

Titolo del corso: Elements of Fractional Calculus

Docenti: Dott. Andrea Giusti (U. Sussex) e Dott. Ivano Colombaro (UniBz)

Membro del collegio proponente: Andrea Mentrelli

Ore frontali di lezione: 20h (Giusti) + 10h (Colombaro)

Periodo di lezione: Novembre–Dicembre 2024

Settore disciplinare del corso: MAT/07

Tipologia di corso: Base

Modalità di verifica dell'apprendimento: Esame Orale al termine del corso.

Abstract del corso:

This course provides an elementary introduction to Fractional Calculus for graduate students. It covers the basics of Fourier and Laplace transforms, some relevant definitions of fractional operators widely used in the literature, a detailed discussion of a class of special functions relevant to fractional calculus, and an invitation to the theory of General Fractional Calculus. The theoretical part of the course is then complemented by the analysis of a selection of relevant applications.

Programma del corso:

- *Module 1 (20h) – Theory*
 1. Integral Transforms: Fourier and Laplace;
 2. Introduction to Fractional Calculus;
 3. Some definitions of Fractional Derivatives: Riemann-Liouville, Caputo, Riesz;
 4. Mittag-Leffler function(s);
 5. General Fractional Calculus (GFC): Kochubei's and Luchko's formulations;
 6. Fractional Laplacian.

- *Module 2 (10h) – Applications*
 1. Implementations of the GFC formalism: Prabhakar and Variable-order fractional calculi;
 2. Fractional Viscoelasticity;
 3. Anomalous Dielectrics;
 4. Modified Newtonian dynamics from fractional gravity;
 5. Emergence of fractional relaxation from local non-linear physics.