Course Syllabus

I. General Information

Course name	Abstract algebra
Programme	Mathematics
Level of studies (BA, BSc, MA, MSc, long-cycle MA)	BA
Form of studies (full-time, part-time)	Full-time studies
Discipline	Mathematics
Language of instruction	English

Course coordinator/person responsible	Dr Małgorzata Nowak-Kępczyk

Type of class *(use only the types mentioned below)*	Number of teaching hours	Semester	ECTS Points
lecture	60	IV	8
tutorial			
classes	30	IV	
laboratory classes			
workshops			
seminar			
introductory seminar			
foreign language classes			
practical placement			
field work			
diploma laboratory			
translation classes			
study visit			

Course pre-requisites	Basic knowledge of mathematical logic, set theory, linear algebra and mathematical analysis.

II. Course Objectives

C1. Presentation of basic concepts and facts of abstract algebra.
C2. Familiarize students with applications of abstract algebra in other areas of mathematics and natural sciences like e.g. number theory.

III. Course learning outcomes with reference to programme learning outcomes

Symbol	Description of course learning outcome	Reference to programme learning outcome
	KNOWLEDGE	
W_01	The student understands the importance of mathematics and its applications, in particular its role in the context of contemporary civilization's dilemmas	K_W01
W_02	The student has a good understanding of the role and importance of proof in mathematics, and the notion of essence of hypotheses	K_W02
W_03	The student understands the structure of mathematical theories, can use mathematical formalism to construct and analyze simple mathematical models in other areas of science	K_W03
W_04	The student Has advanced knowledge of the basic areas of higher mathematics, in particular in calculus, algebra, geometry, logic, measure and integral, probability theory, differential equations, statistics, set theory, topology and others selected fields of mathematics and its applications.	K_W04
W_05	The student knows basic examples both those that illustrate concrete mathematical notions, and those that allow false hypotheses or unsupported argumentation	K_W05
	SKILLS	
U_01	The student can in a clear manner, in speech and writing, present correct mathematical reasoning, formulate theorems and definitions	K_U01
U_02	The student uses entential and quantifier calculus, can properly use quantifiers in colloquial language	K_U02
U_03	The student is able to conduct easy and more advanced proofs be means of complete induction, can define functions and recurrent relations	K_U03
U_04	The student can apply classical logic system to formalize mathematical theories	K_U04
U_05	The student is capable to create new object by means of construction of quotient spaces or Cartesian products	K_U05
U_06	The student utilizes the language of set theory when interpreting problems from the various branches of mathematics	K_U06
U_07	The student perceives presence of algebraic structures (group, ring, field, linear space) in various mathematical contexts, not necessarily in direct connection with algebra	K_U17
	SOCIAL COMPETENCIES	
K_01	The student is prepared to take into account the limits of his own knowledge and skills, adequate assessment of his level of competence, his weaknesses, the need to constantly improve his professional skills, and at the same time know his strengths and present a critical attitude towards opinions not supported by rational justification	K_K01
K_02	Is ready to present selected achievements of higher	K_K05

mathematics in a popular way

IV. Course Content

1. Structures and substructures. 2. Inner operations in a class. Structures with inner operation. 3. Groupoids. Commutativity, associativity and distributivity of operations in groupoids. Neutral and inverse elements of a groupoid. 4. Iterations and the degree of an element in a groupoid. 5. Algebraic structures and substructures. Generators of algebraic structures. 6. Basic types of algebraic structures. 7. Algebraic extensions of algebraic structures. 8. Homomorphisms of algebraic structures. The kernel and image of homomorphism. 9. Quotient algebraic structures. 10. Algebraic structures induced by mappings. 11. The ring of integers and ring of integers modulo p. 12. Fundamental theorem on a homomorphism of algebraic structures. A canonical homomorphism. 13. Divisors of algebraic structures. 14. Divisors of groups – normal divisors. Quotient groups. Fundamental theorem on a homomorphism of groups. The center of a group. Groups of automorphisms. 15. Divisors of rings – ideals. 16. Symmetric groups and permutations. Groups of transformations and Cayley's theorem. 17. Cyclic groups. 18. Finite groups, index of a subgroup and Lagrange's theorem, p-groups and Sylov's theorem. The little Fermat theorem. 19. Direct products of groups. The decomposition of commutative and finite groups on cyclic groups. 20. The structure of commutative and finitely generated groups.

V. Didactic methods used and forms of assessment of learning outcomes

Symbol	Didactic methods *(choose from the list)*	Forms of assessment *(choose from the list)*	Documentation type *(choose from the list)*
KNOWLEDGE			
W_01	Conventional lecture	Exam, oral test	Evaluated written test
W_02	Conventional lecture	Exam, oral test	Evaluated written test
W_03	Conventional lecture	Exam, oral test	Evaluated written test
W_04	Conventional lecture	Exam, oral test	Evaluated written test
W_05	Conventional lecture	Exam, oral test	Evaluated written test
SKILLS			
U_01	Practical classes	Test	Evaluated test
U_02	Practical classes	Test	Evaluated test
U_03	Practical classes	Test	Evaluated test
U_04	Practical classes	Test	Evaluated test
U_05	Practical classes	Test	Evaluated test
U_06	Practical classes	Test	Evaluated test
U_07	Practical classes	Test	Evaluated test
SOCIAL COMPETENCIES			

K_01	Discussion	Observation	Observation report
K_02	Discussion	Observation	Observation report

VI. Grading criteria, weighting factors...

LECTURE:

The completion of classes is required.

Written and oral exam together constitute the final grade:
91 – 100% (5,0)
81 – 90% (4,5)
71 – 80% (4,0)
61 – 70% (3,5)
51 – 60% (3,0)
Less than 51% (2,0)

CLASSES:
At least 80% of attendance is required.
Two tests together constitute the final grade:
91 – 100% (5,0)
81 – 90% (4,5)
71 – 80% (4,0)
61 – 70% (3,5)
51 – 60% (3,0)
Less than 51% (2,0)
Detailed rules of evaluation are given on lectures and classes.

VII. Student workload

Form of activity	Number of hours
Number of contact hours (with the teacher)	**120**
Number of hours of individual student work	**90**

VIII. Literature

Basic literature
1. A. I. Kostrikin, Introduction to Algebra, Springer-Verlag, New York, 1982. 2. A. I. Kostrikin (Ed.), Exercises in Algebra. A Collections of Exercises in Algebra, Linear Algebra and Geometry, Gordon and Breach Publishers, 1996. 3. Białynicki-Birula, Zarys algebry, PWN, Warszawa 1987. 4. Białynicki-Birula, Algebra, PWN, Warszawa 1976. 5. Z. Opial, Algebra Wyższa, PWN, Warszawa 1976. 6. A. I. Kostrikin, Wstęp do algebry, cz.1 Podstawy algebry, Wyd. Nauk. PWN, Warszawa 2004. 7. I. Kostrikin, Wstęp do algebry, cz. 2 Algebra liniowa, Wyd. Nauk. PWN, Warszawa 2004. 8. I. Kostrikin, Wstęp do algebry, cz. 3 Podstawowe struktury algebraiczne, Wyd. Nauk. PWN, Warszawa 2005. 9. I. Kostrikin (red.), Zbiór zadań z algebry, Wyd. Nauk. PWN, Warszawa 2005.

Literatura uzupełniająca
Additional literature
1. S. Lang, Algebra (Revised Third Edition), Graduate Texts in Mathematics 211, 2002 Springer Science + Business Media, New York 2002. 2. J. Browkin, Teoria ciał, PWN, Warszawa 1977. 3. M.I. Kargapałow i J.I. Mierzlakow, Podstawy teorii grup, PWN, Warszawa 1989. 4. A.G. Kurosz, Algebra Ogólna, PWN, Warszawa 1965.