



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Calculus I

Course

Field of study

Artificial Intelligence

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

1 / 1

Profile of study

general academic

Course offered in

English

Requirements

compulsory

Number of hours

Lecture

30

Laboratory classes

Other (e.g. online)

Tutorials

30

Projects/seminars

Number of credit points

5

Lecturers

Responsible for the course/lecturer:

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Faculty of Automatic Control, Robotics and
Electrical Engineering

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Responsible for the course/lecturer:

Prerequisites

The knowledge from the area of high school mathematics. The abilities of solving some problems of calculus and linear algebra. Awareness of the necessity to improve the knowledge and expertise, readiness to undertake a cooperation in the team.

Course objective

The goal of the subject is to attain the knowledge from the area of the selected topics in calculus I and to get the skills that allow to apply the obtained knowledge to analyze the mathematical problems.



Course-related learning outcomes

Knowledge

Knows and understands in an advanced level selected facts, objects and phenomena, as well as methods and theories explaining the complex relations between them, constituting extended knowledge of mathematics [K1st_W1]

Skills

Is able to work individually and in a team; is able to plan and organize work – both individually and in a team; is able to estimate the time needed to complete a task; is able to develop and implement a work schedule ensuring that deadlines are met. The graduate is able to determine and use models of the selected mathematical problems as well as to use them for the analysis and design of computer science [K1st_U3]

Social competences

Is ready to critically evaluate received knowledge and content. Is ready to recognize the importance of knowledge and to consult experts in solving the problem [K1st_K2]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:

- grading knowledge and abilities showed in an written exam

Exercises:

- testing knowledge and preparation to exercises,
- awarding practical knowledge obtained during the previous exercises and lectures,
- grading knowledge and abilities related with calculations,
- test for exercises and/or written elaboration (that can be made partially outside of exercises)

Programme content

1. FUNCTION OF ONE VARIABLE AND THEIR PROPERTIES

Functions (definition, domain, range) and their graphs. Properties of functions (monotone, bounded, periodic, even, odd). Three special functions (absolute-value, signum and entier function). Operations on functions (composition of functions, inverse function).

2. CLASSICAL FUNCTIONS

Exponential and logarithmic functions. The natural logarithm. Trigonometric functions and inverse trigonometric functions (the arc functions). Hyperbolic functions.



3. SEQUENCES OF REAL NUMBERS

Definition of a sequence, bounded and monotone sequences, limits of sequences. Properties of convergent sequences (uniqueness, theorem on three sequences, monotone property, algebraic properties), number e .

4. LIMIT OF A FUNCTION AND CONTINUITY

Limits of functions. Properties of limits. One-sided limits, limits at infinity. Continuous functions. Properties of continuous functions (Weierstrass theorem and Darboux Theorem).

5. THE DERIVATIVE AND DIFFERENTIABLE FUNCTIONS

The derivative. Geometrical interpretation of the derivative (tangent line to the curve). Differentiation rules. The chain rule. Derivatives of inverse functions. Derivatives of exponential and logarithmic functions. Derivatives of trigonometric functions and their inverses. Implicit differentiation. Higher-order derivatives. The Mean-Value Theorem and its consequences (monotonicity of $f = \text{sign of its derivative } f'$). Indeterminate forms of limits and de l'Hospital rule. Taylor formula and Maclaurin formula. Critical points and extreme values (local and global extreme points, monotonicity of a function, points of inflection, convexity and concavity). Asymptotes and graphs of functions.

6. INDEFINITE INTEGRALS

Antiderivatives (primitive functions). Integration of classical functions (exponential, logarithmic, trigonometric). The method of substitution. Integration by parts. The method of partial fractions. Inverse substitutions.

Teaching methods

Lectures – the lecture is organized with the multimedia presentations and complemented with many examples, showing an application of the presented issues.

Exercises – discussing open problems, comprehensive analysis for selected problems in mathematics, initiation open discussion devoted to methods which might be used to solve problems related to selected topics in mathematics, grading homeworks.

Bibliography

Basic

R. A. Adams and C. Essex, "Calculus. A Complete Course", 9th Edition, 2018.

Additional

James Stewart; Calculus: Early Transcendentals, 6th Edition; Thomson Higher Education, Belmont, CA, 2008.



Breakdown of average student's workload

	Hours	ECTS
Total workload	127	5,0
Classes requiring direct contact with the teacher	64	2,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) ¹	63	2,5

¹ delete or add other activities as appropriate