BOĞAZİÇİ UNIVERSITY

DEPARTMENT OF INDUSTRIAL ENGINEERING

IE 518 - ADVANCED GRAPH THEORY

Day/Time/Classroom :	MTT/667/ M2180 M2180 M2180
Instructor :	Tınaz Ekim (tinaz.ekim@boun.edu.tr)
Teaching Assistant :	Oylum Şeker
Office/Phone :	Old Engineering Building, M 4055 / Ext. 6676
Office Hours:	TBA
Prerequisite :	IE 456 or equivalent is preferred but not necessary; students not initiated to graph theory can also attend to this course (but will be required to do some complementary reading).
Grading :	2 Homeworks 15 % 2 Quizzes 15% Project 30 % Final Exam 40 %

Objective : This course focuses on mostly theoretical aspects of graphs. Students are expected to acquire a deep knowledge on some important theorems and milestones of graph theory. The course aims at providing them necessary skills to understand new graph theoretical concepts and to prove theorems on graphs. Projects are based on research papers and allow students to explore various topics of graph theory. Projects are evaluated based on the written report and the class presentation. Students are also expected to actively participate to in-class discussions, especially during project presentations.

References :

1. M.C. Golumbic, Algorithmic Graph Theory and Perfect Graphs, 2004.
2. Ron Shamir, Advanced Topics in Graph Algorithms : http://www.cs.tau.ac.il/ rshamir/atga/atga.html
3. Bondy, Murty, Graph Theory with Applications : http://www.ecp6.jussieu.fr/pageperso/bondy/books/gtwa/gtwa.html
4. C. Berge, Graphs and Hypergraphs, 1976.
5. B. Bollobas, Modern Graph Theory, 1998.
6. R. Diestel, Graph Theory, 2000.

COURSE OUTLINE

1. BASIC NOTIONS *Golumbic Ch1 or Shamir Ch1*

Definitions, graph representations, graph search (BFS, DFS).

2. PERFECT GRAPHS *Alfonsin-Reed (Perfect Graphs) Ch1, Ch2, Garey-Johnson (Computers and Intractability) Ch1*

Introduction to complexity theory, Minimum Vertex Coloring (MVC), Maximum Stable Set (MS), Minimum Clique Cover (MCC), Maximum Clique (MC), Berge graphs, replication lemma, Weak Perfect Graph Theorem, Strong Perfect Graph Theorem, polyhedral characterization of perfect graphs.

3. TRIANGULATED GRAPHS *Golumbic Ch4 or Shamir 3.2/4/5/6.1*

Characterization and basic properties of chordal graphs, recognition, perfect elimination order (PEO), finding chromatic number and all maximal cliques, algorithms for MVC, MS, MCC and MC in chordal graphs, perfectness.

4. COMPARABILITY GRAPHS *Golumbic Ch5 or Shamir 6.2/9*

Properties of comparability graphs, recognition, perfectness, algorithms for MVC, MS, MCC and MC in comparability graphs, Dilworth Theorem on partially ordered sets.

5. PERMUTATION GRAPHS *Golumbic Ch7*

Characterization and recognition, some applications, algorithms for MVC, MS, MCC and MC in permutation graphs.

6. INTERVAL GRAPHS *Golumbic Ch8 or Shamir 10.2/11*

Characterization and recognition, algorithms for MVC, MS, MCC and MC in interval graphs.

7. THRESHOLD GRAPHS *Golumbic Ch10*

Characterization and recognition, links with other graph classes.

8. RAMSEY THEORY FOR GRAPHS

Ramsey Theorem for graphs, Ramsey Numbers.