4.1 CE0410 – Numerical Analysis

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**CE0410**	**SEMESTER**	**4**
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**
	4	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*	General Background Course
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/CIV238

(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 aim of the course is to give the students fundamental concepts of….

• know how errors are transmitted during calculations and choose sound methods for problem solving..

• know and be able to apply the basic methods for solving nonlinear equations, study their convergence and distinguish them in terms of velocity;να γνωρίζουν και να εφαρμόζουν τις βασικές άμεσες και επαναληπτικές μεθόδους

• for the solution of linear systems, to distinguish the advantages of each so that they can choose the most suitable one,

• know how to approach functions with polynomial interpolation

• be able to apply types of arithmetic integration to approach integrals and study error behavior,

• implement the above methods with programs on the computer

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:

- Adaptation to new situations
- Exercise criticism and self-criticism
- Promoting free, creative and inductive thinking
- Search, analysis and synthesis of data and information, using the necessary technologies
- Decision Making.
- Autonomous work

(3) SYLLABUS

1. Basic concepts:

   - Elements of mathematical analysis.
   - Tables and definers.
   - Vectors and arrays norms.
   - Computer arithmetic.
   - Approach and errors.
   - Error Theory.

2. Solve non-linear equations:

   - Dichotomous method.
   - Fixed point method.
   - Newton-Raphson method.
   - Cutting method.
   - Convergence of Newton-Raphson and intersecting methods.
   - Multiple roots and modified Newton-Raphson method.
   - The Newton method for nonlinear systems.

3. Systems of linear equations:

   - Introduction.
   - Stability of linear systems.
   - Gaussian deletion method.
   - Factorization methods (LU factorization, Crout and Choleski methods).
   - Jacobi and Gauss-Seidel iterative methods.
   - Convergence.
   - Sequential hyper relaxation method (SOR).

4. Interference and polynomial approach:

   - Interference. Polynomial Taylor.
   - Lagrange interference
   - Newton interpolation.
   - Interference and approach with partial polynomials (spline interpolation).

5. Least squares method (Discrete, polynomial, exponential). Normal equations.Least squares method (Discrete, polynomial, exponential). Normal equations.

   - Trapezoidal methods,
   - Simpson,
   - Romberg
   - square of Gauss Numerical production and integration:

6. Numerical solution of differential equations:

   - Euler methods. Error analysis.
   - Taylor series method of higher grade.
   - Runge-Kutta method.
   - Multivariate methods.

7. Examples and Applications in Matlab 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*	Additional communication via e-mail, exclusive website of the course, support of the learning process by providing selected additional exercises and indicatively solved examples through the website.
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*	
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.*	Written final exam (100%) of graded difficulty, which may include: multiple choice test, short answer questions, topic development questions, judgment questions and solving exercises using software tools. If possible, during the semester progress will be made whose grade will contribute to the formation of the final grade of the course The evaluation criteria have been presented to the students before the examination, the individual grade of the subjects is written in them and the final grade is accessible through the online platform of the Institution. In addition, students can see their writing, their individual grade on the topics and be given clarifications about them by pointing out any mistakes they make. Final written examination: 80% Preparation for the project: 20%

Activity	***Semester workload***
Lectures	52
Classwork	26
Preparation for Project	15
Personal Study	22
Course total	**115**

(5) ATTACHED BIBLIOGRAPHY

Greek Bibliography:

1. Alexandropoulos Antonios, Vryzidis Lazaros, Applied Mathematics, Modern Editorial, 2016
2. Tailor Aristotle, Applied Numerical Analysis, Open Line Publisher / Masklavanos Theodoros, 2017
3. Pitsoulis L., Introduction to Numerical Analysis, Tziola Publications, 2015

Foreign Bibliography:

1. Scheid F, Numerical Analysis, Jiola Publications, 2004