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|  | **East West University**  **Department of Computer Science and Engineering**  **Course Outline of CSE246** |  |

**Course: CSE246 Algorithms (Sections: All)**

**Credits and Teaching Scheme**

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| --- | --- | --- | --- |
|  | Theory | Laboratory | Total |
| Credits | 3 | 1.5 | 4.5 |
| Contact Hours | 3 Hours/Week for 13 Weeks + Final Exam in the 14th week | 3 Hours/Week for 13 weeks | 6 Hours/Week for 13 Weeks + Final Exam in the 14th week |

**Prerequisite**

CSE103 Structured Programming

CSE207 Data Structured

**Instructor Information**

**Instructor**: Redwan Ahmed Rizvee

Adjunct Lecturer, Department of Computer Science and Engineering

**Office**: Room: N/A

**Tel. No.**: N/A

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**URL:** <https://du.ac.bd/faculty/faculty_details/CSE/61070>

**GTA/UTA:** N/A

**Course Objective**

This course introduces students to the general tools and techniques for analyzing and designing computer algorithms. Initially necessary mathematical preliminaries required for analyzing and designing computer algorithms are taught. Then this course familiarizes students with several algorithmic approaches and corresponding problems. This course will work as a backbone to understanding different core courses of computer science and will be needed as prerequisite knowledge for future courses such as Artificial Intelligence, Computer Networks, and Compiler Design.

**Knowledge Profile**

K4: Forefront engineering specialist knowledge for practice

**Learning Domains**

Cognitive – C3: Applying, C4: Analyzing

Psychomotor - P2: Manipulation, P3: Precision

Affective - A2: Responding

**Program Outcomes (POs)**

PO1: Engineering Knowledge

PO2: Problem Analysis

**Complex Engineering Problem**

EP1: Depth of knowledge required.

EP2: Range of conflicting requirements.

EP3: Depth of analysis required.

**Course Outcomes (COs) with Mappings**

## After completion of this course students will be able to:

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| **CO** | **CO Description** | **PO** | **Learning**  **Domains** | **Knowledge**  **Profile** | **Complex**  **Engineering**  **Problem**  **Solving/**  **Engineering**  **Activities** |
| CO1 | **Model** different real-life problems using graph and **apply** graph related algorithms to solve them. | PO1 | C3 | K4 |  |
| CO2 | **Apply** the basic concepts of number theory, pattern matching for developing  effective problem solutions. | PO1 | C3 | K4 |  |
| CO3 | **Choose** and **justify**  Advanced algorithm design techniques for solving complex problems. | PO2 | C4 | K4 | EP1, EP2,  EP3 |
| CO4 | **Analyze** the complexity of different algorithms and **choose** the suitable  approach for solving complex problems. | PO2 | C4 | K4 |  |

**Course Topics, Teaching-Learning Method, and Assessment Scheme**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Topic** | **Teaching-**  **Learning**  **Method** | **CO** | **Mark of Cognitive**  **Learning Levels** | | | **Quiz** | **Exam**  **(Mark)** |
|  |  |  | C2 | C3 | C4 |  |  |
| Introduction to algorithms, complexity analysis, asymptotic notations, typical running time  functions, classifying.  functions by their asymptotic growth rates, etc. |  | CO4 | 3 |  |  |  | Midterm (30) |
| Divide and conquer  algorithms: Binary search, Closest pair of points, Counting inversion, merge  sort, quick sort etc. |  | CO3 | 2 | 4 |  | Quiz1 (10) |
| Greedy algorithms: Coin  changing, fractional  Knapsack, Huffman codes,  Optimal codes, Activity  selection. Suitability of all these algorithms in greedy  approach. |  | 2 | 4 |  |
| Recurrence relation.  Iteration, Substitution,  Recursion tree and Master  methods |  | CO4 |  |  | 3 | Quiz2 (10) |
| Euclid’s algorithm for  GCD, Extended Euclid’s  algorithm and Number  theoretic algorithms: Sieve  Method.  Pattern matching and  String-matching algorithms (Rabin-Karp Algorithm, KMP Algorithm). |  | CO2 | 3 | 3 |  |
| Introduction to dynamic programming: Fibonacci series, 0-1 knapsack, coin changes and related problems, Longest Common Subsequence (LCS) and related problem |  | CO3 |  | 6 |  |  |
| Dynamic programming (Continue): Longest  Increasing subsequence  (LIS), Rock climbing, matrix chain multiplication, and miscellaneous problem solving. |  | CO3 |  | 6 |  | Quiz3 (10) | Theory final (30) |
| Graphs, graph-based  algorithm - breadth-first  search (BFS), depth-first  search (DFS),  Edge identification. Modification of DFS to find the topological sort, strongly connected component, articulation points, bridges, and Bi-connected components. |  | CO1 | 2 | 6 |  |
| Minimal spanning tree:  basic terminology, applications and algorithms  Single source shortest path algorithms: Dijkstra’s algorithm, Bellman-Ford  algorithm, shortest path in  DAG. Floyd-Warshall algorithm, Transitive closure.  Algorithm strategy, structure and problem types. |  | CO1 | 2 | 6 |  | Quiz4 (10) |
| Network Flow, Max Flow,  Min-Cut, Residual  Network, Augmenting  paths, Ford-Fulkerson and  Edmonds-Karp algorithms. |  | CO1 | 2 | 3 |  |
| P and NP classes, algorithm completeness, discussion on other complex techniques of algorithm design  And analysis. |  | CO4 |  | 3 |  |

**Laboratory Experiments and Assessment Scheme**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Experiment** | **Teaching-**  **Learning**  **Method** | **CO** | **Mark of Cognitive Learning Levels** | | **Mark of**  **Psychomotor Learning**  **Levels** | | **Mark of Affective Learning Levels** | **CO**  **Mark** |
|  |  |  | **C3** | **C4** | **P2** | **P3** | **A2** |  |
| Implementation of  Divide and Conquer  Algorithms | Do | CO3 |  |  |  |  |  |  |
| Implementation of  Greedy- Knapsack  (fractional) and  Huffman codes | Do | CO3 |  |  |  |  |  |  |
| Implementation of  String Matching | Do | CO2 |  |  |  |  |  |  |
| Implementation of  Sieve | Do | CO2 |  |  |  |  |  |  |
| Implementation of  DP- Knapsack, LCS,  LIS, Coin change,  Matrix chain  multiplication and  other DP related  problem | Do | CO3 |  |  |  |  |  |  |
| Implementation of  breadth-first search  (BFS) | Do | CO1 |  |  |  |  |  |  |
| Implementation of  depth-first search  (DFS) | Do | CO1 |  |  |  |  |  |
| Implementation of  Topological sort and  find Strongly  connected  component | Do | CO1 |  |  |  |  |  |
| Implementation of  Dijkstra’s and  Modified Dijkstra’s  algorithms | Do | CO1 |  |  |  |  |  |
| Implementation of  Floyd-Warshall  algorithm and  Transitive closure | Do | CO1 |  |  |  |  |  |
| Implementation of  Max Flow | Do | CO1 |  |  |  |  |  |
| Lab Performance | Individual lab  evaluation |  |  |  |  |  |  | 10 |
| Lab Exam | Individual  lab exam |  |  |  |  |  |  | 10 |
| Total |  |  |  |  |  |  |  |  |

**Mini Projects**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Mini Project** | **Teaching-**  **Learning**  **Method** | **CO** | **Mark of Cognitive Learning Levels** | | **Mark of**  **Psychomotor Learning**  **Levels** | | **Mark of Affective Learning Levels** | **CO**  **Mark** |
|  |  |  | **C3** | **C4** | **P2** | **P3** | **A2** |  |
| Mini Lab Project  including Report  and Presentation | Group based  moderately complex  project with  report  writing, and  oral/poster presentation | CO3 |  |  |  |  |  | 10 |

**Overall Assessment Scheme**

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| --- | --- | --- | --- | --- | --- | --- |
| **Assessment Area** | **CO1** | **CO2** | **CO3** | **CO4** | **others** | **Assessment Area**  **Mark** |
| Class Test |  |  |  |  |  | 10 |
| Midterm |  |  |  |  |  | 30 |
| Final Exam (Theory) |  |  |  |  |  | 30 |
| Lab final |  |  |  |  |  | 10 |
| Lab performance |  |  |  |  |  | 10 |
| Mini Project |  |  |  |  |  | 10 |
| Total Mark |  |  |  |  |  | 100 |

**Teaching Materials/Equipment**

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| --- | --- |
| Text Book | 1. Introduction to Algorithm (3rd edition) by Thomas H. Cormen, Charles E. Leiserson, Ronald Rivest, Clifford Stein  2. Algorithms by Robert Sedgewick |
| Teaching Materials | Lecture notes\*, Lab exercise/ assignments/notes\*, Reference books, Computer and Software |
| Book Link | <https://drive.google.com/drive/folders/14MpuKbttHR28oSXLvVW_1VD6MLi-J2tf?usp=sharing> |
| Slides Link | <https://github.com/rizveeredwan/course-contents/tree/main/EWU/CSE-246/slides> |
| Videos Link | <https://drive.google.com/drive/folders/1f1wsFdvuCvaChcSvcKuKph1kQVKispeh?usp=sharing> |
| Example Codes | <https://drive.google.com/drive/folders/1osRj_7ScY2nkcfeiYmH64FEFdaO4OCX8?usp=sharing> |

**Mini Projects:**

Mini Project description will be provided in time.

**Grading System**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Marks (%)** | **Letter Grade** | **Grade Point** | **Marks (%)** | **Letter Grade** | **Grade Point** |
| >=80 | A+ | 4.00 | >=55 | B- | 2.75 |
| >=75 | A | 3.75 | >=50 | C+ | 2.5 |
| >=70 | A- | 3.50 | >=45 | C | 2.25 |
| >=65 | B+ | 3.25 | >=40 | D | 2.00 |
| >=60 | B | 3.00 | <40 | F | 0.00 |

**Exam Dates**

Can be found on the website.

**Academic Code of Conduct**

**Academic Integrity:**

Any form of cheating, plagiarism, personification, falsification of a document as well as any other form of dishonest behavior related to obtaining academic gain or the avoidance of evaluative exercises committed by a student is an academic offence under the Academic Code of Conduct and **may lead to severe penalties as decided by the Disciplinary Committee of the university.**

**Special Instructions:**

* Students are expected to attend all classes and examinations. A student MUST have at least 80% class attendance to sit for the final exam.
* Students will not be allowed to enter into the classroom after 20 minutes of the starting time.
* For plagiarism, the grade will automatically become zero for that exam/assignment.
* Normally there will be **NO make-up exam**. However, in case of **severe illness, death of any family member, any family emergency, or any humanitarian ground**, if a student miss any exam, the student MUST get approval of makeup exam by written application to the Chairperson through the Course Instructor **within 48hours**of the exam time. Proper supporting documents in favor of the reason of missing the exam have to be presented with the application.
* For **final exam**, there will be NO makeup exam. However, in case of **severe illness, death of any family member, any family emergency, or any humanitarian ground**, if a student miss the final exam, the student MUST get approval of **Incomplete Grade** by written application to the Chairperson through the Course Instructor **within 48 hours** of the final exam time. Proper supporting documents in favor of the reason of missing the final exam have to be presented with the application. **It is the responsibility of the student to arrange an Incomplete Exam within the deadline mentioned in the Academic Calendar in consultation with the Course Instructor**.
* All mobile phones MUST be turned to silent mode during class and exam period.
* There is **zero tolerance for cheating** in exam. Students caught with cheat sheets in their possession, whether used or not; writing on the palm of hand, back of calculators, chairs or nearby walls; copying from cheat sheets or other cheat sources; copying from other examinee, etc. would be treated as cheating in the exam hall. The only penalty for cheating is **expulsion for several semesters as decided by the Disciplinary Committee of the university**.