COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Engineering		
ACADEMIC UNIT	Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	ΟΠ3400	**SEMESTER**	6
COURSE TITLE	Integer Programming and Combinatorial Optimization		

INDEPENDENT TEACHING ACTIVITIES *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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	5	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialized general knowledge, skills development*	specialized general knowledge
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (tutoring)
COURSE WEBSITE (URL)	https://www.mie.uth.gr/?page_id=18352&lang=en

(2) LEARNING OUTCOMES

Learning outcomes

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.

Consult Appendix A

- *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*

This course aims to provide undergraduate students with all the necessary knowledge that will enable them to understand the fundamentals of Integral Programming and Combinatorial Optimization, how to model realistic problems in engineering, as well as the structure of algorithms in order to solve them. Initially there is an overview of the engineering problems that fall into that part of Operation Research referred to as mathematical programming. The various cases studies of mathematical programming are analyzed while their differences are presented. The course focuses initially on the presentation of basic rules and principles for modeling mathematical programming problems for decision optimization.

The course continue with some basic problems of mixed integer programming that appear in several engineering problems. After the presentation of the basic modeling rules of mixed integer programming, a basic software solving mathematical programming problems (LINGO) is presented. The course is followed by a series of real-world modeling approached for realistic engineering problems. The next part of the course focuses on all the basic methods of solving mixed integer problems followed by a plethora of examples. The course concludes with a further presentation of real-world modeling problems.

Upon successful completion of the course the student will be able to:

• distinguishes between different modeling approaches in mathematical programming.
• develop modelling approach for basic problems coming from the literature.
• uses the LINGO program.
• relaxes mathematical problems and finds feasible upper and lower bounds for their optimal solution.
• applies heuristic and analytical methods to solve mixed integer linear problems.
• Model real-world engineering problems.
• is familiar with the basic principles and rules of modeling mixed integer mathematical problems.

• revise modeling approaches making them simpler and easier to be solved.

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?

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
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

- Search for, analysis and synthesis of data and information with the use of the necessary technology
- Working independently
- Independent Work
- Team work
- Decision making
- Project planning and management
- Criticism and self-criticism
- Production of free, creative and inductive
- Production of new research ideas

(3) SYLLABUS

Modeling and solution approaches for mixed integer linear programming problems. Intelligent uses of binary variables in modeling approaches. Branch and bound solution method for mixed integer linear problems. Cutting planes method. Design and analysis of combinatorial optimization algorithmic approaches. Complexity of algorithms. Applications to networks and graphs. Problem solving using local optimization techniques, dynamic programming, myopic algorithms, approximations and heuristic methods.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY ***Face-to-face, Distance learning, etc.***	Face to Face in class
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use webpages, dropbox and emails.

TEACHING METHODS

The manner and methods of teaching are described in detail.
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.

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

Activity	*Semester workload*
Lectures	70
Homework	35
Studding at home	45
Course total	*150*

STUDENT PERFORMANCE EVALUATION ***Description of the evaluation procedure*** *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* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Writing exams at the end of semester (70% of the final grade) – Problem solving Homework (30% of the final grade)

(5) ATTACHED BIBLIOGRAPHY

-Suggested bibliography:

Books in Greek

- *Βασιλείου Π.Χ., (2001). Εφαρμοσμένος Μαθηματικός Προγραμματισμός. Εκδόσεις Ζήτη.*
- *Μηλιώτης Π., (1998). Συνδυαστική Βελτιστοποίηση. Εκδόσεις Σταμούλη.*
- *Πραστάκος Γ., (2000). Διοικητική Επιστήμη: Λήψη Επιχειρησιακών Αποφάσεων στην Κοινωνία της Πληροφορίας. Εκδόσεις Σταμούλη.*
- *Σίσκος Γ., (2000). Γραμμικός Προγραμματισμός. Εκδόσεις Νέων Τεχνολογιών.*

Books in English

- *Nemhauser G.L. and Wolsey L.A., (1988). Integer and Combinatorial Optimization. John Wiley & Sons.*
- *Cook W.J., Schrijver A., Cunningham W.H. and Pulleyblank W.R., (1997). Combinatorial Optimization. John Wiley & Sons.*
- *Schrijver A., (1998). Theory of Linear and Integer Programming. John Wiley & Sons.*
- *Papadimitriou C.H. and Steiglitz K., (1998). Combinatorial Optimization: Algorithms and Complexity. Dover Publications.*
- *Wolsey L.A., (1998). Integer Programming. John Wiley & Sons.*

- Related academic journals:

- *Operational Research*
- *OR spectrum*
- *Global Optimization*
- *Mathematical Programming*
- *Annals of OR*