

COURSE OUTLINE

(1) GENERAL

SCHOOL	UNIVERSITY OF THESSALY		
ACADEMIC UNIT	DEPARTMENT OF CIVIL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	FK4230	SEMESTER	8
COURSE TITLE	OPTIMIZATION TECHNIQUES		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		WEEKLY TEACHING HOURS	CREDITS
		4	5
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialized general knowledge, skills development</i>	Specialized general knowledge, skills development		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. If there are ERASMUS students, material is given in English, and the subjects/exams of the course are in English.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)			

(2) LEARNING OUTCOMES

Learning outcomes <i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i> <i>Consult Appendix A</i> • Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area • Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B • Guidelines for writing Learning Outcomes
The aim of the course is to introduce and understand computational techniques of optimization. The course emphasizes the theory of (continuous and integer) linear programming and the presentation of algorithmic techniques for the exact or approximate solution of the resulting models. In this context, additional fundamental algorithmic results and methods from network optimization are included. - As a result, this course aims to provide students with the basic knowledge of operations research and systems optimization specifically for Civil Engineering problems. Selected optimization methodologies are analyzed, and applications are presented, both in terms of decision making and design in civil engineering projects. <i>Knowledge</i> The course helps students to develop their technical and intellectual capacity preparing them for work as engineers and for postgraduate studies. The course introduces students to the computational techniques of Optimization used in modern civil engineering practice. The course in the field of knowledge features advanced knowledge in a field of study that involves critical understanding of theories. It requires advanced skills and provides the opportunity to solve complex Optimization problems. Can manage complex techniques for decision making in unpredictable study environments. At the end of the course students should have:

- Abilities to optimize problems in the field of civil engineering
- Ability to solve optimization problems and evaluate alternative solutions.

Skills

Upon completion of the course, the student will possess advanced skills in processing, analysis and solution of complex optimization problems used in modern civil engineering practice.

Competences

The student upon completion of the course will be able to manage complex optimization problems and be able to make decisions in civil engineering projects and studies. He/she is also able to work individually and in teams when designing, simulating and managing such problems. In particular, students will be able to

- use optimization techniques for decision making in civil engineering projects and studies
- synthesise, evaluate and propose optimal or new solutions based on the above consideration.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>
<i>Adapting to new situations</i>	<i>Respect for difference and multiculturalism</i>
<i>Decision-making</i>	<i>Respect for the natural environment</i>
<i>Working independently</i>	<i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i>
<i>Team work</i>	<i>Criticism and self-criticism</i>
<i>Working in an international environment</i>	<i>Production of free, creative and inductive</i>
<i>Working in an interdisciplinary environment</i>	<i>.....</i>
<i>Production of new research ideas</i>	<i>Others...</i>
	<i>.....</i>

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Team work on Labs
- Working in an interdisciplinary environment
- Project planning and management
- Production of free, creative and inductive thinking
- Respect for the natural environment
- Showing social, professional and ethical responsibility

(3) SYLLABUS

1. Operational Research – Introduction in systems Optimization
2. Linear Programming (LP)
3. Linear Programming. Simplex Algorithm
4. Special Issues on LP (B Phase Method, Big M Method, Dual problem, Sensitivity analysis
5. Problem Solving (LP on Computer)
6. Integer Linear Programming
7. Branch and Bound method
8. Transportation problems
9. Network Optimization
10. Local Optimization Methods
11. Constrained Nonlinear programming

12. Dynamical Programming
13. Computational Problems. Applications on Matlab and R.
14. Computational Problems. Applications on Matlab and R.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	Lectures with PowerPoint Notes, Exercises and Announcements in e-class	
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i> <i>The student's study hours for each learning activity are given as well as the hours of non- directed study according to the principles of the ECTS</i>	<i>Activity</i>	<i>Semester workload</i>
	Lectures	14 * 4 = 56 hours
	Project	40 hours
	Study	52 hours
	Exams	2 hours
	Course total	150
STUDENT PERFORMANCE EVALUATION		
Description of the evaluation procedure <i>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open- ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i> <i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i>	Language of Evaluation: Greek (English for Erasmus students) Teaching method: Course Lectures are in combination with Laboratory exercises, which are very important in course evaluation. Moreover a semester project is taking place which emphasizes in utilization of the presented methods and techniques. Teaching Rationale: To impart the basic theoretical and practical understanding represented by the knowledge and skills outcomes via a mix of self-learning and formal teaching, including formal lectures and practicals in the lab sessions with active student participation. Lectures introduce theory and concepts, which are then exemplified in computer workshops using specialist packages and tailored data sets. For optimization techniques, the theory underpinning modern practice is taught in lectures and then tested in practical lab sessions. Evaluation method: <u>50% Project/ Exercises:</u> Comprehensive examples of optimization exercises. Technical Report. <u>50% Written examination:</u> Open books and notes. Short answer questions and computer-based optimization problem solving.	

(5) ATTACHED BIBLIOGRAPHY

-Suggested bibliography:

Greek Bibliography

- Bronson R., and Naadimuthu G., 2010. SCHAUM'S Επιχειρησιακή Έρευνα. Εκδόσεις Κλειδάριθμος ΕΠΕ.
Taha H.A., 2012. Εισαγωγή στην Επιχειρησιακή Έρευνα, 9η Έκδοση, Εκδόσεις Τζιόλα.
Καρατζάς Γ., και Παπαδοπούλου Μ., 2016. Μέθοδοι Βελτιστοποίησης Περιβαλλοντικών Συστημάτων, Εκδόσεις Δίσιγμα, Θεσσαλονίκη.
Καρλαύτης Μ.Γ., και Λαγαρός Ν.Δ., 2010. Επιχειρησιακή Έρευνα και Βελτιστοποίηση για Μηχανικούς, Εκδόσεις Συμμετρία. [Προτεινόμενο σύγγραμμα: Κωδικός Βιβλίου στον Εύδοξο: 35475]
Πρωτοπαπάς Α., 2015. Βελτιστοποίηση τεχνικών συστημάτων. [ηλεκτρ. βιβλ.] Αθήνα:Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. Διαθέσιμο στο: <http://hdl.handle.net/11419/5906>.
Ροβιθάκης Γ.Α., 2007. Τεχνικές Βελτιστοποίησης, Εκδόσεις Τζιόλα. [Προτεινόμενο σύγγραμμα: Κωδικός Βιβλίου στον Εύδοξο: 18549025]

English Bibliography

- Bartholomew-Biggs M., 2008. Nonlinear Optimization with Engineering Applications, Springer.
Beck A., 2014. Introduction to Nonlinear Optimization: Theory, Algorithms, and Applications with MATLAB, SIAM.
Lopez C.P., 2014. MATLAB Optimization Techniques, Springer.
Venkataraman P., 2009. Applied Optimization with MATLAB Programming, 2nd Edition, Wiley.

- Related academic journals:

Mathematical Programming and Mathematical Programming Computation, SIAM Journal on Optimization, SIAM Journal on Control and Optimization, Mathematics of Operations Research, EURO Journal on Computational Optimization, Operations Research, Annals of Operations Research, Computational Optimization and Applications, IIE Transactions, Interfaces, INFORMS Journal on Computing, Journal of Combinatorial Optimization, Journal of Global Optimization, Optimization and Engineering, Optimization Methods and Software, Journal of Optimization Theory and Applications, Mathematical Methods in Operations Research, Central European Journal of Operations Research, International Journal on Evolutionary Optimization, Optimization.