General Algebra - course description

General information

Course name	General Algebra
Course ID	11.1-WK-MATP-AO-W-S14_pNadGenCRRVT
Faculty	Faculty of Mathematics, Computer Science and Econometrics
Field of study	Mathematics
Education profile	academic
Level of studies	First-cycle studies leading to Bachelor's degree
Beginning semester	winter term 2020/2021

Course information

Semester	3
ECTS credits to win	4
Course type	obligatory
Teaching language	polish
Author of syllabus	• dr Joanna Skowronek-Kaziów

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	30	2	-	-	Exam
Class	30	2	-	-	Credit with grade

Aim of the course

In the end of this course the students know and understand the basic theorems concerning groups, rings, fields and lattices theory and they can applicate and use the notions and theorems from the abstract algebra in codes, cryptography and combinatorics.

Prerequisites

Linear Algebra 1 and 2.

Scope

1. Prime numbers, The Basic Theorem of Arithmetics, congruences of integer numbers, Euler Totient function, Euler theorem. Definitions and properties of operations in the algebraic structures.
2. Groups, abelian groups, cyclic groups, subgroups, permutation groups, torsion and torsion-free groups. Cayley's theorem and Lagrange's Thorem for groups. Morphisms of groups, normal subgroups, simple groups, congruences in groups. Quotient groups, Isomorphism theorem for groups. Sylow's Thorem.
3. Rings, subrings, ideals, congruences in rings, quotient rings. Isomorphism theorem for rings, principal ideals, prime ideals, Maximal ideals. Chinese theorem. Fields, simple fields, finite fields.
4. Polynomial rings in one and many indeterminates, polynomial roots, symmetric polynomials. Bezout's theorem, Gauss's theorem, Eisenstein-Shönemann's criterion. Algebraic elements over a field, minimal polynomial. Extensions of fields. Fields algebraically closed. Hilbert's zeros Theorem.
5. Lattices, modular and distributive lattices, sublattices, examples. Dedekind-Birkhoff theorem. Boolean algebras.

Teaching methods

Traditional lectures; Solving appropriate selected exercises in the class.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
The student can create the new objects by constructing the quotient algebras or cartesian products of algebras.	• K_W05	• a test • an exam - oral, descriptive, test and other • an observation and evaluation of activities during the classes	• Lecture • Class
The student knows the basic theorems of General Algebra and their proofs – Lagrange Theorem for groups and Group Isomorphism Theorem.	• K_U17	• a test • an exam - oral, descriptive, test and other • an observation and evaluation of activities during the classes	• Lecture • Class

Outcome description	Outcome symbols	Methods of verification	The class form
The student recognizes algebraic structures in different fields of mathematics (sets of numbers , matrices, functions, sequences, vectors and complex numbers with respect to the appropriate operations).	• K_W04	• a test • an exam - oral, descriptive, test and other • an observation and evaluation of activities during the classes	• Lecture • Class
The student knows examples of groups, rings, fields and lattices. Also can describe subalgebras of a given algebra using the appropriate theorems.	• K_U04	• a test • an exam - oral, descriptive, test and other • an observation and evaluation of activities during the classes	• Lecture • Class
The student can search information in the literature to prove some additional facts and theorems.	• K_U05	• an observation and evaluation of activities during the classes	• Lecture • Class
The student applies Hasse diagrams to describe the lattices of normal subgroups of a group or of ideals of a ring.	• K_U08	• a test • an exam - oral, descriptive, test and other • an observation and evaluation of activities during the classes	• Lecture • Class
The student knows examples of algebraic and transcendental numbers.	• K_K06	• a test • an exam - oral, descriptive, test and other • an observation and evaluation of activities during the classes	• Lecture • Class

Assignment conditions

Verifying the level of preparation of students and their activities during the classes. The student has to receive the positive grade from two tests with tasks of different difficulty which help to assess whether students have achieved effects of the course in a minimum degree (40% of the final grade). Written exam (60% of the final grade).

Recommended reading

1. Białynicki-Birula, Zarys algebry, BM tom 63, PWN, Warszawa, 1987.
2. M. Bryński, Algebra dla studentów matematyki, PWN, Warszawa 1987.
3. Gleichgewicht, Algebra, Oficyna GiS, 2002.
4. W. J. GILBERT, W. K. NICHOLSON, MODERN ALGEBRA WITH APPLICATIONS, A JOHN WILEY & SONS, INC., PUBLICATION (http://cs.ioc.ee/~margo/aat/Gilbert W.J., Nicholson W.K. Modern algebra with applications (2ed., Wiley, 2004)(ISBN 0471414514)(347s).pdf)
5. J. Rutkowski, Algebra abstrakcyjna w zadaniach, PWN, Warszawa, 2000.

Further reading

1. G.Birkhoff,T.C.Bartee, Współczesna algebra stosowana, PWN,Warszawa,1983.
2. S. Burris, H. P. Sankappanavar , A Course in Universal Algebra, (http://orion.math.iastate.edu/cliff/BurrisSanka.pdf)
3. M. Bryński, J. Jurkiewicz, Zbiór zadań z algebry, PWN, Warszawa 1985.
4. A.I. Kostrykin, Wstęp do algebry, cz. I, III, PWN, Warszawa, 2005.
5. R. Lidl, Algebra dla przyrodników i inżynierów, PWN, Warszawa 1983.
6. A. Mostowski, M. Stark, Algebra wyższa, cz. I, II, III, PWN, 1966.

Notes

Modified by dr Alina Szelecka (last modification: 18-09-2020 13:45)