UNIVERSITÀ DI PAVIA

Anno Accademico 2016/2017

ADVANCED MATHEMATICAL METHODS FOR ENGINEERS

Enrollment year	2016/2017
Academic year	2016/2017
Regulations	DM270
Academic discipline	MAT/05 (MATHEMATICAL ANALYSIS)
Department	DEPARTMENT OF ELECTRICAL,COMPUTER AND BIOMEDICAL ENGINEERING
Course	ELECTRONIC ENGINEERING
Curriculum	PERCORSO COMUNE
Year of study	1°
Period	1st semester (26/09/2016 - 13/01/2017)
ECTS	9
Lesson hours	76 lesson hours
Language	ENGLISH
Activity type	WRITTEN AND ORAL TEST
Teacher	ROCCA ELISABETTA (titolare) - 9 ECTS
Prerequisites	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.
Learning outcomes	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.
Course contents	Ordinary differential equations Basic definitions, examples and properties Existence and uniqueness, comparison Linear systems, exponential matrix, Liouville Theorem

Basic tools of functional analysis

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

Teaching methods

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

Reccomended or required readings

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.
Assessment methods	Written and oral examination
Further information	A more detailed description of the course can be found on the web page at the URL http://matematica.unipv.it/rocca/
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile