

## 。 GDAŃSK UNIVERSITY OF TECHNOLOGY

## Subject card

Subject name and code	Mathematical approach to symetrical phenomenon, PG_00025535								
Field of study	Mathematics								
Date of commencement of studies	October 2022		Academic year of realisation of subject			2024/2025			
Education level	first-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			at the university			
Year of study	3		Language of instruction			Polish			
Semester of study	5		ECTS credits			5.0			
Learning profile	general academic profile		Assessment form			exam			
Conducting unit	Zakład Analizy Nieliniowej -> Instytut Matematyki Stosowanej -> Faculty of Applied Physics and Mathematic						Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. Marek Izydorek						
	Teachers		prof. dr hab. Marek Izydorek						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Projec	t	Seminar	SUM	
	Number of study hours	30.0	30.0	0.0	0.0		0.0	60	
	E-learning hours included: 0.0								
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 main goal of the course is to present one of the most natural way of looking to the group theory, namely by actions of groups on various structures. Simply saying we will look on groups as groups of symmetries of some objects. We will focus on the action of groups on vector spaces by linear automorphisms of those spaces.								
Learning outcomes	Course outcome		Subject outcome			Method of verification			
	K6_K02		Student is able to formulate precisely basic definitions and theorems in representation theory. He (she) is also able to present clearly proofs of certain theorems.			[SK2] Assessment of progress of work			
	K6_U08		Student understands notion of real and complex representation of a finite group. He is able to check if a representation is irreducible and to compute its character.			[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information			
	K6_W01		Student is able to recognise symmetric fenomena in architecture, art and nature.			[SW2] Assessment of knowledge contained in presentation			
	K6_W03		Student can find representations of certain standard groups, can find symmetry groups of regular polygons and simple solids. Understands Schur's lemma.			[SW2] Assessment of knowledge contained in presentation			

Subject contents	<ol> <li>Theory of groups.</li> <li>Vector spaces and general linear groups.</li> <li>Linear representations of finite groups and basic examples.</li> <li>Direct sum of representations. Subrepresentations.</li> <li>Irreducible and indecomposable representations.</li> <li>Characters. Schur's Lemma.</li> <li>Canonical decomposition of a representation.</li> <li>Unitary representations.</li> <li>Induced representations (existance and uniqueness).</li> <li>Linear representations of given groups, such as dihedral and symmetric groups.</li> </ol>					
Prerequisites and co-requisites	<ul> <li>Linear algebra</li> <li>Algebra I</li> </ul>					
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade			
	Tests during a semester	50.0%	50.0%			
	Written exam	50.0%	50.0%			
Recommended reading	Basic literature	<ol> <li>J.P. Serre, Linear representations of finite groups, Graduate Texts in Mathematics, Vol. 42. <i>Springer-Verlag, New York-Heidelberg</i>, 1977</li> <li>A. Trautman, Grupy oraz ich reprezentacje, skrypt WF UW, Warszawa, 2000.</li> </ol>				
	Supplementary literature	J. Browkin, Teoria reprezentacji grup skończonych, PWN, Warszawa, 2009.				
	eResources addresses	Adresy na platformie eNauczanie:				
Example issues/ example questions/ tasks being completed	<ol> <li>Determine all, up to equivalence, complex, real and rational representations of the cyclic group of order n.</li> <li>Present a relationship between eigenvalues of a matrix and irreducible subrepresentations of a representation of a finite cyclic group.</li> <li>Let V be a complex representation of a finite group G. Show that there exists G-invariant scalar product on V.</li> <li>Let a finite group G act on a finite set X. Show that the character of the permutation representation corresponding to the action calculates number of fixed points under the action of every element of G.</li> <li>Find all irreducible representations of the quaternion group.</li> <li>Determine the canonical decomposition of the regular representations of groupsS<sub>6</sub>, D<sub>8</sub>, Q<sub>8</sub>, D<sub>10</sub>.</li> </ol>					
Work placement	Not applicable					

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