

Academic subject: Fractal Theory			
Degree Class: LM-40		Degree Course: Mathematics	
		Academic Year: 2017/2018	
		Kind of class: optional	
		Year: 1	
		Period: 2	
		ECTS: 7 divided into ECTS lessons: 6,5 ECTS exe/lab/tutor: 0,5	
Time management, hours, in-class study hours, out-of-class study hours lesson:52 exe/lab/tutor:8 in-class study:60 out-of-class study: 115			
Language: Italian		Compulsory Attendance: no	
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		Ricevimento studenti: Dip. Matematica Sandra Lucente Piano II Stanza 22 Marcello D'Abbicco Piano II Stanza 36	
		Giorni e ore ricevimento: Sandra Lucente Martedì 14.30-16.30 In altri giorni previo appuntamento	
Prerequisites: Mathematical Analysis in one and more variables, Early Resources of Complex Analysis, General Topology. These notions are common to students after two years of Bachelor Mathematics L-35			
Educational objectives: Knowledge of the measure of Hausdorff; acquisition of Hausdorff box-counting and topological dimensions comparison of such notions; IFS and Mandelbrot and Julia fractals			
Expected learning outcomes (according to Dublin Descriptors)		<p>Knowledge and understanding: Acquire fundamental concepts and demonstrative techniques of the fractal theory.</p> <p>Applying knowledge and understanding: Ability to calculate some measure and dimensions of sets. Capacity to build some recursive fractals and implement them in a computer environment. Ability to relate the results studied with applications to geology, biology, medicine, etc.</p> <p>Making judgements: Ability to identify the right mathematical tools and the right techniques to deal with complex mathematical problems.</p> <p>Communication: Acquiring advanced mathematical language and mathematical formalism, necessary for the consultation and understanding of articles. Competences in Italian and English communication in mathematical language and formalism; computer skills in relation to the simple processing of fractals; ability to work in groups; the ability to divulge the relationship between fractals and the natural or anthropic world. Capacity to display the studied results for the description, analysis and resolution of some problems of chaos theory</p>	

Lifelong learning skills:

Acquisition of an appropriate study method supported by textbook and i computer programs for the construction of fractals

Course program

Analytical Theory Hausdorff Measure • Hausdorff dimension • Boxcounting dimension • Curve Length • Area Formula

Geometric Theory • Small Inductive dimension • Large Inductive dimension • Covering dimension • Equivalence in Definitions • Brower's Point Theorem and Euclidean Space Dimensions •

Fractal sets • Definition of fractal sets • IFS fractals • Application of the analytical and geometric theory of dimension to Cantor type sets, ultrametric space, Van Koch curve, Sierpinsky, Menger, Apollonius sets • Application to filling curves in particular Peano and Hilbert curves • Mandelbrot, Julia and Fatou Sets.

Applications Graphic methods for calculating the fractal dimension • Graphing methods for representation of fractal sets • Fractal applications in various disciplines

Teaching methods:

Classroom lessons

Auxiliary teaching:

For more complex lessons we give to students lecture notes few days before.

Assessment methods:

A talk starting from scientific articles on fractals.

Bibliography:

Falconer, Kenneth. *Fractal geometry: mathematical foundations and applications*. John Wiley & Sons, 2004.

Edgar, Gerald. *Measure, topology, and fractal geometry*. Springer Science & Business Media, 2007