

COURSE OUTLINE

(1) GENERAL

SCHOOL	UNIVERSITY OF THESSALY		
ACADEMIC UNIT	DEPARTMENT OF CIVIL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	FK1801	SEMESTER	3
COURSE TITLE	NUMERICAL METHODS		
INDEPENDENT TEACHING ACTIVITIES <i>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</i>	WEEKLY TEACHING HOURS	CREDITS	
	4	6	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialized general knowledge, skills development</i>	General background and skills development		
PREREQUISITE COURSES:	Knowledge of calculus, linear calculus, linear calculus, linear calculus, Algebra, Differential Equations, Computer Programming		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	https://eclass.uth.gr/courses/CIV_U_291/		

(2) LEARNING OUTCOMES

<p>Learning outcomes <i>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.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> • <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i> • <i>Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i> • <i>Guidelines for writing Learning Outcomes</i>
<p>The course aims to provide students with the necessary tools for solving known mathematical problems that arise in civil engineering problems (such as solving linear systems, solving differential equations and nonlinear equations, data approximation problems, etc.) The use of the MATLAB software package, which is world-renowned and used by engineers and scientists, makes it possible to implement and study the methods presented in the theory.</p> <p>Upon successful completion of the course the student will:</p> <ul style="list-style-type: none"> - Have an understanding of ways to solve linear systems by direct and iterative methods and will be able to judge which method is appropriate to use for the problem at hand. - Have knowledge of the basic methods of solving non-linear systems of equations. - Have knowledge of methods for approximating and interpolating data with (partial) polynomial functions - Have knowledge of basic methods of numerical finite difference derivation and integration, which will be useful in solving differential equations by numerical methods. - He has knowledge of basic methods of numerical integration and will be able to judge which method

is appropriate to use in the problem at hand.

- Have knowledge of basic methods for solving differential equations and systems of differential equations and finite difference equations for various boundary conditions.
- Have an understanding of the effect of finite arithmetic errors and method errors on the numerical results obtained from the execution of the programmed methods.
- Have a basic knowledge of MATLAB software

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?

<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>
<i>Adapting to new situations</i>	<i>Respect for difference and multiculturalism</i>
<i>Decision-making</i>	<i>Respect for the natural environment</i>
<i>Working independently</i>	<i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i>
<i>Team work</i>	<i>Criticism and self-criticism</i>
<i>Working in an international environment</i>	<i>Production of free, creative and inductive</i>
<i>thinking Working in an interdisciplinary environment</i>	<i>.....</i>
<i>Production of new research ideas</i>	<i>Others...</i>
	<i>.....</i>

Search, analysis and synthesis of data and information, using the necessary technologies
Decision-making Autonomous work
Exercise of criticism and self-criticism
Promoting free, creative and deductive thinking Using new technologies to solve problems

(3) SYLLABUS

Introduction. Floating and fixed subspace operations. The e of the machine. Errors.

Solution of systems of linear equations, Direct Gauss, Gauss-Jordan and Thomas methods.

LU factorization. Unstable systems, matrix norms, matrix state index.

Iterative methods Jacobi, Gauss-Seidel, S.O.R.. Comparison of iterative methods and definition of spectral radius.

Solving nonlinear equations Method of bisection. Method of intersection, Method of

Newton-Raphson method. Finding roots of polynomials. Solving systems of nonlinear equations

Interpolation. Difference tables and finite difference operators. Lagrange interpolation. Newton interpolation. Hermite interpolation. Square and cubic splines. Least squares method.

Integration. Newton Cotes integration. Trapezoidal rule. Integration by Simpson's rule. Complex Simpson's Rule. Romberg's integration. Gauss integration. Errors of methods.

Solving Ordinary Differential Equations (ODEs). Euler's method. Taylor's method of 2nd order, Runge-Kutta methods of 2nd and 4th order. Stiffness. Solving higher order DDEs. Stiffness. Boundary value problems

Finite difference method. Shooting methods

Basic elements of programming in Matlab environment for the implementation of the relevant methods

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face to face Lectures Laboratory exercises in the computer laboratory	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	Using slides on a projector Use of computers in the computer lab to apply the methods taught in MATLAB environment Use of the Eclass environment for the distribution of course material, announcements and communication with students	
TEACHING METHODS <i>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.</i> <i>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</i>	<i>Activity</i>	<i>Semester workload</i>
	Lectures	30
	Laboratory exercises	26
	Study	31
	Tasks	20
	Examinations	3
	Preparing for exams	15
	Course total	125
STUDENT PERFORMANCE EVALUATION <i>Description of the evaluation procedure</i> <i>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</i> <i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i>	Final Written Examination 100%	

(5) ATTACHED BIBLIOGRAPHY

-Suggested bibliography:

1. Introduction to Numerical Analysis, Akrivis G.D., Dugalis V.A. Edition 4/2015, University Publications of Crete
2. Numerical Methods and Applications for Engineers, 4th Edition, Sarris I.- Karakasidis Th. Edition: 4th/2017, Tziola Publications