Corso di Laurea in
SCIENZA E TECNOLOGIA DEI MATERIALI

Triennale – L30

General information		
Academic subject	***Mathematical Analysis 2***	
Degree course	*Materials Science and Technology*	
Academic Year	*2021-2022*	
European Credit Transfer and Accumulation System (ECTS)		10
Language	*Italian*	
Academic calendar (starting and ending date)	*According to teaching calendar*	
Attendance	*NOT compulsory*	

Professor/ Lecturer	
Name and Surname	*Mirella Cappelletti Montano*
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Department and address	*Department of Mathematics*
Virtual headquarters	
Tutoring (time and day)	*by appointment via email*

Syllabus	
Learning Objectives	*Basic knowledge and theoretical and applied comprehension of: elements of Linear Algebra, sequences and series of functions, differential calculus for multivariate functions, curves, differential forms, multiple integrals, surfaces, differential equations.*
Course prerequisites	*Basic Knowledge of the main aspects of Mathematical Analysis I: limits, integral and differential calculus for univariate functions, numrical series.*

Contents	***Linear algebra:*** *Linear spaces and subspaces. Linearly independent vectors. Basis for a linear space and related properties. The space of real polynomials. Matrices and their properties. Transpose matrix. Operations among matrices. Gauss's Method. Determinant of a squared matrix and its properties. Sarrus's Rule. Laplace Formula. Invertible matrices.. Linear sistems and their properties. Cramer's rule. Rouchè-Capelli theorem. Quadratic forms. Eigenvalues and eigenvectors of a matrix. Linear transformations and their properties.* ***Sequences and series of functions:*** *Pointwise and uniform convergence for sequences of functions. Pointwise, uniform, absolute and total convergence of a series of functions. Power series. Radius of convergence and its properties. Cauchy-Hadamard theorem. D'Alembert theorem. Sum of a power series and related properties. Abel Theorem. Taylor series. Examples. Analytic functions. Fourier series. Examples. Pointwise convergence of a Fourier series. L^2 spaces. L^2-convergence of a Fourier series. Parseval Equality.* ***Multivariate differential calculus.*** *R^n and its properties. Euclidean norm, scalar product and vector product in R^n. Topology in R^n. Bounded set. Compact sets. Cluster points. Limits, continuity and related theorems. Partial and directional derivatives. Differentiable functions and related properties. Gradient Theorem. Sufficient condition for the differentiability. Tangent plane. Derivation and composition of functions. Lagrange Theorem. Functions with null gradient. Higher order derivatives. Schwartz Theorem. Hessian Matrix. Taylor formula. Local extrema: necessary conditions and sufficient conditions. Lagrange multipliers. Vector valued functions. Vector fields. Differentiability. Jacobian Matrix. Differentiability and composition. Divergence, curl and laplacian.* ***Curves and differential forms:*** Curves. Simple curves. Closed curves. Regular and piecewise regular curves. Changes of parameters. Rectification of a curve. Length of a regular curve and related properties. Line integral of first kind and related properties. Differential forms. Closed differential forms, exact differential forms and related properties. Potentials. Line integral of second kind and related properties. Conservative vector fields. Irrotational vector fields. Applications. **Multivariate integration.** Double integrals and their properties. Integrability of continuous functions. Geometric meaning of the double integral. Normal domains. Change of variables. Polar coordinates. Regular domains. Gauss-Green formulas. Area of a regular domain. Triple integrals and their properties. Reduction formulas. Volume of a solid of revolution. Change of variables. Cylindric and spherical coordinates. **Surfaces and Surface integrals.** *Surfaces. Regular surfaces. Tangent plane. Area of a regular surface. Notable examples. Surface integrals. Oriented*

Books and bibliography	*M. BRAMANTI, C.D. PAGANI, S. SALSA, Analisi Matematica 2, Zanichelli, 2009.* *M.BERTSCH, R.DAL PASSO, L. GIACOMELLI, Analisi Matematica Mc Graw-Hill, 2007* *P. MARCELLINI, C. SBORDONE, Esercitazioni di Analisi Matematica 2, Zanichelli, 2017* *M. BRAMANTI, C.D. PAGANI, S. SALSA, Matematica. Calcolo Infinitesimale e Algebra lineare, Zanichelli, 2004*
Additional materials	*Selected chapters from the above bibliography*

Work schedule		
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)
Hours		
250	*64*	*30*
ECTS		
10	*8*	*2*

Teaching strategy	*Lectures and exercises*
Expected learning outcomes	
Knowledge and understanding on:	*Solving the problems in the written exam; knowing the basic definitions and the theorems presented during the lectures.*
Applying knowledge and understanding on:	*Applying the theoretical results to solve the problems presented in the written exam.*
Soft skills	*Autonomy of judgement: evaluating the fittest strategy, in terms of timing and efficiency, in order to solve Mathematical problems.* *Communicating knowledge and understanding: being able to correctly use the logic-deductive mathematical language.* *Capacities of continue learning: being able to compare different source of information, coming from books, notes or on-line material.*

Assessment and feedback	

Methods of assessment	*Intermediate exams during the lessons. Written exam followed by an oral exam. The written exam is passed with an evaluation greater or equal to 18/30.*
Evaluation criteria	*Knowledge and understanding* *Minimum level: Solving half of the problems in the written exam; showing the knowledge of the main definitions and theorems during the oral exam.* *Intermediate level: Solving 2/3 of the problems in the written exam; showing the knowledge of the definitions and theorems (with some proofs) during the oral exam.* *Upper level: solving all the problems in the written exam; showing the knowledge of all the definitions and theorems (with all proofs) during the oral exam.* *Autonomy of judgment* *Minimum level: solving half of the problems in the written exam using correct reasonings; showing some logic-deductive reasoning capacity.* *Intermediate and upper level: solving the problems in the written exam using correct reasonings; being able to present the proofs of the results presented during the lectures.* *Communicating knowledge and understanding* *for all levels: using the correct terminology*
Criteria for assessment and attribution of the final mark	*Weighed average between the written exam (60%) and the oral exam (40%)*
Additional information	Part of the course is carried out by Prof. Sandra Lucente (sandra.lucente@uniba.it) Tutoring: by appointment via mail