Course Number	CS 455	Course Title	Advanced Algorithm Design and Analysis
Semester Hours	3	Course Coordinator SP20	Banafsheh Rekabdar
Catalog Description	An in-depth treatment of the design, analysis and complexity of algorithms with an emphasis on problem analysis and design techniques.		

Textbooks FA18

Cormen, T. H., Leiserson, C. E., Rivest, R. L. & Stein, C. (2009). *Introduction to Algorithms*. MIT Press, 3rd Edition. ISBN: 9780262033848.

References

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
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}

NOTE: When course is taken as 500-level credit (CS 591 “Special Topics”), there will be additional requirements such as a research project.