Academic subject: Numerical Ecology				
Degree class: LM-40- Matematica		**Degree Course:** Mathematics	**Academic Year:** 2018/2019	
		Kind of class: mandatory	**Year:** 1	**Period:** 1
			ECTS: 7 divided into **ECTS** lessons: 7	

Time management, hours, in–class study hours, out–of–class study hours
lesson: 60 exe/lab/tutor: 0 in–class study: 60 out–of–class study: 115

Language: Italian	**Compulsory Attendance:** no		
Subject Teacher Luciano Lopez	**Tel**: +39 080 5442678 **e-mail:** luciano.lopez@uniba.it	**Office:** Department of Mathematics Room 15 , Floor 2	**Office days and hours:** Wednesday 11-13

Prerequisites: Basic knowledge of Algebra of matrices, numerical analysis, statistics, and programming language, knowledge that are acquired in the Bachelor of class L-35.

Educational objectives: Acquiring methods and techniques of applied mathematics for the observation and analysis of data from an ecological/environmental study. Simulation of environmental models described by partial differential equations

Expected learning outcomes (according to Dublin Descriptors)

Knowledge and understanding:
Acquisition of basic concepts of ecological/environmental analysis of a problem.

Applying knowledge and understanding:
Acquisition of numerical methods for ecological data analysis and simulation of environmental models and interpretation of results

Making judgements:
Ability to evaluate the results from a study of an ecological problem through the tools of applied mathematics

Communication:
acquisition of advanced mathematical language in describing a ecological problem and its simulation.

Lifelong learning skills:
Acquisition of appropriate learning methods, through the systematic use of texts, exercises and computer simulations of models

Course program:

Data analysis in Ecology: objects and descriptors in ecology; the ecological matrix. Binding arrays of objects and descriptors.. Association measures: similarity and distance. Statistical dependence of descriptors in ecology. Scattering matrix for descriptors. Covariance matrix and correlation matrix. Multivariate normal distribution. Determination of the principal axes of ellipsoid. Analysis of type R.and type Q: similarity coefficients (symmetric and asymmetric) and coefficients of distance between pairs of objects. Distances: metrics and semi-metrics. Cluster analysis (cluster analysis). Clustering methods: the single link, complete link, average, weighted average, the centroid, centroid weighed, minimum variance or Wart. Sorting in smaller spaces. Principal component analysis (principal component analysis, PCA). Principal components of a correlation matrix.

Linear and non-linear least squares methods. Introduction to data assimilation.

Modelling and numerical solution of environmental problems of distribution and transportation. Objectives and contents: introducing some elementary partial differential equations for environmental problems and acquiring the basic knowledge for the numerical solution with finite difference methods. Deepening of theory with exercises and experiments. Topics covered: differential operators in differential equations: physical meaning. talking. Classification of partial differential equations of second order. Elliptic equations: discretization with finite differences, discrete maximum principle, demonstration of convergence. Dirichlet boundary conditions and Neumann: physical meaning and its numerical solution. Numerical solution of partial differential evolutionary issues: convergence, consistency, stability, Lax theorem. Stability analysis according to **Von** Neumann.______

Teaching methods:
Lectures and exercise sessions

Auxiliary teaching:
Tutorial activity.

Assessment methods:
Oral exam and computer simulation of models

Bibliography:

P. Legendre, L.Legendre, Numerical Ecology, Elsevier 1998.

Holzbecher E, *Environmental Modeling,* Springer, Berlin, 2007

Thomas J.W., *Numerical partial differential equations: finite difference methods,* Springer, New York, 1995