COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Naval Architecture		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	NAOME1114	**SEMESTER**	3rd
COURSE TITLE	**NUMERICAL ANALYSIS**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS (ECTS)**
Lectures		4	5

COURSE TYPE *general background, specialbackground, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/NA184/

(2) COURSE GOALS / LEARNING OUTCOMES

In engineering practice it is quite common to encounter problems for which an analytical solution either does not exist or it is costly and hard to find. Numerical analysis and scientific computing has become a key tool for studying a wide range of physical phenomena and, therefore, plays an increasingly important role in any engineering curriculum.

The course aims to introduce students to theoretical and practical aspects of numerical algorithms, and insight will be given through MATLAB illustrations.

Learning outcomes:

On completion of this course the student should be able to:

- Understand the basic principles of computer arithmetic, including number representation and arithmetic operations.
- Develop and implement numerically stable and accurate algorithms for all the basic tasks of computational science and engineering. Specifically, to
    - use numerical techniques to find the roots of non-linear equations and solve systems of linear equations,
    - understand the use of interpolation,
    - understand numerical integration and numerical solutions of ordinary differential equations.

(3) COURSE CONTENT / SYLLABUS

1. Computer Arithmetic and round-off errors
Computer representation of numbers, floating-point representation, rounding and chopping, computer errors in representing numbers and in arithmetic operations, algorithms and stability.

2. Solution of nonlinear equations
The bisection method, iterative solution of equations, Newton's method, the secant method.

3. Solution of systems of linear equations

- Linear Algebra: Vector Spaces, Matrices, and Linear Systems. Eigenvalues and eigenvectors, Canonical Forms for Matrices. Special matrices. Vector and matrix norms.
- Direct methods for solving linear systems: Gauss elimination, LU factorization, Cholesky decomposition.
- Iterative techniques for solving linear systems: Jacobi, Gauss-Seidel and SOR.

4. Polynomial interpolation
Lagrange interpolation. Newton's form. Piecewise polynomial interpolation: linear and cubic splines.

5. Least squares approximation
Introduction, polynomial approximations, System of normal equations.

6. Numerical integration
Introduction, Newton-Cotes formulae, Composite numerical integration.

7. Initial value problems for ordinary differential equations
Elementary theory of initial value problems, Euler's method, Implicit one-step methods, Runge-Kutta methods, Error control and the Runge-Kutta-Fehlberg method.

(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 ICT in teaching. • Use of mathematical software. • Support learning through the electronic e-class platform.
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	*Workload (hours)*
Lectures	52
Homework assignments	39
Study of Lectures	52
Course total	**143**

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*	Final written examination: 70% Three personal assignments: 30%

(5) ATTACHED BIBLIOGRAPHY

1. R.L. Burden, J.L. Faires, Numerical Analysis, 9th ed., Brooks/Cole, 2011.
2. W. Cheney, D. Kincaid, Numerical Mathematics and Computing, 6th ed., Brooks/Cole, 2008.
3. G. Dahlquist, Å. Björk, Numerical Methods, Prentice-Hall, 1974.
4. D.J. Higham, N.J. Higham, MATLAB Guide, 2nd ed., SIAM, 2005.
5. C.B. Moler, Numerical Computing with Matlab, SIAM 2004.
6. E. Süli, D. Mayers, An Introduction to Numerical Analysis, Cambridge University Press, 2006.