GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Sobolev space, PG_00021516		
Field of study	Mathematics		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2023/2024
Education level	second-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	blended-learning
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	Instytut Matematyki Stosowanej -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Robert Krawczyk	
	Teachers	dr inż. Robert Krawczyk	

Lesson types and methods of instruction

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: 30.0

Additional information:
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37851

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	35.0	100

Subject objectives

The aim of the subject is to present basic properties of Sobolev spaces of functions from an interval to the real line and basic theorems on minimization of integral functionals in Sobolev spaces.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W02] Has good understanding of the role and importance of mathematical reasoning structure.	The student knows the definitions of Sobolev spaces and their basic properties.	[SW1] Assessment of factual knowledge
[K7_W03] Knows the most important theorems and hypotheses of main branches of mathematics.	The student knows the theorems about the representation of continuous linear functionals in selected Sobolev spaces.	[SW1] Assessment of factual knowledge
[K7_U06] Has the ability to recognize topological structures in mathematical objects occurring, for example, in geometry or mathematical analysis; is able to use the basic topological properties of sets, functions and transformations, uses the language and methods of functional analysis in the problems of mathematical analysis and its applications, in particular uses the properties of classical Banach and Hilbert spaces.	The student is able to examine the convergence and weak convergence of sequences in Sobolev spaces.	[SU1] Assessment of task fulfilment

Subject contents

Basic functional spaces: continuous functions, absolutely continuous functions, p-integrable functions, essentially bounded functions. The Sobolev spaces - a definition and basic properties. Convergence and weakly convergence in the Sobolev spaces. Embedding lemmas. Minimization of integral functionals in the Sobolev spaces.

Prerequisites and co-requisites

Functional analysis I.

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Project on a given subject. Project's presentetion on the seminar.</td><td>75.0%</td><td>50.0%</td></tr>
<tr><td>A math test</td><td>50.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Joanna Janczewska, Minimization of integral functionals in Sobolev spaces, Lecture Notes in Nonlinear Analysis, Juliusz Schauder Center for Nonlinear Studies, vol. 12, 2011, p. 61-91.</td></tr>
<tr><td>Supplementary literature</td><td>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.</td></tr>
<tr><td>eResources addresses</td><td>Podstawowe
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37851 -
Uzupełniające
Adresy na platformie eNauczanie:
Przestrzenie Sobolewa 2023/24 - Moodle ID: 37851
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37851</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">1. Is $\{u_n\}$ a Cauchy sequence in $W^{1,p}[a,b]$?

2. Is $\{u_n\}$ convergent (weakly convergent) in $W^{1,p}[a,b]$?

3. Show please that a given functional $I:W^{1,p}[a,b]R$ is linear and continuous.

4. Give please basic properties of the Sobolev spaces $W^{1,p}[a,b]$ (p1) and $W^{1,}[a,b]$.

5. Show please that a given function f:[a,b]R is absolutely continuous.

6. Prove please that any absolutely continuous function f:[a,b]R has a bounded variation.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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