

SYLLABUS

1. Data about the program of study

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| 1.1 Institution | The Technical University of Cluj-Napoca |
| 1.2 Faculty | Automation and Computer Science |
| 1.3 Department | Computer Science |
| 1.4 Field of study | Computer Science and Information Technology |
| 1.5 Cycle of study | Bachelor of Science |
| 1.6 Program of Study / Qualification | Computer Science / Engineer |
| 1.7 Form of education | Full time |
| 1.8 Subject code | 1. |

2. Data about the subject

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|--|--|--------------|---|---|--------|
| 2.1 Subject name | Mathematical Analysis I (Differential calculus) | | | | |
| 2.2 Course responsible / lecturer | Prof. univ. dr. Ivan Dumitru-Mircea - Mircea.Ivan@math.utcluj.ro | | | | |
| 2.3 Teachers in charge of applications | Prof. univ. dr. Ivan Dumitru-Mircea - Mircea.Ivan@math.utcluj.ro | | | | |
| 2.4 Year of Study | I | 2.5 Semester | 1 | 2.6 Type of assessment (E - exam, C - colloquium, V – verification) | E |
| 2.7 Subject category | DF – fundamentală, DD – în domeniu, DS – de specialitate, DC – complementară | | | | DF/DOB |
| | DI – Impusă, DOp – opțională, DFac – facultativă | | | | |

3. Estimated total time

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|---|-----|-----------|--------|----|--------------|----|
| 3.1 Number of hours per week | 4 | of which: | Course | 2 | applications | 2 |
| 3.4 Total hours in the teaching plan | 56 | of which: | Course | 28 | applications | 28 |
| 3.3 Individual study | | | | | | |
| a) Manual, lecture material and notes, bibliography | | | | | | 28 |
| b) Supplementary study in the library, online, and in the field | | | | | | 4 |
| c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays | | | | | | 8 |
| d) Tutoring | | | | | | 2 |
| e) Exams and tests | | | | | | 2 |
| f) Other activities | | | | | | 0 |
| 3.4 Total hours of individual study | 44 | | | | | |
| 3.5 Total hours per semester | 100 | | | | | |
| 3.6 Number of credit points | 4 | | | | | |

4. Pre-requisites (where appropriate)

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| 4.1 Curriculum | Basic knowledge of Differential Calculus and Set Theory |
| 4.2 Competence | Competences in elementary Differential Calculus: elements of set theory, limits, sequences and series, derivatives. |

5. Requirements (where appropriate)

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| 5.1 For the lectures | |
| 5.2 For the applications | |

6. Specific competences

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| 6.1 Professional competences | C1 - Operating with basic Mathematical, Engineering, and Computer Science concepts <ul style="list-style-type: none"> C1.1 - Recognizing and describing concepts that are specific to the fields of calculability, complexity, programming paradigms, and modeling computational and communication systems C1.3 - Building models for various components of computing systems C1.5 - Providing a theoretical background for the characteristics of the designed systems |
| 6.2 Cross competences | N/A |

7. Discipline objectives (as results from the *key competencies gained*)

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| 7.1 General objective | A presentation of the concepts, notions, methods, and fundamental techniques used in differential calculus. |
| 7.2 Specific objectives | Use of differential calculus to solve problems in engineering. Use of differential calculus in modelling and solving practical problems concerning spatial forms. |

8. Contents

| 8.1. Lecture (syllabus) | | Teaching methods | Notes |
|--|--|---|-------|
| Elements of Set Theory. Set operations. Functions. Cardinal numbers. | | Explanation Demonstration Collaboration Interactive activities | |
| General Topology. Topologies and topological spaces. Open and closed sets. Neighborhoods. Interior and closure of a set. Limit points. | | | |
| Metric. Topology of a metric space. Sequences in metric spaces. | | | |
| Sequences of Numbers. Stolz-Cesaro criterion. | | | |
| Series of Numbers. Convergence tests for series. Infinite products. | | | |
| Continuity. Continuous mappings on topological, metric, and Euclidean spaces. | | | |
| Differential Calculus for Functions of One Variable. Mean-value theorems. Taylor's formula for real functions of one variable. The differential of functions of one variable. | | | |
| Differential Calculus for Functions of Several Variables. Partial derivatives. Derivative of composite functions. Homogeneous functions. Euler's identity. Gradient. Directional derivative. Lagrange's mean value theorem. The differential of functions of several variables. Taylor's formula for functions of several variables. | | | |
| Functional Sequences and Series. Power series. Trigonometric and Fourier series. | | | |
| Implicit Functions. Existence theorems for implicit functions. Change of coordinates and variables. | | | |
| Extrema of Functions. Unconditional and conditional extrema. | | | |
| Bibliography: 1. Mircea Ivan. Elemente de calcul integral. Mediamira, Cluj-Napoca, 2003. 2. Dumitru Mircea Ivan. Calculus. Editura Mediamira, Cluj-Napoca, 2002. | | | |
| 8.2. Applications (Seminars) | | Teaching methods | Notes |
| Exercises related to: set operations, functions, and cardinal numbers. | | Explanation Demonstration Collaboration Interactive activities | |
| Exercises related to topologies, open and closed sets, neighborhoods, interior, and closure of a set. | | | |
| Example of metrics with application in engineering. | | | |
| Exercises related to sequences of numbers. | | | |
| Exercises concerning convergence tests for series. | | | |
| Exercises related to continuous mappings. | | | |
| Exercises concerning mean-value theorems and Taylor's formula for real | | | |

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| functions of one variable. | | |
| Exercises related to partial derivatives, derivative of composite functions, gradient, directional derivative, differential of functions of several variables, and Taylor's formula for functions of several variables. | | |
| Exercises related to Power and Fourier series. | | |
| Exercises related to implicit functions, change of coordinates, and variables. | | |
| Exercises concerning unconditional and conditional extrema. | | |
| Bibliography: <div><div>1.</div><div>Dumitru Mircea Ivan, Calculus, 2002, Editura Mediamira, Cluj-Napoca</div></div> <div><div>2.</div><div>Dumitru Mircea Ivan, et al. Analiză matematică - Culegere de probleme pentru seminarii, examene și concursuri. Editura Mediamira, Cluj-Napoca, 2002.</div></div> <div><div>3.</div><div>Mircea Ivan et al. Culegere de Probleme Pentru Seminarii, Examene și Concursuri. UT Press, Cluj-Napoca, 2000.</div></div> | | |

9. Bridging course contents with the expectations of the representatives of the community, professional associations, and employers in the field

Collaboration with engineers in order to identify and solve problems raised by the market.

10. Evaluation

| Activity type | Assessment criteria | Assessment methods | Weight in the final grade |
|---|--|---------------------|---------------------------|
| Lectures | Ability to understand and use the concepts and proofs creatively | Written examination | 40% |
| Applications | Ability to solve problems and apply algorithms | Written examination | 60% |
| Minimum standard of performance: Ability to present a theoretical subject coherently and to solve problems with practical content. | | | |

| Date of filling in: | Responsible | Title, First name Last name | Signature |
|---------------------|--------------|-----------------------------------|-----------|
| 26.02.2025 | Course | Prof.univ.dr. Dumitru-Mircea IVAN | |
| | Applications | Prof.univ.dr. Dumitru-Mircea IVAN | |
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| Date of approval in the department | Head of Department of Mathematics, Prof.dr. Dorian Popa |
| Date of approval by the Faculty Council | Dean, Prof.dr.eng. Vlad Mureșan |