# COURSE DESCRIPTION CARD - SYLLABUS

Course name

Algebra with geometry

## Course

| Field of study | Year/Semester |
|---|---|
| Automation and robotics | 1/1 |
| Area of study (specialization) | Profile of study |
| - | general academic |
| Level of study | Course offered in |
| First-cycle studies | Polish |
| Form of study | Requirements |
| part-time | compulsory |

## Number of hours

| Lecture | Laboratory classes | Other (e.g. online) |
|---|---|---|
| 18 | 0 | 0 |
| Tutorials | Projects/seminars | |
| 18 | 0 | |

## Number of credit points

5

## Lecturers

Responsible for the course/lecturer:

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## Prerequisites

Knowledge: Basic knowledge of mathematics (core curriculum for secondary schools, basic level). In addition, the student of this subject should understand the need to expand their competences.

Skills: Acquiring and using information from the indicated sources.

Social Competence: In addition, it should demonstrate such qualities as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

## Course objective

1. Provide students with basic knowledge of linear algebra in the field of applications in automation and robotics.

## Course-related learning outcomes

Knowledge

1. The student possessa knowledge including algebra with geometry, algebra for the description and analysis of numerical data, signals and algorithms occurring in automation and robotics. - [K1_W1].

Skills

1. The student is able to demonstrate the abilities of abstract thinking about the elements being the subject of algebra. - [-]

Social competences

1. The student, understanding the issues of algebra, will have the opportunity to properly learn the issues of automation and robotics and thus perform tasks in the field of automation and robotics, the effects of which will be goods expected by the society. - [-]

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

a) in the scope of lectures:

based on answers to questions about the material discussed in previous lectures

b) in the scope of tutorials, assesment of the assumed learning outcomes is based on:

i.assessment of answers to questions concerning the material discussed in previous lectures and tutorials, the knowledge of which is necessary to perform the current tasks,

ii. assessment of tests - written work consisting in solving computationals problems (2 tests).

Obtaining additional points for activity during classes, in particular for:

i. discuss of additional aspects of the issue,

ii. effectiveness of applying the acquired knowledge while solving a given problem,

iii. comments related to the improvement of teaching materials,

Summative assessment:

a) in the scope of lectures the verification of the assumed learning outcomes is carried out by:

i. assessment of the knowledge and skills shown in the exam - written work containing problem questions and written calculation tasks; getting 50% of the number of total points give a positive rating, the questions are a detailed version of the issues made available to students in order to prepare for the exam,

ii. discussion about exam results,

b) in the scope of tutorials, it is a resultant assessment resulting from the formative assessments.

## Programme content

The lecture covers the following topics:

1. Introduction - application of algebra in automatics and robotics. Operation and its properties, multiplication of permutations, algebraic structure - group.

2. Operations on complex numbers (canonical, trigonometric, exponential form; multiplication, addition, power, root, logarithm).

3. Operations on matrices (addition, multiplication), calculating the determinant and its properties, rank of matrices.

4. Calculating the determinant using Laplace expansion, matrix inversion (by computing algebraic complement and performing elementary transformations).

5. Solving systems of equations with Cramer's formulas, Gauss-Jordan elimination and matrix inversion. Kronecker-Capelli theorem.

6. Vector space (concepts: linear combination of vectors, linearly independent vectors, basis)

7. Projecting a vector onto a subspace (projection matrix, orthogonality, least squares approximation).

8. Complete solution of a system of equations.

9. Linear transformation (matrix of linear transformation), calculation of values and eigenvectors. Calculation of LU distribution and Cholesky distribution.

As part of the exercises, the solutions to the tasks containing the issues presented during the lecture are presented in detail.

The tutorial program includes computational tasks in the field presented during the lecture.

## Teaching methods

1. Lecture: multimedia presentation, presentation illustrated with examples given on the board, solving problems

2. Tutorials: solving problems on the blackboard, discussing problem tasks

## Bibliography

Basic

1. Maciej Grzesiak, Wiktor Jankowski, "ALGEBRA dla kierunku telekomunikacja", Wydawnictwo Politechniki Poznańskiej, Poznań 1992

2. Maciej Grzesiak, "Liczby zespolone i algebra", Wydawnictwo Politechniki Poznańskiej, Poznań 2003

3. G. Strang, Introduction to linear algebra, Wellesley-Cambridge Press, MA, 2009

Additional

1. Andrzej Sołtysiak, "Algebra liniowa", Wydawnictwo Naukowe UAM, Poznań 1999

2. Bolesław Gleichgewicht, "Algebra", Oficyna Wydawnictwo GiS, Wrocław 2002

3. Teresa Jurlewicz, Zbigniew Skoczyłaś, "Algebra liniowa 1 - definicje, twierdzenia, wzory", Oficyna Wydawnicza GiS, Wrocław 2005

4. Teresa Jurlewicz, "Algebra liniowa 2 ? kolokwia i egzaminy", Oficyna Wydawnicza GiS, Wrocław 2006

5. Marian Gewert, Zbigniew Skoczyłaś, "Algebra liniowa 1 - kolokwia i egzaminy", Oficyna Wydawnicza GiS, Wrocław 2005

6. "Zbiór zadań z algebry", pod.red. Aleksieja I. Kostrikina, Wydawnictwo Naukowe PWN, Warszawa 2005

7. J.Klukowski, I.Nabiałek, "Algebra dla studentów", Wydawnictwo Naukowo-Techniczne, Warszawa 2004

8. Tadeusz Trajdos, "Matematyka cz.III", Wydawnictwa Naukowo-Techniczne, Warszawa 1971 - 1994

9. Jerzy Rutkowski, "Algebra abstrakcyjna w zadaniach", Wydawnictwo Naukowe PWN, Warszawa 2002

10. Computational Science and Engineering, by Gilbert Strang, Wellesley-Cambridge Press, 2007

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 80 | 5,0 |
| Classes requiring direct contact with the teacher | 36 | 3,0 |
| Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1] | 44 | 2 |

[1] delete or add other activities as appropriate