

4.6 CE0460 – Project Technoeconomic Analysis and Operational Research

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CE0460	SEMESTER	4
COURSE TITLE	Project Technoeconomic Analysis and Operational Research		
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	4	
<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, specialised general knowledge, skills development</i>	Special Background Course		
PREREQUISITE COURSES:	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek, English, French, Italian		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/PEY106/		

(2) LEARNING OUTCOMES

<p>Learning outcomes</p> <p><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></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> • <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i> • <i>Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i> • <i>Guidelines for writing Learning Outcomes</i> <p>The today's dynamic and unpredictable business environment, in which civil engineering projects are carried out, requires a systematic and holistic approach for the decision making problems. From the one hand we have the economic impact and consequences of technical decisions, i.e. the level of resource consumption, the expected yield, and on the other hand the optimization of business performance such as revenue, profits, costs, resource management, etc. The aim of this course is to introduce the students to the basic concepts of project technoeconomic analysis and some of the operational research methods that are used in engineering and management.</p> <p>On successfully completing this course unit, students will be able to:</p> <ul style="list-style-type: none"> • Calculate and compare current and future economical values of products, • Perform a financial appraisal of a project and determine if it is financially viable, • Have an understanding of how operational research techniques can be applied to engineering decision-making (resource allocation; production scheduling; environmental risk minimisation; transport planning),

- Use standard linear programming, integer programming, dynamic programming techniques, etc.,
- Ability to use software to quickly prototype mathematical programming models relating to engineering problems,
- Utilise skills in optimisation, decision-making, and stochastic methods.

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

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Others...

The course aims to the following general competences:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Working in an international environment
- Decision making

(3) SYLLABUS

Theory Lectures

- Introduction to financial engineering, basic concepts and methods of feasibility analysis, time value of money, cash flows, discount rate, discounted funds, final & present value of capital, Net Present Value.
- Criteria and benchmarks for Feasibility Evaluation of enterprising plans, activities, investments & projects, civil engineering project financial appraisal (including cost-benefit analysis and return of investment), sources of financing, investments, type of investments, investment planning, risk analysis, Decision trees, breakeven point, sensitivity analysis and tornado charts.
- Cost of machinery, materials, labor & overhead costs of a work or construction, project budgeting, financing chart.
- Overview of the operations research modeling approach
- Introduction to Linear Programming:
 - The Linear Programming model
 - The Graphical Solution
 - Solving Linear Programming Problems: The Simplex Method
 - The Simplex Method Μέθοδος for minimization problems – The Big M method
 - Duality Theory and Sensitivity Analysis
 - Applications – Exercises – Case Studies
- Integer Programming – Applications of Integer Linear Programming, The Branch-and-Bound Technique
- Binary Integer Programming – The assignment Problem
- The Transportation Problem – Northwest corner rule, Least Cost Method, Vogel’s approximation method, Stepping stone method
- Network Optimisation Models – The Shortest – Path Problem, The minimum spanning tree problem.
- Multi-objective Linear Programming Problems
- Multi-Criteria Decision Aid (MCDA): Introduction to MCDA, Criteria Modeling, Analytical Hierarchical Process (AHP)

Computer Laboratory Lectures

The analytical program of the laboratory lectures follows the program of the theoretical part mentioned above. Each laboratory exercise is designed to establish a grounded view of the relation between theory and application. Students are exposed to a wide class of problems drawn from all aspects of Civil Engineering and are asked to solve these using software programs like Solver (MS EXCEL), MATLAB and LINDO.

The exercises must be carried out within the time of the workshop and the students are assessed according to the degree of completion. In the last week of the semester, the final examination of the laboratory is carried out.

(4) TEACHING and LEARNING METHODS - EVALUATION

<p style="text-align: center;">DELIVERY</p> <p style="text-align: center;"><i>Face-to-face, Distance learning, etc.</i></p>	<p>This module is taught through a combination of lectures, tutorial exercises, laboratory sessions and coursework exercises.</p>												
<p style="text-align: center;">USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</p> <p style="text-align: center;"><i>Use of ICT in teaching, laboratory education, communication with students</i></p>	<ul style="list-style-type: none"> • Teaching using of Interactive Board and projector • Support learning process through electronic e-class platform. Exercises and educational material are provided through e-class. 												
<p style="text-align: center;">TEACHING METHODS</p> <p><i>The manner and methods of teaching are described in detail.</i></p> <p><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></p> <p><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></p>	<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th style="background-color: #d9ead3;">Activity</th> <th style="background-color: #d9ead3;">Semester workload</th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td>39</td> </tr> <tr> <td>Laboratory Lectures</td> <td>13</td> </tr> <tr> <td>Personal Study</td> <td>35</td> </tr> <tr> <td>Coursework</td> <td>33</td> </tr> <tr> <td>Course total</td> <td>120</td> </tr> </tbody> </table>	Activity	Semester workload	Lectures	39	Laboratory Lectures	13	Personal Study	35	Coursework	33	Course total	120
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<p style="text-align: center;">STUDENT PERFORMANCE EVALUATION</p> <p><i>Description of the evaluation procedure</i></p> <p><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></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>Student performance is assessed through coursework completed during term time and through formal examinations.</p> <p>Written Examination (70%) – Coursework (30%)</p>												

(5) ATTACHED BIBLIOGRAPHY

Greek Bibliography:

1. Moussas, V.C. (2016), Financial & Technical Optimization of Engineering Works, Athens: ION Publishing Group (in Greek).
2. Siskos, Y. (2000), Linear Programming – Methodologies for Decision Aid, Multi-Criteria Optimization, 40 Operational Problems, Softwares and Solutions in Excel, Newtech Publications (in Greek).
3. Ipsilandis, P. (2015), Operational Research – Decision Making Methods and Techniques (5th edition), Propobos Publications (in Greek).
4. Frederick S. Hillier, Gerald J. Lieberman (2018), Introduction to Operations Research (10th Edition– edited by Alexandros Diamantidis), Tziola Publications (in Greek).
5. Bernard W. Taylor III (2018), Introduction to Management Science (edited by Gkoletsis George, Doumpos Michael, Zopounidis Konstantinos), Broken Hill Publishers LTD (in Greek).
6. Karlaftis, M., Lagaros, N. (2010), Operational Research and Optimization for Engineers, Simmetria Publications (in Greek).
7. Polyzos, S. (2018), Management and Management of Projects: Methods and Techniques (3rd edition), Kritiki Publications (in Greek).
8. Chelson, J.V., Payne, A.C. and Reavill, L.R.P. (2008), Business Management and Entrepreneurship for Engineers (edited by Kolliopoulos G.), Ion Publications (in Greek).

Foreign Bibliography:

1. Frederick S. Hillier, Gerald J. Lieberman (2015), Introduction to Operations Research (10th Edition), Publisher: McGraw-Hill Publishing.
2. Randy L. Haupt, Sue Ellen Haupt (2004), Practical genetic algorithms (2nd Edition), Publisher: John Wiley & Sons, Inc., Hoboken, New Jersey.
3. Beaumont, P. (2004), Financial Engineering Principles, Publisher: John Wiley & Sons, Inc., Hoboken, New Jersey.
4. Lyuu, Y-D (2004), Financial Engineering and Computation: Principles, Mathematics, Algorithms, Publisher: Cambridge University Press, UK.

Related academic journals:

1. European Journal of Operational Research (EJOR), ELSEVIER Publications
2. International Journal of Operational Research (IJOR), INDERSCIENCE Publications
3. Operational Research: An International Journal (ORIJ), SPRINGER Publications
4. International Journal of Project Management, ELSEVIER
5. Project Management Journal, SAGE Publications