University of Tehran
School of Electrical and Computer Engineering

Course	Advanced Graph Theory		
Course type, level, credit	Elective	Graduate	3 units
Field, Major	Computer Engineering	Software	
Co-requisite(s)	-		
Prerequisite(s)	-		
Prerequisite by topic	Data structures and algorithm		
Goals	This is an advanced course about recent developments in algorithmic graph theory. The main objective of this course is to give students exposure to advanced topics in graph theory which may help them in their research.		
Outcome	Upon successful completion of the course, the students will gain a knowledge and understanding about advanced topics in algorithmic graph theory and its many applications. Here are some of the subjects that the students are expected to learn: • Special classes of graphs and hard problems that become easy on these classes. • Understanding the connection between a mathematical result and the algorithm that exploits it. • Combining results in graph theory with other fields of mathematics to build more powerful tools.		
Topics	**1. Review of Fundamental Concepts** • Fundamental definitions, bipartite graphs, coloring. • Adjacency and Incidence. • Paths, cycles, walks, trails. Eulerian circuits, Hamiltonian cycles. • Vertex degree, graphic sequence, directed graphs. • Extremal problems. **2. Interval Graphs and Perfect Elimination Order** • Interval graphs and representation		

	• Perfect elimination order (p.e.o) • Algorithms for graphs with a p.e.o • Finding a perfect elimination order **3. Comparability Graphs** • Complements of interval graphs • Comparability graphs recognition • Problems on comparability graphs **4. Perfect Graphs** • Perfect graph theorem • Intersection graphs • Chordal graphs • Circular arc graphs **5. Trees and Treewidth** • Review of trees and matching • Steiner tree • Tree decomposition • Partial k-trees • Algorithms for partial k-trees **6. Planar Graphs** • Review of planar graphs and Euler formula • Problems on planar graphs • Planarity testing • Triangulated graphs **7. Spectral Analysis** • Review on linear algebra • The spectrum of a graph • The Laplacian spectrum • Comparison of spectra

Required software	-
Assignments	Students are expected to work on 5 sets of homework (including 2 R labs) throughout the semester.
Projects	The students are expected to complete a research project. In this project, they will choose a topic of their interest, perform thorough analysis of the topic, and deliver a report and presentation on it.
Grading	Assignments and quiz: 15 % Project: 25% Midterm exam: 25 % Final exam: 35 %
Textbook(s)	[1] M.C. Golumbic, "Algorithmic Graph Theory and Perfect Graphs," 2nd ed., Elsevier, 2004.
Further readings	[1] D. B. West, "Introduction to Graph Theory," 2nd ed., Prentice Hall, 2001. [2] J.A. Bondy and U.R. Murty, "Graph theory," Springer, 2008.