COURSE OUTLINE

1. GENERAL

SCHOOL	School of Environment and Agricultural Engineering		
ACADEMIC UNIT	Department of Natural Resources Development and Agricultural Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**35**	**SEMESTER**	6^{th}
COURSE TITLE	Numerical Analysis		

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	2	5
Laboratory exercises	3	
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*	General background, specialized general knowledge, skills development
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)
COURSE WEBSITE (URL)	http://openeclass.aua.gr

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

- distinguish the capabilities of Numerical Analysis in solving fundamental problems with applications in engineering,
- understand the main reasons for having errors in numerical solutions and analyze the conditions,
- know the basic numerical methods for the approximate solution of mathematical problems using programming. Indicative examples include the numerical finding of roots of non-linear algebraic equations, the numerical solution of systems of algebraic equations, the interpolation method, the least squares method, and numerical differentiation and integration,
- utilize the basic principles of programming, algorithmic structures, and program

development techniques to leverage the capabilities of numerical methods in the creation of a fundamental toolkit through which they can perform fundamental numerical procedures for data visualization, results, or graphical representations of functions,
- utilize other software packages for data processing and analysis, evaluation of results, and decision-making in their scientific field,
- use the computer for collaborative learning with colleagues, within the framework of a group.

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
- Working independently
- Decision Making
- Production of free, creative and inductive thinking
- Project planning and management

3. SYLLABUS

Theory (3 ECTS)

- Elements of mathematical analysis: Matrices, vectors, and determinants. Vector and matrix norms. Approximation and error analysis of solutions.
- Numerical solution of non-linear equations/systems: Fixed point method, Newton-Raphson method, Bisection method. Convergence of the iterative methods. Multiple solutions and improved Newton-Raphson method.
- System of linear equations: Introduction. Stability. Gauss method and factorization methods (LU decomposition, Crout and Choleski methods). Iterative Jacobi and Gauss-Seidel methods. Convergence. Successive approximations method (SOR).
- Interpolation: Taylor polynomial. Lagrange interpolation. Newton interpolation. Interpolation and approximation with piecewise polynomials (spline interpolation).
- Least squares method (Discrete, polynomial, exponential). Normal equations.

- Numerical differentiation and integration: Trapezoidal, Simpson, Romberg, and Gaussian quadrature methods.
- Numerical solution of differential equations: Euler methods. Error analysis. Higher-order Taylor series method. Runge-Kutta method. Multi-step methods.

Lab (2 ECTS)

- Introduction to Octave/Matlab.
- Matrices, vectors, polynomials, logical operations, m-files, plots: Examples and exercises.
- Solution of non-linear equations/systems: Examples and exercises.
- Solving linear equations/systems: Examples and exercises.
- Interpolation and polynomial approximation: Examples and exercises.
- Least squares method: Examples and exercises.
- Numerical differentiation and integration: Examples and exercises.
- Numerical solution of differential equations: Examples and exercises.

4. TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Use of ICT in teaching, laboratory education and communication with students.
• Use of programming software.
• Use of e-class, the electronic course management system.
• Communication with students via an open electronic classroom platform and email.</td></tr>
<tr><td>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</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>26 hours</td></tr>
<tr><td>Laboratory</td><td>39 hours</td></tr>
<tr><td>Study</td><td>60 hours</td></tr>
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<tr><td></td><td></td></tr>
<tr><td>Course total
(25 working hours per ECTS)</td><td>125 hours</td></tr>
</table>
</td></tr>
<tr><td>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</td><td>Final exam that might contain multiple choice questions, short-answer questions, open-ended questions and problem solving.</td></tr>
</table>

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.*	

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography (in Greek):

- Αριθμητική Ανάλυση με εφαρμογές σε Matlab και Mathematica. Γ.Σ. Παπαγεωργίου και Χ.Γ. Τσίτουρας. Εκδόσεις ΤΣΟΤΡΑΣ ΑΘΑΝΑΣΙΟΣ, 2015. Κωδικός Βιβλίου στον Εύδοξο: 50658287.
- Αριθμητκές Μέθοδοι και Εφαρμογές για Μηχανικούς, Σαρρής Ι. Καρακασίδης Θ., Εκδόσεις ΤΖΙΟΛΑ, 2017, Κωδικός Βιβλίου στον Εύδοξο: 68373915
- Εισαγωγή στην Αριθμητική Ανάλυση, Ακρίβης Γ. Δουγαλής Β., Πανεπιστημιακες Εκδόσεις Κρήτης, 2015, Κωδικός Βιβλίου στον Εύδοξο: 59366700.