COURSE DESCRIPTION CARD - SYLLABUS

Course name
Abstract algebra [S1MNT1>AA]

Course

Field of study
Mathematics of Modern Technologies

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

dr Anna Iwaszkiewicz-Rudoszańska
anna.iwaszkiewicz-rudoszanska@put.poznan.pl

Lecturers

Prerequisites

Basic knowledge of linear algebra and calculus. Logical thinking skills. Understanding of the limitations of one’s knowledge and motivation for further education.

Course objective

The course is intended to give basic skill in the concepts and methods of abstract algebra and its applications.

Course-related learning outcomes

Knowledge:
• student has structured knowledge of algebra terminology [K_W03(P6S_WG)];
• student has an extended and in-depth knowledge of algebra and detailed knowledge of the application of algebra methods in selected areas of exact and technical sciences [K_W01(P6S_WG)].

Skills:
• student notices the presence of algebraic structures (groups, rings, fields) in various mathematical problems and other areas of knowledge and knows how to use them [K_U01(P6S_UW)];

• student uses the concepts of homomorphism, isomorphism and automorphism of algebraic structures and the basic concepts of the theory of divisibility in integral domains [K_U01(P6S_UW)].

Social competences:
• student knows the limitations of her/his knowledge and understands the need for further education [K_K02(P6S_KK)].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: valuation of knowledge and skills during oral exam.
Tutorials: two colloquia.

Programme content

Algebraic structures and their homomorphisms and isomorphisms. Groups, lagrange's theorem, quotient group, group homomorphisms, first isomorphism theorem, cyclic groups, permutation groups, structure of finite abelian groups. Rings, polynomial rings, ideals and quotient rings, chinese reminder theorem, field of fractions, factorization in integral domains, Euclidean domains. Fields, subfields and field extensions, finite fields. Boolean algebras.

Course topics

Update: 31.05.2024r.
Lectures:
• algebraic structures: operations, properties of operations, external operations, algebraic structures and their homomorphisms and isomorphisms;
• groups: definition and examples, order of a group, order of an element of a group, subgroups, cosets, normal subgroups, lagrange's theorem, quotient group, group homomorphisms, kernels and images of homomorphisms, first isomorphism theorem, cyclic groups, permutation groups, direct product of groups, structure of finite abelian groups;
• rings: definitions and examples, zero divisors and invertible elements, integral domains, subrings, ring homomorphisms, polynomial rings, ideals and quotient rings, principal ideals prime and maximal ideals, chinese reminder theorem, field of fractions, factorization in semigroups and in integral domains, irreducible elements, unique factorization, prime elements, gcd i lcm, principal ideal domains, Euclidean domains, Euclidean algorithm;
• fields: characteristic of a field, examples, subfields and field extensions, finite fields;
• boolean algebras: definitions, switching circuits;
Tutorials:
• properties of operations;
• groups, subgroups, normal subgroups, cosets and quotient groups;
• group homomorphisms, kernels and images of homomorphisms;
• group isomorphism (definition, first isomorphism theorem);
• order of an element of a group,cyclic groups;
• permutations, structure of finite abelian groups;
• rings, zero divisors and invertible elements, integral domains, subrings, ring homomorphisms, polynomial rings, ideals and quotient rings, principal ideals prime and maximal ideals, first isomorphism theorem, reducible and irreducible elements, unique factorization, prime elements, gcd i lcm, Euclidean algorithm;
• field extensions, finite fields.

Teaching methods

Lectures: mulimedia presentation accompanied with examples presented on the blackboard as well as asking questions to students.
Tutorials: solving examples on the blackboard, initiating discussions about solutions, real-time feedback from the teacher.

Bibliography

Basic:
• William J. Gilbert, W. Keith Nicholson, Algebra współczesna z zastosowaniami, WNT, Warszawa 2008;

• Andrzej Białynicki-Birula, Algebra, PWN, Warszawa 2009;
• Andrzej Białynicki-Birula, Zarys algebry, PWN, Warszawa 1987;
• Aleksiej Kostrikin, Wstęp do algebry, Podstawy algebry, t. 1, PWN, Warszawa 2015;
• Jerzy Rutkowski, Algebra abstrakcyjna w zadaniach, PWN, Warszawa 2005.

Additional:
• Garret Birkhoff, Saunders Mac Lane, Przegląd algebry współczesnej, PWN, Warszawa 1963;
• A.I. Kostrikin, Zbiór zadań z algebry, Warszawa 2015.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	63	2,50