

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										
Kleinberg. <i>Algorithm Design</i> . Addison-Wesley, 2006. ISBN: 9780321295354.										
References										
<ul style="list-style-type: none"> • Kozen, Dexter. <i>The Design and Analysis of Algorithms</i>. 1992. • Tardos, Eva and Jon Kleinberg. <i>Algorithm Design</i>. 										
Course Learning Outcomes										
<ul style="list-style-type: none"> • 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 Program 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}