University of Gdańsk

Subject card

Subject name and code	Algebra I, PG_00155399		
Field of study	Mathematics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
Education level	Bachelor's studies	Subject group	Obligatory subject group in the field of study
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	3	ECTS credits	5.0
Learning profile	academic	Assessment form	exam
Conducting unit	Institute of Mathematics -> Faculty of Mathematics, Physics and Informatics -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Andreas Zastrow	
	Teachers	dr hab. Michał Stukow dr hab. Andreas Zastrow	

Lesson types

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

E-learning hours included: 0.0

eNauczanie source addresses:
Moodle ID: 13297 ATC-WMFI-MAT-L3DZ-(2025/2026)-Wykład z Algebry
https://mdl.ug.edu.pl/course/view.php?id=13297

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

Learning basic algebraic concepts (in this term primarily from group theory) and the theorems describing the properties of these concepts and the relationships between them.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[MATL3_K02] is ready to precisely formulate questions to deepen his/her own understanding of a given topic or to find missing elements of reasoning	is ready to precisely formulate questions to deepen his/her understanding of algebra, or finding the missing elements for some reasoning	[SK1] oral statement/conversation/discussion
[MATL3_W03] knows and understands the basic concepts, methods and theorems of linear algebra and analytical geometry, as well as basic examples both illustrating specific concepts in these fields and enabling the refutation of erroneous hypotheses or unauthorized reasoning	knows and understands the concepts of linear algebra and geometry in the algebraic context: algebraic structures related to vector spaces, algebraic structures related to geometric transformations	[SW1] oral statement/conversation/discussion
[MATL3_U08] is able to formulate definitions and theorems in an understandable way, both orally and in writing, and present correct mathematical reasoning regarding the acquired issues	is able to formulate definitions and theorems in an understandable way, both verbally and in writing, and present correct mathematical reasoning regarding the acquired issues, is able to examine its properties for a given object, for example whether the ideal is principal, maximal or prime and whether a given mapping is a homomorphism or epimorphism, monomorphism or isomorphism, can decide whether two algebraic objects are isomorphic	[SU4] test/exam - oral or written [SU6] demonstration of practical skills
[MATL3_W09] knows and understands the role and importance of proof in mathematics, as well as the concept of the importance of assumptions	knows and understands the role and importance of proof in mathematics, as well as the concept of the importance of assumptions	[SW4] test/exam - oral or written
[MATL3_U09] is able to plan how to solve a specific problem and prepare a correct record of this solution, providing strict and precise justification for the correctness of his reasoning	is able to plan a way to solve a specific problem and prepare a correct record of this solution, providing strict and precise justification for the correctness of his reasoning, is able to indicate or construct examples of algebraic objects that meet specific properties	[SU4] test/exam - oral or written
[MATL3_K01] is ready to accept the limitations of his/her own knowledge and understands the need for further education	is ready to acknowledge the limitations of one's own knowledge and understand the need for further education, is ready to independently expand algebraic knowledge based on existing textbooks devoted to more advanced content	[SK8] observation of student's independent or team work
[MATL3_K09] is ready to critically evaluate arguments, find gaps in reasoning and constructively criticize other people's reasoning	is ready to critically evaluate arguments, find gaps in algebraical reasoning and constructively criticize other people's reasoning	[SK1] oral statement/conversation/discussion
[MATL3_K04] is ready to understand and appreciate the importance of intellectual honesty in one's own and other people's actions; is willing to act ethically	is willing to understand and appreciate the importance of intellectual honesty in his own and other people's actions; ethical conduct	[SK8] observation of student's independent or team work
[MATL3_W01] knows and understands the basic concepts, methods and theorems of mathematical logic and set theory, as well as basic examples illustrating specific concepts in these fields and enabling the refutation erroneous hypotheses or unauthorized reasoning	knows and understands the concepts of mathematical logic and set theory in an algebraic context: equivalence relations and their classes, Cartesian products, binary operations	[SW4] test/exam - oral or written
[MATL3_W04] knows and understands the basic concepts, methods and theorems of general algebra as well as basic examples that both illustrate specific concepts from these fields and enabling the refutation erroneous hypotheses or unauthorized reasoning	knows and understands the basic concepts, methods and theorems of general algebra as well as basic examples both illustrating specific concepts (groups, homomorphisms, kernels) and allowing to refute erroneous hypotheses or unauthorized reasoning	[SW4] test/exam - oral or written

Course outcome	Subject outcome	Method of verification
[MATL3_K06] is ready to formulate opinions on basic mathematical issues	is ready to formulate opinions on learned algebraical theories and issues	[SK1] oral statement/conversation/ discussion
[MATL3_U04] is able to correctly use the acquired concepts of general algebra, is able - at a simple and medium level of difficulty - to apply the known theorems and methods of these fields and is able to interpret the obtained results	is able to correctly use the acquired concepts of general algebra (groups, homomorphisms, kernels), is able - at a simple and medium level of difficulty - to apply the known theorems and methods in these fields and is able to interpret the obtained results	[SU4] test/exam - oral or written [SU6] demonstration of practical skills
[MATL3_U03] is able to correctly use the acquired concepts of linear algebra and geometry, is able - at a simple and medium level of difficulty - to apply the known theorems and methods in these fields and is able to interpret the obtained results	can correctly use the concepts of linear algebra and geometry in an algebraic context: algebraic structures related to vector spaces, algebraic structures related to geometric transformations)	[SU4] test/exam - oral or written [SU6] demonstration of practical skills
[MATL3_W08] knows and understands the structure of mathematical theories, is able to use mathematical formalism to build and analyze simple mathematical models in other fields of science	knows and understands the structure of mathematical theories, is able to use mathematical formalism to build and analyze simple algebraical models in other fields of science	[SW1] oral statement/ conversation/discussion
[MATL3_U01] is able to correctly use the known concepts of mathematical logic and set theory, is able - at a simple and medium level of difficulty - to apply the known theorems and methods of these fields and is able to interpret the obtained results	can correctly use the concepts of mathematical logic and set theory in an algebraic context: equivalence relations and their classes, Cartesian products, binary operations	[SU4] test/exam - oral or written [SU6] demonstration of practical skills

Subject contents

- **Group Theory**

1. Definition of groups, subgroups, examples, cosets, index, Lagrange's theorem.
2. Subgroups generated by subsets, the order of elements, cylic groups.
3. Permutations, decomposition into disjoint cycles and transpositions, permutation sign of a permutation.
4. Homomorphisms of groups, kernel and its properties, normal subgroups, construction of a quotient group, isomorphism theorems for groups.
5. Cayley's theorem on subgroups of permutation groups.
6. Internal and external direct and semidirect sum for groups, relationships between these concepts.
7. Theorem on the structure of finitely generated Abelian groups.
8. Groups acting on sets, examples, Cauchy's theorem, Sylow theorems.

- **The beginning of ring theory:** (If time in the first term should suffice)

1. Definition of rings and ideals, quotient ring.
2. Ring homomorphisms, kernel, isomorphism theorem for rings.
3. Polynomial rings as examples.
4. Degree of a polynomial, division of polynomials, roots of a polynomial, Bezout's theorem and its consequences (otherwise this will be in the second term).

Prerequisites and co-requisites

elementary knowledge of Linear Alegbra

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
observation of the student's attitude	51.0%	0.0%
tests	51.0%	50.0%
exam	51.0%	50.0%

Recommended reading

Basic literature	A. Białynicki-Birula, Algebra, PWN (wiele wydań). J. Rutkowski, Algebra Abstrakcyjna w Zadaniach, PWN.
Supplementary literature	S. Lang, Algebra, PWN 1973. M. Bryński, J. Jurkiewicz, Zbiór zadań z algebry, PWN 1985. K. Szymiczek, Zbiór zadań z teorii grup.
eResources addresses	

Example issues/ example questions/ tasks being completed

Not applicable

Work placement

Not applicable

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