MATEMATICA PER L'INGEGNERIA

PhD courses

M1 Sobolev Spaces and Applications to Partial Differential Equations,
Planned period: June 2020 (3 CFU)
Prof. A. F. Tedeev (South Mathematical Institute of VSC RAS)

M2 Introduction to fractals and boundary control problems in domains
Planned period: March/April 2020 (3 CFU+3 CFU)
Prof. Anna Chiara Lai, Maria Rosaria Lancia (SBAI, Sapienza)

M3 Lie algebras, vertex operators, and integer partitions.
Prof. Stefano Capparelli(SBAI, Sapienza)
Period: Second semester (5 CFU)

M4 Perron-Frobenius theorem and non-negative matrices: some applications.
Prof. Giovanni Cirulli Irelli (Sbai, Sapienza),
Period: Second semester (2 CFU+parte algoritmica)

List of useful courses from the Master degree:

Master M1 Mathematical Methods for Information Engineering (3 CFU) (Corso di Laurea in Ingegneria delle Comunicazioni)
Prof. Paola Loreti (SBAI, Sapienza)
period: February-May 2020

Master M2 Metodi Matematici per l'Ingegneria (3 CFU) (Corso di Laurea in Ingegneria Meccanica)
Prof. Daniele Andreucci (SBAI, Sapienza)
period: November-December 2019

Master M3 Metodi Numerici per l'Ingegneria Biomedica (4 CFU) (Corso di Laurea in Ingegneria Biomedica)
Prof. Francesca Pitolli (SBAI, Sapienza)
period: November-December 2019

Seminars

MS1 “Introduction to Fractional Laplacian”
Prof. Maria Medina (Pontificia Universidad Católica de Chile)
Planned period: January/Febraury 2020 (10 hours)

MS2 "La matematica, ponte naturale tra scienza e umanesimo"
Prof. Paolo Maroscia
Planned period: 2nd semester (4 hours)
1. "Il problema isoperimetrico: una storia da riscrivere?"

2. "La centralità dei numeri, sulle orme di Pitagora"

3. "Matematica e letteratura: un matrimonio d'interesse"

4. "L'unità affascinante della matematica

MS3 "Model reduction for PDEs"
Prof: Alessandro Alla (PUC-Rio de Janeiro)
Planned period: 30/01 - 04/02 - 06/02 – 07/02 2020

MS4 "Introduction to fractional calculus"
Prof. Mirko D'Ovidio (SBAI)
Planned period: December, 2019

M1 Sobolev Spaces and Applications to Partial Differential Equations,

Planned period: June 2020 (3 CFU)

Prof. A. F. Tedeev (South Mathematical Institute of VSC RAS)

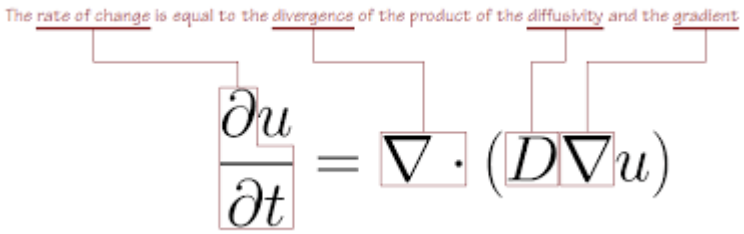
Program:

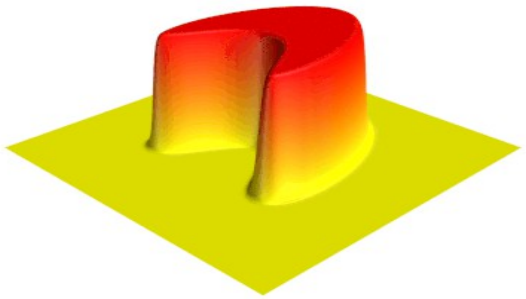
This course will cover the basic theory of Sobolev Spaces in the Euclidean Space and in Riemannian manifolds.

1) Sobolev spaces. Basic theory. Approximation by smooth functions. Results of compactness. Embeddings. Poincaré and Hardy inequalities. Isoperimetric and Faber-Krahn inequalities. Interplay betweenthe geometry of the manifold and the embedding results.

2) Linear and non-linear diffusion equations; the concept of solutions and the variety of possible behaviors. The energy method. Regularization and iterative techniques.

3) Asymptotics for large times: classical results in the Euclidean space.The asymptotic profile in linear and nonlinear diffusion. The case of the Neumann problem in subdomains of the Euclidean space. Asymptotic behavior in manifolds.





M2 Introduction to fractals and boundary control problems in domains

Planned period: March/April 2020 (3 CFU+3 CFU)

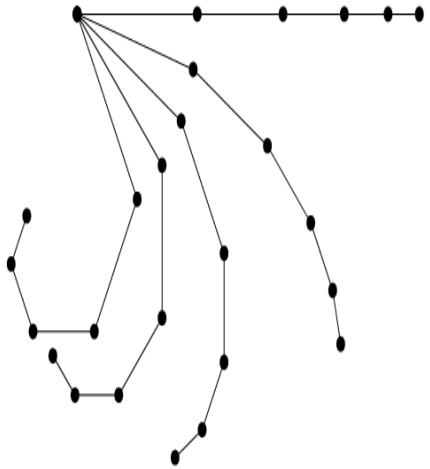
Prof. Anna Chiara Lai, Maria Rosaria Lancia (SBAI, Sapienza)

Modulo 1 (Prof. Anna Chiara Lai)

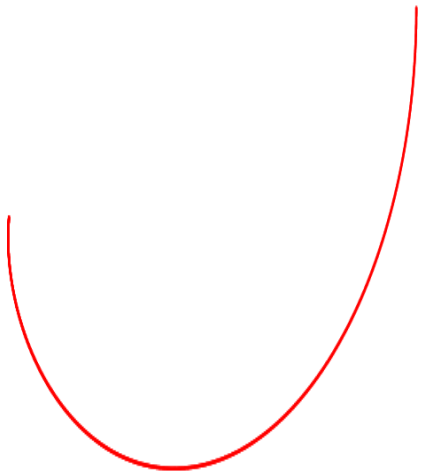
This module presents an introduction to fractals and their mathematical foundations. The final part of the module is devoted to the implementation, with Wolfram Mathematica software, of simple visualization and fractal dimension algorithms.

Modulo 2 (Prof.Maria Rosaria Lancia)

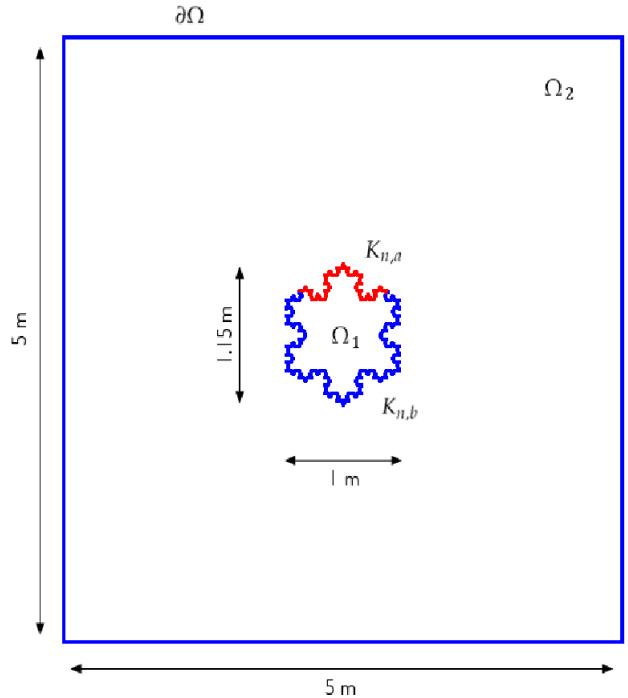
This module of the course will be devoted to an introduction of some problems of fractal analysis. Our aim will be to study some elliptic and parabolic PDES within fractal sets and in fractal domains.



(A) TLM engagement for Finger 4



(B) Talon (i.e. extremal of the toe) trajectory

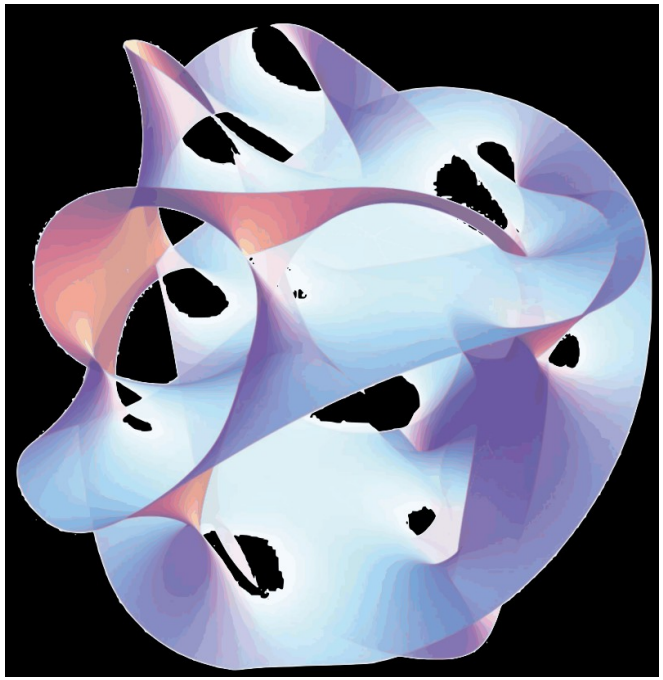


M3 Lie algebras, vertex operators, and integer partitions.

Prof. Stefano Capparelli(SBAI, Sapienza)

Period: Second semester (5 CFU)

This course will be an introduction to the theory of vertex operators and the integer partition theory. The level of the course will be elementary/introductory, and I will try to keep it essentially self-contained.



M4 Perron-Frobenius theorem and non-negative matrices: some applications.

Prof. Giovanni Cirulli Irelli (Sbai, Sapienza),

Period: Second semester (2 CFU+parte algoritmica)

We state and prove the celebrated theorem of Perron and its refinement due to Frobenius concerning the spectrum of a non-negative matrix. We then explore some of its many applications, e.g. Google page ranking. We review the singular value decomposition of a matrix and some of its applications, e.g. image compression.

$$PAP^{-1} = \begin{pmatrix} 0 & A_1 & 0 & 0 & \dots & 0 \\ 0 & 0 & A_2 & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & & \vdots \\ 0 & 0 & 0 & 0 & \dots & A_{h-1} \\ A_h & 0 & 0 & 0 & \dots & 0 \end{pmatrix},$$