COURSE OUTLINE

GENERAL

SCHOOL	Sciences and Engineering		
ACADEMIC UNIT	Computer Science		
LEVEL OF STUDIES	1st Cycle		
COURSE CODE	MATH-343	**SEMESTER**	Spring
COURSE TITLE	Numerical Methods for Data Science		

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**
	2.5	6
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*	Specialization
PREREQUISITE COURSES:	MATH-195, MATH-280 and COMP-240
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	
COURSE WEBSITE (URL)	

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*

After completion of the course students are expected to be able to:

- Use error and asymptotic order of convergence to assess numerical methods.
- Implement approximate methods for finding the solution of nonlinear algebraic equations.
- Apply direct methods to solve linear systems of algebraic equations.
- Use polynomial interpolation and least squares to approximate functions and fit data.
- Utilize finite differences to approximate derivatives of functions.
- Apply fundamental numerical integration methods.
- Design numerical algorithms and implement them using the Python programming language.

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…*
	…….

Analysis and synthesis of data with the use of the necessary technology, adapting to new situations, decision-making, working independently, working in an interdisciplinary environment, analytical, algorithmic and quantitative thinking, synthesis of ideas.

SYLLABUS

1.Review of Calculus and Introductory Concepts
   a. Taylor's Theorem, the Mean Value and Extreme Value Theorems
   b. Error and Asymptotic Order
   c. Elementary Computer Arithmetic
2.Root Finding
   a. The Bisection Method
   b. Newton's Method
   c. The Secant Method
   d. Fixed Point Iterations
3.Numerical Solution of Linear Systems
   a. Review of Linear Algebra
   b. Gaussian Elimination and Pivoting
   c. Operation Counts
   d. LU Decomposition.
4.Approximation and Interpolation
   a. Lagrange Interpolation
   b. Least Squares Approximation
5.Numerical Differentiation
   a. Finite Difference Approximations to Derivatives
   b. Truncation Error
6.Numerical Integration
   a. Review of the Riemann Integral
   b. The Trapezoidal Rule
   c. Simpson's Rule
   d. The Midpoint Rule

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 / Χρήση ΤΠΕ* *Communication with students / Επικοινωνία με Φοιτητές*
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.*	- Theoretical and Programming Assignments - Midterm Exam - Final Exam

Activity	***Semester workload***
Lectures	35
Practice problems	35
Study of the textbook, lecture notes and online material	40
Written and programming assignments	40
Course total	***150***

ATTACHED BIBLIOGRAPHY

Required Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
An Introduction to Numerical Methods and Analysis (2nd Edition, also available as e-textbook)	J. F. Epperson	Wiley	2013	9781118367599
Numerical Python (E-book available via UNic library)	R. Johansson	Apress Berkeley	2015	9781484205532

Recommended Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Applied Numerical Methods with Python for Engineers and Scientists	S. Chapra and D. Clough	McGraw-Hill	2022	9781266651496
Numerical Mathematics and Computing (7^{th} Edition)	W. Cheney and D. Kincaid	Cengage Learning	2012	9781133103714