UNIVERSITÀ DI PAVIA

Anno Accademico 2020/2021

ADVANCED MATHEMATICAL METHODS FOR ENGINEERS

Anno immatricolazione	2020/2021
Anno offerta	2020/2021
Normativa	DM270
SSD	MAT/05 (ANALISI MATEMATICA)
Dipartimento	DIPARTIMENTO DI INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE
Corso di studio	ELECTRONIC ENGINEERING
Curriculum	PERCORSO COMUNE
Anno di corso	1°
Periodo didattico	Primo Semestre (28/09/2020 - 22/01/2021)
Crediti	9
Ore	72 ore di attività frontale
Lingua insegnamento	English
Tipo esame	SCRITTO E ORALE CONGIUNTI
Docente	ROCCA ELISABETTA (titolare) - 9 CFU AURICCHIO GENNARO - 0 CFU
Prerequisiti	Differential and integral calculus, complex functions, sequence and series of functions, linear algebra, differential operators, power and Fourier series, Laplace and Fourier transforms for classical signals, linear differential equations with constant coefficients.
Obiettivi formativi	The course is an introduction to some basic elements of linear functional analysis (Hilbert spaces and distributions), variational principles, ordinary differential equations and dynamical systems, with simple applications to basic partial differential equations.
Programma e contenuti	Ordinary differential equations Basic definitions, examples and properties Existence and uniqueness, comparison

Linear systems, exponential matrix, Liouville Theorem

Basic tools of functional analysis

Lebesgue integral.
Functional spaces, norms and Hilbert spaces
Best approximation and projection theorem, orthonormal basis
Linear operators: boundedness and continuity, symmetry, self-adjointness, eigenvalues and eigenfunctions. Sturm-Liouville Problems.
Applications to simple PDE's

Partial differential equations

Examples and modelling
Wave equations, D'Alembert formula, characteristics and boundary value problems, spherical waves, solutions in two and three dimensions
The Laplace and heat equations
Simple techniques for calculating explicit solutions; separation of variables.

Distributions

Introduction, examples and applications.
Operating on distributions: sum, products, shift, rescaling, derivatives.
Sequence and series of distributions: Fourier series.
Fourier transform, temeperate distributions, convolutions

Metodi didattici

Lectures (hours/year in lecture theatre): 54
Practical class (hours/year in lecture theatre): 22
Practicals / Workshops (hours/year in lecture theatre): 0

Testi di riferimento

Ordinary Differential Equations and Systems
E.A. Coddington, An Introduction to Ordinary Differential Equations, Dover Publications, Inc., New York, 1961.
M.W. Hirsch and S. Smale, Differential Equations, Dynamical Systems, and Linear Algebra, Academic Press, New York, 1974.
V.V. Nemytskii and V.V. Stepanov, Qualitative Theory of Differential Equations, Dover Publications, Inc., New York, 1989.
W.T. Reid, Sturmian Theory for Ordinary Differential Equations, Applied Mathematics Series 31, Springer-Verlag, New York Heidelberg Berlin, 1980.

Basic Tools of Functional Analysis
B. D. Reddy, Introductory Functional Analysis, Texts in Applied Mathematics n. 27, Springer Verlag, New York, (1998).
W. Rudin, Functional Analysis, Mc Graw Hill, New York, (1973).
W. Rudin, Real and Complex Analysis, Mc Graw Hill, New York, (1966).

Distributions
E. DiBenedetto, Real Analysis, Birkhauser, Boston, (2002): Chapter VII.
F.G. Friedlander, Introduction to the theory of distributions, Cambridge

	University Press, Cambridge, (1998). S. Salsa, Partial Differential Equations in Action. From Modelling to Theory, Springer-Verlag Italia, (2008): Chapter 7. Partial Differential Equations E. DiBenedetto, Partial Differential Equations, 2nd Edition, Birkhaüser, (2009): Chapter 6. S. Salsa, Partial Differential Equations in Action. From Modelling to Theory, Springer-Verlag Italia, (2008): Chapter 5. W. Strauss. Partial Differential Equations: an introduction. Wiley.
Modalità verifica apprendimento	Written and oral examination. The written examination consists of exercises on the topics of the course. The minimum score to pass the written examination is 18/30. Oral examination will follow the written one for the students who got at least 18/30. The oral examination will be based on questions aiming at understanding which are the concepts acquired by the student. The minimum score to pass the exam is 18/30, the maximum score is 30/30 cum laude. In case of online exams (due to Covid-19 emergency), the exam could be replaced by only oral exam. The rules will be communicated in due time by the professor.
Altre informazioni	A more detailed description of the course can be found on the web page at the URL http://matematica.unipv.it/rocca/
Obiettivi Agenda 2030 per lo sviluppo sostenibile	Gli obiettivi