# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mathematical Analysis I

## Course

Field of study
Mathematics in Technology
Area of study (specialization)

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

Lecture
60
Laboratory classes

Other (e.g. online)

Tutorials
60
Projects/seminars

## Number of credit points

## Lecturers

Responsible for the course/lecturer:
Prof. dr hab. Ryszard Płuciennik

Responsible for the course/lecturer:

## Prerequisites

Basic knowledge of mathematical analysis I, in particular the ability to use the notion of the limit of sequences and functions, calculate derivatives and integrals and use them in specific practical situations.

## Course objective

Providing students with deep knowledge of differential and integral calculus (real functions of many variables) necessary for further study of mathematics. Obtaining the ability to apply the acquired knowledge, both to theoretical and practical issues.

## Course-related learning outcomes

Knowledge

Knowledge of differential and integral calculus at an advanced level, including functions of one and many variables. Mastering definitions, theorems, proofs, methods of proving, terminology, also in a foreign language.

Knowledge of the basic theorems of mathematical analysis II and their proofs. Mastering and understanding the relationship between mathematical analysis and other disciplines.

Advanced knowledge of mathematical analysis issues necessary to understand the material in the field of numerical methods and giving the possibility of constructing numerical algorithms.

Skills

Ability to prove and apply the most important theorems of mathematical analysis II and to construct examples and counterexamples.

Ability to interpret and explain functional dependencies presented in the form of formulas, tables, graphs, diagrams and apply them in practical issues from other scientific disciplines.

Social competences

Preparation for further education due to the awareness of the limitations of one's own knowledge.

Preparation for a critical evaluation of the obtained results of research and analysis.

Prepare to formulate precise questions to deepen your understanding of advanced differential and integral calculus and to find missing parts of reasoning.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:

Valuation of knowledge and skills during oral and oral exam.

Tutorials:

Two large tests concerning an application of knowledge from the lectures in exercises.

Systematic control of theoretical knowledge in form of short quizes.

Valuation of student answers during lessons.

Valuation of activity during lessons.

## Programme content

The definite integral and its mechanical and geometric applications. Improper integrals. Convergence criteria of improper integrals. Application of improper integrals. Functional sequences and series. Pointwise convergence and uniform convergence. Power series and their properties. The Cauchy-

Hadamard theorem. Metrics in the plane and in space. Limit and continuity of functions of many variables. Partial derivatives. Total differential and Taylor's formula for functions of many variables. The use of partial derivatives to find the extremes of functions of many variables. Implicit functions. Searching for extrema of an implicit function. Jordan measure. Multiple integrals and their geometrical and physical applications. Curvilinear integrals undirected in the plane and in space. Geometrical and physical applications of undirected line integrals. Directed line integrals and their properties. Methods of calculating directed line integrals. Green's theorem and its applications. Surface integrals of scalar fields and their properties. Geometrical and physical applications of surface integrals of scalar fields. Elements of field theory. Surface integrals of vector fields and their properties. The Gauss-Ostrogradski theorem and its applications. Stokes' theorem and its applications.

## 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. G. M. Fichtenholz, Rachunek różniczkowy i całkowy, PWN, Warszawa 2007.

2. H. J. Musielakowie, Analiza matematyczna, Wydawnictwo Naukowe UAM 2000

Additional

1. W. Rudin, Analiza rzeczywista i zespolona, PWN, Warszawa 1998.

2. A. Sołtysiak, Analiza matematyczna? cz. I , cz. II. WN UAM, Poznań 2004.

3. W. Swokowski, Calculus with analytic geometry, Prindle, Weber & Schmidt Publishers 1998.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 220 | 8,0 |
| Classes requiring direct contact with the teacher | 122 | 5,0 |
| Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1] | 98 | 3,0 |

[1] delete or add other activities as appropriate