STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Functional analysis		**1010341751010347253**
Field of study	Profile of study (general academic, practical)	Year /Semester
Mathematics in Technology	**general academic**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**elective**
Cycle of study:	Form of study (full-time,part-time)	
First-cycle studies (Polish Qualifications Framework level six)	**full-time**	

No. of hours				No. of credits
Lecture: **30**	Classes: **30**	Laboratory: **-**	Project/seminars: **-**	**4**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
basic	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
The sciences	**4 100%**
Mathematical sciences	**4 100%**

Responsible for subject / lecturer:

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Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Basic knowledge in domain of calculus and topology on the level of studies of the first degree. [K_W01 (P6S_WG)]
2	**Skills**	Using of basic notions of topology, in particular topological spaces, metric spaces, convergence of sequences in these spaces and continuity of functions. Mastery in application of the most important topological notions in context of metric spaces. [K_U01 (P6S_UW)], [K_U13 (P6S_UW)]
3	**Social competencies**	Understanding of limitation of own knowledge and motivation for further education. [K_K01 (P6S_KK)], [K_K02 (P6S_KK)], [K_K05 (P6S_KK)]

Assumptions and objectives of the course:

Deep knowledge in functional analysis. Skills for application of acquired knowledge to theoretical as well as practical problems in other subjects mathematics and physics.

Study outcomes and reference to the educational results for a field of study

Knowledge:

A student has deep and wide knowledge in functional analysis and its applications and connections with another fields of mathematics, as topology, linear algebra, harmonic and mathematical analysis, or differential equations. He understands the role and significance of a mathematical proof, as well, as the role of assumptions. - [K_W01 (P6S_WG)]

Skills:

1. A student is familiar with basic theorems occurred in studied areas of mathematics, he understands the role of mathematics in the development civilization and its applications. A student understands structure of mathematical theories and structure of mathematical proof, he is able to use logical formalism in order to build and to analyse the simple mathematical models describing phenomena of various scientific disciplines. He can also present his knowledge in a clear and precise way. - [[K_U01 (P6S_UW)]

2. The student is able to use English (or in another foreign language) mathematical literature - [K_U13 (P6S_UW)]

Social competencies:

1. A student is aware in his knowledge in the area of mathematical sciences. He is able to formulate a problem precisely and try to solve it. - [K_K01 (P6S_KK)]
2. A student is able search out some information In literature (also English), by oneself. - [K_K02 (P6S_KK)]
3. He has knowledge about history of functional analysis and polish school of mathematics and ability popularization it. - [K_K05 (P6S_KK)]

Assessment methods of study outcomes

Lectures

Valuation of knowledge and skills during oral and written exam.

Practical Lessons

Two large tests concerning an application of knowledge from the lectures in exercises (student can use his own notes)

Systematic control of theoretical knowledge in form of short quizes.

Valuation of student answers during lessons.

Valuation of activity during lessons.

Course description

Revised 2018

Applied methods of education: lectures and practical lessons.

Interactive lectures with problems and questions for students. The activity of students is taken into account in valuation of them. Discussion during lectures is expected. Connections with others mathematical subjects are indicated.

Practical lessons. Solving of exemplary exercises on a blackboard. Discussion of solutions with relative comments.

Normed and Banach spaces. Examples of such spaces. Hölder Inequality and Minkowski Inequality. Linear operators and linear functionals. Norm of a linear operator and its properties. Open Map Theorem and Closed Graph Theorem. Riesz Theorem on compactness of a ball. Sequences of linear and continuous operators ? Banach-Steinhaus Theorem. An application of Banach-Steinhaus Theorem to classical analysis. Hahn-Banach Theorem and its application. Representation theorems for linear and continuous functional in concrete function or sequence spaces. Weak convergence and weak topologies in normed spaces. Elements of geometry of Banach spaces. Krein-Milman Theorem. Mazur Theorem. Hilbert spaces. Elements of spectral theory.

Basic bibliography:

1. J. Musielak, Wstęp do analizy funkcjonalnej, Warszawa PWN 1989.
2. S. Prus, A. Stachura, Analiza funkcjonalna w zadaniach, Warszawa PWN 2007.

Additional bibliography:

1. R.E. Megginson, An Introduction to Banach Space Theory, Springer Verlag 1998.
2. W. Rudin, Analiza funkcjonalna, Warszawa PWN 2011.

Result of average student's workload

Activity	Time (working hours)
1. Taking part in lectures	30
2. Taking part in practical lessons	30
3. Preparing for practical lessons	15
4. Prepating for tests	15
5. Preparing for the exam and taking part in it	20
6. Consultations	4

Student's workload

Source of workload	hours	ECTS
Total workload	114	4
Contact hours	66	2
Practical activities	48	1