TECHNISCHE UNIVERSITÄT WIEN

Institute of Analysis and Scientific Computing

Course announcement [2020W]

ASC

Course Title:	**Theory of Distributions**
First Meeting:	The first meeting, to fix the lecture dates, will be via **zoom** on **Friday 09.10.2020**, at **12:15pm**. The **zoom** link will be posted on the course web page (but can also be requested via email).
Lecturer:	Di Fratta, Giovanni (✉ giovanni.difratta@asc.tuwien.ac.at)
Course web page:	🌐 www.asc.tuwien.ac.at/~difratta/?open=teaching2020

Course description:

The theory of distributions is an extension of classical analysis, which, other than providing a mathematical foundation for many heuristic arguments used in mathematical physics, also gives new and powerful tools for the study of partial differential equations. The theory was created by Laurent Schwartz in the 20th century and gives a unified broader framework in which to reformulate and develop classical problems. The need for such a generalization arises in many problems in engineering, physics, and mathematics. The course aims to make the interested student acquainted with the foundations of the theory of distributions as introduced by Schwartz in the elegant framework of topological vector spaces. Applications in partial differential equations and harmonic analysis will be emphasized whenever possible. Finally, the theory of distributions is a beautiful piece of mathematics, and the course is undoubtedly an excellent opportunity for all those interested in broadening their foundational mathematical baggage.

> «The invention of distributions occurred in Paris,in early November 1944.The discovery was quite sudden, taking place in a single night. I always called the night of my discovery a marvelous night, the most beautiful night of my life. On this particular night, I felt sure of myself and filled with a sense of exaltation. I lost no time in rushing to explain everything in detail to Cartan, who as I mentioned earlier, lived next door. He was enthusiastic: "*There you are, you've just resolved all the difficulties of differentiation*! *Now, we'll never again have functions without derivatives*" he told me. If a function has no (Weierstrass) derivative, then this simply means that its derivatives are operators, but not functions»
>
> **Laurent Schwartz**

Learning Outcomes:

After successful completion of the course, students can: ▸ Understand the role of the theory of distributions in other areas of modern analysis, especially in Calculus of Variations and Partial Differential Equations; ▸ Manage abstract results in the context of topological vector spaces, locally convex spaces, and Fréchet spaces; ▸ Explain Radon measures, Sobolev, and BV functions as examples of distributions of finite-order, and to derive statements about them; ▸ Apply the ideas and methods of the Theory of Distributions to prove central theorems of modern analysis.

Teaching methods:

Lecture. 2 hours per week. The instructor will spend most of the class time on presenting the new material. The students are encouraged to ask questions and seek help from the instructor.

Mode of examination:

Immanent

Course Outline:

▸ Topological vector spaces ▸ Locally Convex Spaces ▸ Fréchet spaces ▸ Fundamental function spaces ▸ Space of distributions ▸ Tensor product of Distributions ▸ Convolution of Distributions.

References:

▸ Schwartz, Laurent. *Théorie des distributions*. Paris: Hermann, 1997.

▸ Treves, François. *Topological Vector Spaces, Distributions and Kernels*. Elsevier, 2016.

▸ Horváth, John. *Topological vector spaces and distributions*. Addison-Wesley, 2012.

▸ Hörmander, Lars. *The analysis of linear partial differential operators I: Distribution theory and Fourier analysis*. Springer, 2015.

Prerequisites:

▸ A good knowledge of basic functional analysis is of advantage.