36** | Single source shortest path | **CO4** | **[T1]** | **Lecture** |  |
| **37** | Bellman-Ford algorithm | **CO5** | **[T1]** | **Lecture** |  |
| **38** | Dijkstra’s algorithm | **CO5** | **[T1]** | **Lecture** |  |
| **39** | All pair shortest path(Floyd- Warshall algorithm) | **CO4** | **[T1]** | **Lecture** |  |
| **40** | Example | **CO4** | **[T1]** | **Lecture** | **Assignment 2- release** |
|  | **Module 6: Branch and Bound method** | | | | |
| **41** | Branch and Bound method introduction  n-queens problem | **CO6** | **[T1]** | **Lecture** |  |
| **42** | knapsack problem | **CO6** | **[T1]** | **Lecture** |  |
| **43** | Subset sum problem | **CO6** | **[T1]** | **Lecture** |  |
| **44** | TSP problem | **CO3** | **[T1]** | **Lecture** | **Test-2** |
| **45** | Example and analysis | **CO3** | **[T1]** | **Lecture** |  |
| **46** | B & B strategies | **CO4** | [T1] | Lecture | **Quiz-2** |
| **47** | NP hard | **CO5** | **[T1]** | **Lecture** |  |
| **48** | NP complete problem | **CO3** | **[T1]** | **Lecture** |  |

1. **SUGGESTED READINGS:**

**Text Book**

# T1: Introduction to Algorithms, Third Edition, By [Thomas H. Cormen](https://mitpress.mit.edu/contributors/thomas-h-cormen), [Charles E. Leiserson](https://mitpress.mit.edu/contributors/charles-e-leiserson), [Ronald L. Rivest](https://mitpress.mit.edu/contributors/ronald-l-rivest) and [Clifford Stein](https://mitpress.mit.edu/contributors/clifford-stein), 2009.

**Reference Books:**

# R1: Introduction to the Design and Analysis of Algorithms, Dr. Anany Levitin,

**Video Resources:**

[V1]. <https://www.youtube.com/playlist?list=PL08885AEAE85EA836>

[V2]. https://nptel.ac.in/downloads/106106131/

**GUIDELINES**

***Cell Phones and other Electronic Communication Devices*:** Cell phones and other electronic communication devices (such as Blackberries/Laptops) are not permitted in classes during Tests or the Mid/Final Examination. Such devices MUST be turned off in the class room.

***E-Mail and online learning tool:*** Each student in the class should have an e-mail id and a password to access the LMS system regularly. Regularly, important information – Date of conducting class tests, guest lectures, via online learning tool. The best way to arrange meetings with us or ask specific questions is by email and prior appointment. All the assignments preferably should be uploaded on online learning tool. Various research papers/reference material will be mailed/uploaded on online learning platform time to time.

***Attendance:*** Students are required to have **minimum attendance of 75%** in each subject. Students with less than said percentage shall **NOT** be allowed to appear in the end semester examination.

**Course outcome assessment:** To assess the fulfilment of course outcomes two different approaches have been decided. Degree of fulfillment of course outcomes will be assessed in different ways through direct assessment and indirect assessment. In Direct Assessment, it is measured through quizzes, tests, assignment, Mid-term and/or End-term examinations. It is suggested that each examination is designed in such a way that it can address one or two outcomes (depending upon the course completion). Indirect assessment is done through the student survey which needs to be designed by the faculty (sample format is given below) and it shall be conducted towards the end of course completion. The evaluation of the achievement of the Course Outcomes shall be done by analyzing the inputs received through Direct and Indirect Assessments and then corrective actions suggested for further improvement. Capping

***Passing criterion:*** Student has to secure minimum 35 marks individually in both the ‘End-Semester examination’ and ‘Total Marks’ in order to pass in that paper.

* Passing Criterion for B. Tech: Minimum 30% and 40% of the highest marks in the class applicable to the students admitted before July 2015 and onwards July 2015 respectively.
* Passing Criterion for M. Tech: minimum 40% of the highest marks in the class

**Sample format for Indirect Assessment of Course outcomes**

|  |
| --- |
| NAME: |
| ENROLLMENT NO: |
| SAP ID: |
| COURSE: |
| PROGRAM: |

Please rate the following aspects of course outcomes of Automotive transmissions systems.

Use the scale 1-4\*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sl. No. |  | 1 | 2 | 3 | 4 |
| 1 | CO1.Apply mathematical techniques to find the Complexity of an algorithm design |  |  |  |  |
| 2 | CO2. Understand and analyze algorithms and estimate their worst and average case behavior. |  |  |  |  |
| 3 | CO3. Study good principles of algorithm designs |  |  |  |  |
| 4 | CO4. Design an appropriate data structure to reduce the complexity of an algorithm. |  |  |  |  |
| 5 | CO5. Implement algorithms in a programming language. |  |  |  |  |
| 6 | CO6. Understand about P, NP hard and NP Complete problems. |  |  |  |  |

3

Below Average

Good

1

**\***

Very Good

Average

4

2