

Course number and name	END 447/ Network Models
Credits, contact hours, categorization of credits	3 credits / 42 hours / Engineering topic
Instructor or course coordinator	Özgür KABAK
Text book and other supplemental materials	• Ahuja, R.K., Magnanti, T.L., Orlin, J.B. (1993), "Network Flows", Prentice Hall. • Wilson, R. J., (1990), "Introduction to Graph Theory ", Longman Scientific & Technical • Price, W. L., (1990), "Graphs and Networks", Butterworth Group. • Wilson, R. J., Watkins, J. J., (1990), "Graphs, An Introductory Approach", John Wiley & Sons. • Bharath, R., (1991), "Computers & Graph theory", Ellis Horwood. • Ceyhun, Y., (1976), "Çizge Kuramı", ODTÜ Yayınları.

Course information	
Content	Introduction to networks and network flows. Teach how to formulate and solve network flow models such as shortest path problem, spanning tree, maximum flow, minimum cost flow and multi commodity flow problems. Real life examples of network flows. Solution by Excel Solver and GAMS software
Prerequisites	END 331 Operation Research I
Type	Selected elective

Course learning outcomes
Students who pass the course will be able: - Know basic information on graphs and networks together with their structures - Model appropriate problems as a Shortest Path Problem and solve with various algorithms - Model appropriate problems as a Maximum Flow Problem and solve with various algorithms - Model appropriate problems as a Minimum Spanning Tree Problem and solve with various algorithms - Model appropriate problems as a Minimum Cost Flow Problem and solve with various algorithms - Model appropriate problems as a Multicommodity Flow Problem and solve with various algorithms - Solve network flow models using software

Student outcomes	Level of contribution
SO1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	High
SO2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	Partial
SO3. An ability to communicate effectively with a range of audiences.	Not applicable
SO4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	Partial
SO5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	High
SO6. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions.	High
SO7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	High

Week	Topics	Learning outcome(s)
1	Introduction to network flows and Basic Concepts	I
2	Shortest path problem: introduction, formulation, application to various problems	I, II
3	Solution of Shortest path problem: Dijkstra's Algorithm, Excel Solver and GAMS	II, VII
4	Maximum flow problem: introduction, formulation, application to various problems	I, III
5	Solution of maximum flow problem: Path augmenting algorithm, labeling algorithm, Excel Solver and GAMS	III, VII
6	Minimum Spanning Tree: introduction, formulation, application to various problems	I, IV
7	Solution of Minimum Spanning Tree problem: Kruskal algorithm, greedy algorithm, Excel Solver and GAMS	IV, VII
8	Minimum cost flow problem: introduction, formulation, application to various problems	I, V
9	Solution of minimum cost flow problem: Network simplex	V
10	Sensitivity analysis using network simplex	V
11	Solution of minimum cost flow problem: Excel Solver and GAMS	V, VII
12	Multicommodity flow: introduction, formulation	I, VI
13	Solution of Multicommodity flow problems: Excel Solver and GAMS	VI, VII
14	Formulation of various network flow problems and their solution by Excel Solver and GAMS	VII