BOĞAZİÇİ UNIVERSITY
DEPARTMENT OF INDUSTRIAL ENGINEERING

Spring 2017 – 2018

IE 516 - COMBINATORIAL OPTIMIZATION

Day and Time	: M 9:00 – 11:00	W 9:00 – 11:00
Classroom	: M 2180	M 3120
Instructor	: İ. Kuban Altınel	
Office / Phone	: Old Engineering Building, M 4034 / Ext. 6407	
Office Hours	: M 11:00 – 13:00	W 14:00 – 16:00

Grading

Prob. sets	: 4 or 5, 30% for their average
Midterm	: 30%, Close book, in class exam
Final	: 35%, Close book, in class exam
Makeup	: Only registered students who are eligible to take the final will be given a makeup exam if he/she fails the course or he/she is absent at the final exam with an officially accepted excuse.
Attendance	: 5%

Prerequisite: IE 501 or a graduate course in Linear Programming

Textbook: *Combinatorial Optimization* by W.J. Cook, W.H. Cunningham, W.R. Pulleyblank, A. Schrijver

References:

Bertsimas, D., Tsitliklis, J. N., Introduction to Linear Optimization, 1997
Bazaraa, M. S., Jarvis, J. J., Sherali, H. D., Linear Programming and Network Flows, 4th ed., 2010
Ahuja, R.K., Magnanti, T.L., Orlin, J.B., Network Flows, Theory and Algorithms, 1993
Nemhauser, G.L., Wolsey, L.A., Integer and Combinatorial Optimization, 1988
Cook, W.J., Cunningham, W.H., Pulleyblank, W.R., Schrijver, A., Combinatorial Optimization, 1998
Schrijver, A., Combinatorial Optimization, 2003, v.1, v.2, v.3.
Sipser, M., Introduction to the theory of computation, 2006
Garey, M., Johnson, D., Computers and Intractability, 1979
Lang, S., Linear Algebra, 3rd edition, 1987

THEY ARE ALL AVAILABLE **ON RESERVE** AT THE LIBRARY

TENTATIVE OUTLINE

1. INTRODUCTION: What is combinatorial optimization? What is Integer Programming? Their relations and examples..
2. SHORTEST PATHS and SPANNING TREES: Trees, Dijkstra's algorithm, Heaps and their use, Bellman-Ford algorithm, All pair shortest path problem, Minimum Spanning Tree Problem, Kruskal and Prim algorithms, Disjoint set structures.
3. FLOWS and CIRCULATIONS: Menger's theorem, Flows in networks, Maximum flow problem, minimum cost flow.
4. MATCHINGS and COVERS IN BIPARTITE GRAPHS: Maximum cardinality matching, weighted bipartite matching.
5. MATCHINGS and COVERS IN GENERAL GRAPHS: Tutte – Berge formula, maximum cardinality matching, weighted matching, the matching polytope.
6. INTEGRAL POLYHEDRA: Totally unimodular matrices, balanced and totally balanced matrices, packing and perfect graphs.
7. MATROIDS AND SUBMODULAR FUNCTION OPTIMIZATION: Matroid axioms, matroid duality, weighted bipartite matching and matroids, submodularity, submodular flows.

IE 516 TENTATIVE PROGRAM

WEEK	MONTH	DAY	TENTATIVE DAILY OUTLINE
1	February	05M	Introduction
		07W	Spanning tree problem
2		12M	Spanning tree problem
		14W	Spanning tree problem
3		19M	Shortest path problem
		21W	Shortest path problem
4		26M	Shortest path problem
		28W	Maximum flow problem
5	March	05M	Maximum flow problem
		07W	Maximum flow problem
6		12M	Matching theory / Tutte – Berge formula
		14W	Matching theory / Tutte – Berge formula
7		19M	Maximum cardinality matching in bipartite graphs
		21W	Maximum cardinality matching in nonbipartite graphs
8		26M	Maximum cardinality matching in nonbipartite graphs
		28W	Minimum weight perfect matching in bipartite graphs
9	April	02M	Minimum weight perfect matching in nonbipartite graphs
		04W	Minimum weight perfect matching in nonbipartite graphs
10		09M	Integral polyhedra
		11W	Integral polyhedra
11		16M	SPRING BREAK
		18W	SPRING BREAK
12		23M	HOLIDAY
		25W	Integral polyhedra
13		30M	Matroids
	May	02W	Matroids
14		07M	Matroids
		09W	Matroids