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.		

Textbooks

SP15

Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, MIT Press, 3rd Edition, 2009, ISBN: 9780262033848.

References

- *The Design and Analysis of Algorithms*. Kozen, Dexter. 1992.
- *Algorithm Design*. Tardos, Eva and Jon Kleinberg.

Course Learning Outcomes

- Deeper understanding 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 proving the correctness and proving the optimality in terms of time efficiency.
- To learn the basic concepts of NP-completeness and approximation algorithms.

Assessment of the Contribution to Student Outcomes

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

Prerequisites by Topic

CS 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, recurrence relationships, worst case analysis {4 classes}
2. Asymptotically tight bounds: lower/upper bounds for finding minimum and sorting, lower bound analysis, growth rate of various functions {4 classes}
3. Divide-and-conquer: merge sort, quick sort, median selection, polynomial algorithms, and matrix algorithms, shortest distance, fast Fourier transform (FFT) {8 classes}
4. Greedy algorithms: elements of the greedy strategy, minimum spanning tree, shortest path, proof of optimality{5 classes}
5. Advanced graph algorithms: bi-connected components, strongly connected components, flow algorithms {5 classes}
6. Dynamic programming: optimal secondary structure prediction, optimal search trees, approximate string matching, Floyd's algorithm {6 classes}
7. NP-completeness and approximation algorithms {4 classes}
8. PRAM algorithms {4 classes}