



## COURSE DESCRIPTION CARD- SYLLABUS

Course name

Linear algebra with analytic geometry II

### Course

Field of study

Mathematics in Technology

Area of study (specialization)

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Level of study

first-cycle studies

Form of study

full-time

Year/Semester

1/2

Profile of study

general academic

Course offered in

Polish

Requirements

compulsory

### Number of hours

Lectures

30

Tutorials

30

Laboratory classes

—

Projects/seminars

—

Other (e.g. online)

—

### Number of credit points

5

### Lecturers

Responsible for the course/lecturer::

dr hab. inż. Paweł Kolwicz prof. PP

Responsible for the course/lecturer::

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### Prerequisites

Knowledge of linear algebra and analytical geometry from the first semester of this subject. Ability to use matrix calculus, solve systems of linear equations, use vector calculus in analytical geometry, use the basic concepts of the theory of linear spaces and linear operators. Is aware of the need to expand their competences, readiness to cooperate.

### Course objective

To be able to check the determinateness of square form (bilinear form). To recognize basic notions of the space with the inner product (in particular the notion of orthogonal basis). To recognize the curves as well as surfaces of second degree. To be aware of chosen elements of differential geometry of curves.



## Course-related learning outcomes

### Knowledge

- has the knowledge of notions of bilinear (quadratic) form, the matrix of form, the notion of inner product, orthogonal basis, curve of second degree (circle, parabol, hiperbol, ellipse), surface of second degree (cylinder, cone, paraboloid, hiperboloid), the osculating circle;
- understand ideas and proofs of more important selected theorems .

### Skills

- can find matrices of quadratic (bilinear) forms, study determinateness of quadratic forms, calculate inner product and norm in the respective Euclidean space;
- apply theorems concerning determining curves and surfaces of second degree, find the equation of osculating circle.

### Social competences

- can think and behave in good mathematical manner in the area of linear algebra analitical geometry;
- knows the limitation of own knowledge and understand the need of more far education and the necessity of systematic work.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

### Lectures:

- assessment of knowledge and skills at the written exam checking knowledge of concepts and the ability to prove theorems and illustrate the theory with examples (short practical tasks are also possible);
- passing threshold: 50% of points. Exam issues on the basis of which questions are prepared will be sent to students by e-mail using the university e-mail system.

### Tutorials:

- continuous evaluation – rewarding the activity (additional points) manifested in the discussion and in cooperation in solving practical tasks;
- continuous assessment – rewarding the increase of skills in using the techniques learned;
- obtaining additional points for activity during classes, including the presentation of papers discussing additional aspects of issues, in particular the application of the theory in other sciences or a reference to the place in the history of mathematics;
- active participation in consultations deepening knowledge and directing further work;
- knowledge acquired as part of the exercises is verified by two tests carried out on about 7 and 15 exercises. Passing threshold: 50% of points.

## Programme content

Update: 31.01.2020r.



**Lectures:** theoretical issues (definitions, lemmas, theorems, conclusions, algorithms) and suitable examples for the issues:

- bilinear and quadratic forms (matrix of forms, studying of determinateness of the form);
- Euclidean spaces;
- algebraic curves (circle, parabol, hiperbol, ellipse) and surfaces of the second degree (cylinder, cone, paraboloid, hiperboloid);
- differential geometry of curves.

**Tutorials:** solving practical problems illustrating the concepts discussed and examples of problems using the theoretical machinery of the lecture, e.g. .:

- finding the matrix of the bilinear form and the quadratic form in a fixed base, studying the determinateness of the quadratic form (2 methods);
- checking whether a given function is a scalar product, examination of orthogonal and orthonormal bases, base orthogonalization using the Gram-Schmidt method;
- examination of second degree curves and their parameters, recognition on the basis of the equation of a curve and surface of degree 2;
- making graphs, determining the equation of a osculating circle to the curve and the envelope of the family of lines.

### Teaching methods

**Lectures:**

- a lecture on an interactive board with questions for a group of students;
- students' activity (preparation of historical reports on the subject of mathematicians related to the presented material, reports about the applications of algebra in engineering sciences, presentation of proofs left to be done independently) during classes can increase the final assessment;
- initiating discussions during the lecture;
- theory presented in connection with the current knowledge of students from previous lectures.

**Tutorials:**

- solving sample tasks on the board;
- detailed reviewing the solutions of tasks by the teacher and discussions on comments.

### Bibliography

Basic

- A. I. Kostykin, Wstęp do algebry, cz.1 Podstawy algebry, PWN, Warszawa 2004.
- A. I. Kostykin, Wstęp do algebry, cz.2 Algebra liniowa, PWN, Warszawa 2004.
- A. I. Kostykin, Zbiór zadań z algebry, PWN, Warszawa 2005.



- M. Grzesiak, Liczby zespolone i algebra liniowa, Poznań 1999.
- T. Jurlewicz, Z. Skoczylas, Algebra liniowa 1, Wrocław 2003.
- T. Jurlewicz, Z. Skoczylas, Algebra liniowa 2, Wrocław 2005.

Additional

- H. Arodź, K. Rościszewski, Zbiór zadań z algebry i geometrii analitycznej dla fizyków, PWN, 1990.

**Breakdown of average student's workload**

	Hours	ECTS
Total workload	125	5
Classes requiring direct contact with the teacher	70	3
Student's own work (literature studies, preparation for tutorials, preparation for tests/exam)	55	2