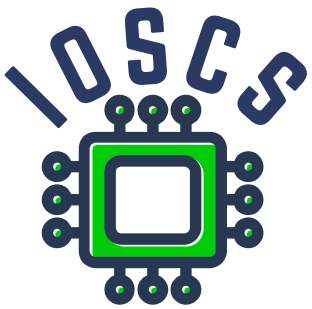

Project: Innovative Open Source Courses for Computer Science

Mathematical Analysis supported by wxMaxima Sylabus

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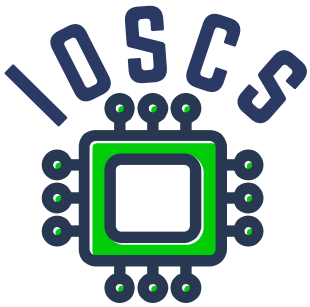
31. 1. 2020



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Project information

Project was implemented under the Erasmus+.
Project name: **"Innovative Open Source courses for Computer Science curriculum"**
Project nr: **2019-1-PL01-KA203-065564**
Key Action: **KA2 – Cooperation for innovation and the exchange of good practices**
Action Type: **KA203 – Strategic Partnerships for higher education**

Consortium

ZACHODNIOPOMORSKI UNIWERSYTET TECHNOLOGICZNY W SZCZECINIE
MENDELOVA UNIVERZITA V BRNĚ
ŽILINSKÁ UNIVERZITA V ŽILINE

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COURSE DESCRIPTION

Field of study: Computer science

Level: First cycle

Course name: Mathematical Analysis supported by wxMaxima

ECTS credits: 6

Instruction forms: lecture, laboratory

Instruction hours: 24, 24

Type, extent and method of teaching activities: 2 – 0 – 2 (lectures – exercises – labs) hours weekly, presence study.

Prerequisites: none

Module/course unit objective: By studying the subject, the student will acquire basic knowledge of the theory of real functions, the theory of numerical sequences and series, the theory of differential and integral calculus. He will be able to apply this knowledge effectively and successfully in mathematical and non-mathematical subjects, areas and subsequently also in practice (eg in economics, informatics, etc.).

After completing the course the student: Learns/repeats basic concepts of higher mathematics. Acquire new knowledge in the above areas. Acquire the ability to apply the acquired knowledge in solving practical tasks. Acquire basic tools and methods for practical and theoretical solution of analytical problems using Open Source tools.

Course content divided into various forms of instruction (with number of hours):

Week	Lecture (2h per week)	Laboratory (2h per week)
1	Introduction to wxMaxima Basic Operations, Arithmetic, Algebra, Trigonometry, Expressions and Functions, 2D and 3D Plots, Defining and Solving Equations.	Introduction to the wxMaxima, First steps, Installing wxMaxima, Basic features of wxMaxima, wxMaxima as a calculator and as symbolic solver, Getting help, Quiting and interruption wxMaxima.
2	Basic facts about real fuctions Definitions and basic properties of functions, Sets and their basic properties, Domain, injective surjective and bijective functions, Special functions.	Introduction to the wxMaxima, wxMaxima commands for defining functions and operating on functions, Graphs of functions, Function compositions, Function inverses, Module Exercises.
3	Sequences and series Their basic properties, Convergence and divergence, Limit, Basic convergence kriteria, Sequence of partial sums, Sum of the series.	Introduction to the wxMaxima, wxMaxima commands for interpreting sequences and series, Graphical interpretation of sequences and series, Limit of sequences, Module Exercises.

4	Introduction to wxMaxima Sequences and Sums, Application.	Introduction to the wxMaxima, Infinite sequences and their Limits, Classical convergence tests, Comparison tests, Alternating series and Absolute convergence, Module Exercises.
5	Real functions Explicit, parametric and implicit forms of functions, Monocity and extrema of functions, Elementary functions and their basic properties.	Introduction to the wxMaxima, Polynomial and Rational functions, Trigonometric functions, Exponential functions, Function transformations, Parity of functions, Algebraic combinations of functions, Function compositions, Function inverses, Module Exercises.
6	Limits of functions Basic properties, Rules for computing with limits, One-side limits, Several important limits.	Exploring the formal definition of limit, Using sequences to approximate limits, wxMaxima's limit commands, Module Exercises.
7	Continuity of functions Basic properties, Continuity of function at on a point and a set, relation with limit, The types of points of discontinuity of the function, Some properties of continuous functions.	Exploring the formal definition of continuious, Practical applications of Weierstrass theorem on intervals and Cauchy theorem of zero value, Module Exercises.
8	Derivative of functions Derivative of functions of real variable at the point at real set, Rules for computing derivatives, Derivative of compound and inverse function, Some properties of continuos functions.	The tangent Line as a limit, wxMaxima's derivative commands, Products, Quotients and linear combinations, Derivatives of function compositions, The chain rule, Module Exercises.
9	Aplications of derivatives of function Higher order derivatives, Mean value theorems in differential calculus, L'Hospital's rule, taylor formula, method of substitution, The asymptotes of functions, Investigation of behaviour of functions.	Implicit diferentiation, Aplications of derivatives, Increasing, Decreasing and local extrema, Concavity and inflection, Module Exercises.
10	Aplications of derivatives of function Investigation of behaviour of functions.	Behaviour of functions, Module Exercises.
11	Indefinite integral Primitive function, Definition of indefinite integral, Basic formulas for computation of indefinite integrals, Basic methods for computation of integrals – the decomposition method.	Antiderivatives, The fundamental theorem of calculus, Area integrals, Computing integrals, Basic antiderivatives, Transforming integrals with substitutions, Partial fractions decomposition, More integration techniques, Integration by parts, Module Exercises.

12	Definite integral The concept of definite Riemann integral, Geometric meaning, The relationship between the indefinite and definite integrals, The calculation of the definite integral.	Definite Integral, wxMaxima's definite integral commands, Approximating area from a list of data, Transforming integrals with substitutions, t-Substitution, Integration by parts, Module Exercise.

Student workload – forms of activity: Individual work with computer in the wxMaxima, solving problems from calculus and programming in wxMaxima, working with real data.

Teaching methods/tools: Lectures and laboratories, computer laboratory with anywhere OS (linux OS, Win, OS2), installed wxMaxima environment (Open Source for any OS) and connection to internet.

Evaluation methods: Evaluation is based on two components – the continuous evaluation during the semester and final exam (total 100 points).

Evaluation process:

- Semester — 60 points: knowledge verification (written in the 9th week of the semester) — max. 30 points, special activities — max. 30 points.
- Exam — 40 points: test — max. 20 points, theoretical questions/tasks — max. 20 points.

To register for the exam the student must obtain at least 30 points during the semester.

Final Evaluation:

The condition for successful completion of the course is obtaining at least 61 points. This means at least 30 points during the semester, at least 10 points per test during the exam and at least 10 points for theoretical questions. Final evaluation of the course:

- **A** 93 — 100,
- **B** 85 — 92,
- **C** 77 — 84,
- **D** 69 — 76,
- **E** 61 — 68.

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