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| **Dept Number** | **CS 455** | **Course Title** | **Advanced Algorithm Design and Analysis** |
| **Semester Hours** | **3** | **Course Coordinator** | **Qiang Cheng** |
| **Catalog Description** | An in-depth treatment of the design, analysis and complexity of algorithms with an emphasis on problem analysis and design techniques. Prerequisites: CS 330 with a grade of C or better or graduate standing. | | |

**Textbooks**

Algorithm Design by Eva Tardos and Jon Kleinberg.

**References**

- The design and Analysis of Algorithms by Dexter Kozen, 1992.
- Introduction to Algorithms, 2nd Ed. By Cormen, Leiserson, Rivest, and Stein, MIT Press, 2001.

**Course Learning Outcomes**

- Understand the basic concepts of algorithm design.
- To learn the design techniques for efficient algorithms.
- To learn the methods for analyzing the complexity of the algorithms.
- To design algorithms with an emphasis on data structure selection and time/space requirements.
- To learn the basic concepts of NP-completeness and approximation algorithms.

**Assessment of the Contribution to Program Outcomes**

| **Outcome →** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Assessed →** | X | X | X | | X | X | X | X | | |

**Prerequisites by Topic**

330 with a grade of *C* or better or graduate standing.

## Major Topics Covered in the Course

1. Mathematical preliminaries: principles and examples of algorithm analysis, average case analysis, worst case analysis {4 classes}
2. Lower Bounds: lower bounds for finding minimum and sorting, lower bound arguments {4 classes}
3. Divide-and-conquer: merge sort, quick sort, median selection, polynomial algorithms, and matrix algorithms {8 classes}
4. Greedy algorithms: elements of the greedy strategy, minimum spanning tree, shortest path {4 classes}
5. Advanced graph algorithms: bi-connected components, strongly connected components, flow algorithms {4 classes}
6. Dynamic programming: optimal matrix multiplication, optimal search trees, approximate string matching, Floyd's algorithm {6 classes}
7. NP-completeness and approximation algorithms {6 classes}
8. PRAM algorithms {4 classes}