# LEARNING MODULE DESCRIPTION

**GENERAL INFORMATION**

1. Module title: Distributions, Fourier Transform and PDE
2. Module code: 06-DDFTUMO-E
3. Term:
4. Duration: 30 h of lectures + 30 h of exercises
5. ECTS: 6
6. Module lecturer: prof. dr hab. Leszek Skrzypczak
7. E-mail: lskrzyp@amu.edu.pl
8. Language: English

**DETAILED INFORMATION**

1. Module aim (aims)

The theory of distributions was a breakthrough point in the development in mathematical analysis in XX century. The theory find the crucial applications in partial differential equations, harmonic analysis, representation theory of Lie groups ect. The aim of the module is to introduce the main concepts and ideas of the theory of distributions and the main scheme of its applications to partial differential equations. After the course the student should be able to use distributions as a tool and environment to solve different problems in mathematical analysis in particular in PDE.

2. Pre-requisites in terms of knowledge, skills and social competences (where relevant)
   It is assume that students have basic knowledge in mathematical analysis, e.g. in the scope of modules Analysis I, II, III offered by Faculty of Mathematics and Computer Science some knowledge about Lebesgue integral on Euclidean space will be also helpful.

**READING LIST**


1. D.D. Haroske, H.Triebel, Distributions, Sobolev spaces Elliptic Equations, EMS Publishing House 2008.
2. L. Hoermander, The Analysis of Linear Partial Differential Operators I, Distribution Thoery and Fourier Analysis, Springer 1983.
3. W.Rudin, Functional Analysis, McGraw-Hill 1991.
4. L.Schwartz, Theorie des distributions I,II Herman Paris 1950-51.
5. E.Stein, R. Shakarchi, Functional Analysis Princeton Lectures in Analysis. IV, Princeton University Press 2011.
6. R. Strichartz, A guide to distribution Theory and Fourier Analysis. CRC Press 1994


**SYLLABUS:**

Week 1: Spaces of test functions and definitions of the corresponding spaces of distributions
Week 2: Operations on distributions: differentiation, multiplication by smooth functions.
Week 3: Localization and the support of the distributions
Week 4: Regular distributions, compactly supported distributions, distribution with point support.
Week 5: Convolution of the distributions. Theorem of supports
Week 6: Distributional and fundamental solutions of partial differential operators
Week 7: Tensor products and the Kernel Theorem
Week 8: Tempered distributions and the Fourier transform
Week 9: Fourier-Laplace transform and Paley-Wiener-Schwartz- Theorem
Week 10: Sobolev spaces on Euclidean spaces and on domains
Week 11: Embeddings of function spaces
Week 12: Extensions and Traces
Week 13: Laplace operator, Laplace-Poisson Equation and the Green functions
Week 14: Parametrices and regularity for elliptic operators
Week 15: Information on elliptic boundary value problems