STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Functional analysis		**1010342631010347253**
Field of study: **Mathematics**	Profile of study (general academic, practical): **(brak)**	Year /Semester: **2 / 3**
Elective path/specialty: **-**	Subject offered in: **Polish**	Course (compulsory, elective): **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time): **full-time**	
No. of hours: Lecture: **30** Classes: **30** Laboratory: **-** Project/seminars: **-**		No. of credits: **6**
Status of the course in the study program (Basic, major, other): **(brak)**	(university-wide, from another field): **(brak)**	
Education areas and fields of science and art		ECTS distribution (number and %)

Responsible for subject / lecturer:

prof. dr hab. Ryszard Płuciennik, prof. nadzw.
email: ryszard.pluciennik@put.poznan.pl
tel. 61 665 33 20
Faculty of Electrical Engineering
ul. Piotrowo 3A 60-965 Poznań

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.
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.
3	**Social competencies**	Understanding of limitation of own knowledge and motivation for further education.

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:

1. The student is able to understand well the role and weight of construction of examples and counterexamples in functional analysis. - [K_W02]
2. The student is able to master functional analysis with definitions, theorems and proofs. - [K_W05]
3. The student is able to understand in subject of functional analysis open problems and problems at the stage of study. - [K_W06]
4. The student is able to understand connections of functional analysis with other subjects of classical analysis. - [K_W07]

Skills:

1. The student is able to verify hypothesis in functional analysis by construction of proper examples and counterexamples. - [K_U01]
2. The student is able to present content connected with functional analysis and verify correctness of deduction in mathematical proofs. - [K_U02, K_U03, K_U04]
3. The student is able to distinguish the topological structure in objects occurring in functional analysis and draw a conclusions from it. - [K_U08]

Social competencies:

1. The student is able to formulate a problem precisely and try to solve it. - [K_K02]
2. The student understand the need for adducing intuition to his own understanding as well as to popularization of abstract mathematics. - [K_K05]
3. The student is able search out some information In literature (also English), by oneself. - [K_K06]

Assessment methods of study outcomes

Lecture:

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

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.

3. M. Fabian, P. Habala, P. Hajek, V. Montesinos Santalucia, J. Pelant, V. Zizler, Functional Analysis and Infinite-dimensional Geometry, Springer Verlag 2001.

Additional bibliography:

1. W. Rudin, Analiza funkcjonalna, Warszawa PWN 2011.

2. R.E. Megginson, An Introduction to Banach Space Theory, Springer Verlag 1998.

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	40
4. Prepating for tests	30
5. Preparing for the exam and taking part in it : (18 godz. + 2 godz)	30

Student's workload

Source of workload	hours	ECTS
Total workload	160	6
Contact hours	62	0
Practical activities	0	0