COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mathematical Analysis [N1AiR2>AM]

Course

Field of study
Automatic Control and Robotics

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
40

Laboratory classes
0

Other (e.g. online)
0

Tutorials
20

Projects/seminars
0

Number of credit points

6,00

Coordinators

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Lecturers

Prerequisites

Basic mathematical knowledge from secondary school. Skills of efficient evaluating of algebraic formulas. Basic knowledge of trigonometric, logarithmic and exponential functions. Efficient fraction and formulas transformation.

Course objective

Deep knowledge differential and integral calculus which is necessary to study automatic control and robotics. Skills for application of acquired knowledge to practical problems in area of technical sciences, especially automatic control and robotics.

Course-related learning outcomes

Knowledge:
1. Students know fundamental theorems in calculus and their application in practice.
2. Students have advavced knowledge in mathematical logic, set theory, sequence and series theory.
3. Students have advavced knowledge in differential and integral calculus.

Skills:

1. Students are able to present basic theorems of mathematical analysis and to apply them to solving problems illustrating concrete practical issues.
2. Students are able to use logical formalisms in order to build and analyse the simple mathematical models describing phenomena of technical disciplines.
3. Students have the ability to communicate in an understandable way (in speech and writing) mathematical reasonings and formulating theorems and definitions.
4. Students are able to apply the predicate calculus and quantifiers to solving of concrete mathematical problems.

Social competences:
1. Students are able to formulate presisely questions in order to deepen understanding of a given subject or to find the missing elements of reasoning.
2. Students have awareness of the limitations of own knowledge and understanding the need of further education in sciences technical topics.
3. Students are aware of the responsibility for own work and they are ready to adopt teamwork rules.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lecture:
Valuation of knowledge and skills during oral and written exam. 50% credit score threshold. Illustrative examples and issues are sent to students via University e-mail system.
Tutorials:
Three tests concerning an application of knowledge from the lectures in exercises. Valuation of activity during lessons.

Programme content

1. Elementary functions of one variable.
2. Concept of limit function of one variable and applications.
3. Differential calculus of function of one variable.
4. Integral calculus of function one variable.
5. Series numbers, the concept of convergence of the series. Convergence tests of series.
6.The concept of a function of several variables, domain, graph, limit of a function.
7. Differential calculus of the functions of two nad three variables, some applications in engineering practice.
8. Double integrals, some applications in engineering practice.
9. Line integrals.
10. Power series. Expanding some functions into a power series. Applying power series to approximate calculatios.
11. Fourier series.

Course topics

1. Elementary scalar functions of one variable (formulas, graphs, properties). Sequences, limit of a sequence.
2. Concept of limit a function of one variable. Limits involving infinity and one-sided limits. Applications (asymptotes, continuity of functions).
3. Concept of derivative function.. The geometrical maining and physical maining of the derivative. Differential calculus of function of one variable. The derivatives of certain simple functions. Basic differentiation rules .The derivative of a composite function, the derivative of an inverse function, the derivative of an implicit function, the derivative of a logarithmic and an expotential functio, the derivatives of inverse trigonometric functions, the derivative of a function rerpresented parametrically. Derivatives of higher orders. Increase and decrease of a function, maxima and minima of a function of one variable, concavity and convexity of a graph of a function, points of inflection. L'Hospital's rule. Taylor's formula..
4. Antiderivative. Indefinite integral. Basic properties of the indefinite integral. Basic integration methods. Techniques for integrating rational fractions with quadratic denominator. Integration of simplest irrational expressons. Integration of trigonometric functions.
The conept of the definite integral. Geometrical maining of the definite integral. Basic properties of the definite integral. Some applications of the definite integrals (areas in rectangular coordinates, the arc length

in rectangular coordinates, the volume of asolidof revolution). Impropper integrals.
5. Series numbers, the concept of convergence of the series. Convergence tests of series.
6. The concept of a function of several variables, domain, graph, limit of a function.
7. Differential calculus of the functions of two nad three variables. Partial derivatives. Directional derivatives. The gradient. The extremum (maximum or minimum) of functions teo and three variables.The total differential of a function. Application of the differential of a function to approximate computations. Constructing empirical formulas by the method of last squares.
8. Double integrals. Double integral in rectangular cartesiań coordinates. expressing a double integral in s polar coordinates. Geometrical applications of the double integral.
9. Line integrals with selected applications in engineering practice. The line integral of the first kind. The line integral og the second kind. Condition under which the line integral of the second kind is independent of path. The work performed by a potential force.
10. Power series, the concept of convergence of the series, the study of convergence. Expanding a given function into power series.
11. Fourier series. Expanding a given function into Fourier series.

Teaching methods

Lecture:
1. The lecture conducted in an interactive way with formulating questions for a group of students or for selected students.
2. The theory presented in relation to the current knowledge of students.
3. Student activity during classes is taken into account when the final grade is considered.
Tutorials:
1. Solving sample tasks on the board.
2. Detailed reviewing of task solutions and discussions with comments.
3. Initiating discussions on solutions.

Bibliography

Basic:
1. M. Gewert, Z. Skoczylas, Analiza matematyczna 1 (definicje, twierdzenia, wzory), Oficyna Wydawnicza GiS, Wrocław, 2019
2. M. Gewert, Z. Skoczylas, Analiza matematyczna 2 (definicje, twierdzenia, wzory), Oficyna Wydawnicza GiS, Wrocław, 2019
3. Analiza matematyczna w zadaniach, t. 1, t. 2, W. Krysicki, L. Włodarski, PWN, Warszawa, 2011

Additional:
1. M. Gewert, Z. Skoczylas, Analiza matematyczna 1 (przykłady i zadania), Oficyna Wydawnicza GiS, Wrocław, 2020
2. M. Gewert, Z. Skoczylas, Analiza matematyczna 2 (przykłady i zadania), Oficyna Wydawnicza GiS, Wrocław, 2019
3. I. Foltyńska, Z. Ratajczak, Z. Szafrański, Matematyka dla studentów uczelni technicznych, t.II i III, Wydawnictwo Politechniki Poznańskiej, Poznań 2004

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,00
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)	88	3,50