GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00066265		
Field of study	Mathematics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Specialty subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	5.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Robert Krawczyk	
	Teachers	dr inż. Robert Krawczyk	

Lesson types						
Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	0.0	0.0	15.0	60

E-learning hours included: 0.0

eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=3071

Moodle ID: 3071 Przestrzenie Sobolewa 2025/26 https://enauczanie.pg.edu.pl/2025/course/view.php?id=3071

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	60	5.0	60.0	125

Subject objectives	The aim of the course is to familiarize students with the basic properties of Sobolev spaces for functions from a line segment to a line and with basic theorems on the minimization of integral functionals on Sobolev spaces.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U05] recognize topological structures in mathematical objects occurring, for example, in geometry or mathematical analysis; uses the basic topological properties of sets, functions and transformations, uses the language and methods of functional analysis	The student is able to investigate convergence and weak convergence of sequences in Sobolev spaces.	[SU1] Assessment of task fulfilment
[K7_U07] at an advanced level and covering modern mathematics, applies and presents in speech and in writing the content and methods of a selected branch of mathematics	The student knows the definitions of Sobolev spaces and their basic properties.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W05] demonstrates knowledge the numerical methods used to find approximate solutions to mathematical problems posed by applied fields	The student is able to construct a sequence of successive approximations for a certain Cauchy problem.	[SW3] Assessment of knowledge contained in written work and projects
[K7_W01] has enhanced knowledge of basic branches of mathematics,demonstrates knowledge theorem and hypotheses, has understanding of the role and importance of mathematical reasoning structure.	The student knows theories on the representation of continuous linear functionals in selected Sobolev spaces.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture
Basic function spaces: continuous functions, p-integrable functions, essentially bounded functions, absolutely continuous functions. Sobolev spaces - definition and basic properties. Convergence and weak convergence in Sobolev spaces. Embedding lemmas. Basic theorems on the minimization of integral functionals in Sobolev spaces.

Course content – exercises
Basic function spaces: continuous functions, p-integrable functions, essentially bounded functions, absolutely continuous functions. Sobolev spaces - definition and basic properties. Convergence and weak convergence in Sobolev spaces. Embedding lemmas. Basic theorems on the minimization of integral functionals in Sobolev spaces.

Course content – seminar
Basic function spaces: continuous functions, p-integrable functions, essentially bounded functions, absolutely continuous functions. Sobolev spaces - definition and basic properties. Convergence and weak convergence in Sobolev spaces. Embedding lemmas. Basic theorems on the minimization of integral functionals in Sobolev spaces.

Prerequisites and co-requisites

The student has completed the functional analysis course I.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
exam	50.0%	50.0%
presentation at the seminar	75.0%	50.0%

Recommended reading

Basic literature	1. Joanna Janczewska, Minimization of integral functionals in Sobolev spaces, Lecture Notes in Nonlinear Analysis, Centrum Badań Nieliniowych im. J.P. Schaudera, tom 12, 2011, s. 61-91
Supplementary literature	1. Robert A. Adams, John J.F. Fournier, Sobolev Spaces, Pure and Applied Mathematics, 140, Elsevier, 2009 2. Giovanni Leoni, A First Course in Sobolev Spaces, Graduate Studies in Mathematics, 105, Amer. Math. Soc., 2009
eResources addresses	

Example issues/ example questions/ tasks being completed

1. Is the given sequence {un} a Cauchy sequence in the Sobolev space W1,p[a,b]?
2. Is the given sequence {un} convergent (weakly convergent) in the Sobolev space W1,p[a,b]?
3. Show that the given functional I:W1,p[a,b]->R is linear and continuous.
4. List the basic properties of the Sobolev spaces W1,p[a,b] (p1) and W1,[a,b].
5. Show that the given function f:[a,b]->R is absolutely continuous.
6. Prove that the absolutely continuous function f:[a,b]->R has a finite variation.

Practical activites within the subject

Not applicable

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