COURSE DESCRIPTION CARD - SYLLABUS

Course name
Harmonic Analysis [S2MwT1>AH]

Course

Field of study
Mathematics in Technology

Year/Semester
1/2

Area of study (specialization)
Programming in Technology

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other (e.g. online)
0

Tutorials
30

Projects/seminars
0

Number of credit points

4,00

Coordinators

dr Alicja Dota
alicja.dota@put.poznan.pl

Lecturers

Prerequisites

Student is familiar with the knowledge of mmathematical analysis, complex analysis, measure theory and functional analysis.

Course objective

Student knows basic ideas of harmonic analysis, see their connections to other fields of mathematics and can apply them in differential equations.

Course-related learning outcomes

Knowledge:
1. Student knows basic concepts of Fourier transform, Fourier series and theory of distributions.
2. Student knows basic ideas, theorems and problems of Fourier transform, Fourier series and theory of distributions.

Skills:
1. Student understand idea of Fourier transform and its importance.
2. Student can apply Fourier transform and theory of distribution, for example, to solve differential or

partial differential equations.

Social competences:
1. The student can formulate questions precisely in order to deepen his own understanding of a given subject or to find the missing elements of reasoning.
2. The student is able to find information in literature on one’s own including literature written in foreign languages.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lectures: Valuation of knowledge and skills during oral and written exam.
Tutorials: Two large tests concerning an application of knowledge from the lectures in exercises. Valuation of student answers during lessons. Valuation of activity during lessons.

Programme content

1. Convolution algebra L^1 and basic of Fourier series.
2. Approximation kernels: Fejer kernel, Poisson and de la Vallée Poussin kernel.
3. Fourier coefficients of special classes of functions.
4. Fourier series of functions from L^2 (Riesz-Fischer, Parseval and Plancherel theorems).
5. Pointwise convergence of Fourier series .
6. Conjugate function, Hilbert and Riesz transforms.
7. Distributions and tempered distributions.
8. Derivatives and transforms of tempered distributions.
9. Fourier transform on R^n.
10. Inverse Fourier transform and applications.
11. Maxial operator, Calderon-Zygmund operators and Hilbert transform.
12. Malgrange-Ehrenpreis theorem and applications to differential equations.
13. Fourier multipliers.

Teaching methods

Lectures:
-presenting theory and relating it with a students knowledge,
- presenting new material in connection with refeering to pevious lectures and subjects,
Tutorials:
- solving exercises strictly connected with the theory presented on lectures,
- solving exercises on the blackboard,
- detailed discussion of solutions.

Bibliography

Basic
1. W. Rudin, Analiza funkcjonalna, Wyd. Nauk PWN, 2002.
2. J. Musielak, Wstęp do analizy funkcjonalnej, PWN, 1976.
3. L. Grafakos, Classical Fourier Analysis, 2ed, Springer, 2008.
4. Y. Katznelson, An introduction to harmonic analysis, 3ed.
5. H. Helson, Harmonic analysis, Addison-Wesley Publ. Company, 1983.
Additional
1. L. C. Evans, Równania różniczkowe cząstkowe, PWN, 2002.
2. E. Stein, R. Shakarchi, Fourier analysis. An introduction, Princeton University Press, 2007.

Breakdown of average student's workload

	Hours	ECTS
Total workload	115	4,00
Classes requiring direct contact with the teacher	67	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	48	1,50