5.7 CE0570 - Computer-based Solution Methods

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**CE0570**	**SEMESTER**	**5**
COURSE TITLE	**Computer-based Solution Methods**		

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	4
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*	Special Background Course
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/CIV207/

(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*

The aims of the course are: a) To introduce the student to the methods of modeling, simulation, machine learning (ML) and pattern recognition (PR), b) To provide the student with programming knowledge of advanced solving methods, c) To give basic knowledge of the available artificial intelligence (AI) tools and their application to civil engineering problems

Upon successful completion of the course, students will be able to:

- understand the subject of algorithms and machine learning methods
- solve complex computing problems using applications such as MatLab
- efficiently use the methods of machine learning, pattern recognition and modeling
- functionally combine different applications with each other, to analyze data and draw conclusions using computer simulations

- understand the basic logic and philosophy of artificial intelligence (AI) methods that enter any field of their specialty, and apply them with the help of application tools such as MatLab.

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…*

Specifically, students will be able to perform:

- Search, analysis and synthesis of data and information, using the necessary technologies
- Autonomous work
- Teamwork
- Promotion of free, creative and inductive thinking

(3) SYLLABUS

DESCRIPTION: Advanced programming techniques and their applications in modeling, simulation and optimization of dynamic processes & processes are presented, for the solution of problems of the specialty of Civil Engineer. Special emphasis is given to the processing of data and use of models of physical problems, for identification and classification, simulation and prediction of their stochastic behavior, and to the extraction of optimal solutions or decisions. The implementation is done in MatLab or Python environment.

CONTENTS: Introduction - Basics, Linear Algebra, Tables, Uncertainty, Probabilities, Random Variables, Random Numbers, Errors, MatLab IDE & Language Components, Data, Sampling, Statistical Parameters, Information Processing/Extraction, Introduction to Pattern Recognition, Machine Learning, Artificial Intelligence, and their Applications. Simulation, Simulation Models, Monte Carlo Simulation, Model Categories: Linear (LR), Non-Linear (NLR), Statutes (State-Space), Stochastic (Kalman), Time Series (AR- ARMA), Neural Networks (ANN), Fuzzy, Markov, etc. Model Identification, State Estimation, Forecasting/Prediction, Identification, Smoothing, Classification, Clustering and Learning, Heuristic Search, Optimization, Criteria, Decisions and Confusion Matrices, with applications in the field of Civil Engineering and in MatLab / Python environment.

(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*	Teaching using ICT, Communication and Electronic Submission, supported by the university e-Class platform and Specialised software for programming - IDE (MatLab/Octave, Excel/Calc).
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	39
Classwork	
Preparation for Project	30
Personal Study	31
Course total	**100**

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.*	Language of evaluation: Greek Final score is tha average of Theory & Laboratory results. Theory: - Final written examination: 60% - Midterm examination & projects: 40% (20+20) The evaluation criteria, and the grades are presented to the students through the online platform of the Institution. The language of assessment is Greek unless the students come from the Erasmus program, in which case the examination is in English.

(5) **ATTACHED BIBLIOGRAPHY**

Greek Bibliography:

1. Αναγνώριση Προτύπων Και Μηχανική Μάθηση, C.M. Bishop, Εκδότης Φούντας, 2019.
2. Τεχνητή Νοημοσύνη, Βλαχαβας Ι., Κεφαλας Π., Βασιλειάδης Ν., Κοκκορας Φ., Σακελλαρίου Η., Παν. Μακεδονίας, 2011.

Foreign Bibliography:

1. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2006
2. Probabilistic Machine Learning for Civil Engineers, James-A. Goulet, MIT, 2020