SYLLABUS
COURSE DESCRIPTION

COURSE TITLE	Mathematics 2
COURSE CODE	76202
SCIENTIFIC SECTOR	MAT/05 and MAT/08
DEGREE	Bachelor in Computer Science
SEMESTER	2nd
YEAR	1st
CREDITS	12
MODULAR	Yes

TOTAL LECTURING HOURS	80
TOTAL LAB HOURS	40
PREREQUISITES	There are no prerequisites.
COURSE PAGE	https://ole.unibz.it/

SPECIFIC EDUCATIONAL OBJECTIVES	• Type of course: "di base" for L-31 • Scientific area: "Formazione matematica-fisica" for L-31 • MODULE 1: The aim of this course is to teach students how to derive, analyze and implement numerical methods for solving systems of linear equations, computing eigenvalues of matrices, approximating functions and integrals, solving differential equations. To achieve these aims, students will numerically solve mathematical problems and analyze the mathematical theory to build the methods used for the numerical solution. The course will cover the basic topics of stability, error analysis and efficiency for various numerical algorithms for solving linear systems, computing eigenvalues, solving differential equations. Computer projects may be completed using any preferred programming language. However, a numerical computing environment known as Matlab will be used to teach the course, and Matlab codes will be provided. Module 2 The aim of this module is to introduce students to the following topics: sequences and series, univariate functions, normed vector spaces, derivatives and differentials, calculus, and integration.

MODULE 1	**Analysis**
MODULE CODE	76202A
MODULE SCIENTIFIC SECTOR	MAT/05
CREDITS	6
LECTURER	Tammam Tillo
SCIENTIFIC SECTOR OF THE LECTURER	ING-INF/05
TEACHING LANGUAGE	English
OFFICE HOURS	During the lecture times Thursday 14:00-16:00, Faculty of computer science, Piazza Domenicani 3, Office 1.17 (it is recommended to make an appointment by email)
TEACHING ASSISTANT	Simone Ugolini, Piazza Domenicani, 3 – Office 1.04, Simone.Ugolini@unibz.it
OFFICE HOURS	By appointment via email.
LIST OF TOPICS COVERED	• Sequences and series: real sequences, convergence, montonicity, limits, infinite sums and series, geometric series, power series, convergence radius, exponential and trigonometric functions • Univariate functions: (sequentially) continuous functions, limits of (univariate) functions, intermediate value theorem, bisection, compactness of continuous functions • Normed vector spaces: normed vector spaces (NVSs), sequences and series in NVSs, topology of finite dimensional NVSs, Bolzano-Weierstrass theorem, continuous multivariate functions, compactness • Derivatives and differentials: first and second derivatives of a real-variate NVS-valued function, Rolle’s theorem, minimax theorems, mean value theorem, derivative of a NVS-variate NVS-valued function, multilinear algebra and higher order derivatives • Calculus: Riemann integral of a real-variate NVS-valued function, mean value theorem, Taylor’s expansion, basic differential geometry of curves, complex variate functions • Integration: volumes, determinants and Denjoy-Perron’s integral, surfaces, manifolds and differential forms, Gauss theorem and electrostatics, differential equations
TEACHING FORMAT	This course will be delivered through a combination of formal lectures and exercises

MODULE 2	**Computational Mathematics**
MODULE CODE	76202B
MODULE SCIENTIFIC SECTOR	MAT/08
CREDITS	6
LECTURER	Bruno Carpentieri http://www.inf.unibz.it/~bcarpentieri/
SCIENTIFIC SECTOR OF THE LECTURER	MAT/08
TEACHING LANGUAGE	English
OFFICE HOURS	Office 310, Bruno.Carpentieri@unibz.it, By appointment via email.
TEACHING ASSISTANT	Pietro Galliani
OFFICE HOURS	By appointment via email.
LIST OF TOPICS COVERED	• Functional approximation: polynomial interpolation, numerical integration, orthgonal polynomials, least squares. • Matrix computation: substition and triangular systems, LU factorization, pivoting (row, column, full), Doolittle's algorithm and Cholesky's algorithm, QR factorization and applications to least squares solutions • Fixed point methods: divide and average, Heron's algorithm, Banach–Caccioppoli contraction lemma, convergence rates, linear, quadratic, superlinear, quadratic Banach–Caccioppoli contraction • Newton–Raphson method: derivation and basic examples, convergence criteria, optimization, applications to mechanics and calculus of variations • Iterative methods for linear algebra: Jacobi and Gauss-Seidel iterations, conjugate gradient (CG) method, eigenproblem solution via the Von Mises power method, QR iteration • Differential equations: theory of differential equations, Picard-Lindelöff iteration, Euler's methods for initial value problems (IVPs), Higher order methods for IVPs, methods for boundary value problems (BVPs)
TEACHING FORMAT	Frontal lectures, exercises in lab.

Learning outcomes	- Knowledge and understanding - Have a solid knowledge of the theoretical foundations of computer science; - Have a solid knowledge of mathematics that are in support of computer science; - Applying knowledge and understanding - Be able to use the tools of mathematics and logics to solve problems; - Making judgments - Be able to work autonomously according to the own level of knowledge and understanding - Communication skills - To be able to use English technical terms and communication appropriately; - Ability to learn - Have developed learning capabilities to pursue further studies with a high degree of autonomy; - Be able to learn the innovative features of state-of-the-art technologies and information systems.

ASSESSMENT	**Module 1:** The aim of the assessments are to check to which degree students have mastered the following learning outcomes: 1) Knowledge and understanding, 2) applying knowledge and understanding, 3) making judgment. In principle, the written exam will consist of a set of questions and exercises which will be evaluated in term of correctness and clarity. **Module 2**: Written exam: In the written there will be verification questions, transfer of knowledge questions and exercises. The learning outcome related to knowledge and understanding, applying knowledge and understanding and those related to the student's ability to learn and apply the acquired learning skills, will be assessed by the written exam.
ASSESSMENT LANGUAGE	English
EVALUATION CRITERIA AND CRITERIA FOR AWARDING MARKS	Module 1: Final Written Exam (accounts for the full marks of Module 1) Module 2: Final Written Exam (accounts for the full marks of Module 2)

REQUIRED READINGS	Module 1: Students should refer primarily to their notes taken in class (lectures and exercise classes) and consult the suggested textbooks. Module 2: *Greenbaum, A. and Chartier, T. P. (2012), Numerical Methods. Design, Analysis, and Computer Implementation of Algorithms, Princeton University Press* *Lindfield, G. R. and Penny, J. E. T. (2012), Numerical Methods Using MATLAB, Academic Press* *Attaway, S. (2016), Matlab: A Practical Introduction to Programming and Problem Solving, Butterworth-Heinemann*
SUPPLEMENTARY READINGS	Module 1: Textbooks will be recommended during the course. Module 2 *Atkinson, K. E. (1989), An Introduction to Numerical Analysis, Wiley* *Moler, C. (2004), Numerical Computing with MATLAB, SIAM, Philadelphia*
SOFTWARE USED	No software is needed for Module 1 *Matlab* for Module 2