COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	FINANCIAL AND MANAGEMENT ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ΔΕ0103	SEMESTER	7
COURSE TITLE	DECISION ANALYSIS & KNOWLEDGE ENGINEERING		

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
	3	5
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, specialised general knowledge, skills development*	Track Compulsory
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	http://www.fme.aegean.gr/en/undergraduate-programme

(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*

Upon successful completion of the course the student should be confident about the following:

Understanding of basic concepts in decision theory.

Modeling of the decision making process.

Handling of uncertainty.

Computer Assisted Decision Making.

Understanding the particularities of decision analysis methods.

Preconditions for the proper adjustment of the methods taught in real decision problems.

How to apply the proper method for each decision problem.

Understanding of the role of a Knowledge and Decision Engineer: From the data collection process, to the design, implementation and application of the proper decision making methodology.

The course constitutes a precondition for elaborating later a Diploma Thesis in the domain.

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

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Adapting to new situations

Decision-making

Working independently

Working in an interdisciplinary environment

Production of new research ideas

Criticism and self-criticism

Production of free, creative and inductive thinking

(3) SYLLABUS

Description

The course primarily refers to methods for decision-making under uncertainty and deals with analytical approaches in this respect. Topics covered include:

o decision making processes, decision trees, Bayes-theorem and Bayesian revision
o value of information, basic utility theory, multi-attribute decision making, construction and analysis

of decision trees and influence diagrams using decision analysis software
o quantification of judgments, risk preferences, and degree of risk aversion via subjective expected utility

Generalizations of expected utility theory to problems in which consequences are descriptively complex and multi-attributed are illustrated with applications in engineering and management.

The course also teaches mathematical logic principles (propositional and categorical logic) as a basis for understanding rule based systems for decision support (expert systems, fuzzy rule based systems).

Furthermore the course contains introductory lectures to approximate reasoning, fuzzy decision analysis and computational intelligence-based approaches for the handling of uncertainty, in real-world problems (soft computing, fuzzy rule-based systems, neural computation, inductive machine learning, evolutionary computing – genetic programming, hybrid and adaptive intelligent schemes, nature inspired intelligence). Some lectures include demonstration of indicative algorithms and programs for computer assisted decision analysis.

Finally, the course contains a brief reference to other decision methodologies such as multi-criteria decision making, analytical hierarchical process, game-theory for strategic decision making, etc.

Module Contents (Syllabus)

1. Introduction to the Decision Making Process
2. Types of Decisions / Data Analysis / Uncertainty
3. Introduction to Mathematical Logic – Logic Operators
4. Propositional Logic (Truth Tables – Logical Consequences – Laws – Normal Forms – Examples
5. Predicate Logic – Symbols – Laws of Predicate Calculus – Prenex and Skolem Normal Forms – Examples
6. Mechanical Theorem Proving – Herbrand Theorem – Resolution Principle – Solved Problems and Case Studies
7. 1st Written Test
8. Decisions Under Uncertainty – Subjective Probabilities (Bayes) – Decision Trees – Raiffa's Basic Problem
9. Utility Theory and Decision Trees – Risk and Utility Functions – Special Topics in Decision Analysis
10. Solved Problems and Case Studies in Decision Analysis
11. 2nd Written Test
12. Computational Methods for Decision Making (Inductive Learning and Inductive Decision Trees, Fuzzy Logic and Fuzzy Rule Based Systems) – Presentation of related algorithms and programs
13. Evolutionary Computation and Decision Making – Neural Networks – Nature Inspired Intelligence – Other data driven decision making methodologies

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of web sources for elaboration of projects
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*
Scheduled Lectures	39 hrs
Partial (mid-semester) exams	46 hrs
Project elaboration (written text and oral presentation)	25 hrs
Preparation for the final exam	40 hrs
Course total	***150 hrs***

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.*	Final exam on course notes for 100% of the final mark of the student. Two mid-semester exams offer up to 20% bonus in the final mark. A project with written and oral part offers up to 10% additional bonus to the final mark of the student.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

A) Course Notes

B) Additional Reading

1. Decision Analysis, Raiffa H., Addison-Wesley, 1968.
2. Decision Making with Multiple Objectives, Keeney R., Raiffa H., Wiley, 1976.
3. Applied Decision Analysis, Bunn D., McGraw-Hill, 1984.
4. C-L Chang, R C-T Lee (1973), Symbolic Logic and Mechanical Theorem Proving, Academic Press 5. Z. Chen (1999), Computational Intelligence for Decision Support, CRC Press

- *Related academic journals:*

IEEE Transactions on Knowledge and Data Engineering
Intelligent Data Analysis