COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Industrial Design and Production Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**2001**	**SEMESTER**	**2**
COURSE TITLE	Numerical Analysis		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
	Lectures	3	3
	Laboratory	1	2
		4	**5**
COURSE TYPE	General background		
PREREQUISITE COURSES:	No		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/IDPE280/		

(2) LEARNING OUTCOMES

Learning outcomes

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

- acquire the required theoretical background and ability to be able to choose the appropriate approximation method for the numerical solution of the problem they face
- acquire the required theoretical background and ability to be able to analyze the convergence order of the approximation method they apply
- be aware of the basic methods of arithmetic integration and arithmetic derivation that are necessary in numerical solutions
- know the most efficient ways to solve linear and non-linear systems to which the discretization of most engineering applications leads
- acquire the ability to deal with problems involving the approach and interpolation of data with partial polynomial functions
- understand and analyze the capable and necessary conditions, as well as the corresponding error, under which the arithmetic methods give the required results
- acquire the ability to implement course methods and algorithms in the Matlab software computing environment
- colllect information on the existence of computer numerical libraries and other related tools.

General Competences

- Working independently
- Team work
- Working in an interdisciplinary environment

(3) SYLLABUS

Basic concepts. Movable and fixed decimal operations. Rounding errors and their effect on calculations. Algorithm stability. Troubleshooting.

Constant points of functions. Banach's constant point theorem. Numerical methods for locating constant points. Behavior, convergence and complexity.

Newton's method and the intersecting method.

Solving linear systems. Direct methods (Gauss, factorization). LU factorization. Repetitive methods (Gauss Seidel and Jacobi). Vector and matrix norms. Vector method for calculating eigenvalues. Matrix status indicator.

Polynomial interpolation. Taylor, Lagrange, Newton, Hermite Polynomials. Interpolation with splines.

Solving non-linear equations. The method of bifurcation. Regula-Falsi method. Constant point iterative methods. Numerical methods of nonlinear systems. Newton method. Intersection method. Schroder method. Behavior, convergence and complexity.

Numerical derivation and integration. Newton, trapezoidal and Simpson methods. Simpson complex rule. Errors.

Finite difference methods.

Applications using Matlab software. Examples of 1st and 2nd order differential equations (ordinary and partial) in Matlab. Transformations (Fourier, Laplace).

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Communication with students through the platform with emails & announcements on the course's website (e-class). Powerpoint display with projector and laptop. Demonstration of modern mathematical software (Matlab, Mathematica, Wolfram Alpha) on the taught subjects. Announcement of course notes in electronic form on the course's website (e-class). Referral to websites with related applications (Desmos, Maxima, Geogebra). Utilization of the computer laboratory of the Department. Possibility of examinations through the tool of Exercises in e-class.	
TEACHING METHODS	***Activity***	***Semester workload***
	Lectures	39
	Laboratory	26
	Computing exercises	35
	Individual study	50
	Course Total (30h/ECTS)	**150**

STUDENT PERFORMANCE EVALUATION	**Language of assessment:** Greek (English for ERASMUS students upon request). Students are assessed through a written examination, which includes short-answer questions and problem solving. There is a possibility for an intermediate examination in the middle of the semester. Delivery of assignments and written/oral examination in the Laboratory (40%). Students with learning difficulties are examined in accordance with article 37 of the Internal Regulations of the UNIWA. The evaluation criteria have been presented to the students before the final examination and the individual grade of the subjects is written in them. Students can see their writing and their individual grades in the topics, as well as receive clarifications about them after pointing out any mistakes.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Εισαγωγή στην Αριθμητική Ανάλυση, Ακρίβης Γ.Δ., Δουγαλής, Β.Α.
2. Αριθμητική ανάλυση, Γ.Σ. Σοφιανός & Ε. Θ. Τυχόπουλος, Εκδόσεις Σταμούλης, 2005.
3. Αριθμητική Ανάλυση-Εισαγωγή, Μιχαήλ Ν. Βραχάτης, Εκδόσεις Κλειδάριθμος 2011.
4. Αριθμητικές μέθοδοι και προγράμματα για μαθηματικούς υπολογισμούς, G.E. Forsythe, M.A. Malcolm & C.B. Moler, μετάφραση από τους Γ.Δ. Ακριβή & Β.Α. Δούγαλη, Πανεπιστημιακές Εκδόσεις Κρήτης, 1997.
5. Introduction to numerical analysis, F.B. Hildebrand, Dover, 1956.
6. Theory and applications of numerical analysis, G.M. Philips & PJ Taylor, 2nd ed., 1996.

- Related academic journals:

SIAM Journal on numerical analysis