

Course unit title:	Introduction to Optimization Methods and Applications		
Course unit code:	AEEE434		
Type of course unit:	Technical Elective		
Level of course unit:	Bachelor (1st Cycle)		
Year of study:	4		
Semester when the unit is delivered:	7,8		
Number of ECTS credits allocated :	6		
Name of lecturer(s):	Dr. Lestas Marios		
Learning outcomes of the course unit:	<ul style="list-style-type: none"> • Transform practical engineering problems into standard form linear programming problems. Introduce the concept of slack variables. Formulate linear programming problems such as the manufacturing problem, the transportation problem, the routing problem, the scheduling problem etc. • Introduce the concepts of extreme points, vertices, basic solutions, basic feasible solutions and degeneracy and state the fundamental theorem of linear programming. • Solve linear programming problems in standard form using the simplex method. Describe the full tableau implementation of the simplex method. Implement the simplex method on Matlab. • Transform the primal linear programming problem into the dual problem. State the duality theorem and introduce the concepts of simplex multipliers, sensitivity and complementary slackness. • Describe the dual simplex method and implement it on Matlab. • Formulate and solve instances of the following problems: the assignment problem, the transportation problem, the minimum-cost flow problem and the maximal flow problem. • Introduce the standard form of the unconstrained non-linear programming problem. Comment on the existence and uniqueness of optimal solutions and state necessary and sufficient conditions for optimality. • Introduce the gradient methods with particular emphasis on the steepest descent method and the Newton's method. • Introduce the least squares problem through examples: curve fitting, dynamic system identification, neural networks, pattern recognition, adaptive control. Describe iterative methods to solve the least squares problem. • Introduce the standard form of the constrained non-linear programming problem. Comment on the existence and uniqueness of optimal solutions, state the optimality conditions and present the conditional gradient method. 		
Mode of delivery:	Face-to-face		
Prerequisites:	AMAT314	Co-requisites:	None
Recommended optional program components:	None		
Course contents:	<ul style="list-style-type: none"> • Linear Programming: The standard form of the linear programming problem, slack variables, the manufacturing problem, the transportation problem, the routing problem, the scheduling problem, revision on linear algebra, linear dependence, Gaussian elimination, existence and uniqueness of optimal solutions, extreme points, vertices, basic solutions, basic feasible solutions and degeneracy, the fundamental theorem of linear programming. • The Simplex Method: The full tableau implementation of the simplex method. 		

	<ul style="list-style-type: none"> • Duality: Transformation of primal linear programming problems into the dual problems. The duality theorem, simplex multipliers, sensitivity and complementary slackness. The dual simplex method. • Practical Optimization Problems: The assignment problem, the transportation problem, the minimum-cost flow problem and the maximal flow problem. • Unconstrained Non-Linear Programming: The standard form of the nonlinear programming problem, convexity, existence and uniqueness of optimal solutions, necessary and sufficient conditions for optimality, gradient methods, steepest descent method, Newton's method, least squares problem, curve fitting, adaptive control, neural networks. • Constrained Non-Linear Programming: Existence and uniqueness of optimal solutions, necessary and sufficient conditions for optimality, Conditional gradient methods.
Recommended and/or required reading:	
Textbooks:	<ul style="list-style-type: none"> • David. G. Luenberger, Linear and Nonlinear Programming, Addison-Wesley, 1984
References:	<ul style="list-style-type: none"> • D. P. Bertsekas, Nonlinear Programming, Athena Scientific, 1999 • D. Bertsimas, J.N. Tsitsiklis, Introduction to Linear Optimization, Athena Scientific, 1997
Planned learning activities and teaching methods:	<ul style="list-style-type: none"> • Students are taught the course through lectures (3 hours per week) in classrooms or lectures theatres, by means of traditional tools or using computer demonstration. • Auditory exercises, where examples regarding matter represented at the lectures, are solved and further, questions related to particular open-ended topic issues are compiled by the students and answered, during the lecture or assigned as homework. • Topic notes are compiled by students, during the lecture which serve to cover the main issues under consideration and can also be downloaded from the lecturer's webpage. Students are also advised to use the subject's textbook or reference books for further reading and practice in solving related exercises. Tutorial problems are also submitted as homework and these are solved during lectures or privately during lecturer's office hours. Further literature search is encouraged by assigning students to identify a specific problem related to some issue, gather relevant scientific information about how others have addressed the problem and report this information in written or orally. • Students are assessed continuously and their knowledge is checked through tests with their assessment weight, date and time being set at the beginning of the semester via the course outline. • Students are prepared for final exam, by revision on the matter taught, problem solving and concept testing and are also trained to be able to deal with time constraints and revision timetable. • The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course.
Assessment methods and criteria:	<ul style="list-style-type: none"> • Assignments 10% • Tests: 30% • Final Exam 60%
Language of instruction:	English

Work placement(s):

No