Course number and name	END 458E / Nonlinear Optimization
Credits, contact hours, categorization of credits	3 credits / 42 hours / Engineering topic
Instructor or course coordinator	Gülşah HANÇERLİOĞULLARI KÖKSALMIŞ
Text book and other supplemental materials	 Bertsekas, Dimitri P. Nonlinear Programming. 3rd ed. Athena Scientific Press, 2016. ISBN: 1886529051/ Winston W.L. (2004) Operations Research: Applications and Algorithms, Brooks/Cole – Thomson Learning. Bazaraa, Mokhtar S., Hanif D. Sherali, and C. M. Shetty. Nonlinear Programming: Theory and Algorithms. New Yok: John Wiley & Sons, 1993. Nonliear Programming Algorithm, A. Nemirovsk.

Course information			
Content	This course introduces students to the fundamentals of nonlinear optimization theory and methods. Topics include unconstrained and constrained optimization, linear and quadratic programming, interior-point algorithms and theory, Lagrangian relaxation, generalized programming, and semi-definite programming. Algorithmic methods used in the class include steepest descent, Newton's method, conditional gradient and subgradient optimization, interior-point methods and penalty and barrier methods.		
Prerequisites	END331E Operations Research I; 3 rd or 4 th year		
Туре	Selected elective		

Course learning outcomes

Students who pass the course will:

- I. Describe non-linear programming problems;
- II. Distinguish non-linear programming and linear programming problems;
- III. Know concave and convex function;
- IV. Solve non-linear programming problems with one variable;
- V. Analyze the problems of constrained and unconstrained nonlinear programming;
- VI. Analyze the problems of quadratic and separable programming.

Student outcomes	Level of contribution
SO1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	Partial
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.	Little
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.	Little
SO6. An ability to develop and conduct appropriate experimentation, analyze 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.	Partial

Week	Topics	Learning outcome(s)
1	Review of Differential Calculus	Ι
2	Introductory Concepts	I, II
3	Convex and Concave Functions	III
4	Newton's Method	I, II
5	Solving NLPs with One Variable	IV
6	Solving NLPs with One Variable	IV
7	Golden Section Search	IV
8	Unconstrained Maximization and Minimization with Several Variables	V
9	Unconstrained Maximization and Minimization with Several Variables	V
10	The Method of Steepest Ascent	V
11	Lagrange Multipliers	V
12	The Kuhn-Tucker Conditions	V
13	Quadratic Programming	VI
14	Separable Programming	VI