M136	**Fourier analysis and applications**	L	P	S	ECTS
		2	2	0	6

Course objectives. To familiarize students with main results and applications of Fourier analysis.

Prerequisites. Undergraduate analysis programme.

Course content.

1. Introduction: periodic phenomena and periodic functions, idea of Fourier analysis and historical background. Lebesgue integral and spaces L^1 and L^2.
2. Fourier series and Fourier coefficients. Complex variant. Parseval identity and Riesz-Fischer theorem. Fourier series of periodic functions and trigonometric basis. Convergence and Gibbs phenomenon.
3. Applications of Fourier series.
4. Fourier integral and Fourier transformation for rapidly decaying smooth functions. Extension to spaces L^1 and L^2. Plancharel theorem. Inverse Fourier transformation.
5. Applications of Fourier transformation.
6. Discrete Fourier transformation. Fast Fourier transformation. Applications.
7. Basic notions of multiresolution analysis. Haar's wavelets.

LEARNING OUTCOMES

No.	LEARNING OUTCOMES
1.	Identify the real-world periodic phenomena.
2.	Understand and explain fundamental notions, as well as main idea of Fourier analysis.
3.	Explain and prove main properties of Fourier series and Fourier transformation.
4.	Use Fourier series and transformation for solving different real-world problems.
5.	Recognize and explain similarities and differences between discrete Fourier transformation and Fourier series and transformation.
6.	Use fast Fourier transformation for computing discrete Fourier transformation, particularly on examples coming from real-world problems.
7.	Explain basic notions of multiresolution analysis.
8.	Formulate conjectures related to the subject and prove or deny them.

RELATING THE LEARNING OUTCOMES, ORGANIZATION OF THE EDUCATIONAL PROCESS AND ASSESSMENT OF THE LEARNING OUTCOMES

TEACHING ACTIVITY	ECTS	LEARNING OUTCOME **	STUDENT ACTIVITY*	EVALUATION METHOD	POINTS	
					min	max
Attending lectures	1	1-8	Lecture attendance, discussion, team work and independent work on given tasks	Attendance lists, tracking activities	0	4
Written exam (Mid-terms)	2	1-8	Preparing for written exam	Evaluation	25	48
Final exam	3	1-8	Revision	Oral exam	25	48
TOTAL	6				50	100

Teaching methods and student assessment. Lectures and exercises are obligatory. The exam consists of a written and an oral part. Upon completion of the course, students can take the exam. Successful midterm exam scores replace the written exam.

Can the course be taught in English: Yes

Basic literature:

1. H. Dym, H. P. McKean, Fourier Series and Integrals, Academic Press, 1972.
2. W. L. Briggs, V. E. Henson, The DFT: An Owner's Manual for the Discrete Fourier Transform, Society for Industrial and Applied Mathematics, 1995.

Recommended literature:

1. G. Kaiser, A Friendly Guide to Wavelets, Birkhaüser, 2011.
2. I. Daubechies, Ten Lectures on Wavelets, SIAM, 1992.
3. A. Popoulis, The Fourier Integral and its Applications, Mc Grow-Hill 1984.