Algebraic and geometrical methods in physics - course description

General information

Course name	Algebraic and geometrical methods in physics
Course ID	13.2-WF-FizP-AGMP-I-S17
Faculty	Faculty of Physics and Astronomy
Field of study	Physics
Education profile	academic
Level of studies	First-cycle Erasmus programme
Beginning semester	winter term 2017/2018

Course information

Semester	1
ECTS credits to win	6
Course type	obligatory
Teaching language	english
Author of syllabus	• prof. dr hab. Wiesław Leoński • 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	30	2	-	-	Exam
Class	45	3	-	-	Credit with grade

Aim of the course

The main aim of course is to give students mathematical tools of algebra and analytic geometry necessary for their further studies of physics. Developing the ability to use algebraic and geometric tools for setting and solving physical problems. Use of vector mathematical tools such as vector space, linear transformation or Euclidean space.

Prerequisites

Knowledge of mathematics and physics at the level of post-gymnasium

Scope

Lecture:

I. Complex numbers: Cartesian and polar parameterization. Complex roots, rootsof unity.

II. Polynomials of one variable: operations on polynomials, division of polynomials with rest, roots of polynomials, fundamental theorem of algebra.

III. Matrices: operations on matrices, matrix classification. Square matrices: determinant and its properties. Methods of calculation of determinants.

Cramer linear systems and methods for solving them.

IV. Euclidean vector spaces: vectors in R^2, R^3 and R^n, vector components, vector operations, vector norms, scalar and vector product,, orthogonal vectors, angle between vectors.

V. Geometry of linear systems: vectors of solutions of systems of homogeneous and non-homogeneous linear equations.Order of a matrix, Kronecker-Capelli theorem. Methods of solving for general systems of linear equations. Linear transformations and their basic properties. Matrix of linear transformation, eigenvectors and eigenvalues

VI. Elements of analytical geometry: parametric equations of straight lines in R^2 and R^3, equations of planes in space, equations of straight lines and planes with given various data, conics in Cartesian and polar systems,

Class:

Practical realization of the matter presented during lectures and enhancement of the calculus skills.

Teaching methods

Lecture: classical lecture

Class: solving of problems related to the subjects considered during lectures with applications in physics.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form

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Student can determine various forms of complex number, perform various algebraic operations on complex numbers and know the physical applications of complex numbers. He/shi knows the notion of matrix and determinant, performs operations on matrices, calculate determinants. He/she uses determinants to solve linear systems of equations. He/she knows the concept of linear space and its properties, knows various examples of linear spaces, especially those used in physics; performs various operations on vectors and knows their physical applications. He/she understands the concept of linear transformation between vector spaces, knows how to determie eigenvalues and eigenvectors. Student can write equations of straight lines in the plane and equations of planes in three-dimensional space based on various given data. He/she recognizes conics, writes equations of conics in coordinate systems with moved origin, apply these equations to describe physical problems. The student knows characeristic properties of Euclidean spaces and can orthogonalize the given vectors.		• an evaluation test • an exam - oral, descriptive, test and other	• Lecture • Class
Student knows and understands selected topics of complex number theory, linear algebra and analytical geometry. He/she knows the elementary terminology used in these sciences.		• an evaluation test • an exam - oral, descriptive, test and other	• Lecture • Class
Student has the ability to use a mathematical apparatus to describe and model physical phenomena and processes.		• an exam - oral, descriptive, test and other	• Lecture • Class
Student is aware of his/her knowledge and skills; understands the need and knows the possibilities of continuing education at higher education levels.		• a discussion	• Lecture • Class

Assignment conditions

Lecture: Positive passing of written exam

Class: Positive passing of all written tests.

Before taking the exam a student must gain positive grade during the class.

Total score: average rating of the exam and grade from the class.

Recommended reading

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

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

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

[4] R. Larson, Elmentary linear algebra, 8 edition, Cengage Learning, 2007

[5] S. Lipschutz, M. Lipson, Schaum's outlines. Linear algebra, 3 edition, 2001

[6] E. W. Swokowski, *Calculus with analytic geometry*, Prindle, Weber & Schmidt Publishers, Boston 1983.

Further reading

Notes

Modified by dr hab. Maria Przybylska, prof. UZ (last modification: 29-10-2017 00:02)