COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE PROGRAM		
COURSE CODE		**SEMESTER**	**E**
COURSE TITLE	NUMERICAL ANALYSIS		
INSTRUCTORS	Vassilis Koukouloyannis (Lecture) and Christos Tsagaris (Lab sessions)		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
		6	9
COURSE TYPE	General background		
PREREQUISITE COURSES:	NO		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.math.aegean.gr/index.php/en/academics/undergraduate-programs		

(2) LEARNING OUTCOMES

Learning outcomes
On completion of this course, students should be armed with numerical and computational techniques for solving a wide variety of basic and fundamental mathematical problems that arise in diverse scientific areas. In particular, students will be able to solve non-linear algebraic equations, systems of linear equations, calculate integrals, approximate functions, calculate derivatives and many others.
General Competences
Working independently. Team working. Working in an interdisciplinary environment

(3) SYLLABUS

Number representation in computers. The floating point numbers. The effects of round-off errors in the computations. Accuracy and stability of numerical algorithms. Properly-posed, well-posed, and well/bad conditioned mathematical problems.

Solution of non-linear algebraic equations. The bisection method. The fixed-point iterative method. The contraction mapping theorem. The Newton and secant methods.

Solution of systems of linear equations. The Gauss elimination method with/without pivoting. LU decomposition. Vector and matrix norms. The iterative Jacobi and Gauss-Seidel methods. Criteria for convergence of the iterative methods.

Function approximation using (i) the Taylor polynomial, (ii) the interpolating polynomial at a set of distinct points. Existence and uniqueness of the interpolating polynomial. The accuracy of the polynomial interpolation. Construction of the interpolating polynomial according to (i) Lagrange method, (ii) Newton method/divided differences. The example of Runge and the choice of the interpolating points. Interpolation using linear splines. Hermite interpolation.

Numerical integration using (i) the Taylor polynomial, (ii) the interpolating polynomial. The regular rectangular, midpoint, trapezoidal, and Simpson quadrature rules. Accuracy of the quadrature rules.

Open and closed Newton-Cotes formulas. Numerical differentiation using (i) the interpolating polynomial, (ii) finite difference formulas. The method of determined coefficients for finding finite difference formulas for any derivative of a function with specific accuracy. The effects of (i) truncation error, and (ii) the round-off error on the numerical differentiation formulas.

TEACHING MATERIAL DISTRIBUTION	The teaching material of the course is uniformly distributed during the semester.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face-to-face lectures
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	• Communication with students via e-mail. • Uploading course material on moodle system.
TEACHING METHODS	

Activity	***Semester workload***
Lectures	39
Tutorial	13
Laboratory practice	26
Independent study	147
Course total (25 per ECTS)	***225***

COURSE COMMITMENTS	Attending course and tutorial sessions is not obligatory.
STUDENT PERFORMANCE EVALUATION	Student's evaluation is done in Greek through a written examination which includes short-answers questions, problem solving and laboratory work. For students with disabilities, evaluation takes place via oral exams.

(5) ATTACHED BIBLIOGRAPHY

1. Introduction to numerical analysis, F.B. Hildebrand, Dover, 1956.
2. Theory and applications of numerical analysis, G.M. Philips & PJ Taylor, 2nd ed., 1996.

- *Related academic journals:* SIAM Journal on Numerical Analysis.