Algebraic and geometrical methods in physics II - course description

General information

Course name	Algebraic and geometrical methods in physics II
Course ID	13.2-WF-FizP-AGMP-S17
Faculty	Faculty of Physics and Astronomy
Field of study	Physics
Education profile	academic
Level of studies	First-cycle studies leading to Bachelor's degree
Beginning semester	winter term 2019/2020

Course information

Semester	2
ECTS credits to win	4
Available in specialities	General physics
Course type	obligatory
Teaching language	english
Author of syllabus	• dr hab. Maria Przybylska, prof. UZ

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	15	1	-	-	Exam
Class	30	2	-	-	Credit with grade

Aim of the course

Learning students of more advanced concepts, facts and methods of linear algebra with chosen elements of abstract algebra and analytical geometry. Obtaining the ability to solve certain typical exercises illustrating introduced notions. The aim of the course is also to develop the students' precise thinking skills and to prepare the methods and techniques of linear algebra in various branches of physics.

Prerequisites

algebraic and geometric methods in physics

Scope

1. Algebraic structures. Sets, relations, operations (two-arguments), properties of operations, examples. Definition of a group, a ring, a ring with unity and a field, Examples of applications of various algebraic structures with particular emphasis on groups, examples of various groups.
2. Linear spaces. General definition of a linear space, linear subspaces, linear independence, base, dimension, subspace, intersection and the sum of a simple subspace. Examples of various linear spaces
3. Linear mappings and their basic properties. Examples of mappings. Kernel and image of linear mapping. Composition of linear mappings, inverse mapping.
4. Matrix representation of a linear mapping. Definition of matrix representation of linear mapping, mutual uniqueness between linear mappings and matrices. Theorems on the form of the matrix of the composition of linear mappings and the matrix of the inverse mapping to a given automorphism.
5. Matrix of transition and its properties. Theorem on the change of the mapping matrix when changing the domain bases and the counter-domain.Invariant subspaces. Eigenvectors and eigenvalues

6. Transformation of the linear transformation matrix when changing the vector space base. Diagonalization of the matrix. Jordan's theorem. Matrix functions.
7. Euclidean spaces. General definition, scalar product, angle between vectors, orthogonal and orthonormal base, orthogonal decomposition, Gram-Schmidt orthogonalization.
8. Quadratic forms. Linear transformations of quadratic forms, canonical forms, specificity of forms. Classification of curves and second degree algebraic surfaces in R^2 and in R^3.

Teaching methods

Conventional lecture examples of application of algebra and analytic geometry in physics.

Calculation classes, within which students solve tasks illustrating the content of the lecture enriched with physical applications.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form

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The student can use a mathematical apparatus to describe and model phenomena and physical processes.	• K1A_W02	• a quiz • an exam - oral, descriptive, test and other	• Lecture • Class
The student uses a variety of materials in Polish and English, provided both by leecturer and self-found using modern technologies. Acquires a critical attitude towards materials of poorly established origin found on the web.	• K1A_U07	• a quiz • an exam - oral, descriptive, test and other	• Lecture • Class
The student knows and understands selected topics of linear and abstract algebra and analytic geometry. He knows the terminology used in these sciences	• K1A_W02 • K1A_W04	• a quiz • an exam - oral, descriptive, test and other	• Lecture • Class
The student knows and applies the general concepts: operations, groups, fields, linear space, vector, linear independence, vector space base, linear transformation, norms, Euclidean space, square form, knows different examples of linear spaces, especially those used in physics; performs operations on vectors belonging to different vector spaces and knows their physical applications; understands the concept of linear transformation between vector spaces, can determine eigenvectors and eigenvalues, finds a diagonal form of the matrix, knows the structure of the Jordan form; can bring square forms to the canonical form; can classify curves and second degree algebraic surfaces in R^2 and R^3.	• K1A_W02 • K1A_U01 • K1A_U07	• a quiz • an exam - oral, descriptive, test and other	• Lecture • Class

Assignment conditions

Lecture: Positive passing of exam (written).
Classes: Positive passing of all tests (written).
Before taking the exam a student must gain positive grade during the class.

Final grade: the arithmetic average of the exam grades and pass the exercises.

Recommended reading

[1] T. Jurlewicz, Z. Skoczylas, *Algebra liniowa 2*, Oficyna Wydawnicza GiS, Wrocław 2011

[2] T. Jurlewicz, Z. Skoczylas, *Algebra i geometria analityczna*, Oficyna Wydawnicza GiS, Wrocław 2011.

[3] J. Klukowski, I. Nabiałek, Algebra dla studentów, Wydawnictwo Naukowo-Techniczne, Warszawa 1999.

[4] A. Mostowski, M. Stark, Algebra liniowa, Państwowe Wydawnictwo Naukowe, Warszawa 1977.

[5]Strona:http://wazniak.mimuw.edu.pl/index.php?title=Algebra_liniowa_z_geometrią_analityczną

[6] W.D. Clark, S.L. McCune, Linear Algebra, McGraw-Hill Companies, Inc, 2013

[7] RS. Lipschutz, M. Lipson, Schaum's Outline of Theory and Problems of Linear Algebra, McGraw-Hill Companies, Inc, 2001

[8] A.V. Pogorelov, Analytical Geometry, Mir Publisher, Moscow, 1980

[9] Materiały udostępnione przez prowadzących zajęcia.

Further reading

[1] R. Larson, Elementary Linear Algebra, CENGAGE Learning, 2017

[2] 6] E. W. Swokowski, *Calculus with Analytic Geometry,* Alternate Edition -PWS Publisher 1983.

Notes

Modified by dr hab. Piotr Lubiński, prof. UZ (last modification: 19-02-2020 15:24)