Course Outline

CE-460, Financial-Technical Analysis and Operational Research

(1) General

Faculty	Faculty of Engineering		
Academic Unit	Department of Civil Engineering		
Level of Studies	*Undergraduate*		
Course Code	**CE-460**	**Semester**	4
Course Title	**Financial-Technical Analysis and Operational Research**		

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**	**ECTS**
Lectures	3	4
Laboratory exercises	1	1
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).	**4**	**5**

Course Type *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge
Pre-requisite Courses:	None
Teaching Language:	Greek, English, French, Italian
Is the course offered to ERASMUS students?	YES
Course Website (URL)	https://eclass.uniwa.gr/modules/auth/opencourses.php?fc=69

(2) Module aims – Learning outcomes

Module aims – 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*

Module aims

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. 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 financial & technical analysis and some of the operational research methods that are used in engineering and management.

Learning outcomes

On successfully completing this course unit, students will be able to:

- 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
……
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) Module 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.
- Queueing Theory – Basic structure of Queueing Models, The role of the Exponential Distribution
- Inventory Theory – Component of Inventory Models

- 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 Strategy – Assessment Strategy

Teaching Methods *Face-to-face, Distance learning, etc.*	This module is taught through a combination of lectures, tutorial exercises, laboratory sessions and coursework exercises.
Use of Information and Communications Technology *Use of ICT in teaching, laboratory, education, communication with students*	• Teaching using of Interactive Board and projector • Support learning process through electronic e-class platform. Exercises and educational material are provided through e-class.
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 nondirected study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures for the theoretical part of the course	60
• Computer Laboratory Exercises • Tutorial Exercises	40
Independent study	20
Coursework	20
Total	**140**

Assessment Method *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.*	Student performance is assessed through coursework completed during term time and through formal examinations. Written Examination (60%) – Coursework (40%)

(5) Reading List

Recommended Bibliography

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

-Related scientific 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